Fecal Bacteria and General Standard TMDL Implementation Plan Development for Back Creek

Prepared for:
New River-Highlands Resource Conservation and Development Commission

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Officials from throughout and representing the Back Creek watershed

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EXECUTIVE SUMMARY

Back Creek was listed as impaired according to the 1996 303 (d) TMDL Priority List (VADEQ 1996). The Virginia Department of Environmental Quality (VADEQ) has identified this segment as impaired with regard to both fecal coliform and the General Standard (benthic). Back Creek remained on the 1998 and 2002 303 (d) lists for fecal impairment and was listed in 2002 for the General Standard (benthic) impairment. The stream does not support primary contact recreation (*e.g.*, swimming, wading, and fishing) due to violations the state's fecal bacteria standards. The fecal bacteria standards at the time of listing specified that the in-stream fecal coliform levels must not exceed a single sample maximum of 1,000 cfu/100 ml or a geometric mean of 200 cfu/100 ml. In addition the stream does not support the aquatic life use and violates the state's general standard. The general standard specifies that all state waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with designated uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life. As a result of the listings and court actions taken against the United States Environmental Protection Agency (EPA), a total maximum daily load (TMDL) report was developed (Fecal Bacteria and General Standard Total Maximum Daily Load Development for Back Creek – MapTech, 2004) which established the reduction in loads needed to restore these waters. Virginia law requires that a plan be developed to achieve fully supporting status for impaired waters. In fulfilling the state's requirement for the development of a TMDL Implementation Plan (IP), a framework was established for reducing fecal bacteria and sediment levels to achieve the water quality goals for the impaired streams.

Review of TMDL Development

MapTech, Inc., was contracted by the VADEQ, to develop a fecal bacteria TMDL and a General Standard (benthic) TMDL for Back Creek in Pulaski County, Virginia. Modeling conducted in support of the fecal bacteria TMDL considered loads in runoff resulting from wildlife, livestock, and residential sources, as well as direct loads to the stream (including direct deposition from cattle and wildlife), uncontrolled discharges (straight pipes), and permitted sources. The water quality endpoints used for determining the necessary reduction to fecal bacteria loads were the instantaneous *E. coli* standard (235 cfu/100 ml) and the monthly geometric mean *E. coli* standard (126 cfu/100 ml). An implicit margin of safety was used. The final allocation scenario requires significant reductions in the fecal bacteria load in wash-off from cropland, pasture (including hayland), and residential areas. Additionally, a 100% reduction in livestock stream deposition and straight pipes is necessary. Although significant reductions in the wildlife load were indicated as necessary to achieve zero violations of the standard, de-listing of streams occurs when the violation rate drops below 10.5%. The modeling indicated that this level of reduction could be achieved without reductions to the wildlife load.

Modeling conducted in support of the fecal sediment TMDL considered sediment loads in runoff from agricultural (pasture and cropland), forest, barren and residential areas, as well as sediment (solids) loads from VPDES permitted point sources, straight pipes, and streambank erosion. Sediment load reductions identified in the TMDL included reductions from cropland (69%), pasture/hay (60%), and streambank erosion (66%).

Public Participation

Public participation was an integral part of the TMDL Implementation Plan Development, and is critical to promote reasonable assurances that the implementation activities will occur. Public participation took place on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project as well as a forum for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups and steering committee). Second, working groups were assembled from communities of people with common concerns regarding the TMDL process and were the primary arena for seeking public input. The following working groups were formed: Agricultural, Residential, and Governmental. A representative of MapTech attended each working group meeting in order to facilitate the process and integrate information collected from the various communities. Third, a steering committee was formed with representation from all of the working groups, VADCR, VADEQ, and MapTech.

Varied opinions were voiced throughout the public participation meetings regarding the IP process. A consensus of the working groups agreed that a cornerstone of the IP is cultivating public involvement, education of all stakeholders as well as encouraging commitment and partnerships among the citizens and government agencies in the watershed in order to reduce fecal bacteria, and sediment loads to the Back Creek. An assertion to individual responsibility provides a foundation for building partnerships among citizens, interest groups, and government agencies. It can also cultivate voluntary implementation and long-term support for reducing pollutant levels and restoring water quality in the Back Creek watershed.

Assessment of Implementation Action Needs

The quantity of control measures, or BMPs, required during implementation was determined through spatial analyses, modeling alternative implementation scenarios, as well as some field inspections. Spatial analyses included the processing of data that included land use, census data, stream networks, and elevation, along with data archived from the VADCR Agricultural BMP Database and TMDL development documents. The map layers and archived data were combined to establish the number of control measures required overall, in each watershed, and in each subwatershed, where appropriate. Estimates of the amount of on-site treatment systems, sewer connections, streamside fencing, number of full livestock exclusion systems, and number of hardened crossings were made through these analyses. The quantities of additional control measures were determined through modeling alternative scenarios and applying the related reduction efficiencies to their associated loads. Overall, the following needs for the ten-year implementation period were identified:

Control Measure	Unit	Cost/Unit	Units Needed
Grazing Land Protection Systems (SL-6)	System	$29,126	47
Stream Protection Systems (WP-2T)	System	$4,159	3
Fence Maintenance	ft (length)	$3	14,530
Improved Pasture Management	Ac-Treated	$107	5,350
Conservation Tillage	Ac-Treated	$100	401
Manure Incorporation	Ac-Treated	$18	1,055
Waste Storage – Livestock	System	$20,754	4
Retention Ponds	Ac-Treated	$138	13,400
Septic System Repair	System	$3,000	17
Septic System Installation	System	$6,000	117
Alternative Waste Treatment System	System	$22,500	39
Septic Tank Pump-Outs	System	$225	100
Residential Education Program	Program	$7,500	1
Rain Gardens	Ac-Treated	$5,000	30
Streambank Stabilization	ft (streambank)	$12	31,700

Cost/Benefit Analysis

Unit costs for control measures were determined through analysis of control measures previously installed through the Virginia Cost-Share Program in the Skyline SWCD service area, discussion with local agency representatives, and working groups. The cost of technical assistance was determined through discussion with the local Skyline SWCD. The estimated total cost to install agricultural, residential and in-stream control measures in the Back Creek watershed is 3.99, 1.81, and 0.38 million respectively excluding technical assistance. The estimated total cost to provide technical assistance during implementation is expected to be $1 million. The total cost estimated for ten years of implementation is $122 million.

The primary benefit of implementation is the reduction of fecal bacteria and sediment in Back Creek. With the implementation of this IP, the risk of fecal bacteria illness through swimming in or drinking water from this stream will decrease. Streambank protection, provided through exclusion of livestock from streams, will lead to improved aquatic habitat. Soil losses should decrease due to vegetated buffers, and infiltration of precipitation should increase through the implementation of agricultural BMPs. The practices recommended in this document will provide economic benefits to the landowner as well as the anticipated environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, and intensive pasture management will improve profitability of farms, while private sewage system installation and maintenance will ultimately save homeowners money by preventing expensive fees and repairs.

Measurable Goals and Milestones for Attaining Water Quality Standards

Implementation is scheduled to occur in three main stages, each lasting 5 years. The first stage involves implementation of the most cost-effective control measures. During this stage, approximately 64% of the targeted load reductions will be achieved, with approximately 49% of the total estimated cost of implementation. Stage II describes the remainder of the control measures required to achieve the targeted pollutant load reductions, if the water quality goals are not achieved during Stage I. Finally, the third stage is a 5-year period for assessment of stream conditions, in which the streams are expected to recover and attain the stated water quality goals.

Targeting of critical areas for agricultural BMP installation was accomplished through analysis of land use, farm boundaries, stream network GIS layers, and monitoring results. The subwatersheds were ranked by the ratio of animals per length of fence needed. An additional method of targeting in both agricultural and residential areas involves considering the cost-efficiency of specific practices. Cost-efficiencies of each practice proposed in this IP were calculated and reported.

Stakeholders and their Role in Implementation

Implementation progress success will be determined by monitoring conducted by VADEQ through the agency's monitoring program. Three stations on Back Creek will be monitored monthly for *E. coli* concentrations, and one station will be assessed every other year for the health of the aquatic community.

The Skyline SWCD will be in charge of initiating contact with farmers in the impaired watersheds to encourage the installation of agricultural and residential BMPs. This one-on-one contact will facilitate communication of the water quality problems and the corrective actions needed. Once funded, the field technicians employed for implementation of the IP should conduct a number of outreach activities in the watershed to promote participation and community support to obtain the implementation milestones and to make the community aware of the TMDL requirements. Such activities will include information exchange through newsletters, mailings, field days, organizational meetings, etc. The technicians will work with appropriate organizations such as VCE to educate the public.

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. The agencies regulating activities that impact water quality in Virginia include: VADEQ, VADCR, Virginia Department of Agriculture and Consumer Services (VDACS), and VDH.

Achieving the goals of this IP (*i.e.*, improving water quality and removing these waters from the Section 303(d) list) is dependent on stakeholder participation – not only the local citizens needing agricultural control measures or residential waste treatment facilities, but also all citizens living in the watershed. It must be acknowledged first that there is a water quality problem, and changes must be made as needed in operations, programs, and legislation to address these pollutants.

Funding

Potential funding sources available during implementation were identified during plan development. Sources may include:

- Federal Clean Water Act Section 319 Increment Funds
- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Agricultural Best Management Practices Loan Program
- Virginia Small Business Environmental Assistance Fund Loan Program
- Virginia Water Quality Improvement Fund
- Community Development Block Grant Program
- Conservation Reserve Program (CRP)
- Conservation Reserve Enhancement Program (CREP)
- USDA Environmental Quality Incentives Program (EQIP)
- USDA Wildlife Habitat Incentive Program (WHIP)
- Wetland Reserve Program (WRP)

- Southeast Rural Community Assistance Project (SE/R-CAP)
- National Fish and Wildlife Foundation
- Clean Water State Revolving Fund

1. INTRODUCTION

1.1 Background

The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet certain water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of the five beneficial uses: fishing, swimming, shellfish, aquatic life, and drinking.

When streams fail to meet standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (WQMIRA) states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters". The TMDL Implementation Plan (IP) describes control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), to be implemented in a staged process.

Back Creek was listed as impaired according to the 1996 303 (d) TMDL Priority List (VADEQ 1996). The Virginia Department of Environmental Quality (VADEQ) has identified this segment as impaired with regard to both fecal coliform and the General

Standard (benthic). Back Creek remained on the 1998 and 2002 303 (d) lists for fecal impairment and was listed in 2002 for the General Standard (benthic) impairment. The impairment of Back Creek begins 0.70 miles below the Rt. 636 crossing to the mouth of Back Creek on the New River.

The detrimental effects of bacteria in food and water supplies have been documented repeatedly. In September of this year (2006), a strain of deadly *E. coli* was found in packaged spinach, which killed three people and sickened nearly 200 in half of the states. *E. coli* is a type of fecal coliform bacteria commonly found in the intestines of humans and animals. The outbreak was tentatively linked to a cattle ranch next to the Salinas Valley spinach fields, where the spinach was grown, however, other sources (*e.g.*, wildlife and secondary-treated irrigation water) have not been ruled out. It was the 20th such outbreak in lettuce or spinach since 1995. In May 2000 in Walkerton, Ontario (a town of approximately 5,000 people), there were seven confirmed deaths and more than 2,000 poisonings, all attributed to drinking water polluted by *E. coli* Type 0157:H7 (Raine, 2000; Miller, 2000). Financially, the contamination resulted in a $250 million class action lawsuit filed against the Ontario government. According to the Cattleman's Association, the likely source of the pollution was runoff from a feedlot located more than 5 miles from the wells used for the town's water supply. Cattle are the "number one reservoir for this type of *E. coli* " according to veterinarian Gerald Ollis, and 5 to 40 % of cattle shed the bacteria at any given time.

On August 8, 1994, VDH was notified that campers and counselors at a Shenandoah Valley summer camp developed bloody diarrhea. It was confirmed that *E. coli* 0157:H7 was the causative agent (CDC, 1995). In Franklin County, Virginia, a 1997 outbreak of illnesses involving three children was attributed to *E. coli* (0157:H7) in Smith Mountain Lake. The children came in contact with the bacteria while swimming in the lake, and a two-year-old child almost died as a result of the exposure (Roanoke Times, 1997a, 1997b, 1998b). In August 1998, seven children and two adults at a day-care center in rural Floyd County were infected with *E. coli* (0157:H7). Upon investigation, two of the property's wells tested positive for total coliform (Roanoke Times, 1998a, 1998c). On

June 6, 2000, Crystal Spring, (Roanoke, Virginia's second largest water source) was shut down by the VDH for *E. coli* contamination (Roanoke Times, 2000).

These are not isolated cases. Throughout the United States, the Centers for Disease Control estimates that at least 73,000 cases of illnesses and 61 deaths per year are caused by *E. coli* 0157:H7 bacteria (CDC, 2001). Other fecal coliform (FC) pathogens (*e.g., E. coli* 0111) are responsible for similar illnesses. In addition, the presence of other bacterial and viral pathogens is indicated by the presence of FC. Whether the source of contamination is human or livestock waste, the threat of these pathogens appears more prevalent as both populations increase. As stakeholders, we must assess the risk we are willing to accept and then implement measures to safeguard the public from these risks.

The General Standard is meant to protect the health of aquatic life, and also to serve as a fallback monitoring program to identify problems that are not detected by the ambient monitoring system (e.g., pollutant discharges that are intermittent in occurrence, isolated incidents of pollutant discharge, and discharge of pollutants that are not normally measured through the ambient monitoring system). The health of the aquatic life is measured through assessment of the benthic macroinvertebrate community, which is integral to the food chain that supports higher-level organisms. An unhealthy aquatic community, will impact local and downstream fisheries. Additionally, an aquatic community that is already impacted will not be a good indicator of pollutant problems in the stream.

As for the specific pollutants being addressed for these TMDLs, bacteria and sediment loadings have relevance in downstream water bodies as well as Back Creek. Specifically, Back Creek is a tributary to the New River. The New River is among the oldest rivers on the continent. It is also rich in cultural and natural history, and offers an abundance of scenic and recreational opportunities. Protection of this resource begins with protection of its tributaries. Back Creek itself is a spring-fed creek with the potential, according to local biologists, for supporting native trout species if the benthic macroinvertebrate community can be restored. Restoration of Back Creek through reduction of bacteria and sediment loadings will allow it to be a valuable recreational resource.

The Back Creek watershed, located in Pulaski County, Virginia is part of the New River basin (Figure 1.1). Back Creek flows into the New River, which joins the Ohio River and flows into the Mississippi River. The Mississippi River then drains to the Gulf of Mexico.

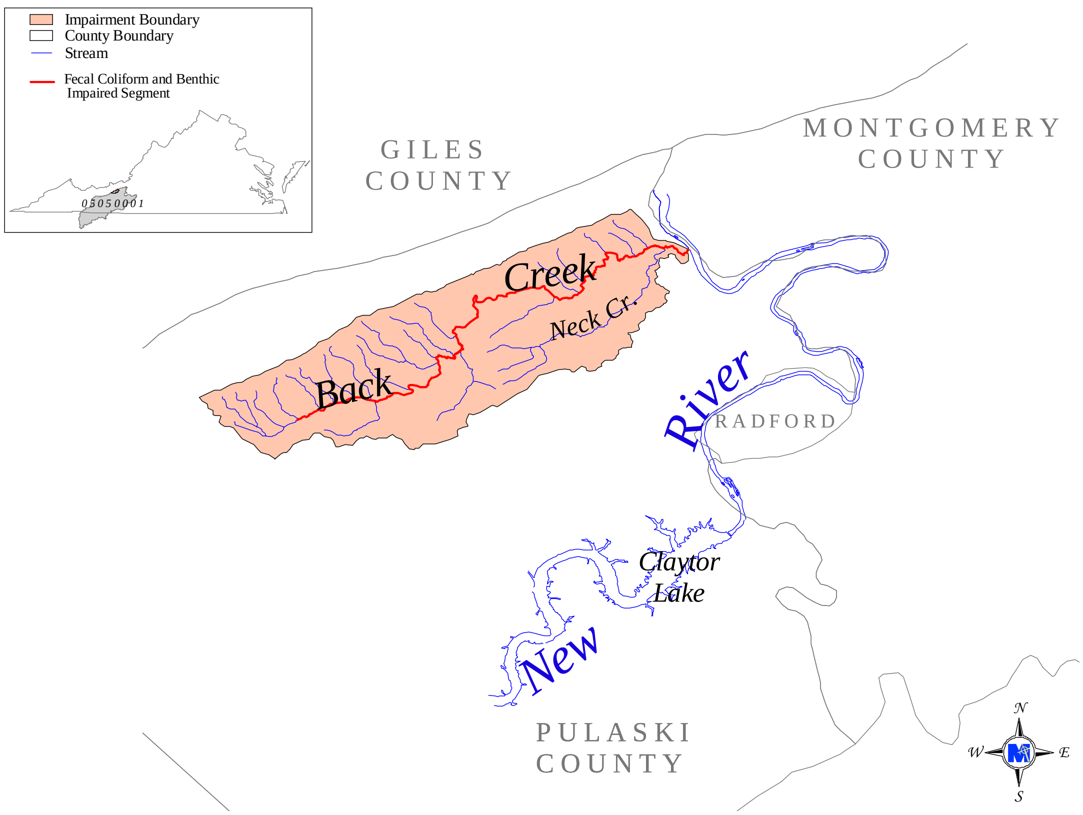

Figure 1.1 Location of the impaired stream in the Back Creek Watershed.

Back Creek (waterbody ID #VAW-N22R) was listed as impaired for fecal coliform during the 1996 assessment. Out of 16 samples collected at river mile 09.47 during the 1998 assessment period, 14 violated the fecal coliform standard. During the 2002 assessment period, 17 of 23 samples taken at river mile 09.47 violated the standard. A single benthic monitoring survey indicated severely impaired conditions in the Back Creek segment. The impairment of Back Creek begins 0.70 miles below the Rt. 636 crossing to the mouth of Back Creek on the New River.

The Back Creek watershed (USGS Hydrologic Unit Code #0505001) is part of the New River basin. The land area of the affected watersheds is approximately 25,500 acres, with pasture/hay and woodland as the primary landuses (Figure 1.2).

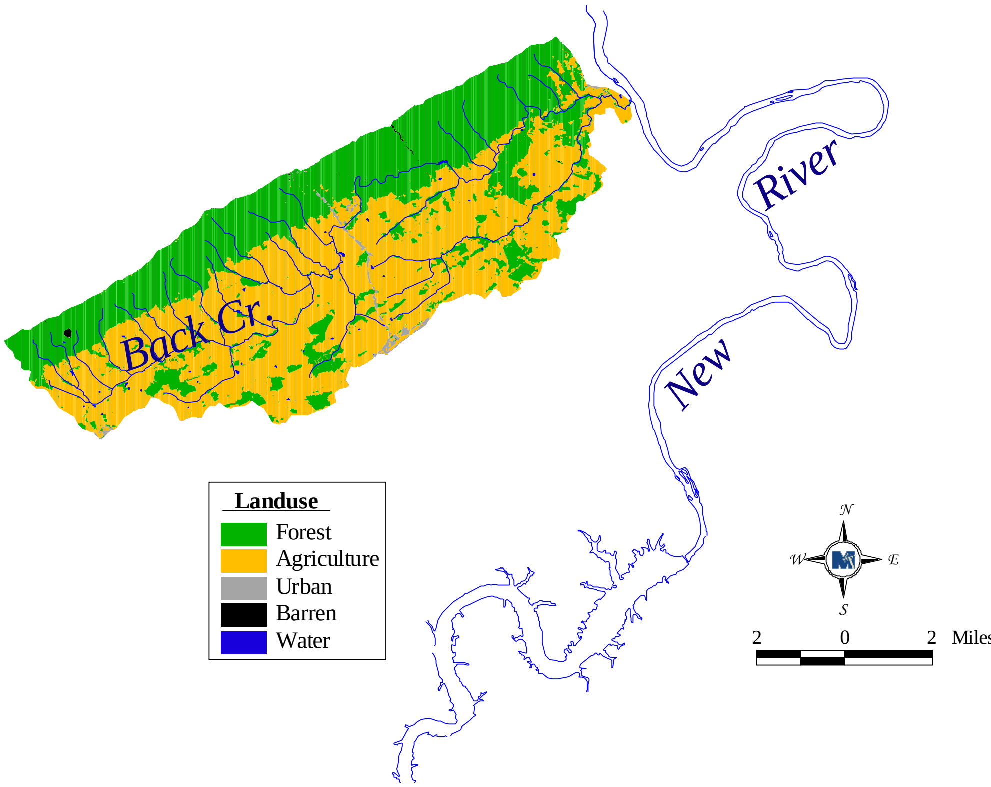

Figure 1.2 Land uses in the Back Creek Watershed

The National Land Cover Dataset (NLCD) produced cooperatively between the U.S. Geological Survey (USGS) and U.S. Environmental Protection Agency (EPA) was utilized for this study. The collaborative effort to produce this dataset is part of a Multi-Resolution Land Characteristics (MRLC) Consortium project led by four U.S. government agencies: EPA, USGS, the Department of the Interior National Biological Service (NBS), and the National Oceanic and Atmospheric Administration (NOAA). Using 30-meter resolution Landsat 5 Thematic Mapp(TM) satellite images taken between 1990 and 1994, digital landuse coverage was developed identifying up to 21 possible landuse types. Classification, interpretation, and verification of the land cover data;

population and housing density data; state or regional land cover data sets; USGS landuse and land cover (LUDA) data; 3-arc second Digital Terrain Elevation Data (DTED) and derived slope, aspect and shaded relief; and National Wetlands Inventory (NWI) data. Approximate acreages and landuse proportions for each impaired segment are given in Table 1.1.

Table 1.1 Area affecting the impairment and contributing landuses.

Back Creek	
Landuse	**Acreage**
Water	13
Residential/Recreational	38
Commercial & Services	131
Barren	22
Woodland/Wetland	10,868
Pasture/Hay	12,344
Livestock Access	702
Cropland	1,337

The estimated human population within the drainage area is 1,888 (USCB, 1990,2000). Among Virginia counties, Pulaski County ranks 19th for the number of dairy cows, 18th for the number of all cattle and calves, 18th for beef cattle, 6th for the number of sheep and lambs and 11th for the production of corn silage (Virginia Agricultural Statistics, 2001). Pulaski County is also home to 471 species of wildlife, including 53 types of mammals (e.g. beaver, raccoon, and white-tailed deer) and 418 types of birds (e.g. wood duck, wild turkey, Canada goose) (VDGIF, 1999).

In developing this IP, elements from both state and federal guidance were incorporated and the recommended guidelines from Virginia's "Guidance Manual for Total Maximum Daily Load Implementation Plans" were followed. Specific state and federal requirements of an IP are described in chapter 2 of this document.

Once developed, the Virginia Department of Environmental Quality (VADEQ) will take TMDL implementation plans to the State Water Control Board (SWCB) for approval as the plan for implementing the pollutant allocations and reductions contained in the TMDLs. Also, VADEQ will request SWCB authorization to incorporate the TMDL implementation plan into the appropriate Water Quality Management Plan (WQMP) in accordance with the CWA's Section 303(e). In response to a Memorandum of Understanding (MOU) between EPA and VADEQ, VADEQ also submitted a draft Continuous Planning Process to EPA in which VADEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

1.2 Applicable Water Quality Standards: Fecal Coliform Impairment

According to Virginia Water Quality Standard 9 VAC 25-260-5, "water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC §1251 et seq.)."

Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses.) states:

A. *All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.*

♦

E. *At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under §§301(b) and 306 of the Clean Water Act and cost-effective and reasonable best management practices for nonpoint source control.*

♦

H. *The [State Water Quality Control] board may remove a designated use which is not an existing use, or establish subcategories of a use, if the board can demonstrate that attaining the designated use is not feasible because:*

    1. *Naturally occurring pollutant concentrations prevent the attainment of the use;*

2. *Natural, ephemeral, intermittent or low flow conditions or water levels prevent the attainment of the use unless these conditions may be compensated for by the discharge of sufficient volume of effluent discharges without violating state water conservation requirements to enable uses to be met;*

♦

6. *Controls more stringent than those required by §§301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.*

Because this study addresses both fecal bacteria and benthic impairments, two water quality criteria are applicable. Section 9 VAC 25-260-17- applies to the fecal bacteria impairment, whereas the General Standard section (9 VAC 25-260-20) applies to the benthic impairment.

At the time when Back Creek was designated as impaired and the TMDLs were developed, the State's water quality criterion for fecal bacteria was based on fecal coliform. For a non-shellfish supporting waterbody to be in compliance with Virginia fecal coliform standard for contact recreational use, VADEQ specified the following criteria (Virginia Water Quality Standard 9 VAC 25-260-170):

A. *General requirements. In all surface waters, except shellfish waters and certain waters addressed in subsection B of this section, 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 exceeded either criterion more than 10% of the time, the waterbody was classified as impaired and a TMDL was developed and implemented to bring the waterbody into compliance with the water quality criterion. Based on the sampling frequency, only one criterion was applied to a particular datum or data set (Virginia Water Quality Standard 9 VAC 25-260-170). If the sampling frequency was one sample or less per 30 days, the instantaneous criterion was applied; for a higher sampling frequency, the geometric criterion was applied.

1.3 Water Quality Standard Changes

Two regulatory actions related to the bacteria water quality standard in Virginia have been implemented. The first rulemaking pertains to the indicator species used to measure bacteria pollution. The second rulemaking is an evaluation of the designated uses as part of the state's triennial review of its water quality standards.

1.3.1 Indicator Species

EPA recommended that all states adopt an *E. coli* or *enterococci* standard for fresh water and *enterococci* criteria for marine waters by 2003.

E. coli and enterococci bacteria per 100 mL of water shall not exceed the following:

	Geometric Mean[1]	Single Sample Maximum[2]
Freshwater[3]		
E. coli	*126*	*235*
Saltwater and Transition Zone[3]		
enterococci	*35*	*104*

[1] For two or more samples taken during any calendar month.

[2] 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.

[3] See 9 VAC 25-260-140 C for freshwater and transition zone delineation.

EPA is pursuing the states' adoption of these standards because there is a stronger correlation between the concentration of these organisms (*E. coli* and *enterococci*) and the incidence of gastrointestinal illness than with fecal coliform. *E. coli* and *enterococci* are both bacteriological organisms that can be found in the intestinal tract of warm-blooded animals. Like fecal coliform bacteria, these organisms indicate the presence of fecal contamination. The adoption of the *E. coli* and *enterococci* standard has been in effect in Virginia since January 15, 2003.

1.3.2 Designated Uses

All waters in the Commonwealth have been designated as "primary contact" for the swimming use regardless of size, depth, location, water quality or actual use. The fecal coliform bacteria standard is described in 9 VAC 25-260-170 and in Section 1.2 of this report. This standard is to be met during all stream flow levels and was established to protect bathers from ingestion of potentially harmful bacteria. However, many headwater streams are small and shallow during base flow conditions when surface runoff has minimal influence on stream flow. Even in pools, these shallow streams do not allow full body immersion during periods of base flow. In larger streams, lack of public access often precludes the swimming use.

Recognizing that all waters in the Commonwealth are not used extensively for swimming, the Commonwealth of Virginia has approved a process for re-designation of the swimming use for secondary contact in cases of: 1) natural contamination by wildlife, 2) small stream size, and 3) lack of accessibility to children, as well as due to widespread socio-economic impacts resulting from the cost of improving a stream to a "swimmable" status.

The re-designation of the current swimming use in a stream will require the completion of a Use Attainability Analysis (UAA). A UAA is a structured scientific assessment of the factors affecting the attainment of the use, which may include physical, chemical, biological, and economic factors as described in the federal regulations. The stakeholders in the impacted watershed, Virginia, and EPA will have an opportunity to comment on these special studies.

1.3.3 Wildlife Contributions

In some streams for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of fecal coliform (other than wildlife), the stream will not attain standards. TMDL allocation reductions of this magnitude are not realistic and do not meet EPA's guidance for reasonable assurance. Based on the water quality modeling, many of these streams will not be able to attain standards without some reduction in wildlife. **Virginia and EPA are not proposing the reduction of wildlife to allow for the attainment of water quality standards.** This is obviously an impractical action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL. In such a case, after demonstrating that the source of fecal contamination is natural and uncontrollable by effluent limitations and BMPs, the state may decide to re-designate the stream's use for secondary contact recreation or to adopt site-specific criteria based on natural background levels of fecal coliforms. The state must demonstrate that the source of fecal contamination is natural and uncontrollable by effluent limitations and BMPs through a UAA as described above. All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comments during this process.

1.4 Applicable Criterion for Benthic Impairment

The General Standard**,** as defined in Virginia state law 9 VAC 25-260-20, states:

> A. *All state waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene established standards or interfere directly or indirectly with designated uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life.*

The General Standard is implemented by VADEQ through application of the modified Rapid Bioassessment Protocol II (RBP II). Using the modified RBP II, the health of the benthic macroinvertebrate community is typically assessed through measurement of eight biometrics (Table 1.2) which evaluate different aspects of the community's overall health. Surveys of the benthic macroinvertebrate community performed by VADEQ are assessed at the family taxonomic level (Barbour, 1999).

Each biometric measured at a target station is compared to the same biometric measured at a reference (not impaired) station to determine each biometric score. These scores are then summed and used to determine the overall bioassessment (*e.g.*, not impaired, slightly impaired, moderately impaired, or severely impaired).

Table 1.2 Components of the modified RBP II Assessment.

Biometric	Benthic Health [1]
Taxa Richness	↑
Modified Family Biotic Index (MFBI)	↓
Scraper to Filtering Collector Ratio (SC/CF)	↑
EPT / Chironomid Ratio (EPT/CHI ABUND)	↑
% Contribution of Dominant Family (% DOM)	↓
EPT Index	↑
Community Loss Index (COMM. LOSS INDEX)	↓
Shredder to Total Ratio (SH/TOT)	↑

[1] An upward arrow indicates a positive response in benthic health when the associated biometric increases.

1.5 Project Methodology

The overall goal of this project was to begin the process of restoring water quality in Back Creek. The Back Creek IP development is unique in that it is part of a larger research effort. This research effort has the goal of identifying and assessing alternative BMPs for addressing the large bacterial load reductions that are needed in many watersheds throughout the state. The effort focuses specifically on agricultural BMPs. While this IP is being developed using "standard" BMPs, the hope is that information from the research effort will be used to adjust the IP once the alternative BMPs being researched are better understood.

The key components of the staged implementation plan are discussed in detail in the following sections: State and Federal Requirements for Implementation Plans, Review of TMDL Development, Process for Public Participation, Assessment of Needs, Measurable Goals and Milestones, and Implementation.

With successful implementation of IPs, Virginia will be well on the way to restoring the impaired waters and enhancing the value of this important resource. Additionally, development of an approved IP will improve the localities' chances for obtaining monetary assistance during implementation.

2. STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

The goal of this chapter is to clearly define the state and federal requirements and recommendations for TMDL IPs. This chapter has three sections that discuss the requirements outlined by the WQMIRA that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, the EPA recommended elements of IPs, and the required components of an IP in accordance with Section 319 guidance. The IP is intended to include both the required and recommended elements described in this chapter.

2.1 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 VADEQ to "develop and implement a plan to achieve fully supporting status for impaired waters." In order for IPs to be approved by the Commonwealth, they must meet the requirements as outlined by WQMIRA. WQMIRA requires that IPs include the following:

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

2.2 Federal Recommendations

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

- 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.

The Commonwealth of Virginia strongly suggests that the EPA recommendations be addressed in the IP, in addition to the required components as described by WQMIRA.

2.3 Requirements for Section 319 Fund Eligibility

The EPA develops guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine processes that must be reflected in the IP in order 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 nonpoint (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.

9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

3. REVIEW OF TMDL DEVELOPMENT

MapTech, Inc., was contracted by the VADEQ, to develop a fecal bacteria TMDL and a General Standard (benthic) TMDL for Back Creek in Pulaski County, Virginia. The approved TMDL documents are posted at http://www.deq.virginia.gov/tmdl/. Water Quality monitoring, water quality modeling, and allocated reductions were reviewed to determine the implications of the TMDLs and modeling procedures on IP development.

3.1 TMDL Water Quality Monitoring Results

Virginia's Department of Environmental Quality (VADEQ) has three monitoring stations established on Back Creek (Figure 3.1). TMDL development typically relies on monitored data collected prior to the TMDL study; however, supplemental data is often collected during the TMDL study. In the case of Back Creek, MapTech, Inc. was contracted to do analyses of fecal coliform and *E.coli* concentrations as well as bacterial source tracking (BST) during the TMDL study. For the General Standard TMDL, diurnal DO measurements were collected and toxicity tests were conducted to support the identification of stressors to the aquatic community. Except where pertinent to the development of this IP, data are summarized in this chapter. Additional details can be obtained from the original TMDL report.

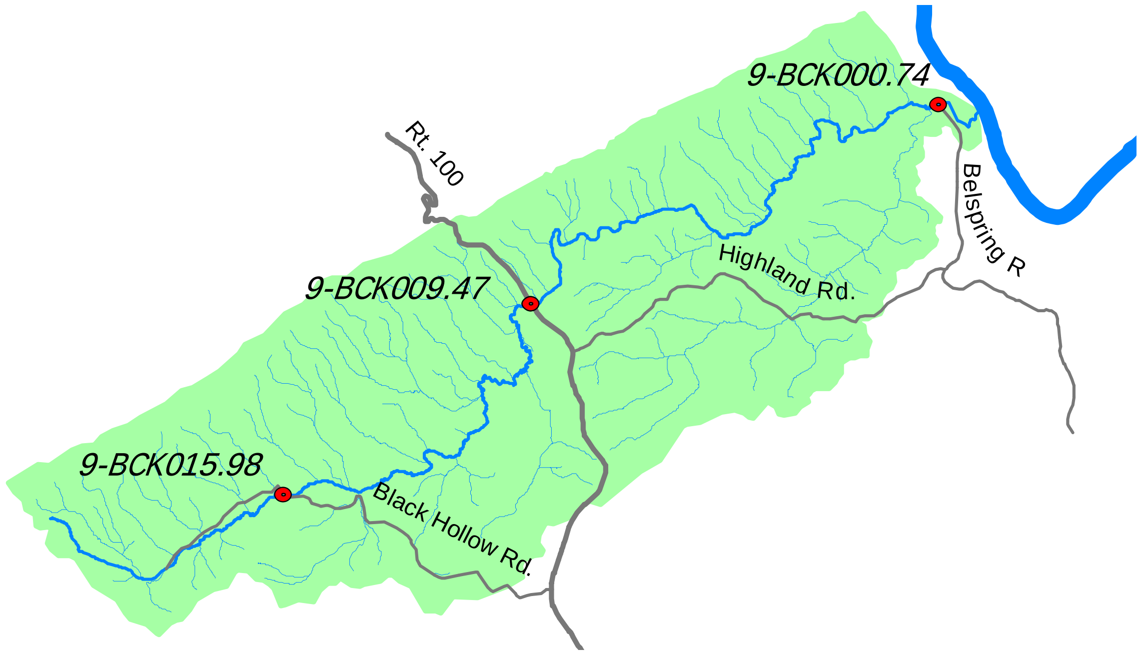

Figure 3.1 VADEQ water quality monitoring stations in the Back Creek watershed.

3.1.1 Data Collected to Support the Fecal Bacteria TMDL

The fecal bacteria TMDL reports historical violation rates of 67%, 90%, and 70% at stations 9-BCK000.74, 9-BCK009.47, and 9-BCK015.98, respectively. These results are based on data collected from August 1992 to February 2004 by VADEQ, and the interim instantaneous fecal coliform standard of 400 cfu/100 mL. Continued monitoring in these streams by MapTech and VADEQ supports the impaired condition reported in the TMDL.

MapTech conducted BST analyses at the two downstream stations (*i.e.*, 9-BCK000.74, and 9-BCK009.47) on Back Creek. Bacterial source tracking is intended to aid in identifying sources (*i.e.* human, pets, livestock, or wildlife) of fecal contamination in water bodies. Data collected provided insight into the likely sources of fecal contamination, aided in distributing fecal loads from different sources during model calibration, and will improve the chances for success in implementing solutions. BST results of water samples collected at the two VADEQ stations in the Back Creek drainage are reported in Table 3.1. The fecal coliform and *E. coli* enumerations are given to indicate the bacteria concentration at the time of sampling. The proportions reported are formatted to indicate statistical significance (*i.e.,* **BOLD** numbers indicate a statistically significant result). The statistical significance was determined through 2 tests. The first was based on the sample size. A z-test was used to determine if the proportion was significantly different from zero (alpha = 0.10). Second, the rate of false positives was calculated for each source category in each library, and a proportion was not considered significantly different from zero unless it was greater than the false-positive rate plus three standard deviations.

The BST results indicate the presence of all sources (*i.e.* human, livestock, wildlife, and pets) contributing to the fecal bacteria violations. The generally higher bacteria counts at the upstream station indicate that loads decrease slightly downstream from the Rt. 100 Bridge. The contribution from livestock is persistent and significant at both the upstream and downstream stations. The contribution from human sources, while sporadic, is significant, and slightly more frequent at the upstream station. This indicates the likely presence of failing septic systems and/or straight pipes, with a higher likelihood of occurrence upstream from the Rt. 100 Bridge.

Table 3.1 Summary of bacterial source tracking results from water samples collected in the Back Creek impairment.

Station	Date	Fecal Coliform (cfu/100 ml)	*E. coli* (cfu/100 ml)	Percent Isolates classified as[1]: Human	Pets	Livestock	Wildlife
9-BCK000.74	11/25/02	370	<1	--	--	--	--
	12/17/02	2,000	300	0	**13**	**62**	**25**
	1/29/03	830	680	**29**	**54**	0	**17**
	2/25/03	300	140	4	**29**	**42**	**25**
	3/31/03	11,000	9,000	4	**33**	**50**	**13**
	4/29/03	430	330	**22**	**22**	**43**	**13**
	5/2803	2,000	540	**42**	**29**	**25**	4
	6/26/03	800	610	0	**17**	**38**	**45**
	7/22/03	690	390	0	4	**71**	**25**
	8/27/03	3,900	620	0	0	**96**	4
	9/22/03	2,000	1,900	**50**	0	**21**	**29**
	10/22/03	380	340	0	**12**	**76**	**12**
9-BCK009.47	11/25/02	520	500	**88**	8	4	0
	12/17/02	9,000	2,200	0	0	**33**	**59**
	1/29/03	2,000	950	**29**	**33**	**17**	**21**
	2/25/03	4,000	1,200	8	**29**	**59**	0
	3/31/03	24,000	18,000	**29**	**50**	**13**	8
	4/29/03	2,200	900	**21**	**62**	4	**13**
	5/28/03	3,000	2,100	**38**	0	**41**	**21**
	6/26/03	3,000	920	**17**	**21**	**41**	**21**
	7/22/03	3,200	1,100	**58**	0	**25**	**17**
	8/27/03	6,900	1,700	4	**38**	**25**	**33**
	9/22/03	6,000	2,600	**17**	**17**	**33**	**33**
	10/22/03	600	310	4	**17**	8	**71**

[1]**BOLD** type indicates a statistically significant value.

3.1.2 Data Collected to Support the General Standard TMDL

Aquatic life assessments conducted by VADEQ indicated that this stream is moderately impaired. Habitat assessments and ambient water quality monitoring supported the conclusion that sediment was a significant stressor in Back Creek. While organic enrichment was identified as a possible stressor, it was concluded that the efforts to control fecal loads to the stream would address this issue. Toxicity tests and diurnal dissolved oxygen (DO) assessments conducted during the TMDL study did not indicate any problems with toxic pollutants or low levels of DO. Based on these assessments, it was concluded that the General Standard TMDL for Back Creek would be developed with the intention of reducing sediment loads.

3.2 Water Quality Modeling

In order to understand the implications of the load allocations determined during TMDL development, it is important to understand the modeling methods used in the analysis. Different modeling approaches were used for the fecal bacteria and aquatic life TMDLs. These approaches are presented here in the "Fecal Bacteria Modeling" section and the "Sediment Modeling" section.

3.2.1 Fecal Bacteria Modeling

United States Geological Survey (USGS) Hydrologic Simulation Program - Fortran (HSPF) water quality model was used as the modeling framework to simulate hydrology and fecal coliform fate and transport for the bacteria TMDL allocations. Because the current bacteria standard is based on *E. coli*, VADEQ's fecal coliform to *E. coli* translator was used to predict *E. coli* concentrations based on the modeled fecal coliform levels. The water quality endpoints used for determining the necessary reduction to *E. coli* loads were the instantaneous standard (235 cfu/100 ml) and the monthly geometric mean standard (126 cfu/100 ml). An implicit margin of safety was used.

3.2.1.1 Fecal Bacteria Sources

Potential sources of fecal bacteria considered in the TMDL development included both point source and non point source contributions. Point sources permitted to discharge in the Back Creek watershed though the Virginia Pollutant Discharge Elimination System (VPDES) are listed in Table 3.2 and shown in Figure 3.2.

Table 3.2 Permitted Point Sources in the Back Creek Watershed.

Facility	VPDES #	Design Discharge (MGD)	Permitted For Fecal Control	Data Availability
Residence	VAG402033	0.0005	Yes	No Data
Residence	VAG402086	0.001	Yes	No Data
Back Creek Dairy	VPG120009	-----------NO DISCHARGE-----------		
Goochs Recycling	VAR050140	Stormwater	No	No Data

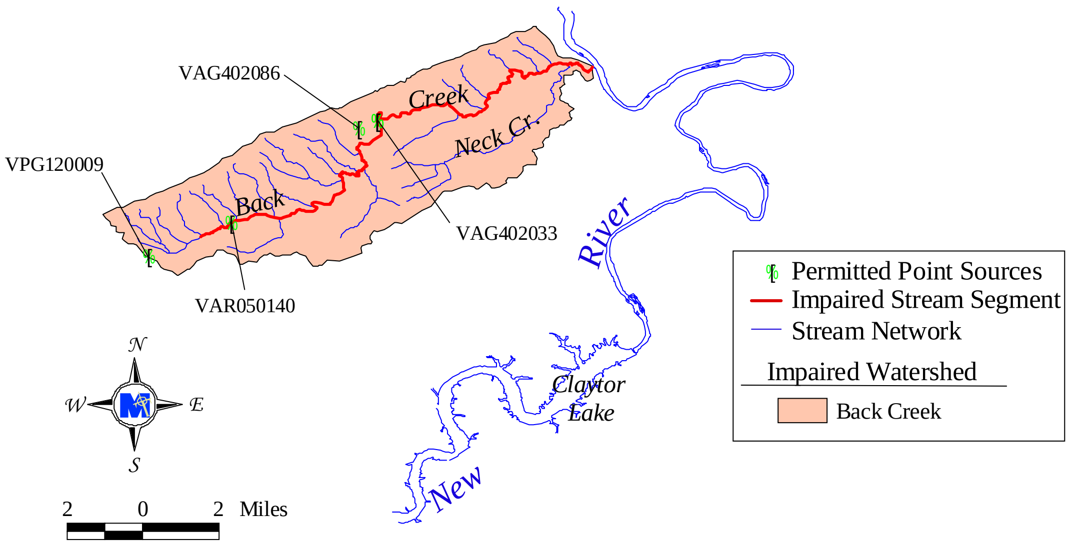

Figure 3.2 Location of VPDES permitted point sources in the Back Creek watershed.

There are currently no Municipal Separate Storm Sewer System (MS4) permitted discharges in the watershed. At the time the Back Creek TMDLs were created, the permitted discharges that could contain pathogens associated with fecal matter had a bacteria discharge limit of 200 cfu/100 mL. Typically, fecal coliform concentrations are reduced to levels well below the 200 cfu/100 mL limit.

Both agricultural and residential nonpoint sources of fecal bacteria were considered. Sources included residential sewage treatment systems, land application of waste, livestock, wildlife, and domestic pets. Loads were represented either as land-based loads, where they were deposited on land and available for wash off during a rainfall event, or as direct loads, where they were directly deposited to the stream. Land-based nonpoint sources are represented as an accumulation of pollutants on land, where some portion is available for transport in runoff. The amount of accumulation and availability for transport vary with land use type and season. The model accounts for bacterial die-off on land through a user-specified maximum accumulation. Some nonpoint sources, rather than being land-based, are represented as being deposited directly to the stream (*e.g.*, animal defecation in stream, straight pipes). These sources are modeled similarly to point sources, as they do not require a runoff event for delivery to the stream.

3.2.1.2 Fecal Bacteria Model Allocation

Several model runs were made investigating scenarios that would meet the standards cited above (Table 3.3). The final allocation scenario requires significant reductions in the fecal bacteria load in wash-off from cropland, pasture (including hayland), and residential areas. Additionally, a 100% reduction in livestock stream deposition and straight pipes is necessary. Although significant reductions in the wildlife load were indicated as necessary to achieve zero violations of the standard, de-listing of streams occurs when the violation rate drops below 10.5%. The modeling indicated that this level of reduction could be achieved without reductions to the wildlife load.

Table 3.3 Allocation scenarios for bacterial concentration with current loading estimates in the Back Creek impairment.

Scenario Number	Percent Reduction in Loading from Existing Condition						Percent Violations	
	Direct Wildlife	NPS Wildlife	Direct Livestock	NPS Pasture / Cropland	Res./ Urban	Straight Pipe	GM > 126 cfu/ 100ml	Single Sample Exceeds 235 cfu/ 100ml
1	0	0	0	0	0	0	100	82.6
2	0	0	0	0	0	100	100	82.6
3	0	0	90	50	50	100	76.7	36.7
4	0	0	100	60	60	100	63.3	31.9
5	0	0	100	99	99	100	0.0	2.74
6	75	75	100	99	99	100	0.0	1.48
7	99	99.5	100	99.5	99.5	100	0.0	0.44
8	38	93	100	99.8	95	100	0.0	0.0

3.2.2 Sediment Modeling

Excessive sedimentation is considered to be a primary cause of the benthic impairment in Back Creek. Sedimentation has impacted the benthic community in these streams due to increases caused by agricultural and residential runoff, streambank de-stabilization, the loss of riparian buffers, and other processes. The Generalized Watershed Loading Function (GWLF) model (Haith et al., 1992) was used to model sediment for Back Creek. Since there is no state standard for sediment, a reference watershed approach was used to establish the water quality endpoint for TMDL allocations. Using this approach, a similar, but non-impaired, watershed is selected and modeled to determine the acceptable load of the pollutant in question. The reference watershed for Back Creek was Toms Creek in Montgomery County, Virginia.

3.2.2.1 Sediment Allocations

Several load allocations scenarios were developed for the Back Creek impairment. The scenario selected during the implementation plan development for Back Creek is presented in Table 3.4.

Table 3.1 Sediment allocations for Back Creek.

Source Category	Sediment Reduction (%)
Row Crops	69
Pasture / Hay	60
Streambank Erosion	66

3.3 Implications of the TMDLs and Modeling Procedure on Implementation Plan Development

The major implication in the development of these TMDLs is that extreme reductions are required to achieve the water quality standard, particularly in the case of the bacteria TMDL. All uncontrolled discharges, and failing septic systems must be identified and corrected, and most livestock must be excluded from streams. Residential, and agricultural nonpoint sources of fecal bacteria, and agricultural nonpoint sources of sediment must be reduced. Additionally, streambank erosion must be reduced considerably.

However, there are subtler implications as well. Implicit in the requirement for 100% correction of uncontrolled discharges is the need to maintain all functional septic systems. Although reductions to the fecal bacteria load from wildlife are indicated, these reductions will not be explicitly addressed by this implementation plan. Wildlife control measures implemented by local authorities will help to reduce the fecal bacteria load; however, implementation efforts discussed in this document will be directed at controlling anthropogenic sources. See Section 1.3.3 in this report for a discussion of regulatory issues regarding wildlife.

4. PUBLIC PARTICIPATION

Public participation was an integral part of the TMDL Implementation Plan Development, and is critical to promote reasonable assurances that the implementation activities will occur. Public participation took place on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project as well as a forum for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups and steering committee). Second, working groups were assembled from communities of people with common concerns regarding the TMDL process and were the primary arena for seeking public input. The following working groups were formed: Agricultural, Residential, and Governmental. A representative of MapTech attended each working group meeting in order to facilitate the process and integrate information collected from the various communities. Third, a steering committee was formed with representation from all of the working groups, VADCR, VADEQ, and MapTech.

The goals of the Agricultural and Residential Working Groups were to identify obstacles to implementation in their respective communities and suggest workable solutions that will overcome these obstacles. Potential solutions included identification of alternative best management practices (BMPs) options, identification of alternative funding sources, identification of existing or potential partnerships, and recommendations as to the best approaches for education and outreach. The goals of the Governmental Working Group were to identify technical and financial resources available to carry out the implementation plan, recommend to the Steering Committee how to deliver agricultural, and residential components of the IP, and identify legal or regulatory controls associated with implementation. The purpose of the Steering Committee was to assimilate the recommendations of the working groups into the IP and guide the overall development of the final IP document. In addition, this committee had the responsibility for identifying control measures that are founded in practicality, establishing a time-line to ensure expeditious implementation, and setting measurable goals and milestones for attaining water quality standards.

Public participation related to the Back Creek IP development differed from previous IP development efforts in two ways. First, the Agricultural Working Group input was handled through an Agricultural Workshop that was comprised of a series of 8 meetings over a 4-week period. Second, because there was significant overlap in the membership, the Government Working Group and Steering Committee meetings were combined. All meetings conducted during the course of the TMDL IP development are listed in Table 4.1. Individuals on local, state, and federal levels representing agricultural, residential, and governmental interests devoted hundreds of work-hours to attending meetings.

Table 4.1 Meetings held pertaining to the Back Creek TMDL Implementation Plan development.

Date	Meeting Type	Location	Attendance
1/12/2006	Public	New River Community College	28
2/21/2006	Agricultural Workshop	Dublin Town Hall	16
2/23/2006	Agricultural Workshop	Dublin Town Hall	11
2/28/2006	Agricultural Workshop	Dublin Town Hall	12
3/2/2006	Agricultural Workshop	Dublin Town Hall	12
3/7/2006	Agricultural Workshop	Dublin Town Hall	14
3/9/2006	Agricultural Workshop	Dublin Town Hall	11
3/14/2006	Agricultural Workshop	Dublin Town Hall	10
Various	Agricultural Workshop (6 Farm Visits)	Various	Various
8/31/2006	Residential Working Group	Dublin Town Hall	8
9/14/2006	Government/Steering Committee	Dublin Town Hall	12
10/17/2006	Public	Dublin Town Hall	12

4.1 Public Meetings

Attendance at public meetings is critical to the public participation effort, and was encouraged through announcements in the *Virginia Register*, and direct mailings to all residents of the watershed.

The first formal public meeting was held in Dublin, VA on November 23, 2004. Information delivered to the public at the meeting included: a general description of the

TMDL process, a more detailed description of TMDL development and implementation plan development, and a solicitation for participation in working groups.

The final public meeting was on October 17, 2006 in Dublin, VA with attendees from the community, government agencies, and MapTech. The primary purpose of this meeting was to present the Final TMDL Implementation Plan. A presentation was given describing the implementation plan using major components as an outline: review of TMDL development, public participation, assessment of needs, measurable goals and milestones, and implementation. A copy of the presentation was distributed to attendees. Maps with land use, topographic features, and analysis results were displayed and discussed after the presentation.

4.1.1 Agricultural Working Group

The Agricultural Working Group (AWG) consisted of 7 local farmers. Representatives from organizations that serve this community and will have a role in implementation were also included (*e.g.,* SSWCD and National Resources Conservation Service (NRCS)). As discussed above, this working group was handled as a workshop. Agricultural stakeholders from the Back Creek watershed were invited and paid for their attendance. Approximately ten stakeholders account for the majority of livestock production in the watershed, and all were invited. During this workshop, participants were informed as to the specific implementation needs indicated by the TMDLs, given information regarding the specific innovative BMPs being considered in the project, and asked for input as to the economic and social sustainability of the practices being considered. The workshop involved a four-week educational program (meeting twice per week) with the primary stakeholders (landowners/farmers) to provide extensive training on developing conservation plans and integrating BMPs for water quality control. This program provided a highly focused environment whereby candid exchange of new innovative techniques and traditional BMPs could be explored as candidates for achieving water quality goals for the watershed. The group had access to statewide databases for their area, as well as modeling and other tools that are available to develop control strategies and to evaluate effectiveness.

The group discussed the type of livestock exclusions BMPs that would be both effective and practical in these watersheds. Due to the nature of farming in these watersheds, compliance with the 35-foot buffer width required by cost/share programs is believed to be impractical. Of the farmers that participated in the workshops, they preferred installing exclusion fencing with a five to 10 foot buffer.

4.1.2 Residential Working Group

The Residential Working Group (RWG) met on August 31, 2006 at the Dublin Town Hall. Eight people attended the meeting with seven representing state and local government agencies and one resident from the watershed. The purpose for the group was to develop a plan to (1) identify and eliminate straight pipes and failing septic systems, (2) recognize difficulties faced by landowners in correcting these problems, (3) identify potential means of funding corrections, (4) determine how to get landowners to come forward when there is fear of regulatory action and unknown costs, (5) determine technical assistance needed, and (6) determine educational tools that are most likely to help.

The group discussed the need to educate homeowners on the subjects of pet litter control and septic tank drainfield maintenance. It was pointed out that this is a karst area and that septic systems could be failing to sinkholes. A pumpout program was suggested as one way to increase understanding of the issues, and identify existing problems. There was a suggestion to require the installation of an observation port with each pumpout or septic repair/installation that is funded. The likely distribution of repair vs. replacement of septic systems and standard vs. alternative systems was discussed. And, data from the fluorometry monitoring sweep was discussed.

4.1.3 Governmental Working Group /Steering Committee

Because there was significant overlap in the membership, the Government Working Group and Steering Committee meetings were combined. The group consisted of 12 members with representatives from the Agricultural and Residential Working Groups, Skyline SWCD, VADCR, VADEQ, VCES, VDH, NRCS, NRH-RC&D and MapTech.

The meeting was held on September 14, 2006 in Dublin to review the draft IP results. The group suggested that the length of streambank to be fenced could be accurate, but that it would likely entail fewer farms, each with more stream to be fenced. There were concerns over the inclusion of retention ponds in Phase II of the plan. These concerns included that producers would not be interested in building them, that by attracting wildlife they may add to the bacteria load, and that they are an expensive proposition. Additional waste storage and feedlot management were suggested as alternatives. For the residential practices, it was suggested that many houses could be signed-up for the pumpout program, and then the whole group could be bid-out to a contractor at a savings. Input from the Steering Committee was incorporated into the draft document and presentation.

4.1.4 Summary

Varied opinions were voiced throughout the public participation meetings regarding the IP process. A consensus of the working groups agreed that a cornerstone of the IP is cultivating public involvement, education of all stakeholders as well as encouraging commitment and partnerships among the citizens and government agencies in the watershed in order to reduce fecal bacteria, and sediment loads to the Back Creek. An assertion to individual responsibility provides a foundation for building partnerships among citizens, interest groups, and government agencies. It can also cultivate voluntary implementation and long-term support for reducing pollutant levels and restoring water quality in the Back Creek watershed.

5. ASSESSMENT OF IMPLEMENTATION ACTION NEEDS

An important element of the TMDL IP is the encouragement of voluntary compliance with implementation actions by local, state, and federal government agencies, business owners, and private citizens. In order to encourage voluntary implementation, information was obtained on the types of actions and program options that can achieve the goals practically and cost-effectively.

5.1 Identification of Control Measures

Potential control measures, their associated costs and efficiencies, and potential funding sources were identified through review of the TMDLs, input from Working Groups, and literature review. Control measures were assessed based on cost, availability of existing funds, reasonable assurance of implementation, and water quality impacts. Measures that can be promoted through existing programs were identified, as well as those that are not currently supported by existing programs and their potential funding sources. The assurance of implementation of specific control measures was assessed through discussion with the Working Groups and Steering Committee. Some control measures were indicated or implied by the TMDL allocations, while others were selected through a process of stakeholder review and analysis of effectiveness in these watersheds. These measures are discussed in sections 5.1.1 and 5.1.2, respectively.

5.1.1 Control Measures Implied by the TMDLs

The allocations determined during TMDL development dictate some of the control measures that must be employed during implementation. In order to meet the 100% reductions in direct deposition from livestock, some form of stream exclusion is necessary. Fencing is the most obvious choice, however, the type of fencing, distance from the stream bank, and most appropriate management strategy for the fenced pasture are less obvious. The 100% reduction in loads from straight pipes, and failing septic systems is a pre-existing legal requirement as well as a result of these TMDLs. This reduction indicates that all illicit discharges (*i.e.*, straight pipes) in the watersheds should be corrected, and that all onsite sewage treatment systems (OSTS) (*e.g.*, septic systems and alternative waste treatment systems) must be maintained in proper working condition.

While it is recognized that farmers will want to minimize the cost of fencing and the amount of pasture lost, it was understood that any fencing installed through the use of cost-share programs must follow established NRCS specifications and be located 35-ft from the stream bank, at a minimum, as is specified in existing Virginia cost-share programs. Additionally, a contributing factor to the sediment problem in Back Creek is that it was straightened in many reaches. In these straight reaches, high flows cause downcutting within the stream channel resulting in steep, eroded banks and a stream that is cutoff from its natural flood plain. Thus, one goal of stream bank restoration could be to create natural meanders and channels where the stream can get into the flood plain. For this to occur, wide buffers would be optimal to avoid creating a condition where new fencing would fall into the stream.

An alternative water source will typically be required where pasture is fenced off from streams. The Skyline Soil and Water Conservation District and NRCS staff have assisted with the installation of many types of alternative water systems. The main criterion is that the system be dependable. Water systems alone (*i.e.,* with no streamside fencing) have been shown to reduce the amount of time cattle spend in the stream by as much as 50 to 80%. This is not a large enough reduction to meet the fecal bacteria TMDL, however it has been recognized that some farmers may be willing to install their own fence to their own specifications if cost-share money is available for the water system. It should be restated here that it is recommended that all fence, even that which is installed solely at the landowner's expense, be placed at least 35-ft from the stream. The inclusion of a buffer helps to reduce sediment and bacteria loads in runoff. The incorporation of effective buffers could reduce the need for more costly control measures.

From an environmental perspective, the best management scenario would be to exclude livestock from the stream bank 100% of the time and establish permanent vegetation in the buffer area. This prevents livestock from eroding the stream bank, provides a buffer for capturing pollutants in runoff from the pasture, and establishes (with the growth of streamside vegetation) one of the foundations for healthy aquatic life. From a livestock-production perspective, the best management scenario is one that provides the greatest profit to the farmer. Obviously, taking land (even a small amount) out of production is contrary to that goal. However, a clean water source has been shown to improve milk production and weight gain. Clean water will also improve the health of animals (*e.g.,* cattle and horses) by decreasing the incidence of waterborne illnesses and exposure to swampy areas near streams. Additionally, intensive pasture management, which becomes possible with an alternative water source, has been shown to improve overall farm profitability and environmental impact. From a part-time farmer's perspective, the best management scenario is one that requires minimal input of time. This would seem to preclude intensive pasture management; however, those farmers who have adopted an intensive pasture-management system typically report that the additional management of the established system amounts to "opening a gate and getting out of the way" every couple of days. Additionally, the efficient use of the pasture often means that fewer supplemental feedings are necessary. Among both part-time and full-time farmers there are individuals who are hesitant to allow streamside vegetation to grow unrestricted because of aesthetic preferences or because they have spent a lifetime preventing this growth. However, there is a cost savings associated with not having to purchase and apply herbicides or engage in manual removal of vegetation as a means of controlling its presence on the stream bank. Nonetheless, given the reductions needed in pollutant (*i.e.*, fecal bacteria and sediment) delivery to the stream, a vegetated buffer will be needed. For planning purposes, it was assumed that a vegetated buffer will be established in conjunction with stream fencing.

The options identified for correcting illicit discharges and failing septic systems included: installation of a septic system, repair of an existing septic system, and installation of an alternative waste treatment system. It is anticipated that some portion of straight pipes will be located in areas where an adequate site for a septic drain field is not available. In these cases, the landowner will have to consider an alternative waste treatment system.

5.1.2 Control Measures Selected through Stakeholder Review

In addition to the control measures that were directly indicated by the TMDLs, a number of measures were needed to control fecal bacteria from land-based sources and sediment loads. Various scenarios were developed and presented to Working Groups. All scenarios began with implementation of the measures indicated by the TMDLs. Next, specific sources of fecal bacteria were addressed where highly economic practices were identified. For instance, a pet-litter-control education program was specified in the watershed. Similarly, with regard to sediment, practices that specifically address these pollutants were identified. An important control measure for reducing sediment loads in Back Creek is streambank restoration.

Beyond this level of control for the pollutants of interest, practices that require the control or treatment of runoff are the primary tools available. These sorts of measures control bacteria and sediment. The resulting set of additional BMPs included; improved pasture management, conservation tillage, rain gardens, and retention ponds. While economically attractive, infiltration basins would not be appropriate in these watersheds, given the karst geology of the area. The final set of control measures identified and the efficiencies used in this study to estimate needs are listed in Table 5.1. The control measures listed in Table 5.1 are divided into categories based on the method of load reduction. "Direct Reductions" are those that reduce the load of pollutant from a specific source to the stream itself or to the land. "Buffer" practices control pollutants through both a land conversion and treatment of runoff from an upslope area. "Runoff Treatment" measures are those that either treat runoff from a given land area (*e.g.*, retention ponds) or treat runoff based on changing the runoff-producing characteristics of the land (*e.g.*, improved pasture management).

Table 5.1 Potential control measure costs and efficiencies in removing pollutants.

Control Measure	Efficiencies: Bacteria	Efficiencies: Sediment	Reference
Direct Reduction Efficiency			
Streamside Fencing	100%	0%	2
Corrected Straight-pipe	100%	100%	2
Repaired Septic System	100%	100%	2
Pet Litter Control Program	75%	0%	4
Manure Incorporation	90%	0%	5
Streambank Restoration	N/A	2.55 lbs/ft/yr	3
Buffer Efficiency[1]			
Vegetated Buffer	50%	50%	3
Runoff Treatment Efficiency			
Improved Pasture Management	50%	50%	3
Conservation Tillage	61%	61%	6, 7
Rain Gardens	85%	85%	3, 7
Retention Ponds	80%	80%	3, 7

1 Buffer efficiencies shown here are applied to runoff from twice the buffer area upstream of the buffer. Additional reductions result from the conversion of land from its existing condition to the buffer area.

2 Removal efficiency is defined by the practice.

3 Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/

4 Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.

5 Kern, J.D. 1997.

6 Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1992. Soil and Water Conservation Engineering, 4th Edition. Wiley.

7 Bacteria efficiency estimated based on sediment efficiency.

5.2 Quantification of Control Measures

The quantity of control measures required during implementation was determined through spatial analyses, modeling alternative implementation scenarios, as well as some field inspections. Spatial analyses included the processing of data that included land use, census data, stream networks, and elevation, along with data archived from the VADCR Agricultural BMP Database and TMDL development documents. The map layers and archived data were combined to establish the number of control measures required overall, in each watershed, and in each subwatershed, where appropriate. Estimates of the amount of on-site treatment systems, sewer connections, streamside fencing, number of full livestock exclusion systems, and number of hardened crossings were made through these analyses. The quantities of additional control measures were determined through modeling alternative scenarios and applying the related reduction efficiencies to their associated loads.

Implicit in the TMDLS is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction, and from sources that may develop over time, as implementation proceeds. One potential for additional sources of the pollutants identified is future residential development. Care should be taken to monitor development and its impacts on water quality. The principles of Low-Impact Development (LID) should be considered, wherever feasible, as increased pollutant loads from newly developed sources could undermine the work being proposed in this IP.

5.2.1 Agricultural Control Measures

5.2.1.1 Agricultural Control Measures: Livestock Exclusion

To estimate fencing requirements, the stream network was overlaid with land use. Stream segments that flowed through or adjacent to land-use areas that had a potential for supporting cattle (*e.g.*, improved pasture) were identified. If the stream segment flowed through the land-use area, it was assumed that fencing was required on both sides of the stream, while if a stream segment flowed adjacent to the land-use area, it was assumed that fencing was required on only one side of the stream. These assumptions were further refined to examine land parcel boundaries, size of resultant pasture, and existing BMPs. Both perennial and intermittent streams were included in this process. Land uses included cattle operations, pasture, and dairy facilities. Not every land-use area identified as pasture has livestock on it at any given point in time. However, it is assumed that all pasture areas have the potential for livestock access. A map of potential streamside fencing required for streams in the Back Creek watershed is shown in Figure 5.1.

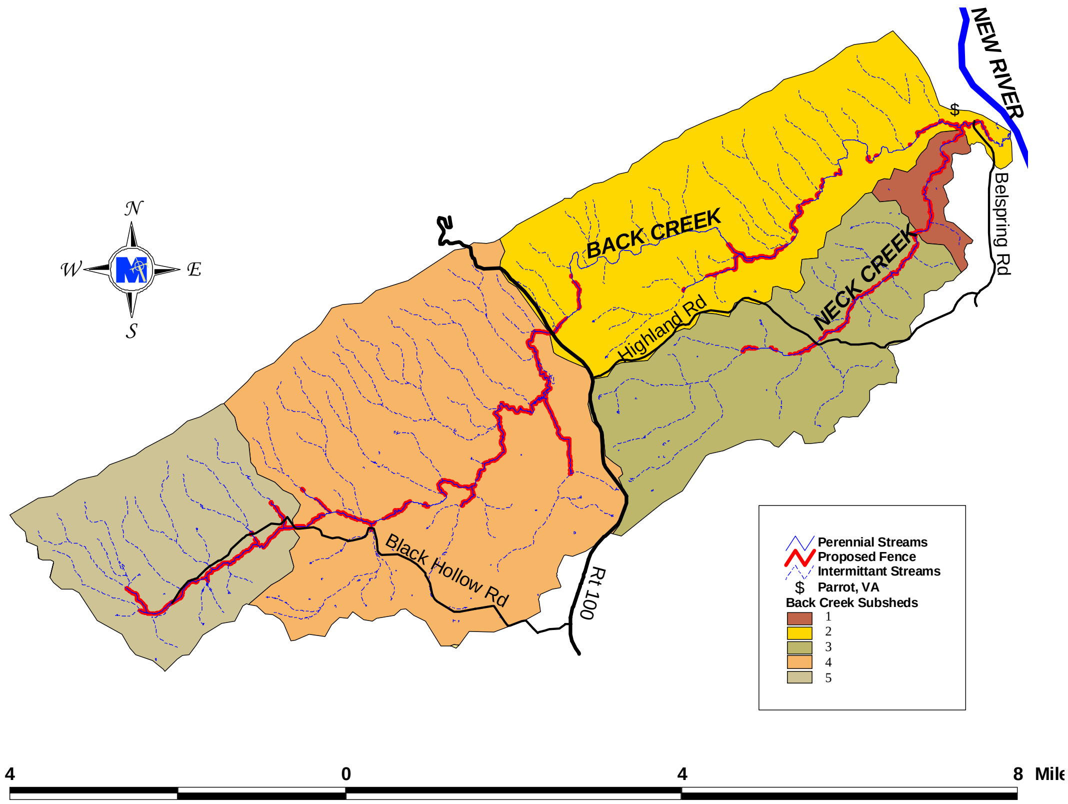

Figure 5.1 Potential streamside fencing for perennial streams in the Back Creek watershed.

The VADCR Agricultural BMP Database was utilized to determine typical characteristics (*e.g.*, streamside fencing length per practice) of full livestock exclusion systems in the local area. The database was queried for information on Grazing Land Protection Systems (SL-6) and Stream Protection Systems (WP-2 and WP-2T) installed in the Skyline SWCD service area. The SL-6 system includes streamside fencing, cross fencing, alternative watering system, and a 35-ft buffer from the stream. The WP-2 and WP-2T systems include streamside fencing, hardened crossings, and a 35-ft buffer from the stream. In TMDL implementation areas, the WP-2T practice is eligible. In cases where a watering system already exists, a WP-2T system is a more appropriate choice. Before 1999, the number of acres benefited from installing the system was recorded, while after 1999, the streamside fencing length was recorded. One hundred forty-eight systems have been installed with 84 systems characterized by streamside fencing length, and 64 with acres benefited. The average streamside fencing length was 1,435 feet and 36 acres benefited per installation.

To establish the total number of full livestock exclusion systems necessary to achieve full implementation, systems were calculated by dividing the potential pasture streamside fencing required by the average streamside fencing length per system. The breakdown of number of exclusions systems that are expected to be SL-6 or WP-2T systems is based on historical use of these practices in the Skyline SWCD service area. This IP focuses on fencing along perennial streams. It was determined that 135 total livestock exclusion systems (SL-6 and WP-2) are required(Table 5.2).

Table 5.2 Estimation of total streamside fencing, and number of full exclusion systems required in the Back Creek watershed, prior to adjusting for local stakeholder input.

Subwatershed	Streambank Protected[1] (ft)	SL-6[2] (#)	WP-2T[2] (#)
1	15,000	10	1
2	37,000	24	2
3	26,000	18	1
4	77,000	50	4
5	39,000	26	2

[1] Values rounded to the nearest thousand.
[2] Values rounded to the nearest whole unit.

These estimates were revised based on local input. For instance, it was anticipated that the size and cost of livestock exclusion systems in Back Creek would be significantly greater than the local average. An analysis of spatial data indicated that there are 50 tracts with more than 5 acres of pasture on perennial streams in the Back Creek watershed. This number was used to adjust the size and cost of livestock exclusion systems upward from the initial estimate. Table 5.2 reflects the results of analyses prior to making this adjustment. Since no spatial distribution of the system size was available, this table stands as the best available estimate of the distribution of fencing needs within each impaired watershed. However, overall needs were adjusted and the costs that were calculated reflect this adjustment.

5.2.1.2 Agricultural Control Measures: Land-Based

The Back Creek TMDLs require large reductions to land-based agricultural loads. In order to meet these strict requirements, the BMPs in Table 5.3 must be implemented, however, a staged approach to implementation is described in Chapter 6 of this document, whereby much of the needed reductions can be achieved without overly intensive actions. One category of practices that is expected to have a substantial impact on water quality improvement is improved pasture management. In the case of the Back Creek watershed, it is anticipated that this improved management will take the form of both rotational grazing systems and rotational loafing lot systems.

Table 5.3 Agricultural Land-Based BMPs required to meet the Back Creek TMDLs.

Control Measure	Quantity
Waste Storage Facilities (#)	
Cattle Manure	4
Improved Pasture Management (ac)	5,350
Conservation Tillage (ac)	
Cropland	401
Manure Incorporation (ac)	1,055
Retention Pond (ac-treated)	
Cropland	1,150
Pasture/Hay	12,250

5.2.2 Residential Control Measures

5.2.2.1 BMPs to Correct Failing Septic Systems and Straight Pipes

All straight pipes and failing septic systems must be identified and corrected during implementation since a 100% load reduction from these sources was deemed necessary to meet the TMDL goals. The number and location of failing septic systems and straight pipes were based on analysis of census data and review by the Residential Working Group (RWG). Table 5.4 shows the number of failing septic systems and straight pipes for each subwatershed.

The Residential Working Groups identified the following BMPs to correct failing septic systems and straight pipes: septic system repairs, septic systems, and alternative waste treatment systems. The RWG estimated that approximately 5-10% of the failing septic systems would need basic repairs, while the remainder would need new systems. Any residence requiring a new system that does not pass the current VDH percolation tests may need an alternative waste treatment system. For cost estimations, it was decided to assume that 75% of the installed systems would be standard septic systems (~$6,000) and the other half would be alternative systems (~$15,000). A total need of 173 new waste treatment systems or repairs are estimated for these watersheds (Tables 5.4 and 5.5).

Table 5.4 Estimated failing septic systems and straight pipes in the Back Creek watershed.

Subwatershed	Septic	Potential Failing Septic Systems	Potential Straight Pipes
1	18	4	0
2	477	102	1
3	121	26	
4	95	20	1
5	90	19	
Totals	**801**	**171**	**2**

Table 5.5 Estimated control measure needs in the Back Creek watershed.

Control Measure Description	VA Cost-Share Practice Number	Total
Septic Tank Pumpout	RB-1	100
Sewer Connection	RB-2	0
Septic System Repair	RB-3	17
Septic System Installation/Replacement	RB-4	117
Alternative Waste Treatment System	RB-5	39

5.2.2.2 Residential Control Measures: Land-Based

The Back Creek TMDLs require large reductions to land-based residential loads. In order to meet these strict requirements, the BMPs in Table 5.6 must be implemented, however, a staged approach to implementation is described in Chapter 6 of this document, whereby much of the needed reductions can be achieved without overly intensive actions. It was recognized that educational efforts would be vital to the successful implementation of these TMDLs. This education includes a septic tank pump-out program addressing 100 systems, as well as dissemination of information about rain gardens and pet waste handling.

Table 5.6 Residential Land-Based BMPs required to meet the Back Creek TMDLs.

Control Measure	Total
Residential Education Program (#)	1
Rain Garden (ac - treated)	30

5.2.3 In-Stream Control Measures

In addition to land-based load reductions, the TMDLs identified the need for reductions of streambank erosion (66%). Streambank erosion can be caused by excessive flow velocities in the stream channel and/or other physical disturbance of the streambanks. In Back Creek, both causes are present. The combination of soil type, agricultural practices, and channelization of the stream have lead to higher velocities in the stream than would appear under natural conditions. In addition, livestock with access to the stream have disturbed streambanks. Streambank restoration is the most obvious control measure that can be implemented to achieve the required reduction. Streambank restoration can be achieved through regrading steep, eroding streambanks, revegetating, and in some cases, strengthening highly erosive streambanks with stones, gabions, or log structures. It is estimated that 31,700 feet of streambank will need restoration to achieve the required reductions. Much of this restoration can be achieved through the livestock exclusion practices discussed earlier. By preventing access to the stream, denuded streambanks will naturally revegetate and reduce erosion. Other practices discussed earlier (*e.g.*, improved pasture management, conservation tillage, and rain gardens) will reduce flow velocities in the stream. However, for accounting purposes, it has been assumed that some level of streambank restoration will be required on the full 31,700 feet.

5.3 Technical Assistance and Education

Members of the Working Groups and the Steering Committee agree that technical assistance and education is key to getting people involved in implementation. There must be a proactive approach to contact farmers and residents to articulate exactly what the TMDLs mean to them and what practices will help meet the goal of improved water quality. Several education/outreach techniques will be utilized during implementation. Articles describing the process, the reasons why high levels of the pollutants are a problem, the methods through which the problem can be corrected, the assistance that is currently available for landowners to deal with the problem, and the potential ramifications of not dealing with the problem should be made available to the public through as many channels as possible (*e.g.,* Farm Bureau newsletters, Farm Service Agency (FSA) newsletters, and targeted mailings). Workshops and demonstrations should be organized to show landowners the extent of the problem, the effectiveness of control measures, and the process involved in obtaining technical and financial assistance.

For the agricultural community, field days, pasture walks, and presentations offered through local farm groups are recommended. The emphasis should be with local farmers discussing their experiences with cost-share programs, demonstrating the advantages of a clean water source and pasture management, and presenting monitoring results to demonstrate the problem. It is generally accepted that farmers will be more persuaded by discussion with local technical personnel or fellow farmers who have implemented the suggested control measures than through presentations made by state-agency representatives.

For residential issues, public outreach should focus on increasing awareness of private residential sewage treatment systems, control of pet waste, and control of storm runoff (rain gardens). This outreach effort will provide useful information to residents and increase the likelihood of identifying straight pipes and failing septic systems in the impaired watersheds. Small community meetings similar to the small workshops proposed for the agricultural community can be organized for educating homeowners about residential issues. Information about the TMDLs can be presented using media outlets, direct mailings, and presentations to community groups. An educational packet about septic system issues should be disseminated to new homeowners. Additionally, educational tools (*e.g.*, a model septic system used to demonstrate functioning and failing septic systems, a video of septic maintenance and repair) would be useful in communicating the problem to the public. With future development expected in the watershed, impervious surfaces are expected to increase resulting in increased runoff volumes and altered hydrology to Back Creek and its tributaries. This type of hydrologic alteration would exacerbate the sediment problem. Therefore, efforts should be made to educate county planners, developers, and local home building associations in the benefits and methods of Low-Impact Development (LID) in future residential and commercial development in the watershed. The technical assistance and educational outreach tasks needed in the residential community during implementation were identified during plan development.

The following tasks associated with agricultural and residential programs were identified:

Agricultural Programs

1. Make contact with landowners in the watershed to make them aware of implementation goals, cost-share assistance, and voluntary options that are beneficial.
2. Provide technical assistance for agricultural programs (*e.g.*, survey, design, layout, and approval of installation).
3. Develop educational materials & programs.
4. Organize educational programs (*e.g.*, pasture walks, presentations at field days or club events).
5. Distribute educational materials (*e.g.*, informational articles in FSA or Farm Bureau newsletters, local media).
6. Handle and track cost-share.
7. Assess and track progress toward BMP implementation goals.
8. Coordinate use of existing agricultural programs and suggest modifications where necessary.

Residential Programs

1. Identify straight-pipes and failing septic systems (*e.g.*, contact landowners in older homes, septic pump-out program).
2. Handle and track cost-share.
3. Develop educational materials & programs.
4. Organize educational programs (*e.g.*, demonstration septic pump-outs, pet waste control, rain garden demonstration).
5. Distribute educational materials (*e.g.*, informational pamphlets on TMDL IP, rain gardens, and on-site sewage disposal systems).
6. Track BMP installations.
7. Assess progress toward implementation goals.

Members of the Steering Committee agreed that one full time equivalent (FTE), for residential efforts, over the ten-year implementation period would be adequate to provide residential technical assistance and educational outreach tasks. One FTE is equal to one full-time staff member.

The Skyline SWCD has agreed to manage the agricultural and residential programs once funding is attained. In this capacity, they will be in charge of funds for the associated FTEs, either to pay existing staff or hire new employees to carry out the implementation of BMPs. Historical work records of the Skyline SWCD were utilized to determine the level of agricultural technical assistance needed to complete implementation. Based on these analyses, it was determined that approximately 1 FTE would be needed over the course of 10 years to achieve full implementation of the agricultural control measures.

5.4 Cost Analysis

5.4.1 Agricultural Control Measures

Streamside fencing through or adjacent to pasture with potential livestock access was translated and quantified into full livestock exclusion systems as described in Section 5.2.1. An average cost estimate of livestock exclusion needs was calculated through assuming a mix of Grazing Land Protection Systems (SL-6, typical full livestock exclusion system), and Stream Protection Systems (WP-2T, livestock exclusion system without installation of a water system, plus a fence maintenance incentive payment). The cost for one SL-6 and one WP-2T system were estimated from systems already in place in the Skyline SWCD service area. The average cost of an SL-6 system installed by the Skyline SWCD was $9,832.76. However, based on local input regarding the size and number of farms in the Back Creek watershed (Section 5.2.1.1), this cost was adjusted upward to $29,126. The cost of a WP-2 system was based on the average Skyline SWCD cost of $4,159.23.

The total cost of livestock exclusion systems includes not only the costs associated with fence installation, repair, and maintenance, but also the cost of taking land (*e.g.*, 35-ft buffer area) out of production. The cost of fence maintenance was identified as a deterrent to participation. Financial assistance possibilities for maintaining fences include an annual 25% tax credit for fence maintenance and conservation easements where the landowner is paid a percentage of the land value to leave it undisturbed. Additionally, the Stream Protection (WP-2T) cost-share practice will be available as part of the implementation project and provides an incentive payment to maintain stream fencing. It was recognized that maintenance of fencing would add a significant cost. In order to estimate maintenance costs, it was assumed that 7.5% of installed fencing would need to be replaced during implementation, at an average cost of $3 per foot of fence replaced.

The remaining costs outlined in Table 5.7 were determined through literature review, analysis of the Virginia Agricultural BMP Database, and discussion with stakeholders. The number and type of practices that have been installed since the development of the TMDLs (2004) were determined through discussions with local personnel, and data from the Virginia Agricultural BMP Database. The estimated cost of implementing all agricultural practices except the retention ponds is $2.1M. As will be further discussed in Chapter 6, this level of effort removes much of the pollutants required by the TMDLs. However, to address the TMDLs, full implementation will cost $3.99M.

Table 5.7 Agricultural control measure costs and needs.

Control Measure	Unit	Cost/Unit	Units Needed
Agricultural			
Grazing Land Protection Systems (SL-6)	System	$29,126	47
Stream Protection Systems (WP-2T)	System	$4,159	3
Fence Maintenance	ft (length)	$3	14,530
Improved Pasture Management	Ac-Treated	$107	5,350
Conservation Tillage	Ac-Treated	$100	401
Manure Incorporation	Ac-Treated	$18	1,055
Waste Storage – Livestock	System	$20,754	4
Retention Ponds	Ac-Treated	$138	13,400

5.4.2 Residential Control Measures

Following recommendations from the RWG, it was assumed that approximately 10% of the failing septic systems would need basic repairs, while the remainder would need new systems. For cost estimations, 75% of the installed systems were estimated as standard septic systems (~$6,000) and the remaining 25% would be alternative systems (~$22,500).

The cost of rain gardens was based on a reduction in the cost of bioretention filters. A major portion of the cost of bioretention filters is excavation. Smaller scale, residential rain gardens can be installed with considerably less excavation, which is anticipated to cut the cost of installation in half. This results in a cost of $5,000 per acre treated.

The remaining costs outlined in Table 5.10 were determined through literature review, and discussion with stakeholders. The number and type of practices that have been installed since the development of the TMDLs (2004) were determined through discussions with local personnel, and field surveys. The estimated cost of implementing all residential practices is $1.51M.

Table 5.8 Residential control measure costs and needs.

Control Measure	Unit	Cost/Unit	Units Needed
Septic System Repair	System	$3,000	17
Septic System Installation	System	$6,000	117
Alternative Waste Treatment System	System	$22,500	39
Septic Tank Pump-Outs	System	$225	100
Residential Education Program	Program	$7,500	1
Rain Gardens	Ac-Treated	$5,000	30

5.4.3 In-Stream Control Measures

As discussed in Section 5.2.3, much of the streambank erosion reductions are likely to be achieved through implementation of the land-based measures identified in this IP. However, in order to be thorough, the cost of restoring the full 31,700 ft of streambank quantified in Section 5.2.3 is included. The cost of this effort was determined through literature review, and discussion with stakeholders. An average cost of $12 per foot of streambank restored was used in the cost calculation. The total cost of restoring 31,700 ft of streambank is $380,400.

5.4.4 Technical Assistance

It was determined by the Working Group and Steering Committee members that it would require $50,000 to support the salary, benefits, travel, training, and incidentals for education of one technical FTE. With quantification analysis yielding a need for approximately 1 agricultural technical FTE per year, the total potential cost to provide agricultural technical assistance during implementation is expected to be $0.5M total for 10 years. Similarly, for residential technical assistance, approximately $0.5M is needed to support one technical FTE over the 10 years.

5.5 Benefit Analysis

The primary benefit of implementation is cleaner waters in Virginia. Specifically, fecal contamination in Back Creek will be reduced to meet water quality standards, and the aquatic community in this stream will be restored. Table 5.9 indicates the cost efficiencies of the various practices being proposed in this IP. It is hard to gage the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the reductions required, the incidence of infection from fecal sources through contact with surface waters should be reduced considerably. In addition to allowing the aquatic community to thrive, the control measures that will be implemented to control sediment will also serve to reduce delivery of other pollutants to the stream from upland locations. Many of the BMPs intended to reduce soil losses should increase infiltration of precipitation, decreasing peak flows downstream.

Table 5.9 Cost efficiencies of control measures in units removed per $1,000.

Control Measure	Bacteria (colonies)	Sediment (lbs)
Agricultural		
Livestock Exclusion	3.00E+12	469
Improved Pasture Management	1.65E+12	2,026
Conservation Tillage	2.93E+13	14,945
Manure Incorporation	1.68E+14	-
Waste Storage – Livestock	5.91E+13	-
Retention Ponds	3.54E+12	3,345
Residential		
Septic System Repair/Replacement	2.51E+10	-
Residential Education Program	3.59E+12	-
Rain Gardens	3.19E+11	10
In-Stream		
Streambank Stabilization	-	213

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the community, as well as the expected environmental benefits. Specifically, alternative (clean) water sources, exclusion of cattle from streams, improved pasture management, and private sewage system maintenance will each provide economic benefits to land owners. Additionally, money spent by landowners and state agencies in the process of implementing this plan will stimulate the local economy.

A clean water source has been shown to improve weight gain and milk production in cattle. Fresh clean water is the primary nutrient for livestock with healthy cattle consuming, on a daily basis, close to 10% of their body weight during winter and 15% of their body weight in summer. Many livestock illnesses can be spread through contaminated water supplies. For instance, coccidia can be delivered through feed, water and haircoat contamination with manure (VCE, 2000). In addition, horses drinking from marshy areas or areas where wildlife or cattle carrying Leptospirosis have access tend to have an increased incidence of moonblindness associated with Leptospirosis infections (VCE, 1998b). A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills.

In addition to reducing the likelihood of animals contracting waterborne illnesses by providing a clean water supply, streamside fencing excludes livestock from wet, swampy environments as are often found next to streams where cattle have regular access. Keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998a) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. On a larger scale, mastitis costs the U.S. dairy industry about $1.7 billion to 2 billion annually or 11% of total U.S. milk production. While the spread of mastitis through a dairy herd can be reduced through proper sanitation of milking equipment, mastitis-causing bacteria can be harbored and spread in the environment where cattle have access to wet and dirty areas. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas.

Taking the opportunity to instigate an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates by 30 to 40 %, and consequently, improve the profitability of the operation. With feed costs typically responsible for 70 to 80 % of the cost of growing or maintaining an animal, and pastures providing feed at a cost of 0.01 to 0.02 cents/lb of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/lb TDN for hay, increasing the amount of time that cattle are fed on pasture is clearly a financial benefit to producers (VCE, 1996). Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing costs to producers, intensive pasture management can boost profits by allowing higher stocking rates and increasing the amount of gain per acre. Another benefit is that cattle are closely confined allowing for quicker examination and handling. In general, many of the agricultural BMPs recommended in this document will provide both environmental benefits and economic benefits to the farmer.

The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry. In terms of economic benefits to homeowners, an improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (*e.g.*, not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system. Additionally, the repair/replacement and pump-out programs will benefit owners of private sewage (*e.g.*, septic) systems, particularly low-income homeowners, by sharing the cost of required maintenance.

In addition to the benefits to individual landowners, the economy of the local community will be stimulated through expenditures made during implementation, and the infusion of dollars from funding sources outside the impaired areas. Building contractors and material suppliers who deal with septic system pump-outs, private sewage system repair and installation, fencing, and other BMP components can expect to see an increase in business during implementation. Additionally, income from maintenance of these systems should continue long after implementation is complete. As will be discussed in greater detail in Section 6.1, a portion of the funding for implementation can be expected to come from state and federal sources. This portion of funding represents money that is new to the area and will stimulate the local economy. In general, implementation will provide not only environmental benefits to the community, but economic benefits as well, which, in turn, will allow for individual landowners to participate in implementation.

6. MEASURABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

Tasks that are expected to be completed during implementation are detailed in Section 6.3 of this document. Given the scope of work involved with implementing these TMDLs, full implementation is expected in ten years, with de-listing from the Virginia Section 305(b)/303(d) list within 15 years. Described in this section are funding sources, identification of milestones, timeline for implementation, targeting of control measures, and the roles of stakeholders during the process.

6.1 Milestones Identification

The end goals of implementation are restored water quality of the impaired waters and subsequent de-listing of the waters from the Commonwealth of Virginia's Section 305(b)/303(d) list within 15 years. Progress toward end goals will be assessed during implementation through tracking of control measure installations and continued water quality monitoring. Agricultural control measures will be tracked through the Virginia Agricultural Cost-Share Program.

Expected progress in implementation is established with two types of milestones: *implementation milestones* and *water quality milestones*. Implementation milestones establish the amount of control measures installed within certain timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The milestones described here are intended to achieve full implementation within ten years, leaving five years to assess water quality for de-listing. These goals are the basis for two of the milestones (*i.e.*, full implementation at the 10-year mark, and de-listing at the 15-year mark).

Although the cost-efficiency of retention ponds is fairly high with regard to removal of sediment and bacteria (Table 5.9), this practice was viewed as the least desirable to stakeholders as it required land to be taken out of production and didn’t offer any obvious benefit to the farm operation. However, large reductions in pollutant loads can be met through other means. The Stage I goals for implementation will focus on all practices other than retention ponds and half of the required streambank restoration. These efforts, combined will result 85% and 44% of the bacteria and sediment goals, respectively, being met.

Implementation is anticipated to begin in January 2007, after which two milestones will be sought over the next ten years (Tables 6.1). The first milestone will be five years after implementation begins, whereby the more locally-acceptable control measures will be installed, with significant reductions in bacteria and sediment loads anticipated. Following Stage I implementation the steering committee should evaluate water quality improvements and determine how to proceed to complete implementation (Stage II). The timeline presented here proposes completing Stage II after ten years from the start of implementation. Based on completing both implementation stages, the final milestone would be de-listing of the impaired segments from the Section 303(d) list, which is anticipated by 2022.

Table 6.1 Stage I and Stage II implementation goals for Back Creek.

Control Measure	Units	Stage I	Stage II
Agricultural			
Grazing Land Protection Systems (SL-6)	Systems	47	0
Stream Protection Systems (WP-2T)	Systems	3	0
Fence Maintenance	Feet	7,265	7,265
Improved Pasture Management	Acres	5,350	0
Conservation Tillage	Acres	401	0
Manure Incorporation	Acres	1,055	0
Waste Storage – Livestock	Systems	4	0
Retention Ponds	Ac-treated	0	13,400
Residential			
Septic System Repair	Systems	17	0
Septic System Installation	Systems	117	0
Alternative Waste Treatment System Installation	Systems	39	0
Septic Tank Pump-Outs	Systems	100	0
Residential Education Program	Program	1	1
Rain Gardens	Ac-treated	10	20
In-Stream			
Streambank Stabilization	Feet of Streambank	15,850	15,850
Pollutant Reductions			
Bacteria (% violations 235 cfu/100ml *E. coli*)		36%	3% [1]
Bacteria (% of reduction goal)		85%	100%
Sediment (% of reduction goal)		42%	100%

1 Lowest violation rate (% obtainable) without addressing reduction of the wildlife loading.

6.2 Targeting

Implicit in the process of a staged implementation is targeting of control measures. Targeting ensures optimum utilization of resources. Targeting of critical areas for livestock fencing was accomplished through analysis of land use, farm boundaries, and stream network GIS layers. For each subwatershed, the livestock population and the fencing requirements were determined. The subwatersheds were then ranked in descending order based on the ratio of animals per fence length. If feasible, effort should be made to prioritize resources in the order shown in Figures 6.1. The lightest subwatershed is the highest ranked and the darkest is the lowest ranked in this figures.

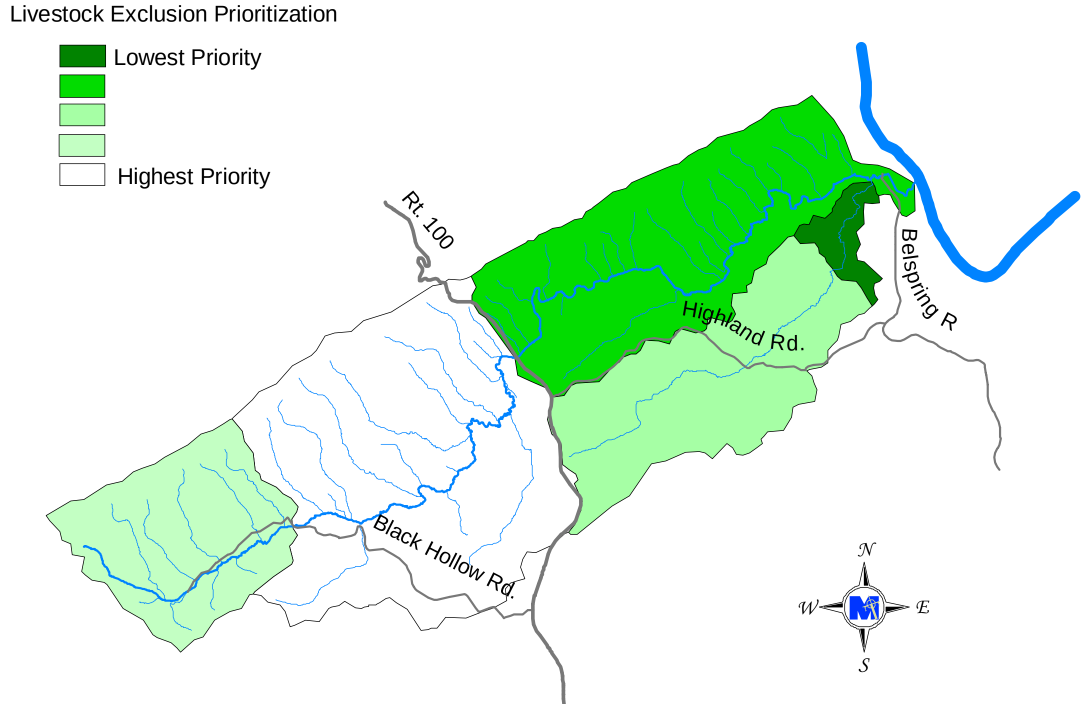

Figure 6.1 Back Creek subwatersheds ranked by stream fence implementation priority.

One method of targeting in agricultural, residential, and urban areas involves considering the cost-efficiency of specific practices. Table 5.9 indicates the cost-efficiencies of the practices proposed in this IP. Practices with high cost-efficiencies, relative to other practices, will provide the greatest benefit per dollar invested.

6.3 Timeline

Based on meeting the above milestones, a fifteen-year implementation plan timeline was formulated for the Back Creek watershed (Figure 6.2, Table 6.2). The timelines describe the needs for implementation in terms of completion of the agricultural, residential, and urban control measures. Table 6.3 shows the projected staged implementation costs for agricultural, residential, and in-stream control measures, including technical assistance. The cost of full implementation is approximately $7.18 million.

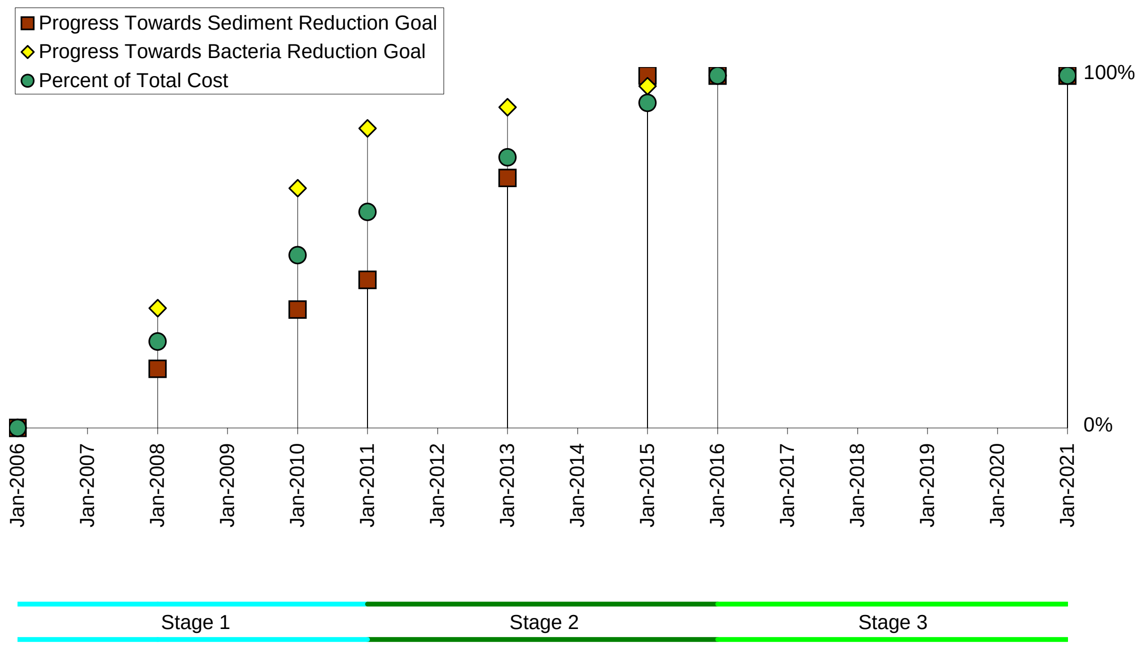

Figure 6.2 Timeline for implementation in the Back Creek watershed.

Table 6.2 Timeline for implementation in the Back Creek watershed.

	---------*Stage 1*---------			---------*Stage 2*---------			*Stage 3*
Back Creek	**Year 2**	**Year 4**	**Year 5**	**Year 7**	**Year 9**	**Year 10**	**Year 15**
Progress Toward Reduction Goals							
Bacteria	34%	68%	85%	91%	97%	100%	100%
Sediment	17%	34%	42%	71%	100%	100%	100%
Total	25%	51%	64%	81%	99%	100%	100%
Bacteria Violations							
235 cfu/100ml *E. coli*	83%	53%	36%	25%	11%	3%	0%
Cost (% of Total)	0%	25%	49%	61%	77%	92%	100%

Table 6.3 Costs to implement the Back Creek TMDLs.

	Agricultural BMPs (Million $)	Residential BMPs (Million $)	In-Stream BMPs (Million $)	Technical Assistance (Million $)	Total (Million $)	Total Cost Per Year (Million $)
Stage I (1st 5 years)	$2.12	$1.71	$0.19	$0.50	$4.52	$0.90
Stage II (2nd 5 years)	$1.87	$0.10	$0.19	$0.50	$2.66	$0.53
Total	**$3.99**	**$1.81**	**$0.38**	**$1.00**	**$7.18**	

7. STAKEHOLDERS AND THEIR ROLE IN IMPLEMENTATION

Achieving the goals of this effort (*i.e.*, improving water quality and removing these waters from the impaired waters list) is without a doubt dependent on stakeholder participation. Not only the local stakeholders charged with implementation of control measures, but also the stakeholders charged with overseeing our nation's human health. It must be acknowledged first that there is a water quality problem and changes must be made as needed in operations, programs, and legislation to address these pollutants.

The impacts of fecal bacteria on human health are well documented and some specific cases of contamination are discussed in Section 1.1 of this document. Additionally, some of the impacts on livestock are discussed in Section 5.5. The importance of a healthy aquatic community (i.e., the benthic macroinvertebrate community) to both support of fish populations and our ability to identify pollutant impacts was discussed in Section 1.1. The continued impairment of Back Creek presents a risk to human health, economic vitality, and ecologic wellbeing. As stakeholders, we must assess the risk we are willing to accept and then implement measures to safeguard the public from these risks.

7.1 Monitoring

The only water quality monitoring that is currently funded is performed by VADEQ. Through their ambient monitoring program, the three stations identified in Figure 7.1 will be monitored every other month for the next six years. This sampling will include *E. coli* enumerations. Additionally, the aquatic community at Station 9-BCK009.47 will be assessed every other year during this time period. This effort will increase awareness of the water quality problem and encourage citizen participation.

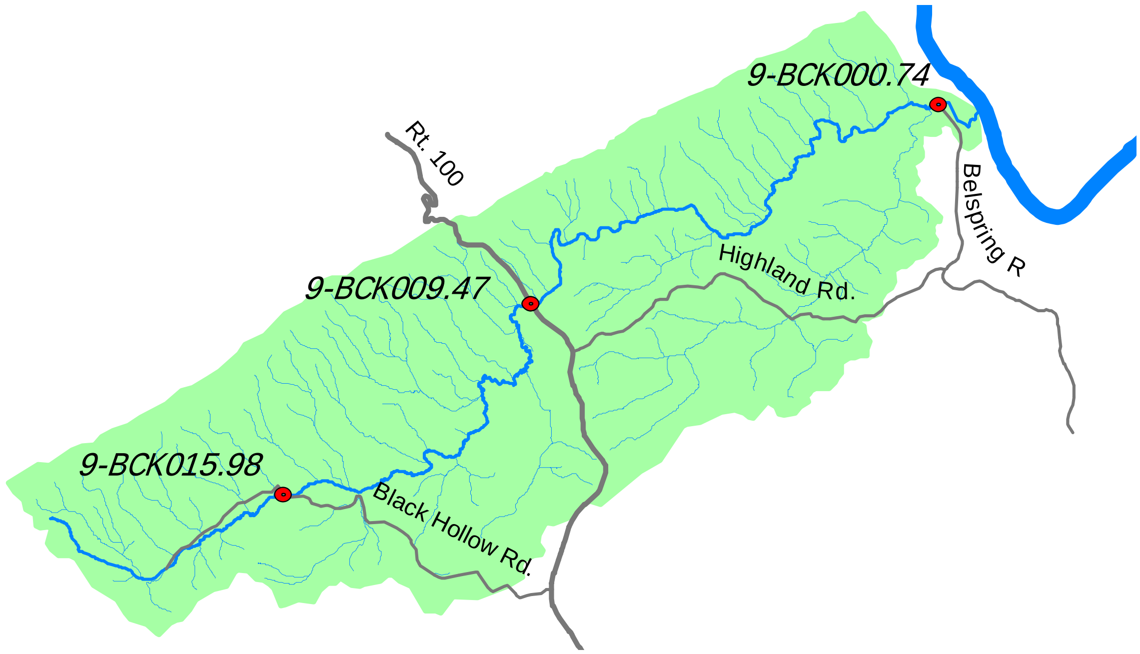

Figure 7.1 VADEQ water quality monitoring stations in the Back Creek watershed.

7.2 Education

The primary organization that will be responsible for public education will be Skyline SWCD. The SSWCD will be in charge of initiating contact with farmers and residents in the Back Creek watershed to encourage the installation of agricultural and residential BMPs. This one-on-one contact will facilitate communication of the water quality problems and the corrective actions needed. The SSWCD can also send out mailings, and arrange field days to educate the public during implementation.

7.3 Legal Authority

The EPA has the responsibility of overseeing the various programs necessary for the success of the CWA. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are four state agencies responsible for regulating activities that impact water quality in Virginia. These agencies are VADEQ, VADCR, VDACS, and VDH.

VADEQ has responsibility for monitoring waters to determine compliance with state standards, and for requiring permitted point dischargers to maintain loads within permit limits. It has the regulatory authority to levy fines and take legal action against those in violation of permits. Beginning in 1994, animal waste from confined animal facilities in excess of 300 animal units (cattle and hogs) has been managed through a Virginia general pollution abatement permit. These operations are required to implement a number of practices to prevent surface and groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, in 1999 the Virginia General Assembly passed legislation requiring VADEQ to develop regulations for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens) (ELI, 1999).

VADCR holds the responsibility for addressing nonpoint sources (NPS) of pollution. Most VADCR programs dealing with agricultural NPS pollution have historically been through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the TMDLs – required 100% participation of stakeholders. To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentive programs must be reevaluated to account for 100% participation. It should be noted, though, that VADCR does not have regulatory authority over the majority of NPS issues addressed here.

Through Virginia's Agricultural Stewardship Act, the Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty of up to $5000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. Virginia Department of Agriculture and Consumer Services (VDACS) has only 2 staff members dedicated to enforcing the Farm Stewardship Act, and very little funding is available to support water quality sampling. The Agricultural Stewardship Act is entirely complaint-driven. In the last year reported (April 1, 2003 through March 31, 2004) 28 complaints, of which 8 were founded, had been received statewide. No fines have resulted from these complaints.

VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and, historically, regulation of biosolids land application on permitted farmland sites. Additionally, VDH has the responsibility of conducting shoreline surveys to determine potential sources of contamination and for monitoring the waters for FC bacteria impairment of shellfish waters. Like VDACS, VDH's actions are 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. In the scheme of TMDLs, VDH has the responsibility of enforcing actions to correct or eliminate failed septic systems and straight pipes.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments in conjunction with the state can develop ordinances involving pollution prevention measures. In addition, citizens have the right to bring litigation against persons or groups of people shown to be causing some harm to the claimant. The judicial branch of government also plays a significant role in the regulation of activities that impact water quality through hearing the claims of citizens in civil court and the claims of government representatives in criminal court.

7.4 Legal Action

The Clean Water Act Section 303(d) calls for the identification of impaired waters. It also requires that the streams be ranked by the severity of the impairment and a Total Maximum Daily Load be calculated for that stream that would bring its water back into compliance with the set water quality standard. Currently, TMDL implementation plans are not required in the Federal Code; however, Virginia State Code does incorporate the development of implementation plans for impaired streams. The nonpoint source section of the Clean Water Act was largely ignored by EPA until citizens began to realize that regulating only point sources was no longer maintaining water quality standards. Beyond the initiation of the CWA, the entire TMDL program has been complaint-driven. Lawsuits from citizens and environmental groups citing EPA for not carrying out the statutes of the CWA began as far back as the 1970s and have continued until the present. In Virginia in 1998, the American Canoe Association and the American Littoral Society filed a complaint against EPA for failure to comply with provisions of §303d. The suit was settled by Consent Decree, which contained a TMDL development schedule through 2010. It is becoming more common for concerned citizens and environmental groups to turn to the courts for the enforcement of water quality issues.

In 1989, concerned residents of Castile, Wyoming County, New York filed suit against Southview Farm. Southview had around 1,400 head of milking cows and 2,000 total head of cattle. Tests on private wells found the water was contaminated with nitrates traced to irresponsible handling of animal wastes by Southview. In 1990, Southview was given a notice of violations under the Clean Water Act. Rather than change their farming practices or address the contaminated wells, they ignored the warning. In 1995, after court hearings and an appeal, the case was finally settled. Southview had to donate $15,000 to the Dairy Farms Sustainability Project at Cornell University, pay $210,000 in attorney fees for the plaintiff, and employ best management practices (Knauf, 2001).

On the Eastern Shore of Virginia, an aquaculture operation owner, raising clams and oysters, brought suit against his neighbor, a tomato grower. The aquaculture operation owner claimed the agricultural runoff created from the plasticulture operation carried pollutants and, thereby, destroyed his shellfish beds. The suit was settled out of court in favor of the aquaculture operation owner.

Successful implementation depends on stakeholders taking responsibility for their role in the process. The primary role, of course, falls on the landowner. However, local, state and federal agencies also have a stake in establishing that Virginia's waters are clean and providing a healthy environment for its citizens. An important first step in correcting the existing water quality problem is recognizing that there is a problem and that the health of citizens, particularly those who are least able to protect themselves (*i.e.*, children), is at stake. Virginia's approach to correcting NPS pollution problems has been, and continues to be, encouragement of participation through education and financial incentives.

8. FUNDING

The following practices are identified as vital to attaining the goals of the Back Creek IP: Livestock Exclusion from Streams, Improved Pasture Management, Conservation Tillage, Manure Incorporation, Livestock Waste Storage, Retention Ponds, Septic System Repair, Septic System Installation, Alternative Waste Treatment System Installation, Septic Tank Pump-Out, Residential Education Program (*i.e.*, Pet Litter Control, Septic System Upkeep), Rain Garden, and Streambank Restoration. Potential funding sources available during implementation were identified during IP development. A brief description of the programs and their requirements is provided in this chapter. (Detailed descriptions can be obtained from the SWCDs, VADCR, NRCS, and VCE). Each of the funding sources has specific requirements and benefits that will vary in applicability to specific circumstances. It is recommended that participants discuss funding options with experienced personnel at their local SWCD in order to choose the best option. Information on program description and requirements was provided from fact sheets prepared by Virginia State Technical Advisory Committee, VADEQ, VADCR, and Southeast Rural Community Assistance Project, Inc.

Federal Clean Water Act 319 Incremental Funds

Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds to implement the nonpoint source programs. VADCR administers the money in coordination with the Nonpoint Source Advisory Committee (NPSAC) to fund watershed projects, demonstration and educational programs, nonpoint source pollution control program development, and technical and program staff. VADCR reports annually to the EPA on the progress made in nonpoint source pollution prevention and control. The Back Creek Steering Committee will request that VADCR pursues funding through the 319 program for the technical assistance required (FTEs).

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control sediment, nutrient loss, and transportation of pollutants into our waters due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Program participants are recruited by SWCDs based upon those factors, which have a great impact on water quality. The objective is to solve water quality problems by fixing the worst problems first. Cost-share is typically 75% of the actual cost, not to exceed the local maximum. Each contract has a maximum cap of $50,000 if there is no local maximum set. The Virginia Water Quality Improvement Fund (WQIF) provides funding for this program, which is dependent upon a percentage of state surpluses. Standard practices that are funded through this program and applicable to this project include: SL-6 (Grazing Land Protection), WP-2T (Streambank Protection in TMDL areas), WP-4 (Animal Waste Control Facility), RB-1 (Septic Tank Pump-Out), RB-3 (Septic System Repair), RB-4 (Septic Tank System Installation/Replacement), RB-5 (Alternative On-site Waste Treatment System), SL-15A (Continuous No-till System), WP-2A (Streambank Stabilization), WP-4B (Loafing Lot Management System), and WP-1 (Sediment Retention, Erosion or Water Control Structures).

Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, shall be allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. "Agricultural best management practices" are approved measures that will provide a significant improvement to water quality in the state's streams and rivers, and is consistent with other state and federal programs that address agricultural nonpoint source pollution management. Any practice approved by the local SWCD Board shall be completed within the taxable year in which the credit is claimed. The credit shall be allowed only for expenditures made by the taxpayer from funds of his/her own sources. The amount of such credit shall not exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed, as certified by the Board. If the amount of the credit exceeds the taxpayer's liability for such taxable year, the excess may be carried over for credit against income taxes in the next five taxable years until the total amount of the tax credit has been taken. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing. All practices listed above within the BMP Cost-Share Program are eligible. Additional standard practices that are eligible for this program and applicable to this project include: WP-2C (Stream Channel Stabilization), WP-7 (Surface Water Runoff Impoundment for Water Quality), and WP-8 (Relocation of Confined Feeding Operations from Environmental Sensitive Areas),

Virginia Agricultural Best Management Practices Loan Program

Loan requests are accepted through VADEQ. The interest rate is 3% per year and the term of the loan coincides with the life span of the practice. To be eligible for the loan, the BMP must be included in a conservation plan approved by the local SWCD Board. The minimum loan amount is $5,000; there is no maximum limit. Eligible BMPs include 23 structural practices such as animal waste control facilities, loafing lot management systems, and grazing land protection systems. The loans are administered through certain participating lending institutions.

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 non-refundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint pollutant loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources are administered through VADEQ and grants for nonpoint sources are administered through VADCR. Most WQIF grants provide matching funds on a 50/50 cost-share basis. Successful applications are listed as draft/public-noticed agreements, and are subject to a public review period of at least 30 days.

Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, intended to develop viable communities by providing decent housing and a suitable living environment and by expanding economic opportunities primarily for persons of low and moderate income. Recipients may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

Conservation Reserve Program (CRP)

Offers are accepted and processed during fixed signup periods that are announced by FSA. All eligible (cropland) offers are ranked using a national ranking process. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. Cost-share assistance is available to establish the conservation cover of tree or herbaceous vegetation. The per-acre rental rate may not exceed the Commodity Credit Corporation's maximum payment amount, but producers may elect to receive an amount less than the maximum payment rate, which can increase the ranking score. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years, and 2) cropland is classified as "highly-erodible" by NRCS. Eligible practices include planting these areas to trees and/or herbaceous vegetation. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA CRP Continuous Sign-up. It has been "enhanced" by increasing the cost-share rates from 50% to 75% and 100%, increasing the rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Pasture and cropland (as defined by USDA) adjacent to streams, intermittent streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Buffers consisting of native, warm-season grasses on cropland, to mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30% of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Cost-sharing (75% - 100%) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. In addition, a 40% incentive payment upon completion is offered and an average rental rate of $70/acre on stream buffer area for 10-15 years. The State of Virginia will make an additional incentive payment to place a perpetual conservation easement on the enrolled area. The Commonwealth’s goals are 15,000 acres in the Southern Rivers portion of Virginia, and 25,000 acres in the Chesapeake Bay portion of the state.

The landowner can obtain and complete CREP application forms at the FSA center. The forms are forwarded to local NRCS and SWCD offices while FSA determines land eligibility. If the land is deemed eligible, NRCS and the local SWCD determine and design appropriate conservation practices. A conservation plan is written, and fieldwork is begun, which completes the conservation practice design phase.

FSA then measures CREP acreage, conservation practice contracts are written, and practices are installed. The landowner submits bills for cost-share reimbursement to FSA. Once the landowner completes BMP installation and the practice is approved, FSA and the SWCD make the cost-share payments. The SWCD also pays out the state's one-time, lump sum rental payment. FSA conducts random spot checks throughout the life of the contract, and the agency continues to pay annual rent throughout the contract period.

Environmental Quality Incentives Program (EQIP)

This program was established in the 1996 Farm Bill to provide a single voluntary conservation program for farmers and landowners to address significant natural resource needs and objectives. This program replaces the Agricultural Conservation Program (ACP) and the Water Quality Incentive Program (WQIP). Approximately 65% of the EQIP funding for the state of Virginia is directed toward “Priority Areas.” These areas are selected from proposals submitted by a locally led conservation work group. Proposals describe serious and critical environmental needs and concerns of an area or watershed, and the corrective actions they desire to take to address these needs and concerns. The remaining 35% of the funds are directed toward statewide priority concerns of environmental needs. EQIP offers 5 to 10-year contracts to landowners and farmers to provide 75% cost-share assistance, 25% tax credit, and/or incentive payments to implement conservation practices and address the priority concerns statewide or in the priority area. Eligibility is limited to persons who are engaged in livestock or agricultural production. Eligible land includes cropland, pasture, and other agricultural land in priority areas, or land that has an environmental need that matches one of the statewide concerns.

Wildlife Habitat Incentive Program (WHIP)

WHIP is a voluntary program for landowners and land users who want to develop or improve wildlife habitat on private agriculture-related lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner’s goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. In Virginia, these plans will be prepared to address one or more of the following high priority habitat needs: early grassland habitats that are home to game species such as quail and rabbit as well as other non-game species like meadowlark and sparrows; riparian zones along streams and rivers that provide benefits to aquatic life and terrestrial species; migration corridors which provide nesting and cover habitats for migrating songbirds, waterfowl and shorebird species; and decreasing natural habitat systems which are environmentally sensitive and have been impacted and reduced through human activities. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Applicants will be competitively ranked within the state and certain areas and practices will receive higher ranking based on their value to wildlife. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows. For cost-share assistance, USDA pays up to 75% of the cost of installing wildlife practices.

Wetland Reserve Program (WRP)

This program is a voluntary program to restore and protect wetlands on private property. The program benefits include providing fish and wildlife habitat, improving water quality, reducing flooding, recharging groundwater, protecting and improving biological diversity, and furnishing recreational and esthetic benefits. Sign-up is on a continuous basis. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements of a minimum 10-year duration. Under the permanent easement option, landowners may receive the agricultural value of the land up to a maximum cap and 100% of the cost of restoring the land. For the 30-year option, a landowner will receive 75% of the easement value and 75% cost-share on the restoration. A ten-year agreement is also available that pays 75% of the restoration cost. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities. At any time, a landowner may request that additional activities be added as compatible uses. Land eligibility is dependent on length of ownership, whether the site has been degraded as a result of agriculture, and the land's ability to be restored. Restoration agreement participants must show proof of ownership. Easement participants must have owned the land for at least one year and be able to provide clear title.

Southeast Rural Community Assistance Project (SE/R-CAP)

The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SE/R-CAP central office staff across the region. They can provide (at no cost to a community): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/installation of a septic system and $2,000 toward repair/replacement/installation of an alternative waste treatment system. Funding is only available for families making less than 125% of the federal poverty level. The federal poverty threshold for a family of four is $18,850.

National Fish and Wildlife Foundation

Offers are accepted throughout the year and processed during fixed signup periods. The signup periods are on a year-round, revolving basis, and there are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. An approved pre-proposal is a pre-requisite to the submittal of the full proposal. Grants generally range between $10,000 and $150,000. Payments are based on need. Projects are funded in the U.S. and any international areas that host migratory wildlife from the U.S. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, the proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated. A pre-proposal that is not accepted by a special grant program may be deferred to the general grant program.

Clean Water State Revolving Fund

EPA awards grants to states to capitalize their Clean Water State Revolving Funds (CWSRFs). The states, through the CWSRF, make loans for high-priority water quality activities. As loan recipients make payments back into the fund, money is available for new loans to be issued to other recipients. Eligible projects include point source, nonpoint source and estuary protection projects. Point source projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. Nonpoint source projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc. Estuary protection projects include all of the above point and nonpoint source projects, as well as habitat restoration and other unique estuary projects.

REFERENCES

Barbour, M.T., J. Gerritsen, B.D. Snyder, and J.B. Stribling. 1999. Rapid bioassessment protocols for use in streams and wadeable rivers: Periphyton, Benthic macroinvertebrates and Fish, Second Edition. EPA 841-B-99-002. U.S. Environmental Protection Agency; Office of Water, Washington, D.C.

CDC. 1995. *Escherichia coli* 0157:H7 outbreak at a summer camp – Virginia, 1994. CDC MMWR Weekly. June 9, 1995. 44(22);419-421. Available at: http://www.cdc.gov/epo/mmwr/preview/mmwrthtml/00037189.htm

CDC. 2001. Outbreaks of *Escherichia coli* 0157:H7 infections among children associated with farm visits --- Pennsylvania and Washington, 2000. CDC MMWR Weekly. April 20, 2001 / 50(15);293-7. Available at: http://www.cdc.gov/mmwr/preview/mmwrhtml/mm5015a5.htm

Commonwealth of Virginia. 2005. Chesapeake Bay Nutrient and Sediment Reduction Tributary Strategy. www.naturalresources.virginia.gov/Initiatives/TributaryStrategies/

ELI. 1999. Locating Livestock: How Water Pollution Control Efforts Can Use Information From State Regulatory Programs. Environmental Law Institute. Research Report 1999. ELI Project #941718.

Haith, D.A., R. Mandel, and R.S. Wu. 1992. GWLF. Generalized Watershed Loading Functions, version 2.0 User's Manual. Department of Agricultural and Biological Engineering, Cornell University, Ithaca, New York.

Knauf, A.J. 2001. The Southview Farm Case: A giant step to end special treatment for agriculture under environmental laws. Available at: http://www.nyenvlaw.com/southview.htm

Miller, G. 2000. Ontario *E. coli* Outbreak Linked to Lax Groundwater Laws. Environment News Services. July 27, 2000. Available at: http://ens.lycos.com/ens/jul2000/2000L-07-27-10.html

Pugh, S. 2001. Letter regarding: The Agricultural Stewardship Act and TMDLs. February 13, 2001.

Raine, M. 2000. Cattle likely brought *E. coli* to Walkerton. The Western Producer. June 8, 2000. Available at: http://www.producer.com/articles/20000608/news/20000608news04.html

Roanoke Times. 1997a. *E. coli* cases pit health officials against boaters, swim at your own risk. Roanoke Times. November 9 1997. Page B1.

Roanoke Times. 1997b. Meeting taps concerns over lake's water quality, some want education, others regulation, to prevent sickness. Roanoke Times. November 15, 1997. Page B1

Roanoke Times. 1998a. Confirmed *E. coli* count now at 9. Roanoke Times. August 22, 1998.

Roanoke Times. 1998b. *E. coli* levels hard to track. Roanoke Times. October 19, 1998. Page C1.

Roanoke Times. 1998c. State tests confirm *E. coli* infections still no source determined. Roanoke Times. August 19, 1998.

Roanoke Times. 2000. Health Dept. shuts off tap on Crystal Spring's water. Roanoke Times. June 6, 2000. Page A1.

Schwab, G.O., D.D. Fangmeier, W.J. Elliot, R.K. Frevert. 1992. Soil and Water Conservation Engineering, 4th Edition. Wiley.

Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.

USCB. 2000. *2000 Census*. United States Census Bureau. Washington D.C.

USEPA. 1999. Guidance for Water Quality-Based Decisions: The TMDL Process. http://www.epa.gov/OWOW/tmdl/decisions/dec1c.html.

VADEQ. 1998. 303(d) Total Maximum Daily Load Priority List and Report.

VCE. 1996. Controlled grazing of Virginia's pastures, by Harlan E. White and Dale D. Wolf, Virginia Cooperative Extension Agronomists; Department of Forages, Crop, and Soil Environmental Sciences, Virginia Tech. Publication Number 418-012. July 1996. Available at: http://www.ext.vt.edu/pubs/livestock/418-012/418-012.html

VCE. 1998a. Mastitis cost? by Gerald M. (Jerry) Jones, Extension Dairy Scientist, Milk Quality and Milking Management, Virginia Tech. Dairy Pipeline. December 1998. Available at: http://www.ext.vt.edu/news/periodicals/dairy/1998-12/mastitis$.html

VCE. 1998b. Safe water for horses, questions about water testing, by Larry Lawrence, Extension Animal Scientist, Horses, Animal and Poultry Sciences, Virginia Tech. Livestock Update. December 1998. Available at: http://www.ext.vt.edu/news/periodicals/livestock/aps-98_12/aps-1005.html

VCE. 2000. Feeder and stock health and management practices, by John F. Currin and W. D. Whittier, Extension Specialists, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech. Publication Number 400-006. January 2000. http://www.ext.vt.edu/pubs/beef/400-006/400-006.html