Roanoke River Bacteria and Sediment TMDL Implementation Plan

Part II

Prepared For

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Abbreviations and Acronyms

BMP	Best management practice
BRLC	Blue Ridge Land Conservancy
CCS	Council of Community Services
CDBG	Community Development Block Grant
CDC	Centers for Disease Control
cfu	colony forming unit
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CSP	Conservation Stewardship Program
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Fund
EPA	U.S. Environmental Protection Agency
EQIP	Environmental Quality Incentives Program
E. coli	*Escherichia coli*
FRPP	Farm and Ranch Lands Protection Program
FSA	Farm Service Agency
FTE	Full Time Equivalent
GIS	Geographic Information System
GRP	Grassland Reserve Program
GWLF	Generalized Watershed Loading Functions
HSPF	Hydrologic Simulation Program FORTRAN
IP	Implementation plan
lbs	pounds
LID	low impact development
LU	land use
MS4	municipal separate storm sewer system
N/A	not applicable
NFWF	National Fish and Wildlife Foundation
NLCD	National Land Cover Database
NPS	nonpoint source
NRCS	Natural Resources Conservation Service
PDC	Planning District Commission
PWS	public water supply
QAPP	quality assurance project plan
RVARC	Roanoke Valley-Alleghany Regional Commission
SBU	Stormwater Billing Unit
SERCAP	Southeast Rural Community Assistance Project, Inc.
SLAF	Virginia Stormwater Local Assistance Fund
SWCD	soil and water conservation district
SWPPP	Stormwater pollution prevention plan
TAP	Total Action for Progress
TDN	total digestible nutrients
TMDL	Total Maximum Daily Load
TU	Trout Unlimited

U&CF	Urban and Community Forestry
UAA	Use Attainability Analysis
UAL	Unit Area Load
URRR	Upper Roanoke River Roundtable
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
VADCR	Virginia Department of Conservation and Recreation
VADEQ	Virginia Department of Environmental Quality
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VDOT	Virginia Department of Transportation
VOF	Virginia Outdoors Foundation
VSMP	Virginia Stormwater Management Program
WQIF	Water Quality Improvement Fund
WQMIRA	Water Quality Monitoring, Information, and Restoration Act
WRP	Wetlands Reserve Program
yr	year

EXECUTIVE SUMMARY

Monitoring performed by the Commonwealth of Virginia identified waterbodies within the Roanoke River watershed that did not meet the *Escherichia coli* (*E. coli*) standards and therefore did not protect the recreation beneficial use. In addition, monitoring also identified portions of the mainstem of the Roanoke River not attaining the aquatic life use based on impaired benthic macroinvertebrate communities. The bacteria impaired segments were first listed as impaired on one of Virginia's 303(d) Total Maximum Daily Load (TMDL) Priority List and Reports starting in 1998. The benthic impaired segments, which are located downstream of the Part II watershed, were first listed as impaired on Virginia's 1996 303(d) Total Maximum Daily Load Priority List and Report. TMDLs were developed and approved for these impaired segments in 2006. These TMDLs developed bacteria and sediment reductions necessary to meet the *E. coli* and aquatic life water quality standards, respectively. The goal of the Roanoke River TMDL Implementation Plan (IP) Part II is to restore water quality within the North and South Fork Roanoke Rivers and associated tributaries, to achieve full supporting status for the impaired segments, and to de-list the impaired segments from the Virginia 303(d) List of Impaired Waters for bacteria and aquatic life impairments.

State and Federal Requirements

The Virginia Water Quality Monitoring, Information, and Restoration Act (WQMIRA) directs Virginia Department of Environmental Quality (VADEQ) to "develop and implement a plan to achieve fully supporting status for impaired waters." To meet the requirements of WQMIRA, an IP must include the date of expected achievement of water quality objectives, measureable goals, corrective actions, and costs, benefits, and environmental impact of addressing the impairment. The federal requirements outline the minimum elements of an approvable IP. These include implementation actions and management measures, a timeline for implementation, legal or regulatory controls, time required to attain water quality standards, and a monitoring plan and milestones for attaining water quality standards. Requirements for Section 319 funding eligibility were also considered.

Review of TMDL Development

The Roanoke River TMDL IP Part II addresses bacteria impairments within five subwatersheds (including the unimpaired North Fork Roanoke River watershed) located within parts of the Counties of Floyd, Montgomery, and Roanoke and the Towns of Blacksburg and Christiansburg. Although a specific TMDL was only developed for the Wilson Creek watershed, the drainage areas for the other bacteria impaired segments were included within the developed TMDL watershed area. Development of the bacteria TMDLs used the *E. coli* water quality standards of a geometric mean concentration of 126 colony forming units (cfu)/100 ml and a single sample concentration of 235 cfu/100 ml. Benthic impairments, located on the mainstem Roanoke River downstream from the Part II subwatersheds within parts of Roanoke County and the Cities of Salem and Roanoke, are also addressed. During development of the benthic TMDL, a stressor analysis identified sedimentation as the most probable cause of the benthic macroinvertebrate community impairment. Using a reference watershed approach, the numeric TMDL endpoint for the impaired watershed was established based on the sediment loading rate in a similar, but non-impaired reference watershed. The benthic TMDL study area was divided into two parts for the development of the Roanoke River TMDL IP. Part II of the IP is described in this document and prepares actions for the more upstream portions of the total study area. The inclusion of the North Fork and South Fork Roanoke Rivers and tributaries in the IP recognizes that even though Part II subwatersheds were not specifically identified as having a sediment impairment, they are contributing to the mainstem Roanoke River sediment load in the downstream portions.

The allocation scenarios for meeting the bacteria and sediment TMDLs were updated during the IP development based on a determination of allocation loads and reductions for bacteria impaired segments that did not have an individual established TMDL, land use changes, and corrections to the instream erosion loads. Development of the allocation scenarios considered bacteria land uses and sources including developed, cropland, pasture/hay, forest, water/wetlands, and other land uses and input from livestock and wildlife direct loading and failing septic systems. Sediment loads and allocations for the benthic impairments were based on the NLCD 2006 land use distribution including developed, cropland, pasture/hay, forest, water/wetlands, and other land uses as well as loading from instream erosion.

The reductions in bacteria loading include 100% reductions for failing septic system loads, reductions of 88% to 97% for livestock direct, and variable reductions from developed and pasture land. The sediment allocations include an overall 72% reduction in sediment loading to meet the TMDL endpoint. Sediment loading from all land use sources and instream erosion would require a reduction of approximately 75%. The allocation scenarios used in this IP are presented in Tables E-1 and E-2.

Table E-1: Load Reductions for *E. coli*

2006 Land Use/Source	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Wilson Creek
Developed	22%	82%	77%	98%
Cropland	0%	0%	0%	0%
Pasture/Hay	32%	90%	77%	98%
Forest	0%	0%	0%	0%
Water/Wetlands	-	0%	0%	0%
Other	-	-	-	-
Livestock Direct	88%	88%	95%	97%
Wildlife Direct	95%	99%	99%	99%
Failing Septic Systems	100%	100%	100%	100%
Total	**54%**	**84%**	**78%**	**98%**

Table E-2: Load Reductions for Sediment

2006 Land Use Category		Percent Reduction
Land Sources	Developed	75%
	Cropland	75%
	Pasture/Hay	75%
	Forest	0%
	Water/Wetlands	-
	Other	75%
Instream Erosion		75%
Point Sources		0%
	Total	**72%**

Public Participation

Public participation in the development of an IP is important in order to educate and inform the local stakeholders about the issues and to solicit input on appropriate solutions. Participation involved public meetings, steering committees, and smaller working groups for agricultural, government, and residential stakeholders. The public meetings were held to educate the public about the need for watershed cleanup, introduce the Roanoke River TMDL IP Part II and the IP development process and progress, and highlight ways for the public to get involved with the IP. The intent of the working groups was for the stakeholders to provide their specialized input concerning the watershed and best management practices. The working groups made recommendations for their areas of interest with education and outreach and funding being primary recommendations for most groups. The information and suggestions provided by each working group were used to develop the IP as applicable. The steering committee meetings were a forum to consider the issues and recommendations of all the working groups as well as funding sources and involvement of the public. Representatives from each of the working groups presented the main comments and suggestions from their group. Additionally, technical aspects of the IP development process were discussed.

Implementation Actions

Implementation actions necessary to reduce the bacteria and sediment loads and associated costs and pollutant removal efficiencies were identified through extensive stakeholder input, public participation, and review of land use/source data and pollutant delivery mechanisms. Published reference materials used include the Virginia Agricultural Cost Share Best Management Practices (BMP) Manual, Virginia Stormwater BMP Clearinghouse, and the Virginia Stormwater Management Handbook.

Quantifiable BMPs proposed in this implementation plan are grouped by the land use (i.e., agricultural, residential, or urban) or pollution source with which the BMPs are associated such as livestock or pet waste. The proposed BMPs were quantified to meet both the bacteria and sediment reductions called for in the TMDLs. TMDL IPs are designed to meet TMDL pollutant reduction targets within a watershed based on land use as defined by TMDL studies. IPs may be utilized by localities for pollutant reduction strategies; however they are not considered a requirement for permit compliance. Further, IPs do not prescribe specific BMPs for localities to

implement to meet their MS4 permit requirements. Site-specific analysis is required prior to the siting, design, and implementation of the BMPs.

Table E-3 presents the various BMPs proposed in the Roanoke River TMDL IP Part II. They include residential BMPs, detention pond retrofits, street sweeping, stormwater BMPs, Livestock Exclusion Systems, cropland BMPs, pasture BMPs, and stream restoration. The cost associated with each BMP and the distribution of BMPs across the three stages is also presented in Table E-3. In addition to proposed BMPs, there were several innovative BMPs proposed by stakeholders that did not have enough information to be quantified but have been included in the plan. They include enhanced erosion and sediment control, educational programs, off-stream watering without fencing, and outreach opportunities. Technical assistance for agricultural, residential, and non-MS4 urban BMPs was also evaluated and proposed.

The main benefit of implementation of the various control measures is the improvement of the water quality of the Roanoke River and its tributaries. Reducing bacteria and sediment loads in the Roanoke River watershed will protect human health and safety, promote healthy aquatic communities, improve agricultural production, and add to the economic vitality of communities through enhancement of residential property, reduction in flood losses, and opportunities for outdoor recreation. The cost-effectiveness for each BMP category considers the pollutant loads reduced per $1,000 or additionally in the case of sediment, the cost per 1,000 pounds of sediment reduced.

Table E-3: Roanoke River TMDL IP Part II - Proposed BMPs and Costs per BMP			
Best Management Practice	Unit	Cost Per Unit	Number of Units
Residential BMPs			
Septic System Pump-Out (RB-1)	Pump Out	$300	779
Sewer Connection (Targeted Areas and RB-2)	System	$9,500	49
Repaired Septic System (RB-3)	System	$3,600	104
Septic System Installation/Replacement (RB-4, RB-4P)	System	$6,000-$8,000	115
Alternative Waste Treatment System Installation (RB-5)	System	$16,000	23
Pet Waste Education Campaign	Program	$5,000	One per Subwatershed
Pet Waste Composter	Unit	$100	245
Pet Waste Station	Unit	$4,070	25
Existing BMPs and Detention Pond Retrofits			
Infiltration Trench	System	$6,000	222
Constructed Wetlands	System	$2,900	674
Street Sweeping (additional miles to be swept annually)	Curb Mile	$520	3,231
Stormwater BMPs			
Bioretention	Acre Treated	$10,000	1,400
Rain Garden	Acre Treated	$5,000	1,500
Infiltration Trench	Acre Treated	$6,000	740
Manufactured BMP	Acre Treated	$20,000	890
Constructed Wetland	Acre Treated	$2,900	1,040
Detention Pond	Acre Treated	$3,800	480
Permeable Pavement	Acre Treated	$240,000	25
Vegetated Swale	Acre Treated	$18,150	2,000
Rain Barrel	System	$150	4,938
Riparian Buffer: Forest	Acre Installed	$3,500	252
Riparian Buffer: Grass/Shrub	Acre Installed	$360	284
Cistern	System	$1,000	164
Livestock Exclusion Systems			
CREP Livestock Exclusion (CRSL-6)	System	$27,000	27
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	System	$40,000-45,000	103
Livestock Exclusion with Riparian Buffers (LE-1T)	System	$21,000	105
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	System	$17,000	14
Small Acreage Grazing System (SL-6AT)	System	$9,000	14
Stream Protection/Fencing (WP-2/WP-2T)	System	$21,000	14
Cropland BMPs			
Continuous No-Till (SL-15)	Acre Installed	$100	1,033
Small Grain Cover Crop (SL-8)	Acre Installed	$30	870
Permanent vegetative cover on cropland (SL-1)	Acre Installed	$175	61
Sod Waterway (WP-3)	Acre Installed	$1,600	61
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	$1,000	61
Pasture BMPs			
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	$3,500-5,000	5,017
Reforestation of Erodible Pasture (FR-1)	Acre Installed	$1,000	1,937
Woodland Buffer Filter Area (FR-3)	Acre Installed	$700	912
Pasture Management (EQIP 528, SL-10T)	Acre Installed	$75	17,297
Grazing Land Management (SL-9)	Acre Installed	$200	880

Wet Detention Pond for Pastureland	Acre Treated	$150	5,850
Stream Restoration			
Stream Restoration	Feet	$300	83,828
Stream Stabilization	Feet	$75	4,531

Goals and Milestones of the Roanoke River TMDL IP Part II

The primary goals of the Roanoke River TMDL IP Part II are to restore water quality in the impaired waterbodies and de-list the impaired segments from the Virginia 303(d) List of Impaired Waters for bacteria and aquatic life impairments. This IP describes specific implementation and water quality milestones, the link between implementation and water quality improvement, a timeline for implementation, and tracking and monitoring to measure implementation of achievements.

Implementation milestones establish the amount of control measures installed within prescribed timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The implementation of control measures proposed in the Roanoke River TMDL IP Part II will take place over three stages in a 15- or 20-year timeline. Implementation actions for smaller and/or more rural subwatersheds will occur over a 15-year timeline. The first two stages will be implemented over six years each; the final stage will be implemented over three years. This approach is proposed for the *Bradshaw Creek and North Fork Roanoke River* subwatersheds. Implementation actions for larger and/or more urbanized subwatersheds will occur over a 20-year timeline. The first two stages will be implemented over eight years each; the final stage will be implemented over four years. This approach is proposed for the *South Fork Roanoke River and Wilson Creek* subwatersheds.

For each timeline, the first stage focuses on implementing the more cost-effective and commonly implemented actions such as livestock exclusion practices, crop and pasture BMPs, and septic system repairs. The delisting goal is achieved for Bradshaw Creek and South Fork Roanoke River watersheds in stage 1 and for North Fork Roanoke River and Wilson Creek watersheds in stage 2. The third stage implements the remainder of the more expensive BMPs and helps to not violate the bacteria geometric mean criterion required by the TMDLs. All four watersheds at the end of stage 3 have a bacteria violation rate of less than 10% for the single sample maximum and

also meet the geometric mean criterion (0% violation rate) required by the TMDLs. The Unimpaired North Fork Roanoke River is not impaired and does not have water quality milestones to meet, but implementation milestones are shown. The IP addresses implementation actions to reduce the human-induced sources of bacteria and does not address wildlife reductions both direct and indirect in the TMDLs.

The Hydrologic Simulation Program FORTRAN (HSPF) model was used to determine the percent exceedance of the geometric and single sample maximum water quality criterion for each stage (or milestone) for each subwatershed. In addition, the instream average annual bacteria loading (cfu/year) at each milestone was determined (Table E-4). Table E-5 depicts the sediment reductions (tons/year) obtained from implementing BMPs at each stage. The total sediment reduction required to meet the benthic TMDL is 17,571 tons per year (Section 3.3.3). From the implementation of the BMPs necessary to meet the bacteria TMDL reductions, 97% of the benthic TMDL is estimated to be attained at the end of Stage II, and 99% of the TMDL is met at the end of Stage III.

Table E-4: Water Quality Milestones - Bacteria Criteria Exceedances and Average Annual *E. coli* Load (cfu/yr) per IP stage

Stage	Exceedance Criteria	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Wilson Creek
Stage I	% Exceedance Geometric Mean (126 cfu/100 mL)	1%	4%	3%	0%
	% Exceedance Single Sample Maximum (235 cfu/100 mL)	10%	16%	3%	12%
	Average Annual *E. coli* Load at end of stage (cfu/yr)	2.99E+13	2.02E+14	2.76E+14	1.07E+14
Stage II	% Exceedance Geometric Mean (126 cfu/100mL)	1%	1%	1%	0%
	% Exceedance Single Sample Maximum (235 cfu/100 mL)	7%	6%	8%	6%
	Average Annual Load *E. coli* at end of stage (cfu/yr)	2.42E+13	1.16E+14	1.61E+14	6.49E+13
Stage III	% Exceedance Geometric Mean (126 cfu/100 mL)	0%	0%	0%	0%
	% Exceedance Single Sample Maximum (235 cfu/100 mL)	6%	3%	4%	5%
	Average Annual Load *E. coli* at end of stage (cfu/yr)	2.30E+13	6.23E+13	1.26E+14	5.60E+13

Table E-5: Water Quality Milestones - Cumulative Sediment Reductions by IP Stage (tons/year) and Percentage Attainment of TMDL Goal			
Subwatershed	**Stage I**	**Stage II**	**Stage III**
Bradshaw Creek	891	1,685	1,697
North Fork Roanoke River	2,379	4,354	4,493
South Fork Roanoke River	4,808	8,849	8,959
Unimpaired North Fork Roanoke River	587	1,100	1,114
Wilson Creek	643	1,054	1,083
Percent of TMDL Reductions Attained	**53%**	**97%**	**99%**

Part of the staged implementation process includes the targeting of more specific locations for BMP implementation. Specific analysis within the Roanoke River TMDL IP Part II targeted subwatersheds for on-site sewage disposal, urban riparian zone creation, urbanized area for maximum reductions via stormwater BMPs, and livestock exclusion practices.

Implementation tracking and monitoring are two actions used to evaluate changes in the watershed and progress toward meeting water quality milestones. Implementation actions should be tracked to ensure that BMPs are adequately installed and maintained. BMP tracking would include quantification of the various BMPs identified in the IP and a reporting of the applicable units that are installed in each subwatershed. VADEQ would focus monitoring efforts on the original listing stations for both the bacteria and benthic impairments.

Stakeholders Roles and Responsibilities

Stakeholders are individuals or groups who live or have land management responsibilities in the watershed, including federal, state and local government agencies, special interest groups, and citizens. Stakeholder participation and support is essential for improving water quality and removing streams from the impaired waters list. These stakeholders worked together to develop the Roanoke River TMDL IP Part II through meeting attendance, comments and suggestions on various aspects of the plan, and through the provision of watershed and water quality data. In the future, many will also play a role in the implementation of the control measures described in the IP.

Federal government stakeholders include the U.S. Environmental Protection Agency (EPA) and the Natural Resources Conservation Service (NRCS). EPA oversees the Clean Water Act

programs and NRCS provides technical expertise and financial resources to both private stakeholders and government agencies for conservation of natural resources.

Currently, there are six state agencies that have a major role in regulating and/or overseeing statewide activities that impact water quality. These include: VADEQ, Virginia Department of Conservation and Recreation (VADCR), Virginia Department of Agriculture and Consumer Services (VDACS), Virginia Department of Health (VDH), Virginia Department of Forestry (VDOF), and Virginia Cooperative Extension (VCE). VADEQ is the lead state agency in the TMDL process. The other agencies administer water quality related programs and provide technical and financial assistance for water quality improvement projects and BMPs. VADEQ, VADCR, and VDH participated in the TMDL IP development process.

Local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their community that may help to ensure the success of TMDL implementation. The Skyline soil and water conservation district (SWCD) works closely with watershed residents such as farmers, ranchers and other land users on understanding and implementing conservation practices. Planning District Commissions (PDCs) promote the efficient development of the regional physical, social, and economic resources. PDCs focus much of their efforts on water quality planning, and often contract TMDL development and implementation projects. Specifically, the Roanoke Valley-Alleghany Regional Commission (RVARC) contracted the Roanoke River TMDL IP. City and county government staff work closely with PDCs and state agencies to develop and implement TMDLs, promote education and outreach to stakeholders on the TMDL process, and can enact ordinances that reduce water pollutants and support BMPs.

Community watershed and conservation groups offer opportunities for river and land conservation groups to share ideas and coordinate preservation efforts. These groups have a valuable knowledge of the local watershed and river habitat that is important to the implementation process and are also a showcase site for citizen action. Citizens are involved in the TMDL and IP processes through participation in public meetings, assistance with public outreach and education, provision of local watershed history, and/or implementation of BMPs on their property to help restore water quality. Community civic groups perform a wide range of

community service including environmental projects where they assist in the public participation process, educational outreach, and with implementation activities in local watersheds. Animal clubs and associations provide a resource to assist and promote conservation practices among farmers and other land owners especially in rural areas and urban areas where pet waste has been identified as a source of bacteria in water bodies.

Integration with Other Watershed Plans

Water quality issues and improvement in the Roanoke River watershed is a component of many different organizations, programs and activities. Examples of these voluntary and regulatory efforts include watershed implementation plans, TMDLs, Roundtables, Water Quality Management, Erosion and Sediment Control Regulations, Stormwater Management Programs, Source Water Assessment Programs, local comprehensive and strategic plans, and local environmentally-focused organizations. Efforts in the Roanoke River watershed that coincide with the goals of the Roanoke River TMDL IP Part II include various watershed-wide plans, local comprehensive plans, legal authority, and monitoring.

Frequently regional and local plans and programs focus on watershed attributes such as natural resources, water quality and quantity, stormwater, and public education. These endeavors focus resources on protecting and improving the natural environment and educating the public about watershed problems. Mandatory ordinances regulating stormwater management and erosion and sediment control are common throughout the Roanoke River watershed. The Towns of Blacksburg and Christiansburg have enacted a Stormwater Utility Ordinance with fees dependent on impervious surface and the installation and maintenance of stormwater BMPs. Additionally, the Town of Christiansburg has a regulation concerning sewer connection. Voluntary citizen monitoring programs educate the public about water quality issues and can assist in the listing or delisting of impaired waters, TMDL development, tracking the progress of implementation plans, and identifying waters for potential future VADEQ monitoring.

Potential Funding Sources

Funding sources that may be available to support the Roanoke River TMDL IP Part II include:

Federal

- Federal Clean Water Act Section 319 Incremental Funds
- United States Fish and Wildlife Service (USFWS) grants
- Roanoke Logperch Annual Grant
- United States Department of Agriculture (USDA) – Farm Service Agency (FSA)
    - Conservation Reserve Program (CRP)
    - Conservation Reserve Enhancement Program (CREP)
- USDA – Natural Resources Conservation Service (NRCS)
    - Conservation Stewardship Program (CSP)
    - Environmental Quality Incentives Program (EQIP)
    - Agricultural Lands Easement Program

State

- Virginia Agricultural Best Management Practices (BMPs) Cost-Share Program
- Virginia Agricultural Best Management Practices Loan Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Clean Water Revolving Loan Fund
- Virginia Department of Environmental Quality Citizen Water Monitoring Grant Program
- Virginia Outdoors Foundation (VOF)
- Virginia Department of Forestry
    - Urban and Community Forestry Assistance Program (U&CF)
    - Virginia Forest Stewardship Program
- Virginia Department of Environmental Quality
    - Virginia Small Business Environmental Compliance Assistance Loan Fund
    - Virginia Stormwater Local Assistance Fund (SLAF)
    - Virginia Water Quality Improvement Fund

Regional and Private

- Community Development Block Grant (CDBG)
- Foundation for Roanoke Valley
- National Fish and Wildlife Foundation (NFWF)
- Five Star and Urban Waters Restoration Grant Program
- Southeast Rural Community Assistance Project (SERCAP)
- Total Action for Progress
- Virginia Environmental Endowment
- Wetland and Stream Mitigation Banking

1.0 Introduction

The Clean Water Act (CWA) requires that streams, rivers, and lakes within the United States meet specified water quality standards and that states conduct monitoring to identify waterbodies that are polluted and do not meet these standards. When streams fail to meet the 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) requires states to develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL determines the maximum amount of pollutant loading that a waterbody can receive without exceeding the appropriate water quality standards. Once a TMDL is developed, states work with local stakeholders to develop an implementation plan to address the pollutant sources impairing the waterbodies and meet the TMDL. The ultimate goal is to remove the polluted waterbody from the impaired waters list.

Required monitoring performed by the Commonwealth of Virginia identified waterbodies within the North Fork and South Fork Roanoke River watersheds that did not meet the *Escherichia coli* (*E. coli*) and fecal coliform criteria and therefore did not protect the primary contact recreational beneficial uses. In addition, monitoring identified portions of the mainstem Roanoke River not attaining the aquatic life use General Standard based on impaired benthic macroinvertebrate communities. TMDLs were developed and approved for these impaired segments in 2006 (VADEQ 2006a, 2006b). Since the development of the TMDLs, other segments were found to be impaired (VADEQ, 2014) due to violations of *E. coli* and fecal coliform criteria and are incorporated within this implementation plan. Addressing impairments that occurred after approval of the original TMDLs is feasible since these newer impairments occur within the watershed areas that drain to original TMDL segments. The original TMDL modeling was revisited and utilized to develop updated pollutant loads. In addition, the 2014 305(b)/303(d) Integrated Report (draft), has identified six segments which have been officially nested into the Roanoke River Benthic TMDL (VADEQ, 2006b) as having benthic communities impaired by excessive sediment; however, this IP does not specifically address these segments in terms of identifying TMDL loads or IP actions to mitigate the pollution. See the "*2014 305(b)/303(d)*

Water Quality Assessment Integrated Report" (VADEQ, 2014b) for the benthic macroinvertebrate community impairment nesting rationale.

Due to the large watershed sizes in the TMDL reports, the Roanoke River TMDL Implementation Plan is split into two parts. This report addresses the second part of the plan. Part II of the Roanoke River TMDL Implementation Plan (herein referred to as the implementation plan or "IP") addresses the following waterbodies identified as impaired because they do not support the primary contact recreation beneficial use due to *E. coli* and fecal coliform exceedances: Bradshaw Creek; North Fork Roanoke River; South Fork Roanoke River; and Wilson Creek (Figure 1-1); and benthic impaired portions of the mainstem Roanoke River (Figure 1-2). This report also covers a portion of the North Fork Roanoke River that is unimpaired. The first part of the Roanoke River TMDL IP (prepared as a separate report in February 2016) addresses impairments downstream on the mainstem of the Roanoke River and associated tributaries.

1.1 Purpose of the Implementation Plan

After development and approval of a TMDL, certain actions and measures must be implemented in order to reduce the bacteria load and excess sediment entering the impaired waterbodies and to work towards meeting the *E. coli* and aquatic life (benthic macroinvertebrate community) water quality standards, respectively. The TMDLs provide the foundation for pollutant reduction measures and actions. The Roanoke River TMDL IP Part II describes the measures and details through a staged process necessary to reduce the bacteria and sediment sources contributing to the impaired waterbodies. These measures include better treatment technology, best management practices (BMPs), and educational and outreach programs. The purpose of the Roanoke River TMDL IP Part II is to reduce bacteria and sediment to the levels stated in the TMDLs and to restore the waterbodies to conditions that support the primary contact recreational uses and attain the aquatic life use standard. The staged IP should allow for cost-effective reduction in bacteria and sediment as well as improve stakeholders' opportunities to receive financial and other assistance for implementation activities.

1.2 Implementation Plan Components

The specific components discussed in the Roanoke River TMDL IP Part II include:

- State and federal requirements for implementation plans;
- Review of the associated TMDL development studies including descriptions of the watersheds and associated land use, the impairments, the water quality monitoring performed and data collected, modeling details, pollutant sources and existing loads, updated allocations and load reductions based on new land use data, and the incorporation of the impaired segments not specifically separated out in the established TMDLs;
- Public participation process including steering committee, working group, and public meetings;
- Implementation actions including identification of existing or future BMPs and other management activities, determination of BMP reduction efficiencies, quantification of type and numbers of new control measures required, and cost-effectiveness analysis;
- Measurable goals and milestones for attaining water quality standards including timelines for implementation and corresponding achievement of water quality improvements, number and type of implementation measures installed in each timeframe, and monitoring of these milestones;
- Roles and responsibilities of watershed stakeholders including outreach and educational actions;
- Description of other watershed plans and ongoing activities that could support implementation efforts; and
- Potential funding sources for implementation actions.

1.3 Impairment Listing

The Roanoke River TMDL IP Part II addresses the impaired segments for one bacteria TMDL study and one benthic macroinvertebrate community (sediment) TMDL study (VADEQ 2006a, 2006b). A benthic macroinvertebrate TMDL was developed to address the attainment of the aquatic life use standard in various river segments of the Roanoke River. The analysis

determined that sediment was the most probable stressor to benthic macroinvertebrate communities for the benthic TMDL addressed in the Roanoke River TMDL IP Part II.

1.3.1 Bacteria Impairment

For the Roanoke River TMDL IP Part II, the watershed area for bacteria impairments covers approximately 253 square miles including five subwatersheds (including the unimpaired North Fork Roanoke River watershed) with nine impaired segments. It is located in Floyd, Montgomery, and Roanoke Counties and the Towns of Blacksburg and Christiansburg (Figure 1-1). The impaired segments were all first listed as impaired on one of Virginia's 303(d) Total Maximum Daily Load Priority List and Reports. Table A-1 in Appendix A summarizes the details of the impaired segments as listed in the 2012 305(b)/303(d) Water Quality Integrated Report.

Not every impaired segment listed in Table A-1 has an established TMDL. However, the drainage area and associated pollutant loads for each segment without an established TMDL were indirectly incorporated during hydrologic and water quality modeling performed for the established bacteria TMDL study, entitled *Bacteria TMDLs for Wilson Creek, Ore Branch and Roanoke River Watersheds, VA* (VADEQ, 2006a). Bacteria source assessments and pollutant load allocations for these impairments were established by modeling performed for Part II of the Roanoke River TMDL IP.

1.3.1.1 Applicable Water Quality Standards

Water quality standards consist of designated uses for a water body and water quality criteria necessary to support those designated uses. According to Virginia Water Quality Standards (9 VAC 25-260-5), the term "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.)."

1.3.1.2 Designated Uses

According to Virginia Water Quality Standards (9 VAC 25-260-10):

> "*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.*"

The listed segments defined in Table A-1 in Appendix A do not support recreation uses, based on the water quality monitoring data.

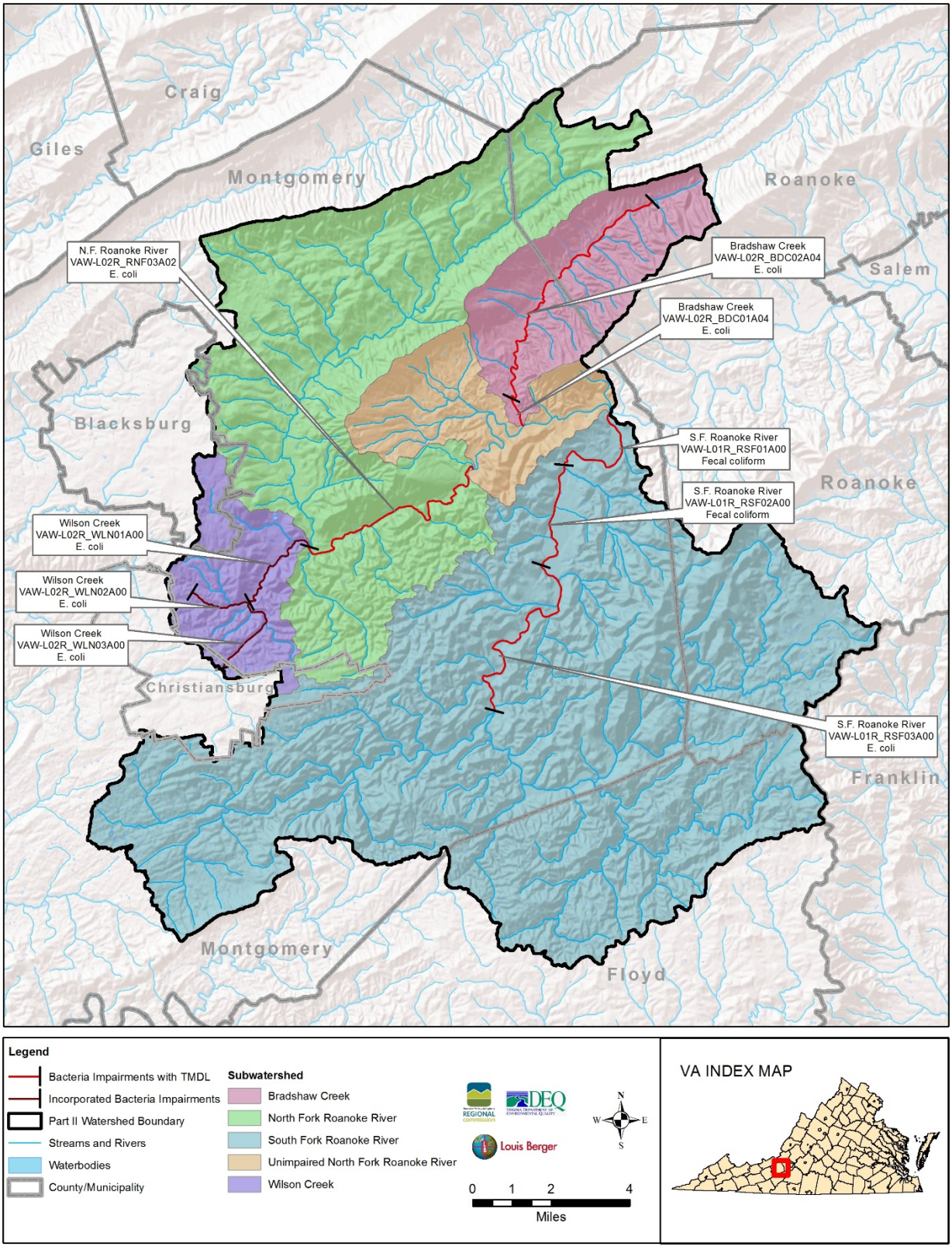


Figure 1-1. Bacteria Impaired Watersheds and Segments

1.3.1.3 Applicable Water Quality Criteria

The water quality standards were stated in terms of fecal coliform bacteria when some of the impaired segments were initially listed. However, effective February 1, 2010, VADEQ specified a new bacteria standard in 9 VAC 25-260-170.A, in which the water quality standard is expressed in terms of *E. coli* bacteria. This standard replaced the existing fecal coliform standard of 9 VAC 25-260-170. For a waterbody to be in compliance with Virginia bacteria standards for primary contact recreation in freshwater, the current criteria are as follows:

> *"E. coli bacteria shall not exceed a monthly geometric mean of 126 CFU/100 ml in freshwater. If there are insufficient data to calculate monthly geometric means in freshwater, no more than 10% of the total samples in the assessment period shall exceed 235 E. coli CFU/100 ml."*

1.3.1.4 Wildlife Contributions

The previously established bacteria TMDL for Wilson Creek demonstrates that the existing wildlife bacteria load in the subwatershed is greater than the allocated bacteria load. This indicates that removal of all bacteria sources, except wildlife, would not allow the stream to attain the required water quality standard. Neither the Commonwealth of Virginia nor EPA is proposing the elimination of wildlife to allow for the attainment of water quality standards. Not only is this an impractical action but the reduction of wildlife or the changing of natural background conditions is not the intended goal of a TMDL IP.

Addressing bacteria loads from wildlife is neither feasible nor addressed in this implementation plan. Therefore, the Roanoke River TMDL IP Part II intends to use an adaptive implementation approach consisting of an iterative process to enhance the existing monitoring plan as well as to implement reasonable and practicable control actions. If, after implementation of these control actions, exceedances of the water quality standard persist due to wildlife loadings, then a special study called a Use Attainability Analysis (UAA) may become necessary. A UAA could address the removal and re-designation of the existing designated use. The UAA collects data and analyzes various factors (e.g., physical, chemical, biological, chemical, and economic) affecting the attainment of the designated use as described in the federal regulations under 40 CFR §131.10(g).

1.3.2 Benthic Impairment

The overall Roanoke River TMDL IP benthic watershed area for benthic impairments covers approximately 525 square miles with six impaired segments, all located on the mainstem of the Roanoke River. The watershed is located in Bedford, Botetourt, Floyd, Montgomery, and Roanoke Counties, the Cities of Salem and Roanoke, and the Towns of Blacksburg and Christiansburg (Figure 1-2). The impaired segments are all on the mainstem Roanoke River downstream from the Part II subwatersheds addressed in this implementation plan. Segments of the Roanoke River were first listed as impaired on Virginia's 1996 303(d) Total Maximum Daily Load Priority List and Report. Table A-2 in Appendix A summarizes the details of the six impaired segments as listed in the 2010 305(b)/303(d) Water Quality Integrated Assessment. Each benthic impaired segment was incorporated during modeling performed for the established TMDL, *Benthic TMDL Development for the Roanoke River, Virginia* (VADEQ, 2006b). The sediment load for the benthic impairment watershed was split between the Roanoke River TMDL IP Part I and II watersheds based on land use. Part II does not cover newly impaired benthic segments but will focus on the sediment loads for the upper portion of the benthic subwatershed, also known as the Part II benthic watershed. The Roanoke River TMDL IP Part II benthic watershed drains approximately 273 square miles.

1.3.2.1 Applicable Water Quality Standards

Water quality standards consist of designated uses for a waterbody and water quality criteria necessary to support those designated uses. According to Virginia Water Quality Standards (9 VAC 25-260-5), the term 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 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.)."

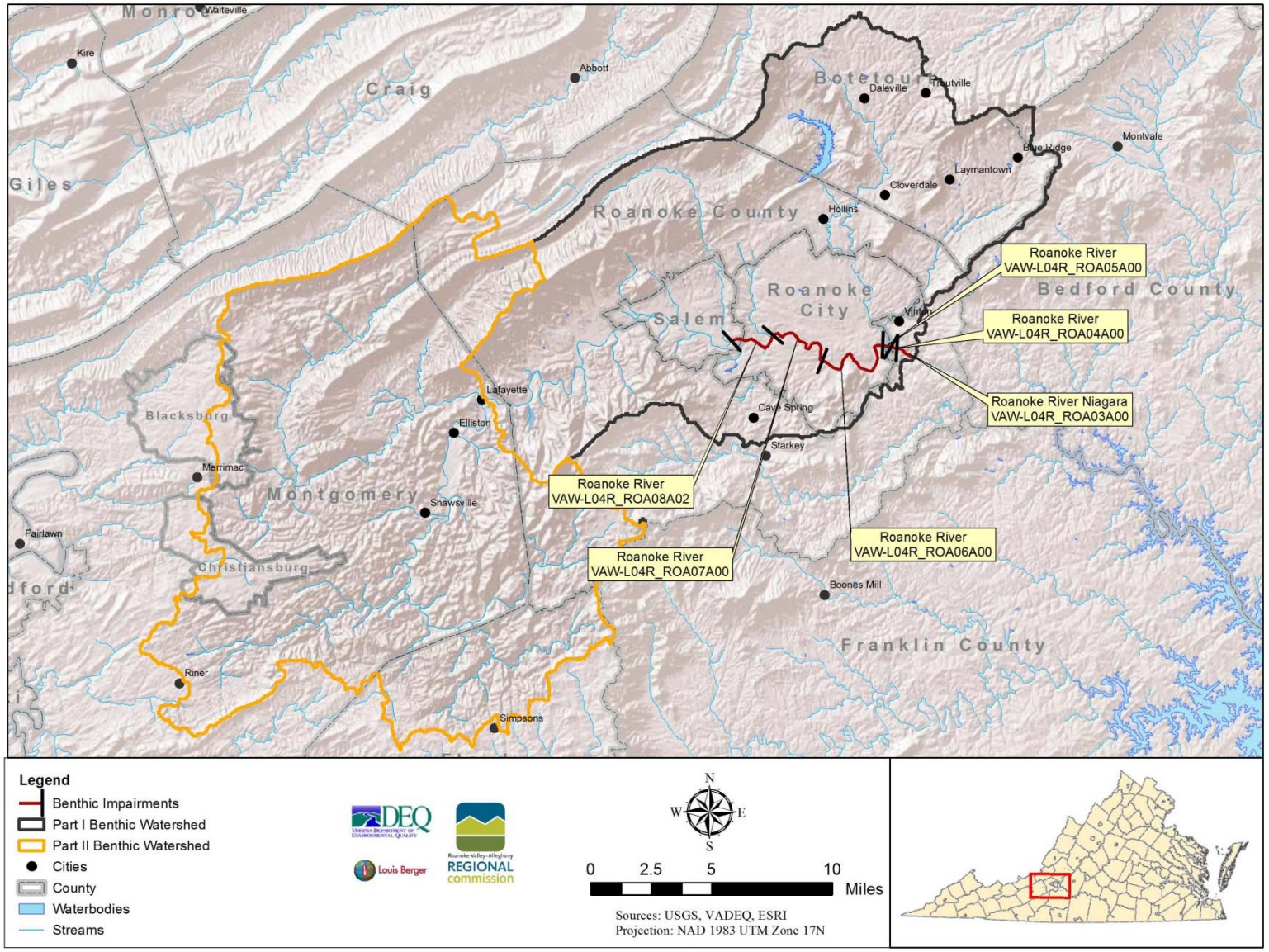


Figure 1-2. Benthic Impaired Segments and Watersheds in Parts I and II

1.3.2.2 Designated Uses

According to Virginia Water Quality Standards (9 VAC 25-260-10):

> "*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*."

The listed segments defined in Table A-2 in Appendix A do not support the propagation and growth of aquatic life in the Roanoke River, based on the biological assessment surveys conducted on the river.

1.3.2.3 Applicable Water Quality Criteria

The General Standard defined in Virginia Water Quality Standards (9 VAC 25-260-20) provides general, narrative criteria for the protection of designated uses from substances that may interfere with attainment of such uses. The General Standard states:

> *"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."*

2.0 State and Federal Requirements for Implementation Plans

There are a number of state and federal requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define these and explicitly state if the elements are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter has three sections that discuss the a) requirements outlined by the Water Quality Monitoring, Information, and Restoration Act (WQMIRA) that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) EPA recommended elements of IPs, and c) required components of an IP in accordance with Section 319 guidance.

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). WQMIRA directs Virginia Department of Environmental Quality (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. To meet the requirements of WQMIRA, IPs must include the following:

- Date of expected achievement of water quality objectives;
- Measureable goals;
- Necessary corrective actions;
- Associated costs, benefits, and environmental impact of addressing the impairment.

2.2 Federal Requirements

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

The listed elements in the EPA Guidance (1999) include:

- a description of the implementation actions and management measures,
- a timeline 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.

2.3 Requirements for Section 319 Funding Eligibility

EPA develops guidelines that describe the process and criteria to be used to award Clean Water Act Section 319 nonpoint source grants to states. Congress amended the CWA in 1987 to establish the 319 Nonpoint Source Management Program. Under Section 319, States, Territories, and Indian Tribes receive grant money, which supports a wide variety of activities including the restoration of impaired waters. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

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

7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

For more information on the requirements for Section 319 fund eligibility, refer to:

- *http://www.deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/NonpointSourcePollutionManagement.aspx*
- *http://water.epa.gov/polwaste/nps/cwact.cfm*

3.0 Review of TMDL Development

The Roanoke River TMDL IP Part II addresses bacteria impairments within five subwatersheds (including the unimpaired North Fork Roanoke River watershed) located within parts of the Counties of Floyd, Montgomery, and Roanoke and the Towns of Blacksburg and Christiansburg. This TMDL IP Part II also addresses benthic impairments located on the mainstem Roanoke River downstream from the Part II subwatersheds within parts of Roanoke County and the Cities of Salem and Roanoke. The impairments were originally encompassed within two TMDL study watersheds (i.e., one bacteria watershed and one benthic watershed) (VADEQ 2006a, 2006b). The Unimpaired North Fork Roanoke River subwatershed is not impaired for bacteria and does not have bacteria TMDL reductions but the land area was covered under the 2006 bacteria TMDL watershed (VADEQ, 2006a). In addition, this chapter assigns allocations to the bacteria-impaired segments that were not specifically included in the previously developed bacteria TMDL report (VADEQ 2006a) because these segments were listed as impaired after completion of the TMDLs. These segments are referred to as nested impairments. Pollutant load allocations for these nested impairments were established by the Hydrologic Simulation Program FORTRAN (HSPF) model, which was used in the original TMDL development, and are described in Section 3.1.1.3.1.

This chapter includes a review, update and summary of the bacteria and benthic TMDL development studies. Additionally, because of significant land use changes between 1992 (i.e., the year of the original TMDL land use data) and 2006 (i.e., the year of the most current available land use data at initiation of this IP), pollutant load allocations were adjusted using the 2006 National Land Cover Database (NLCD) for all impairments included in this IP to give a more realistic and practical basis for implementation.

3.1 Update of TMDL Allocation Loads

The original TMDLs were developed in 2006 (VADEQ, 2006a, 2006b). Current land use distributions have changed since that time. Therefore, for the purpose of Roanoke River TMDL IP Part II development, adjustments were made to the bacteria and benthic TMDLs to reflect the land uses changes. Note that the aforementioned adjustments were not official TMDL

modifications; but rather an exercise applied to the IP effort in order to develop a reasonable plan based on more recent land use information. Additionally, the original benthic TMDL (VADEQ, 2006b) sediment allocation loads were revised because of calculations used during that period overestimating instream erosion rates. This error was subsequently discovered as future benthic TMDLs were developed.

3.1.1 Bacteria Load Revision

3.1.1.1 Original Water Quality Modeling

The bacteria TMDL study used the HSPF model to simulate the hydrology and bacteria fate and transport in the various reaches of the Roanoke River watershed including Wilson Creek. HSPF is a hydrologic, watershed-based water quality model that explicitly accounts for specific physical conditions of the watershed, variations in rainfall and climate, and various bacteria sources. Development of the bacteria TMDLs used the *E. coli* water quality standard of a geometric mean concentration of 126 colony forming units (cfu)/100 ml and a single sample concentration of 235 cfu/100 ml.

During the original development of the bacteria TMDLs, the project area was divided into smaller subwatersheds to represent the local watershed conditions and to improve the accuracy of the model. Using the existing conditions within these subwatersheds, the model was run until allocation scenarios were obtained by iteratively running the model while adjusting source contributions until the model runs resulted in attainment of the *E. coli* water quality standard.

3.1.1.2 HSPF Model Adjustments

In the bacteria TMDL study (VADEQ 2006a), the 1992 NLCD was used to develop the land use distributions, perform hydrology and water quality calibrations, and to develop the allocations for Wilson Creek. However, this subwatershed as well as surrounding areas experienced changes in land use distributions between 1992 and 2006. The 2006 NLCD land use data were used to capture these changes and adjust the various bacteria sources and allocations. Additionally, several impaired segments within this IP do not have an established TMDL, as discussed in Section 3.1.1.3.1, Section 3.2, and Table A-1. Steps taken to determine allocation loads and reductions for these impaired segments are explained below, as applicable.

3.1.1.3 HSPF Modeling Update - Land Use

The 2006 NLCD land use categories are different from the 1992 NLCD categories and a direct comparison/adjustment of the bacteria load from each specific 1992 NLCD land use category is not feasible. Therefore, in the update to the TMDL allocations, land uses were reclassified into more general categories. Differences between 1992 and 2006 land use categorizations are found in Table 3-1.

Table 3-1: Land Use Category Reclassification

Reclassified Land Use Type	1992 NLCD Land Use	2006 NLCD Land Use
Developed	Commercial/Industrial/ Transportation	High Intensity Developed
	High Intensity Residential	Medium Intensity Developed
	Low Intensity Residential	Low Intensity Developed
		Open Space Developed
Cropland	Row Crops	Cultivated Crops
Pasture/Hay	Pasture/Hay	Pasture/Hay
Forest	Deciduous Forest	Deciduous Forest
	Evergreen Forest	Evergreen Forest
	Mixed Forest	Mixed Forest
Water/Wetlands	Emergent Herbaceous Wetlands	Emergent Herbaceous Wetlands
	Open Water	Open Water
	Woody Wetlands	Woody Wetlands
Other	Quarries/Strip Mines/Gravel Pits	Barren Land
	Transitional	Grassland/Herbaceous
	Urban/Recreational Grasses	Shrub/Scrub

Overall, developed land increased from 1992 to 2006 whereas cropland, forest, and water/wetland land use decreased (Table 3-2). Pasture/hay land use decreased in all subwatersheds except for Bradshaw Creek where there was a very slight increase. The land use changes impact the 1992 existing and allocated loads and therefore these loads were adjusted to reflect the 2006 land use conditions (in Unit Area Load [UAL – cfu/acre]). The adjusted loads are presented for each subwatershed in Section 3.2. The following modeling approach was used to update the established TMDL for Wilson Creek:

- Develop a 1992 UAL for each land use category and source using the 1992 land use distribution and the 1992 bacteria allocations.

- For the direct bacteria sources, use pasture/hay land area that intersects the stream layer to develop the UAL for direct livestock and use forested area to develop the UAL for direct wildlife.
- For direct septic loads, use the same loads presented in the TMDL. It was assumed that the increase in developed land would not increase direct septic loads because either new development is connected to the sewer network or has newly installed septic systems, which should still be functioning properly. Although not changing the direct septic load, updated housing data from municipalities were used to re-estimate failing septic systems in this IP.

- Estimate the 2006 existing conditions and allocation loads for bacteria using the 1992 UALs and the 2006 land use distributions.
  - Application of Pet Waste: Due to population density, pet waste is applied on all developed land use categories within the 2010 urban census boundary. Outside of the urban census boundary, pet waste is only applied on residential land and not on developed open space, which primarily corresponds to roads.
  - The 1992 and 2006 developed land use categories do not directly reflect each other, which is why they were lumped in Part II of the Roanoke River TMDL IP. In the modeling, which is based on the 1992 NLCD, pet waste is modeled on high and low intensity developed land use categories but not the commercial/industrial/transportation land use category. These loads are then combined to form a 1992 NLCD Developed Land bacteria load and divided by the total developed acreage to get a unit load for developed land use. For Wilson Creek subwatershed, the controllable developed land bacteria load is estimated by multiplying the developed land unit load by the area of all high/medium/low intensity land and the developed, open space land within the 2010 urban census area.
- Adjust the allocations and reductions to ensure that the 2006 total bacteria allocated load is the same for each subwatershed as the load developed during the TMDL study using the 1992 NLCD data.

Table 3-2: Roanoke River Implementation Bacteria Land Use Changes (acres)								
Subwatershed	**Land Use**	**Developed**	**Cropland**	**Pasture /Hay**	**Forest**	**Water/ Wetlands**	**Other**	**Total**
Bradshaw Creek	NLCD 1992	95	195	744	10,846	3.5	128	12,012
	NLCD 2006	592	48	749	10,603	0.0	20	12,012
	% Change	**524%**	**-75%**	**0.6%**	**-2.2%**	**-100%**	**-84%**	**0%**
North Fork Roanoke River	NLCD 1992	434	1,027	8,523	34,096	17	18	44,114
	NLCD 2006	3,378	298	8,177	32,245	8.2	8.0	44,114
	% Change	**679%**	**-71%**	**-4.1%**	**-5.4%**	**-50%**	**-56%**	**0%**
South Fork Roanoke River	NLCD 1992	818	2,072	11,461	73,558	192	238	88,340
	NLCD 2006	6,386	779	9,580	71,395	127	73	88,340
	% Change	**681%**	**-64%**	**-16%**	**-2.9%**	**-34%**	**-70%**	**0%**
Unimpaired North Fork Roanoke River	NLCD 1992	263	245	984	7,833	3.2	3.3	9,331
	NLCD 2006	835	60	865	7,565	1.3	5.1	9,331
	% Change	**218%**	**-76%**	**-12%**	**-3.4%**	**-59%**	**57%**	**0%**
Wilson Creek	NLCD 1992	665	139	1,438	5,643	10	356	8,251
	NLCD 2006	2,687	31	808	4,696	3.8	25	8,251
	% Change	**304%**	**-78%**	**-44%**	**-17%**	**-62%**	**-93%**	**0%**
Average Change		**481%**	**-73%**	**-15%**	**-6.2%**	**-61%**	**-49%**	

3.1.1.3.1 Impaired Segments without an Established TMDL

Bacteria source assessments were developed within this IP for several nested impairments. These segments include North Fork Roanoke River, South Fork Roanoke River, and Bradshaw Creek (Table A-1 in Appendix A). The following steps describe the approach used to develop existing conditions and allocations for *E. coli* for these segments and their subwatersheds:

- Develop 1992 existing conditions fecal coliform loads for each impaired segment without an established TMDL by running the calibrated HSPF model with the bacteria source assessments.
- Convert the 1992 existing conditions fecal coliform loads obtained from the model output into 1992 *E. coli* loads.
- Develop individual 1992 allocation loads for each impaired segment without an established TMDL by using the estimated level of *E. coli* reductions from the original Roanoke River TMDL as a guide.
- Adjust the 1992 *E. coli* existing conditions and allocations loads developed, in the previous steps, for the impaired segments without an established TMDL to the 2006 land use conditions. Use a similar approach to that described in Section 3.1.1.3 for bacteria load adjustments to the 2006 land use.
- Application of Pet Waste: Due to population density, pet waste is applied on all

developed land use categories within the 2010 urban census boundary. Outside of the urban census boundary, pet waste is only be applied on residential land and not on developed open space, which primarily corresponds to roads. The North and South Fork Roanoke River subwatersheds have land within the 2010 urban census boundary but Bradshaw Creek subwatershed does not have land within the boundary.

- The 1992 and 2006 developed land use categories do not directly correspond to each other which is why they were lumped in Part II of the Roanoke River TMDL IP. In the modeling, which is based on the 1992 NLCD land use, pet waste is modeled on high and low intensity developed land use categories but not the commercial/industrial/transportation land use category. These loads are then lumped together to form a 1992 NLCD Developed Land bacteria load and divided by the total developed acreage to get a unit load for developed land use. The controllable developed land bacteria load is then estimated by multiplying the developed land unit load by the area of all 2006 NLCD developed land within the 2010 urban census area.

3.1.2 Sediment Load Revision

3.1.2.1 Original Water Quality Modeling

The Generalized Watershed Loading Functions (GWLF) model was used to simulate runoff and sediment loads within the watershed for the benthic TMDL (VADEQ, 2006b). A reference watershed approach was used to establish the numeric TMDL endpoint for the Roanoke River. Using this approach, the TMDL endpoint for an impaired watershed was established based on conditions in a similar, but non-impaired reference watershed. In terms of benthic impairment caused by excessive sediment, the TMDL endpoint is the sediment loading rate in the non-impaired reference watershed. Reduction of the sediment loading rate in the impaired watershed to levels comparable to the reference watershed is assumed to be sufficient for recovery of the benthic community in the impaired watershed. Instream erosion was estimated based on the streambank lateral erosion rate equation introduced by Evans et al. (2003).

The watershed draining to the VADEQ biomonitoring station at river mile 224.5 on the Roanoke River was selected as the reference watershed for benthic TMDL development.

3.1.2.2 GWLF Model Adjustments

Review of modeling files and data used during the development of the Roanoke River benthic TMDL indicated that the recommended sediment reduction level (69.5%) developed using the 1992 NLCD data was slightly overestimated mainly due to an error in the estimation of the instream erosion loads in the impaired and reference watershed. Additionally, land use distributions within the benthic TMDL watershed changed from 1992 to 2006 necessitating load allocation adjustments to reflect these changes. Note that adjustments described here were made for the purposes of developing this IP and do not replace existing approved TMDLs.

The first step in updating the Roanoke River benthic TMDL was to correct the instream erosion loads for the impaired and reference watersheds and recalculate the annual average sediment loadings and sediment reductions necessary to meet the sediment endpoint using the 1992 NLCD data. Since developing the benthic TMDL for the Roanoke River watershed using the 1992 NLCD data, there was significant land use change including a noticeable increase in urban areas and a corresponding decrease in forested and agricultural areas. Similar to the adjustments performed for the bacteria impaired segments, the sediment loads were adjusted to the 2006 NLCD land use distribution.

The steps used in the adjustment of the sediment allocations for the Roanoke River (VAW-L04R) for instream erosion and the 2006 NLCD land use data were as follows:

- Adjust the instream erosion rates to the 2006 land use distribution. The most sensitive variable to the instream erosion rates was the percent of urban areas that increased from 1992 to 2006.
- Adjust the land-based sediment loads using sediment Unit Area Loads (UAL) and similar approach as the one used for the bacteria impairments in Section 3.1.1.3.

3.2 Bacteria TMDL Subwatersheds

The effective watershed area for the bacteria portion of the IP covers five subwatersheds with nine impaired segments (Figure 3-1). This watershed area encompasses one previously developed bacteria TMDL (Wilson Creek) as well as nested segments that were not specifically included in the previous TMDL development. Specifically, the VADEQ (2006a) TMDL report

included the three bacteria impaired segments in Wilson Creek subwatershed and developed a bacteria TMDL for Wilson Creek. Table A-1 in Appendix A defines the impaired segments covered under this IP. The effective watershed area also includes an unimpaired subwatershed of the North Fork Roanoke River.

Although a specific TMDL was only developed for the Wilson Creek watershed, the drainage areas for the other subwatersheds were included within the developed TMDL watershed area. The Roanoke River watershed from the VADEQ (2006a) TMDL report encompassed the bacteria impaired segments and drainage areas for the nested segments for Bradshaw Creek, North Fork Roanoke River, and South Fork Roanoke River.

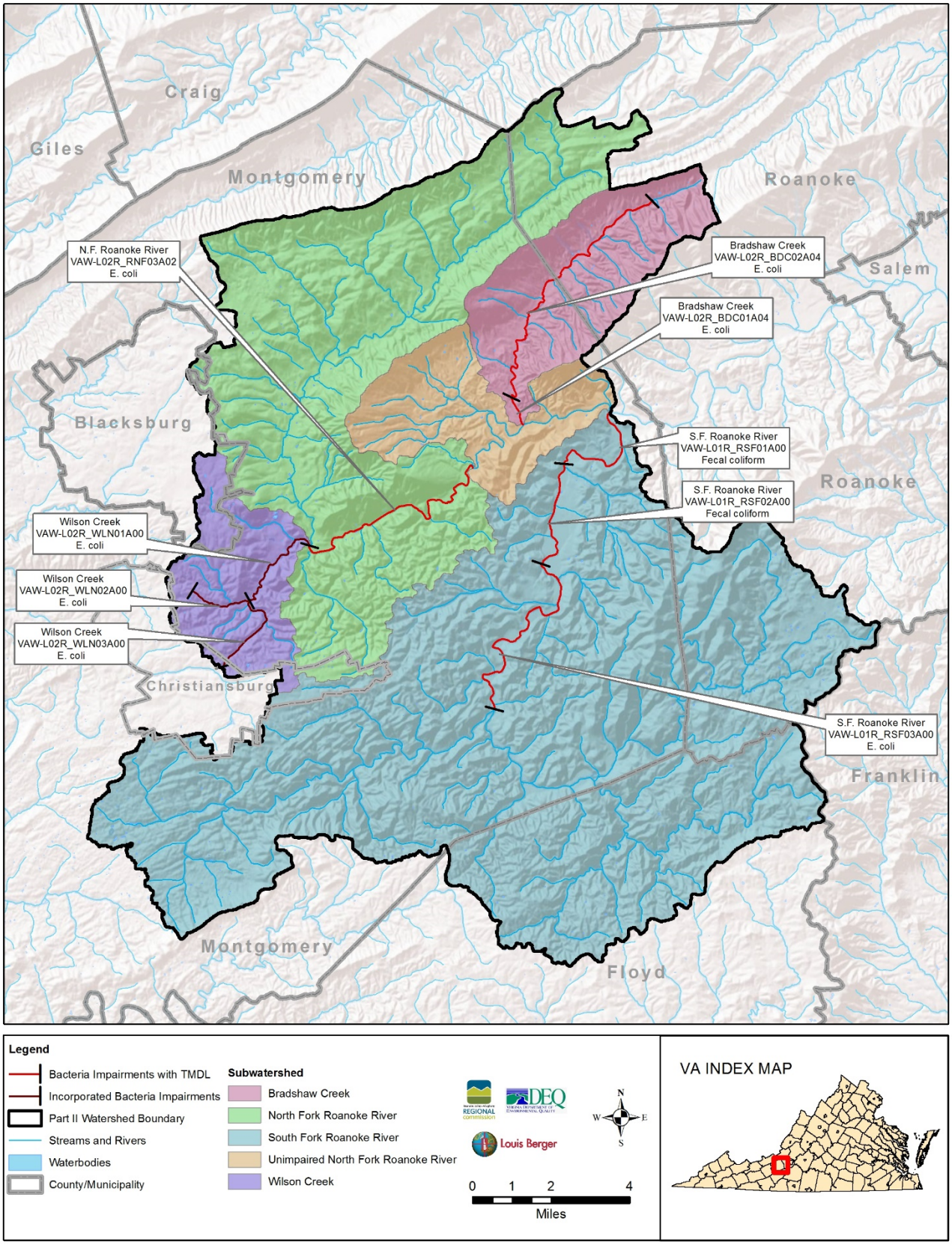


Figure 3-1. Bacteria Subwatersheds and Impaired Segments

3.2.1 Wilson Creek

Description of Watershed and Impairment

The headwaters of Wilson Creek are located in central Montgomery County just south of the Town of Blacksburg (Figure 3-2). The creek flows south and east until its confluence with the North Fork Roanoke River. The drainage area of this subwatershed is approximately 8,251 acres. The dominant NLCD 2006 land uses consist of forest (57%) and developed land (33%). The developed land associated with the Towns of Blacksburg and Christiansburg and their suburbs is located in the northern and western portions of the watershed. The forest land occurs throughout the rest of the watershed interspersed with portions of pasture/hay land.

Wilson Creek was first listed as impaired in Virginia's 1998 section 303(d) Total Maximum Daily Load Priority List and Report due to exceedances of Virginia's water quality standard for fecal coliform bacteria (400 cfu/100 ml instantaneous criterion). Since the initial listing, an *E. coli* standard was established, and subsequent listings were based on exceedances of the *E. coli* single sample maximum of 235 cfu/100 ml. Due to these exceedances, the primary contact recreation use was not supported along 6.92 miles of the waterbody (Table 3-3). Development of the TMDL was based on the *E. coli* water quality standard.

Table 3-3: Impairment Summary for Wilson Creek

Assessment Unit	Length (miles)	Boundaries of Impaired Segments	Cause
VAW-L02R_WLN01A00	2.77	Wilson Creek mainstem segment extends from WLN02A00 downstream to the Wilson Creek mouth on the North Fork Roanoke River.	*Escherichia coli*
VAW-L02R_WLN02A00	1.66	This northern arm extends upstream from mainstem Wilson Creek to the Rt. 114 & Rt. 460 intersection behind major developed area near New River Valley Mall.	
VAW-L02R_WLN03A00	2.49	Wilson Creek mainstem segment extends from near Rt. 460/I-81 intersection downstream to intersection of segments WLN02A with WLN01A.	

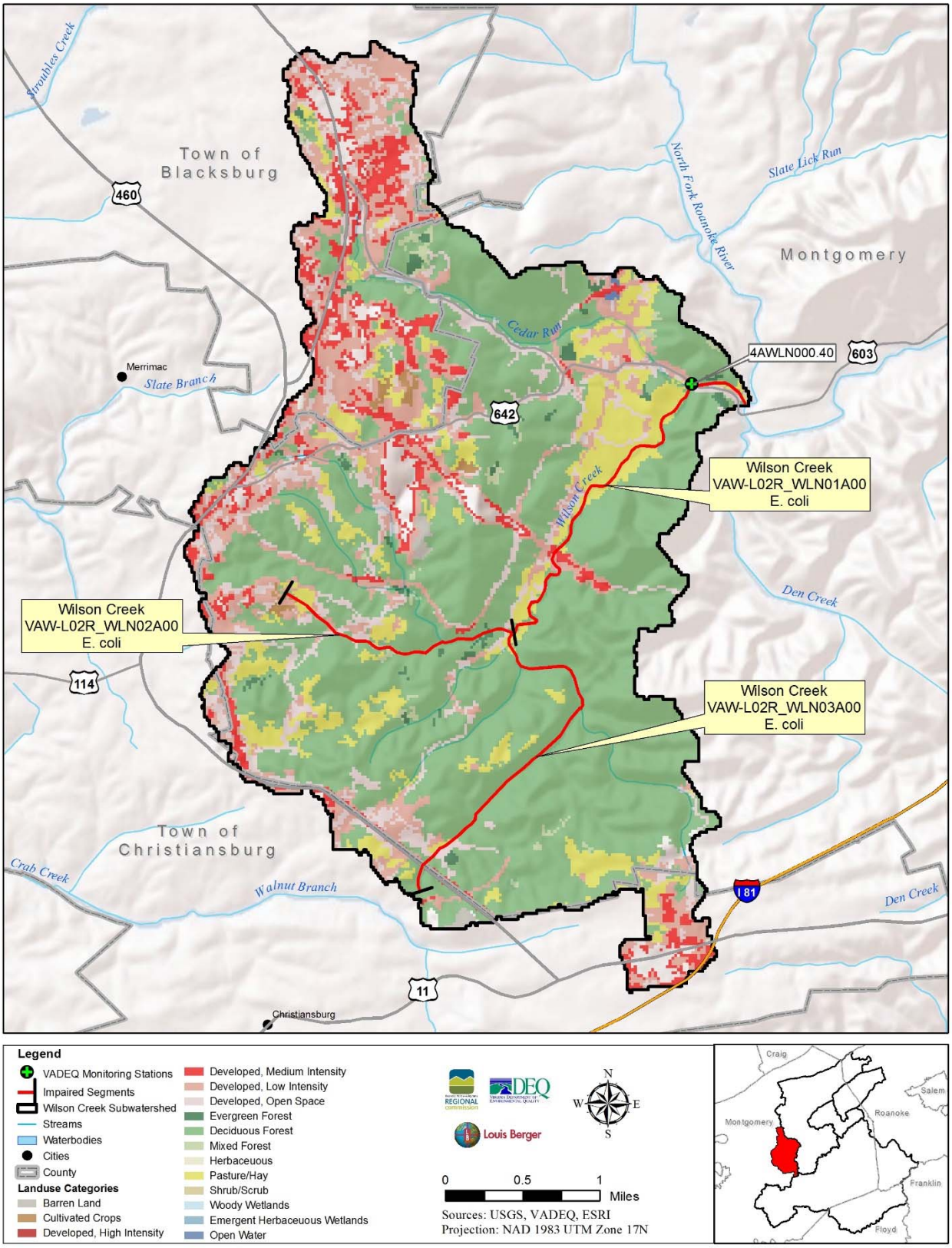


Figure 3-2. Wilson Creek Subwatershed

Bacteria Sources

The primary contributor to bacteria loading in the Wilson Creek subwatershed is nonpoint source runoff from developed land use and wildlife direct sources (Figure 3-3).

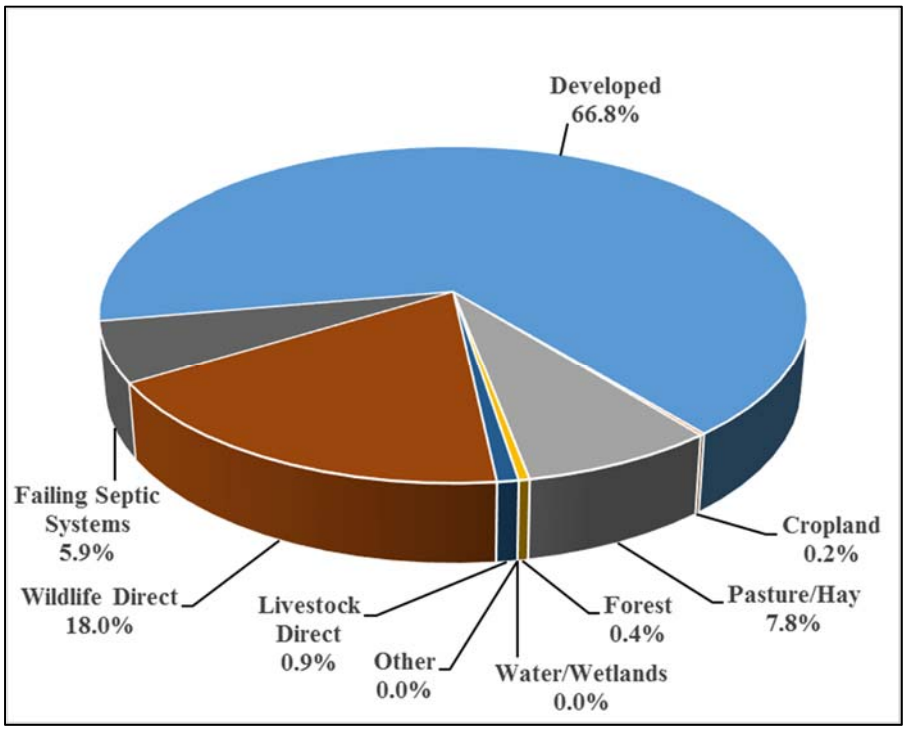


Figure 3-3. Bacteria Sources in Wilson Creek Subwatershed

Bacteria Allocation Summary/Load Reduction

Reductions from bacteria sources are presented in the load allocation table for the Wilson Creek subwatershed (Table 3-4).

Table 3-4: Wilson Creek Load Allocation for *E. coli*

2006 Land Use/Source	Annual Average *E. coli* Loads (cfu/year)		Percent Reduction
	Existing	Allocation	
Developed	1.06E+13	2.13E+11	98%
Cropland	3.05E+10	3.05E+10	0%
Pasture/Hay	1.24E+12	2.48E+10	98%
Forest	6.91E+10	6.91E+10	0%
Water/Wetlands	1.83E+07	1.83E+07	0%
Other	-	-	-
Livestock Direct	1.37E+11	4.11E+09	97%
Wildlife Direct	2.87E+12	2.87E+10	99%
Failing Septic Systems	9.39E+11	0.00E+00	100%
Total	**1.59E+13**	**3.70E+11**	**98%**

3.2.2 Bradshaw Creek (Nested Watershed)

Description of Watershed and Impairment

The headwaters of Bradshaw Creek are located in northwestern Roanoke County (Figure 3-4). The creek flows in a southwesterly direction before flowing into the North Fork Roanoke River in northeastern Montgomery County. The subwatershed drains approximately 12,012 acres. The dominant 2006 NLCD land use is forest (88%). Small portions of pasture/hay (6%) and developed land (5%) are located along the valley that runs through the watershed.

Bradshaw Creek was first listed as impaired in Virginia's 2010 305(b)/303(d) Water Quality Assessment Integrated Report due to exceedances of Virginia's water quality standard for *Escherichia coli* (*E. coli*). Specifically, two out of 12 samples exceeded the 235 cfu/100 ml *E. coli* single sample maximum. Due to these exceedances, the primary contact recreation use was not supported along 8.72 miles of the waterbody (Table 3-5).

Table 3-5: Impairment Summary for Bradshaw Creek

Assessment Unit	Length (miles)	Boundaries of Impaired Segments	Cause
VAW-L02R_BDC01A04	0.82[1]	Bradshaw Creek from the upstream end of the WQS PWS designation downstream to its mouth on the North Fork Roanoke River.	*Escherichia coli*
VAW-L02R_BDC02A04	7.9[1]	Bradshaw Creek mainstem from near its headwaters downstream to the upstream ending of the WQS PWS designation.	

[1]Segment was nested with applicable TMDLs during the 2010 303(d)/305(b) Integrated Report.

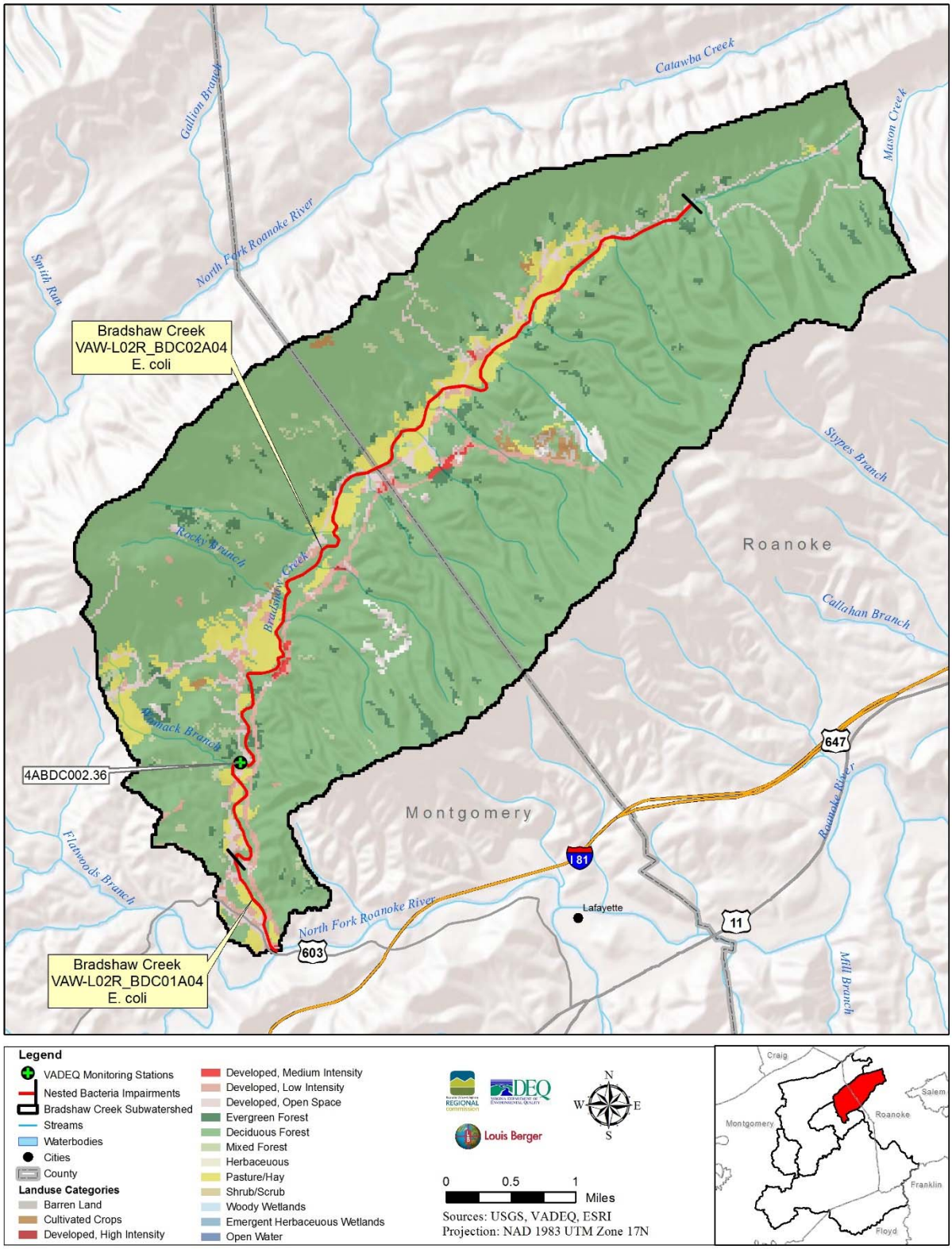


Figure 3-4. Bradshaw Creek Subwatershed

Bacteria Sources

The primary contributor to bacteria loading in the Bradshaw Creek subwatershed is nonpoint source runoff from pasture/hay land use and wildlife direct sources (Figure 3-5).

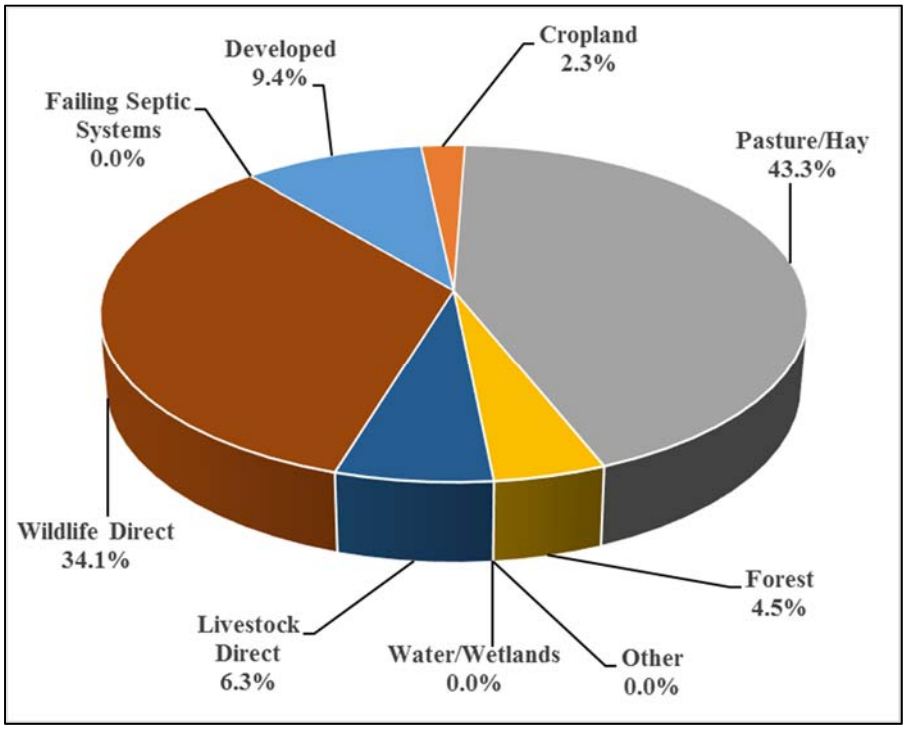


Figure 3-5. Bacteria Sources in Bradshaw Creek Subwatershed

Bacteria Allocation Summary/Load Reduction

Reductions from bacteria sources are presented in the load allocation table for the Bradshaw Creek subwatershed (Table 3-6).

Table 3-6: Bradshaw Creek Load Allocation for *E. coli*

2006 Land Use/Source	Annual Average *E. coli* Loads (cfu/year)		Percent Reduction
	Existing	Allocation	
Developed	2.32E+12	1.80E+12	22%
Cropland	5.62E+11	5.62E+11	0%
Pasture/Hay	1.07E+13	7.25E+12	32%
Forest	1.11E+12	1.11E+12	0%
Water/Wetlands	-	-	-
Other	-	-	-
Livestock Direct	1.56E+12	1.87E+11	88%
Wildlife Direct	8.41E+12	4.21E+11	95%
Failing Septic Systems	1.17E+09	0.00E+00	100%
Total	**2.46E+13**	**1.13E+13**	**54%**

3.2.3 North Fork Roanoke River

Description of Watershed and Impairment

The headwaters of the North Fork Roanoke River are located in northwestern Roanoke County (Figure 3-6). The creek flows southwest before its confluence with Wilson Creek in northeastern Montgomery County. At the confluence, it begins to flow to the east-northeast. The drainage area of the subwatershed is approximately 44,114 acres. The dominant 2006 NLCD land uses include forest (73%) and pasture/hay (19%). Most of the subwatershed is forest; however, there is pasture/hay land concentrated along the main valley running through the watershed with other larger patches located in the northern and western portions. Small areas of developed land are also scattered throughout these areas.

The North Fork Roanoke River was first listed as impaired in 2002 for fecal coliform bacteria. This segment and watershed was included in the Roanoke River watershed TMDL of 2006 (VADEQ, 2006a). Virginia's 2006 Integrated Report listed the North Fork Roanoke River due to exceedances of Virginia's water quality standard for *Escherichia coli* (*E. coli*). Specifically, 12 out of 21 samples exceeded the 235 cfu/100 ml *E. coli* single sample maximum. The *E. coli* single sample maximum criterion was also exceeded in 2008, 2010, and 2012. Due to these exceedances, the primary contact recreation use was not supported along 6.58 miles of the waterbody (Table 3-7).

Table 3-7: Impairment Summary for North Fork Roanoke River

Assessment Unit	Length (miles)	Boundaries of Impaired Segments	Cause
VAW-L02R_RNF03A02	6.58	North Fork Roanoke River mainstem from a right bank entry of an unnamed tributary in the community of Ironto upstream to the mouth of Wilson Creek.	*Escherichia coli*

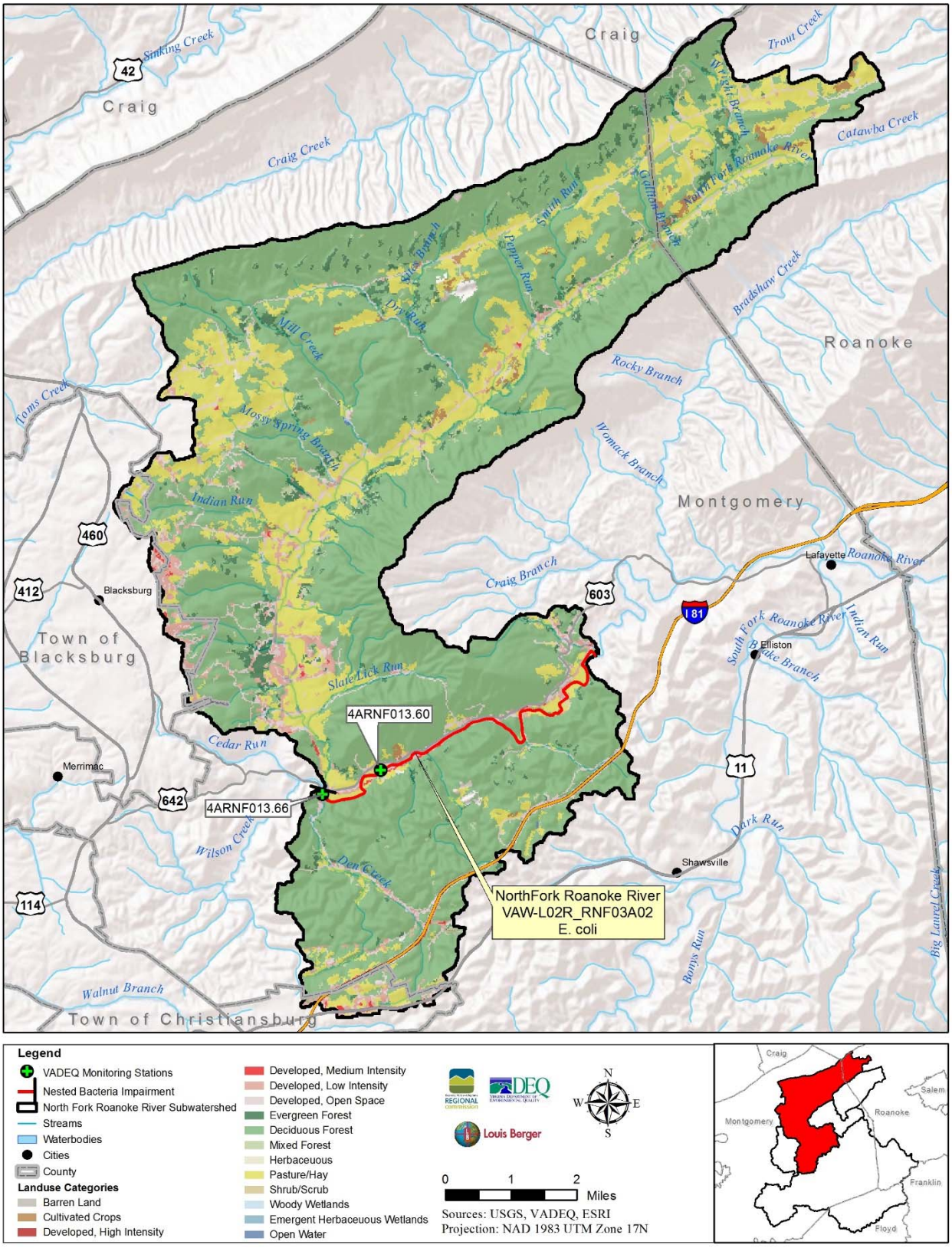


Figure 3-6. North Fork Roanoke River Subwatershed

Bacteria Sources

The primary contributor to bacteria loading in the North Fork Roanoke River subwatershed is nonpoint source runoff from developed and pasture/hay land uses (Figure 3-7).

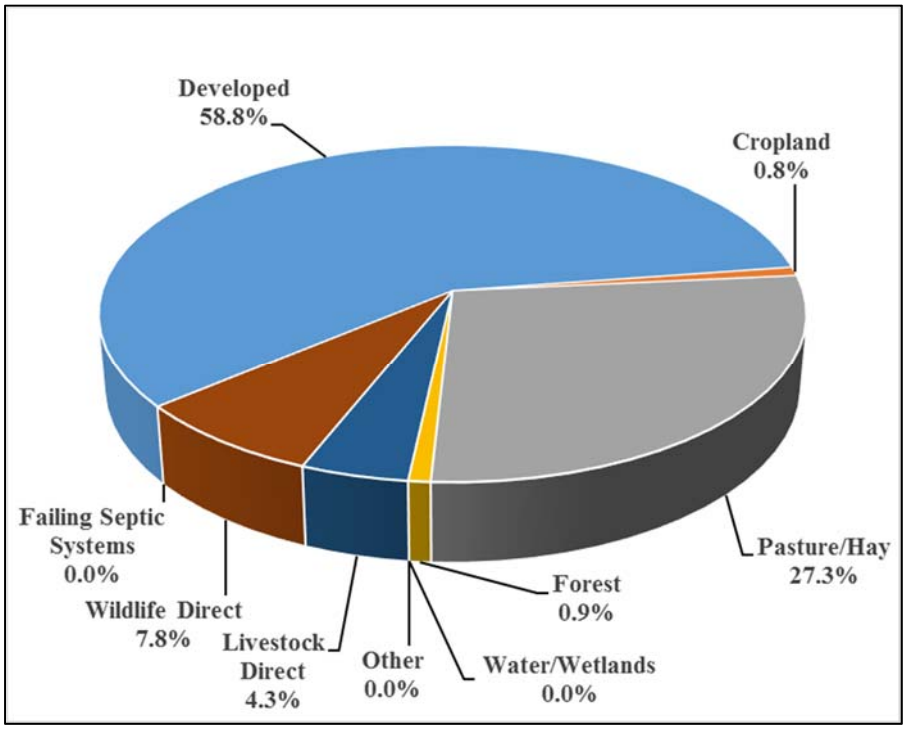


Figure 3-7. Bacteria Sources in North Fork Roanoke River Subwatershed

Bacteria Allocation Summary/Load Reduction

Reductions from bacteria sources are presented in the load allocation table for the North Fork Roanoke River subwatershed (Table 3-8).

Table 3-8: North Fork Roanoke River Load Allocation for *E. coli*

2006 Land Use/Source	Annual Average *E. coli* Loads (cfu/year)		Percent Reduction
	Existing	Allocation	
Developed	2.65E+14	4.75E+13	82%
Cropland	3.81E+12	3.81E+12	0%
Pasture/Hay	1.23E+14	1.23E+13	90%
Forest	4.00E+12	4.00E+12	0%
Water/Wetlands	4.98E+08	4.98E+08	0%
Other	-	-	-
Livestock Direct	1.95E+13	2.25E+12	88%
Wildlife Direct	3.51E+13	3.51E+11	99%
Failing Septic Systems	8.71E+10	0.00E+00	100%
Total	**4.50E+14**	**7.02E+13**	**84%**

3.2.4 South Fork Roanoke River

Description of Watershed and Impairment

The headwaters of the South Fork Roanoke River begin in northeastern Floyd County (Figure 3-8). The river flows north into Montgomery County accumulating flow from numerous tributaries draining large portions of land to the east and west of the main river including areas of Roanoke County. The mainstem Roanoke River begins at the confluence of the South Fork and North Fork Roanoke Rivers close to the Montgomery County-Roanoke County line. The South Fork Roanoke River subwatershed drains approximately 88,340 acres. The majority of the 2006 NLCD land use is forest (81%) land interspersed with small patches of pasture/hay (11%) and developed (7%) lands. Pasture/hay land uses are concentrated along the stream valley in the north as well as areas to the west and east. The developed land is associated with the Town of Christiansburg in the west and Shawsville, Elliston, and Lafayette in the north.

The South Fork Roanoke River was initially listed as impaired in Virginia's 2004 Section 303(d) TMDL Priority List and Report due to due to exceedances of Virginia's water quality standard for fecal coliform bacteria. These segments and subwatershed were included within the Roanoke River watershed in the 2006 bacteria TMDL (VADEQ, 2006a). According to the 2004 Integrated Report, two water quality monitoring stations had exceedances. Specifically, three out of 18 samples from one station and three out of 12 samples from the second station exceeded the 400 cfu/100 ml fecal coliform instantaneous criterion. The primary contact recreation use was not supported along a total of 6.3 miles due to the fecal coliform exceedances and along 6.4 miles due to the *E. coli* exceedances for a total of 12.6 miles (Table 3-9).

Table 3-9: Impairment Summary for South Fork Roanoke River			
Assessment Unit	**Length (miles)**	**Boundaries of Impaired Segments**	**Cause**
VAW-L01R_RSF01A00	3.28[1]	South Fork Roanoke River mainstem extends from the PWS WQS upstream ending on downstream to the South Fork's confluence with the North Fork Roanoke River.	Fecal Coliform
VAW-L01R_RSF02A00	2.98[1]	South Fork Roanoke River mainstem segment extends from Shawsville STP downstream to the WQS designated PWS upstream ending.	
VAW-L01R_RSF03A00	6.37[1]	South Fork Roanoke River from the mouth of Elliott Creek downstream to the Shawsville STP.	*Escherichia coli*

[1]Segment was nested with applicable TMDLs during the 2010 303(d)/305(b) Integrated Report.

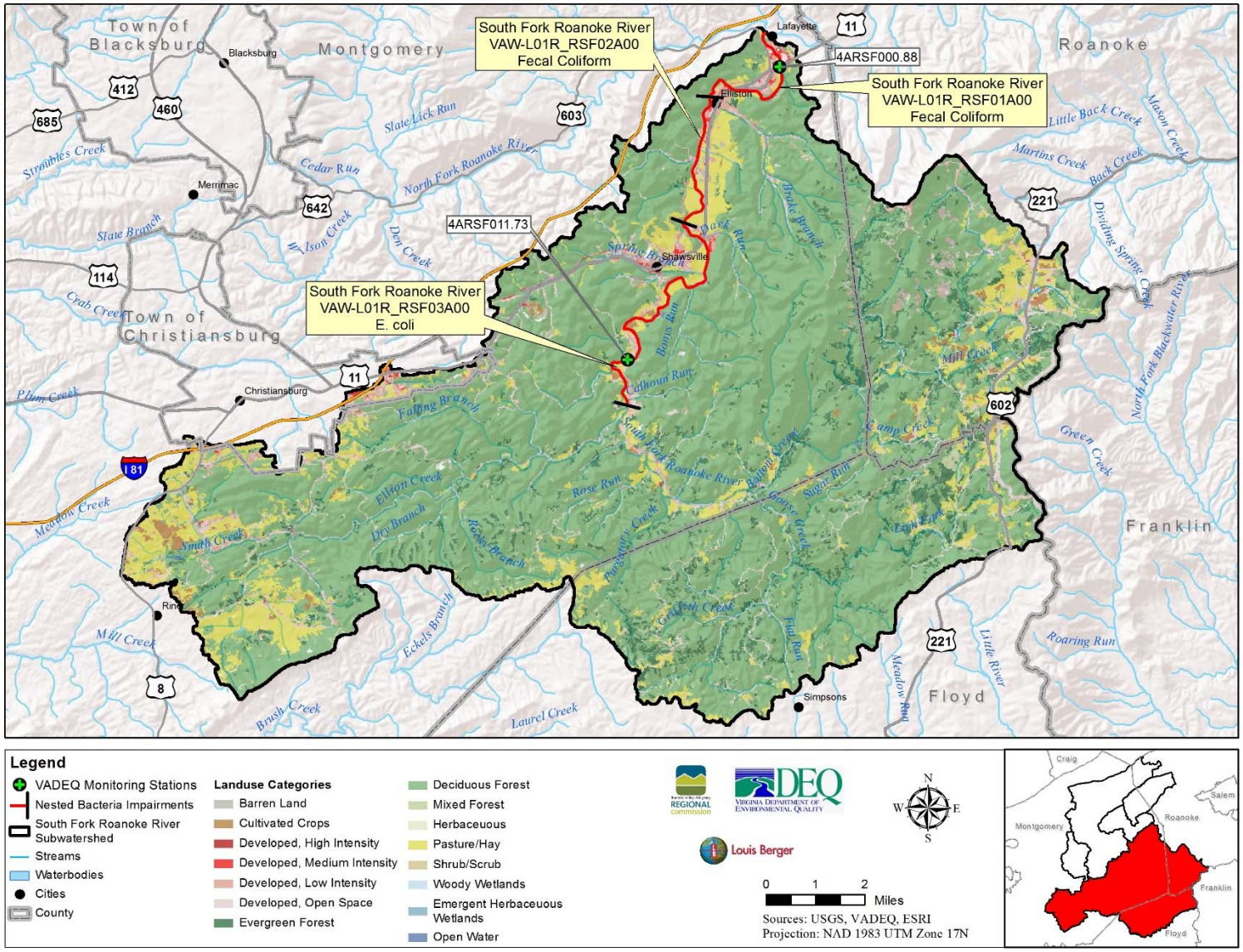


Figure 3-8. South Fork Roanoke River Subwatershed

Bacteria Sources

The primary contributor to bacteria loading in the South Fork Roanoke River subwatershed is nonpoint source runoff from developed and pasture/hay land uses as well as wildlife direct sources (Figure 3-9).

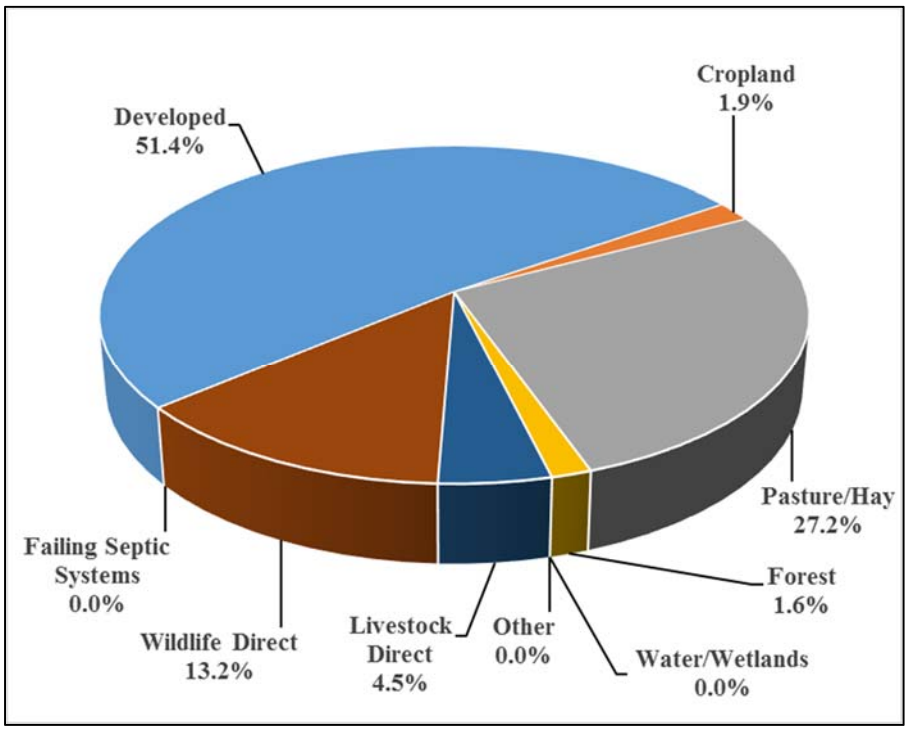


Figure 3-9. Bacteria Sources in South Fork Roanoke River Subwatershed

Bacteria Allocation Summary/Load Reduction

Reductions from bacteria sources are presented in the load allocation table for the South Fork Roanoke River subwatershed (Table 3-10).

Table 3-10: South Fork Roanoke River Load Allocation for *E. coli*

2006 Land Use/Source	Annual Average *E. coli* Loads (cfu/year)		Percent Reduction
	Existing	Allocation	
Developed	2.41E+14	5.44E+13	77%
Cropland	8.80E+12	8.80E+12	0%
Pasture/Hay	1.27E+14	2.88E+13	77%
Forest	7.56E+12	7.56E+12	0%
Water/Wetlands	4.26E+09	4.26E+09	0%
Other	-	-	-
Livestock Direct	2.10E+13	1.05E+12	95%
Wildlife Direct	6.19E+13	6.19E+11	99%
Failing Septic Systems	6.71E+10	0.00E+00	100%
Total	**4.68E+14**	**1.01E+14**	**78%**

3.2.5 Unimpaired North Fork Roanoke River (Unimpaired Watershed)

Description of Watershed and Impairment

The Unimpaired North Fork Roanoke River subwatershed is located downstream of the impaired segment of the North Fork Roanoke River and its' associated subwatershed (Figure 3-10). As the unimpaired segment flows east-northeast, several tributaries, including the impaired segment of Bradshaw Creek, join the North Fork Roanoke River before its confluence with the impaired segments of the South Fork Roanoke River. The unimpaired subwatershed has a drainage area of approximately 9,331 acres. The dominant 2006 NLCD land use is include forest (81%). Small amounts of pasture/hay (9%) are associated with the river and tributaries. Some developed land (9%) is found along the highway and associated with the community of Ironto.

The Unimpaired North Fork Roanoke River subwatershed is not impaired for bacteria and therefore, it does not have to meet bacteria TMDL reductions. Although the segment is currently not impaired, the Unimpaired North Fork Roanoke River subwatershed has been included in this TMDL IP because the land area was included in the 2006 bacteria TMDL (VADEQ, 2006a) and it is a potential contributor to bacteria loads in the river downstream. Incorporation in the IP will allow any future bacteria impairments in the unimpaired subwatershed to be addressed through implementation funding.

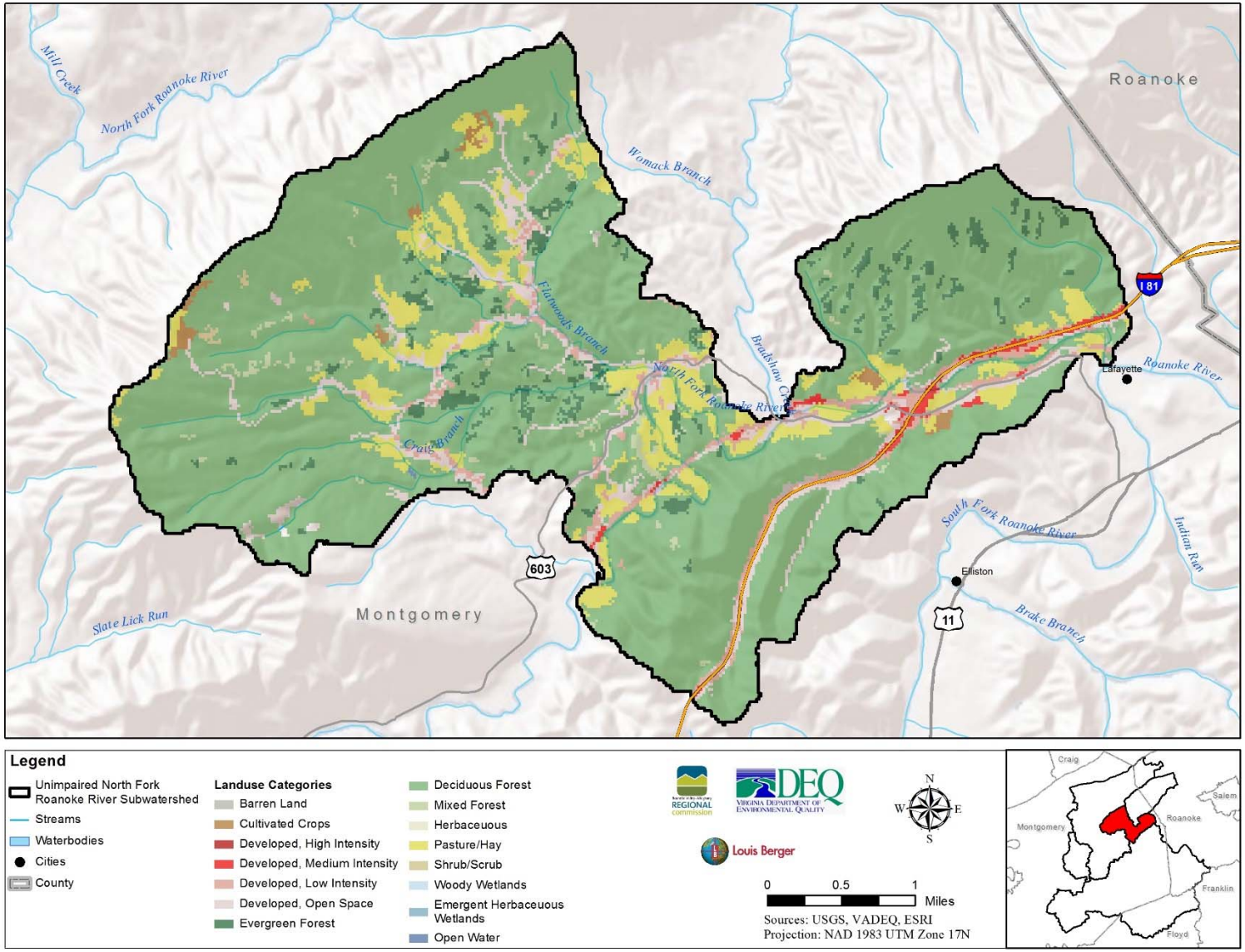


Figure 3-10. Unimpaired North Fork Roanoke River Subwatershed

3.3 Benthic TMDL Watershed

The study area for the benthic portion of this IP encompasses a previously developed benthic macroinvertebrate community TMDL (benthic TMDL) for the mainstem Roanoke River (VADEQ 2006b). The stressor analysis process, which is the process utilized during TMDL development to identify the cause of the benthic macroinvertebrate community impairment, resulted in sedimentation as the most probable cause. The resulting benthic TMDL defined sediment-impaired segments on the mainstem Roanoke River. For the Roanoke River TMDL IP Parts I and II, the benthic TMDL study area was not divided into smaller subwatersheds, as described for the bacteria impairment study area, because the TMDL-defined sediment impairments are along the mainstem Roanoke River and not in the tributary waterbodies. However, the inclusion of these tributaries and associated subwatersheds in the IP recognizes that even though the tributaries and upstream waterbodies, such as Part II subwatersheds, were not specifically identified as having a sediment impairment, they are contributing to the mainstem Roanoke River sediment load. In subsequent sections, the entire contributing benthic TMDL study area will be referred to as the benthic impairment watershed.

3.3.1 Description of Watershed and Impairment

The overall Roanoke River benthic impairment watershed delineated in the benthic TMDL includes sections of Roanoke, Montgomery, Floyd, and Botetourt Counties, as well as the Cities of Roanoke and Salem and portions of the Towns of Blacksburg and Christiansburg (Figure 3-11). The drainage area of this watershed is approximately 335,518 acres (525 square miles). The impaired segments are located on the mainstem of the Roanoke River and flow through the City of Roanoke.

The benthic TMDL study area was divided into two parts for the development of the Roanoke River TMDL IP. Part II of the IP is described in this document and prepares actions for the upper, or more upstream, portions of the total study area (Figure 3-11). The Part II benthic impairment study area includes portions of Floyd, Montgomery, and Roanoke Counties as well as the Towns of Blacksburg and Christiansburg. The drainage area of this watershed is approximately 174,644 acres (273 square miles).

The dominant land use types in this benthic impairment watershed are forest (78%) and pasture/hay (12%) with a small amount of developed land (8.6%). Forest land occurs throughout the watershed except within the Towns of Blacksburg and Christiansburg where developed land use dominates. Pasture/hay land use is present in the headwaters and valleys of the watershed (Figure 3-11).

The Roanoke River was first listed as impaired on Virginia's 1996 Section 303(d) TMDL Priority List and Report due to exceedances of Virginia's General Standard (benthic impairment). The benthic impairment within this IP includes six impaired segments totaling 11.3 miles (Table 3-11). The impaired segments are located downstream of the Part II watershed.

Table 3-11: Benthic Impairment Summary

Assessment Unit	Stream Name	Length (miles)	Boundaries of the Impaired Segments	Cause
VAW-L04R_ROA03A00	Roanoke River, Niagara	0.86	Roanoke River mainstem from near the backwaters of the Niagara Impoundment upstream to the end of the WQS designated public water supply (PWS section 6i) segment. The upstream ending of the PWS segment from SML 795 ft. pool elevation.	Sediment
VAW-L04R_ROA04A00	Roanoke River	0.25	Roanoke R. mainstem from near the backwaters of Niagara Impoundment upstream to the Tinker Creek confluence on the Roanoke River (section 6). The upstream ending of the WQS designated public water supply (PWS) segment from SML 795 ft. pool elevation.	
VAW-L04R_ROA05A00		0.35	Roanoke River mainstem from the Western Virginia Water Authority Roanoke Regional Water Pollution Control Plant downstream to the Tinker Creek confluence (WQS section 6).	
VAW-L04R_ROA06A00		4.33	Roanoke River mainstem from the Murray Run mouth downstream to the Western Virginia Water Authority Roanoke Regional Water Pollution Control Plant.	
VAW-L04R_ROA07A00		3.31	Roanoke River mainstem from the Peters Creek mouth downstream to the Murray Run confluence on the Roanoke River.	
VAW-L04R_ROA08A02		2.21	Roanoke River mainstem from the Mason Creek mouth downstream to the confluence of Peters Creek on the Roanoke River.	

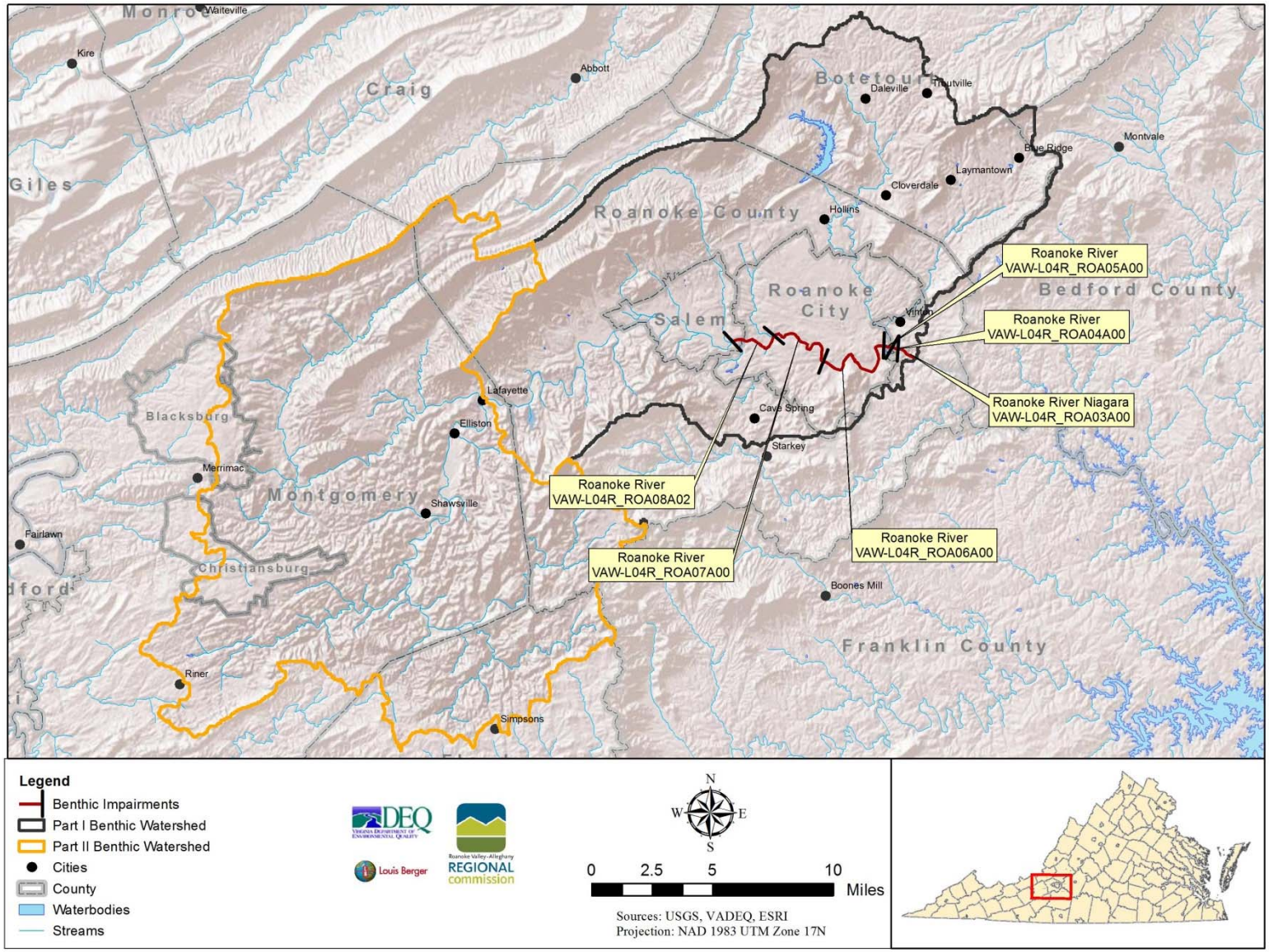


Figure 3-11. Benthic Impaired Segments and Watersheds in Part I and Part II

3.3.2 Stressor Analysis

During development of the Roanoke River benthic TMDL several water quality parameters were evaluated to determine the most probable stressor causing the impaired benthic macroinvertebrate community. These parameters included dissolved oxygen, temperature, pH, metals, and organic and other toxic compounds. Sediment was identified as the most probable stressor.

Habitat quality is evaluated using several components to determine an integrated habitat score. The scores for the Roanoke River impaired segments showed diminished habitat quality as evidenced by increased substrate embeddedness and minimal riparian vegetation. These observations in combination with other habitat component scores indicated that there was little stream protection from sediment entering the waterbody and increased sediment loading instream. In addition, higher water temperatures in the impaired reaches suggested the presence of developed land characterized by reduced riparian vegetation and more impervious surfaces. The many stormwater permits located in the City of Roanoke portion of the benthic impaired watershed further signified high stormwater runoff. The stressor analysis determined that excessive sedimentation was the primary stressor to the benthic community and the resulting TMDL study calculated necessary sediment load reductions for the Roanoke River.

Sediment is delivered to the Roanoke River through stormwater runoff, channel and streambank erosion, as well as background geological processes. Natural sediment generation is accelerated through land-disturbing activities related to agricultural, urban, and forest land uses. During rain events, exposed sediment particles can be dislodged from the soil and carried in runoff from both pervious and impervious surfaces within the watershed to the stream. Streambank instability from decreased riparian vegetation, increased stormwater runoff, and livestock trampling causes streambank failure and erosion and increases sediment loading. Sediment loading can also result from improperly installed or maintained erosion and sediment control practices.

3.3.3 Sediment Allocation Summary/Load Reduction

Sediment loads and allocations for Part II of the Roanoke River TMDL IP for the Roanoke River benthic impairments are based on the NLCD 2006 land use distribution and are presented in Table 3-12. These allocations were used as the basis for the sediment portion of the IP in the Roanoke River (VAW-L04R). The allocations include an overall 72% reduction in sediment loading to meet the TMDL endpoint; all land use sources except forest would require 75% reductions in sediment loading. Sediment from instream erosion also would need to be reduced by 75%. There are no loads from water/wetland land uses and therefore no reductions are required.

Table 3-12: Roanoke River Load Allocation for Sediment for Part II Watershed

2006 Land Use Category		Existing Load (tons/year)	Allocated Load (tons/year)	Percent Reduction
Land Sources	Developed	2,301	575	75%
	Cropland	983	245	75%
	Pasture/Hay	901	225	75%
	Forest	622	622	0%
	Water/Wetlands	-	-	-
	Other	514	128	75%
Instream Erosion		18,712	4,667	75%
Point Sources		320	320	0%
Total		**24,353**	**6,782**	**72%**

4.0 Public Participation

Public participation in the development of any watershed implementation plan is important in order to educate and inform the local stakeholders about the issues and to solicit input on appropriate solutions. Meetings with the public, steering committees, and working groups (agricultural, government, and residential) were held to achieve these goals. Table 4-1 shows the date of each meeting as well as the specific type, location, and number of attendees. Minutes and notes from the steering committee and working group meetings were available on online throughout the duration of Part II IP development and are presented in Appendix B.

Table 4-1: Meetings during Development of the Roanoke River TMDL Implementation Plan Part II

Date	Meeting Type	Attendance	Location
04/30/2015	Public Meeting #1	34	Meadowbrook Community Room, 267 Alleghany Spring Road, Shawsville, VA 24162
06/16/2015	Agricultural Working Group #1	9	Meadowbrook Community Room, 267 Alleghany Spring Road, Shawsville, VA 24162
06/16/2015	Residential Working Group #1	6	Meadowbrook Community Room, 267 Alleghany Spring Road, Shawsville, VA 24162
07/29/2015	Government Working Group #1	13	Town of Christiansburg Administration Building, 100 East Main Street, Christiansburg, VA 24073
12/03/2015	Residential Working Group #2 and Agricultural Working Group #2	14	Meadowbrook Community Room, 267 Alleghany Spring Road, Shawsville, VA 24162
03/16/2016	Steering Committee Meeting #1 and Government Working Group #2	12	Blacksburg Library, 200 Miller Street, Blacksburg, VA 24060
07/14/2016	Public Meeting #2	23	Meadowbrook Community Room, 267 Alleghany Spring Road, Shawsville, VA 24162

Stakeholders within a watershed include agencies, organizations, and individuals. Each of these stakeholders has knowledge and interest about existing watershed and water quality issues, conditions, resources, and management activities. By holding different types of meetings, each of these varied groups can provide their specialized input concerning the watershed and best management practices. The informational aspect of the meetings highlight the ongoing progress

in the development process as well as the resultant outcomes, thus allowing for public input at several levels of plan development. Public participation could lead to citizen involvement in the watershed cleanup process through knowledge about available pollutant prevention measures and local stakeholder attitudes.

4.1 Public Meetings

The first public meeting for the North and South Fork Roanoke River cleanup plan (Part II) was held on April 30, 2015 with 34 participants. The main objectives of the meeting were to provide background information on the development of cleanup plans; highlights from the Roanoke River TMDL Implementation Plan Part I including available BMPs, outreach efforts, and funding sources; the ongoing plan development process and progress; and kickoff Part II of the cleanup plan for the impaired segments on the North Fork and South Fork Roanoke Rivers. The presentation highlighted the pollutants (i.e., bacteria and sediment) and waters that need to be cleaned up. The Roanoke Valley Alleghany Regional Commission presented highlights of the Roanoke Valley Livability Initiative and the Roanoke River Blueway. Input, comments, and questions were solicited from the public and stakeholders and displays and informational materials were available. Questions from the public dealt with the types of waterbodies covered under the plan, development of pollutant reduction scenarios, and how funding is available to organizations and individual landowners. VADEQ discussed water quality monitoring and its' relationship to the 303(d) list. It was explained that BMPs are recommended practices to help a waterbody meet water quality standards. Working group information and sign-in sheets were also available.

VADEQ staff presents at the Final Public Meeting for the Roanoke River Cleanup Plan Part II.

The second public meeting for the Roanoke River watershed cleanup plan was held on July 14, 2016 with 23 participants. The meeting began with a description of the overall importance of clean water and the role of TMDLs followed by a review of the project history and the associated bacteria and sediment impairments. The main objective of the meeting was to present to the public the draft Roanoke River TMDL implementation plan Part II including proposed BMPs, outreach efforts, and funding sources. VADEQ showed video presentations highlighting the benefits and drawbacks of cattle exclusion fencing and livestock health concerns related to polluted water. Input, comments, and questions were solicited from the public and stakeholders and displays and informational materials were available showing the watersheds and impaired waters. Questions from the public dealt with funding sources (specifically the Water Quality Improvement Fund), pharmaceuticals in drinking water, *E. coli* water quality standards, testing for heavy metals, bacteria sources, cattle exclusion fencing and fencing maintenance. Concerns were raised regarding the problems caused by streamside vegetation during and after flood events. VADEQ discussed water quality monitoring and monitoring stations, and their relationship to water quality standards. It was explained that BMPs are recommended practices to help a waterbody meet water quality standards and the reasons certain BMPs are used in particular land uses.

4.2 Agricultural/Residential Working Groups Meetings

The agricultural and residential working groups meetings were held on June 16, 2015 with 15 participants and December 3, 2015 with 14 participants. The working groups were given background information on the Roanoke River implementation plan Part II and the IP process. Overall, meeting participants mentioned that there is a lack of interest as well as knowledge on the importance of water quality issues throughout the watershed. The residential working group discussed sewer and on-site sewage disposal systems including known problem areas, pet waste issues, and stormwater issues. In terms of on-site sewage disposal systems, group attendees conveyed concerns regarding the lack of ordinances requiring septic system maintenance, the percentage of homes on sanitary sewer, the known areas with septic system problems, and cost-share options and other funding for tying in to local sewer systems. Aging sewer systems, leaking sewers, and sewer overflows were also discussed. Some localities in the watershed have stormwater utility fees and discussion included the relationship between the fees and the

implementation plan. Development negatively affects water quality by increasing impervious surfaces and concerns were expressed over stormwater regulations. Although bank erosion is problematic along some stream reaches, it was noted that landowners may be hesitant to install stream restoration or bank stabilization measures. Group attendees reported that citizens might be less likely to use pet waste stations in more rural areas or where yards are fenced. They also mentioned that pet waste composters are a new concept to the area and might have the same usage issue as pet waste stations.

In terms of the agricultural discussion, members expressed concerns with tracking non-cost share agricultural practices, and discussed the various BMPs to consider in the plan and the cost-share and stipulations associated with the BMPs. Concern was expressed over the limitations of cost-share programs with regard to livestock exclusion fencing and non-traditional agriculture, as well as the physical limitations of implementing this BMP in areas with steep slopes. Stakeholders discussed the amount of land in cropland, sod, livestock production, and non-traditional operations. Outreach and education on proposed agricultural cleanup plan practices and activities were discussed. An overall issue throughout the watershed is the limited funding and resources available to evaluate and address the water quality issues and solutions.

Louis Berger staff presents background information to the Agricultural and Residential Working Group.

Over the course of the two meetings, the agricultural and residential working groups made recommendations for each of the areas of discussion. Education and outreach were some of the primary recommendations from these working groups. Attendees suggested the IP include education and outreach for septic system maintenance, pet waste water quality issues, and "scoop the poop" campaigns as well as the proper methods of pet waste disposal. For sewer systems, they suggested prioritizing sewer connections with the limits of the Towns of Blacksburg and Christiansburg. For pet waste, participants discussed the difficulty of persuading the public in more residential and rural areas to pick up after pets. The group reviewed proposed pet waste stations and suggested additions. It was suggested that pet waste composters could be used at places that house large numbers of dogs such as kennels and hunt clubs and outreach could be available at pet stores and veterinary offices. The general outreach methods recommended for septic and pet waste were mailings, municipal websites, community events, local newspapers, farmers markets, schools, Ruritan Club, Isaac Walton League, homeowners associations, and developers. The group proposed incentivizing outreach by providing a participant with a free pet waste composter, pet waste bag holder, or rain barrel following completion of an online questionnaire on water quality issues and control. Attendees mentioned that there are erosion and sediment control issues in the watershed especially in areas with steep slopes. It was suggested that a good way to educate the public about erosion and sediment control issues is by having landowners speak about their experiences with restoration work as well as implementing cooperative efforts among municipal and other local entities. Stakeholders said that some existing stormwater BMPs are degrading providing opportunities for BMP retrofits. Partnerships with existing organizations, agencies, educational institutions, and public interest groups were suggested to aid in implementation of the cleanup plan and the proposed BMPs.

The agricultural recommendations included addressing non-traditional farming constituents and providing clarity on cost-share money availability and requirements. Although many larger farms already work with local soil and water conservation districts (SWCDs) on BMPs and understand the benefits, some newer agricultural entities including the non-traditional and hobby farmers may need this information. Participants mentioned various construction projects that could be a source of sediment in the watershed and recommended these as areas to focus sediment and erosion control efforts. Possible areas for manure management include dairy and

beef operations. The working group meeting notes and the working group reports to the steering committee are included in Appendix B.

4.3 Government Working Group Meetings

The government working group meetings were held on July 29, 2015 with 13 participants and March 16, 2016 with 12 participants. Background information on the Roanoke River implementation plan Part II project was presented to the working group. The discussions focused on several broad topics initially introduced in the other working groups including on-site sewage disposal systems, pet waste, stream restoration, stormwater programs, and agricultural programs. Data was requested from localities regarding existing BMPs including type, age, location, and drainage area, size, or length. Government working group participants helped identify potential partnerships and funding sources, identified additional programs, technical resources, regulatory controls, and partner agencies for water quality improvement efforts. As with the other working groups, the main concerns and discussion topics revolved around education and outreach, BMP maintenance, and the lack of funding and resources.

For onsite sewage disposal systems, discussion specifically surrounded outreach and education for septic system maintenance, existing sewer systems and associated connection requirements; revision of estimated numbers of septic, sewer, and straight pipes; and the presence of karst topography throughout the watershed and how this affects water quality and BMPs. Sewer overflows and limited inspection personnel were highlighted as a problems and it was noted that it would be difficult to expand connections to existing sewer systems due to wastewater treatment plant capacity. For pet waste, the discussion focused on the fact that there are not very many areas where pets are concentrated in the watershed and therefore locations for pet waste stations. Stormwater related topics discussed included the retrofitting of detention ponds, the importance of karst topography present in the area, street sweeping, and stormwater utility fees. Also, stream restoration and stabilization options and required permitting were discussed. The agricultural concerns included the inefficiency of riparian buffers in mountainous areas, the use of critical area acreage is usually low, and installation of BMPs in Bradshaw Creek subwatershed will be difficult. Additionally, there was also discussion on funding issues including landowners' fears of losing control of land if they participate in government-sponsored BMP funding

programs and that funding is no longer available through the United States Fish and Wildlife Service (USFWS) Landowner Incentive Program.

During and after much discussion, the government working group made recommendations to the steering committee. For on-site sewage disposal systems, the group said that public education about sewer and septic issues is necessary and provided several suggestions including municipal mailings and public events. Other specific items included revision of sewage disposal numbers for Floyd County, increased proposal of alternative waste treatment systems due to underlying karst, and further assessment of funding options for sewage management in low-income areas. For pet waste, the group concluded that pet waste education through the proposed education campaign is necessary in all areas of the watershed including the Unimpaired North Fork Roanoke River subwatershed and that pet waste composters should be proposed in the plan. For stream restoration, the group stated that the plan should incorporate streambank stabilization BMPs because these are more appealing to agricultural landowners than stream restoration projects. The group mentioned that opportunities are present in the North Fork Roanoke River subwatershed, especially for bank stabilization, but that there is a need for targeted grant funds for these projects.

For stormwater, the group requested that the plan include street sweeping and the need to obtain specific sweeping data from localities. Additionally, cisterns should be added to the proposed stormwater BMPs. Meeting participants discussed and confirmed or revised the appropriate numbers of each proposed BMP. Soil type and drainage characteristics were taken into account during the discussion. For agricultural programs, the group said that there is a need for top-of-bank fencing and interior fencing BMPs in mountainous areas because of the inefficiency of riparian buffer in those areas and the inclusion of the Woodland Buffer Filter Area (FR-3) BMP. Meeting participants suggested specifically targeting Wilson Creek for proposed agricultural BMPs. A large part of the discussion centered on the appropriate costs for the agricultural BMPs. Lastly, wet ponds were recommended to only be implemented on pasture in the last implementation stage due to high costs. Education and outreach were recommended for all BMP categories including pet waste and septic system maintenance. Suggested methods included presenting information at events throughout the watershed and mailing included with utility bills.

Meeting notes and working group recommendations by the government working group are included in Appendix B.

4.4 Steering Committee Meetings

The first steering committee meeting was held on March 16, 2016 with 12 participants. This meeting was held in conjunction with the second Government Working Group meeting. A summary of the working group reports was presented including concerns and recommendations from each group. A draft of proposed BMP numbers and costs were presented to the steering committee. Discussion considered the proposed types, numbers, and costs of the BMPs and suggested revisions when necessary. Additionally, the conversation touched on funding, potential partner organizations, and the roles and responsibilities of stakeholders. Specific discussion topics and recommendations are the same as those highlighted in the government working group meeting section.

5.0 Implementation Actions

Due to the detailed TMDL analysis and the high degree of complexity of the Roanoke River watershed and its impairments, implementation actions necessary to reduce the bacteria and sediment loads were identified through extensive stakeholder input, public participation, and review of land use/source data and pollutant delivery mechanisms. This chapter focuses on the controllable sources of bacteria and sediment loadings in the watershed. These controllable sources include direct deposition of bacteria by livestock, overland runoff from agricultural land (cropland and pasture), overland runoff from residential and urban land, failing septic systems and straight pipes, and streambank erosion. Described in this chapter are the following topics:

- Selection and quantification of appropriate implementation actions to reduce bacteria and sediment loading
- Steps needed toward meeting water quality standards
- Associated costs and benefits of the actions associated with implementing agricultural, residential, and urban BMPs (both municipal separate storm sewer system [MS4] and non-MS4) and technical assistance associated with implementing agricultural, residential, and non-MS4 urban BMPs.

The following chapter (Chapter 6) provides the IP actions in succession for each watershed among three stages as an iterative process toward meeting water quality goals.

5.1 Identification of Control Measures

Proposed measures to control bacteria and sediment were identified through multiple sources. Several BMPs were suggested in the original TMDL reports including livestock exclusion, septic system BMPs, riparian buffers, and pet waste management (VADEQ 2006a, 2006b). Appropriate control measures were also identified through review of published materials such as stormwater BMP literature and the Virginia Agricultural Cost Share BMP Manual. Stakeholders at working group meetings provided input on existing and potential control measures. Additionally, some measures have been proposed based on existing Virginia TMDL IPs with similar watershed conditions.

Quantifiable BMPs proposed in this IP are listed in Table 5-1 grouped by land use (i.e., agricultural, residential, or urban) or pollution source associated with the BMPs. Also listed are sediment and bacteria removal efficiencies of each BMP and associated source documents.

Table 5-1: Best Management Practice Efficiency

BMP Type	BMP	Sediment Removal Efficiency (%)	Bacteria Removal Efficiency (%)	Reference (Sediment/ Bacteria)
Agricultural				
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	56	100	1/2
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	56	100	1/2
	Livestock Exclusion with Riparian Buffers (LE-1T)	56	100	1/2
	Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	56	100	1/2
	Small Acreage Grazing System (SL-6AT)	56	100	1/2
	Stream Protection/Fencing (WP-2/WP-2T)	56	100	1/2
Pasture	Vegetative Cover on Critical Areas (SL-11)	75	75	3
	Reforestation of Erodible Pasture (FR-1)	LU Conversion	LU Conversion	N/A
	Woodland Buffer Filter Area (FR-3)	70	57	3
	Pasture Management (EQIP 528, SL-10T)	30	50	4
	Grazing Land Management (SL-9)	30	50	4
	Wet Detention Pond for Pastureland	50	70	5
Cropland	Continuous No-Till (SL-15)	70	70[1]	3
	Small Grain Cover Crop (SL-8)	20	20	4
	Permanent Vegetative Cover on Cropland (SL-1)	75	75	3
	Sod Waterway (WP-3)	50	50	3
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	50	50	3
Residential				
Waste Treatment	Septic System Pump-Out (RB-1)	N/A	5	3
	Sewer Connection (Targeted Areas and RB-2)	N/A	100	2
	Repaired Septic System (RB-3)	N/A	100	2
	Septic System Installation/Replacement (RB-4, RB-4P)	N/A	100	2
	Alternative Waste Treatment System Installation (RB-5)	N/A	100	2
Pet Waste	Pet Waste Composter	N/A	99	2
	Pet Waste Education Campaign	N/A	50	6
	Pet Waste Station	N/A	Included in Pet Waste Education Campaign	N/A
Urban				
Stormwater	Rain Barrel	6	N/A	7
	Permeable Pavement	80	N/A	5
	Infiltration Trench (including Retrofit)	75	90	5/8
	Bioretention	70	90	5/9
	Rain Garden	70	70	10
	Vegetated Swale	65	0	5
	Constructed Wetland (including Retrofit)	50	80	5
	Manufactured BMP[2]	80	80	4
	Cistern	12	N/A	7
	Detention Pond	50	30	5
	Riparian Buffer: Forest	70	57	3
	Riparian Buffer: Grass/Shrub	50	50	3
Other	Street Sweeping	Variable[3]	5.50E+08[4]	11

Table 5-1: Best Management Practice Efficiency				
BMP Type	**BMP**	**Sediment Removal Efficiency (%)**	**Bacteria Removal Efficiency (%)**	**Reference (Sediment/ Bacteria)**
	Stream Restoration	310 pounds /feet/year	N/A	Stakeholder Input
	Stream Stabilization	25.5 pounds /feet/year	N/A	12

LU – Land use
CREP – Conservation Reserve Enhancement Program
[1]Based on sediment reduction
[2]Manufactured BMPs or manufactured treatment devices (also referred to as proprietary treatment devices) are commercial products fabricated in manufacturing facilities that provide stormwater pollution treatment. Some examples include hydrodynamic separators and filters. (Source: VA Stormwater BMP Clearinghouse).
[3]Based on type of sweeping
[4]cfu per curb mile per year

BMP References (see column to the right):

1. Rivanna River Basin Commission. 2012. Moores Creek Bacteria Implementation Plan 2012 Update.
2. Removal efficiency is defined by the practice.
3. VADCR. 2003. Virginia Guidance Manual for Total Maximum Daily Load Implementation Plans. Available at: *http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/ipguide.pdf*
4. USEPA-CBP. 2006. Nonpoint Source Best Management Practices that have been Peer-Reviewed and CBP-approved for Phase 5.0 of the Chesapeake Bay Program Watershed Model, Revised 02/09/2011.
5. VADEQ. 2013. Virginia Stormwater Management Handbook. Available at: *http://www.deq.virginia.gov/fileshare/wps/2013_SWM_Handbook/*
6. 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. 112p.
7. James River Association. 2013. Linking Local TMDLs to the Chesapeake Bay TMDL in the James River Basin. Prepared by The Center for Watershed Protection. Available at: *http://www.jamesriverassociation.org/what-we-do/LinkingLocalTMDLstotheBayTMDL.pdf*
8. USEPA.2014. Best Management Practices: Infiltration Trench. Accessed on 1/20/2014 at: *http://water.epa.gov/polwaste/npdes/swbmp/Infiltration-Trench.cfm*
9. USEPA.2014. Best Management Practices: Bioretention. Accessed on 1/20/2014 at: *http://water.epa.gov/polwaste/npdes/swbmp/Bioretention-Rain-Gardens.cfm*
10. Hunt, W.F., J.T. Smith, and J. Hathaway. 2007. City of Charlotte Pilot BMP Monitoring Program, Mal Marshall Bioretention Final Monitoring Report. Prepared for the City of Charlotte.
11. VADCR. 2010. South River and Christians Creek Water Quality Improvement Plan.
12. VADCR. 2013. Spout Run Water Quality Improvement Plan.

The BMP pollutant reduction efficiency values reported in Table 5-1 are averages and are subject to revision based on actual conditions present at the sites where each BMP is implemented. This is a planning level document and more accurate reduction efficiencies would be dependent on site conditions, BMP design and implementation. Additional information pertaining to stormwater BMPs can be found on the Virginia Stormwater BMP Clearinghouse (*http://www.vwrrc.vt.edu/swc/*) and the Virginia Stormwater Management Handbook (*http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/Publications.aspx*) websites.

Some BMPs identified during the IP development process could not be quantified for various reasons. These BMPs are discussed in more detail in Section 5.3.

5.2 Quantification of Control Measures

The first step in the process to determine the number of each type of BMP was to identify existing BMPs and determine if they were established prior to 2003 or after 2003. The BMPs that were implemented before 2003 and their associated removal of pollutant loads were already taken into account in the development of the previous fecal coliform bacteria and sediment TMDLs for the Roanoke River and tributaries. The data for a majority of the existing BMPs provided a date of installation, however several did not. According to the BMPs with installation dates, there are no BMPs in the TMDL IP Part II watershed that were established before 2003. To account for some pollutant reduction benefit from the existing stormwater BMPs without installation dates, VADEQ and stakeholders agreed that reductions from these existing BMPs should be included but using an alternate pollutant reduction efficiency. The pollutant reduction efficiencies for BMPs without installation dates were represented as 50% of the efficiency reported in Table 5-1. It was assumed that this was a conservative and reasonable method to account for existing BMPs in the IP.

Following identification of existing BMPs and the assessment of their pollutant removal capabilities, additional BMPs were recommended to achieve the TMDL pollutant reduction goals. The quantification procedures for proposed agricultural, residential, and urban land use BMPs are detailed below. Specific locations for the proposed BMPs were not determined in this IP. Instead the approach proposed a specific suite of recommended BMPs based on land use (in

the form of unit area pollutant loadings) and stakeholder input. Site-specific analysis is required prior to the siting, design, and implementation of the proposed BMPs.

The BMPs proposed in the following sections will address both bacteria and sediment pollution in the Roanoke River TMDL IP Part II watershed. The BMPs were quantified to meet both the bacteria and sediment reductions called for in the TMDLs. In this analysis, bacteria loads required greater reductions than sediment loads needed to meet the TMDLs.

5.2.1 Agricultural Control Measures

This section depicts the BMPs associated with agricultural activities. The following section will summarize the existing and proposed livestock exclusion BMPs, pasture BMPs, and cropland BMPs needed to meet the bacteria and sediment reductions called for in the TMDLs.

5.2.1.1 Existing Agricultural BMPs

In the time period between the development of the TMDL and the Part II TMDL IP, agricultural BMPs have been implemented in three subwatersheds, Bradshaw Creek, North Fork Roanoke River and South Fork Roanoke River. Table 5-2 presents the BMPs implemented after the TMDL modeling period (post-TMDL development) and includes Harvestable Cover Crop/Small Grain Cover Crop for Nutrient Management (SL-8), Aforestation of Erodible Crop and Pastureland (FR-1), CREP Riparian Forest Buffer Planting (CRFR-3), Permanent Vegetative Cover on Critical Areas (SL-11), Livestock Exclusion with Reduced Setback (LE-2), and Stream Exclusion with Grazing Land Management (SL-6).

Table 5-2: Existing Agricultural BMPs

Existing Agricultural BMP	Bradshaw Creek			North Fork Roanoke River			South Fork Roanoke River		
	Total Acres Installed	Total Acres Benefited	Stream Length Installed (ft)	Total Acres Installed	Total Acres Benefited	Stream Length Installed (ft)	Total Acres Installed	Total Acres Benefited	Stream Length Installed (ft)
Cropland BMPs									
Harvestable Cover Crop/Small Grain cover crop for Nutrient Management (SL-8)	-	-	-	-	-	-	288.3	-	-
Pasture BMPs									
Aforestation of erodible crop and pastureland (FR-1)	-	-	-	-	-	-	1.5	-	-
CREP Riparian Forest Buffer Planting (CRFR-3)	-	-	-	26.5	182.6	-	0.4	-	-
Permanent vegetative cover on critical areas (SL-11)	-	-	-	-	-	-	1.3	-	-
Stream Exclusion BMPs									
Livestock Exclusion with Reduced Setback (LE-2)	-	-	-	-	-	-	-	1.0	3947
Stream Exclusion With Grazing Land Management (SL-6)	-	45.6	1260	-	472.9	26197	-	737.84	29228
Stream Stabilization									
Streambank Stabilization - Length (feet)	-	-	-	-	25.5	1119	-	-	-
Bacteria Reduction From Existing BMPs (cfu/year)	2.04E+10			1.57E+12			6.87E+11		
Sediment Reduction From Existing BMPs (ton/year)	1.0			29.0			51.5		

5.2.1.2 Proposed Livestock Exclusion and Pasture BMPs

The existing BMPs associated with livestock exclusion and pasture land are summarized in Section 5.2.1.1.

Livestock exclusion BMPs proposed in this IP include CREP Livestock Exclusion (CRSL-6), Livestock Exclusion with Grazing Land Management (SL-6/SL-6T), Livestock Exclusion with Riparian Buffers (LE-1T), Small Acreage Grazing System (SL-6AT), Livestock Exclusion with Reduced Setback (LE-2/LE-2T), and Stream Protection/Fencing (WP-2/WP-2T). The overall length of all livestock exclusion systems proposed throughout the Roanoke River watershed was determined using a geographic information system (GIS) spatial analysis of aerial imagery, land use (NLCD 2006), and National Hydrography Dataset stream layers as well as consultation with partners such as the SWCD. Using data from the NLCD 2006 land use layer and the aerial imagery, the length of perennial and intermittent streams with and without adequate riparian buffer was analyzed for all obvious pasture areas. Next, a distribution percentage for each type of livestock exclusion BMP was determined based on guidance from Natural Resources Conservation Service (NRCS) and SWCD, with specific percentages identified for several subwatersheds. These percentages ranged from 10% for CREP Livestock Exclusion; 38% for Livestock Exclusion with Grazing Land Management; and 5% each for Small Acreage Grazing System, Livestock Exclusion with Reduced Setback, and Stream Protection/Fencing. In each subwatershed, the length of each proposed BMP was calculated by multiplying the overall length of all proposed livestock exclusion systems (as described above) by the appropriate distribution percentage. This length was then divided by the average length (based on local practices as reported by the VADCR Agricultural BMP Database) of each livestock exclusion system BMP to arrive at the number of each type of livestock exclusion BMP proposed for each subwatershed (Table 5-3). The average length of each livestock exclusion system was calculated from the lengths of the existing systems within the Upper Roanoke River watershed.

Example of Livestock Exclusion

(Photograph courtesy of USFWS)

Table 5-3: Proposed Livestock Exclusion BMPs (systems)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total
CREP Livestock Exclusion (CRSL-6)	3	10	10	3	1	27
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	12	38	38	10	5	103
Livestock Exclusion with Riparian Buffers (LE-1T)	12	38	39	11	5	105
Small Acreage Grazing System (SL-6A)	2	5	5	1	1	14
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	2	5	5	1	1	14
Stream Protection/Fencing (WP-2/WP-2T)	2	5	5	1	1	14

The quantification of acres installed for the proposed pasture BMPs (Table 5-4) was based on the area of pasture located within each subwatershed and the pollutant reductions required from this land use. Vegetative Cover on Critical Areas (SL-11) was proposed for 5% to 30% of the pasture land; Reforestation of Erodible Pasture (FR-1) was proposed for 5% to 10% of pasture; and Woodland Buffer Filter Area (FR-3) was proposed for 5% of pasture. Pasture Management

(EQIP 528, SL-10T) was applied to the remaining acreage. Wet detention ponds, quantified as acres treated, were proposed if the necessary pollutant reductions on pasture land use could not be accomplished through the other BMPs.

Table 5-4: Proposed Pasture BMPs (acres-installed)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total (acres-installed)
Vegetative Cover on Critical Areas (SL-11)	36	2,208	2,587	41	145	5,017
Reforestation of Erodible Pasture (FR-1)	37	818	958	43	81	1,937
Woodland Buffer Filter Area (FR-3)	36	368	431	41	36	912
Pasture Management (EQIP 528, SL-10T)	177	7,360	8,622	411	727	17,297
Grazing Land Management (SL-9)	176	176	176	176	176	880
Wet Detention Pond (acres treated)	0	3,800	1,720	0	330	5,850

5.2.1.3 Cropland BMPs (Existing/Proposed)

Cropland BMPs reported in the DCR Agricultural BMP Database are present in the South Fork Roanoke River subwatershed (Table 5-2). The bacteria and sediment reductions resulting from the post-TMDL development BMPs were calculated using the acreage in which the practice was installed, the amount of pollutant produced by each acre, and the pollutant reduction efficiency of the BMP.

For South Fork Roanoke River, pollutant load reductions from the existing cropland BMPs were quantified and then subtracted from the pollutant load reductions called for in the TMDLs prior to proposing new cropland BMPs. The acres installed for each proposed cropland BMPs (Table 5-5) was based on the amount of cropland located within each subwatershed and the pollutant reductions required from this land use. Continuous No-Till and Small Grain Cover Crop BMPs were the primary BMPs proposed for pollutant reductions from cropland. If the pollutant load reductions could not be met from the first two BMPs, other cropland BMPs were proposed using the following percentages: Permanent Vegetative Cover on Cropland on 5% of cropland area, Sod Waterway on 5% of cropland area, and Cropland Buffer/Field Borders on 5% of cropland area.

Table 5-5: Proposed Cropland BMPs (acres-installed)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total (acres-installed)
Continuous No-Till (SL-15)	41	253	662	51	26	1,033
Small Grain Cover Crop (SL-8)	48	283	452	57	30	870
Permanent Vegetative Cover on Cropland (SL-1)	2	15	39	3	2	61
Sod Waterway (WP-3)	2	15	39	3	2	61
Cropland Buffer/Field Borders (CP-33 and WQ-1)	2	15	39	3	2	61

5.2.2 Residential Bacteria Control Measures

5.2.2.1 Failing Septic Systems, Straight Pipes, Sewer Connections

Western VA Water Authority Sewerline Connection
(Photograph courtesy of WVWA)

BMPs available to address failing septic and sewer systems consist of septic system pump-outs (RB-1), sewer connections (targeted areas and RB-2), septic system repairs (RB-3), septic system installation or replacement (RB-4, RB-4P), and alternative waste treatment system installation (RB-5). Quantification of the existing residential sewage disposal methods was based on a spatial analysis using data on the buildings in each subwatershed, the extent of the sewer system, the stream network, and the application of a variable percentage of failing septic systems (including straight pipes) (VADEQ, 2006a; Stakeholder Data). The spatial data provided by the Town of Blacksburg and Montgomery County specified whether the building was on septic or sewer. The quantification process assumed that all houses in Floyd County and Roanoke County within the Part II watershed use septic systems; this assumption was confirmed by stakeholders. A spatial analysis of the sewer line and building layers revised the number of homes on sewer so that only homes adjacent to a sewer line were considered to be on sewer. Existing straight pipe numbers were estimated using a percentage (0.45%) of houses within 200 feet of the stream as reported for Montgomery County in the *Bacteria TMDLs for Wilson Creek, Ore Branch, and Roanoke River Watersheds, Virginia* (VADEQ, 2006a).

The quantification of the proposed residential waste treatment BMPs used the estimated numbers of existing houses on sewer, septic, and straight pipes as well as the estimated number of failing septic systems. The percentage of failing septic systems was estimated as 3% of existing septic systems (VADEQ, 2006a). It was agreed upon by stakeholders that 10% of the total existing number of households on septic systems should be pumped out (RB-1). The number of proposed

residential waste treatment systems were calculated using implementation percentages derived from input from the Virginia Department of Health. These percentages were then applied to the estimated number of failing septic systems in each subwatershed. Therefore, 45% of failing septic systems were proposed for septic repair (RB-3), 45% for septic install/replace (RB-4, RB-4P), and 10% for alternative waste treatment systems (RB-5). Corrections to straight pipes are included under the septic install/replace category (RB-4, RB-4P).

Quantification of sewer connection (RB-2) as a BMP was based on consultation with the Virginia Department of Health and stakeholders using a targeted approach to tackle areas with previous or existing septic problems. Only small portions of the South Fork Roanoke River, North Fork Roanoke River, and Wilson Creek subwatersheds are connected to the sewer system. The Bradshaw Creek and Unimpaired North Fork Roanoke River subwatersheds are too rural for any sewer connections and there are no existing sewer systems within the subwatersheds for potential expansion. Stakeholders indicated that the sewer treatment plant(s) in Montgomery County are at capacity. This affected the number of sewer connections proposed in the South Fork Roanoke River subwatershed. Specific areas mentioned by stakeholders for potential sewer connection include areas on the periphery of the Town of Blacksburg and Shawsville.

Table 5-6 details the number of septic system pump-outs, sewer connections, septic system repairs, new septic systems (install/replace), and alternative waste treatment systems for each subwatershed.

Table 5-6: Proposed Sewage Disposal BMPs (systems)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total
Total Septic Pump-out (RB-1)	58	203	416	31	71	779
Sewer Connection (Target Areas and RB-2)	N/A	25	11	N/A	13	49
Total Septic Repair (RB-3)	8	27	56	4	9	105
Total Septic Install /Replace (RB-4, RB-4P)	9	30	62	4	10	116
Total Alternative Waste Treatment System (RB-5)	2	6	12	1	2	23

5.2.2.2 Pet Waste Reduction

Pet Waste Station
(Photograph courtesy of Scoopmasters.com)

BMPs proposed to reduce pet waste include pet waste stations, pet waste composters, and pet waste education campaigns. There are no existing pet waste stations within the Part II watershed but municipalities and counties in the watershed support online education aimed at cleaning up pet waste. Several homeowner associations and neighborhoods have also initiated campaigns encouraging residents to pick up pet waste including education, outreach, signage, and/or stations.

Pet waste composters are in-ground pet waste disposal systems that function similar to a household septic system. Pet waste composters are most appropriate for pet owners that have small lots and live in an urban area with limited outdoor space for pets. The unit requires the addition of water and a digester enzyme mixture to break down dog waste into a liquid that is released to and absorbed by the underlying soil. Pet waste composters were proposed for 15% of pet-owning households for the Wilson Creek subwatershed and for 5% of pet-owning households for Bradshaw Creek, North Fork Roanoke River, South Fork Roanoke River, and the Unimpaired North Fork Roanoke River subwatersheds. The bacteria reduction efficiency for composters was added to the pet waste education campaign reduction efficiency.

Typical pet waste stations include pet waste trash bags, bag dispenser, a steel trashcan for waste disposal, and signage directing citizens about the importance of picking up after pets. The pet waste stations proposed in this IP include a supply of bag refills for a five year period. This plan focused on placing pet waste disposal stations in locations where there is the likelihood of pet presence. Stakeholders recommended pet waste stations at parks, trails, buildings (e.g., apartments, hotels, and restaurants), neighborhoods, and other developed sites. The strategy for placing pet waste stations was to install one station at each park, trail, and pet-friendly apartment, hotel, or rest stop within the Roanoke River watershed. If the park, trail, or neighborhood was of

a larger size, then additional pet waste stations were proposed. Appropriate areas for pet waste stations were determined through GIS analysis and stakeholder suggestions.

Lastly, it was assumed that a total of four pet waste education campaigns, or one pet waste education campaign per subwatershed, would be appropriate and feasible. The Unimpaired North Fork Roanoke River subwatershed would be included in the campaign for North Fork Roanoke River. The campaigns will include installation of signage in residential areas reminding citizens to pick up after their pets because of the water quality issues in the watershed, flyers mailed to residents explaining the detrimental effects of not picking up after pets, targeted campaigns at veterinarian clinics and kennels, and outreach through animal control officers and parks and recreational staff. Table 5-7 details the number of pet waste education campaigns, and proposed pet waste stations and pet waste composters for each subwatershed.

Table 5-7: Proposed Pet Waste BMPs (units)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total
Pet Waste Education Campaign	1	1	1	Included in North Fork Roanoke River campaign	1	4
Pet Waste Composter	11	43	87	6	98	243
Pet Waste Station	0	3	6	1	15	25

5.2.3 Urban Control Measures (Existing/Retrofits/Proposed)

5.2.3.1 Stormwater

When it rains, runoff from impervious surfaces, i.e. roads, parking lots, and sidewalks, picks up pollutants such as bacteria and sediment along the way. In addition, impervious surfaces lead to increases in the velocity of water entering streams which in turn causes increased stream erosion. Stormwater BMPs consist of practices which mitigate these impacts by filtering and storing stormwater runoff before it reaches surface waters. In the Roanoke River TMDL IP Part II, both water quantity and water quality need to be addressed by implementing stormwater BMPs. Some BMPs such as rain barrels and rain gardens work on a small scale whereas others such as detention ponds and constructed wetlands filter stormwater from larger areas. This IP has

proposed a wide selection of stormwater BMPs that range from low-impact development (LID) techniques, which mimic natural hydrology by allowing rainwater to infiltrate/filter/evaporate at the source, and more traditional BMP techniques which channel and pipe stormwater to large scale holding areas.

Existing Stormwater BMPs

The Towns of Blacksburg and Christiansburg as well as Montgomery County provided stormwater BMP information for inclusion in this IP. Based on these data, there are approximately 116 existing stormwater management BMPs within the Roanoke River TMDL IP Part II watershed that drain approximately 381 acres (Table 5-8). Most of these BMPs consist of detention ponds and underground detention. Other BMPs that drain larger areas but are fewer in number include extended detention ponds and bioretention basins.

Bioretention Area, Wetland Studies and Solutions, Inc., Virginia
(Photograph courtesy of VADEQ)

Although the majority of the existing BMPs drain developed land, some BMPs also drain other land uses especially forest and pasture land. Reductions in bacteria and sediment loads from these land uses due to the existing BMPs were calculated and taken into account during quantification of new proposed BMPs (Table 5-10). Most stormwater BMPs indicated a date of installation, however, some did not. Therefore, the separation of BMPs between those installed prior to TMDL development and those installed post-TMDL development were accounted for in an alternative manner. In order to account for some benefit from existing stormwater BMPs without an installation date, VADEQ and stakeholders agreed that reductions from these existing

BMPs should be accounted for in the IP by reducing their pollutant reduction efficiencies by 50%.

Proposed Detention Basin Retrofits

Retrofits of existing BMPs such as detention ponds and infiltration basins are more economically viable because the infrastructure is already in place. Existing detention basins were initially constructed for water quantity control but can be upgraded to also reduce or remove pollutants and improve water quality. Retrofitting can include a combination of the following actions: conversion to a wet pond, structure enlargement, and the addition of outlet control structures, sediment forebays, wetlands, and bioretention and infiltration capabilities. The first step in quantification of retrofits was to determine the percentage of each type of soil (well-draining, poorly draining, and blank/urban land) in each subwatershed as well as the presence of karst topography. Existing BMPs overlying well-draining soil are appropriate for infiltration basin retrofits because the nature of the treatment technique requires that runoff has the ability to percolate through the soil. Existing BMPs overlying poorly draining soil are more suited to constructed wetland retrofits that retain the runoff in a specific area allowing the vegetation and soil to uptake pollutants in the stormwater. The presence of karst topography underneath certain BMPs could result in damage to or the failure of the BMP as well as possible water quality and safety concerns. Therefore, one existing detention pond was excluded from the retrofits due to karst topography. It is critical to note that site specific analysis needs to be performed before these BMP retrofits can be sited, designed and implemented. Table 5-9 details the proposed detention pond retrofits for each watershed, including the number of BMPs and the associated drainage areas. These associated drainage areas primarily consist of developed and forested land, but also treat a minimal amount of other land uses, as defined by the NLCD 2006 dataset.

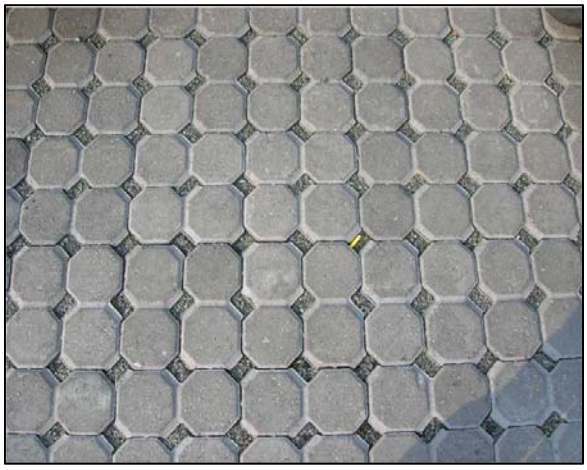
Table 5-8: Existing Stormwater BMP Summary

Stormwater BMP	North Fork Roanoke River		South Fork Roanoke River		Wilson Creek	
	Number	Acres Treated	Number	Acres Treated	Number	Acres Treated
Bioretention	1	0.34	-	-	25	11
Detention	8	29	9	39	44	192
Extended Detention	1	3	-	-	5	16
Infiltration	1	1	-	-	1	0
Manufactured BMP	-	-	-	-	4	2
Underground Detention	-	-	-	-	10	12
Vegetated Filter Strip	-	-	-	-	1	1
Water Quality Grass Swale	-	-	-	-	2	3
Wet Pond	2	21	1	52	1	0
Total	**13**	**54**	**10**	**91**	**93**	**236**
Bacteria Reduction From Existing BMPs (cfu/year)	2.08E+12		1.80E+12		4.10E+11	
Sediment Reduction From Existing BMPs (ton/year)	3.51		5.43		16.8	

Table 5-9: Proposed Detention Pond Retrofits

BMP	North Fork Roanoke River	South Fork Roanoke River	Wilson Creek
	Number	Number	Number
Infiltration Basin	3	4	9
Constructed Wetland	5	4	33

Proposed Stormwater BMPs



Permeable/Porous Pavement
(Photograph courtesy of VADEQ)

Proposed stormwater BMPs include bioretention basins, rain gardens, infiltration basin/trenches, manufactured BMPs[1], constructed wetlands, detention ponds, cisterns, permeable pavement, rain barrels, vegetated swales, and riparian buffers (forested or grass/shrub) (Table 5-10). Similar to BMP retrofits, some stormwater BMPs function better when placed on particular soil types. Infiltration basins or trenches are better on well-draining soil, whereas bioretention basins, manufactured BMPs, and constructed wetlands work better on poorly draining soil. Because of area and size constraints, BMPs on dense urban landscapes typically include bioretention and manufactured BMPs.

A variety of methods were applied for the quantification of stormwater BMPs. The stormwater BMPs are proposed on the available developed land within the watershed, while not exceeding this amount. Stakeholders agreed that proposing 15% of houses in each subwatershed purchase rain barrels would be a reasonable goal for this type of BMP. Cisterns were proposed for 0.5% of houses. A total drainage area of five acres for permeable pavement and 200-600 acres for vegetated swales were proposed for each subwatershed. A total drainage area of 10-200 acres for detention ponds were proposed for each subwatershed. Table 5-10 presents the proposed drainage area for each stormwater BMP by watershed.

Quantification of the appropriate length of urban riparian buffer required spatial analysis of aerial imagery, land use and stream layers using GIS. Stream layers located within urban land uses were evaluated and the lengths of perennial and intermittent streams that were lacking adequate riparian buffer were noted. In addition, the analysis noted whether the riparian buffer was needed on one or both sides of the stream. An average urban riparian buffer of 100 feet was used

[1] Manufactured BMPs or manufactured treatment devices (also referred to as *proprietary treatment devices*) means commercial products fabricated in manufacturing facilities that provide stormwater pollution treatment. Some examples include hydrodynamic separators and filters. (Source: VA Stormwater BMP Clearinghouse).

to calculate the maximum total acreage of proposed buffer. This average buffer was used in lieu of site specific riparian buffer widths. However, riparian buffers naturally vary in width and narrower riparian buffers can still provide stream bank stabilization and result in instream water quality benefits. Therefore, a riparian buffer of 25 feet was used to calculate the minimum total acreage of proposed buffer. Site-specific analysis is required prior to the siting, design, and implementation of this BMP in order to determine the appropriate width and type for each location. After summing the total length of stream (either on one side or both) and multiplying it by 25 feet and 100 feet, the minimum and maximum total acreage was determined and then split evenly between the forested and grass/shrub buffer types. Streams that appeared to be associated with a stormwater detention pond or retention area were not included nor were streams that flowed through residential or other developed areas where the addition of riparian buffer would not be feasible. Table 5-10 presents the proposed urban riparian buffer length for each watershed.

Table 5-10: Proposed Stormwater BMPs (Acre-Treated)						
	Bradshaw Creek	**North Fork Roanoke River**	**South Fork Roanoke River**	**Unimpaired North Fork Roanoke River**	**Wilson Creek**	**Total**
Bioretention	50	300	600	150	300	1,400
Rain Garden	50	300	700	150	300	1,500
Infiltration Trench	20	200	400	20	100	740
Manufactured BMP[1]	20	150	400	20	300	890
Constructed Wetland	20	200	500	20	300	1,040
Detention Pond	10	100	200	20	150	480
Cistern[2]	6	23	41	3	91	164
Permeable Pavement	5	5	5	5	5	25
Vegetated Swale	200	400	600	300	500	2,000
Rain Barrel[2]	174	694	1,243	91	2,736	4,938
Riparian Buffer (Forested)[3]	2-8	15-71	27-124	2-11	8-38	55-251
Riparian Buffer (Grass/Shrub)[3]	2-9	15-80	27-140	2-13	8-42	55-284

[1]Manufactured BMPs or manufactured treatment devices (also referred to as proprietary treatment devices) are commercial products fabricated in manufacturing facilities that provide stormwater pollution treatment. Some examples include hydrodynamic separators and filters. (Source: VA Stormwater BMP Clearinghouse).
[2]Units
[3]Acre-Installed (based on a range of buffer widths from 25-100 feet)

5.2.3.2 Street Sweeping

Street Sweeper
(Photograph courtesy of VA Stormwater Handbook)

Street sweeping frequency and equipment vary by locality in the Roanoke River watershed. Street sweeping is one of the most economical BMPs utilized with respect to reductions of sediment. The quantification of the street sweeping BMP is based on municipalities and therefore is not separated by subwatershed. The IP is proposing to create a street sweeping program for roadways located within the boundary of Montgomery and Roanoke Counties and to expand the existing street sweeping programs in the Towns of Blacksburg and Christiansburg.

The Town of Blacksburg sweeps all Town streets at least once per month; more frequent sweeping occurs during winter months due to gravel in the streets (Town of Blacksburg, 2013). Information on the amount of miles swept per year and the tons of sediment removed from the existing program were not available. Calculation of sediment reductions from expansion of the street sweeping program used spatial data showing the extent of the Town streets. There are approximately 45 miles of streets maintained by the Town within the Roanoke River TMDL IP Part II watershed. The proposed expansion of the existing Town of Blacksburg program included an increase in the sweeping frequency from an average of 12 cycles per year to 24 cycles per year (i.e. approximately once every two weeks). Using the total street length within the Part II watershed (i.e., 45 miles), the expansion to 24 cycles would result in the sweeping of an additional 542 miles per year. An average annual sediment reduction of 0.28[2] tons per curb mile was used to extrapolate the projected additional sediment reduction of approximately 150 tons of sediment and 2.98E+11 cfu of bacteria per year.

[2] The Upper Stroubles Creek Watershed TMDL Implementation Plan (VADEQ and VADCR, 2006) proposed street sweeping on an additional 58.47 curb miles resulting in a sediment reduction of 16.15 tons per year. This is 0.28 tons of sediment reduced per mile.

The annual goal for the Town of Christiansburg street sweeping program is to sweep streets on a regular basis (i.e., at least once per year) and whenever complaints are made (Town of Christiansburg, 2014). Over the 2012-2013 and part of the 2013-2014 street sweeping cycles, the Town of Christiansburg swept an average of 281 miles per month resulting in an average sediment and debris removal of 24 tons per month. Extrapolation over one year results in approximately 3,370 miles swept and 285 tons of sediment removed annually. In reality these values are variable because the street sweeping program and associated removal of sediment and debris are dependent on sweeper maintenance and weather. Therefore, an average sediment removal of 0.08[3] tons per curb mile was used to estimate greater increases in sediment removal from the program's expansion. There are approximately 37 curb miles of streets within the Roanoke River TMDL IP Part II watershed. The proposed expansion of the existing Town of Christiansburg program included an increase in the sweeping frequency from an average of once per year to twelve times per year (i.e., once per month). Using the approximately 37 miles of roads within the Part II watershed, this would result in the sweeping of an additional 404 miles per year. It was assumed that these expansions would amount to an additional sediment reduction of approximately 34 tons of sediment and 2.22E+11 cfu of bacteria per year.

The pollutant reductions associated with the creation of a street sweeping program on roads located within the boundary of Roanoke County used the following assumptions. The new program would sweep half of the approximately 76 miles of roads located within both the boundary of the county and the Part II watershed on a frequency of one time per month. The average annual sediment reduction per curb mile from the City of Salem and City of Roanoke's program (0.55 tons) was used to extrapolate the projected sediment reduction of approximately 250 tons and 2.50E+11 cfu of bacteria per year.

The pollutant reductions associated with the creation of a street sweeping program on roads located within the boundary of Montgomery County used the following assumptions. The new program would sweep 7% of the approximately 1114 miles of roads located within both the boundary of the county and the Part II watershed on a frequency of one time every five weeks.

[3] The MS4 Annual Report for 2012-2013 and 2013-2014 reported sweeper mileage and sediment tonnage removed for most months. An average of miles swept per month and tonnage removed per month resulted in an average of 0.08 tons of sediment removed per mile per year.

The average annual sediment reduction of 0.28 tons per curb mile was used to extrapolate the projected sediment reduction of approximately 437 tons and 8.58E+11 cfu of bacteria per year.

Table 5-11 depicts the existing and expanded street sweeping programs for the Towns of Blacksburg and Christiansburg, the new program for roads within the boundaries of Montgomery and Roanoke Counties, and the total annual sediment reductions expected from the overall programs.

Table 5-11: Street Sweeping Programs - Existing and Proposed[1]

Location	Existing Program		Proposed Program		Total Annual Sediment Reduction (tons)
	Average Miles Swept Annually	Average Annual Sediment Reduction (tons)	Additional Miles Swept Annually	Annual Additional Sediment Reduction (tons)	
Town of Blacksburg	542	150	542	150	299
Town of Christiansburg	37	3	404	34	37
Roads within Montgomery County	-	-	1,559	437	437
Roads within Roanoke County	-	-	455	250	250

[1]All mileage and sediment values are only for the portion of the Town or County within the Part II watershed.

There is no proposed street sweeping for Floyd County due to the limited amount of streets with curbs and gutters.

5.2.4 Stream Restoration (Existing/Proposed)

Stream restoration projects are those that use instream engineering methods and/or natural stream design techniques to protect and restore the stream and associated hydrology and enhance riparian plant communities, which will reduce erosion and sediment transport. Stream stabilization projects are those that use vegetation and/or harder materials to stabilize and protect the streambanks. Several restoration projects have already been completed on the North Fork Roanoke River. These include two projects that restored 815 linear feet and 1,560 linear feet, respectively, through channel realignment and construction of riffles, rock vanes, revetments, or bank stabilization. Another project planted riparian buffer along 2,150 linear feet, graded the banks, and installed revetments.

Stream restoration throughout the watershed aims to reduce the sediment loading from instream erosion (Table 3-12). Using the sediment reduction efficiency of stream restoration and stabilization projects as reported in Table 5-1, the total amount of stream length necessary to achieve the sediment loading reductions was calculated as 90,613 linear feet. The total restoration length was distributed among the subwatersheds by using the percentage of stream length within each subwatershed compared to the total stream miles of all the subwatersheds within this study area. The lengths of all stream restoration projects completed post-TMDL development, and of any planned projects (with funds allocated), were calculated and subtracted from the required stream restoration length to determine the proposed stream restoration lengths for each subwatershed (Table 5-12). Finally, stream stabilization was proposed for 5% of the stream miles.

Table 5-12: Planned and Proposed Stream Restoration Lengths				
Subwatershed	**Total Estimated Stream Length for Restoration (feet)**	**Planned, Ongoing, Completed Projects (feet)**	**Additional Proposed Stream Restoration (feet)**	**Additional Proposed Stream Stabilization (feet)**
Bradshaw Creek	9,844	0	9,844	492
North Fork Roanoke River	22,793	6,785	16,008	1,140
South Fork Roanoke River	48,140	0	48,140	2,407
Unimpaired North Fork Roanoke River	6,063	0	6,063	303
Wilson Creek	3,773	0	3,773	189

5.3 Innovative Pollution Control Strategies and Outreach Opportunities

Working group meetings included discussions about innovative strategies that ultimately could not be tied directly to pollutant reductions. These measures and techniques to control pollution could not be quantified for a variety of reasons. For some, the quantification procedure was unknown or prohibitively difficult, or the extent of installation could not be determined, whereas for others the scientific data to support pollutant removal efficiencies was unavailable. These measures are described below but were not quantified or accounted towards attaining TMDL pollutant reductions.

- **Enhanced Erosion and Sediment Control:** Erosion and sediment control practices are used during construction projects throughout the watershed. However, sometimes these practices are not installed properly or are not maintained and therefore do not prevent as much erosion and sediment transport to surrounding waterways as designed. A suggestion by the stakeholders was to improve the erosion and sediment control mitigation necessary for developers during construction. There was not enough information provided to quantify additional sediment reductions by enhancing the erosion and sediment control practices. More information about Virginia's Erosion and Sediment Control requirements can be found here: *http://www.deq.virginia.gov/Programs/Water/StormwaterManagement/Publications/ESCHandbook.aspx*
- **Educational Programs**
    - *Sanitary Sewer Educational Program:* Stakeholders suggested a program to increase awareness of the sanitary sewer system and sewage related issues and to change public habits to benefit the system. Specifically mentioned were issues related to disposable wipes causing sanitary sewer overflows. The program should also educate the public about the need to report sewage smells and sewer overflow problems.
    - *Collaborative Programs:* Stakeholders mentioned partnering with neighboring municipalities and counties to improve educational outreach related to water

quality issues. Stakeholders suggested incorporating stormwater and pollutant (e.g., bacteria and sediment) issues into local school curriculums.

- *Non-traditional Farmer Outreach:* Non-traditional agriculture and hobby farmers are becoming more prevalent in the watershed. Stakeholders mentioned the need for outreach to these operations to educate them on how they can help maintain a healthy watershed and the types of practices and programs available to them.
- *Erosion Control on Steep Slopes:* Stakeholders suggested enhanced outreach to landowners concerning the importance of erosion control and the use of proper practices in mountainous and other steep slope areas.
- *Residential Low Impact Development Educational Program:* Stakeholders suggested a program to educate citizens on what they can do on their own properties to improve water quality, and educate them in general about the issues with stormwater runoff and LID techniques.

- **Off-stream Watering without Fencing:** Livestock exclusion BMPs in Virginia typically use fencing to keep animals from entering the stream. However, a practice that only provides alternative water sources for livestock but does not fence out streams still reduces bacteria loading. This practice is offered through the Virginia Agricultural Cost-share Program as a tax credit only BMP.
- **Outreach Opportunities:** Within the North Fork and South Fork Roanoke Rivers watershed, opportunities to educate the public on the importance of regional water quality and the goals of this IP include:
  - Earth Day Celebrations (Spring)
  - River Clean-ups (Year-round)
  - Farm Bureau meetings (Year-round)
  - Go Outdoor Festival (Fall)
  - Livestock and Farmers markets (Year-round)
  - Montgomery County Citizen Academy (every other Fall)
  - Municipality public service websites and mailers (Year-round)
  - New River Valley Eco Expo (Spring/Summer)
  - New River Valley Home Builders Home Expo (Spring)
  - Young Farmers of Virginia meetings and newsletters (Year-round)

- Local newspaper, radio, and television public service announcements (Year-round)
- Wilderness Trail Festival (Fall)
- Tomato Festival in Shawsville (Summer)

5.4 Technical Assistance

Technical assistance will be necessary beyond what local programs and services provide to help the stakeholders implement agricultural, residential, and stormwater BMPs proposed in this plan. Technical assistance includes (1) performing administrative and organizational tasks, (2) providing outreach and education about BMPs and available funding, and (3) assisting with the design and installation of BMPs. Quantification of technical assistance is in Full Time Equivalents (FTEs). Technical assistance for agricultural BMPs would be provided through the Skyline Soil and Water Conservation District (SWCD) and Blue Ridge SWCD. Technical assistance for residential BMPs could possibly be provided through SWCDs, Health Departments, regional planning commission or county governments, dependent upon available grant funding. In addition, there will be a need for technical assistance for stormwater BMP implementation, which could be handled through a regional planning commission or county governments. Below are lists of potential activities associated with technical assistance by program type.

- **Potential technical assistance and educational outreach tasks associated with agricultural programs**
  1. Make contacts with landowners in the watershed to make them aware of implementation goals and cost-share assistance programs.
  2. Provide technical assistance for agricultural programs (e.g., survey, design, layout, and approval of BMP installation).
  3. Administer cost-share assistance and track BMP implementation.
  4. Develop educational materials and programs, based on local needs.
  5. Organize educational programs (e.g., pasture walks, presentations at field days or grazing-club events, etc.).
  6. Distribute educational materials (e.g., informational articles in Farm Service Agency (FSA) or Farm Bureau newsletters, local media, etc.).
  7. Assess progress towards BMP implementation goals.
  8. Follow-up contact with landowners who have installed BMPs.

9. Coordinate use of existing agricultural programs and suggest modifications where necessary.

- **Potential technical assistance and educational outreach tasks associated with residential programs**

1. Make contacts with landowners in targeted areas where there are documented problems with on-site sewage systems based on age of homes, poor soils, and high number of repairs and replacements of systems needed based on IP data.
2. Track septic system repairs/ replacements / installations.
3. Administer cost-share assistance and track BMP implementation.
4. Develop educational materials and programs.
5. Organize educational programs (e.g., demonstration of septic pump-outs).
6. Distribute educational materials (e.g., informational pamphlets on TMDLs, and on-site sewage disposal systems).
7. Assess progress toward BMP implementation goals.
8. Follow-up contact with landowners who have participated in the program(s).

- **Potential technical assistance and educational outreach tasks associated with stormwater BMP implementation**

1. Make contacts with landowners in the local watersheds to make them aware of implementation goals.
2. Assist in the identification of grant opportunities and development of grant writing to fund BMP implementation.
3. Provide assistance for stormwater BMPs (e.g., survey, design, layout, and approval of installation).
4. Develop educational materials and local workshops on rain barrels, rain gardens, vegetated buffers, turf to trees, etc.
5. Organize educational programs.
6. Distribute educational materials.
7. Assess and track progress toward BMP implementation goals.
8. Follow-up contact with landowners who have installed BMPs.

As stated previously, the BMPs proposed in this plan would be implemented over the course of a 15 or 20 year timeline depending on the subwatershed. BMP numbers by watershed vary and are staggered across the timeline; this approach includes implementation of the more cost-effective BMPs in the earlier stages, and the more costly or challenging BMPs in the later stages. The

technical assistance proposed in this plan reflects the differences in BMP implementation goals across the staged timeline and experiences from TMDL watershed implementation projects statewide. Chapter 6, Section 6.1 will describe the staging of the BMPs in greater detail for each subwatershed.

A total of 1.5 FTEs for agricultural BMPs are proposed per year (one FTE for Skyline SWCD and 0.5 FTE for Blue Ridge SWCD) for the first stage, one FTE per year for the second stage, and 0.5 FTE per year for the third stage. Two FTEs would be necessary for implementation of residential waste treatment BMPs for the first and second stages, and one for the final stage. FTEs for non-MS4 stormwater BMPs would apply to Floyd, Montgomery, and Roanoke Counties because there are urban areas in those counties that are outside of MS4 boundaries. When the NLCD 2006 land use layer is overlaid with the 2010 Urban Census layer which MS4 urban areas are based on, there is very little development outside of the boundaries. The development outside the boundaries primarily consists of streets and roads, many of which would fall under VDOT's MS4. As a result, one half FTE for the first stage (one quarter FTE for Montgomery County and one quarter divided between Floyd and Roanoke Counties) per year for the first two stages and then one quarter FTE per county per year split between the three counties for the final stage would be sufficient to assist in the implementation of stormwater BMPs (Table 5-13).

Table 5-13: Full Time Equivalent Positions by IP Stage and BMP Category

	Stage 1 (Year 1-8)	**Stage 2 (Year 9-16)**	**Stage 3 (Year 17-20)**
Agricultural	1.5	1	0.5
Residential	2	1	1
Non-MS4 Urban	0.5	0.5	0.25

5.5 Costs of Control Measures

The costs for the control measures were derived from multiple sources. Table 5-14 shows the cost of each BMP per system/unit/program, per acre installed, or acre treated, as well as the cost sources. Costs in Table 5-14 and subsequent tables are based on BMP installation and do not include maintenance, unless otherwise noted. Maintenance costs are recognized as an added expense in implementing BMPs, but maintenance costs vary widely. There is no feasible way to incorporate BMP maintenance costs across all source sectors addressed by the TMDL IP: agriculture, onsite sewage systems, streambank stabilization and restoration, and stormwater.

Tables 5-15 through 5-19 present the total costs of all IP actions for all three implementation stages by subwatershed, grouped by BMP category and type; these costs do not include costs associated with street sweeping and technical assistance. Tables 5-20 and 5-21 depict the costs associated with street sweeping and technical assistance, respectively, which transcend watershed boundaries. Included in the cost for street sweeping is the purchase of a street sweeper for programs within the boundaries of Montgomery County and Roanoke County. Table 5-22 summarizes the cost for all subwatersheds to attain the bacteria and sediment TMDL allocations set in the individual TMDLs and found in Chapter 3. Table 5-23 summarizes the costs necessary to de-list the bacteria impaired segments from the Impaired Waters List. The cost to delist for bacteria excluded the costs associated with stream restoration, permeable pavement, vegetated swales, cisterns, and rain barrels, as these activities are not effective at reducing bacteria.

Table 5-14: Best Management Practice Cost			
Agricultural			
BMP Type	**BMP**	**Cost (per system or acre)**	**Reference**
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	$27,000	1
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	$40,000-45,000	2
	Livestock Exclusion with Riparian Buffers (LE-1T)	$21,000	2
	Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	$17,000	3
	Small Acreage Grazing System (SL-6AT)	$9,000	3
	Stream Protection/Fencing (WP-2/WP-2T)	$21,000	1
Pasture	Vegetative Cover on Critical Areas (SL-11)	$3,500-5,000	2
	Reforestation of Erodible Pasture (FR-1)	$1,000	2
	Woodland Buffer Filter Area (FR-3)	$700	2
	Pasture Management (EQIP 528, SL-10T)	$75	3
	Grazing Land Management (SL-9)	$200	1
	Wet Detention Pond for Pastureland	$150	4
Cropland	Continuous No-Till (SL-15)	$100	11
	Small Grain Cover Crop (SL-8)	$30	11
	Permanent Vegetative Cover on Cropland (SL-1)	$175	1
	Sod Waterway (WP-3)	$1,600	1
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	$1,000	1
Residential			
BMP Type	**BMP**	**Cost (per system or program)**	**Reference**
Waste Treatment	Septic System Pump-Out (RB-1)	$300	1
	Sewer Connection (Targeted Areas and RB-2)	$9,500	5
	Repaired Septic System (RB-3)	$3,600	1
	Septic System Installation/Replacement (RB-4, RB-4P)	$6,000-$8,000	1
	Alternative Waste Treatment System Installation (RB-5)	$16,000	1
Pet Waste	Pet Waste Education Campaign (program)	$5,000	6
	Pet Waste Composter	$100	15
	Pet Waste Station[1]	$4,070	7
Urban			
BMP Type	**BMP**	**Cost (per acre-treated)**	**Reference**
Stormwater	Rain Barrel	$150	8
	Permeable Pavement	$240,000	9
	Infiltration Trench (including Retrofit)	$6,000	8
	Bioretention	$10,000	10
	Rain Garden	$5,000	10
	Vegetated Swale	$18,150	11
	Constructed Wetland (including Retrofit)	$2,900	11
	Manufactured BMP	$20,000	12
	Cistern	$1,000	8
	Detention Pond	$3,800	11
	Riparian Buffer: Forest	$3,500	13
	Riparian Buffer: Grass/Shrub	$360	10
Other	Street Sweeping	$520 per curb mile	14
	Stream Restoration	$300 per linear foot	Stakeholder Input
	Stream Stabilization	$75 per linear foot	Stakeholder Input

[1]Cost includes initial unit and five years' worth of bag and trash can liner refills.

References (right column in table):

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5. Western Virginia Water Authority, personal communication. August, 28, 2013.
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12. VADCR. 2013. Spout Run Water Quality Improvement Plan.
13. Rivanna River Basin Commission. 2012. Moores Creek Bacteria Implementation Plan 2012 Update.
14. Schilling, J.G. 2005. Street Sweeping – Report No. 1, State of the Practice. Prepared for Ramsey- Washington Metro Watershed District (*http://www.rwmwd.org*). North St. Paul, Minnesota. June 2005.
15. Pet Solutions Website (*http://www.petsolutions.com/C/Dog-Lawn-Care/I/Doggie-Dooley-Model-3000.aspx*).

Table 5-15: Bradshaw Creek TMDL IP Costs				
Agricultural				
BMP Type	**BMP**	**Cost (per system)**	**Systems**	**Total Cost**
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	$27,000	3	$81,000
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	$45,000	12	$540,000
	Livestock Exclusion with Riparian Buffers (LE-1T)	$21,000	12	$252,000
	Livestock Exclusion w/ Reduced Setback (LE-2/LE-2T)	$17,000	2	$34,000
	Small Acreage Grazing System (SL-6AT)	$9,000	2	$18,000
	Stream Protection/Fencing (WP-2/WP-2T)	$21,000	2	$42,000
BMP Type	**BMP**	**Cost (per acre)**	**Acre-Installed**	**Total Cost**
Pasture	Vegetative Cover on Critical Areas (SL-11)	$5,000	36	$177,760
	Reforestation of Erodible Pasture (FR-1)	$1,000	37	$37,420
	Woodland Buffer Filter Area (FR-3)	$700	36	$24,890
	Pasture Management (EQIP 528, SL-10T)	$75	177	$13,280
	Grazing Land Management (SL-9)	$200	176	$35,200
	Wet Detention Pond for Pastureland (acre-treated)	$150	0	$0
Cropland	Continuous No-Till (SL-15)	$100	41	$4,080
	Small Grain Cover Crop (SL-8)	$30	48	$1,440
	Permanent Vegetative Cover on Cropland (SL-1)	$175	2	$420
	Sod Waterway (WP-3)	$1,600	2	$3,840
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	$1,000	2	$2,400
Residential				
BMP Type	**BMP**	**Cost (per system or program)**	**Systems**	**Total Cost**
Waste Treatment	Septic System Pump-Out (RB-1)	$300	58	$17,520
	Sewer Connection (Targeted Areas and RB-2)	$9,500	N/A	$0
	Repaired Septic System (RB-3)	$3,600	8	$29,160
	Septic System Installation/Replacement (RB-4, RB-4P)	$8,000	9	$73,116
	Alternative Waste Treatment System Installation (RB-5)	$16,000	2	$28,800
Pet Waste	Pet Waste Education Campaign (program)	$5,000	3	$15,000
	Pet Waste Station	$4,070	0	$0
	Pet Waste Composter	$100	11	$1,065.80
Urban				
BMP Type	**BMP**	**Cost (per acre-treated)**	**Acre-Treated**	**Total Cost**
Urban	Bioretention	$10,000	50	$500,000
	Rain Gardens	$5,000	50	$250,000
	Infiltration Trench	$6,000	20	$120,000
	Manufactured BMP	$20,000	20	$400,000
	Constructed Wetland	$2,900	20	$58,000
	Detention Pond	$3,800	10	$38,000
	Permeable Pavement	$240,000	5	$1,200,000
	Vegetated Swale	$18,150	200	$3,630,000

	Rain Barrel (number of barrels)	$150	174.1	$26,110
	Cistern (number of cisterns)	$1,000	5.8	$5,800
	Riparian Buffer: Forest (acre-installed)[1]	$3,500	2-8	$7,000-$27,260
	Riparian Buffer: Grass/Shrub (acre-installed)[1]	$360	2-9	$720-$3,170
Stream Restoration				
BMP		**Cost (per linear foot)**	**Linear Feet**	**Total Cost**
Stream Restoration		$300	9,844	$2,953,080
Stream Stabilization		$75	492	$36,913.53
			Total Subwatershed IP Cost	**$10,680,725**

[1]Based on a range of buffer widths (25-100 feet)

Table 5-16: North Fork Roanoke River TMDL IP Costs				
Agricultural				
BMP Type	**BMP**	**Cost (per system)**	**Systems**	**Total Cost**
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	$27,000	10	$270,000
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	$45,000	38	$1,710,000
	Livestock Exclusion with Riparian Buffers (LE-1T)	$21,000	38	$798,000
	Livestock Exclusion w/ Reduced Setback (LE-2/LE-2T)	$17,000	5	$85,000
	Small Acreage Grazing System (SL-6AT)	$9,000	5	$45,000
	Stream Protection/Fencing (WP-2/WP-2T)	$21,000	5	$105,000
BMP Type	**BMP**	**Cost (per acre)**	**Acre-Installed**	**Total Cost**
Pasture	Vegetative Cover on Critical Areas (SL-11)	$5,000	2,208	$11,039,470
	Reforestation of Erodible Pasture (FR-1)	$1,000	818	$817,740
	Woodland Buffer Filter Area (FR-3)	$700	368	$257,590
	Pasture Management (EQIP 528, SL-10T)	$75	7,360	$551,970
	Grazing Land Management (SL-9)	$200	176	$35,200
	Wet Detention Pond for Pastureland (acre-treated)	$150	3,800	$570,000
Cropland	Continuous No-Till (SL-15)	$100	253	$25,300
	Small Grain Cover Crop (SL-8)	$30	283	$8,480
	Permanent Vegetative Cover on Cropland (SL-1)	$175	15	$2,600
	Sod Waterway (WP-3)	$1,600	15	$23,810
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	$1,000	15	$14,880
Residential				
BMP Type	**BMP**	**Cost (per system or program)**	**Systems**	**Total Cost**
Waste Treatment	Septic System Pump-Out (RB-1)	$300	203	$60,900
	Sewer Connection (Targeted Areas and RB-2)	$9,500	25	$237,500
	Repaired Septic System (RB-3)	$3,600	27	$98,820
	Septic System Installation/Replacement (RB-4, RB-4P)	$8,000	30	$237,060
	Alternative Waste Treatment System Installation (RB-5)	$16,000	6	$97,600
Pet Waste	Pet Waste Education Campaign (program)	$5,000	3	$15,000
	Pet Waste Station	$4,070	3	$12,210
	Pet Waste Composter	$100	43	$4,250
Urban				
BMP Type	**BMP**	**Cost (per acre-treated)**	**Acre-Treated**	**Total Cost**
Urban Retrofit	Infiltration Basin	$6,000	29	$171,853
	Constructed Wetland	$2,900	58	$168,880
Urban	Bioretention	$10,000	300	$3,000,000
	Rain Gardens	$5,000	300	$1,500,000
	Infiltration Trench	$6,000	200	$1,200,000
	Manufactured BMP	$20,000	150	$3,000,000
	Constructed Wetland	$2,900	200	$580,000
	Detention Pond	$3,800	100	$380,000

	Permeable Pavement	$240,000	5	$1,200,000
	Vegetated Swale	$18,150	400	$7,260,000
	Rain Barrel (number of barrels)	$150	694	$104,124
	Cistern (number of cisterns)	$1,000	23	$23,140
	Riparian Buffer: Forest (acre-installed)[1]	$3,500	15-71	$54,100-$248,820
	Riparian Buffer: Grass/Shrub (acre-installed)[1]	$360	15-80	$5,560-$281,275
Stream Restoration				
BMP		**Cost (per linear foot)**	**Linear Feet**	**Total Cost**
Stream Restoration		$300	16,008	$4,802,330
Stream Stabilization		$75	1,140	$85,470
			Total Subwatershed IP Cost	**$40,876,927**

[1]Based on a range of buffer widths (25-100 feet)

Table 5-17: South Fork Roanoke River TMDL IP Costs				
Agricultural				
BMP Type	**BMP**	**Cost (per system)**	**Systems**	**Total Cost**
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	$27,000	10	$270,000
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	$45,000	38	$1,710,000
	Livestock Exclusion with Riparian Buffers (LE-1T)	$21,000	39	$819,000
	Livestock Exclusion w/ Reduced Setback (LE-2/LE-2T)	$17,000	5	$85,000
	Small Acreage Grazing System (SL-6AT)	$9,000	5	$45,000
	Stream Protection/Fencing (WP-2/WP-2T)	$21,000	5	$105,000
BMP Type	**BMP**	**Cost (per acre)**	**Acre-Installed**	**Total Cost**
Pasture	Vegetative Cover on Critical Areas (SL-11)	$5,000	2,587	$12,933,200
	Reforestation of Erodible Pasture (FR-1)	$1,000	958	$958,020
	Woodland Buffer Filter Area (FR-3)	$700	431	$301,770
	Pasture Management (EQIP 528, SL-10T)	$75	8,622	$646,660
	Grazing Land Management (SL-9)	$200	176	$35,200
	Wet Detention Pond for Pastureland (acre-treated)	$150	1,720	$258,000
Cropland	Continuous No-Till (SL-15)	$100	662	$66,230
	Small Grain Cover Crop (SL-8)	$30	452	$13,560
	Permanent Vegetative Cover on Cropland (SL-1)	$175	39	$6,820
	Sod Waterway (WP-3)	$1,600	39	$62,330
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	$1,000	39	$38,960
Residential				
BMP Type	**BMP**	**Cost (per system or program)**	**Systems**	**Total Cost**
Waste Treatment	Septic System Pump-Out (RB-1)	$300	416	$124,890
	Sewer Connection (Targeted Areas and RB-2)	$9,500	11	$104,500
	Repaired Septic System (RB-3)	$3,600	56	$202,320
	Septic System Installation/Replacement (RB-4, RB-4P)	$8,000	62	$498,000
	Alternative Waste Treatment System Installation (RB-5)	$16,000	12	$199,820
Pet Waste	Pet Waste Education Campaign (program)	$5,000	3	$15,000
	Pet Waste Station	$4,070	6	$24,420
	Pet Waste Composter	$100	87	$8,670
Urban				
BMP Type	**BMP**	**Cost (per acre-treated)**	**Acre-Treated**	**Total Cost**
Urban Retrofit	Infiltration Basin	$6,000	47	$284,456
	Constructed Wetland	$2,900	48	$139,627
Urban	Bioretention	$10,000	600	$6,000,000
	Rain Gardens	$5,000	700	$3,500,000
	Infiltration Trench	$6,000	400	$2,400,000
	Manufactured BMP	$20,000	400	$8,000,000
	Constructed Wetland	$2,900	500	$1,450,000
	Detention Pond	$3,800	200	$760,000

	Permeable Pavement	$240,000	5	$1,200,000
	Vegetated Swale	$18,150	600	$10,890,000
	Rain Barrel (number of barrels)	$150	1,243	$186,520
	Cistern (number of cisterns)	$1,000	41	$41,450
	Riparian Buffer: Forest (acre-installed)[1]	$3,500	27-124	$94,100-$432,820
	Riparian Buffer: Grass/Shrub (acre-installed)[1]	$360	27-140	$9,678-$489,270
Stream Restoration				
BMP		**Cost (per linear foot)**	**Linear Feet**	**Total Cost**
Stream Restoration		$300	48,140	$14,441,970
Stream Stabilization		$75	2,407	$180,520
			Total Subwatershed IP Cost	**$69,490,043**

[1]Based on a range of buffer widths (25-100 feet)

Table 5-18: Unimpaired North Fork Roanoke River TMDL IP Costs				
Agricultural				
BMP Type	**BMP**	**Cost (per system)**	**Systems**	**Total Cost**
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	$27,000	3	$81,000
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	$45,000	10	$450,000
	Livestock Exclusion with Riparian Buffers (LE-1T)	$21,000	11	$231,000
	Livestock Exclusion w/ Reduced Setback (LE-2/LE-2T)	$17,000	1	$17,000
	Small Acreage Grazing System (SL-6AT)	$9,000	1	$9,000
	Stream Protection/Fencing (WP-2/WP-2T)	$21,000	1	$21,000
BMP Type	**BMP**	**Cost (per acre)**	**Acre-Installed**	**Total Cost**
Pasture	Vegetative Cover on Critical Areas (SL-11)	$5,000	41	$205,460
	Reforestation of Erodible Pasture (FR-1)	$1,000	43	$43,250
	Woodland Buffer Filter Area (FR-3)	$700	41	$28,760
	Pasture Management (EQIP 528, SL-10T)	$75	411	$30,820
	Grazing Land Management (SL-9)	$200	176	$35,200
	Wet Detention Pond for Pastureland (acre-treated)	$150	0	$0
Cropland	Continuous No-Till (SL-15)	$100	51	$5,060
	Small Grain Cover Crop (SL-8)	$30	57	$1,700
	Permanent Vegetative Cover on Cropland (SL-1)	$175	3	$520
	Sod Waterway (WP-3)	$1,600	3	$4,760
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	$1,000	3	$2,970
Residential				
BMP Type	**BMP**	**Cost (per system or program)**	**Systems**	**Total Cost**
Waste Treatment	Septic System Pump-Out (RB-1)	$300	31	$9,150
	Sewer Connection (Targeted Areas and RB-2)	$9,500	N/A	$0
	Repaired Septic System (RB-3)	$3,600	4	$14,580
	Septic System Installation/Replacement (RB-4, RB-4P)	$8,000	4	$32,400
	Alternative Waste Treatment System Installation (RB-5)	$16,000	1	$14,640
Pet Waste	Pet Waste Education Campaign (program)	$5,000	0	0
	Pet Waste Station	$4,070	1	$4,070
	Pet Waste Composter	$100	6	$560
Urban				
BMP Type	**BMP**	**Cost (per acre-treated)**	**Acre-Treated**	**Total Cost**
Urban	Bioretention	$10,000	150	$1,500,000
	Rain Gardens	$5,000	150	$750,000
	Infiltration Trench	$6,000	20	$120,000
	Manufactured BMP	$20,000	20	$400,000
	Constructed Wetland	$2,900	20	$58,000
	Detention Pond	$3,800	20	$76,000
	Permeable Pavement	$240,000	5	$1,200,000
	Vegetated Swale	$18,150	300	$5,445,000

	Rain Barrel (number of barrels)	$150	91	$13,640
	Cistern (number of cisterns)	$1,000	3	$3,030
	Riparian Buffer: Forest (acre-installed)[1]	$3,500	2-11	$8,660-$39,820
	Riparian Buffer: Grass/Shrub (acre-installed)[1]	$360	2-13	$890-$45,010
Stream Restoration				
BMP		**Cost (per linear foot)**	**Linear Feet**	**Total Cost**
Stream Restoration		$300	6,063	$1,819,010
Stream Stabilization		$75	303	$22,740
			Total Subwatershed IP Cost	**$12,694,770**

[1]Based on a range of buffer widths (25-100 feet)

Table 5-19: Wilson Creek TMDL IP Costs				
Agricultural				
BMP Type	**BMP**	**Cost (per system)**	**Systems**	**Total Cost**
Livestock Exclusion	CREP Livestock Exclusion (CRSL-6)	$27,000	1	$27,000
	Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	$45,000	5	$225,000
	Livestock Exclusion with Riparian Buffers (LE-1T)	$21,000	5	$105,000
	Livestock Exclusion w/ Reduced Setback (LE-2/LE-2T)	$17,000	1	$17,000
	Small Acreage Grazing System (SL-6AT)	$9,000	1	$9,000
	Stream Protection/Fencing (WP-2/WP-2T)	$21,000	1	$21,000
BMP Type	**BMP**	**Cost (per acre)**	**Acre-Installed**	**Total Cost**
Pasture	Vegetative Cover on Critical Areas (SL-11)	$5,000	145	$726,770
	Reforestation of Erodible Pasture (FR-1)	$1,000	81	$80,750
	Woodland Buffer Filter Area (FR-3)	$700	36	$25,440
	Pasture Management (EQIP 528, SL-10T)	$75	727	$54,510
	Grazing Land Management (SL-9)	$200	176	$35,200
	Wet Detention Pond for Pastureland (acre-treated)	$150	330	$49,500
Cropland	Continuous No-Till (SL-15)	$100	26	$2,650
	Small Grain Cover Crop (SL-8)	$30	30	$890
	Permanent Vegetative Cover on Cropland (SL-1)	$175	2	$270
	Sod Waterway (WP-3)	$1,600	2	$2,490
	Cropland Buffer/Field Borders (CP-33 and WQ-1)	$1,000	2	$1,560
Residential				
BMP Type	**BMP**	**Cost (per system or program)**	**Systems**	**Total Cost**
Waste Treatment	Septic System Pump-Out (RB-1)	$300	71	$21,240
	Sewer Connection (Targeted Areas and RB-2)	$9,500	13	$123,500
	Repaired Septic System (RB-3)	$3,600	9	$34,020
	Septic System Installation/Replacement (RB-4, RB-4P)	$8,000	10	$83,600
	Alternative Waste Treatment System Installation (RB-5)	$16,000	2	$33,980
Pet Waste	Pet Waste Education Campaign (program)	$5,000	3	$15,000
	Pet Waste Station	$4,070	15	$61,050
	Pet Waste Composter	$100	98	$9,790
Urban				
BMP Type	**BMP**	**Cost (per acre-treated)**	**Acre-Treated**	**Total Cost**
Urban Retrofit	Infiltration Basin	$6,000	146	$873,130
	Constructed Wetland	$2,900	568	$1,646,210
Urban	Bioretention	$10,000	300	$3,000,000
	Rain Gardens	$5,000	300	$1,500,000
	Infiltration Trench	$6,000	100	$600,000
	Manufactured BMP	$20,000	300	$6,000,000
	Constructed Wetland	$2,900	300	$870,000
	Detention Pond	$3,800	150	$570,000

	Permeable Pavement	$240,000	5	$1,200,000
	Vegetated Swale	$18,150	500	$9,075,000
	Rain Barrel (number of barrels)	$150	2,736	$410,330
	Cistern (number of cisterns)	$1,000	91	$91,180
	Riparian Buffer: Forest (acre-installed)[1]	$3,500	8-38	$28,570-$131,420
	Riparian Buffer: Grass/Shrub (acre-installed)[1]	$360	8-42	$2,940-$148,560
Stream Restoration				
BMP		**Cost (per linear foot)**	**Linear Feet**	**Total Cost**
Stream Restoration		$300	3,773	$1,131,970
Stream Stabilization		$75	189	$14,150
			Total Subwatershed IP Cost	**$28,894,880**

[1]Based on a range of buffer widths (25-100 feet)

Table 5-20: Cost of Additional Street Sweeping				
Location	**Additional Miles to be Swept per year**	**Cost Per mile swept**	**Street Sweeper Equipment Cost[1]**	**Total Cost (per year)**
Town of Blacksburg	542	$520	NA	$281,631
Town of Christiansburg	404		NA	$210,114
Roads within Montgomery County	1,559		$175,000	$810,760
Roads within Roanoke County	455		$175,000	$236,435
			Total per year	$1,538,939
			Total Cost[2]	$28,410,280

[1]One time cost; cost only incurred for one year

[2]Total reflects the varied timelines of the subwatershed (15 and 20 years)

Table 5-21: Technical Assistance for Roanoke River IP Part II				
BMP Category	**Stage 1 (Year 1-8)**	**Stage 2 (Year 9-16)**	**Stage 3 (Year 17-20)**	**Total**
Agricultural	$720,000	$480,000	$120,000	$1,320,000
Residential	$960,000	$480,000	$240,000	$1,680,000
Urban/Stormwater	$300,000	$300,000	$75,000	$675,000
Total Cost	**$1,980,000**	**$1,260,000**	**$435,000**	**$3,675,000**

Table 5-22: Summary of Cost of Roanoke River IP (Part II) by Subwatershed					
BMP Category	**Agricultural**	**Residential**	**Urban**	**Stream Restoration**	**Total**
Bradshaw Creek	$1,267,730	$164,662	$6,258,340	$2,989,994	$10,680,725
North Fork Roanoke River	$16,360,040	$763,340	$18,865,747	$4,887,800	$40,876,927
South Fork Roanoke River	$18,354,750	$1,177,620	$35,335,183	$14,622,490	$69,490,043
Unimpaired North Fork Roanoke River	$1,167,500	$75,400	$9,610,120	$1,841,750	$12,694,770
Wilson Creek	$1,384,030	$382,180	$25,982,550	$1,146,120	$28,894,880
Subtotals	***$38,534,050***	***$2,563,202***	***$96,051,940***	***$25,488,154***	***$162,637,345***
Additional Street Sweeping[1]					$28,410,280
Technical Assistance					$3,675,000
Total Cost					**$194,722,625**

[1]Total reflects the varied timelines of the subwatershed (15 and 20 years)

Table 5-23: Summary of Bacteria Delisting Cost of Roanoke River TMDL IP (Part II) by Subwatershed	
Subwatershed	**Approximate Cost to Delist the Subwatershed for Bacteria Impairment[1]**
Bradshaw Creek	$3,297,194
North Fork Roanoke River	$27,597,253
South Fork Roanoke River	$46,791,936
Unimpaired North Fork Roanoke River	N/A
Wilson Creek	$21,872,630
Technical Assistance	$3,240,000
Total Bacteria Delisting Cost	**$102,799,013**

[1]Costs do not include cost associated with Permeable Pavement, Vegetated Swales, Rain Barrels, Cisterns, and Stream Restoration as they do not reduce bacteria.

5.6 Benefits of Control Measures

The ultimate goal of this Roanoke River IP Part II is to meet water quality standards that support human recreational use and aquatic life. Successful bacteria and sediment reductions through BMPs and educational programs would allow the impaired segments to be delisted. The main benefit of implementation of the various control measures is the improvement of the water quality of the North Fork Roanoke and South Fork Roanoke Rivers and tributaries. Benefits are derived not only from the resulting clean water but also directly from the actual control measures themselves. Enhanced natural resources also provide for enriched recreational opportunities. Reducing bacteria and sediment loads in the North Fork Roanoke and South Fork Roanoke Rivers watershed will protect human health and safety, promote healthy aquatic communities, improve agricultural production, and add to the economic vitality of communities.

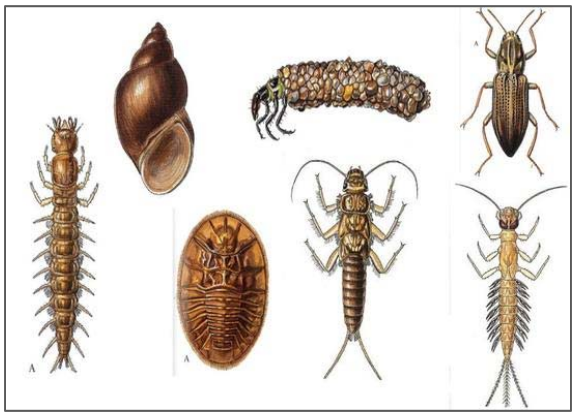
Human Health and Safety

Human, livestock, and wildlife waste can carry viruses and bacteria that are harmful to human health. Although the full range of effects from reduced bacteria loadings on public health is uncertain, the improved water quality should, at the very least, reduce the incidence of infection derived from contact with surface waters (VADCR, 2003). Throughout the United States, the Centers for Disease Control (CDC) 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 pathogens (e.g., *E. coli* 0111) are responsible for similar illnesses. Reducing the presence of bacteria in the watershed should considerably reduce the potential of infection from *E. coli* through contact with surface

waters in the North Fork Roanoke and South Fork Roanoke Rivers and their tributaries. In addition to preventing infection and disease, the measures proposed in this plan to address stormwater could help mitigate and prevent future flooding.

Healthy Aquatic Communities

Excessive sediment can harm a stream by killing aquatic flora and clogging the spaces between river bed substrates that usually provide habitat for benthic macroinvertebrates (Harrison et al., 2007). Accumulation of sediment may also lead to changes in the composition of the benthic macroinvertebrate community by favoring tolerant taxa over intolerant types (examples shown in the picture to the right). These benthic macroinvertebrates are often a major food source for many species of freshwater fish and a decrease in their availability can ripple through the food web. Therefore, the health of the whole aquatic ecosystem is dependent in part on its' physical habitat.



Examples of intolerant benthic macroinvertebrates

Reducing sediment in the Part II watershed would help restore the health of aquatic communities for the benefit of the flora, fauna, and human residents. Improved water quality would provide better instream habitats for aquatic wildlife as well as terrestrial wildlife that use the surrounding waters. Implementation of many of the BMPs would protect and enhance existing natural resources and habitats such as riparian areas, forests, wetlands, and vegetated areas used by wildlife typically found in urban areas. For example, streamside buffers of trees and shrubs help reduce erosion and shade the stream. This helps keep water temperatures lower during the summer and allows for a greater amount of dissolved oxygen in the stream thereby benefiting macroinvertebrates and fish. The resulting healthy fisheries will provide more stock for local anglers. In 2011 alone, approximately $3.5 billion was spent on wildlife recreation in Virginia (USDOI et al., 2011). Buffers can also improve habitat and food sources for wildlife and migratory songbirds that also benefit from having access to a healthy, thriving aquatic community.

Agricultural Production

This plan recognizes that all farmers face their own unique management challenges. Some of the BMPs in this plan may be more suitable and more cost-effective for one landowner than for another in the watershed. Similarly, the benefits of implementing these practices will vary, but can be estimated based on general research.

Restricting cattle access to streams and providing them with a clean water source can improve weight gain (Surber et al., 2005; Landefeld and Bettinger, 2002). Increasing weight associated with drinking from off-stream waterers can translate into economic gains for producers as shown in Table 5-24 (Zeckoski et al., 2007). Additionally, keeping cattle in clean, dry areas has been shown to reduce the occurrence of *mastitis* and foot rot. The Virginia Cooperative Extension estimates *mastitis* costs producers $150 per cow in reduced milk production quantity and quality (Jones and Balley, 2009).

Table 5-24: Production Gains Associated with Provision of Clean Water for Cattle

Typical calf sale weight	Additional weight gain with access to clean water[1]	Price	Increased revenue
500 lb/calf	5% (25lb)	$0.60/lb	$15/calf

[1]Source: Surber et al., 2005

Implementation of an improved pasture management system in conjunction with installation of 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. Feed costs are typically responsible for 70% to 80% of the cost of growing or maintaining an animal. Pastures provide feed at a cost of 0.01 to 0.02 cents/pound of total digestible nutrients (TDN) compared to 0.04 to 0.06 cents/pound TDN for hay. Therefore, increasing the amount of time that cattle are fed on pasture is 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 of pasture management systems 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 and economic benefits to the farmer.

Economic Benefits of Stormwater and Residential BMPs

Stormwater BMPs can be incorporated into a landscape design as an amenity both on private and public properties. Many BMPs such as vegetated swales, buffer strips, and infiltration trenches are inexpensive and easy to implement given limited space and other constraints. Installation of stormwater BMPs provide educational opportunities to increase awareness of water quality strategies (i.e., watershed plans) and green initiatives.

Potential economic benefits of stormwater BMPs (Wise, 2007):

- Incremental implementation and funding can result in less debt service
- Less capital intensive and may have overall lower costs
- Extend the existing capacity of current infrastructure
- Capture the asset values (ecosystem services) of clean water, soil capacity, and open space amenities
- Reduce wastewater and water treatment costs
- Increase property values and benefits the private sector and public revenue collection

Stormwater infrastructure that reduces stormwater runoff onsite can reduce losses from flood damage by $6,700-$9,700 per acre (Medina et al., 2011). Urban stormwater BMPs can also help increase stormwater retention and lower peak discharges, thereby reducing the pressure on and the need for stormwater infrastructure. This can result in lower engineering, land acquisition, and material costs for municipalities and private enterprises.

Individual homeowners and residents could also see financial benefits from stormwater and residential waste treatment BMPs. Proposed BMPs including education and outreach will help give homeowners the knowledge and tools needed for properly maintaining and extending the life of their septic systems. The overall cost of home ownership could be reduced by advocating regular septic pump outs which cost about $300 compared to the $3,000-$25,000 cost of a repair or replacement system. Localized and widespread flooding can be expensive at the residential level through property damage and taxpayer costs. Property owners can help mitigate flood water damages and associated costs by reducing stormwater volume and flow rates through installation

of infiltration type BMPs such as rain gardens and vegetated swales. Johnston et al. (2006) applied two different methods, one cost based and one value based, for estimating economic benefits of employing conservation design practices (e.g., vegetated swales, green roofs, permeable pavement, and native vegetation). The researchers found quantifiable economic benefits to property values downstream of areas where conservation practices were implemented. Flood damage values were reduced by an average of $6,700-$9,700 per acre for a 100-year event.

Community Economic Vitality

Not only will clean water and improved habitats benefit a landowner that earns their livelihood through their land but it will also benefit the overall regional economy by encouraging outdoor pursuits that stimulate the local economy and employment such as fishing, canoeing, kayaking, hiking, and other recreational tourism.

Healthy watersheds provide many ecosystem services necessary for the well-being of a community. These services include, but are not limited to, water filtration and storage, air filtration, carbon storage, energy and nutrient cycling, removal of pollutants, soil formation, recreation opportunities, food production, and timber harvesting. Many of these services are hard to quantify in terms of dollars and are often undervalued (Bockstael et al., 2000). However, it is understood that many of these services are difficult to replace and often expensive to artificially engineer. Efforts to restore the North Fork Roanoke and South Fork Roanoke Rivers watershed to a healthier state may reduce the financial burden on residents, businesses, and municipalities who currently bear the cost of damages such as flooding caused by a degraded aquatic system. Improvement of water quality provides greater economic opportunities throughout the area. Lastly, the combined economic and natural resource benefits provide for a better quality of life for local and regional residents now and in the future.

After completion of the IP, organizations in the watershed will be eligible to apply for competitive funding to help cover some of the costs associated with installing the BMPs. These potential funds along with matching funds from other sources will benefit many local contractors involved in the repair and installation of septic systems, construction of livestock exclusion systems, and installation and retrofits of stormwater BMPs. In a 2009 study, researchers

estimated that every $1 million invested in environmental efforts such as reforestation, land and watershed restoration, and sustainable forest management, would create approximately 39 jobs (Heintz et al., 2009). Economic benefits to the region and individual stakeholders are an indirect result of the IP.

5.6.1 Cost-Effectiveness Analysis

Tables 5-25 and 5-26 present the cost-effectiveness of each proposed BMP which has quantifiable bacteria and sediment reductions in the Roanoke River IP Part II. The practices are ranked from the most to least cost-effective practices for each BMP category. The cost-effectiveness is based on the amount of bacteria (in cfu; Table 5-25) and sediment (in pounds; Table 5-26) reduced per $1,000 spent. Table 5-26 also includes the cost of the practice per 1,000 pounds of sediment reduction. For bacteria, the effectiveness values are based on the bacteria loading from the Wilson Creek subwatershed. Because the bacteria loading within each subwatershed varies, the bacteria loads reduced per $1,000 spent would be slightly different for the other subwatersheds.

Table 5-25: BMP Cost-Effectiveness for Bacteria Reduction in the Roanoke River Watershed Part II[1]	
BMP	**Bacteria Reduction per $1,000 (in cfu)**
Stormwater BMPs	
Riparian Buffer: Grass/Shrub	5.49E+09
Constructed Wetland (including retrofit)	1.09E+09
Street Sweeping	1.06E+09
Riparian Buffer: Forest	6.44E+08
Infiltration Trench (including retrofit)	5.93E+08
Rain Garden	5.54E+08
Bioretention	3.56E+08
Detention Pond	3.12E+08
Manufactured BMP	1.58E+08
Rain Barrel	NA
Permeable Pavement	NA
Vegetated Swale	NA
Cistern	NA
Residential BMPs	
Repaired Septic System (RB-3)	2.61E+11
Septic System Pump-Out (RB-1)	1.57E+11
Septic System Installation/Replacement (RB-4, RB-4P)	1.17E+11
Sewer Connection (RB-2)	9.88E+10
Alternative Waste Treatment System Installation (RB-5)	5.87E+10
Pet Waste Composter	3.91E+10
Pet Waste Education Campaign	3.95E+08
Cropland BMPs	
Continuous No-Till (SL-15)	6.85E+09
Small Grain Cover Crop (SL-8)	6.53E+09
Permanent Vegetative Cover on Cropland (SL-1)	4.20E+09
Sod Waterway (WP-3)	4.89E+08
Cropland Buffer/Field Borders (CP-33 and WQ-1)	3.06E+08
Pasture BMPs	
Pasture Management (EQIP 528, SL-10T)	1.02E+10
Wet Detention Pond	7.17E+09
Grazing Land Management (SL-9)	3.84E+09
Woodland Buffer Filter Area (FR-3)	1.25E+09
Vegetative Cover on Critical Areas (SL-11)	2.30E+08
Reforestation of Erodible Pasture (FR-1)	NA
Livestock Exclusion BMPs	
Stream Protection/Fencing (WP-2/WP-2T)	1.48E+10
Small Acreage Grazing System (SL-6AT)	7.81E+09
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	6.32E+09
CREP Livestock Exclusion (CRSL-6)	4.92E+09
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	2.95E+09
Livestock Exclusion with Riparian Buffers (LE-1T)	2.95E+09

[1]The bacteria loads from Wilson Creek subwatershed were used as the basis for this table, however each subwatershed has slightly different bacteria loading due to local conditions

Table 5-26: BMP Cost-Effectiveness for Sediment Reduction in the Roanoke River Watershed Part II		
BMP	**Sediment Reduction per $1000 (in lbs)**	**Sediment Reduction per 1,000 lbs (in $)**
Stormwater BMPs		
Street Sweeping[1]	2115.4	$473
Riparian Buffer: Grass/Shrub	332.1	$3,011
Rain Barrel	95.6	$10,456
Constructed Wetland (including Retrofit)	41.2	$24,259
Rain Garden	33.5	$29,875
Detention Pond	31.5	$31,788
Infiltration Trench (including Retrofit)	29.9	$33,461
Cistern	28.7	$34,855
Bioretention	16.7	$59,751
Manufactured BMP[2]	9.6	$104,564
Vegetated Swale	8.6	$116,790
Permeable Pavement	0.8	$1,254,770
Cropland BMPs		
Continuous No-Till (SL-15)	8,690.4	$115
Small Grain Cover Crop (SL-8)	8,276.5	$121
Permanent Vegetative Cover on Cropland (SL-1)	5,320.6	$188
Cropland Buffer/Field Borders (CP-33 and WQ-1)	620.7	$1,611
Sod Waterway (WP-3)	388.0	$2,578
Pasture BMPs		
Pasture Management (EQIP 528, SL-10T)	301.0	$3,323
Wet Detention Pond	250.8	$3,987
Grazing Land Management (SL-9)	112.9	$8,860
Woodland Buffer Filter Area (FR-3)	75.2	$13,291
Reforestation of Erodible Pasture (FR-1)	65.5	$15,276
Vegetative Cover on Critical Areas (SL-11)	11.3	$88,604
Livestock Exclusion BMPs		
Stream Protection/Fencing (WP-2/WP-2T)	4.7	$213,598
Small Acreage Grazing System (SL-6AT)	2.5	$403,463
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	2.0	$498,396
CREP Livestock Exclusion (CRSL-6)	1.6	$640,794
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	0.9	$1,067,990
Livestock Exclusion with Riparian Buffers (LE-1T)	0.9	$1,067,990
Stream Restoration		
Stream Restoration[2]	1,033.3	$968
Stream Stabilization[2]	340.0	$2,941

[1]Per curb mile per year

[2]Per foot per year

6.0 Measurable Goals and Milestones for Attaining Water Quality Standards

The primary goals of the Roanoke River TMDL IP Part II are to restore water quality in the impaired waterbodies and subsequently de-list the impaired segments from the Virginia 303(d) List of Impaired Waters for bacteria and aquatic life impairments. This section will outline specific implementation milestones, water quality milestones, the link between implementation and water quality improvement, provide a timeline for implementation, and describe additional tracking and monitoring to measure implementation of achievements.

6.1 Milestone Identification

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 prescribed timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met. The implementation of control measures proposed in the Roanoke River IP Part II will take place over three stages in a 15 or 20 year timeline. The period of implementation varies by the size and urban land use coverage of the subwatershed:

- Implementation actions for smaller and/or more rural subwatersheds will occur over a 15-year timeline. The first two stages will be implemented over 6 years each; the final stage will be implemented over 3 years. This approach is proposed for the following subwatersheds: *Bradshaw Creek and North Fork Roanoke River*.
- Implementation actions for larger and/or more urbanized subwatersheds will occur over a 20-year timeline. The first two stages will be implemented over 8 years each; the final stage will be implemented over 4 years. This approach is proposed for the following subwatersheds: *Wilson Creek and South Fork Roanoke River*.

Of the three implementation stages, the first stage focuses on implementing the more cost-effective and commonly implemented actions such as livestock exclusion practices, crop and pasture BMPs, septic system repairs/replacements and removal of straight pipes, and pet waste source removal and treatment BMPs. The second stage focuses on implementing the majority of

the remaining BMPs to reach the goal of delisting the bacteria impaired segments. The delisting goal is achieved for *Bradshaw Creek* and *South Fork Roanoke River* watersheds in stage 1 and for *North Fork Roanoke River* and *Wilson Creek* watersheds in stage 2. The third stage implements the remainder of the more expensive BMPs and helps to not violate the bacteria geometric mean criterion required by the TMDLs. All four watersheds at the end of stage 3 have a bacteria violation rate of less than 10% for the single sample maximum and also meet the geometric mean criterion (0% violation rate) required by the TMDLs. The Unimpaired North Fork Roanoke River is not impaired and does not have water quality milestones to meet, but implementation milestones are shown (Table 6-5). This subwatershed would have a lower priority for implementation funds in comparison to the impaired watersheds. The IP addresses implementation actions to reduce the anthropogenic sources of bacteria and does not address wildlife reductions for both direct and indirect sources to surface water in the TMDLs.

Tables 6-2 to 6-11 present the three stages for each subwatershed with specific control measures distributed in each stage. Actions listed in each stage are cumulative in nature, and there are place-markers for the later stages to mark when the extent of proposed BMP implementation has been accomplished in a previous stage.

Implementation milestones establish the amount of control measures installed within prescribed timeframes, while water quality milestones establish the corresponding improvements in water quality that can be expected as the implementation milestones are met.

One of the goals of the Roanoke River TMDL IP Part II is to link the implementation of control measures to corresponding improvements in water quality. These improvements in water quality of the impaired segments can be determined through bacteria modeling and adding total sediment reductions. The HSPF model was used to determine the percent exceedance of the geometric and single sample maximum water quality criterion for each stage (or milestone) for each subwatershed. In addition, the instream average annual bacteria loading (cfu/year) at each milestone was determined (Tables 6-2 to 6-10). Table 6-1 depicts the sediment reductions (tons/year) obtained from implementing BMPs at each stage. The total sediment reduction required to meet the benthic TMDL is 17,571 tons per year (Section 3.3.3). From the implementation of the BMPs necessary to meet the bacteria TMDL reductions, 97% of the

benthic TMDL is estimated to be attained at the end of Stage II, and 99% of the TMDL is met at the end of Stage III.

Table 6-1: Water Quality Milestones - Cumulative Sediment Reductions by IP Stage (tons/year) and Percentage Attainment of TMDL Goal

Subwatershed	Stage I	Stage II	Stage III
Bradshaw Creek	891	1,685	1,697
North Fork Roanoke River	2,379	4,354	4,493
South Fork Roanoke River	4,808	8,849	8,959
Unimpaired North Fork Roanoke River	587	1,100	1,114
Wilson Creek	643	1,054	1,083
Total	**9,308**	**17,041**	**17,346**
Percent of TMDL Reductions Attained	**53%**	**97%**	**99%**

Table 6-2: Bradshaw Creek Implementation Staging				
Best Management Practice	Unit	Stage I (Y1-Y6)[1]	Stage II (Y7-Y12)[1]	Stage III (Y13-Y15)[1]
Residential BMPs				
Septic System Pump-Out (RB-1)	Pump Out	58	-	-
Sewer Connection (RB-2)	System	0	-	-
Repaired Septic System (RB-3)	System	8	-	-
Septic System Installation/Replacement (RB-4, RB-4P)	System	9	-	-
Alternative Waste Treatment System Installation (RB-5)	System	2	-	-
Pet Waste Education Campaign	Program	1	1	1
Pet Waste Station	Unit	0	-	-
Pet Waste Composters	Unit	11	-	-
	Total Cost	$154,662	$5,000	$5,000
Existing BMPs				
Street Sweeping (additional miles to be swept annually)[2]	Miles Swept	148	148	148
	Total Cost	$460,270	$460,270	$230,130
Stormwater BMPs				
Bioretention	Acre Treated	13	45	50
Rain Gardens	Acre Treated	25	45	50
Infiltration Trench	Acre Treated	5	18	20
Manufactured BMPs	Acre Treated	10	18	20
Constructed Wetland	Acre Treated	5	18	20
Detention Pond	Acre Treated	3	9	10
Permeable Pavement	Acre Treated	1	4	5
Vegetated Swale	Acre Treated	100	180	200
Rain Barrel	System	87	174	-
Riparian Buffer: Forest	Acre Installed	4	8	-
Riparian Buffer: Grass/Shrub	Acre Installed	4	9	-
Cistern	System	0	0	6
	Total Cost	$2,647,270	$2,805,670	$805,400
Livestock Exclusion Systems				
CREP Livestock Exclusion (CRSL-6)	System	2	2	3
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	System	6	9	12
Livestock Exclusion with Riparian Buffers (LE-1T)	System	6	9	12
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	System	1	2	2
Small Acreage Grazing System (SL-6AT)	System	1	2	2
Stream Protection Fencing (WP-2/WP-2T)	System	1	2	2
	Total Cost	$483,500	$241,750	$241,750
Pasture BMPs				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	9	28	37
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	9	27	36
Woodland Buffer Filter Area (FR-3)	Acre Installed	9	27	36
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	89	177	0
Wet Detention Ponds	Acre Treated	0	0	0
Grazing Land Management (SL-9)	Acre Installed	44	132	176
	Total Cost	$75,458	$144,275	$68,818
Cropland BMPs				
Continuous No-Till (SL-15)	Acre Installed	41	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	48	-	-
Permanent Vegetative Cover on Cropland (SL-1)	Acre Installed	2	-	-
Sod Waterway (WP-3)	Acre Installed	2	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	2	-	-

	Total Cost	$12,180	-	-
Stream Restoration				
Stream Restoration	Feet	4,922	9,844	-
Stream Stabilization	Feet	246	492	-
	Total Cost	$1,494,997	$1,494,997	-
Total Cost Per Stage		**$5,328,336**	**$5,151,962**	**$1,351,098**
Percent Exceedance Geometric Mean (126 cfu/100 mL)		**1.4%**	**1.4%**	**0.0%**
Percent Exceedance Single Sample Maximum (235 cfu/100mL)		**9.6%**	**7.0%**	**6.2%**
Bacteria Load Per Stage (cfu/year)		**2.99E+13**	**2.42E+13**	**2.30E+13**

[1] Numbers represent cumulative total of BMPs implemented
[2] Not cumulative, represented annually

Table 6-3: North Fork Roanoke River Implementation Staging				
Best Management Practice	Unit	Stage I (Y1-Y6)[1]	Stage II (Y7-Y12)[1]	Stage III (Y13-Y15)[1]
Residential BMPs				
Septic System Pump-Out (RB-1)	Pump Out	203	-	-
Sewer Connection (RB-2)	System	25	-	-
Repaired Septic System (RB-3)	System	27	-	-
Septic System Installation/Replacement (RB-4, RB-4P)	System	30	-	-
Alternative Waste Treatment System Installation (RB-5)	System	6	-	-
Pet Waste Education Campaign	Program	1	1	1
Pet Waste Station	Unit	3	-	-
Pet Waste Composters	Unit	43	-	-
	Total Cost	$753,340	$5,000	5,000
Existing BMPs and Detention Pond Retrofits				
Infiltration Trench	System	21	29	-
Constructed Wetlands	System	44	58	-
Street Sweeping (additional miles to be swept annually)[2]	Miles Swept	844	844	844
	Total Cost	$3,014,120	$2,843,753	$1,379,280
Stormwater BMPs				
Bioretention	Acre Treated	75	270	300
Rain Gardens	Acre Treated	150	270	300
Infiltration Trench	Acre Treated	50	180	200
Manufactured BMPs	Acre Treated	75	135	150
Constructed Wetland	Acre Treated	50	180	200
Detention Pond	Acre Treated	25	90	100
Permeable Pavement	Acre Treated	1	4	5
Vegetated Swale	Acre Treated	200	360	400
Rain Barrel	System	347	694	-
Riparian Buffer: Forest	Acre Installed	36	71	-
Riparian Buffer: Grass/Shrub	Acre Installed	40	80	-
Cistern	System	0	0	23
	Total Cost	$7,660,937	$8,848,937	$2,015,140
Livestock Exclusion Systems				
CREP Livestock Exclusion (CRSL-6)	System	5	8	10
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	System	19	29	38
Livestock Exclusion with Riparian Buffers (LE-1T)	System	19	29	38
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	System	3	4	5
Small Acreage Grazing System (SL-6AT)	System	3	4	5
Stream Protection Fencing (WP-2/WP-2T)	System	3	4	5
	Total Cost	$1,506,500	$753,250	$753,250
Pasture BMPs				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	204	613	818
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	552	1,656	2,208
Woodland Buffer Filter Area (FR-3)	Acre Installed	92	276	368
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	3,680	7,360	0
Wet Detention Ponds	Acre Treated	0	0	3,800
Grazing Land Management (SL-9)	Acre Installed	44	132	176
	Total Cost	$3,313,485	$6,350,985	$3,607,500
Cropland BMPs				
Continuous No-Till (SL-15)	Acre Installed	253	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	283	-	-
Permanent Vegetative Cover on Cropland (SL-1)	Acre Installed	15	-	-

Sod Waterway (WP-3)	Acre Installed	15	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	15	-	-
	Total Cost	$75,050	-	-
Stream Restoration				
Stream Restoration	Feet	8,004	16,008	-
Stream Stabilization	Feet	570	1,140	-
	Total Cost	$2,443,900	$2,443,900	-
Total Cost Per Stage		**$18,777,352**	**$21,245,825**	**$7,760,170**
Percent Exceedance Geometric Mean (126 cfu/100 mL)		**4.2%**	**1.4%**	**0.0%**
Percent Exceedance Single Sample Maximum (235 cfu/100mL)		**16.3%**	**5.7%**	**3.4%**
Bacteria Load Per Stage (cfu/year)		**2.02E+14**	**1.16E+14**	**6.23E+13**

[1] Numbers represent cumulative total of BMPs implemented
[2] Not cumulative, represented annually

Table 6-4: South Fork Roanoke River Implementation Staging				
Best Management Practice	Unit	Stage I (Y1-Y8)[1]	Stage II (Y9-Y16)[1]	Stage III (Y17-Y20)[1]
Residential BMPs				
Septic System Pump-Out (RB-1)	Pump Out	416	-	-
Sewer Connection (RB-2)	System	11	-	-
Repaired Septic System (RB-3)	System	56	-	-
Septic System Installation/Replacement (RB-4, RB-4P)	System	62	-	-
Alternative Waste Treatment System Installation (RB-5)	System	12	-	-
Pet Waste Education Campaign	Program	1	1	1
Pet Waste Station	Unit	6	-	-
Pet Waste Composters	Unit	87	-	-
	Total Cost	$1,167,620	$5,000	5,000
Existing BMPs and Detention Pond Retrofits				
Infiltration Trench	System	36	47	-
Constructed Wetlands	System	36	48	-
Street Sweeping (additional miles to be swept annually)[2]	Miles Swept	1,326	1,326	1,326
	Total Cost	$5,834,012	$5,621,971	$2,757,970
Stormwater BMPs				
Bioretention	Acre Treated	150	540	600
Rain Gardens	Acre Treated	350	630	700
Infiltration Trench	Acre Treated	100	360	400
Manufactured BMPs	Acre Treated	200	360	400
Constructed Wetland	Acre Treated	125	450	500
Detention Pond	Acre Treated	50	180	200
Permeable Pavement	Acre Treated	1	4	5
Vegetated Swale	Acre Treated	300	540	600
Rain Barrel	System	622	1,243	-
Riparian Buffer: Forest	Acre Installed	62	124	-
Riparian Buffer: Grass/Shrub	Acre Installed	70	140	-
Cistern	System	0	0	41
	Total Cost	$14,482,325	$16,787,325	$3,641,450
Livestock Exclusion Systems				
CREP Livestock Exclusion (CRSL-6)	System	5	8	10
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	System	19	29	38
Livestock Exclusion with Riparian Buffers (LE-1T)	System	20	29	39
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	System	3	4	5
Small Acreage Grazing System (SL-6AT)	System	3	4	5
Stream Protection Fencing (WP-2/WP-2T)	System	3	4	5
	Total Cost	$1,517,000	$758,500	$758,500
Pasture BMPs				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	240	719	958
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	647	1,940	2,587
Woodland Buffer Filter Area (FR-3)	Acre Installed	108	323	431
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	4,311	8,622	0
Wet Detention Ponds	Acre Treated	0	0	1,720
Grazing Land Management (SL-9)	Acre Installed	44	132	176
	Total Cost	$3,880,378	$7,437,425	$3,815,048
Cropland BMPs				
Continuous No-Till (SL-15)	Acre Installed	662	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	452	-	-
Permanent Vegetative Cover on Cropland (SL-1)	Acre Installed	39	-	-

Sod Waterway (WP-3)	Acre Installed	39	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	39	-	-
	Total Cost	$187,900	-	-
Stream Restoration				
Stream Restoration	Feet	24,070	48,140	-
Stream Stabilization	Feet	1,203	2,407	-
	Total Cost	$7,311,245	$7,311,245	-
Total Cost Per Stage		**$34,380,480**	**$37,921,466**	**$10,977,968**
Percent Exceedance Geometric Mean (126 cfu/100 mL)		**2.8%**	**1.4%**	**0.0%**
Percent Exceedance Single Sample Maximum (235 cfu/100mL)		**2.9%**	**7.6%**	**3.9%**
Bacteria Load Per Stage (cfu/year)		**2.76E+14**	**1.61E+14**	**1.26E+14**

[1] Numbers represent cumulative total of BMPs implemented
[2] Not cumulative, represented annually

Table 6-5: Unimpaired North Fork Roanoke River Implementation Staging				
Best Management Practice	Unit	Stage I (Y1-Y6)[1]	Stage II (Y7-Y12)[1]	Stage III (Y13-Y15)[1]
Residential BMPs				
Septic System Pump-Out (RB-1)	Pump Out	31	-	-
Sewer Connection (RB-2)	System	0	-	-
Repaired Septic System (RB-3)	System	4	-	-
Septic System Installation/Replacement (RB-4, RB-4P)	System	4	-	-
Alternative Waste Treatment System Installation (RB-5)	System	1	-	-
Pet Waste Education Campaign	Program	0	-	-
Pet Waste Station	Unit	1	-	-
Pet Waste Composters	Unit	6	-	-
	Total Cost	$75,400	$0	$0
Existing BMPs and Detention Pond Retrofits				
Street Sweeping (additional miles to be swept annually)[2]	Miles Swept	141	141	141
	Total Cost	$441,030	$441,030	$220,510
Stormwater BMPs				
Bioretention	Acre Treated	38	135	150
Rain Gardens	Acre Treated	75	135	150
Infiltration Trench	Acre Treated	5	18	20
Manufactured BMPs	Acre Treated	10	18	20
Constructed Wetland	Acre Treated	5	18	20
Detention Pond	Acre Treated	5	18	20
Permeable Pavement	Acre Treated	1	4	5
Vegetated Swale	Acre Treated	150	270	300
Rain Barrel	System	45	91	-
Riparian Buffer: Forest	Acre Installed	6	11	-
Riparian Buffer: Grass/Shrub	Acre Installed	6	13	-
Cistern	System	0	0	3
	Total Cost	$4,065,045	$4,407,145	$1,137,930
Livestock Exclusion Systems				
CREP Livestock Exclusion (CRSL-6)	System	3	-	-
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	System	10	-	-
Livestock Exclusion with Riparian Buffers (LE-1T)	System	11	-	-
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	System	1	-	-
Small Acreage Grazing System (SL-6AT)	System	1	-	-
Stream Protection Fencing (WP-2/WP-2T)	System	1	-	-
	Total Cost	$809,000	-	-
Pasture BMPs				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	11	32	43
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	10	31	41
Woodland Buffer Filter Area (FR-3)	Acre Installed	10	31	41
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	205	411	0
Wet Detention Ponds	Acre-treated	0	0	0
Grazing Land Management (SL-9)	Acre Installed	44	132	176
	Total Cost	$93,578	$171,745	$78,168
Cropland BMPs				
Continuous No-Till (SL-15)	Acre Installed	51	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	57	-	-
Permanent Vegetative Cover on Cropland (SL-1)	Acre Installed	3	-	-
Sod Waterway (WP-3)	Acre Installed	3	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	3	-	-

	Total Cost	$15,010	-	-
Stream Restoration				
Stream Restoration	Feet	3,032	6,063	-
Stream Stabilization	Feet	152	303	-
	Total Cost	$920,875	$920,875	-
	Total Cost Per Stage	**$6,419,938**	**$5,940,795**	**$1,436,608**

[1] Numbers represent cumulative total of BMPs implemented
[2] Not cumulative, represented annually

Table 6-6: Wilson Creek Implementation Staging				
Best Management Practice	Unit	Stage I (Y1-Y8)[1]	Stage II (Y9-Y16)[1]	Stage III (Y17-Y20)[1]
Residential BMPs				
Septic System Pump-Out (RB-1)	Pump Out	71	-	-
Sewer Connection (RB-2)	System	13	-	-
Repaired Septic System (RB-3)	System	9	-	-
Septic System Installation/Replacement (RB-4, RB-4P)	System	10	-	-
Alternative Waste Treatment System Installation (RB-5)	System	2	-	-
Pet Waste Education Campaign	Program	1	1	1
Pet Waste Station	Unit	15	-	-
Pet Waste Composters	Unit	98	-	-
	Total Cost	$372,180	$5,000	$5,000
Existing BMPs and Detention Pond Retrofits				
Infiltration Trench	System	109	146	
Constructed Wetlands	System	426	568	
Street Sweeping (additional miles to be swept annually)[2]	Miles Swept	772	772	772
	Total Cost	$5,102,465	$3,842,795	$1,606,480
Stormwater BMPs				
Bioretention	Acre Treated	75	270	300
Rain Gardens	Acre Treated	150	270	300
Infiltration Trench	Acre Treated	25	90	100
Manufactured BMPs	Acre Treated	150	270	300
Constructed Wetland	Acre Treated	75	270	300
Detention Pond	Acre Treated	38	135	150
Permeable Pavement	Acre Treated	1	4	5
Vegetated Swale	Acre Treated	250	450	500
Rain Barrel	System	1,368	2,736	-
Riparian Buffer: Forest	Acre Installed	19	38	-
Riparian Buffer: Grass/Shrub	Acre Installed	21	42	-
Cistern	System	0	0	91
	Total Cost	$10,126,015	$10,784,515	$2,552,680
Livestock Exclusion Systems				
CREP Livestock Exclusion (CRSL-6)	System	1	-	-
Livestock Exclusion with Grazing Land Management for TMDL IP (SL-6/SL-6T)	System	5	-	-
Livestock Exclusion with Riparian Buffers (LE-1T)	System	5	-	-
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	System	1	-	-
Small Acreage Grazing System (SL-6AT)	System	1	-	-
Stream Protection Fencing (WP-2/WP-2T)	System	1	-	-
	Total Cost	$404,000	-	-
Pasture BMPs				
Reforestation of Erodible Pasture (FR-1)	Acre Installed	20	61	81
Vegetative Cover on Critical Areas (SL-11)	Acre Installed	36	109	145
Woodland Buffer Filter Area (FR-3)	Acre Installed	9	27	36
Pasture Management (EQIP 528, SL-10T, SL-9)	Acre Installed	363	727	0
Wet Detention Ponds	Acre Treated	0	0	330
Grazing Land Management (SL-9)	Acre Installed	44	132	176
	Total Cost	$244,295	$461,335	$266,540
Cropland BMPs				
Continuous No-Till (SL-15)	Acre Installed	26	-	-
Small Grain Cover Crop (SL-8)	Acre Installed	30	-	-
Permanent Vegetative Cover on Cropland (SL-1)	Acre Installed	2	-	-

Sod Waterway (WP-3)	Acre Installed	2	-	-
Cropland Buffer/Field Borders (CP-33 and WQ-1)	Acre Installed	2	-	-
	Total Cost	$7,860	-	-
Stream Restoration				
Stream Restoration	Feet	1,887	3,773	-
Stream Stabilization	Feet	94	189	-
	Total Cost	$573,060	$573,060	-
Total Cost Per Stage		**$16,829,875**	**$15,666,705**	**$4,430,700**
Percent Exceedance Geometric Mean (126 cfu/100 mL)		**0.0%**	**0.0%**	**0.0%**
Percent Exceedance Single Sample Maximum (235 cfu/100mL)		**12.4%**	**5.7%**	**5.1%**
Bacteria Load Per Stage (cfu/year)		**1.07E+14**	**6.49E+13**	**5.60E+13**

[1] Numbers represent cumulative total of BMPs implemented
[2] Not cumulative, represented annually

6.2 Targeting

Targeting more specific locations for BMP implementation is part of staged implementation. In order to use limited resources in the most effective manner, targeting smaller areas for BMP implementation, other than on the subwatershed level, can prove useful. To do this, the model segments used in the original TMDL development (Figure 6-1) (VADEQ, 2006a) were ranked based on different criteria for stakeholders to use as a guide in the implementation process.

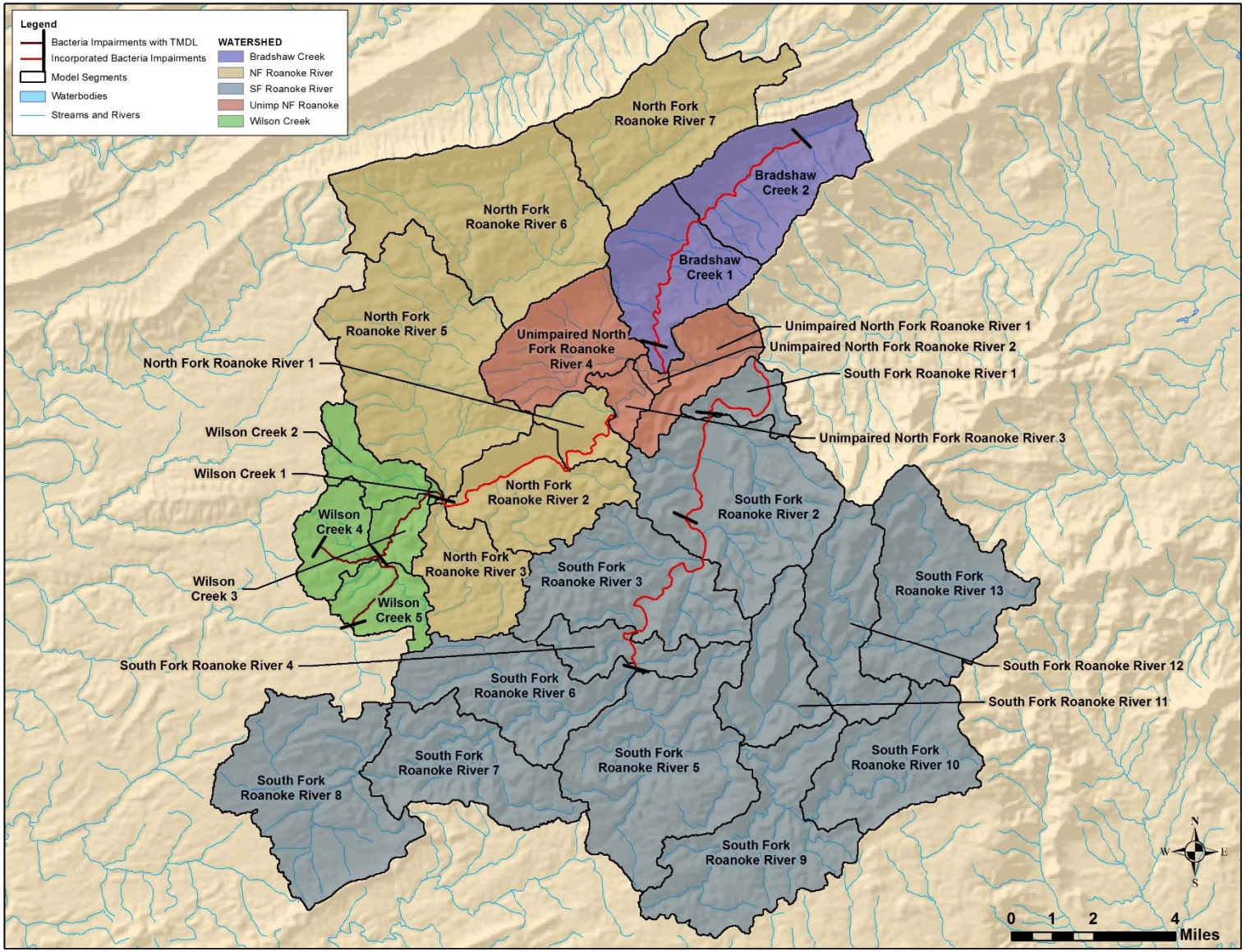


Figure 6-1. HSPF Modeling Segments for the Roanoke River Implementation Plan Part II

The first ranking of the subwatersheds was on residential on-site sewage disposal. The ranks were derived from the number of failing septic systems to be corrected in each model segment and the potential sewer connections from targeted areas (see 5.2.2.1) (Table 6-7).

Table 6-7: Targeting of Priority Subwatersheds for Residential On-Site Sewage Disposal BMPs

Model Segment	Rank
North Fork Roanoke River 5	1
South Fork Roanoke River 13	2
South Fork Roanoke River 3	3
Wilson Creek 2	4
South Fork Roanoke River 2	5
South Fork Roanoke River 8	6
North Fork Roanoke River 7	7
Bradshaw Creek 2	8
South Fork Roanoke River 5	9
Wilson Creek 4	10
North Fork Roanoke River 6	11
South Fork Roanoke River 10	12
South Fork Roanoke River 9	13
Bradshaw Creek 1	14
South Fork Roanoke River 6	15
Wilson Creek 5	16
South Fork Roanoke River 12	17
South Fork Roanoke River 1	18
North Fork Roanoke River 2	19
South Fork Roanoke River 4	20
South Fork Roanoke River 7	21
North Fork Roanoke River 1	22
North Fork Roanoke River 3	23
Wilson Creek 3	24
South Fork Roanoke River 11	25
Wilson Creek 1	26
North Fork Roanoke River 4	27
Unimpaired North Fork Roanoke River 4	28
Unimpaired North Fork Roanoke River 3	29
Unimpaired North Fork Roanoke River 1	30
Unimpaired North Fork Roanoke River 2	31

Another targeting analysis was based on the estimated length of riparian buffer creation in urban areas. Riparian buffer width was not considered in this analysis. While there are a total of 31 segments in the Roanoke River Implementation Plan Part II, not all segments had streams running through urban areas which warranted a riparian buffer creation; hence only 25 segments were ranked. The segments are ranked by the total length of urban riparian zone creation proposed in each segment (Table 6-8). Figure 6-2 illustrates the potential urban riparian zone creation opportunities in all subwatersheds.

Table 6-8: Spatial Targeting of Urban Riparian Buffer Creation

Model Segment	Rank
South Fork Roanoke River 2	1
South Fork Roanoke River 3	2
North Fork Roanoke River 5	3
North Fork Roanoke River 2	4
Wilson Creek 2	5
South Fork Roanoke River 5	6
Wilson Creek 5	7
Wilson Creek 4	8
South Fork Roanoke River 10	9
North Fork Roanoke River 3	10
North Fork Roanoke River 7	11
South Fork Roanoke River 6	12
South Fork Roanoke River 13	13
South Fork Roanoke River 4	14
South Fork Roanoke River 8	15
South Fork Roanoke River 9	16
North Fork Roanoke River 6	17
South Fork Roanoke River 7	18
Bradshaw Creek 1	19
Bradshaw Creek 2	20
South Fork Roanoke River 12	21
Wilson Creek 1	22
South Fork Roanoke River 1	23
Unimpaired North Fork Roanoke River 4	24
Unimpaired North Fork Roanoke River 1	25

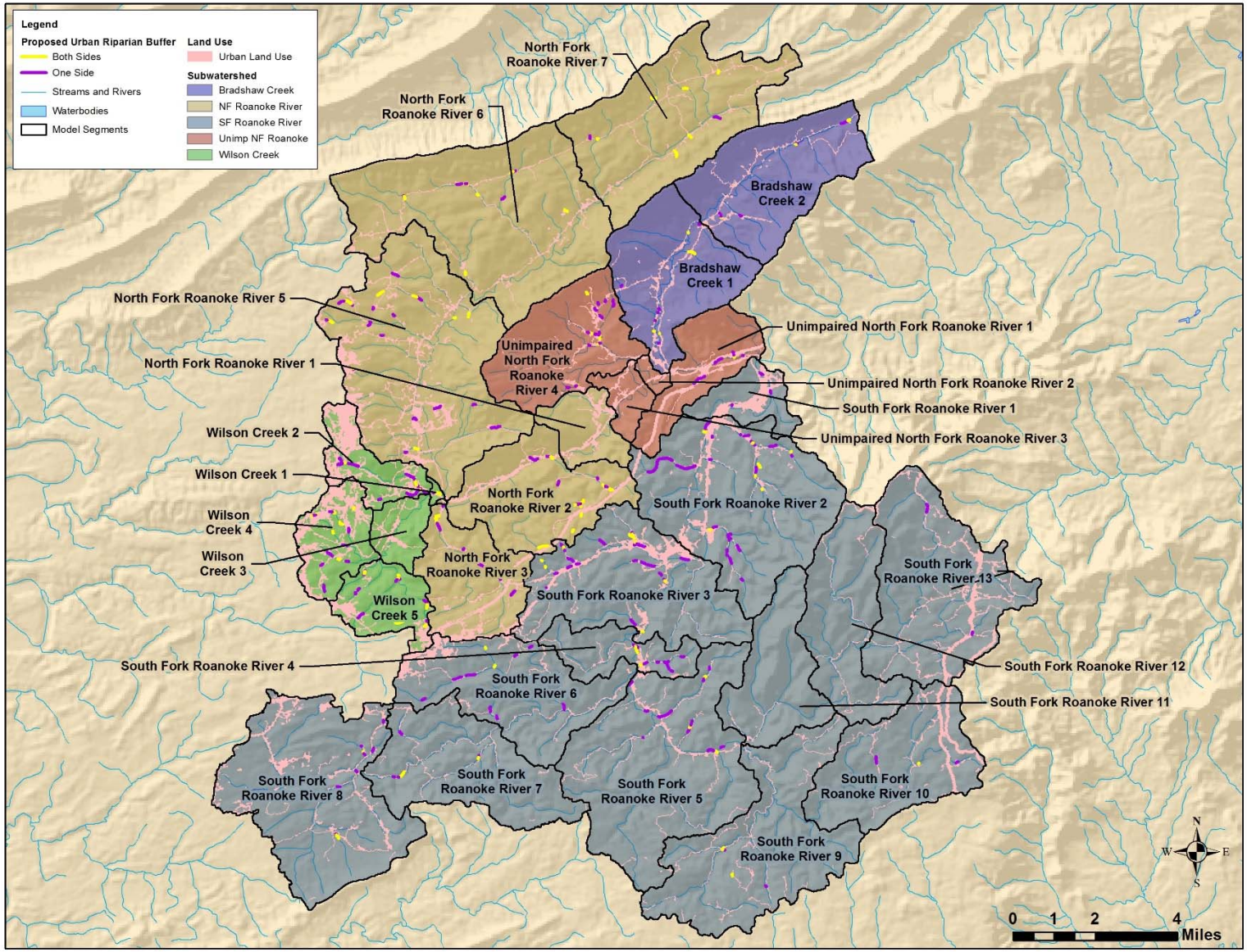


Figure 6-2. Proposed Urban Riparian Zone Creation by Segment for the Roanoke River Implementation Plan Part II

Stakeholders expressed the desire that the IP would help them identify areas which contribute high bacteria and sediment loads so stormwater controls could be implemented to maximize reductions. Table 6-9 ranks the model segments by the density of urban land, or in other words, those model segments which would require the highest coverage of stormwater BMPs. Several segments were 100% urbanized, so in this case, the model segments were ranked based on total urban area. Figure 6-3 presents the spatial distribution of the urban land use in all subwatersheds.

Table 6-9: Spatial Targeting of Urbanized Model Segments for Implementation of Stormwater BMPs

Model Segment	Rank	Model Segment	Rank
North Fork Roanoke River 5	1	Bradshaw Creek 1	17
Wilson Creek 4	2	North Fork Roanoke River 7	18
Wilson Creek 2	3	Bradshaw Creek 2	19
South Fork Roanoke River 3	4	North Fork Roanoke River 1	20
South Fork Roanoke River 8	5	South Fork Roanoke River 12	21
South Fork Roanoke River 13	6	South Fork Roanoke River 7	22
South Fork Roanoke River 2	7	South Fork Roanoke River 4	23
South Fork Roanoke River 6	8	Wilson Creek 3	24
North Fork Roanoke River 3	9	South Fork Roanoke River 11	25
South Fork Roanoke River 10	10	Wilson Creek 1	26
South Fork Roanoke River 5	11	North Fork Roanoke River 4	27
North Fork Roanoke River 6	12	Unimpaired North Fork Roanoke River 1	28
North Fork Roanoke River 2	13	Unimpaired North Fork Roanoke River 4	29
Wilson Creek 5	14	Unimpaired North Fork Roanoke River 3	30
South Fork Roanoke River 1	15	Unimpaired North Fork Roanoke River 2	31
South Fork Roanoke River 9	16		

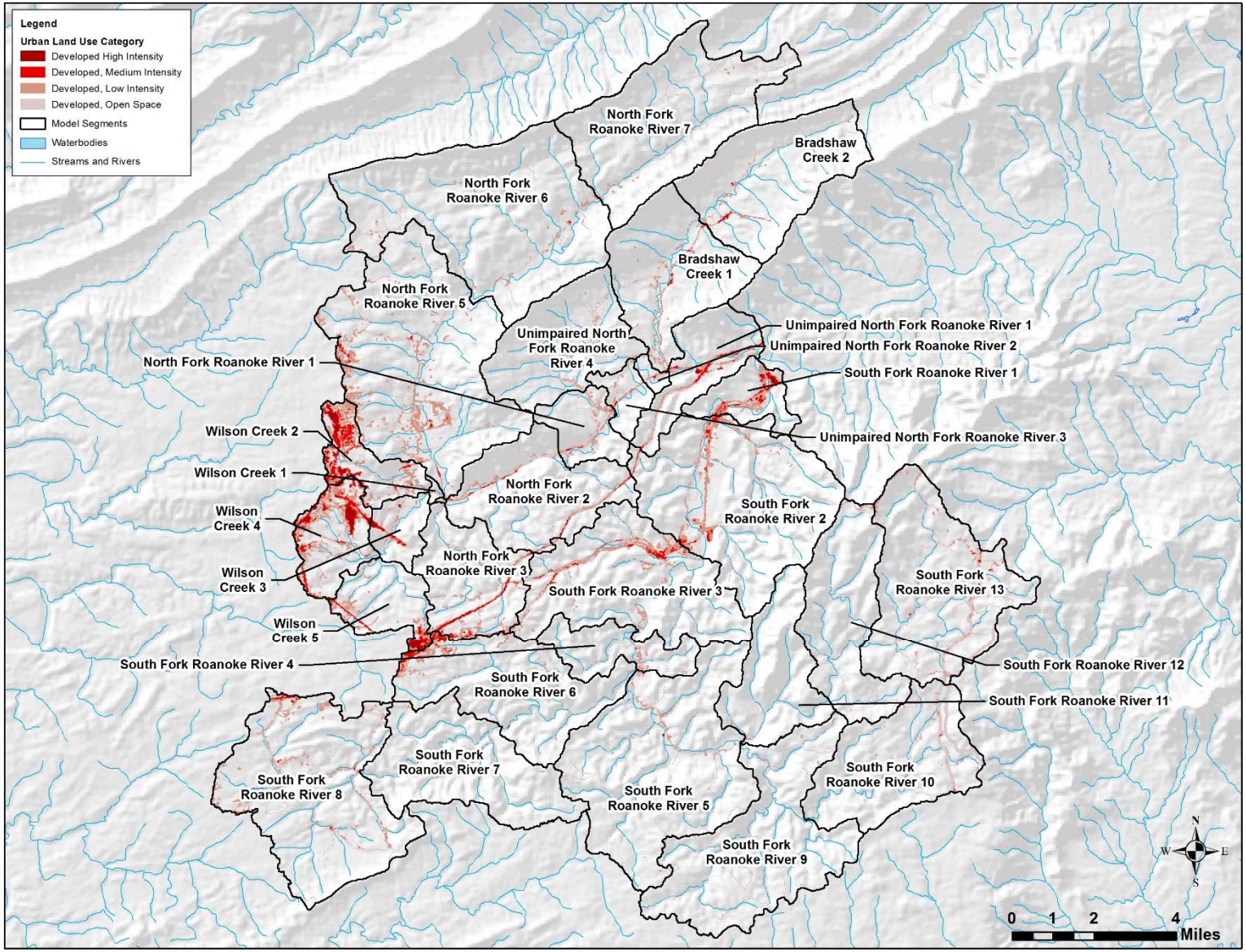


Figure 6-3. Urban Area Density by Segment for the Roanoke River Implementation Plan Part II

Livestock exclusion practices are another spatially calculated BMP which lends itself to targeting, and is highly effective at removing bacteria from streams. As is the case with the urban riparian buffer analysis, not all segments had livestock exclusion practices proposed, thereby only 30 model segments are shown. Table 6-10 ranks each model segment by the total length of livestock stream fencing proposed for these model segments; Figure 6-4 shows the potential stream segments which would need installation of livestock stream fencing.

Table 6-10: Spatial Targeting of Livestock Stream Fencing

Model Segment	Rank	Model Segment	Rank
North Fork Roanoke River 5	1	South Fork Roanoke River 2	16
South Fork Roanoke River 8	2	South Fork Roanoke River 7	17
South Fork Roanoke River 13	3	South Fork Roanoke River 9	18
North Fork Roanoke River 7	4	South Fork Roanoke River 11	19
Bradshaw Creek 2	5	South Fork Roanoke River 1	20
North Fork Roanoke River 6	6	Wilson Creek 5	21
Bradshaw Creek 1	7	South Fork Roanoke River 4	22
Wilson Creek 3	8	Wilson Creek 4	23
North Fork Roanoke River 1	9	North Fork Roanoke River 4	24
South Fork Roanoke River 5	10	Wilson Creek 1	25
South Fork Roanoke River 6	11	Wilson Creek 2	26
North Fork Roanoke River 3	12	Unimpaired North Fork Roanoke River 4	27
South Fork Roanoke River 3	13	Unimpaired North Fork Roanoke River 1	28
South Fork Roanoke River 12	14	Unimpaired North Fork Roanoke River 3	29
North Fork Roanoke River 2	15	Unimpaired North Fork Roanoke River 2	30

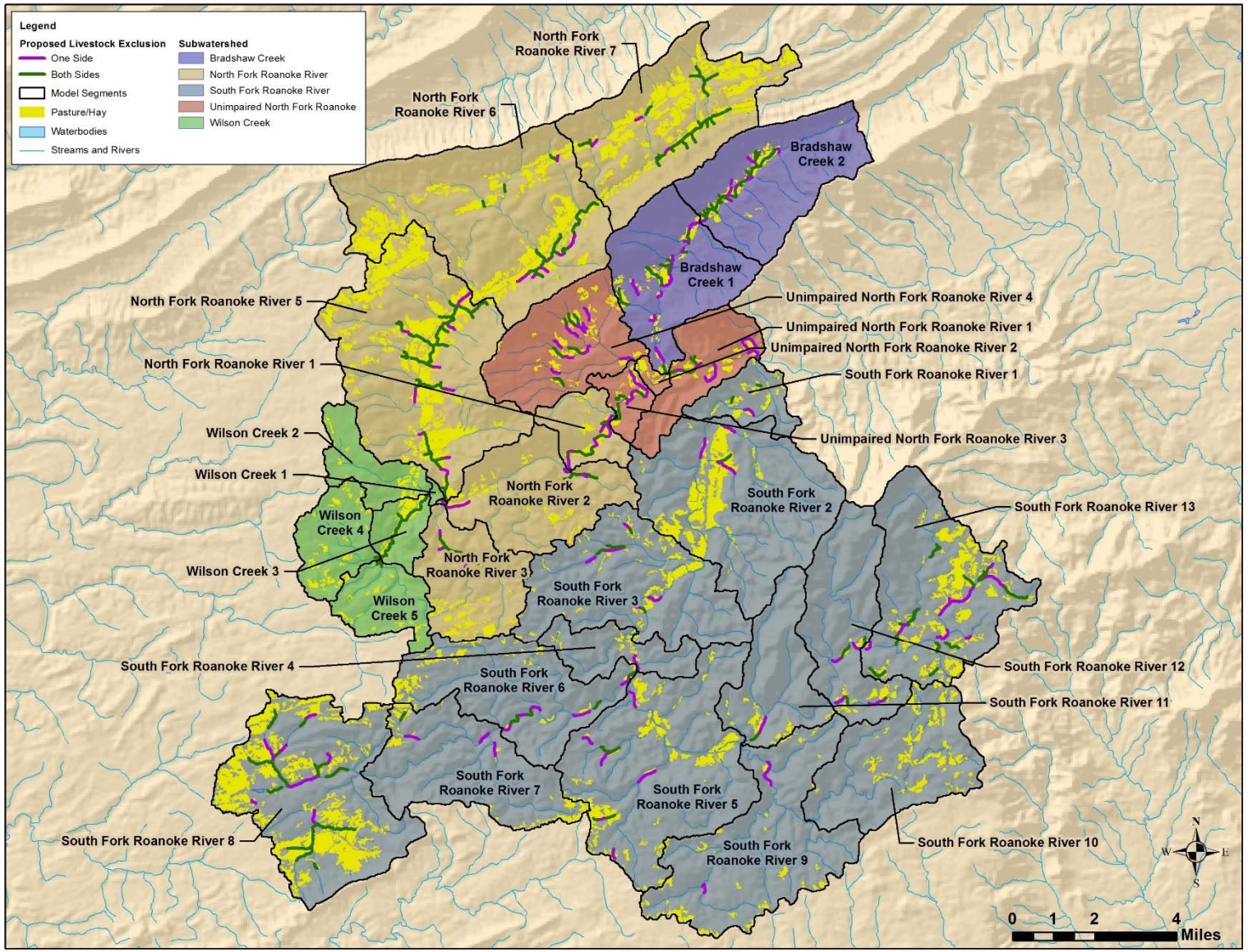


Figure 6-4. Proposed Livestock Exclusion by Segment for the Roanoke River Implementation Plan Part II

6.3 Reasonable Assurance

A big portion of the IP process is to solicit information and vet proposed BMPs, educational programs, and the experiences of the stakeholders. Many of the actions are voluntary, so buy-in from the public is crucial to the success of the watershed IP. During the entire IP process, the major stakeholders and a variety of local conservation agency personnel participated in public meetings, working groups and steering committees. They provided feedback in-person and through emails, and information specific to their fields in regards to BMPs proposed. The high level of participation, diverse group of stakeholders and the presence of MS4 permit holders provide reasonable assurance that the public contributed to and influenced the selection of implementation practices proposed in this IP.

6.4 Implementation Tracking

Implementation actions should be tracked to ensure that BMPs are adequately installed and maintained. Implementation tracking involves inventorying the locations of and the numbers of BMPs put into place within the watershed and will be used to evaluate changes in the watershed. BMP tracking will include the quantification of the various BMPs identified in the IP and reporting the applicable units that are installed in each subwatershed. Management measures, such as types of outreach education activities (e.g., workshops, mailings, field days) and number of participants, should also be tracked. The agricultural practices that are cost-shared will be tracked through the local Soil and Water Conservation Districts and be part of the Virginia Agricultural Cost-share Database, administered by VADCR. Tracking of stormwater BMPs will occur on a municipality level, as the municipalities in the area must track and report progress towards meeting their wasteload allocations for local watershed TMDLs to VADEQ as required by their MS4 permits. A subset of the IP steering committee may want to reconvene and collaborate on implementation tracking at key points throughout the implementation timeline.

6.5 Monitoring Plan

In order to evaluate progress toward meeting water quality milestones, monitoring the water quality of the impaired watersheds will occur throughout the timeline of the IP. Monitoring will also show the progress made from implementing the BMPs proposed in this plan. Since the primary goal of the IP is to de-list the impaired segments for both bacteria and aquatic life,

VADEQ will focus its monitoring efforts on the original listing stations for both the bacteria and benthic impairments (Tables 6-11 and 6-12, Figure 6-5). VADEQ supported monitoring will occur at these and/or additional stations in the IP area after a period of at least 2 years of implementation project installation in a particular subwatershed (to allow for the effectiveness of BMPs to be in place). Key stakeholders may convene with VADEQ to discuss monitoring start times and implementation activities. Monitoring at bacteria and water chemistry stations will occur on a bi-monthly cycle and twice annually for biomonitoring stations, typically in the spring and fall. If VADEQ is unable to de-list the impaired segments in this plan for bacteria and/or sediment using these timeframes, additional monitoring may be scheduled.

Table 6-11: Bacteria Monitoring Stations in the Roanoke River Watershed Part II

Watershed Code	Station ID	Station Description	Stream Name
VAW-L01R	4ARSF002.20	Private Bridge above Green Hill	South Fork Roanoke River
VAW-L01R	4ARSF011.73	Rt. 637 Bridge at Gage	South Fork Roanoke River
VAW-L01R	4ARSF014.02	Persimmon Road Bridge	South Fork Roanoke River
VAW-L01R	4AGOS000.71	Along Rt. 653	Goose Creek
VAW-L02R	4ABDC002.36	Rt. 629 Bridge	Bradshaw Creek
VAW-L02R	4ACDN000.01	Confluence of Cedar Run and Wilson Cr.	Cedar Run
VAW-L02R	4ARNF013.66	Route 603 Bridge Near Ellett (Montgomery County)	North Fork Roanoke River
VAW-L02R	4ARNF016.80	Taylor Hollow Road / Rt. 712 Bridge	North Fork Roanoke River
VAW-L02R	4AWLN000.40	Route 603 Bridge (Montgomery County)	Wilson Creek
VAW-L03R	4AROA227.42	Rt. 773 at Gaging Sta. in Lafayette	Roanoke River
VAW-L03R	4AROA224.54	Route 639 Bridge Near Dixie Caverns (Roanoke County)	Roanoke River

Table 6-12: Benthic Monitoring Stations in the Roanoke River Watershed Part II

Water Shed Code	Station ID	Station Description	Stream Name
VAW-L02R	4ARNF015.22	Upstream of Wilson Creek crossing / downstream of RR Crossing	North Fork Roanoke River
VAW-L03R	4AROA224.54	Route 639 Bridge Near Dixie Caverns (Roanoke County)	Roanoke River

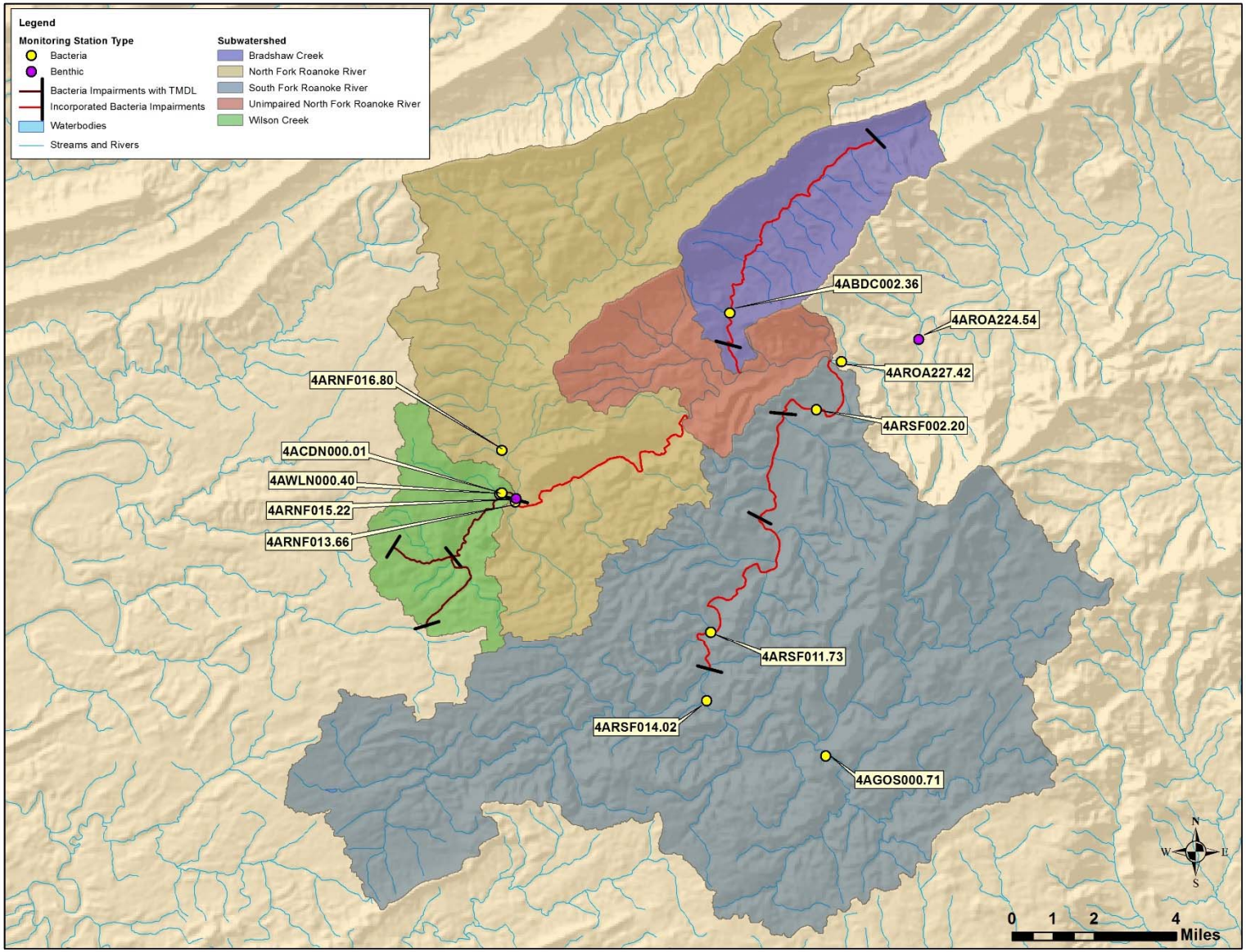


Figure 6-5. Monitoring Station Map for the Roanoke River Implementation Plan Part II

7.0 Stakeholders' Roles and Responsibilities

Stakeholders are individuals or groups who live or have land management responsibilities in the watershed, including federal, state and local government agencies, businesses, special interest groups, and citizens. Stakeholder participation and support is essential for improving water quality and removing streams from the impaired waters list. The purpose of this chapter is to acknowledge the roles of the stakeholders who worked together to develop the Roanoke River IP Part II and to identify and define the roles and responsibilities many of these stakeholders will also play in the implementation of the control measures described in the IP.

7.1 Federal Government

U.S. Environmental Protection Agency (EPA): **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. Section 303(d) of the CWA and current EPA regulations do not require the development of TMDL implementation plans. EPA has outlined nine minimum elements of an approvable IP for states to receive Section 319 funding for IP development and implementation.

Natural Resources Conservation Service (NRCS): NRCS, as part of the U.S. Department of Agriculture, works closely with the American people to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state and federal agencies and policymakers also rely on the expertise of NRCS staff. NRCS is also a major funding stakeholder for impaired water bodies through the Environmental Quality Incentive Program (EQIP). For more information on NRCS, visit *http://www.nrcs.usda.gov/*.

7.2 State Government

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are six state agencies that have a major role for regulating and/or overseeing statewide activities that impact water quality in Virginia. These agencies include: Virginia Department of Environmental Quality (VADEQ), Virginia Department of Conservation and Recreation (VADCR), Virginia Department of

Agriculture and Consumer Services (VDACS), Virginia Department of Health (VDH), Virginia Department of Forestry (VDOF), and Virginia Cooperative Extension (VCE). VADEQ, VADCR, VDOF, and VDH have participated in the Roanoke River IP Part II development process through meeting attendance, comments and suggestions on various aspects of the plan, and/or through provision of watershed and water quality data.

Virginia Department of Environmental Quality (VADEQ): **VADEQ** is the lead agency in the TMDL process. The Code of Virginia (62.1-44.19:5) directs VADEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. VADEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs and IPs to EPA and the State Water Control Board for approval. VADEQ also provides available grant funding and technical support for TMDL implementation. VADEQ has a role in working with local agency partners to track implementation progress for control measures identified in the IP. In addition, DEQ regional staff will work with interested partners on grant proposals to generate funds for implementation. VADEQ is also responsible for assessing water quality to determine compliance with water quality standards. VADEQ will continue monitoring water quality in the Roanoke River and tributaries in order to assess water quality and determine when water quality standards are attained and the streams can be removed from Virginia's impaired water list. More information on VADEQ is available at *http://www.deq.virginia.gov/*.

Virginia Department of Conservation and Recreation (VADCR): **VADCR** administers the Virginia Agricultural Cost Share Program, working closely with Soil and Water Conservation Districts to provide cost share and operating grants needed to deliver this program at the local level and track BMP implementation. In addition, VADCR administers the state's Nutrient Management Program, which provides technical assistance to producers in appropriate manure storage and applications of manure and commercial fertilizer. More information on VADCR water quality programs is available at *http://www.dcr.virginia.gov/soil_and_water/index.shtml*.

Virginia Department of Agriculture and Consumer Services (VDACS): **VDACS** administers the Agricultural Stewardship Act and with the local soil and water district investigates and reviews claims that an agricultural producer is causing a water quality problem. Examples include

sediment erosion and runoff containing nutrients and pesticides. 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 may include civil penalties. 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. Although complaint-driven, the Agricultural Stewardship Act is considered a regulatory tool that can support the implementation of conservation practices to address pollutant sources in TMDL impaired watersheds. More information on VDACS is available at *http://www.vdacs.virginia.gov/stewardship/index.shtml*.

Virginia Department of Health (VDH): **VDH** is responsible for adopting and implementing regulations for onsite wastewater treatment and disposal. VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq.*). Homeowners are required to secure permits for handling and disposal of sewage (e.g., repairing a failing septic system or installing a new treatment system). VDH staff provide technical assistance to homeowners with septic system maintenance, design and installation, and respond to complaints regarding failing septic systems and straight pipes. The localities included in this IP are served by the Alleghany Health District office located in Fincastle, Virginia or the New River Health District office located in Christiansburg, Virginia. More information on VDH programs is available at *http://www.vdh.state.va.us/EnvironmentalHealth/Onsite/index.htm*.

Virginia Department of Forestry (VDOF): **VDOF** water quality inspectors assist loggers and landowners with timber harvest planning and execution and encourage the use of specific voluntary best management practices to keep streams free of silvicultural sediments. If loggers fail to apply necessary BMPs on harvest sites, sediment deposition may occur, and that can lead to civil penalties under the Virginia Silvicultural Water Quality Law (10.1-1181.2). The VDOF has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas *(http://www.dof.virginia.gov/water/index-BMP-Guide.htm)*. VDOF also has a major role in protecting watersheds through riparian forest buffers. Forest buffers provide

nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediments that enter local streams. VDOF administers several cost-share programs including the Reforestation of Timberlands (RT) Program which provides financial assistance to private landowners and the forest industry for pine reforestation. More information on VDOF programs is available at *http://www.dof.virginia.gov/water/index.htm*.

Virginia Cooperative Extension (VCE): **VCE** is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the U.S. Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has published several publications that deal specifically with TMDLs. More information on these publications and the location of county extension offices is available at *http://www.ext.vt.edu*.

Virginia Department of Transportation (VDOT): **VDOT** has prepared a manual to provide guidance in the design of BMPs for water quality control and stormwater management related to VDOT projects and facilities. In addition, VDOT participates in educating the public on the protection of state waters, stormwater pollution prevention, and their MS4 program. VDOT participated in the Roanoke River IP Part II development process through meeting attendance, comments and suggestions on various aspects of the plan, and/or provision of watershed data. More information and resources on VDOT stormwater programs is available at *http://www.virginiadot.org/programs/stormwater_management.asp*. The VDOT BMP Design Manual is available at *http://www.virginiadot.org/business/resources/LocDes/BMP_Design-Manual/BMP_Design_Manual_Cover.pdf*.

Virginia Department of Game and Inland Fisheries (VDGIF): **VDGIF** is responsible for the management of inland fisheries, wildlife, and recreational boating for the Commonwealth of Virginia. Part of the mission of VDGIF is to manage Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth; to provide opportunity for all to enjoy wildlife, inland fish, boating and related outdoor recreation; and to

provide educational outreach programs and materials that foster an awareness of and appreciation for Virginia's fish and wildlife resources, their habitats, and hunting, fishing, and boating opportunities. VDGIF participated in the Roanoke River IP Part II development process through meeting attendance, comments and suggestions on various aspects of the plan, and/or provision of watershed data. More information and resources on VDGIF programs is available at *http://www.dgif.virginia.gov/*.

7.3 Local Government

Local government groups work closely with state and federal agencies throughout the TMDL process; these groups possess insights about their community that may help to ensure the success of TMDL implementation. These stakeholders have knowledge about a community's priorities, how decisions are made locally, and how the watershed's residents interact. Some local government groups and their roles in the TMDL process are listed below.

Soil and Water Conservation Districts (SWCDs): SWCDs are local units of government responsible for the soil and water conservation work within their boundaries. The districts' role is to increase voluntary conservation practices among farmers, ranchers and other land users. District staff work closely with watershed residents and have valuable knowledge of local watershed practices. The **Skyline SWCD** (covering the Floyd and Montgomery Counties portion of the IP) participated in the Roanoke River IP Part II development process through meeting attendance, comments and suggestions on agricultural practices included in the plan, and/or provision of watershed data.

Planning District Commissions (PDCs): PDCs were organized to promote the efficient development of the physical, social, and economic resources of the regional district, including the environment, by assisting and encouraging local governmental agencies to plan for the future. PDCs focus much of their efforts on water quality planning, which is complementary to the TMDL process. TMDL development and implementation projects are often contracted through PDCs. More information on the PDCs located in Virginia is available at *http://www.institute.virginia.edu/vapdc/*. The **Roanoke Valley-Alleghany Regional Commission** (RVARC) contracted the Roanoke River TMDLs IP project and participated in the

IP development process through meeting attendance, comments and suggestions on various aspects of the plan, and through the provision of watershed and water quality data.

County/City Government Departments: City and county government staff work closely with PDCs and state agencies to develop and implement TMDLs. They may also help to promote education and outreach to citizens, businesses and developers to introduce the importance of the TMDL process. Local governments have the ability to enact ordinances that aid in the reduction of water pollutants and support BMP implementation such as requirements for pet waste pickup and septic system maintenance and pump out. They operate the locality Virginia Stormwater Management Program in the capacity as a Virginia Stormwater Management Program Authority in accordance to the Stormwater Management Act (62.1-44.15:24). Representatives from **Floyd, Montgomery, and Roanoke Counties; the City of Roanoke; and the Towns of Blacksburg and Christiansburg** participated in the IP development process through meeting attendance, comments and suggestions on various aspects of the plan, and/or provision of watershed, BMP, and water quality data.

7.4 Community Groups and Citizens

While successful implementation depends on stakeholders taking responsibility for their role in the process, the primary role falls on the local groups that are most affected; that is, community watershed groups and citizens.

Community Watershed and Conservation Groups: Local watershed and conservation groups offer a meeting place and events for river and land conservation groups to share ideas and coordinate preservation efforts and are also a showcase site for citizen action. These groups also have a valuable knowledge of the local watershed and river habitat that is important to the implementation process. The following organizations work in parts of the Part II TMDL IP watershed.

Blue Ridge Land Conservancy (BRLC) promotes the conservation of western Virginia's natural resources—farms, forests, waterways and rural landscapes. They educate landowners and professionals about land conservation options, hold and steward conservation easements, encourage land planning and development which minimizes environmental impacts, and promote

best management practices for forestry and agriculture. Their priority places include rivers and streams as well as family farms and greenways/trails. They serve the Counties of Bedford, Botetourt, Craig, Floyd, Franklin, Montgomery, and Roanoke. Additional information is available at *http://www.blueridgelandconservancy.org.*

Roanoke River Blueway focuses on recreation, sustainability, land conservation, and other environmental pursuits. The organization seeks to promote stewardship and appreciation of the natural and cultural resources in the Upper Roanoke River watershed through increased access, use, awareness and education, and watershed events.

Trout Unlimited (TU) is a national conservation organization devoted to the protection and restoration of coldwater fisheries and associated watersheds on national, state, and local levels. TU uses education, funding, and cooperation with other conservation partners to initiate studies, sampling, restoration projects, and funding of grassroots projects. The local chapter is based in the Roanoke Valley.

Citizens: The primary role of citizens within the TMDL and implementation process is involvement and input. This may include participating in public meetings, assisting with public outreach and education, providing input about the local watershed history, and/or implementing best management practices on their property to help restore water quality. Local residents and farmers have participated in the Part II IP development process through meeting attendance, comments, and suggestions on various aspects of the plan.

Community Civic Groups: Community civic groups take on a wide range of community service including environmental projects. Such groups include Ruritan, Isaac Walton League, Farm Clubs, Homeowner Associations and youth organizations such as 4-H and Future Farmers of America. These groups offer a resource to assist in the public participation process, educational outreach, and assisting with implementation activities in local watersheds.

Southeast Rural Community Assistance Project, Inc. (SERCAP) is a nonprofit organization founded and based in Roanoke that focuses on improving the quality of life within rural communities. Through training programs, technical assistance, and community action as well as partnerships with federal, state, regional and local agencies and businesses SERCAP primarily

addresses water and wastewater needs in rural communities but also assists with community and economic development, housing, and health care.

Animal Clubs/Associations: Clubs and associations for various animal groups (e.g., beef, equine, poultry, swine, and canine) provide a resource to assist and promote conservation practices among farmers and other land owners, not only in rural areas, but in urban areas as well, where pet waste has been identified as a source of bacteria in water bodies.

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

The benefits of involving the public in the implementation process can be very rewarding, but the process of doing so in an effective manner is often challenging. It is, therefore, the primary responsibility of these stakeholder groups to work with the various state agencies to encourage public participation and assure broad representation and objectivity throughout the IP development process.

8.0 Integration with Other Watershed Plans

Water quality in the Roanoke River watershed is an important component of the efforts of many different organizations, programs and activities. Such efforts include both voluntary and regulatory actions through watershed implementation plans, TMDLs, Roundtables, Water Quality Management, Erosion and Sediment Control Regulations, Stormwater Management Programs, Source Water Assessment Programs, local comprehensive and strategic plans, and local environmentally-focused organizations. These efforts should be evaluated to determine how they may compliment the implementation goals outlined in this plan and how local efforts can be more effective. Often these efforts are related or collaborative, but this is not always the case. Coordination of local programs can increase participation, prevent redundancy, and provide diversity. Initiatives coinciding with the Roanoke River TMDL IP Part II efforts in this watershed include, but are not limited to, those described below.

8.1 Projects and Programs

There are various existing programs, projects, and plans that focus on aspects of the Roanoke River Part II watershed including natural resources, water quality and quantity, stormwater, and public education. Brief descriptions of some of these are provided below.

8.1.1 Watershed-wide Plans

Livable Roanoke Valley: In 2011 the Roanoke Valley Alleghany Regional Commission (RVARC) and the Council of Community Services (CCS) created the Partnership for a Livable Roanoke Valley (Livable Roanoke Valley) to address regional challenges such as the economy, employment, population growth, retention of the workforce, health care, poverty, and to plan for a better future. The first integrated regional plan for the Roanoke Valley was developed with an overall goal to promote economic opportunity and a greater quality of life for all residents. One of the plan's additional goals is to work collaboratively to preserve the historic, cultural, and natural assets of the region, which includes the strategy of improving air and water quality. In a survey, 85% of respondents indicated clean air and water as a top priority for the valley. Actions to support this strategy include the development of stormwater banking systems and the restoration and maintenance of stream buffers along critical waterways. More information on this plan is available at *http://livableroanoke.org/*.

New River Valley Livability Initiative: The Livability Initiative began in 2011 as a three-year regional planning process to develop a vision for the future and develop strategies that businesses, community organizations, local governments, and individuals can use to make the vision a reality. The final Livability plan identifies ways to increase regional self-reliance and prosperity, save tax dollars, increase support for local businesses, support and revitalize existing communities, offer more choices in housing and transportation, improve community health, and protect the region's rural character, natural environment and scenic beauty. Goals included in the plan are to protect natural landscapes and ecosystems and to protect and improve water resources. Strategies discussed to achieve these goals are improvements to waste, water and stormwater systems; land conservation; protection and restoration of wetlands, forests, riparian areas; continued outreach and education on water resources and water quality; development of watershed management and stream restoration plans; outreach and implementation for agricultural and stormwater BMPs; and expansion of water quality monitoring. The Initiative is now in the 'Livability in Action' phase, where community partners and individuals from around the region are working to bring the vision, goals, and strategies outlined in the plan to life. The Community Foundation of the New River Valley and the New River Valley Regional Commission created a partnership to support implementation of the Livability Initiative's goals and strategies and support collaboration, track progress on key indicators, and identify the resources needed to move the vision to action. More information on this plan is available at *http://nrvlivability.org/*.

Upper Roanoke River Roundtable (URRR): As described in Section 7.4, the URRR supports numerous projects including education and outreach activities, riparian plantings, clean-up activities, citizen stream monitoring, and pet waste stations. These efforts intend to identify, prevent, and resolve water resources issues in the watershed. The URRR partners with other stakeholders for restoration projects. Partnered with localities, the URRR continues to work on pet waste issues including ongoing education, the installation of three new pet waste collection stations on greenways and trails within the Roanoke River watershed, and the provision of supplies for the stations. These programs and activities are intended to reduce nonpoint source pollution and improve the health of streams within the region.

Roanoke River Blueway: The Roanoke River Blueway is a 45-mile water trail running from the South Fork Roanoke River in Montgomery County to Smith Mountain Lake in Bedford County. The Blueway includes a portion of the South Fork Roanoke River and an access point located in Eastern Montgomery Park located in Elliston, VA. The Blueway continues along the mainstem of the Roanoke River within Bedford, Franklin, Montgomery, and Roanoke Counties. River access through the Blueway facilitates recreational pursuits such as canoeing, kayaking, fishing, and wildlife viewing. In addition to recreational opportunities, the Blueway holds a goal of educating the public about the importance of watersheds and water resources. See *http://www.roanokeriverblueway.org/* for more information.

Trout Unlimited (TU): The Roanoke Valley Chapter of TU focuses on locally implementing projects which support the TU mission to "conserve, protect and restore North America's trout and salmon fisheries and their watersheds." The New River Valley and Roanoke Valley Chapters are involved in stream cleanups, vegetation planting, and stream ecology education. See *https://sites.google.com/site/roanokevalleytu/home* for more information.

8.1.2 Local Comprehensive Plans

Floyd County: The Floyd County Comprehensive Plan highlights goals for the community and protection of natural resources and agricultural land uses (Floyd County 2013). Several goals and policies are recommended that correspond with the goals of the Roanoke River TMDL IP Part II. These include the use of best management practices for agricultural and forest land. Several policies also address the goals of understanding and protecting water resources including homeowner education on private sewer system maintenance, identification of areas where central water and sewer could be established, proper use and care of private septic systems and storage tanks, collaboration among public and private agencies to improve surface water and groundwater, and protection of natural areas. The plan suggests the use of measures such as permeable pavement and rain gardens that would retain more stormwater runoff rather than quickly moving it offsite.

Montgomery County: The Montgomery County 2025 Comprehensive Plan provides goals and strategies for planning and land use, environmental resources, and utilities that would aid watershed cleanup (Montgomery County, 2004). The plan describes expansion areas adjacent to

Blacksburg, Christiansburg, Elliston/Lafayette and Shawsville where new development could be accommodated and could potentially be served by new public sewer extensions. Environmental resource focus is on the protection and conservation of natural resources including streams, rivers, and groundwater. Strategies include education and outreach on water resources issues and BMPs; encouraging the use of agricultural, sewage disposal, and stormwater BMPs; septic system maintenance; and ordinances to protect water quality. Community members have expressed concern about old or failing septic systems as well as the protection of surface water and groundwater. Strategies for Montgomery County utilities in the expansion areas and elsewhere include the evaluation of using alternative wastewater systems and continued extension of sewer especially in areas of designated public health problems. Stormwater management goals and strategies focus on stormwater runoff and erosion for the protection of surface water quality, aquatic habitat, and human health and safety including the development of BMPs and low-impact development (LID) techniques for development projects.

Roanoke County: The Roanoke County 2005 Community Plan objectives include protecting soils, aquatic life and water quality by reducing runoff and soil erosion and reducing flooding and flood damage by protecting floodplains and wetlands (Roanoke County, 2005). The County has adopted the Roanoke River Overlay District as part of the zoning ordinance, which provides a moderate level of environmental protection to this significant water resource. Given the large land base of the county and the amount of construction activity occurring, the county requires additional monitoring and enforcement resources directed towards the control and prevention of soil erosion. The county has developed a regional stormwater management plan.

Future strategies listed in the plan that would help meet water quality objectives in the Roanoke River TMDL IP Part II watershed include: adopting a protective tree ordinance; developing a county-wide "conservation and development" resource map including such features as wetlands and floodplains; adopt a Natural Resources Overlay District which encompasses lands that include wetlands and floodplains; incorporate the design and development of the greenway system into the regional stormwater management plan; revise parking lot standards to reduce impervious surfaces; adopt stormwater management techniques, such as grassy swales, that are both effective on-site control measures and aesthetically pleasing; and enhance existing

regulations and enforcement procedures to reduce soil runoff and erosion and provide for the protection of soils, aquatic life and water quality.

Town of Blacksburg: The Town of Blacksburg Comprehensive Plan is a guide for future growth and provides objectives and policies for an economic, environmental, and socially sustainable community (Town of Blacksburg, 2014). The overall goal for the environment is to retain the beauty, functions, and values of the natural and rural environments that characterize Blacksburg. The plan highlights natural, land, and water resources including open space, agriculture, watersheds, stormwater, and groundwater. Goals that coincide with water quality clean up include the promotion of and education of the public about the value of natural resources, the evaluation of the impacts of proposed development and mitigation measures on watersheds, prohibition of development within riparian buffers, and the protection and preservation of streams and water quality from further degradation.

Town of Christiansburg: The Comprehensive Plan for the Town of Christiansburg provides goals and strategies to guide growth and development and to enhance the livability of the Town (Town of Christiansburg, 2013). Areas highlighted include natural resources, stormwater, water quality, watersheds, open space and land use, and pollution control. Strategies that would correspond to the goals of the Roanoke River TMDL IP Part II include incentives for LID techniques; public education on rain barrels, rain gardens, and stormwater runoff reduction; encouragement and expansion of the use of green infrastructure BMPs including bioretention, rain gardens, permeable pavement, infiltration systems, stream restoration; implementation of riparian buffers and potential establishment of riparian buffer standards; improvement of the stormwater management system, and reduction of stormwater runoff. One pollution strategy includes the creation of designated pet walking zones on public land that include bags and trash cans for pet waste cleanup.

8.2 MS4 TMDL Action Plans

There are four MS4 permits within the Roanoke River TMDL IP Part II watershed. These are for Montgomery County, Town of Blacksburg, Town of Christiansburg, and Virginia Department of Transportation (VDOT). MS4 permittees are required to limit and prevent, to the extent possible, pollutants from entering the stormwater system in order to protect the water quality of

surrounding surface waters. To achieve the required TMDL wasteload allocations, MS4 operators must develop and implement a TMDL action plan that includes public education and outreach on stormwater impacts, public involvement and participation, illicit discharge detection and elimination, construction site stormwater runoff control, post-construction stormwater management in new development and redevelopment, and pollution prevention/good housekeeping for municipal operations. These include measures such as BMPs, stormwater management strategies, maintenance of stormwater infrastructure and discharge data, public involvement, education, and outreach. Most of the MS4 permittees have an illicit discharge detection and elimination system in place. In preparing local TMDL action plans, MS4 permittees can use the Roanoke River IP Part II as a resource for action plan development. However, the IP does not provide prescriptive actions for the localities to employ in order to meet their MS4 requirements.

8.3 Legal Authority

In accordance with the Virginia Stormwater Management Law and the Virginia Erosion, Sediment Control Law, ordinances regulating stormwater management and erosion and sediment control are mandatory within the Roanoke River TMDL implementation Part II study area. These regulations address land disturbing activities to prevent an increase in stormwater quality and quantity issues such as erosion, sedimentation, flooding, and polluted stormwater runoff and surface waters. Although every local program varies, each contains a stormwater pollution prevention plan (SWPPP) that must include a stormwater management plan, erosion and sediment control plan, and pollution prevention plan outlining techniques and best management practices to prevent and reduce stormwater related issues. Available BMPs are those described in the Virginia Stormwater BMP Clearinghouse. This clearinghouse is a source of the BMPs included in this IP as well. BMPs and other information concerning the Clearinghouse are available at *http://www.vwrrc.vt.edu/swc/.*

The Blacksburg Town Council approved a Stormwater Utility Ordinance effective January 2015. All developed properties, excluding VDOT rights-of-way, Virginia Tech, and town-owned properties are subject to the fee (Stormwater Utility Fee) based on the total impervious area of a parcel unless such properties are expressly exempt from the fee under State Code or under the Stormwater Utility Ordinance. The fee will fund maintenance and improvements, compliance

with the Virginia Stormwater Management Program (VSMP) and MS4s, infrastructure mapping and modeling, water quality monitoring, inspections and oversight, public education, watershed planning, and reporting. The goals and benefits of the Stormwater Utility are to improve public health and safety, ensure healthy habitats in local streams, protect drinking water sources, fund infrastructure improvements for stormwater problem areas, comply with federal and state regulations, improve water quality, and minimize streambank erosion. Additional information is available at *http://www.blacksburg.gov/index.aspx?page=1864.*

The Christiansburg Town Council approved a Stormwater Utility Fee effective July 2016. All developed properties are subject to the fee (Stormwater Utility Fee), which is based on the average square footage of impervious surface of a residential property, or a Stormwater Billing Unit (SBU). Residential properties are charged based on one SBU with larger properties assessed the fee on a tiered system. Developed properties that have stormwater management facilities could receive credits that could be used towards the fee. The fee, a component of the stormwater enterprise fund, will support operation and maintenance of the stormwater drainage system, stormwater capital projects, and compliance with the Virginia Stormwater Management Program and Municipal Separate Storm Sewer System (MS4) program requirements. The stormwater utility fee and stormwater management help ensure the proper functioning of the Town's stormwater infrastructure, preserve the health of rivers and streams, prevent water pollution, reduce bank erosion, decrease the impact of flooding, and help the Town comply with state and federal regulations. Additional information is available at *http://www.christiansburg.org/index.aspx?nid=921*.

Ordinance creation is an avenue for compliance with proposed IP actions; however, the IP does not specifically prescribe ordinance creation. Localities have the option to pursue ordinances. The Town of Blacksburg has several regulations concerning connection to the sewer system. Section 18-107 of the Town code requires all houses within 200 feet of the public sanitary sewer to be connected to sewer. Additionally, any house with a septic system that needs repair and is within 400 feet of the sewer systems must connect to the sewer rather than perform the septic repair. Residents typically pay for materials and the town provides the equipment and labor to connect to public sewer.

The Town of Christiansburg requires residents to connect to the sewer systems when a septic system needs repairs. There is no defined distance for this requirement but the Town does look at the distance to the sewer and the cost and will allow septic repair instead of sewer connection if the cost is prohibitive.

8.4 Citizen Monitoring

VADEQ supports a program for the voluntary monitoring of state waters by citizen groups. This monitoring can assist in the listing or delisting of impaired waters, TMDL development through source identification, tracking progress of waters with approved TMDLs or TMDL implementation plans, and identifying waters for potential future VADEQ monitoring. Citizen monitoring also helps to educate the public about water quality in the region and the effect of anthropogenic land uses and activities on water quality. A quality assurance project plan is required before citizens can receive funding for water quality monitoring. State funding allows for development and support of monitoring programs, purchase of equipment, and educational materials. For additional information, see

http://www.deq.state.va.us/Programs/Water/WaterQualityInformationTMDLs/WaterQualityMonitoring/CitizenMonitoring.aspx.

9.0 Potential Funding Sources

Potential funding sources available for the implementation of the proposed control measures and practices (Chapter 5.0) were identified during development of this implementation plan. Funding options vary in applicability to specific watershed conditions, including pollutant sources and land uses, as well as the potential project sponsor(s). A brief description of the programs and their requirements include, but are not limited to, those described below.

9.1 Federal

EPA Federal Clean Water Act Section 319 Incremental Funds – Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds through EPA to implement TMDLs. Stakeholder organizations can apply, on a competitive basis through a Request for Proposals process directed by VADEQ, for 319 grants to implement BMPs and educational components included in a TMDL IP.

United States Department of Agriculture (USDA) – Farm Service Agency (FSA)

Conservation Reserve Program (CRP) – Through this program, cost-share assistance is available to establish cover of trees or herbaceous vegetation on cropland. Offers for the program are ranked, accepted and processed during fixed signup periods that are announced by FSA. If accepted, contracts are developed for a minimum of 10 years and not more than 15 years. 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. Information is available at:
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=crp.

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% to 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 to 15 years. The Commonwealth of Virginia will make an additional incentive payment to place a perpetual conservation easement on the enrolled area. Program details are available at:
http://www.fsa.usda.gov/FSA/webapp?area=home&subject=copr&topic=cep and
http://www.dcr.virginia.gov/soil_and_water/crep.shtml.

USDA – Natural Resources Conservation Service (NRCS)

Conservation Stewardship Program (CSP) – The CSP is a voluntary program that encourages agricultural and forestry producers to address resource concerns by (1) undertaking additional conservation activities, and (2) improving and maintaining existing conservation systems. CSP provides financial and technical assistance to help land stewards conserve and enhance soil, water, air, and related natural resources on their land. CSP is available to all producers, regardless of operation size or crops produced. Eligible lands include cropland, grassland, prairie land, improved pastureland, rangeland, nonindustrial private forest land, and agricultural land under the jurisdiction of an Indian tribe.

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. 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-year 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. Additional information is available at: *http://www.nrcs.usda.gov/wps/portal/nrcs/detail/va/programs/financial/eqip/?cid=nrcs142p2_018820.*

Agricultural Lands Easement Program – The 2014 Farm Bill authorized $1 billion in funding for the new Agricultural Lands Easement program, which consolidates the former Farm and Ranch Lands Protection Program (FRPP), Grassland Reserve Program (GRP) and Wetlands Reserve Program (WRP) into a single program. This program will provide grants to purchase conservation easements that permanently restrict development on important farmland and reward landowners who participate in the program with permanent tax breaks.

USFWS – United States Fish and Wildlife Service

United States Fish and Wildlife Service (USFWS) – The Fish and Wildlife Service administers a variety of natural resource assistance grants to governmental, public and private organizations, groups and individuals. Natural resource assistance grants are available to state agencies, local governments, conservation organizations, and private individuals.

Roanoke Logperch Annual Grant – The grant program is administered jointly by Appalachian Power, USFWS, and the Virginia Department of Game and Inland Fisheries (VDGIF). Project proposals are considered on an annual basis during the November to January timeframe. Projects must be budgeted by VDGIF and approved by the Federal Energy Regulatory Commission. The grant covers the Roanoke River watershed including the North and South Forks of the Roanoke River. Typical grant funding is $50,000 per year. The funds can be used to match federal grants.

9.2 State

Virginia Agricultural Best Management Practices (BMPs) Cost-Share Program – The cost-share program is funded with state and federal monies through local Soil and Water Conservation Districts (SWCDs). SWCDs administer the local programs with state oversight through VADCR to encourage farmers and landowners to use BMPs on their land to better control transport of pollutants into 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 significant impact on water quality. Cost-share is typically 75% of the actual cost. Details concerning this program are available at:
http://www.dcr.virginia.gov/soil_and_water/costshar.shtml#tools, and
http://dswcapps.dcr.virginia.gov/htdocs/agbmpman/csmanual.pdf.

Virginia Agricultural Best Management Practices Loan Program – The purpose of this program is to provide a long term source of low interest financing which will encourage the use of specific BMPs which reduce or eliminate the impact of Agricultural Non-Point Source (NPS) pollution to Virginia waters. This "Low-Interest Loan Program", as it is sometimes referred, is administered by VADEQ. Additional benefits of the program include the protection of open space or natural values of the properties and/or the assurance of the availability of the land for agricultural, forest, recreation, or open space use. Although these other benefits are of value, the principal focus and utilization of the Fund is to improve water quality in the Commonwealth. Details concerning this program and eligible BMPs are available at:
http://dswcapps.dcr.virginia.gov/htdocs/agbmpman/csmanual.pdf.

Virginia Agricultural Best Management Practices Tax Credit Program – For all taxable years, any individual or corporation engaged in agricultural production for market, who has a soil conservation plan approved by the local SWCD in place, is 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. Any practice approved by the local SWCD Board must be completed within the taxable year in which the credit is claimed. The credit is only allowed for expenditures made by the taxpayer from funds of his/her own sources. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. 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. It is also approved for use in supplementing the cost of repairs to streamside fencing (state BMP practice, WP-4D). Details concerning eligible BMPs and other program details are available at:
http://www.dcr.virginia.gov/soil_and_water/costshar.shtml#tools, and
http://dswcapps.dcr.virginia.gov/htdocs/agbmpman/csmanual.pdf.

Virginia Clean Water Revolving Loan 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. Additional information is available at: *http://water.epa.gov/grants_funding/cwsrf/cwsrf_index.cfm.*

Virginia Department of Environmental Quality Citizen Water Monitoring Grant Program – The primary purpose of this program is to provide funding for water quality monitoring groups and individuals to monitor the quality of Virginia's waters. The grant can be used in a variety of ways, including purchasing water quality monitoring equipment, training citizen volunteers, lab analysis costs, and promoting stream monitoring efforts in locations where VADEQ is not currently collecting water quality samples. To be eligible for funding under the regular Citizen Monitoring Grant, a grantee must follow certain guidelines, including developing a quality assurance project plan (QAPP).

Virginia Department of Forestry

Urban and Community Forestry Assistance Program (U&CF) – Funds for U&CF Program are provided by the USDA Forest Service and are administered by the Virginia Department of Forestry. The U&CF Program is designed to encourage projects that promote tree planting, the care of trees, the protection and enhancement of urban and community forest ecosystems, and education on tree issues in cities, towns and communities across the nation. Grants may be awarded to state agencies, local and regional units of government, approved non-profit organizations, neighborhood associations, civic groups, public educational institutions (college level) or community tree volunteer groups for proposals which meet some, or all, of the specific program objectives. Non-governmental organizations must be designated a 501-c-3 non-profit

organization or submit their application through such an organization or a government entity. The typical proposal is in the $5,000 to $10,000 range.

Virginia Forest Stewardship Program – The purpose of this program is to encourage the long-term stewardship of nonindustrial private forest lands, by assisting the owners of such lands to more actively manage their forest and related resources. The Forest Stewardship Program provides assistance to owners of forest land and other lands where good stewardship, including agroforestry applications, will enhance and sustain the long term productivity of multiple forest resources. Special attention is given to landowners in important forest resource areas and those new to, or in the early stages of managing their land in a way that embodies multi-resource stewardship principles. The program provides landowners with the professional planning and technical assistance they need to keep their land in a productive and healthy condition.

Private nonindustrial forest lands that are managed under existing Federal, State, or private sector financial and technical assistance programs are eligible for assistance under the Forest Stewardship Program. Forest resource management activities on such forest lands must meet, or be expanded or enhanced to meet the requirements of the Forest Stewardship Program. Participation in the Forest Stewardship Program is voluntary. To enter the program, landowners agree to manage their property according to an approved Forest Stewardship Management Plan. Landowners also understand that they may be asked to participate in future management outcome monitoring activities. Additional information is available at:
http://www.dof.virginia.gov/manage/stewardship/index.htm, and
http://www.fs.fed.us/cooperativeforestry/programs/loa/fsp.shtml.

Virginia Outdoors Foundation (VOF) – VOF was created by the General Assembly in 1966 to promote the preservation of open-space lands and to encourage private gifts of money, securities, land or other property to preserve the natural, scenic, historic, scientific, open-space and recreational areas of the Commonwealth. The primary way VOF protects land is by holding conservation easements, which are voluntary agreements with landowners that restrict certain types of development on land in perpetuity. VOF also accepts donations of land, which it either protects with an easement and transfers to another landowner, or owns and manages for public benefit.

VOF also administers the Open Space Lands Preservation Trust Fund, which assists landowners with the costs of conveying open-space easements and purchases all or part of the value of easements. Priority for funding is given to applications on family farms and for those with demonstrated financial need. For more information, visit the Preservation Trust Fund page. A gift of a permanent open-space easement may qualify as a charitable gift and be eligible for certain state and federal tax benefits. In addition, there may be local property tax reductions and federal estate tax exemptions. An independent certified appraiser must establish the value of the easement that is primarily based on the value of the development rights forgone. Once that value is established, it becomes the basis for calculating tax benefits. Visit the Tax Benefits section for more information. (Note: VOF does not give tax advice.) Additional information is available at: *http://www.virginiaoutdoorsfoundation.org/*.

Virginia Small Business Environmental Compliance Assistance Loan Fund – 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 $100,000 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. 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. Information is available at: *http://www.deq.virginia.gov/portals/0/deq/air/smallbusinessassistance/autobody/appendix13.pdf.*

Virginia Stormwater Local Assistance Fund (SLAF) – SLAF funds stormwater projects including: (1) new stormwater best management practices, (2) stormwater BMP retrofits, (3) stream restoration, (4) low impact development projects, 5) buffer restorations, (6) pond retrofits, and (7) wetlands restoration. Eligible recipients are local governments, meaning any county, city, town, municipal corporation, authority, district, commission, or political subdivision created by the General Assembly or pursuant to the Constitution or laws of the Commonwealth. The fund is administered by VADEQ.

Virginia Water Quality Improvement Fund (WQIF) – This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources and nonpoint sources are administered through VADEQ. Most WQIF grants provide matching funds on a 50/50 cost-share basis. Additional information is available at: *http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/WaterQualityImprovementFund.aspx.*

9.3 Regional and Private

Community Development Block Grant (CDBG) – The CDBG program is a flexible program that provides communities with resources to address a wide range of unique community development needs. Beginning in 1974, the CDBG program is one of the longest continuously run programs at the United States Department of Housing and Urban Development. The CDBG program provides annual grants on a formula basis to 1209 general units of local government and States.

Over a 1, 2, or 3-year period, as selected by the grantee, not less than 70% of CDBG funds must be used for activities that benefit low- and moderate-income persons. In addition, each activity must meet one of the following national objectives for the program: benefit low- and moderate-income persons, prevention or elimination of slums or blight, or address community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community for which other funding is not available. Information on the program, participation, and eligible activities is available at: *http://portal.hud.gov/hudportal/HUD?src=/program_offices/comm_planning/communitydevelopment/programs.*

Foundation for Roanoke Valley – The Foundation for Roanoke Valley supports qualified nonprofit organizations primarily in the Cities of Roanoke and Salem and the Counties of Roanoke, Alleghany, Botetourt, Craig and Franklin. Consideration may be given to organizations through our geographic affiliates in other areas or when specified by the donor. The Foundation looks for projects and programs where a moderate amount of grant money can produce a

significant result. They look for innovative but practical approaches to solving community problems. Grantees should show a well-planned approach to important public issues; a base of other support (financial, participatory and voluntary); efficient use of community resources; involvement of underserved constituencies; and coordination, cooperation and sharing among nonprofit organizations and elimination of project duplication.

National Fish and Wildlife Foundation (NFWF) – Grant proposals for this funding are accepted throughout the year and processed during fixed sign up periods. 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. Grants generally range between $10,000 and $150,000. 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, a 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.

Five Star and Urban Waters Restoration Grant Program – This NFWF program seeks to develop nation-wide-community stewardship of local natural resources, preserving these resources for future generations and enhancing habitat for local wildlife. Projects seek to address water quality issues in priority watersheds, such as erosion due to unstable streambanks, pollution from stormwater runoff, and degraded shorelines caused by development. The program requires the establishment and/or enhancement of diverse partnerships and an education/outreach component that will help shape and sustain behavior to achieve conservation goals. The Five Star program provides $20,000 to $50,000 grants with an average award size of $25,000. Grants that are in the $30,000 to $50,000 range are typically two years and are in urban areas. Additional information for this program is available at: *http://www.nfwf.org/fivestar/Pages/home.aspx.*

Funding priorities for this program include:

- On-the-ground wetland, riparian, in-stream and/or coastal habitat restoration
- Meaningful education and training activities, either through community outreach, participation and/or integration with K-12 environmental curriculum

- Measurable ecological, educational and community benefits
- Partnerships: Five Star projects should engage a diverse group of community partners to achieve ecological and educational outcomes.

Southeast Rural Community Assistance Project (SERCAP) – 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 SERCAP staff across the region. They can provide (at no cost): 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, or installation of a septic system, and $2,000 toward repair, replacement, or installation of an alternative waste treatment system. Funding is only available for families making less than 125% of the federal poverty level. Details about specific loans and funding opportunities are available at: *http://www.sercap.org/.*

Virginia Environmental Endowment – The Virginia Environmental Endowment is a nonprofit, independent grant-making foundation whose mission is to improve the quality of the environment by using its capital to encourage all sectors to work together to prevent pollution, conserve natural resources, and promote environmental literacy. Current grant-making priorities in Virginia include improving local rivers and protecting water quality throughout Virginia, Chesapeake Bay restoration, enhancing land conservation and sustainable land use, advancing environmental literacy and public awareness, and supporting emerging issues in environmental protection. Applications are accepted biannually with deadlines of June 15th and December 1st. Guidelines and application information are available at: *http://www.vee.org/.*

Wetland and Stream Mitigation Banking – Mitigation banks are sites where aquatic resources such as wetlands, streams and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture that provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking.

Mitigation banks are required to be protected in perpetuity, to provide financial assurances and long term stewardship. The mitigation banking process is overseen by an Inter-Agency Review Team made up of state and federal agencies and chaired by VADEQ and the U.S. Army Corps of Engineers.

Total Action for Progress (TAP) – The mission of TAP is to help individuals and families achieve economic and personal independence through education, employment, affordable housing, and safe and healthy environments. The Indoor Plumbing Rehabilitation program provides installations and renovations of indoor plumbing to homes that do not have indoor plumbing or have inoperable indoor plumbing. Residents of the counties of Alleghany, Bath, Bedford, Botetourt, Craig, Floyd, Franklin, Giles, Henry, Montgomery, Patrick, Pulaski, and Roanoke are potentially eligible for this service. The Indoor Plumbing Rehabilitation program is a loan-based program, based on a 10-year loan with zero interest. The amount a client will pay back on a monthly schedule is based on ability to pay. The rest of the monthly payment is forgiven, as long as the homeowner pays the predetermined payment. The minimum any client will be required to pay is $25.00. Prospective clients for the Indoor Plumbing Rehabilitation Program cannot earn more than 80% of the Area Median Income. Contact information is available at: *https://www.tapintohope.org/IndoorPlumbing.aspx.*

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Appendix A – Impaired Waters Tables

Table A-1: Bacteria Impairment Summary

Cause Group ID	Assessment Unit	Stream Name	Length (mi)	Boundaries	Listing Station ID	Impair-ment	TMDL Established or Nested
L02R-03-BAC	VAW-L02R_BDC01A04	Bradshaw Creek	0.82	Bradshaw Creek from the upstream end of the WQS PWS designation downstream to its mouth on the North Fork Roanoke River.	4ABDC002.36	*Escherichia coli*	Nested
L02R-03-BAC	VAW-L02R_BDC02A04	Bradshaw Creek	7.9	Bradshaw Creek mainstem from near its headwaters downstream to the upstream ending of the WQS PWS designation.	4ABDC002.36	*Escherichia coli*	Nested
L02R-01-BAC	VAW-L02R_RNF03A02	North Fork Roanoke River	6.58	North Fork Roanoke River mainstem from a right bank entry of an unnamed tributary in the community of Ironto upstream to the mouth of Wilson Creek.	4ARNF013.66	*Escherichia coli*	Nested
L01R-01-BAC	VAW-L01R_RSF01A00	South Fork Roanoke River	3.28	South Fork Roanoke River mainstem extends from the PWS WQS upstream ending on downstream to the South Fork's confluence with the North Fork Roanoke River.	4ARSF002.20	Fecal Coliform	Nested
L01R-01-BAC	VAW-L01R_RSF02A00	South Fork Roanoke River	2.98	South Fork Roanoke River mainstem segment extends from Shawsville STP downstream to the WQS designated PWS upstream ending.	4ARSF002.20	Fecal Coliform	Nested
L01R-01-BAC	VAW-L01R_RSF03A00	South Fork Roanoke River	6.37	South Fork Roanoke River from the mouth of Elliott Creek downstream to the Shawsville STP.	4ARSF011.73	*Escherichia coli*	Nested
L02R-02-BAC	VAW-L02R_WLN01A00	Wilson Creek	2.77	Wilson Creek mainstem segment extends from WLN02A00 downstream to the Wilson Creek mouth on the North Fork Roanoke River.	4AWLN000.40	*Escherichia coli*	Established
L02R-02-BAC	VAW-L02R_WLN02A00	Wilson Creek	1.66	This northern arm extends upstream from mainstem Wilson Creek to the Rt. 114 & Rt. 460 intersection behind major developed area near New River Valley Mall.	4AWLN000.40	*Escherichia coli*	Established
L02R-02-BAC	VAW-L02R_WLN03A00	Wilson Creek	2.49	Wilson Creek mainstem segment extends from near Rt. 460/I-81 intersection downstream to intersection of segments WLN02A with WLN01A.	4AWLN000.40	*Escherichia coli*	Established

Source: Based on Virginia's Final 2010 305(b)/303(d) Water Quality Assessment Integrated Report

Table A-2: Benthic Impairment Summary						
Cause Group ID	**Assessment Unit**	**Stream Name**	**Length (mi)**	**Boundaries**	**Listing Station ID**	**Impairment**
L04R-01-BEN	VAW-L04R_ROA03A00	Roanoke River Niagara	0.86	Roanoke River mainstem from near the backwaters of the Niagara Impoundment upstream to the end of the WQS designated public water supply (PWS section 6i) segment. The upstream ending of the PWS segment from SML 795 ft. pool elevation.	4AROA202.20	Aquatic Life
L04R-01-BEN	VAW-L04R_ROA04A00	Roanoke River	0.25	Roanoke R. mainstem from near the backwaters of Niagara Impoundment upstream to the Tinker Creek confluence on the Roanoke River (section 6). The upstream ending of the WQS designated public water supply (PWS) segment from SML 795 ft. pool elevation.	4AROA202.20	Aquatic Life
L04R-01-BEN	VAW-L04R_ROA05A00	Roanoke River	0.35	Roanoke River mainstem from the Western Virginia Water Authority Roanoke Regional Water Pollution Control Plant downstream to the Tinker Creek confluence (WQS section 6).	4AROA202.20	Aquatic Life
L04R-01-BEN	VAW-L04R_ROA06A00	Roanoke River	4.33	Roanoke River mainstem from the Murray Run mouth downstream to the Western Virginia Water Authority Roanoke Regional Water Pollution Control Plant.	4AROA202.20	Aquatic Life
L04R-01-BEN	VAW-L04R_ROA07A00	Roanoke River	3.31	Roanoke River mainstem from the Peters Creek mouth downstream to the Murray Run confluence on the Roanoke River.	4AROA202.20	Aquatic Life
L04R-01-BEN	VAW-L04R_ROA08A02	Roanoke River	2.21	Roanoke River mainstem from the Mason Creek mouth downstream to the confluence of Peters Creek on the Roanoke River.		Aquatic Life

Source: Based on Virginia's 2010 305(b)/303(d) Water Quality Integrated Assessment

Appendix B – Meeting Minutes and Summaries

Table B-1: Meetings During Development of the Roanoke River TMDL Implementation Plan Part II		
Date	**Meeting Type**	**Notes?**
04/30/2015	Public Meeting #1	Y
06/16/2015	Agricultural Working Group #1	Y
06/16/2015	Residential Working Group #1	Y
07/29/2015	Government Working Group #1	Y
12/03/2015	Residential Working Group #2 and Agricultural Working Group #2	Y
03/16/2016	Steering Committee Meeting #1 and Government Working Group #2	Y
07/14/2016	Public Meeting #2	Y

Upper Roanoke River (Roanoke and Botetourt Counties, Cities of Roanoke and Salem, Town of Vinton) TMDL Implementation (Clean-up) Plan Development

Community Meeting to Discuss Two Clean-up Plans: Roanoke River Watershed Clean-up Plan and North Fork and South Fork Roanoke Rivers Clean-up Plan

Presented: April 30, 2015 6:30 p.m. – 8:30 p.m.
Shawsville Community Room, 267 Alleghany Spring Rd., Shawsville, VA

Working Group Participants:

- Mary Dail, Charlie Lunsford, James Moneymaker, Emma Jones, Royce Steiner – Virginia Department of Environmental Quality (DEQ)
- Nick Tatalovich – Louis Berger Group
- John Burke – Town of Christiansburg
- Kafi Howard – Town of Blacksburg
- Charles Maus, Zach Martin – Virginia Tech
- Sarah Orrick, Jeff Christenson, Julio Stephens, Wayne Driscoll, John Holland, Sheilah Holland, Ashley Hall and Katie Brill – EEE on behalf of VDOT
- Irene Leech, Cindy Wells Disney, Doug Burton – Montgomery County
- Liz Belcher – Roanoke
- Shane Sawyer – Roanoke Valley Alleghany Regional Commission
- Paul Angermeier – Virginia Tech
- Donna Conner, David Henderson – Roanoke County
- Sherman Compton, Abe Clark, Javad Torabinejad – Coalition to Protect Blacksburg Waterways
- Ronda Wimmer – Alta Mons
- Cynthia Hancock – Skyline Soil & Water Conservation District
- Betsy Duane, Ben Schoenfeld – Code for NRV

Meeting Agenda

1. **Welcome**
2. **Background on Clean Up Plan Development**
3. **Highlights from Roanoke River Clean-up Plan Part I (Mainstem Roanoke)**
4. **Roanoke Valley Alleghany Regional Commission Initiatives**
5. **General Questions**
6. **Informational Tables & Specific Questions**

Meeting Notes

Meeting began at 6:37 p.m. There were 34 total attendees. Mary Dail (Virginia Department of Environmental Quality or DEQ) welcomed guests and introduced staff. Mary asked the audience how they heard about the meeting. The majority of the audience heard about the meeting via television, newspaper and the Virginia Master Naturalist Network.

Mary explained the background of the project and acknowledged partner organizations. Mary explained TMDL development and the various stages involved. Mary explained the need for a cleanup plan and the human health concerns. She also described the sources of bacteria and sediment impairment.

Nick Tatalovich (Louis Berger Group and DEQ contractor) introduced himself and discussed land use throughout the watershed. Nick explained the contents of the cleanup plan. Nick highlighted the suite of available BMPs and associated outreach efforts. A list of available funding sources was presented to help defray BMP installation expenses.

Mary explained the next steps to achieve water quality goals. The agricultural and residential working groups for Part II of the Roanoke River Watershed Clean-up Plan will meet June 16, 2015.

Shane Sawyer (Roanoke Valley Alleghany Regional Commission) presented highlights of the Roanoke Valley Livability Initiative and Roanoke River Blueways.

Questions/Comments:

Question (Q): What size tributaries are considered part of the Cleanup Plan? Do they have to be perennial?
Answer (A): Any body of water that drains to the Roanoke River above Niagara Dam (sediment) and to the Roanoke River backwaters of Smith Mountain Lake (bacteria) is considered part of the Cleanup Plan. Best management practices (BMPs) are recommended, in some cases, for intermittent streams as well as perennial streams.

Q: How do you decide whether to reduce the total proportion by 75% or 20% or 100%?
A: Advanced modeling is used to mimic natural environmental responses to achieve reductions.

Q: What is the reference being used in this area?
A: Part 2 was used as a reference [with respect to benthic macroinvertebrate communities which are indicators of sedimentation] for Part 1. For bacteria, Virginia's Water Quality Standards determine acceptable bacteria concentrations in streams.

Q: What coordination is there with local government; for example if a large animal operation begins operating?
A: It depends on the size of the animal operation as to whether a Virginia DEQ permit would be required. A permit is required for 300 or more animal units or 200 or more poultry animal units.

Q: How long does DEQ monitor a stream?
A: It depends on the purpose and type of monitoring. DEQ conducts monitoring for water quality assessment using a minimum of 12 samples typically over 2 years. DEQ assesses monitoring data biennially over a six year window. Every two years Virginia updates the "dirty waters" list (303(d) list). DEQ can provide links to water quality data. Some water quality monitoring stations are trend sites, so

they are monitored every year either monthly or bimonthly. Anyone is welcome to ask DEQ staff about a specific stream.

Q: At what point do [best management] practices become mandatory?
A: BMPs aren't mandated for a specific location by DEQ. Permitted facilities and/or entities (as is the case for MS4 permits) may choose to use BMPs to comply with their permits. The cleanup or implementation) plan process recommends types and quantities of BMPs over a timeline that will meet water quality standards.

Q: Do funding sources go strictly to DEQ or are they available for individual landowners?
A: DEQ administers certain types of grant funds, but DEQ does not receive grant funds to install BMPs. SWCDs, watershed groups, and/or universities are common examples of entities that can apply for 319 funding to implement BMPs. There are opportunities for partnerships.

Q: How do you report violations such as straight pipes?
A: The Virginia Department of Health has authority over straight pipes. Since no VDH personnel were available to attend tonight's meeting, DEQ staff can provide contact information for local Health Departments.

Mary Dail reminded attendees to submit comments to the Roanoke River Watershed Clean-up Plan (Part I) by close of business on June 1, 2015. The formal presentation portion of the meeting was closed and attendees were invited to peruse the displays and informational materials as well as ask questions of the Project Team.

Roanoke River Implementation Plan Part 2: North Fork & South Folk Roanoke River, Bradshaw Creek and Wilson Creek

First Agricultural Working Group Meeting

Meadowbrook Community Room, Shawsville, VA
6/16/15, 6-8 pm

Participants: Nick Tatalovich (Louis Berger), Joe Williams (DGIF), Spencer Winfrey (citizen), Leigh Anne Weitzenfeld (City of Roanoke), Randy Lease , Cynthia Hancock (Skyline SWCD), Robert Trout (citizen), Charlie Lunsford (DEQ), and James Moneymaker (DEQ)

General Questions:

1) *How did you hear about tonight's meeting?*

E-mail communication and stream crossing signs

2) *Are there individuals/organizations not present tonight who you think should be here?*

Working group members suggested the USDA Natural Resources Conservation Service (NRCS) and the Virginia Department of Conservation and Recreation (DCR). However, Cynthia Hancock was in attendance representing the Skyline Soil and Water Conservation District. Skyline SWCD, which is collocated with USDA NRCS, helps administer DCR programs and USDA programs.

Other suggested individuals or organizations included the following: Ellett Valley Beef Company, Izaak Walton League, Nature conservancies and more individuals from the farming community.

3) *Are there other ways that we could get the word out about meetings?*

DEQ could partner with Virginia Cooperative Extension to send out mailings to the farming community. Other options include the Link Letter Newsletter or working with farmers market managers to spread the word. Advertisements at the farmers markets were mentioned.

It was mentioned that when DEQ advertises public meetings DEQ should more effectively communicate the purpose of the meeting and describe those that the meeting will affect.

4) *Are there any other bacteria sources that have not been discussed that we should consider in the plan?*

The Implementation Plan accounts for the bacteria sources per the exiting land use categories. No other sources were discussed.

5) *Are there any other sediment sources that have not been discussed that we should consider in the plan?*

Participants mentioned the Mill Creek-Preston Forest subdivision and Virginia Department of Transportation (VDOT) construction projects.

Agricultural Questions:

6) *What is the current growth trend for agriculture in the area?*

Current agricultural trends include the following: fewer cropland acres, more sod acres (South Fork Roanoke River), higher concentrations of horses in some areas and fewer beef cattle, increase in the number of non-traditional agricultural operations that are not eligible for USDA and state agricultural cost-share but may be eligible for other grant funds and could benefit from technical assistance through VCE and SWCDs.

Participants mentioned the Bradshaw Creek area as an area with a greater concentration of horses. Many residents have one or two horses. Participants believe the increase in the number of horses will create more denuded pasture areas.

Regarding cropland, more changes have occurred in the South Fork watershed. One participant asked if there are soil loss calculations for crop fields. Those calculations have not been made. It was mentioned that fields previously farmed as cropland had more residue than current sod farms. Fewer farmers are planting crops.

7) *Are local cattle producers receptive to stream fencing and improving grazing management?*

Many challenges face farmers. Some participants expressed that the stream fencing needed to improve water quality is impractical for individuals to accomplish. Implementation Plans take time. It was mentioned that even the time frame identified in this Implementation Plan may not be long enough to implement the necessary BMPs to improve water quality.

Not all farmers are anti-stream fencing. The majority of large farming operations already work with local soil and water conservation districts and understand the benefits of installed BMPs. It was mentioned that cost-share programs do not always work for every farming operation.

Another common issue is the issue of rented land. A large percentage of farm land is rented. It is more difficult to reach the owners and interest the tenant. Owners are often elderly and on a fixed income. Some tenants are interested in stream fencing; however, they cannot participate based on the uncertainty of their lease agreement.

There is some interest as long as stream fencing remains voluntary. It was mentioned that equine issues exist, but the state has been hesitant to cost-share on equine water quality issues. The thought of local ordinances to control equine issues was suggested. However, some participants expressed they do not agree with local ordinances to regulate equine.

8) *What barriers are holding back progress to implementing stream fencing and improving pasture management?*

Barriers to stream fencing were discussed as follows:

- Fence maintenance during flood events
- Agricultural programs need to provide money for practice maintenance
- Topography and the inability to give up prime farm land on limited acres
- Farmers farming steep terrain cannot give up the required acreage to establish a buffer or setback
- State and federal programs change each year and many farmers do not know what changes occur

9) *Is there existing manure storage in the watershed? Is there a need for additional manure storage?*

According to Skyline SWCD confined feeding operations have mostly addressed manure management issues. Areas of interest may include the Riner area. There are few small dairies and very few intensive beef operations.

10) *Are there any problems with manure spreading on crop or pasture fields locally? What are the best BMPs to address this source?*

Many farmers follow a Nutrient Management Plan and know not to spread on frozen ground. Skyline SWCD reported that there is no manure spreading on cropland in the North Fork Roanoke River, Wilson Creek, and Bradshaw Creek watersheds but was unsure about the South Fork Roanoke River.

11) *Is there poor pasture or erodible cropland in the area that should be converted to forest?*

Very little reforestation occurs in the watershed. It is estimated that less than five percent of cropland is reforested.

12) In general, are there practices that are more easily implemented and/or more appealing than other practices in this area?

With cost-share funding so limited many participants utilize tax credit practices.

13) What are the best ways to outreach to local farmers about water quality and conservation practices in the area? Is there a need for additional education activities/events/materials?

Outreach opportunities include the following:

- Field days
- Farm Bureau meetings
- Young Farmers
- Pesticide licensing meetings
- Livestock and Farmers markets
- Virginia Cooperative Extension
- Trail riding clubs

14) Is there a need for education and outreach on pasture management for horse owners or owners of other types of livestock? Who is best to disseminate this type of information?

Pasture walks and field days are beneficial outreach tools for owners of all types of livestock. Events need to be scheduled to encourage the most participation such as on a weekend or weekday evening. It was suggested that Virginia Cooperative Extension disseminate information to the farming community.

Roanoke River Implementation Plan Part 2: North Fork & South Folk Roanoke River, Bradshaw Creek and Wilson Creek

Residential Working Group Meeting Notes

Meadowbrook Community Room, Shawsville, VA
6/16/15, 6-8 pm

Residential Working Group Meeting Participants

Erin Hagan (Louis Berger Group), Katie Shoemaker (EEE Consulting for VDOT), Jarad Torabinejad, Doug Burton (Montgomery County), Zach Martin and Mary Dail (DEQ)

Prior to breaking out into separate working groups, general background on cleanup plans, Total Maximum Daily Loads (TMDLs), and sediment and bacteria sources was presented. Specific information regarding the Roanoke River Implementation Plan process, contents, sediment and bacteria loads and sources, and best management practices (BMPs). The presentation also explained the working groups and steering committee and how the public can participate throughout the process.

During the presentation a member of the public asked about how municipal separate storm sewer systems (MS4s) factor into the cleanup plan. M. Dail responded that MS4s deal with regulations concerning stormwater and pollutants that are required and not voluntary. The Roanoke River cleanup plan is voluntary and will address sediment and bacteria sources in the non-regulated, non-MS4 areas.

General

1. How did you hear about tonight's meeting?

Signs posted along the river reaches and email.

2. Are there individuals/organizations not present tonight who you think should be here?

Several suggestions were made for individuals or organization that should be present including the New River Valley Planning Commission, Land Conservancy, Virginia Department of Health (VDH), Homebuilders association, and/or Trout Unlimited.

The New River Valley Planning Commission has developed the New River Valley Livability Initiative plan. The Livability Initiative included a focus on improving natural resource assets.

VDH has been trying to obtain a record of septic drain fields in the area and may have GIS data for septics.

3. Are there other ways that we could get the word out about meetings?

Suggestions include:

- The Link Letter monthly local newsletter
- Channel 109 is the Montgomery County cable channel (Doug Burton, Montgomery
- County, volunteered to be the contact)
- Local informal gathering of farmers to sell produce and other products – This occurs infrequently at the little convenience store in Elliston/Shawsville
- Utility bills (note that some residents just have water bills, so this option may not get to
- everyone)
- Ruritan and Isaac Walton League
- Homeowners associations (HOAs) – Could be helpful if there was a list of local HOAs
- Developers – Could reach out to developers to provide education to homeowners on various topics such as septic education including septic maintenance and sediment and erosion control.
- Home Builders Association

Sewer Overflows

4. Are you aware of any sewered areas that may smell of sewage or show other evidence of a sewer leak/overflow, especially during heavy rain?

Participants mentioned that there are sometimes storm sewer overflows in the towns of Blacksburg and Christiansburg. One participant knew of two separate instances of overflows and said that they would provide coordinates.

A question was asked concerning wastewater treatment plant. It was noted that point sources such as wastewater treatment plants are easier to address because they are regulated under a permit.

On-Site Sewage Disposal

5. Are you aware of problems with straight pipes and failing septic systems in the area? Any particular areas?

No participants knew of any straight pipes or failing septic systems. One problem area was discovered in Wilson Creek watershed during the development of the TMDL though.

6. If funds were available to assist residents with straight pipes and failing septic systems, what would be the best ways to notify people of such funds?

- Mailing information to residents the first suggestion. The mailings could be sent out with other required mailings such as a utility bill (sewer, water), tax bill, etc. Should take into account that not all people have certain utilities and make sure that the most people are notified through various types of mailings.
- Local newspaper
- TV announcements could be made on the local cable access channel. Public service announcements are frequently aired on this channel. A participant mentioned that he frequently used this method of notification and added that the station would likely be glad to add an announcement to the rotation.

There are several communities that are considered urban such as Plum Creek, Elliston, Price's Fork but not Shawsville. The urban areas might have different sewage disposal means.

7. Is there an ordinance in Roanoke County, Montgomery County, Blacksburg, or Christiansburg that requires septic tank pumpouts/maintenance? Possibly during property transfers?

One of the participants said they would check on ordinances for septic maintenance. There probably aren't any ordinances in Montgomery County but there may be in the towns.

- *How much does a septic system pump-out cost in this area? How many companies do this type of work?*

  None of the attendees had expertise in this area.

- *Is there a need for alternative systems? What are the regulations associated with alternative systems?*

  Alternative systems are becoming more prevalent because there are stricter regulations for the traditional systems.

10. Is there a need for education regarding the operation and maintenance of septic systems?

Yes, there is a need for septic system maintenance education. Usually the recommended cycle for a septic tank pumpout is every five years.

11. What are some local agencies and organizations best suited for this effort? Available programs? 12. How should education be offered?

Sometimes the soil and water conservation districts (SWCDs) can provide septic education or the health department.

In the towns, printed materials are usually given out when someone moves into a new house. A suggestion was to provide information on the importance of septic pumpout with these other materials.

A possible place for placement of educational information is on a number of Montgomery County webpages. Examples include the Public Services website which mentions septic tanks, or the building inspections or stormwater webpages. Education could be provided through the Montgomery County Citizens Academy.

In Blacksburg, the building permit personnel are overwhelmed therefore it would be difficult to add the additional task of septic system education.

Companies that provide water quality testing services have been able to inform homeowners about the condition of their utility infrastructure. The public frequently is not aware of the condition of their utilities or even if they do or do not have a septic system. A suggestion was that companies that provide these testing services could also send out an educational flyer.

There are many opportunities to piggyback on other events in the area to provide education such as the annual Home Expo in Christiansburg.

A participant asked if any organizations could take on a full time employee. Maybe the regional commission could do a survey or collect information to determine the need for sewer service.

There could be the need/interest/ability to add sewer to Shawsville or nearby areas. If there are mass drain fields in an area that would be efficient to tie that area to an existing sewer system

The Public Service Authority (PSA) has been gathering information on septic and sewer system data.

Pet Waste

13. Are you aware that pets (i.e. dogs) can be a significant source of bacteria entering surface waters in the state? (This is based on bacteria source tracking data collected by DEQ.)

Some participants were aware that pet waste was an issue. On participant who works for the county indicated that he frequently talks about pet waste issues in various aspects of his job. Issues and importance of pet waste removal are frequently successful in the towns but not as much outside of those areas.

Pet waste station maintenance is not an issue for one department. The parks and recreation department would perform the work but needs additional personnel and funding to perform the necessary maintenance.

14. Have you heard about the need to pick up and properly dispose of dog feces locally?

There were not specific areas mentioned within the watershed that had pet waste issues.

15. Are you aware of any localities in the watershed with a "scoop the poop" ordinance?

There was no awareness of any pet waste ordinances.

16. There are pet waste disposal stations on the greenway; are there others in the area? None specifically mentioned.

- *If so, where are they located? (parks, schools, subdivisions, public space) Are there areas where people tend to walk their dogs where such stations could be especially useful?*

Areas where people walk their dogs and where pet waste stations could be useful include the Huckleberry Trail and the Frisbee golf park. Kennels are another place where pet waste stations could be located.

- *17. Are there any local education programs related to pet waste? (ASPCA, veterinarians, 4-H, kiosks, etc.)*

No specific education programs were known.

- *18. How can we educate homeowners about the impact of pet waste? Would people use a pet waste digester?*

One suggestion for education of homeowners about pet waste was through various town registers or licenses (e.g. dog license).

It was suggested to that areas where educational material could distributed or posted include the new animal shelter being built, the Frisbee golf park, and along the Huckleberry trail.

It was suggested that perhaps pet waste is not problematic in the Part II watersheds because of their largely rural nature. With large plots of rural land pet waste is probably not be as big of a problem because of bacteria die off.

Digesters might be used in HOAs or at hunt clubs which frequently have kennels for large numbers of hunting dogs. One kennel for pets that is not far from Montgomery County is Gandalf Kennels; educational materials could be concentrated there or at similar places.

<u>Stormwater</u>

This Clean-up Plan will address the need for some stormwater Best Management Practices to collect and treat runoff from residential and urban land areas that contribute to sedimentation and bacteria from pets, failing septic systems, and illicit sewage discharges. These may include rain gardens, bioretention filters, infiltration trenches, vegetated buffers along streams, rain barrels, etc.

- *19. Do you know of any areas where flooding consistently occurs during heavy rains?*

In Montgomery County, the erosion and sediment control inspectors respond to complaints. Building inspectors are different. Christiansburg has two erosion and sediment control inspectors and Blacksburg has at least one.

- *20. Have you seen any areas of severe bank erosion along the North Fork and/or South Fork Roanoke Rivers or other tributaries? If so, where?*

There are areas of severe bank erosion in the watershed. One participant worked with a lab at Virginia Tech that recently studied and highlighted areas of severe bank erosion. Some areas would require additional surveying and groundtruthing. The study was provided to Virginia Department of Game and Inland Fisheries. The participant said that the information from this study could be provided to the Implementation Plan team.

It would be a good idea to have landowners who have already done restoration work on their property to come in and talk to other members of the public about their experiences.

There are places along the North Fork that landowners don't want to do any riparian buffer or stabilization work.

A suggestion was made to reach out to fishermen through the fishing license process or through Trout Unlimited. There are also one or more fish hatcheries in the watershed that could be good places for the dissemination or gathering of knowledge about restoration needs.

- *21. Do you feel that the term stormwater is recognized by most citizens? If so, what connotation is associated with it (i.e., do people associate stormwater with a fee?)*

There are no local watershed groups.

The problem is the distribution of information.

- *22. Have any of you implemented stormwater BMPs on your property to deal with runoff? If so, what practices?*

No participants indicated that they had implemented BMPs.

Some stormwater BMPs are eroding or degrading so retrofits would work well. Stormwater BMPs have different types of requirements; some of these would require more work.

If North Fork Road is redone, there would be more impervious surface. This would also bring more development which would also increase impervious surface.

A participant was concerned that developments are always allowed to proceed even though they are harmful for water quality. Mitigation for developments must be better. Someone suggested that maybe the issue is with the stormwater BMP regulations not the BMPs themselves.

- *23. Are you aware of what riparian buffer zones are? How willing would your neighbors or other community members be willing to create or expand these zones?* NA
- *24. Are there any public areas where you know of stormwater BMPS having been implemented? What practices? Where?* NA

Other Items for Discussion:

25. Are there any organizations or groups in the area that work on projects related to any of these issues (sewer overflows, sewage disposal, pet waste, stormwater management, stream restoration and cleanup) that aren't represented here?

Virginia Tech could be a potential partner. Another potential partner is the Mountain Valley Charitable Trust. This organization has been involved in funding of charitable ventures such as the YMCA and the thrift shop in Elliston.

26. Is there interest in a watershed tour? NA

27. What are some of the barriers to implementing water quality improvement projects in the watershed?

Blacksburg and Christiansburg have discussed stormwater fees or credit systems. Blacksburg has implemented a stormwater utility fee. There could be a reduction in the fee if a property owner implements a BMP. Barriers include the issue of "double taxation". Montgomery County would have a hard time implementing a stormwater fee.

28. Is there interest in a program like Lynn Haven River Now for homeowners who commit to practices that reduce sediment and bacteria pollution – it could expand beyond the two stressors and cover nutrients (fertilizing, etc.)"PEARL HOMES are places where people care about our community and our environment and want to do what they can to live responsibly and help protect our resources."

- *Scoring system included and flags are distributed to Pearl Homes*

Participants said it was an interesting idea.

North Fork & South Fork Roanoke River Implementation Plan (Part II)

First Governmental Working Group Meeting Notes

Town of Christiansburg Administration Building
100 East Main Street, Christiansburg, VA
7/29/15, 2-4 pm

Attendees:
Kafi Howard (Town of Blacksburg), Katie Shoemaker (EEE Consulting for VDOT) , Ashley Hall (EEE Consulting for VDOT), Joe Williams (VA Dept. Game & Inland Fisheries), Doug Burton (Montgomery County), Leigh Anne Weitzenfeld (City of Roanoke), Chris Barbour (Skyline SWCD), Nick Tatalovich (Louis Berger), Erin Hagan (Louis Berger), John Burke (Town of Christiansburg), Mary Dail (DEQ), Charlie Lunsford (DEQ), James Moneymaker (DEQ)

Attendees briefly introduced themselves. Mary Dail of the Virginia Department of Environmental Quality (DEQ) began the meeting with a brief description of the watershed area and discussed some of the Clean-Up Plan components (powerpoint presentation). DEQ is very appreciative of its partners assisting in this TMDL process.

The Governmental Working Group is tasked with the following: selecting possible best management practices for water quality improvement, identifying funding sources and technical resources presently available, evaluating additional programs/technical resources that could enhance implementation, identifying lead agencies for business and residential implementation support considering regulatory controls that could induce actions to improve water quality and discussion of local government ordinances or policies that may improve water quality.

Nick Tatalovich with The Louis Berger Group (LBG) discussed some of the Best Management Practices (BMPs) that will be necessary to reduce sources of bacteria including residential BMPs, urban BMPs and agricultural BMPs. It is important to keep in mind that all BMPs have varying pollution reduction values. DEQ is requesting all levels of BMP information from localities to aid in this process. The request covers all existing BMPs regardless of age. BMPs will be fully "credited" in terms of their effect on pollutant load reduction, if confirmed they were constructed post-2003 (which is when the modeling period ended). BMPs installed for new construction also need to be identified so there can be interpretation on crediting are not crediting reduction. Discussion with VADEQ, Louis Berger and stakeholders will determine the method which crediting will occur farther down the line of the TMDL IP development. Louis Berger is providing access to its ftp website for localities to upload available GIS data. Louis Berger will begin the modeling process once data collection is complete. Mary Dail explained the next steps in the implementation process and how DEQ and its partners will work to identify recommended BMPs.

Working Group Discussion:

Italicized questions were asked of the group at large.

Are there other individuals or organizations we need to include in this process?

- Roanoke County [unable to attend]
- New River Valley Planning District Commission
- Virginia Tech - Chuck Dietz

Information Request for Localities:

DEQ would appreciate localities sending the following information as is available:

- Stormwater BMP (GIS Layers)
    - Type of BMP (Detention (Dry) Basin, Retention (Wet) Basin, Bioretention, Infiltration Trench, Manufactured Units, Constructed Wetlands, Rain Gardens, Permeable Pavement, Riparian Buffers, Urban Landuse Conversion)
    - Location of BMP
    - Drainage Area of BMP
    - Age of System
- Sewage Disposal Practices (GIS Layers)
    - Sewer Lines
    - Housing/Building Layers (with age of houses)
- Street Sweeping Practices
    - Extent and Frequency of Sweeping
    - Amount of Debris swept
- Pet Waste Program Information
    - Pet Waste Station Locations (Existing and Proposed)
    - Any ongoing educational or outreach efforts
- Streambank stabilization projects
    - During development of the Part I Roanoke River Implementation Plan, 25.5 lbs/ft/year average sediment reduction was applied to streambank stabilization BMPs. Localities are asked if this is a reasonable sediment reduction efficiency and/or if they have data supporting another factor (a spreadsheet would be appreciated in this case).
- Stream Restoration Projects
    - Location, Length and Cost of Project
    - Average Sediment Reduction per foot (310 lbs/ft/yr) was utilized in previous IPs (and Part I Roanoke River IP); if available, please provide calculation spreadsheet if another sediment reduction efficiency is used.
- Grant Funding Opportunities
- Ongoing or Future Watershed Plans
- MS4 Annual Report

Localities were asked to use LBG's ftp site to upload above requested information by 9/18/15.

Sewage Handling and Disposal Discussion Tables:

- A participant asked if the towns are included in the following table: "percentage of houses within each county on public sewer, septic system, and other means". Yes, the portions of the towns located within the boundaries of the impaired watersheds are included in the percentages provided in the table.

- New construction has public sewage available. Blacksburg and VT share a sewer system and Christiansburg has its own sewer system. Montgomery County has a Public Service Authority which maintains joint water and sewer lines. The Authority includes Shawsville.

- Montgomery County has some available GIS data.

- DEQ/LBG are trying to get a realistic number of the houses on conventional septic.

- *Are there any BMPs targeting undersized sanitary sewer or overflows (SSO's)?*

    - The Roanoke City representative stated that the City does not always know when a problem occurs. How can the locality get overflow information? Incidents are required to be reported to DEQ. Sanitary sewer issues are being handled within the permit program at DEQ. Illicit discharges are more difficult to determine versus a sanitary sewer overflow.
    - A stakeholder commented that in general, Inflow &Infiltration (I&I) events are typically underreported. Researchers from Virginia Tech have studied I&I in Blacksburg.
    - The comment was made that Floyd County has no public sewer within the IP area.
    - The Town of Blacksburg representative states that there is little the town can do because the watershed area of interest within town limits is all or almost all on sanitary sewer. They noted there are educational gaps in the need to report sewage smells to the town.
    - Localities mentioned they are short on resources for inspections

- The number of residences served by public sewer are derived from census data. The group stated that the Floyd County numbers for the IP area are incorrect in that there are only septic tanks and potential straight pipes in that portion of the county.

- Stakeholders reported the Blacksburg Country Club, served by Aqua Virginia, empties into the North Fork and has "very weak treatment". DEQ confirmed that historically this facility had permit compliance challenges. Recent DMRs show that the facility is meeting applicable limits. DEQ can further follow up with Compliance staff regarding this facility.

- *Is there a need for public sanitary sewer education?*

    - Stakeholders mentioned that disposable wipes are bad for sanitary sewer systems as they can cause SSO's. More education is needed to increase awareness and change habits.
    - In addition, education of citizens on sewer and pet waste problems is needed. A suggestion was made to include information in mailers; however, it is important to note that there is a discrepancy between people receiving water and sewer bills.

- *Roanoke County requires that houses within a certain distance to the sewer system connect (300 feet). Do other localities enforce a similar ordinance?*

    - The Town of Blacksburg requires connection to the sewer system if the structure is within 200 feet of the sewer line.

- *Is there a need/interest/capacity to add additional sewer? Is that something we should consider as BMPs are recommended?*

    - Montgomery County mentioned that it has a sewage treatment plant at capacity.
    - DEQ/LBG responded that IPs generally do not address costs associated with new sewer construction in local communities because this action is much broader that connecting existing residences with failing septic systems to an existing public sewer footprint. If there were plans to build a small community treatment system to address a number of residences with failing septic systems then this type of action would be appropriate in an IP.

Agricultural Programs and Implementation Locally

- *Interest in conservation programs within the Roanoke River watershed is low. What are the reasons why interest is low?*

    - The Conservation Reserve Enhancement Program (CREP) is intended to improve water quality, but it does not account for rotational grazing fencing. Farms need a grazing system.

- Does CREP include an alternative water system?
  - SWCD personnel responded that it does however there are limits/restrictions
- VDGIF Landowner Incentive Program: Mr. Williams indicates that landowners fear losing control of their land to the government. Fence maintenance is an issue especially due to funding needs. There is no more money available for Landowner Incentive Program projects.
- A comment was made that buffers are not very efficient in mountainous areas and that top-of-bank fencing BMPs and interior fencing BMPs are needed.
  - Charlie Lunsford (DEQ) agrees that we need more flexibility with regional options.
  - A comment was made that sometimes it takes land changing hands for BMPs to be implemented.
  - Charlie asked which watershed of the four could be targeted with limited funding? Chris Barbour is unsure which areas could be targeted at this time.
    - Doug Burton states that there is more livestock in the Riner area.
    - The group agreed that it will be tough to implement agricultural BMPs in Bradshaw Creek. Chris mentioned that there are not many animals in the South Fork that haven't already been excluded although there could be a small amount in Wilson Creek.
- Land use has changed significantly over the years.
- The comment was made that loads are modeled from each acre of pasture. The question was asked if the IP takes into account land use changes. LBG has utilized the Agricultural Statistics Service data; however, it is noted that not every farmer completes those surveys.
- The question was posed about whether nutrient management for urban areas is being considered? The answer is that no, a bacteria reduction is not associated with this BMP. BMPs have different efficiencies by specific pollutant.

Stormwater Programs (Urban Runoff)

- A stakeholder commented that many of the stormwater BMPs in the North Fork will be VDOT BMPs. Another stakeholder responded that VDOT only installs a BMP to offset development projects in other areas.

- Doug Burton states that Montgomery County only has BMPs resulting from new development and not retrofits.

- A stakeholder asked from what year is the Land Use data derived.
  - LBG responded that land use data is from 2006 as was used in Part 1. A locality representative inquired about whether or not the localities should give percent

imperviousness? Nick will follow up with the LBG modeler. Land use is a big driver regarding pollutant loading.

- *Are there streambank restoration opportunities?*
    - The group conveyed that there are a lot of opportunities for streambank restoration especially in the North Fork. Permitting can be an issue for some of these projects. Efficiency may not be specific to streambank restoration versus streambank stabilization. It was suggested that there would likely be a need for specific targeted grants to fund stabilization/restoration measures.

Pet Waste

Do we need to account for pet waste BMPs? Is it more education? How is an education program quantified?

The group responded:

- There are not many concentrated areas for pets (e.g. dog parks).
- It was mentioned that there a pet waste issues in Blacksburg.
- Virginia Tech has data on pet waste bags used on the Huckleberry Trail.

Mary thanked everyone for their time and the meeting adjourned at 4:05 p.m. A Government Working Group representative to the Steering Committee is sought. The next meeting will likely be in November.

[Meeting Handout]

Roanoke River Watershed Clean-up (TMDL Implementation) Plan
Part II: North Fork and South Fork Roanoke Rivers

1.1.1 GOVERNMENT WORKING GROUP

1.1.2 July 29, 2015 2:00 p.m., Town of Christiansburg Offices

2.0 AGENDA

1. Welcome and Introductions
2. Background on Clean-up Plan Development
3. Information Request
4. Discussion
    a. Sewage Handling and Disposal
    b. Agriculture Programs and Local Implementation
    c. Stormwater Programs
    d. Pet Waste
    e. Other Bacteria Sources
    f. Integration with Other Activities and Local Planning
    g. Regulatory Controls

Information Request for Localities:

We are looking for as much information pertaining to the following management practices as is available. While we are seeking detailed information, any form or level of information would be appreciated.

- Stormwater Best Management Practices (GIS Layers)
  - Type
  - Drainage Area
  - Date of Install
- Sewage Disposal Practices (GIS Layers)
  1. Sanitary Sewer Coverage layer
  2. Housing layers with age of houses
- Street Sweeping Practices
  - Extent of Sweeping (miles)
  - Frequency of Sweeping
  - Amount Debris Swept
- Pet Waste
  1. Existing Pet Waste Education Program Information
  2. Existing/Proposed Pet Waste Station Locations (GIS if available)
- Stream Restoration Projects (Completed/Ongoing/Planned)
- Storm Drain Clearing Efforts
- Funding Opportunities for Grants
- Ongoing or Future Watershed Plans
- MS4 Annual Report

Land Use Changes since the original TMDLs were developed:

Part II Landuse Distribution and Comparison							
Landuse	Developed	Cropland	Pasture/Hay	Forest	Water/ Wetlands	Other	Total
NLCD 1992 Acres	2,274	3,678	23,150	131,975	225	743*	162,046
NLCD 2006 Acres	13,878	1,216	20,179	126,504	140	130**	162,046
Percent Change	**510.2%**	**-67.0%**	**-12.8%**	**-4.1%**	**-37.8%**	**-82.4%**	

Sewage Handling and Disposal Discussion Tables

Straight pipe estimates from TMDL:

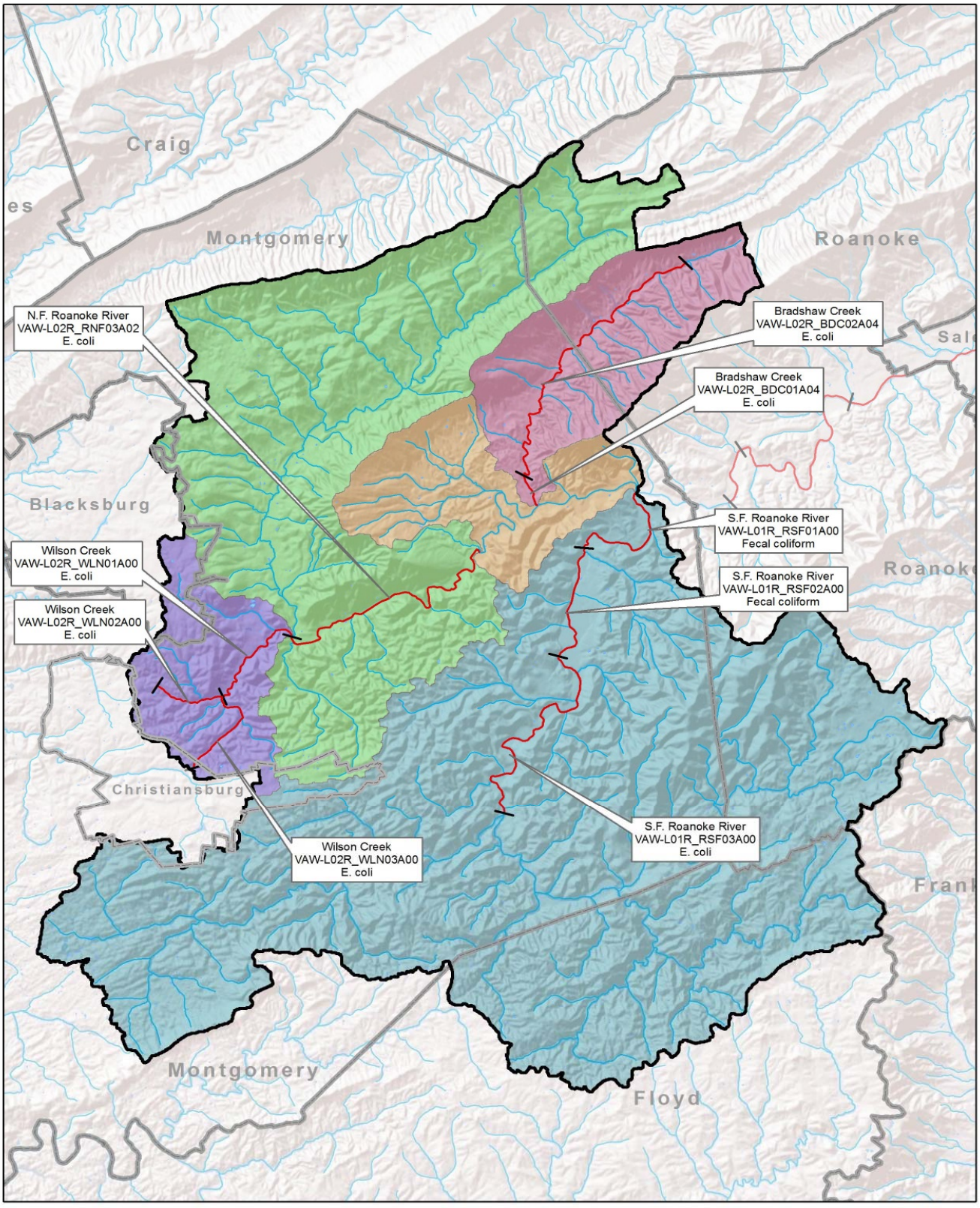
Table 3-16: Estimates of the Number of Septic Systems and Straight Pipes in the Wilson Creek, Roanoke River, and Ore Branch Watershed

Category	Total # of People on Septics	# People per Household	# Failing Septics or Pipes	People Served	Flow (gal/day)	Daily Load (#/day)
Septic Systems	51,504	2.49	620	1,545.1	115,884	4.39E+10
Straight Pipes	162	2.58	63	162.5	12184	4.61E+14

Percent of Houses within each County on public sewer, septic system, and other means:

County	% Public Sewer	% Septic Tank	% Other Means
Floyd County	7.45%	83.96%	8.59%
Montgomery County	65.50%	32.73%	1.78%
Roanoke County	66.46%	32.95%	0.60%
Roanoke City	95.96%	4.00%	0.04%
Salem City	93.10%	6.86%	0.04%
Bedford County	6.75%	90.17%	3.09%
Franklin County	15.04%	81.40%	3.55%

Shaded rows are not applicable to Part II IP but are included in original TMDL



Map of the Roanoke River Watershed Clean-up Plan Part II Area.

Roanoke River Implementation Plan Part 2: North Fork & South Fork Roanoke River, Bradshaw Creek and Wilson Creek

Combined Residential Working Group & Agricultural Working Group Meeting Notes

Meadowbrook Community Center, Shawsville, VA
12/3/15, 6-8 pm

Combined Residential and Agricultural Working Group Participants:
Sue Lindstrom, Erin Hagan, Ginny Snead (Louis Berger Group); Katie Shoemaker (EEE Consulting for VDOT); John Burke (Town of Christiansburg); Kafi Howard (Town of Blacksburg); Shane Sawyer (Roanoke Valley Alleghany Regional Commission); Cynthia Hancock (Skyline Soil & Water Conservation District); James Moneymaker, Mary Dail, Charlie Lunsford (Virginia Department of Environmental Quality [DEQ]); Doug Burton (Montgomery Co.); Javad Torabinejad, and Zach Martin.

Goals of Meeting

Review estimates of implementation measures that will result in reductions in residential and agricultural bacteria and sediment loads. The proposed Best Management Practices (BMPs) by subwatershed presented are designed to meet water quality goals (sediment and bacteria reductions).

Identify potential partnerships and funding sources for implementing clean up measures identified in the plan.

Meeting Notes

Mary Dail briefly introduced attendees to the Roanoke River Implementation Plan Part II for the North and South Fork Roanoke River. Mary introduced new faces to the Louis Berger part of the project team including Ginny Snead and Susan Lindstrom. Today marks Nick Tatalovich's last day at Louis Berger.

Residential BMPs/Educational Outreach Discussion:

Attendees participated in a brief round-robin to inform the group of current activities. John Burke mentioned partnering with the Town of Blacksburg to improve educational outreach. Educational topics include pet waste, lawn care, etc. Doug Burton mentioned working with the school board to include the school board as part of the county MS4. Getting stormwater and bacteria issues into the curriculum could go a long way to modifying behavior. In addition, Shane Sawyer brought up the Clean Valley Council's very active role in Roanoke area schools. That sort of outreach is needed in the Roanoke IP

Part II area. There needs to be more educational effort to modify behavior including outreach concerning erosion control especially in the mountains and other steep sloped areas.

A participant asked what incentive is there for the public to modify behavior. Stormwater utility fees are relatively low for the localities that have the fees. It would cost more for a homeowner to purchase a rain barrel for example. The Roanoke Valley Alleghany Regional Commission (RVARC) is working on a grant application to have funding to distribute rain barrels to people that participate in a workshop. However, non-structural BMPs will continue to be important for residential areas. Pet waste is another challenging area. It is difficult to get people in residential areas to pick up pet waste. Citizens are more likely to utilize pet waste stations in a park, for example, as compared to those with pets in a fenced backyard that may not pick up pet waste.

The group discussed proposed pet waste stations within the project area. The group also discussed maintenance issues and responsibility for those stations. Hotels are good options for pet waste station placement. Cynthia mentioned placing some pet waste stations at restaurants as an option. The group also discussed pet waste digesters which treat waste on-site. A discussion followed concerning the calculation of numbers of digesters. It was suggested that it would be better to base this on a percentage of the population perhaps with a higher percentage in the more urban Wilson Creek subwatershed. Kennels, animal shelters, and veterinary offices would be good locations for pet waste stations. Doug Burton provided some updates to the proposed pet waste locations list. RVARC has mapped all existing pet waste station location. Shane offered to map the location of pet waste stations for Montgomery County and others. A pet waste education campaign was discussed with an average cost of $5,000 per locality per campaign. A suggestion was to have pet stores give out flyers explaining the importance of pet waste pickup and including bags. As part of the education campaign, participants thought helpful information could include a discussion of ways to dispose of pet waste such as throwing it in the trash, composting, or flushing it. A campaign typically includes outreach costs, printed materials, displays, etc. It was suggested that pet waste education materials could be include with existing water treatment and other mailings. Another outreach recommendation was to use an online “exam” after which the participant could receive a free pet waste composter, bag holder, or rain barrel.

The group briefly discussed the different types of septic BMPs. Blacksburg requires homeowners in cases where a septic system has failed to connect to public sewer. A homeowner has to be within 400 feet of existing sewer line. A participant asked about cost-share for septic/sewer BMPs. Those residents typically pay for materials and the town provides the equipment and labor to connect to public sewer.

When outlying systems fail, the town does allow a homeowner to repair their septic system. Bacteria may be coming from aging sewer systems. Funding is needed to repair aging sewer systems. Replacing an aging system is very cost prohibitive. The project team will follow up with the Town of Christiansburg to see if they have a similar approach to assisting homeowners within a certain distance of the sewer line.

Go Fest Festival may be an opportunity for outreach. We need to find other ways to reach out because it is difficult to get citizens to come to just a water quality meeting. Perhaps famer’s markets would be a good idea. The tomato festival in Shawsville was also mentioned.

Agricultural BMP Discussion:

Livestock exclusion remains a challenge in this area with narrow river valleys it is difficult for some landowners to fence 35 feet on each side of a stream.

A meeting participant suggested that it would be helpful to explain that consecutive lengths of stream restoration would be better than small, individual pieces.

[Meeting Handout]

Second Residential and Agricultural Working Groups Meeting

North Fork and South Fork Roanoke Rivers Watershed Cleanup Plan
3 December 2015 6:00 p.m., Community Room at the Meadowbrook Center in Shawsville, VA

Our Task

Include all stakeholders in developing a plan to install Best Management Practices (BMPs) that will reduce levels of bacteria and sediment entering the Roanoke River watershed.

Primary Roles of Residential and Agricultural Working Groups

- Assist in determining types and extent of BMPs needed
- Assist in determining cost for each BMP
- Identify economic incentives/hardships with each BMP
- Identify technical and financial resources to carry out implementation plan
- Report findings to Steering Committee

Goals of Meeting

- Review estimates of implementation measures that will result in reductions in residential and agricultural bacteria and sediment loads. The proposed Best Management Practices (BMPs) by subwatershed presented are designed to meet water quality goals (sediment and bacteria reductions).
- Identify potential partnerships and funding sources for implementing clean up measures identified in the plan.

Discussion

RESIDENTIAL

- Need a new Residential Working Group representative to the Steering Committee
- Review of proposed BMPs:
    - Are the BMPs and costs reasonable for the watershed?
    - Street sweeping will be included, but we are awaiting additional information from the localities (Government Working Group): number of miles swept, frequency of street sweeping, and extent.
- Pet waste stations are proposed at the following locations:

Table 5. Proposed Pet Waste Station Locations		
Subwatershed	**Location Type**	**Location**
North Fork Roanoke River	Hotel	Super 8 Christiansburg
		Quality Inn Christiansburg
	Park	Wayside Park
North Fork Roanoke River	Hotel	Interstate Overnight RV Park
		Days Inn Christiansburg
	Neighborhood	Boggs Mountain Loop-Weeping Willow Ln
	Park	Eastern Montgomery Park
	School	Shawsville Elementary School
		Shawsville Middle School
		Elliston-Lafayette Elementary School
Wilson Creek	Apartment	Cascades Point Apartments
		The Mill at Blacksburg Apartments
		Cedarfield Apartments and Townhomes
	Hotel	Shayona Inn
		Econo Lodge
		Days Inn Blacksburg
		Comfort Inn Blacksburg
	Park	Mid-County Park - Parking lot
		Ellet Valley Recreational Area
		Cedar Hill Park
		Nellies Cave
		Sunrise Park
		Golden Hills Disc Golf Course at Mid-County Park
	Trail	Mid-County Park – nature trail loop system

- Pet waste composters will be incorporated into the plan as a strategy for bacteria reduction from pet waste:
    - Are there certain subwatersheds that are more likely to use them?
    - The number of pet waste composters can be estimated in a variety of ways. Examples:
        - Based on the assumption that half of the units would be used by households that contain one dog and half would be used in households that contain two dogs. Does this seem reasonable?
        - Based on a certain percentage of households?
        - An estimated total number of composters
- Are there any additional educational needs which should be addressed?
    - Homeowner/Developer targeted? Fliers included with utility bills?
- Are there educational/outreach needs for the watershed related to BMPs and water quality?
- Is there interest in an agricultural BMP workshop and/or a visit to see BMPs in place?
- Are there upcoming local community events where project information could be shared?
- What alternative funding sources are available?

AGRICULTURAL

- Need an Agricultural Working Group representative to the Steering Committee
- Livestock exclusion fencing map approach and maps; any comments?
- What alternative funding sources are available?
- Are the proposed BMPs reasonable?
- Are there educational/outreach needs for the watershed related to BMPs and water quality?
- Is there interest in an agricultural BMP workshop and/or a visit to see BMPs in place?
- Are there upcoming local community events where project information could be shared?

Background Information: Total Maximum Daily Load (TMDL) Study Results

Segments on the Roanoke River and its tributaries do not meet water quality standards (WQS) for bacteria. These standards are designed to identify waters that are not suitable for “primary contact recreation” (swimming) because of the risk of illness. The TMDL study identified the sources of bacteria and how much each source category needs to be reduced to restore water quality. A watershed approach was followed during allocation in determining the needed reductions in bacteria loads to streams in order to meet the water quality standards. In the watershed approach, the same percentage reduction is applied throughout the entire watershed and the resulting improvement in simulated water quality conditions is assessed at all impaired subwatershed outlets. Additional reductions to sources are modeled until simulated water quality conditions meet the standard at all impaired subwatersheds. The subwatershed map is shown in the "Maps" section at the end of the document. The area of interest in this Clean-up Plan is the entire drainage area of the North and South Fork Roanoke Rivers including tributary drainages. The Clean-up Plan will outline a staged approach to meet the reductions to human, pet, and agricultural sources determined in the TMDL study. Wildlife is considered a background condition and reductions to wildlife bacteria loads are not explicitly addressed in the TMDL implementation plan.

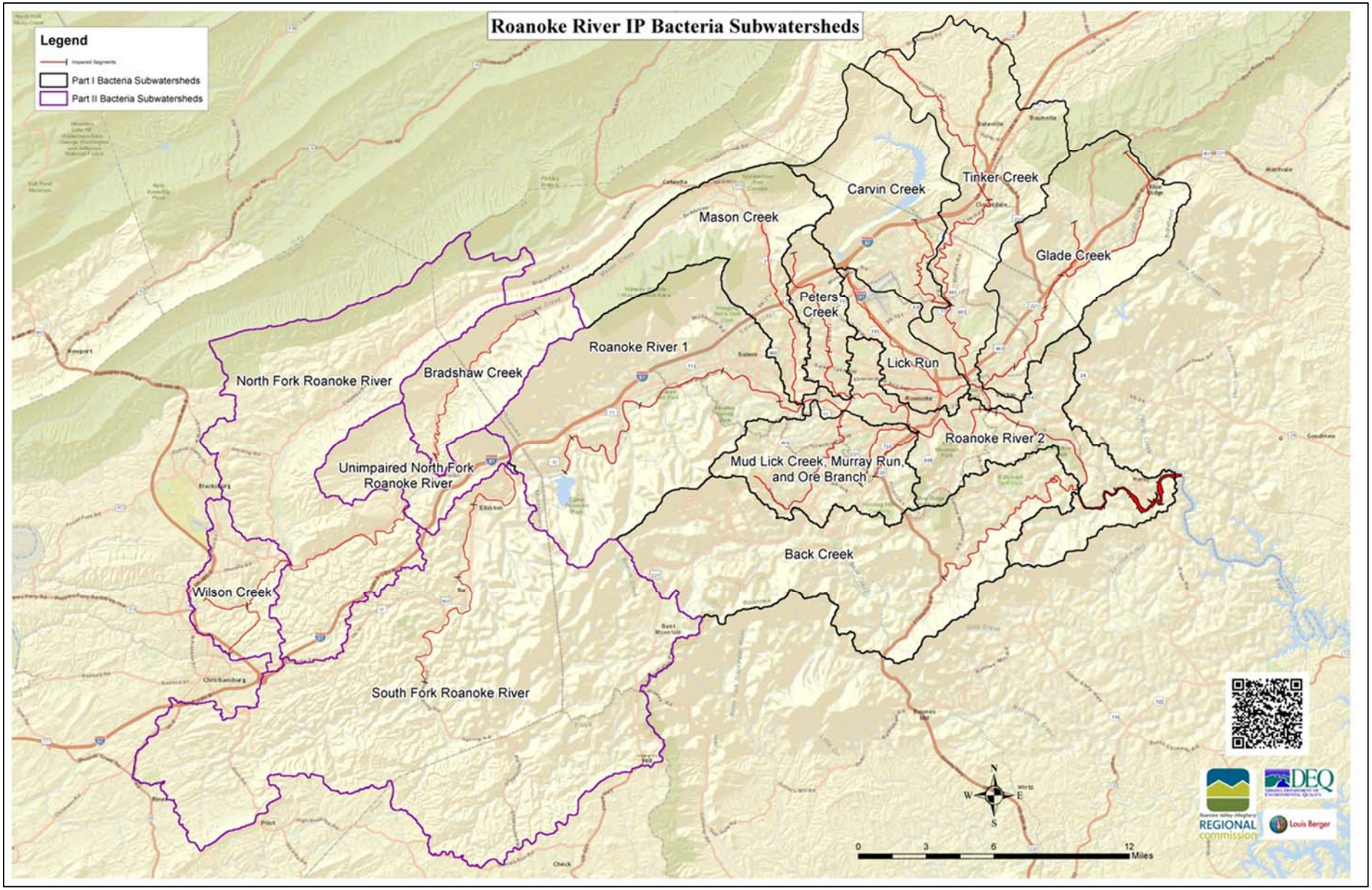
In addition, segments of the Roanoke River were found to have excessive sediment which clogs available habitat for aquatic life and indicates chronic water quality problems. Sediment sources within the Roanoke River watershed include both point and non-point sources. Point sources include solids from permitted discharge facilities and land-based loading from areas covered by municipal separate storm sewer system (MS4) permits. Non-point sources include sediment derived from the erosion of lands present throughout the watershed and the erosion of stream banks within the Roanoke River watershed (including tributaries).

The following list contains the "impaired" stream segments, their lengths and locations, and the reasons for impairment: “impaired” stream, the length of the impaired segment, location and the reason for the impairment: North Fork Roanoke River, 16.09 miles, bacteria; Wilson Creek and Unnamed Tributary to Wilson Creek, 6.99 miles, bacteria; Bradshaw Creek, 10.36, bacteria; South Fork Roanoke River, 17.31

miles, bacteria; and Goose Creek, 2.30 miles, bacteria. These stream segments are located in Montgomery County, Roanoke County and/or Floyd County.

TMDL studies are EPA and Virginia Soil and Water Conservation Board approved and may be viewed on DEQ's website:
http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx

TMDL Studies establish the goals for sediment and bacteria reduction. The Clean-up Plan is the "road map" to meet those water quality goals!



Project Area Map (Parts I and II). Part II includes the North Fork and South Fork Roanoke Rivers (and subwatersheds).

Roanoke River Implementation Plan Part 2: North Fork & South Fork Roanoke River, Bradshaw Creek and Wilson Creek

Combined Government Working Group Meeting #2 and Steering Committee

Blacksburg Public Library, Blacksburg, VA
March 16, 2016, 1:30 p.m. – 3:45 p.m.

Combined Government Working Group and Steering Committee Participants:

Doug Burton (Montgomery Co.); Javad Torabinejad; Katie Shoemaker (EEE Consulting for VDOT); Shane Sawyer (Roanoke Valley Alleghany Regional Commission); Erin Hagan, Sue Lindstrom, Ginny Snead (Louis Berger Group); Mary Dail, Charlie Lunsford, James Moneymaker (Virginia Department of Environmental Quality (DEQ)); Denny McCarthy (Virginia Department of Forestry); Chris Barbour (Skyline Soil and Water Conservation District)

Handouts: *Best Management Practices: Existing and Proposed* handout*, Best Management Practice Efficiency and Costs* handout

All attendees briefly introduced themselves. Mary Dail welcomed everyone and offered thanks for participating. James Moneymaker presented a report of the Agriculture and Residential Working Group. Mary Dail presented the Government Working Group report. Education and outreach were identified by both groups as a priority.

Since there were no questions the meeting moved on to the first agenda item.

Key Topics and Recommendations

The following is a summary of the issues discussed at the Combined Government Working Group and Steering Committee.

Review of Best Management Practice Efficiency and Cost & Proposed Stormwater BMPs:

- Information received from the localities is greatly appreciated.
- Mary Dail mentioned the possibility of setting up a Survey Monkey poll to get input from parties that were unable to attend today's meeting.
- Mary Dail discussed existing stormwater BMPs referencing Table 1.
- A participant asked if the rain barrel efficiency included in the "Best Management Practice Efficiency and Cost" handout is for sediment or bacteria. The Roanoke IP Part I included a small number of rain barrels. Why are so many being proposed for Part II?
    - Rain barrels are intended to reduce sediment runoff.
    - Do the rain barrel numbers look reasonable? Bioretention is somewhat limited in this area due to the terrain.

- A participant suggested including cisterns in the Proposed Stormwater BMP list and the group concurred that cisterns should be added.
- Montgomery County does not currently have a stormwater utility fee. The Town of Blacksburg has a flat fee for residential stormwater.
- The question was asked about what the scientific notation listed for street sweeping means? The scientific notation refers to the amount of bacteria removed per curb mile per year rather than a percentage.
- Chris Barbour with Skyline SWCD suggested that the number of infiltration trenches is not realistic due to the soil type typically found in the area. A detention facility would be recommended in such cases where the soil type is not appropriate for infiltration trench BMPs.
- Doug Burton (Montgomery County) asked about long-term maintenance of BMPs and who is responsible. Limited staff and funding are concerns.
    - Landowners receiving grant funding are required to sign an operation and maintenance agreement, as well as a landowner agreement for the lifespan of the BMP and enter into an agreement if the property is sold during BMP lifespan to repay a pro-rated amount of cost-share or transfer the maintenance responsibility through remainder of life span to the new owner.

- Why is the number of proposed BMPs so high for Wilson Creek?
    - Wilson Creek has the highest percentage of developed land amongst the four impaired watersheds (33%) and it is the only watershed that includes MS4 regulated land area.

- A street sweeping discussion ensued.
    - Street sweeping does occur in Blacksburg and Christiansburg. In the Roanoke IP Part I the recommendation was to increase the frequency of street sweeping.
    - Perhaps street sweeping is not as big of a concern for Montgomery County as the county does not have the same amount of curbing and drop inlets as Christiansburg and Blacksburg.
    - It was suggested that street sweeping be included in the IP to at least quantify an existing baseline of the current level of street sweeping and consider future projections as well.
    - Can we bring VDOT into this discussion?
        - Megan Scott is the new MS4 Coordinator for VDOT Salem District.

- The concern was mentioned that stormwater BMPs would not be accepted by private landowners.
- There was some discussion of detention versus bioretention and the group decided that including a link to the BMP definitions would be helpful.

Proposed Residential Waste Treatment BMPs:

- Louis Berger Group identified the estimated number of failing septic systems utilizing such factors as age of home, proximity to stream, etc.

- A participant asked: do the straight pipe numbers include gray water?
    - VDH considers gray water as sewage.
    - For the purposes of this TMDL Implementation Plan gray water would not be considered a "straight pipe". A straight pipe can refer to an antiquated system that may have a lateral or direct pipe to a waterbody or discharges sewage to a drainage area that during wet weather events empties into surface water.

- The Mount Tabor area reportedly has a number of sink holes. Would alternative waste treatment systems be a good option when working in areas with karst topography?
    - Participants were asked about the Alternative Waste Treatment System installation BMP, specifically should more be proposed in the IP and is the cost accurate? VDH will be consulted about this BMP. It was suggested that it may be beneficial to increase the amount of Alternative Waste Treatment Systems proposed in the IP from 5% to potentially 15%.

- Septic funding was briefly discussed. James Moneymaker mentioned the Indoor Plumbing Rehabilitation Program (IPR). Total Action for Progress (TAP) is the local sub- recipient for the Indoor Plumbing Rehabilitation Program (IPR) working in the Counties of Bath, Alleghany, Rockbridge, Bedford, Roanoke, Craig, Giles, Montgomery, Franklin, Floyd, Henry, Botetourt, Pulaski, Patrick and the associated cities and towns.

Pet Waste BMPs:

- There was a question as to why an education campaign was not included for the unimpaired North Fork Roanoke River; should an education campaign be included in case the area does become impaired in the future? The group agreed to include the unimpaired North Fork Roanoke River subwatershed in the North Fork Roanoke River pet waste education program.
- Table 6 references the proposed pet waste station locations
    - Participants suggested adding several pet waste stations including one to the Ironto rest stop as well as one additional station each for Mid-County Park and the Boggs Mountain-Weeping Willow neighborhood.
- The comment was made that some people do not consider pet waste to be an issue.
- A recommendation was made to include pet waste composters as a pet waste BMP to further reduce the bacteria source load from pets; thereby reducing the number of stormwater BMPs needed to treat the bacteria load in runoff.

Agricultural BMPs:

- The cost for Cropland Buffer/Field Borders (CP-33 and WQ-1) should be $1,000.
- A participant suggested that the cost for the SL-11: Vegetative Cover on critical area treatment seems low and recommended considering $2,500 - $3,500 per acre.
- For the SL-6: Stream Exclusion with Grazing Land Management practice, consider average cost in this area to be $40,000 - $45,000.
- Critical area acreage is typically low within the IP area.
    - Which BMP would be more important in early staging? Wet detention ponds more than likely will not be installed due to the high cost. Higher cost BMPs are included in later stages.
- Signup for the (FR-1) "Aforestation of Crop, Hay and Pasture Land" practice is low within the IP area. Federal USDA NRCS conservation programs for forestry mentioned to be more flexible. Increase the cost of FR-1 practice from $560 to $1,000 because livestock are required to be excluded before trees can be planted.
- The cost for LE-2T: Livestock Exclusion with Reduced Setback should be revised. A suggestion was made to set the cost for LE-2T at half the cost of the SL-6T. The project team decided to keep the LE-2T practice cost consistent with the Part I Roanoke River IP.
- It was mentioned that the (FR-3) Woodland Buffer Filter Area practice is not included in the BMP Efficiency and Cost table.

Stream Restoration BMPs:

- When discussing stream restoration, what are the proposed methods for restoration? Is it a stream channel design using natural materials or a structural design? Description in Part I IP – Stream restoration projects are those that use instream engineering methods and/or natural stream design techniques to protect and restore the stream and associated hydrology, stabilize streambanks, and enhance riparian plant communities which will reduce erosion and sediment transport.
    - $300/acre is currently listed on the BMP Efficiency and Cost table and was used in the Roanoke River IP Part I. The reference to Part I will be added to the BMP Efficiency and Cost table.
    - Consider engineering fee.
- There needs to be a plan in place to facilitate the permitting process to get streambank stabilization practices installed.
- A comment was made that streambank stabilization has been successful in this area and is a lower cost per linear foot. This practice may be more likely to be implemented on agricultural land.
- What is the possibility of voluntary stream restoration generating credits for mitigation banking? There are not many banks within the area.

[Meeting Handout]

Government Working Group Meeting #2 and Steering Committee Meeting

Upper Roanoke River Watershed Cleanup Plan: North Fork and South Fork Roanoke Rivers Watershed (Part II)
3 December 2015 6:00 p.m., Community Room at the Meadowbrook Center in Shawsville, VA

Our Task

Include all stakeholders in developing a plan to install Best Management Practices (BMPs) that will reduce levels of bacteria and sediment entering the Roanoke River watershed.

Primary Roles of Residential and Agricultural Working Groups

- Assist in determining types and extent of BMPs needed
- Reviewing costs for each BMP
- Identify economic incentives/hardships with each BMP
- Identify technical and financial resources to carry out implementation plan
- Report findings to Steering Committee

Goals of Meeting

- Discuss Agricultural and Residential Working Group findings
- Review and provide comments to estimates of implementation measures by subwatershed that will result in reductions in bacteria and sediment loads.
- Discuss milestones and implementation staging approach
- Identify potential partnerships and funding sources for implementing clean up measures identified in the plan.

TMDL Studies establish the goals for sediment and bacteria reduction.
The Clean-up Plan is the "road map" to meet those water quality goals!

Best Management Practices (BMPs) Discussion

- **Existing Stormwater BMPs:**
  - We appreciate the BMP information provided by the localities!
  - Table 1 presents the existing stormwater BMP summary for each subwatershed. Reductions quantified from existing BMPs based on the reported drainage areas (conservative approach).
  - Table 1 also presents the bacteria and sediment reductions from existing BMPs.

Table 1: Existing Stormwater BMP Summary

	North Fork Roanoke River		Wilson Creek	
Stormwater BMP	**Total**	**Acres Treated***	**Total**	**Acres Treated***
Bioretention	1	0.34	22	10.837
Detention	5	3.67	40	7.57
Extended Detention	N/A	N/A	3	2
Infiltration	N/A	N/A	1	Not Listed
Manufactured BMP	N/A	N/A	4	1.53
Underground Detention	N/A	N/A	7	5.36
Vegetated Filter Strip	N/A	N/A	1	0.53
Water Quality Grass Swale	N/A	N/A	1	Not Listed
Wet Pond	1	Not Listed	1	Not Listed
Total	**7**	**4.01**	**80**	**28.23**
Bacteria Reduction From Existing BMPs (cfu/year)	1.10E+11		6.16E+10	
Sediment Reduction From Existing BMPs (ton/year)	0.25		2.01	

*Not all BMPs listed a treated acreage, numbers presented under represent actual coverage of BMPs

- **Proposed Stormwater BMPs:**
  - The strategy was to evenly increase the number of BMPs until the needed bacteria reduction was met.
  - Bradshaw Creek's required developed land bacteria reduction is met by implementing a pet waste education program, but for grant funding purposes, a nominal coverage is proposed for each appropriate BMP.
  - A higher percentage of raingardens proposed in the subwatersheds of the North and South Fork Roanoke River (more rural and have less medium and high intensity development).
  - Urban riparian zones were estimated using the stream and landuse layer in ArcGIS.
  - Rain barrels were estimated for 25% of homes in each watershed.

Table 2: Proposed Stormwater BMPs

Stormwater BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Unit	Cost per unit
Bioretention	2	215	375	10	300	acre-treated	$10,000
Raingarden	2	500	750	10	300	acre-treated	$5,000
Infiltration Trench	2	215	375	10	300	acre-treated	$6,000
Manufactured BMP	0	50	50	0	300	acre-treated	$20,000
Constructed Wetland	2	215	375	10	300	acre-treated	$2,900
Detention Pond	2	215	315	10	30	acre-treated	$3,800
Permeable Paver	1	10	20	5	5	acre-treated	$240,000
Vegetated Swale	2	200	200	10	10	acre-treated	$18,150
Rain Barrel	307	1223	2190	160	4818	barrel	$150
Riparian Buffer (Forested)	7	62	108	10	33	acre-treated	$3,500
Riparian Buffer (Grass/Shrub)	7	62	108	10	33	acre-treated	$360

- **Proposed Residential Waste Treatment BMPs:**
  - GIS based analysis was performed using the provided building layers, sewer networks, and stream networks to update the number of houses in each watershed on sewer, septic, and possible straight pipes.
  - The data provided by Montgomery County specified whether the building was on septic or sewer. Houses were assumed to be on septic unless noted otherwise in the Montgomery County layer or in the GIS analysis.
  - To estimate the number of homes on sewer a GIS analysis was performed using the sewer lines and building layers. Only homes adjacent to a sewer line were considered to be on sewer.
  - The buildings layer data was received from Floyd County after the initial analysis. The additional houses in Floyd County counted using this data were assumed to be on septic.
  - Straight pipes were estimated using the percentages listed for Montgomery County in the TMDL (0.45% of houses within 200 feet of the stream).

Table 3: Revised Sewage Disposal Methods

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total
Total Homes on Septic	584	2030	4163	305	708	**7790**
Total Homes on Sewer	0	299	589	0	1080	**1968**
Number of Failing Septics (3% failure rate)[1]	18	61	125	9	21	**234**
Straight Pipes (0.45% of households within 200ft of Streams)[1]	1	2	6	0	1	**10**

[1]Source: Bacteria TMDLs for Wilson Creek, Ore Branch and the Roanoke River Watersheds (VADEQ 2006)

- Discuss the estimates in Table 4 for proposed number of potential sewer connections.
- Working groups indicated that the sewer treatment plant(s) in Montgomery County are at capacity. This could have an effect on how many sewer connections are proposed in South Fork Roanoke River subwatershed.
- Bradshaw Creek and Unimpaired North Fork Roanoke River are too rural for any sewer connections.

Table 5-5: Proposed Sewage Disposal BMPs (systems)

BMP	Percent of Total Systems	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total
Total Septic Pumpout (RB-1)	10%	58	203	416	31	71	**779**
Sewer Connection (Target Area's and RB-2)	Variable	0	TBD	TBD	0	TBD	**0**
Total Septic Repair (RB-3)	70%	12	43	87	6	15	**163**
Total Septic Install /Replace (RB-4)	25%	6	17	37	2	6	**68**
Total Alternative Waste Treatment System (RB-5)	5%	1	3	6	1	1	**12**

TBD – To be determined

- **Pet Waste BMPs**
  - ArcGIS was used to determine locations of pet friendly hotels, schools, and recreational areas that could be prime locations for pet waste stations.
  - Each pet waste station costs at $4,180, which covers the cost of maintenance for a period of five years.
  - Each pet waste education program costs at $5000.

Table 5: Proposed Pet Waste BMPs (units)

BMP	Pet Waste Education Campaign*	Pet Waste Station	
		Existing	Proposed
Bradshaw Creek	1		0
North Fork Roanoke River	1		3
South Fork Roanoke River	1		5
Unimpaired North Fork Roanoke River	0		0
Wilson Creek	1		14
Total	4		22

Table 6. Proposed Pet Waste Station Locations

Subwatershed	Location Type	Location
North Fork Roanoke River	Hotel	Super 8 Christiansburg
		Quality Inn Christiansburg
	Park	Wayside Park
South Fork Roanoke River	Hotel	Interstate Overnight RV Park
		Days Inn Christiansburg
	Neighborhood	Boggs Mountain Loop-Weeping Willow Ln
	Park	Eastern Montgomery Park
	Restaurant	Cracker Barrel
Wilson Creek	Apartment	Cascades Point Apartments
		The Mill at Blacksburg Apartments
		Cedarfield Apartments and Townhomes
	Hotel	Shayona Inn
		Econo Lodge
		Days Inn Blacksburg
		Comfort Inn Blacksburg
	Park	Mid-County Park - parking lot
		Ellet Valley Recreational Area
		Cedar Hill Park
		Nellies Cave
		Sunrise Park
		Golden Hills Disc Golf Course at MidCounty Park
	Trail	Mid-County Park - nature trail loop system

- **Existing Agricultural BMPs**
  - Agricultural BMPs installed since the TMDLs study were quantified using the Virginia Department of Conservation and Recreation's (VADCR) Agricultural Cost-Share Database.

Table 7. Existing Agricultural BMPs - South Fork Roanoke River

	Bradshaw Creek			North Fork Roanoke River			South Fork Roanoke River		
Existing Agricultural BMP	**Total Acres Installed**	**Total Acres Benefited**	**Stream Length Installed (ft)**	**Total Acres Installed**	**Total Acres Benefited**	**Stream Length Installed (ft)**	**Total Acres Installed**	**Total Acres Benefited**	**Stream Length Installed (ft)**
Cropland BMPs									
Harvestable Cover Crop/Small Grain cover crop for Nutrient Management (SL-8)	-	-	-	-	-	-	288.3	-	-
Pasture BMPs									
Aforestation of erodible crop and pastureland (FR-1)	-	-	-	-	-	-	1.5	-	-
CREP Riparian Forest Buffer Planting	-	-	-	26.5	182.6	-	0.4	-	-
Permanent vegetative cover on critical areas (SL-11)	-	-	-	-	-	-	1.3	-	-
Stream Exclusion BMPs									
Livestock Exclusion with Reduced Setback	-	-	-	-	-	-	-	1	3,947
Stream Exclusion With Grazing Land Management	-	45.6	1,260	-	472.9	26,197	-	737.8	29,228
Stream Stabilization									
Streambank Stabilization - Length (feet)	-	-	-	-	25.5	1,119	-	-	-
Bacteria Reduction From Existing BMPs (cfu/year)	2.04E+10			1.57E+12			6.87E+11		
Sediment Reduction From Existing BMPs (ton/year)	1			29			51.5		

- **Proposed Cropland BMPs:**
  - While it was established there is no manure spreading on cropland in the watershed (i.e. no bacteria reductions needed), there is still a sediment reduction to be met from cropland.
  - The general approach to cropland BMPs was to apply continuous no-till on an area of land, and in combination, have a small grain cover crop, and propose 5% of cropland have permanent vegetative cover, utilize sod waterway and cropland buffer/field borders each (for a total of 15% of cropland under these practices).

Table 8: Proposed Cropland BMPs (acres-installed)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total (acres-installed)	Cost Per systems
Continuous No-Till (SL-15)	41	253	662	51	26	1,033	$100
Small Grain Cover Crop (SL-8)	48	283	452	57	30	869	$30
Permanent Vegetative Cover on Cropland (SL-1)	2	15	39	3	2	61	$175
Sod Waterway (WP-3)	2	15	39	3	2	61	$1,600
Cropland Buffer/Field Borders (CP-33 and WQ-1)	2	15	39	3	2	61	$1,000

- **Proposed Livestock Exclusion BMPs:**
  - Livestock exclusion systems were determined through GIS analysis using aerial imagery, stream networks, landuse and discussions with SWCD personnel
  - To distribute the proposed length of exclusion systems, the distributions from Part I (10% CREP, 75% SL-6/SL-6T/LE-1T, 5% SL-6A/LE-2T/WP-2T) were used.
  - The numbers presented in Table 7 represent the lengths necessary to achieve the reductions in livestock direct loads.

Table 9: Proposed Livestock Exclusion BMPs (systems)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total Systems	Cost Per systems
CREP Livestock Exclusion (CRSL-6)	3	10	10	3	1	27	$27,000
Livestock Exclusion with Grazing Land Management (SL-6/SL-6T and LE-1T)	24	76	77	21	10	208	$21,000
Small Acreage Grazing System (SL-6AT)	2	5	5	1	1	14	$9,000
Livestock Exclusion with Reduced Setback (LE-2/LE-2T)	2	5	5	1	1	14	$17,000
Stream Protection/Fencing (WP-2/WP-2T)	2	5	5	1	1	14	$21,000

- **Proposed Pasture BMPs:**
  - Vegetative cover on critical areas was proposed for 5% of pastureland in Bradshaw Creek and Unimpaired North Fork, 20% in North and South Fork, and 10% in Wilson Creek.
  - Reforestation of erodible pasture was proposed for 5% of pastureland in Bradshaw Creek and Unimpaired North Fork, and 10% in North Fork, South Fork, and Wilson Creek.
  - The varying percentages reflect the bacteria and sediment reductions required in the respective subwatersheds.
  - Then, pasture management was applied to the remaining unconverted land.
  - When bacteria reductions could not be met with the BMPs listed above, an acreage of wet detention ponds was proposed.

Table 10. Proposed Pastureland BMPs (acres-installed)

BMP	Bradshaw Creek	North Fork Roanoke River	South Fork Roanoke River	Unimpaired North Fork Roanoke River	Wilson Creek	Total (acres-installed)	Cost Per acre install
Vegetative Cover on Critical Areas (SL-11)	36	1,472	1,724	41	145	3,418	$1,200
Reforestation of Erodible Pasture (FR-1)	37	818	958	43	81	1,937	$560
Pasture Management (EQIP 528, SL-10T, SL-9, SL-7)	353	7,360	8,622	411	727	17,472	$75
Wet Detention Ponds*	0	3,800	1,720	0	477	5,997	$150

*acres-treated

- **Stream Restoration BMPs:**
  - A sediment reduction of 14,045 tons/year was required from instream erosion. This value was determined by the percentage of the benthic watershed this implementation plan is covering.
  - The sediment reduction requires 90,613 feet of stream restoration throughout the second Roanoke River TMDL IP study area, based on the reduction rate of 310 lbs/ft/year.
  - Distribution of the load by stream miles in each subwatershed can achieve the restoration values.

Table 11. Planned and Proposed Stream Restoration

Subwatershed	Total Estimated Stream Length for Restoration (Feet)	Planned, Ongoing, Completed Projects (feet)	Additional Proposed Stream Restoration (feet)
Bradshaw Creek	9,844	0	9,844
North Fork Roanoke River	22,793	6,785	16,008
South Fork Roanoke River	48,140	0	48,140
Unimpaired North Fork Roanoke River	6,063	0	6,063
Wilson Creek	3,773	0	3,773
Total	90,613	0	90,613

Upper Roanoke River TMDL Implementation (Clean-up) Plan – Part II Development
Residential and Agricultural Working Group Report to Steering Committee Presented:
March 16, 2016 1:30 p.m.
Blacksburg Library, 200 Miller Street, Blacksburg, VA 24060

Working Group Participants: Doug Burton (Montgomery County), Javad Torabinejad, Zach Martin, Joe Williams (Virginia DGIF), Spencer Winfrey, Leigh Anne Weitzenfeld (City of Roanoke), Randy Lease, Robert Trout, Katie Shoemaker (EEE Consulting for VDOT), John Burke (Town of Christiansburg), Shane Sawyer (Roanoke Valley Alleghany Regional Commission), Cynthia Hancock (Skyline Soil & Water Conservation District), Kafi Howard (Town of Blacksburg); Nick Tatalovich, Erin Hagan, Sue Lindstrom, Ginny Snead (Louis Berger Group); Mary Dail, Charlie Lunsford, James Moneymaker (Virginia Department of Environmental Quality [DEQ]) .

Purpose of Working Groups: The Agricultural Working Group concentrated on the following identified problems contributing to excessive sediment and bacteria from agricultural and rural residential areas: lack of streamside vegetation, agricultural runoff, livestock access to streams, failing septic systems and straight pipes, and livestock waste management. The Residential Working Group considered the following identified problems contributing to excessive sediment and bacteria from urban and residential and commercial areas: lack of streamside vegetation, pet waste, stream channel modifications , litter, illicit connections/discharges, pollutant buildup on impervious surfaces, increasing development and peak flows from storm water runoff, and enforcement of erosion and sediment control regulations with residential construction. Both working group meetings were held on the same two dates. During the first meeting (June 16, 2015), the working groups were separate for the discussion portion. Due to low numbers of stakeholders representing each working group at the second round of working group meetings (December 3, 2015), the Residential Working Group and Agricultural Working Group were combined.

Meeting Dates: The Residential and Agricultural Working Groups met on June 16, 2015 at 6:00 p.m. and December 3, 2015 at 6:00 p.m. Both meetings were held at the Meadowbrook Center Community Room in Shawsville, Virginia.

Key Topics and Recommendations

The following is a summary of the issues discussed at the Residential and Agricultural Working Group meetings and their recommendations to the Steering Committee.

On-site sewage disposal systems:

- Alternative systems are becoming more prevalent because there are stricter regulations for the traditional systems.
- Blacksburg requires homeowners to connect to public sewer in cases where a septic system has failed. A homeowner has to be within 400 feet of existing sewer line. Residents typically pay for materials and the town provides the equipment and labor to connect to public sewer.

Pet Waste:

- Citizens are more likely to utilize pet waste stations in a park, but those with pets in a fenced backyard are unlikely to pick up pet waste.

Stormwater:

- The Residential Working group shared some considerations with respect to stormwater BMPs:
    - Some localities in the watershed have the Stormwater utility fees.
    - Roanoke Valley Alleghany Regional Commission (RVARC) is working on a grant application to have funding to distribute rain barrels to people that participate in a workshop.
    - There are areas of severe bank erosion in the watershed. Virginia Tech recently studied and highlighted areas of severe bank erosion; the study was provided to VDGIF. Targeting of these areas would require a site visit.
    - There are places along the North Fork that landowners don't want to do any riparian buffer or stabilization work.
    - Development negatively affects water quality by increasing impervious surfaces and concerns were expressed over stormwater regulations.

Agriculture:

- The group observed the current growth trend for agriculture in the area as follows:
    - There are fewer cropland acres, more sod acres (South Fork Roanoke River), higher concentrations of horses in some areas and fewer beef cattle.
    - Overall there is an increase in the number of non-traditional agricultural operations that are not eligible for USDA and state agricultural cost-share but may be eligible for other grant funds and could benefit from technical assistance through VCE and SWCDs.
    - Bradshaw Creek area, in particular, has a greater concentration of horses. Many residents have just one or two horses.
    - Regarding cropland, more changes have occurred in the South Fork watershed. It was mentioned that fields previously farmed as cropland had more residue than current sod farms. In general, fewer farmers are planting crops.
    - According to Skyline SWCD confined feeding operations have mostly addressed manure management issues.
    - Skyline SWCD reported that there is no manure spreading on cropland in the North Fork Roanoke River, Wilson Creek, and Bradshaw Creek watersheds but was unsure about the South Fork Roanoke River.
    - Very little reforestation occurs in the watershed. It is estimated that less than five percent of cropland is reforested.

- Stream Fencing considerations are as follows:
    - Participants expressed that the stream fencing needed to improve water quality is impractical for some individuals in the watershed. Cost-share programs do not work for every farming operation.
    - Many large farming operations already work with local soil and water conservation districts and understand the benefits.
    - A large percentage of farm land is rented and reaching the owners can be challenging and lease agreement terms may prevent BMP installation.
    - There is some interest as long as stream fencing remains voluntary.
    - Equine-related water quality issues exist, but cost-share isn't usually available for equine water quality issues. There was disagreement among the working group participants regarding establishment of local ordinances to regulate equine.

- Livestock exclusion remains a challenge in this area with narrow river valleys it is difficult for some landowners to fence 35 ft on each side of a stream

Recommendations to Steering Committee:

- The working groups recommended the following organizations be included in clean-up planning and implementation activities: New River Valley Planning Commission, Land Conservancy, Virginia Department of Health (VDH), Homebuilders association, and Trout Unlimited.
- Showcase existing BMPs related to stormwater so that those interested may meet landowners who have installed BMPs.
- Virginia Tech could be a potential partner for BMP installation and water quality improvement. Another potential partner is the Mountain Valley Charitable Trust. This organization has been involved in funding of charitable ventures such as the YMCA and the thrift shop in Elliston.
- Consider facilitating an offset to stormwater utility fee if a landowner implements a BMP in Blacksburg or Christiansburg.
- Onsite sewage disposal and sewer line connection:
  - There is a need for septic system maintenance education. Usually the recommended cycle for a septic tank pump-out is every five years.
  - A suggestion was to provide information on the importance of septic pump-out with these other materials.
  - Septic and sewer system data may be available via the Public Service Authority (PSA).
  - Prioritize sewer system connections in the watershed that are within Blacksburg town limits for first implementation stage. Blacksburg requires homeowners to connect to public sewer in cases where a septic system has failed. A homeowner has to be within 400 feet of existing sewer line; residents typically pay for materials and the town provides the equipment and labor to connect to public sewer.

- **Pet Waste**
  - Digesters might be used by HOAs or installed at hunt clubs which frequently have kennels for large numbers of hunting dogs. One kennel for pets that is not far from Montgomery County is Gandalf Kennels; educational materials could be concentrated there or at similar places.
    - Estimate pet waste digester numbers based on population.
  - The Plan needs to consider existing pet waste stations and build in cost for maintenance of new pet waste stations.
    - Hotels, kennels, veterinarian offices, animal shelters and restaurants are good options for pet waste station placement.
    - RVARC has mapped existing pet waste stations and is willing to continue that effort on the Montgomery Co. side and share this information.
  - Pet waste educational campaign is needed.
    - Enlist pet stores give out flyers explaining the importance of pet waste pickup and including bags.
    - Campaign should include a discussion of ways to dispose of pet waste such as throwing it in the trash, composting, or flushing it.
    - Pet waste education materials could be include with existing water treatment and other mailings

- **Agriculture**
    - The group discussed ways to get the word out about Implementation planning activities and, if applicable, funding sources for agricultural best management practices (BMPs). Advertisements at farmer's markets, the Link Letter newsletter, and partnerships with Virginia Cooperative Extensions were suggested by the group.
    - Working group members recommended considering the Mill Creek-Preston Forest subdivision and Virginia Department of Transportation construction projects as potential sources of sediment.
    - Participants believe the increase in the number of horses will create more denuded pasture areas.
    - Many large farming operations already work with local soil and water conservation districts, have stream exclusion fencing installed and understand the benefits.
    - Cost-share programs do not always work for every farming operation.
    - Barriers to stream fencing were discussed as follows:
        - Fence maintenance during flood events
        - Topography and the inability to give up prime farm land on limited acreage
        - State and federal programs change each year and many farmers do not know what changes occur
- Areas of interest with respect to manure management BMPs may include the Riner area where there are few small dairies and very few intensive beef operations.

- **Education and Outreach**
    - Suggestions from the working groups regarding water quality and BMP outreach:
        - Local newspapers (Roanoke Times)
        - Field days
        - Farm Bureau meetings
        - Young Farmers
        - Pesticide licensing meetings
        - Livestock and Farmers markets
        - Virginia Cooperative Extension
        - Trail riding clubs
        - Channel 109 (Montgomery County cable channel)
        - Local informal gathering of farmers to sell produce and other products (this occurs infrequently at the little convenience store in Elliston/Shawsville)
        - Utility bills (note that some residents just have water bills, so this option may not get to everyone)
        - Ruritan Club
        - Go Fest (Roanoke)
        - Tomato Festival (Shawsville)
        - Isaac Walton League
        - Homeowners associations (HOAs)
        - Developers
        - Home Builders Association, Home Shows
    - Need to work on getting stormwater and bacteria water quality issues into the public school curriculum as this could go a long way to modifying behavior. Clean Valley

Council's very active role in Roanoke area schools.

- Include septic system maintenance and straight pipe education in the Clean-up Plan:
- Newsletters (distributed to homeowners' associations, agricultural groups, etc.), mailings, and door hangers would be effective forms of outreach.
- Incentivize outreach by providing an online "exam" where participants would read information about stormwater, proper pet waste disposal, septic system maintenance, etc. After completion of the tutorial and exam, the participant could receive a free pet waste composter, bag holder, or rain barrel.

Upper Roanoke River TMDL Implementation (Clean-up) Plan – Part II Development

Government Working Group Report to Steering Committee

Presented: March 16, 2016 1:30 p.m.; Updated April 14, 2016

Blacksburg Library, 200 Miller St. Blacksburg, VA 24060

Working Group Participants:

- Doug Burton - Montgomery County
- Joe Williams – Virginia Department of Game and Inland Fisheries
- Leigh Anne Weitzenfeld - City of Roanoke
- Ashley Hall, Katie Shoemaker - EEE Consulting for VDOT
- John Burke - Town of Christiansburg
- Chris Barbour - Skyline Soil & Water Conservation District
- Kafi Howard - Town of Blacksburg
- Nick Tatalovich, Erin Hagan, Sue Lindstrom, Ginny Snead - Louis Berger Group
- Mary Dail, Charlie Lunsford, James Moneymaker – Virginia Department of Environmental Quality (DEQ)
- Javad Torabinejad
- Shane Sawyer – Roanoke Valley Alleghany Regional Commission
- Dennis McCarthy – Virginia Department of Forestry
- Kelli Scott – Virginia Cooperative Extension (consulted but was unable to attend meetings)

Purpose of Working Group: The Government Working Group (GWG) assisted in determining the types and extent of Best Management Practices (BMPs) needed in the subwatersheds that will result in reductions in bacteria and sediment loads. GWG members helped identify potential partnerships and funding sources for implementing clean up measures included in the plan. In addition, the GWG aided in identifying additional programs and technical resources, lead agencies for agricultural and residential water quality improvement efforts, and regulatory controls currently in place that may compel water quality improvement in the impaired watersheds.

Meeting Dates: The Government Working Group met on July 29, 2015 at 2:00 p.m. at the Town of Christiansburg Administration Building (100 E. Main St., Christiansburg) and March 16, 2016 at 1:30 p.m. at the Blacksburg Library (200 Miller St., Blacksburg). The March 16th meeting was a combined with the Steering Committee.

Key Topics and Recommendations

The following is a summary of the issues discussed at the Government Working Group meetings and their recommendations to the Steering Committee:

General Concerns: Working Group members brought up BMP maintenance and are concerned about the lack of funding and personnel to maintain BMPs. Education and outreach with respect to all BMP categories is needed in these watersheds.

Sewage Handling and disposal systems:

- Blacksburg and VT share a sewer system and Christiansburg has its own sewer system.
- Montgomery County has a Public Service Authority which maintains joint water and sewer lines. The Authority includes Shawsville.
- Localities are short on staff for inspections of overflows
- The Floyd County numbers of residents served by public sewer for the IP area are incorrect because there are only septic tanks and potential straight pipes in that portion of the county.
- The Town of Blacksburg requires connection to the sewer system if the structure is within 200 feet of the sewer line.
- Montgomery County mentioned that it has a sewage treatment plant at capacity.
- Working group members are concerned that VDH has not been involved in the process despite efforts to reach out to them.
- Karst topography exists in many parts of these watersheds.

Pet Waste:

- There are not many concentrated areas for pets (like dog parks) in the watershed.
- Virginia Tech has data on pet waste bag use on the Huckleberry Trail.
- Roanoke Valley Alleghany Regional Commission has mapped pet waste stations in other parts of the Roanoke River watershed and is willing to share this information and assist with additional mapping.

Stormwater:

- VDOT only installs BMPs to offset development projects.
- Montgomery Co. only installs BMPs as part of new developments; the county doesn't retrofit existing BMPs.
- Concerns exist over the wide range of stream restoration approaches available. There needs to be a plan in place to facilitate the permitting process to get streambank stabilization practices installed.
- Existing street sweeping efforts need to be evaluated.

Agriculture:

- Some landowners fear losing control of their land if they participate in government- sponsored programs like cost-share.
- There is no longer money available for Landowner Incentive Program projects.
- Riparian buffers are not very efficient in mountainous areas and that top-of-bank fencing BMPs and interior fencing BMPs are needed.
- BMP installation in the Bradshaw Creek subwatershed will be difficult.
- Critical area acreage is typically low within the IP area.

Recommendations to Steering Committee:

- The working group recommended the following organizations be included in clean-up planning and implementation activities: New River Valley Planning Commission, Roanoke County, and Virginia Tech.

- **Onsite sewage disposal and sewer line connection:**
  - Revise Floyd Co. numbers of homes served by sewer (e.g. no public sewer within IP area).
  - Education of citizens on sewer and pet waste problems is needed. A suggestion was made to include information in mailers; however, it is important to note that there is a discrepancy between people receiving water and sewer bills.
  - Project team needs to expand alternative system BMPs in light of karst topography.
  - Government Working Group participants recommend continuing to reach out to VDH to gain a better understanding of regional expertise related to septic systems, straight pipes, and alternative waste treatment systems.
  - Funding for low-income assistance for sewage management needs to be explored and included in the IP.

- **Pet Waste**
  - Pet Waste education is needed in all areas of the watershed and education campaigns need to be extended to all subwatersheds.
  - Pet Waste composters need to be included in the IP.

- **Stream Restoration**
  - North Fork Roanoke River watershed has opportunities for streambank restoration, but there is a need for targeted grant funds for these projects.
  - Landowner Incentive Program (U.S. Fish and Wildlife Service) funds are tapped out.
  - Streambank stabilization BMPs need to be incorporated in the IP because it is more appealing to an agricultural landowner than stream restoration BMPs.

- **Stormwater**
  - Street sweeping needs to be included in the IP and it was recommended that the project team reach out to the localities and VDOT to gain an understanding of where opportunities exist for program enhancement.

- **Agriculture**
  - Riparian buffers are not very efficient in mountainous areas and that top-of-bank fencing BMPs and interior fencing BMPs are needed.
  - Wilson Creek sub-watershed may be a good watershed to target BMPs.
  - Recommended BMP costs for the following practices:
    - The cost for Cropland Buffer/Field Borders (CP-33 and WQ-1) should be $1,000.

        - The cost for the SL-11: Vegetative Cover on critical area treatment was recommended to be $2,500 - $3,500 per acre.
        - Average SL-6: Stream Exclusion with Grazing Land Management practice cost in this area is $40,000 - $45,000.
        - Increase the cost of FR-1 practice from $560 to $1,000 because livestock are required to be excluded before trees can be planted.
    - Wet detention ponds were recommended for implementation in the last stage due to the high cost.
    - The (FR-3) Woodland Buffer Filter Area practice needs to be included in the IP.

- **Education and Outreach**
    - Education and outreach are needed for all BMP categories including pet waste and septic system maintenance.
    - There are opportunities to piggy-back the water quality and IP message onto existing events in the watershed.
    - Utility billing offers opportunities to get the word out about water quality, BMPs, pet waste, and septic system maintenance.

- **Technical Assistance**
    - Technical assistance is needed for BMP design, retrofits, and maintenance.

Roanoke River Implementation Plan Part II: North Fork & South Folk Roanoke River, Bradshaw Creek and Wilson Creek

Final Public Meeting Notes

Meadowbrook Center, Shawsville, VA
July 14 2016, 6:00 p.m.-8:00 p.m.

Attendees: Robert Trout; Charles Maus; Katie Shoemaker (EEE representing VDOT); John Burke (Town of Christiansburg); Mary Dail, James Moneymaker, Charlie Lunsford (DEQ); Ginny Snead, Susan Lindstrom, Erin Hagan (Louis Berger Group); Chris Sidney, Tom Roberts (Roberts Engineering); Allen Sisson (Dairy Farmer); Mark Broomell; Javad Torabinejad (Coalition for Blacksburg Waterways); W.S. Cumbie (Landowner); Dennis R. McCarthy (Virginia Department of Forestry); Doug Burton (Montgomery County); Amanda McGee (Roanoke Valley Alleghany Regional Commission); Marie Goodwin; Sue Perry; Joyce Graham.

James Moneymaker welcomed attendees and described the importance of having clean streams, Total Maximum Daily Loads and how streams are evaluated for water quality problems. He went over the history of the project, the water quality impairments, and detailed why folks should be concerned about water quality. James presented highlights from the Clean-up Plan and talked about types of best management practices that were determined to be appropriate in the North Fork and South Fork Roanoke Rivers and tributaries. James showed two videos: the first was related to the benefits and drawbacks of installing cattle exclusion fencing and the second video showed a veterinarian discussing herd health concerns when cattle spend time in streams and ponds where they defecate. James discussed funding sources. Mary Dail presented information about water quality standards and monitoring and introduced the station locations. Mary discussed the different monitoring programs including biological monitoring, fish tissue and sediment monitoring.

Questions were asked about funding sources (specifically WQIF), pharmaceuticals in drinking water, *E. coli* water quality standards, testing for heavy metals, bacteria sources, cattle exclusion fencing and fencing maintenance. Concerns were raised regarding streamside vegetation causing problems for farmers when streams flood. There were concerns raised about whether or not bacteria water quality standards are attainable. About half of the attendees heard about the meeting via James Moneymaker's email. A few attendees saw the meeting sign posted at a North Fork Roanoke River bridge crossing. A couple of attendees saw the WDBJ channel 7 news story and others saw an article in the paper.

Link to the draft Clean-up Plan: Upper Roanoke River Watershed Clean-up Plan (Part II) - Draft for public comment. Written comments to the draft Clean-up Plan may be submitted to:

James Moneymaker
TMDL Nonpoint Source Coordinator
Department of Environmental Quality
3019 Peters Creek
Road Roanoke, VA
24019 (540)562-6738
james.moneymaker@deq.virginia.gov