Upper Rapidan River
Total Maximum Daily Load (TMDL)
Implementation Plan

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EXECUTIVE SUMMARY

Introduction

The Virginia Total Maximum Daily Load (TMDL) program is a process to improve water quality and restore impaired waters in Virginia. Specifically, TMDL is the maximum amount of pollutant that a waterbody can assimilate without surpassing the state water quality standards for protection of the six beneficial uses: drinking water, recreational (i.e., primary contact/swimming), fishing, shellfishing, aquatic life, and wildlife.

Blue Run and Rapidan River #1 were initially placed on the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report in 2002 for exceedances of the bacteria standard. Marsh Run and Unnamed Tributary (UT) to Rapidan River #1 were initially placed on the list in 2004. After these listings, a TMDL study was conducted to identify bacteria sources in the watersheds. Rippin Run, Beautiful Run, and UT to Rapidan River #2 were listed as impairments in 2012 and Garth Run and Poplar Run were added in 2014. These watersheds are contained within the TMDL developed watershed. As a result, TMDL bacteria loadings and allocations were translated to these nested impairments. After a TMDL study is complete and approved by the United States Environmental Protection Agency, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19:7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters". To comply with this state requirement, a TMDL implementation plan was developed to reduce bacteria levels to attain water quality standards allowing delisting of streams from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report. The TMDL implementation plan describes control measures, which can include the use of better treatment technology and the installation of best management practices, to be implemented in a staged process.

Key components of the implementation plan are discussed in the following sections:

- **Review of TMDL Development Study**
- **Public Participation**
- **Implementation Actions**
- **Measurable Goals and Milestones for Attaining Water Quality Standards**
- **Stakeholder's Roles and Responsibilities**
- **Integration with Other Watershed Plans**
- **Potential Funding Sources**

Review of TMDL Study

Impairment description, water quality monitoring, watershed description, source assessment, water quality modeling, and allocated reductions were reviewed to determine implications of TMDL and modeling procedures on implementation plan development. Conditions outlined in the TMDL development study to address the bacteria impairments in these watersheds include:

- Exclusion of most/all livestock including horses from streams is necessary;

- Substantial land-based nonpoint source pollution load reductions are called for on pasture and cropland;
- All straight pipes and failing septic systems need to be identified and corrected;
- Implicit in the requirement to correct straight pipes and failing septic systems is the requirement to maintain all properly functioning septic systems; and
- Reductions to pet bacteria loads on residential land use are necessary.

Public Participation

The actions and commitments compiled in this document are formulated through input from citizens of the watershed; Madison County government; Greene County government; Orange County Public Service Authority; Orange Farm Service Agency; Ecosystems Services, LLC; Center for Natural Capital; Piedmont Environmental Council; Friends of the Rappahannock; Old Rag Master Naturalists; Culpeper Soil and Water Conservation District; Thomas Jefferson Soil and Water Conservation District; Madison County Health Department; Greene County Health Department; Rappahannock-Rapidan Regional Commission; Virginia Department of Environmental Quality; Virginia Department of Health; Virginia Department of Forestry; Natural Resources Conservation Service; Shenandoah National Park; and Blue Ridge Environmental Solutions, Inc.

Public participation took place during implementation plan development on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project, as well as a forum for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups and Steering Committee). Second, three working groups were formed: Agricultural, Residential, and Governmental. Third, a Steering Committee was formed with representation from the Agricultural, Residential, and Governmental Working Groups; Culpeper Soil and Water Conservation District; Thomas Jefferson Soil and Water Conservation District; Rappahannock-Rapidan Regional Commission; Virginia Department of Environmental Quality; Virginia Department of Health; and Blue Ridge Environmental Solutions, Inc. to guide the development of the implementation plan. Over 200 hours were devoted to attending these meetings by individuals representing agricultural, residential, commercial, environmental, and government interests on a local, state, and federal level.

Implementation Actions

The quantity of control measures, or BMPs, required during implementation was determined through spatial analyses of land use, stream-network, and the Commonwealth of Virginia aerial maps along with regionally appropriate data archived in the Virginia Department of Conservation and Recreation Agricultural BMP Database and TMDL document. Bacteria load reductions on land uses were determined through modeling alternative implementation scenarios, defining percentage of land use area or unit amount treated by control measure, then applying related reduction efficiency to the associated load. Additionally, input from local agency representatives, citizens, and contractors was used to verify the analyses.

The associated cost estimations for each implementation action were calculated by multiplying the average unit cost per the number of units. The funding for implementation costs will be achieved

through cost-share programs, grant programs, in-kind donation, and landowners. For the Stage I (*i.e.*, removal of impaired stream segments from impaired waters list) costs, the total agricultural corrective action costs equal $14.8 million. Estimated corrective action costs needed to replace straight pipes and fix failing septic systems during Stage I totals $9.3 million. The cost to implement the pet waste reduction strategies totals an estimated $0.1 million. Cost to install vegetated buffers, rain gardens, and infiltration trenches during Stage I equal $0.4 million. The total cost to provide assistance in the agricultural and residential programs during Stage I implementation are expected to be both equal to $1.4 million. The total Stage I implementation cost including technical assistance is $27.4 million with the agricultural cost being $16.2 million and residential cost $11.2 million. The total Stage II implementation cost including technical assistance is $12.4 million with the agricultural cost being $12.0 million and residential cost $0.4 million.

The primary benefit of implementation is cleaner waters in Virginia, where bacteria levels in the Garth Run, Rippin Run, Marsh Run, Blue Run, Beautiful Run, Poplar Run, UT to Rapidan River #1, UT to Rapidan River #2, Rapidan River #1, and Rapidan River #2 impairments will be reduced to meet water quality standards, benefiting human and livestock herd health, local economies, and aquatic ecosystems. An important objective of the implementation plan is to foster continued economic vitality and strength by increasing tourism and recreational opportunities.

Measurable Goals and Milestones for Attaining Water Quality Standards

The end goals of implementation are restored water quality in the impaired waters and subsequent de-listing of streams from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report. Progress toward end goals will be assessed during implementation through tracking of control measure installations. The Virginia Department of Environmental Quality will continue to assess water quality through its monitoring program. Implementation will be assessed based on reducing exceedances of the bacteria water quality standard, thereby improving water quality. The implementation of control measures is scheduled for 15 years and will be assessed in two stages. Stage I is based on meeting source allocations that translate to a single maximum water quality standard exceedance rate of 10.5% or less resulting in de-listing of streams. The Stage II goal is meeting the specified TMDL load allocation based on single sample maximum and geometric mean water quality standard criteria.

Implementation in years one through 12 for agricultural source reductions focuses on installing livestock stream exclusion systems, improving pasture management, cropland conversion, planting cover crops, manure incorporation, and constructing animal waste storage facilities. BMPs installed in years 13 through 15 are based on additional treatment of bacteria load not treated during Stage I from pasture and cropland using improved pasture management, cropland conversion, manure incorporation into soil, and sediment retention structures. Implementation in years one through 12 for residential bacteria loads focuses on performing septic tank pump-outs, identifying and removing straight pipes, repairing or replacing failed septic systems, connecting failed septic systems to the Town of Orange sanitary sewer, instituting pet waste control education program, and installing pet waste disposal stations, pet waste enzyme digesting composters, confined canine unit waste treatment systems, vegetated buffers, rain gardens, and infiltration trenches. Vegetated buffers, rain garden and infiltration trench installations will

be concentrated in years 13 through 15 reduce bacteria loads in stormwater runoff from failing septic systems and pets.

Stakeholder's Roles and Responsibilities

Stakeholders are individuals who live or have land management responsibilities in the watershed, including private individuals, businesses, government agencies, and special interest groups. Successful implementation depends on stakeholders taking responsibility for their role in the process, and the primary role falls on the local groups that are most affected; that is, citizens, businesses, and community watershed groups. However, local, state, and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens.

The Culpeper and Thomas Jefferson Soil and Water Conservation Districts will provide cost-share funds, lead education and technical assistance efforts, and track best management practice implementation for the agricultural and residential programs. The Rappahannock-Rapidan Regional Commission will lead education and outreach efforts, coordinate funding distribution to homeowners, and report best management practice implementation for the pet waste program. State agencies conducting regulatory, education, or funding procedures related to water quality in Virginia include: Virginia Department of Environmental Quality; Virginia Department of Conservation and Recreation; Virginia Department of Health; Virginia Department of Agriculture and Consumer Services; Virginia Department of Game and Inland Fisheries; Virginia Department of Forestry; Virginia Cooperative Extension; and Virginia Outdoors Foundation. The Natural Resources Conservation Service will provide cost-share funds and technical assistance. Watershed groups such as Friends of Rappahannock or Old Rag Master Naturalists may assist with educational and citizen water quality monitoring efforts.

Integration with Other Watershed Plans

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographical boundaries and goals. These include but are not limited to Watershed Implementation Plans, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control Regulations, Stormwater Management Program, Source Water Assessment Program, and local comprehensive plans. The progress of these planning efforts needs continuous evaluation to determine possible effects on implementation goals. Coordination of local programs can increase participation in implementation activities and prevent redundancy. Several planned initiatives coinciding with TMDL implementation in this watershed include:

- Updates to Orange, Madison, Greene, and Albemarle Counties Comprehensive Plans
- Madison County Asset Management Plan
- Chesapeake Bay Watershed Implementation Plan
- Piedmont Environmental Council Strategic Plan
- Trout Unlimited Strategic Plan
- Upper York TMDL Implementation Plan
- Upper Hazel TMDL Implementation Plan

- Robinson/Little Dark Run TMDL Implementation Plan
- Moores Creek TMDL Implementation Plan
- Upper Rapidan Brook Trout Restoration Initiative

The implementation actions proposed in this plan will enhance these community improvement initiatives by improving water quality and making the rivers more attractive to visitors for tourism and recreational activities. Combined, these efforts can contribute to improvements in the area economy and residents' quality of life.

Potential Funding Sources

Potential funding sources available during implementation were identified in the course of plan development. An approved Watershed Implementation Plan makes these watersheds eligible for competitively awarded TMDL Implementation grants currently awarded through Virginia Department of Environmental Quality. Detailed descriptions of each funding source (*i.e.*, eligibility requirements, specifications, incentive payments) can be obtained from the Culpeper Soil and Water Conservation District; Thomas Jefferson Soil and Water Conservation District; Virginia Department of Conservation and Recreation; Virginia Department of Health; Virginia Department of Environmental Quality; Virginia Department of Game and Inland Fisheries; Virginia Department of Forestry; Virginia Cooperative Extension; Virginia Outdoors Foundation; Natural Resources Conservation Service; and Rappahannock-Rapidan Regional Commission.

INTRODUCTION

The Virginia Total Maximum Daily Load (TMDL) program is a process to improve water quality and restore impaired waters in Virginia. Specifically, TMDL is the maximum amount of pollutant that a water body can assimilate without surpassing the state water quality standards for protection of the six beneficial uses: drinking water, recreational (i.e., primary contact/swimming), fishing, shellfishing, aquatic life, and wildlife. If the water body surpasses the water quality criteria during an assessment period, Section 303(d) of the Clean Water Act (CWA) and the United States Environmental Protection Agency's (USEPA) Water Quality Management and Planning Regulation (40 CFR Part 130) both require states to develop a TMDL for each pollutant.

Blue Run, and Rapidan River #1 were initially placed on the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report in 2002 for exceedances of the bacteria standard. Marsh Run and Unnamed Tributary (UT) to Rapidan River #1 were initially placed on the list in 2004.

Beef Farm within Watershed

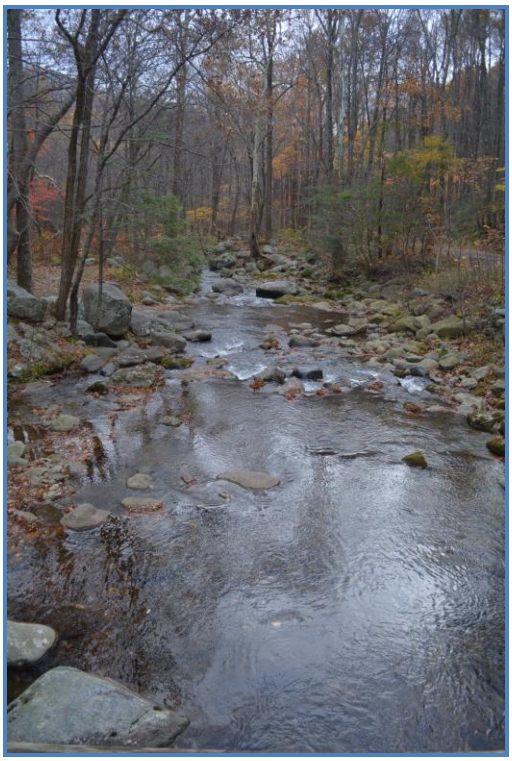
After these listings, a TMDL study was conducted for the Rapidan River watershed in 2007 to identify bacteria sources in the watersheds and set limits on the amount of bacteria these waterbodies can tolerate and still maintain support of the Recreational Use. Rippin Run, Beautiful Run, UT to Rapidan River #2, and Rapidan River #2 were listed as impairments in 2012 and Garth Run and Poplar Run were added in 2014. These watersheds are contained within the TMDL developed watershed. As a result, TMDL bacteria loadings and allocations were translated to these nested impairments.

A TMDL Implementation Plan (IP) was developed to describe and quantify implementation efforts that would reduce bacteria levels to attain water quality standards allowing delisting of the impaired waters from the Section 303(d) List. The TMDL IP describes control measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), to be implemented in a staged process. Local support and successful completion of the implementation plan will enable restoration of the impaired water while enhancing the value of this important resource. Opportunities for Orange, Madison, Greene, and Albemarle Counties, local agencies, and watershed residents to obtain funding will improve with an approved IP.

STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

In developing this implementation plan, both state and federal requirements and recommendations were followed. Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (WQMIRA) directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters" (§62.1-44.19:4 through 19:8 of the Code of Virginia). WQMIRA establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary and the associated costs, benefits, and environmental impacts of addressing the impairments.

Section 303(d) of the CWA and current USEPA regulations do not require the development of implementation strategies. USEPA does, however, outline the minimum elements of an approvable IP in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process". The listed elements include description of the implementation actions and management measures, timeline for implementing these measures, legal or regulatory controls, time required to attain water quality standards, monitoring plan, and milestones for attaining water quality standards.



Rapidan River

USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the nine elements that must be included in the IP to meet the Section 319 requirements.

Once developed, Virginia Department of Environmental Quality (VADEQ) will present the IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDL. In addition, VADEQ will request the plan be included in the appropriate Water Quality Management Plan (WQMP), in accordance with the CWA's Section 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning.

REVIEW OF TMDL DEVELOPMENT STUDY

Bacteria TMDLs for the Marsh Run, Blue Run, Unnamed Tributary (UT) to Rapidan River, and Rapidan River watersheds were completed in April 2007 with subsequent approval by USEPA in December 2007 as part of the Bacteria TMDL Development for the Rapidan River Basin. Garth Run, Rippin Run, Beautiful Run, Poplar Run, UT to Rapidan River, and Rapidan River impairments are nested within the TMDL developed watershed; therefore, bacteria loadings and reductions from the TMDL can be translated to these impairments . The TMDL development document can be obtained at the VADEQ office in Woodbridge, VA or via the Internet at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx.

Impairment description, water quality monitoring, watershed description, source assessment, water quality modeling, and allocated reductions were reviewed to determine implications of TMDL and modeling procedures on IP development.

Straight Pipe & Failing Septic System

Figure 1 depicts watershed boundaries (i.e., all colored areas) draining to impaired segments addressed in the project area of the IP. Garth Run, Beautiful Run, and UT to Rapidan River #2 impairment watersheds are located in Madison County. Rippin Run impairment watershed is located primarily in Greene County and partially in Madison County. Marsh Run impairment watershed is located primarily in Orange County and partially in Greene County. Blue Run impairment watershed is located predominantly in Orange County and partially in Albemarle County. Rapidan River #2 impairment watershed is located in Orange, Madison, and Greene Counties. Rapidan River # 1 impairmet watershed is located in Orange and Madison Counties. Poplar Run and UT to Rapidan River #1 impairment watersheds are located entirely in Orange County. Table 1 and Figure 2 illustrate landuse distribution within impairment watersheds based on 2006 U.S. Geological Survey National Land Coverage Database (NLCD) data used to develop TMDLs. Garth Run, Rippin Run, UT to Rapidan River #2, and Marsh Run drain into Rapidan River #2 before joining Blue Run and draining into Rapidan River #1. Beautiful Run, Poplar Run, and UT to Rapidan River enter Rapidan River #1 before confluence with Robinson River.

Table 1. Watershed area and land use distribution.

Impairment	Watershed Area (ac)	Portion of Watershed Area (%)				
		Cropland	Pasture	Residential	Water / Wetland	Forest
Garth Run	4,849	0	8	2	0	90
Rippin Run	7,478	5	41	7	1	46
Marsh Run	10,709	1	22	4	1	72
Blue Run	20,955	2	39	5	2	52
Beautiful Run	14,702	5	45	3	1	46
Poplar Run	5,543	5	43	13	1	38
UT to Rapidan River #1	1,541	1	51	12	2	34
UT to Rapidan River #2	4,558	10	45	3	0	42
Rapidan River #1	8,702	7	57	7	1	28
Rapidan River #2	78,225	3	25	3	1	68
TOTAL	**157,262**	**3**	**32**	**4**	**1**	**60**

Potential sources of bacteria include both point source and nonpoint source (NPS) contributions. Nonpoint sources include: wildlife, grazing livestock, land application of manure and biosolids, residential runoff, failed and malfunctioning septic systems, and uncontrolled discharges (straight pipes). General strategy to address bacteria impairments in the Garth Run, Rippin Run, Marsh Run, Blue Run, Beautiful Run, Poplar Run, UT to Rapidan River #1, UT to Rapidan River #2, Rapidan River #1, and Rapidan River #2 watersheds includes:

- ★ Exclusion of most/all livestock including horses from streams is necessary;
- ★ Substantial land-based NPS load reductions are called for on pasture and cropland;
- ★ All straight pipes and failing septic systems need to be identified and corrected;
- ★ Implicit in the requirement to correct straight pipes and failing septic systems is the requirement to maintain all properly functioning septic systems; and
- ★ Reductions to pet bacteria loads on residential land use are necessary.

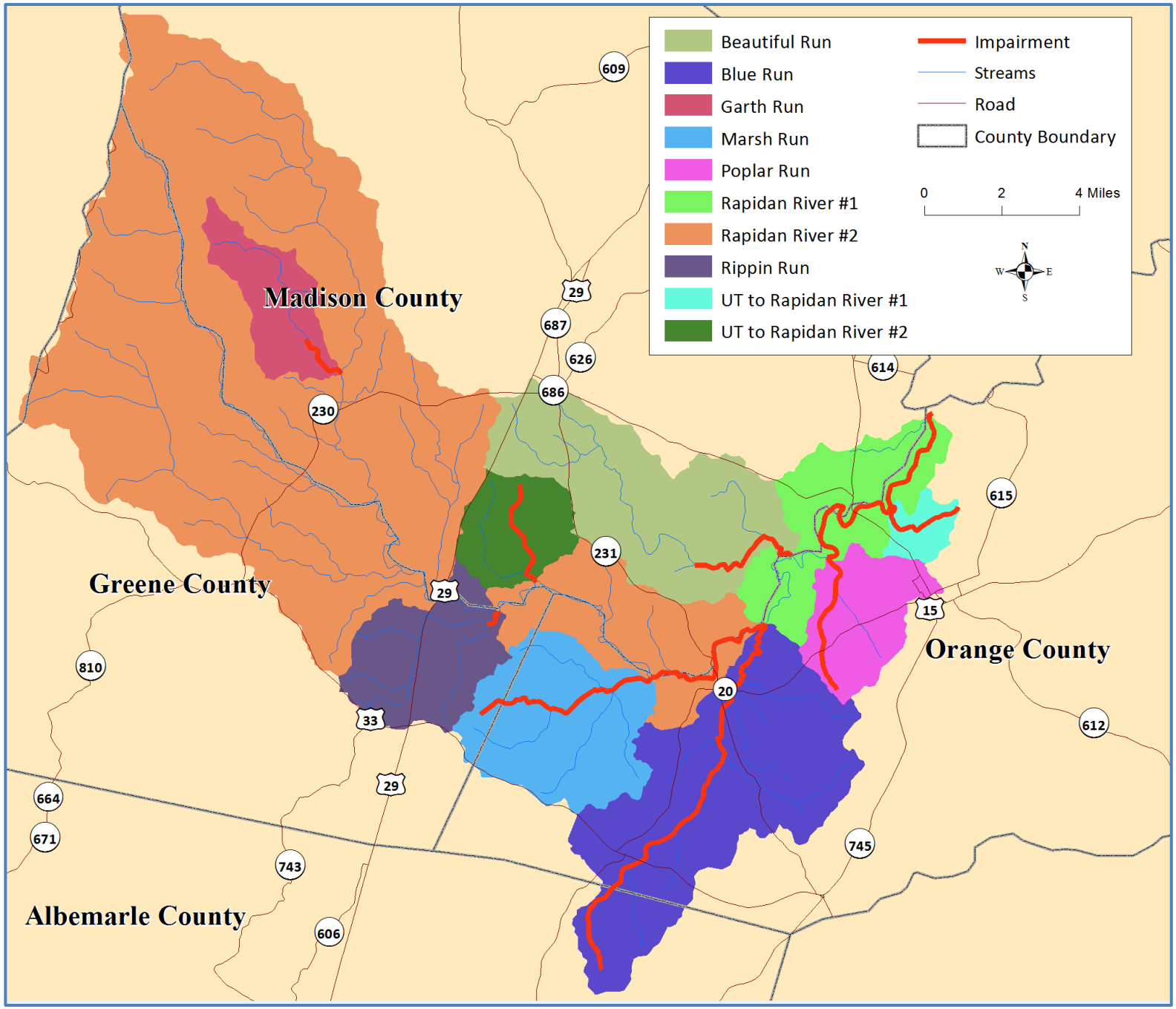


Figure 1. Watersheds location.

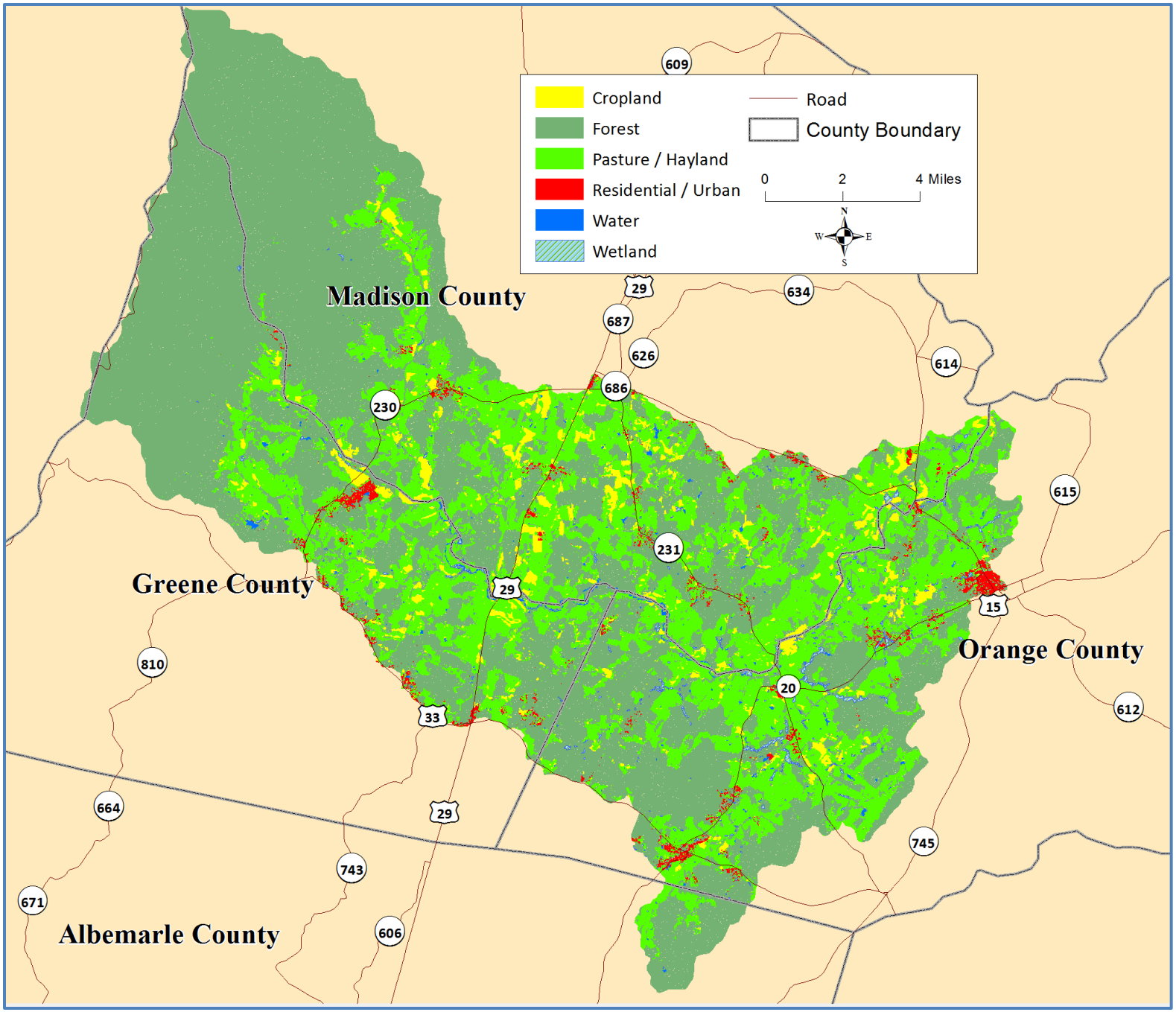


Figure 2. Land uses in the watersheds.

PUBLIC PARTICIPATION

Process

The actions and commitments compiled in this document are formulated through input from citizens of the watershed; Madison County government; Greene County government; Orange County Public Service Authority; Orange Farm Service Agency (FSA); Ecosystems Service, LLC; Center for Natural Capital; Piedmont Environmental Council (PEC); Friends of the Rappahannock; Old Rag Master Naturalists; Culpeper Soil and Water Conservation District (CSWCD); Thomas Jefferson Soil and Water Conservation District (TJSWCD); Madison County Health Department; Greene County Health Department; Albemarle County Health Department; Rappahannock-Rapidan Regional Commission (RRRC); Virginia Department of Environmental Quality (VADEQ); Virginia Department of Health (VDH); Virginia Department of Forestry (VADOF); Natural Resources Conservation Service (NRCS); Shenandoah National Park; and Blue Ridge Environmental Solutions, Inc. (BRES). Every citizen and interested party in the watershed is encouraged to put the IP into action and contribute what he or she is able to help restore the health of these waterbodies.

Public participation took place during implementation plan development on three levels. First, public meetings were held to provide an opportunity for informing the public as to the end goals and status of the project, as well as a forum for soliciting participation in the smaller, more-targeted meetings (*i.e.*, working groups and Steering Committee). Second, three working groups were formed: Agricultural, Residential, and Governmental. Third, a Steering Committee was formed with representation from the Agricultural, Residential, and Governmental Working Groups; Ecosystems Service, LLC; Shenandoah National Park; Friends of Rappahannock; Old Rag Master Naturalists; CSWCD; TJSWCD; RRRC; VADEQ; VDH; and BRES to guide the development of the implementation plan. Over 200 hours were devoted to attending these meetings by individuals representing agricultural, residential, commercial, environmental, and government interests on a local, state, and federal level (Table 2).

Livestock Stream Access

Pastured Livestock

Land Application

Table 2. Meetings held during the TMDL IP development process.

Date	Meeting Type	Location	Attendance	Time (hr)
01/28/15	Public Meeting	Town of Orange Public Works	20	1
01/28/15	Agricultural & Residential Working Group	Town of Orange Public Works	20	1
01/29/15	Public Meeting	PVCC Eugene Giuseppe Center	20	1
01/29/15	Agricultural & Residential Working Group	PVCC Eugene Giuseppe Center	20	1
03/31/15	Governmental Working Group	Madison County Extension	14	2
04/16/15	Agricultural & Residential Working Group	PVCC Eugene Giuseppe Center	14	2
07/10/15	Steering Committee	Madison County Extension	12	2
08/13/15	Public Meeting	James Madison's Montpelier	21	2

Agricultural Working Group Summary

The Agricultural Working Group (AWG) consisted of representatives from organizations that serve this community and will have a role in implementation (*e.g.*, CSWCD, TJSWCD, and NRCS). The AWG is confident that current BMPs eligible for cost-share in TMDL areas and proposed recommendations will provide the necessary incentive for producers and landowners to implement necessary BMPs to meet specified reductions to direct stream, pasture, and cropland bacteria loads. Challenges, recommendations, and keys for success were discussed in the meetings.

Many hay fields and timber tracts have been converted into crop land over the last five years. There has been an increase in poultry farms. Many are new, but some are existing operations that are expanding (i.e., three operations in Orange County). Much of the farmland in the region is leased, both farmland and cropland. It does not impact participation in the cost-share programs, because lessees are eligible provided they have 10-year lease at minimum. Absentee landowners are prevalent in the watershed, but usually the tenant cooperates with the district. A generational shift is occurring where children and grandchildren of farmers, who recognized the damage that poor farming practices create and who helped develop organizations such as Soil and Water Conservation Districts, are not aware of how their farming practices are affecting the soil, water and environment. Many farmers think because they do no-till farming, they do not need to implement other conservation practices.

There is evidence of intensive horse grazing in the watershed, many new horse rescue organizations where the average ratio of horse per acre is 10 to 1. While many horse farms do not allow horses to have direct access to streams, runoff is a significant issue that needs to be addressed. Little to no buffers exist, the soil is badly compacted exacerbating runoff, and often the manure pile is placed close to tributaries. It was recommended that VADEQ & VADCR partner with state equine organizations such as the Virginia Horse Council. However, it should be noted that many equine organizations are very

fragmented; broken down by specific breeds and disciplines (dressage, reining, racing, etc.) and it may be difficult to reach all of them. Both mass outreach from the state-level and local one-on-one grassroots outreach may be needed. Many horse owners may not be the highest priority when prioritizing BMP outreach strategies. However, farms with very high stocking rates and poor forage management should be targeted. Many horse owners do not seem to understand that they are a contributing source of bacteria and may be adding to the stream's bacteria impairment.

Alternative Water Source

In the past, Virginia Cooperative Extension, Piedmont Environmental Council, Virginia Grasslands and Forage Council, and Soil and Water Conservation Districts have offered educational programs and hosted events targeting horse owners, but had very little attendance. Virginia Grasslands and Forage Council found that integrating the educational component into an event and including a well-known horse professional helped reach more horse owners. The Virginia Forage and Grassland Council will be offering a grazing mentoring program that will include the entire state. It will include information on soil retention, nutrient management, electric fencing, definition of flash grazing, etc. It was recommended this information be shared with Soil and Water Conservation Districts and VA Cooperative Extension.

Opportunities exist in the Upper Rapidan River watershed to improve stream buffers, but not all farmers are willing to participate in the cost share programs. Farmers with no stream buffers could be targeted for information distribution. Further up the watershed, it becomes harder to get participation with stream buffers, because the farmer loses a lot of land. To address this issue, attendees recommended that much smaller setbacks be required for those areas and that VADEQ / VADCR consider a no setback BMP for the farmers with many small tributaries needing fencing. Due to potential requirement non-compliance, flash grazing in buffers was not recommended.

Information is best shared one on one with farmers through recognized local government staff with the Soil and Water Conservation District, NRCS, and Virginia Cooperative Extension who have experience and knowledge in farming practices and have the existing relationships with producers and producer groups. Visibility is the key and trust is needed. Running programs on local television shows like Virginia Farming has been done in the past and would be helpful. As well, creative partnerships are an important part of every TMDL IP. Many partnerships currently exist between the various conservation agencies, Virginia Cooperative Extension and producer groups. The Virginia Cooperative Extension may be a good partner to assist with outreach to the equine industry. Other partnerships with established equine groups could also be considered. The Soil Conservation Districts have relationships with government agencies and producer groups, including but not limited to Virginia Farm Bureau and the Central Virginia Cattleman's Association. Other grazing groups were suggested for inclusion. The Culpeper SWCD sends an annual mailing to the Farm Bureau's mailing list, and expects to continue this. Attendees also recommended that education and outreach programs be targeted to the Virginia Cooperative Extension, large animal vets, horse owners, and farriers.

Residential Working Group Summary

The Residential Working Group (RWG) consisting of watershed residents, RRRC, CSWCD, TJSWCD, VADEQ, and NRCS personnel focused on ways to educate and involve public with regard to

implementing corrective actions to replace straight pipes, correct failing septic systems, and manage pet waste. Challenges, recommendations, and keys for success were discussed in the meetings.

Septic Tank Pump-out

Generally, homeowners in the watershed are aware they have a septic system, but while most know that maintenance should be done, they do nothing until they experience a problem. A lot of people do not know that maintenance can extend the life of septic systems. Many homeowners do not know where their septic tank is, and it can be embarrassing to admit they have a problem. Incentives to help address the septic system problem can help mitigate that embarrassment, encouraging them to learn about proper septic system maintenance while participating in the cost-share programs. Rental properties can be a hot spot for septic issues, because of renters flushing undesirable "flushable" products that are not made for septic systems. Attendees expect to see an increase in failing septic systems in the future due to this issue since disposable products are marketed as being septic system friendly. Many homeowners are hesitant to seek help for fear of a VDH violation and possibly opening the door to higher costs if VDH requires substantial repairs. It was recommended that a septic tank pump-out program target areas near streams, but not limit cost-share to areas away from streams. Attendees felt there was more of an issue of grey water in the watershed than straight pipes. It was recommended 100% cost-share be considered for low-income homeowners needing septic systems, particularly those near streams. Partnerships with other agencies, such as Rural Development, could be developed to make this possible, if VADEQ cannot provide the full 100%. There are currently some alternative waste treatment systems attendees were aware of in Orange County, where there are many un-buildable lots with poor soils that don't perk. Attendees felt the systems were fairly new, so were not aware of any maintenance problems but thought it was possible in the future as the systems age.

Going door-to-door and speaking one-on-one was identified as the most promising homeowner outreach. Program information has been spread by word-of-mouth very effectively in residential subdivisions. CSWCD provides educational brochures to the homeowners and distributes the information through various venues. Churches and the Health Department have been especially helpful in getting the word out. Information has also been printed in local newspapers and signs are displayed at homeowners houses when a cost-share program is being implemented, helping to bring awareness to neighbors and the community. In other TML IP watersheds, CSWCD, NRCS and Virginia Cooperative Extension agricultural staff has been helpful in referring farmers to the residential cost-share programs.

Attendees recommended focusing on kennels and hunt clubs rather than pet waste station installations at towns and parks. There are many kennels and hunt clubs, including those used for fox hunting, in Orange and Madison counties. Greene and Madison Counties had once required residents with a certain number of dogs to get a kennel license, and may have that data available. The Town of Orange provided a list of their licensed kennel operations for the purpose of estimating numbers and will cooperate with providing educational information to those individuals. As well, contacts through hunt club associations will be useful when reaching out to the kennel and hunt clubs in the area with information on proper pet waste handling (e.g, digesters or scoop and trash). A portion of the Town of Orange, which is included in the Upper Rapidan watershed, may also have popular dog walking areas in need of pet

waste bag stations. Other rural neighborhoods may wish to install them for residents, or they can be placed at area parks or schools where dog walking takes place. HOWS (Houses of Wood and Straw, a non-profit serving confined outdoor dogs with houses and straw in winter), was recommended to assist with outreach for pet waste programs, such as educational brochures and leash bag holders. Attendees recommended that pet waste stations be placed at parking lots and entrances to the Shenandoah National Park such as White Oak Canyon and Old Rag. Attendees recommended that rain gardens and infiltration trenches be a focus in Phase II of implementation.

Governmental Working Group Summary

The Governmental Working Group (GWG) consisting of representatives from Madison County government; Greene County government; Orange County Public Service Authority; CSWCD; TJSWCD; Madison County Health Department; Greene County Health Department; RRRC; VADEQ; VDH; VADOF; and BRES personnel, focused on control measure estimates, funding sources, technical assistance needs, regulatory controls, and lead agencies responsible for implementation.

Additional cost-share assistance such as SERCAP should be pursued to offset cost for fixing septic system failures. Low interest/no interest loans are available from additional programs. Price gouging by contractors in surrounding TMDL IP watersheds was identified and may be a potential hindrance to implementation. It was recommended that homeowners obtain three price estimates when requesting cost share and that SWCDs review invoices and agree to payment of reasonably priced estimates.

Alternative On-site Sewage Disposal System

Additionally, this concern could be addressed through the modified bid procedures coming out in the 2016 DEQ TMDL BMP Implementation Guidelines. For non–agricultural projects less than $5,000, bids are not required although greater than this amount will require bids. The towns of Orange and Stanardsville were suggested for potential public sewer hook-up options. In the past 5 years, Madison has not had that many new alternative systems, whereas in Greene County there have been about 15-20 alternative systems in that time period, mostly new construction. An area near the Rapidan River and Robinson River confluence was identified as having problem soils and may likely be a suspect area for failing septic systems where homeowners could use assistance. Older vacation style homes that are now full time residences may have septic systems unsuitable for year round usage in Garth Run. Based on this information, along with rocky and steep terrain, it was suggested to include a 50:50 split between new conventional systems (RB-4) and new conventional systems with pump (RB-4P) in the septic BMP estimates. Local average costs to fix or replace failing septic systems and straight pipes were provided. No counties have ordinances requiring mandatory pump-outs.

In rural areas, it is hard to get buy in from community for the pet waste digesters installations, but pet waste stations are popular. Madison County developed a septic database during the Robinson River TMDL IP that covered the entire county and is accessible by record look up. Orange County has some pet waste stations and requires a license for dog kennels.

State and federal agricultural cost-share funds received for Madison, Orange, Greene, and Albemarle Counties are allocated and disbursed by the CSWCD and TJSWCD. The length of fencing went dramatically up (feet) when 100% cost- share became available from the state. Since the 100% cost-share ended in June 2015, a bigger push for CREP will occur and the estimated distribution of cost -share funding should reflect this trend. Members questioned whether there was a regulatory buffer requirement for livestock. There is no regulatory requirement in general, but in order to receive cost-share funds one has to meet set-back requirements. However, it is a voluntary program. The probability that farmers will install exclusion fencing was explored by the AWG. CSWCD had $5 million in cost-share spent on BMPs for 35-foot setback at 100% cost share, 10-foot setback at 50% cost share, and no setback which allows for a 25% tax credit (Fencing installed at top of stream bank under SL - 6B is eligible for a 25% BMP tax credit up to $17, 500 per applicant per year). All of these optional cost-share programs are voluntary, although they require a 10-year maintenance agreement.

Potential funding sources were discussed and some consolidation of programs have occurred in the 2014 Farm Bill. RCPP is a new program this year, which brings together non-government partners with district/state agencies. VADOF administers the Stewardship Program to assist landowners. VADOF has some money available through Virginia Trees for Clean Water for tree planting potentially available next year, but it is dependent on DCR and Chesapeake Bay funds. Funding sources similar to those developed through past TMDLs in Rappahannock County with Piedmont Environmental Council and the Krebser Fund, should be pursued. Incentive funds from Center for Natural Capital, Rapidan Better Housing, and USDA Rural Development should be explored. Although RRRC/Friends of the Rappahannock Rainscape Retrofit Program and CSWCD residential stormwater cost share programs (VCAP) are geared towards nutrient and sediment reductions, they will provide the added benefit of bacteria reductions in some situations. A 100% cost- share rate for straight-pipe conversion as a pilot program to see whether it would yield an improvement in sign-up, since straight pipes are difficult to find, was recommended .

Suggested outreach included a target mailing to older homes and/or dog owners. CSWCD goes door to door instead of using a mailing for their outreach programs. Some other areas include a mailing in the water or electric bill by partnering with utilities. The Center for Natural Capital student interns from Woodbury Forest, Master Naturalists, and Madison County 4H Wildlife Club could be possible groups interested in conducting citizen monitoring in the watershed.

Steering Committee Summary

The Steering Committee consisted of representatives from the AWG, RWG, and GWG; Ecosystems Service, LLC; Shenandoah National Park; Friends of Rappahannock; Old Rag Master Naturalists; CSWCD; TJSWCD; RRRC; VADEQ; VDH; and BRES. The Steering Committee evaluated recommendations from working groups, reviewed BMP quantification and cost estimates, revised the implementation plan document and discussed specific questions of some of the reviewers, and evaluated materials for the final public meeting. A representative from each of the working groups provided a summary of the discussions from the working group sessions. The Steering Committee will periodically revisit implementation progress and suggest plan revisions as needed.

IMPLEMENTATION ACTIONS

An assessment was conducted to quantify actions and costs for two implementation stages. Actions and costs that translate to a single sample maximum standard exceedance rate of 10.5% or less, resulting in removal of these streams from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report, were quantified. This is referred to as the Stage I implementation goal. The Stage II implementation goal is full attainment with the TMDL source load reductions. Estimated units presented in Tables 3 through 6 depict the Stage I and II goals. Potential control measures, their associated costs and efficiencies, and potential funding sources were identified through review of the TMDL, input from working groups, and literature review. Control measures were assessed based on cost, availability of existing funds, reasonable assurance of implementation, and water quality impacts. Measures that can be promoted through existing programs were identified, as well as those not currently supported by existing programs and their potential funding sources. The assurance of implementation of specific control measures was assessed through discussion with the working groups and Steering Committee.

Agricultural Implementation Needs

Removing livestock from the stream corridor was identified as the primary control measure to reduce the livestock direct deposition bacteria load. There are approximately 639 miles of perennial streams in these 10 watersheds. Currently in these watersheds, approximately 82 miles of exclusion fencing have been installed. Exclusion fencing, necessary to prevent access to perennial streams and meet the stated TMDL reductions, was estimated at approximately 202 miles of fence. Figure 3 displays analysis results for a portion of Rapidan River watershed. The exclusion fencing is translated into a total of 314 exclusion systems to be installed to insure full exclusion of livestock from the streams. In order to provide implementation options to producers, several cost-share programs with varying goals and requirements were included. Based on historical cost-share program participation and working group feedback, total exclusion systems were divided between **Conservation Reserve and Enhancement Program (CREP)**, **Environmental Quality Incentives Program (EQIP)**, **Stream Exclusion with Grazing Land Management (SL-6/6T, LE-1T)**, **Livestock Exclusion with Reduced Setback (LE-2/2T)**, **Small Acreage Grazing System (SL-6AT)**, **Stream Protection (WP-2/2T)**, and **Support for Extension of CREP Watering Systems (SL-7T)** (Table 3). **Stream Exclusion (CCI-SE-1)** and **Forested Riparian Buffer (CCI-FRB-1)** were listed to illustrate potential incentives to extend design life and continue maintenance of existing fencing. Implementation costs were not included for these practices.

Stream Exclusion Fencing

Improved pasture management BMPs are needed to reduce bacteria load contributed from grazing animals and transported to stream during precipitation events after accounting for bacteria removal from riparian buffers installed from livestock stream fencing. A total of 49,361 acres in the watershed would require **Improved Pasture Management** with portions of this acreage improved by the **Pasture and Hayland Planting (NRCS Code 512)**, **Prescribed Grazing (NRCS Code 528)**, **Grazing Land Management (SL-9)**, and **Pasture Management (SL-10T)** BMPs. Given that reductions were not sufficient to meet TMDL reduction goals, the installation of **Sediment Retention, Erosion, or Water Control Structures (WP-1)** may be necessary to treat runoff from this acreage during Stage II of implementation.

The AWG decided the primary control measures for cropland bacteria load reduction will be **cover crops (SL-8)**, **permanent conversion of cropland to pasture and forest land uses**, and **manure incorporation**. The conversion was divided between Permanent Vegetative Cover (SL-1) and Reforestation of Erodible Crop and Pastureland (FR-1) BMPs based on input from AWG and landuse difference. Currently in these watersheds, approximately 136 cropland acres have been converted utilizing the SL-1 (128 ac) and FR-1 (8 ac) practices. Planting 3,266 acres of cover crops, converting 43 acres to pasture and 43 acres to forest land uses, and incorporating manure into soil on approximately 892 cropland acres during Stage I & II satisfied the TMDL goals (Tables 3 and 4). The CSWCD identified six opportunities within this watershed to utilize an **Animal Waste Control Facility (WP-4)**.

Permanent Vegetative Cover on Cropland

Re-forestation

Table 3. Estimation of control measures with unit cost (average) needed to meet pasture and cropland bacteria load reduction Stage I (years 1-12) implementation goals.

Control Measure	Unit	Average Unit Cost[4] ($)	Estimated Units Needed (#)										Total
			Garth Run	Rippin Run	Marsh Run	Blue Run	Beautiful Run	Poplar Run	UT to Rapidan River #1	UT to Rapidan River #2	Rapidan River #1	Rapidan River #2	
Pasture and Livestock Exclusion													
Livestock Exclusion System (CREP)	System[6]	18,000	1	4	4	13	6	4	1	1	5	23	**62**
Livestock Exclusion System (EQIP)	System[6]	15,000	0	1	2	6	3	2	0	0	2	11	**27**
Livestock Exclusion System (SL-6/6T, LE-1T)	System[6]	35,500	2	7	9	36	16	11	2	2	13	61	**159**
Livestock Exclusion System (SL-6AT)	System[6]	9,000	1	0	0	2	0	1	0	0	0	2	**6**
Livestock Exclusion System (LE-2/2T)	System[6]	12,000	1	2	3	11	5	3	0	1	4	20	**50**
Livestock Exclusion System (WP-2/2T)	System[6]	2,500	0	0	1	2	1	1	0	0	1	4	**10**
Stream Exclusion (CCI-SE-1)[7]	*Feet*	*1*	*11,400*	*8,500*	*32,700*	*37,300*	*50,400*	*0*	*0*	*44,600*	*8,200*	*239,500*	***432,600***
Forested Riparian Buffer (CCI-FRB-1)[7]	*Acres[2]*	*100*	*9*	*7*	*26*	*30*	*41*	*0*	*0*	*36*	*7*	*192*	***348***
Improved Pasture Management[1]	Acres[2]	165	288	2,380	1,808	6,404	5,152	1,824	620	1,616	3,916	15,492	**39,500**
Cropland													
Permanent Vegetative Cover on Cropland (SL-1)	Acres[2]	350	0	2	8	4	2	2	0	2	8	8	**36**
Reforestation of Erodible Crop & Pastureland (FR-1)	Acres[2]	450	0	2	8	4	2	2	0	2	8	8	**36**
Cover Crops (SL-8)	Acres[2]	50	5	182	65	200	360	129	4	218	306	1,143	**2,612**
Manure / Litter Incorporation Into Soil	Acres[2]	25	8	40	82	217	40	40	8	40	80	160	**715**
Poultry Litter Storage Facility (WP-4)	System	38,000	0	0	0	0	1	0	0	0	0	1	**2**
Dry Manure Storage Facility (WP-4)	System	50,000	0	0	0	1	1	0	0	0	0	0	**2**
Liquid Manure Storage Facility (WP-4)	System	75,000	0	0	0	0	1	0	0	1	0	0	**2**
Technical Assistance													
Agricultural – Pasture and Cropland	FTE[5]	60,000											**2/yr**

[1] Improved pasture management comprised of: Pasture and Hayland Replanting (512), Prescribed Grazing (528), Grazing Land Management (SL-9), and Pasture Management (SL-10T) BMPs; [2] Acres installed; [3] Acres treated; [4] Unit cost = installation or one-time incentive payment; [5] Full time equivalent; [6] System typically includes stream exclusion and cross fencing, water trough, well, distribution piping, and riparian buffer , [7] Illustrates existing fencing, but no implementation cost associated with these potential incentives

Table 4. Estimation of control measures with unit cost (average) needed to meet pasture and cropland bacteria load reduction Stage II (years 13-15) implementation goals.

Control Measure	Unit	Average Unit Cost[4] ($)	Estimated Units Needed (#)										Total
			Garth Run	Rippin Run	Marsh Run	Blue Run	Beautiful Run	Poplar Run	UT to Rapidan River #1	UT to Rapidan River #2	Rapidan River #1	Rapidan River #2	
Pasture and Livestock Exclusion													
Livestock Exclusion System (CREP)	System[6]	18,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Livestock Exclusion System (EQIP)	System[6]	15,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Livestock Exclusion System (SL-6/6T, LE-1T)	System[6]	35,500	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Livestock Exclusion System (SL-6AT)	System[6]	9,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Livestock Exclusion System (LE-2/2T)	System[6]	12,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Livestock Exclusion System (WP-2/2T)	System[6]	2,500	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Stream Exclusion (CCI-SE-1)	Feet	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Forested Riparian Bufffer (CCI-FRB-1)	Acres[2]	100	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Improved Pasture Management[1]	Acres[2]	165	67	592	448	1,602	1,288	459	151	402	976	3,876	**9,861**
Sediment Retention, Erosion, or Water Control Structure (WP-1)	Acres[3]	870	62	758	474	1,761	1,610	445	208	565	1,223	4,358	**11,464**
Cropland													
Permanent Vegetative Cover on Cropland (SL-1)	Acres[2]	350	0	0	2	1	0	0	0	0	2	2	**7**
Reforestation of Erodible Crop & Pastureland (FR-1)	Acres[2]	450	0	0	2	1	0	0	0	0	2	2	**7**
Cover Crops (SL-8)	Acres[2]	50	1	46	16	50	90	32	2	55	76	286	**654**
Manure / Litter Incorporation Into Soil	Acres[2]	25	1	10	21	54	10	10	1	10	20	40	**177**
Poultry Litter Storage Facility (WP-4)	System	38,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Dry Manure Storage Facility (WP-4)	System	50,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Liquid Manure Storage Facility (WP-4)	System	75,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Technical Assistance													
Agricultural – Pasture and Cropland	FTE[5]	60,000											**2/yr**

[1] Improved pasture management comprised of: Pasture and Hayland Replanting (512), Prescribed Grazing (528), Grazing Land Management (SL-9), and Pasture Management (SL-10T) BMPs; [2] Acres installed; [3] Acres treated; [4] Unit cost = installation or one-time incentive payment; [5] Full time equivalent; [6] System typically includes stream exclusion and cross fencing, water trough, well, distribution piping, and riparian buffer

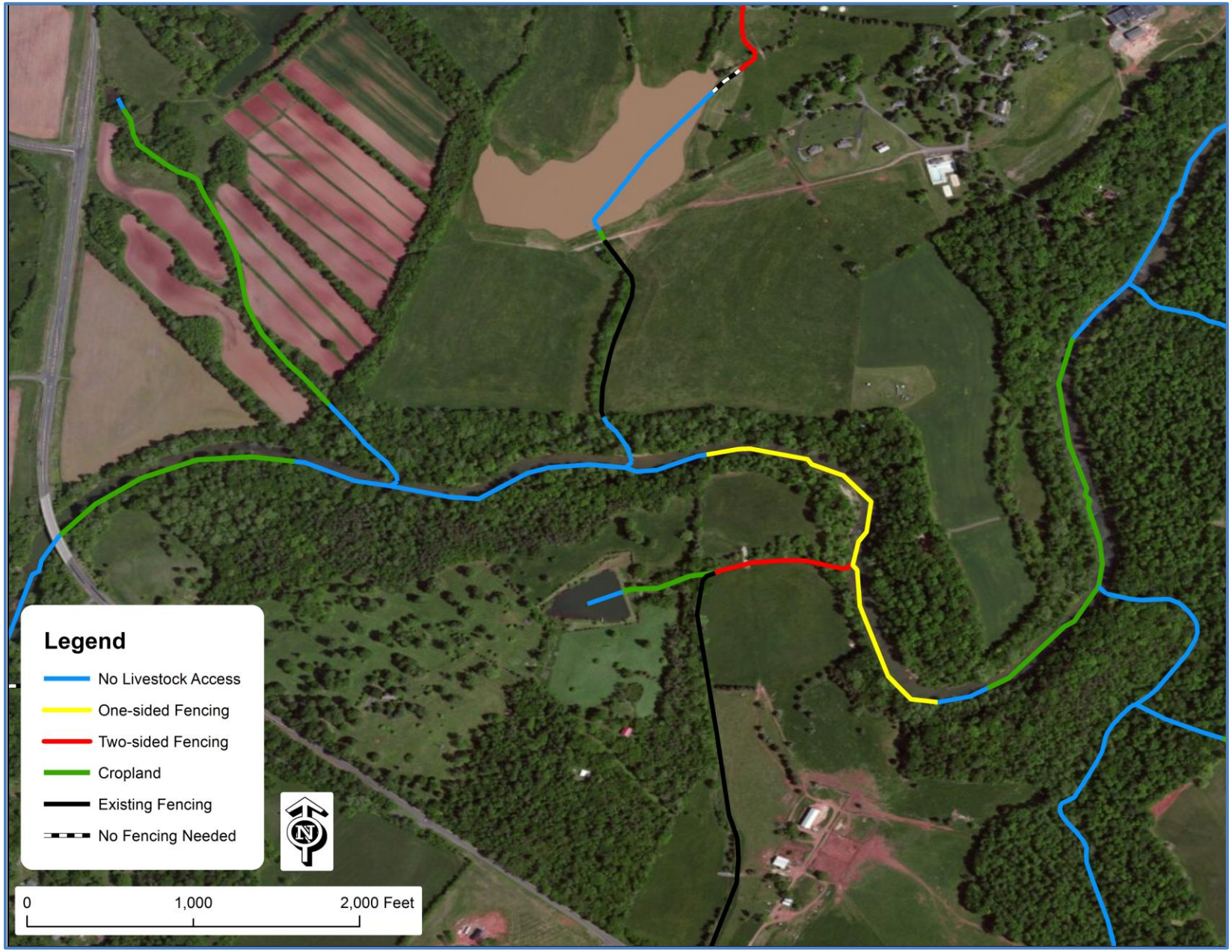


Figure 3. Potential livestock exclusion fencing analysis results for portion of Rapidan River.

Residential/Urban Implementation Needs

Septic System Repair

Number of straight pipes and failing septic systems to correct during implementation was established during TMDL development. Based on discussion with Virginia Department of Health and GWG, it was assumed that 80% of the straight pipes would be replaced with a conventional septic system, 10% replaced with conventional septic system with pump, and 10% replaced with an alternative on-site sewage disposal system (OSDS). Failing septic systems were assumed to be corrected by connecting to public sewer or repairing the existing septic system (70%), installing a new conventional septic system (25%), installing a new conventional septic system with pump (3%), or installing a new alternative OSDS (2%). Garth Run was the exception; whereby, the GWG felt a greater number of conventional septic systems with pumps would be needed due to topography and soils. The RWG and GWG felt strongly that septic tank pump-outs, estimated at number of failing septic systems and straight pipes (about 25% of houses with OSDS), help to identify systems in need of repair and would be needed to identify and correct all failing septic systems and straight pipes. It is estimated that 1,713 **septic tank pump-outs**; 30 **connections to public sewer**; 1,068 **septic system repairs**; 501 **conventional septic systems**; 68 **conventional septic systems with pump**; and 46 **alternative OSDS** are considered necessary to correct straight pipes and failing septic systems during implementation (Table 5).

Pet Waste Kiosk

Pet Waste Composter

A three-step program was proposed to address pet waste reductions. In the first step, **pet waste control programs** consisting of educational packets, signage, and disposal stations in public areas will be instituted in each watershed. The Madison, Greene, Orange, and Albemarle pet waste educational programs for the general public were mostly divided based on watershed area within county boundaries. In some areas it will be necessary to develop a specific outreach and educational program for the kennel and hunt club operations. Sixteen **pet waste disposal stations (PW-1)** were estimated based on at least one in each impairment watershed and three additional stations each in Poplar Run and UT to Rapidan River #1. The second step will be installing **pet waste enzyme digesting composters (PW-2)** at 85 residences. The GWG and Steering Committee estimated that 1% of all residences would utilize a composter for dog waste. The third step will be identification of confined canine units (CCU) and installing approximately five **CCU waste treatment systems** throughout the watersheds. CCUs may be in the form of a septic system specifically designed to break down dense dog waste, which could be more expensive, or a less expensive dry stacking/composting system. The installation of **vegetated buffers**, **bioretention**, and **infiltration trenches** during Stages I & II on residential land use to reduce bacteria loads from failing septic systems and pets then transported to streams during precipitation events are outlined in Tables 5 & 6.

Table 5. Estimation of control measures with unit cost (average) needed to meet residential and onsite sewage disposal systems bacteria load reduction Stage I (years 1-12) implementation goals.

Control Measure	Unit	Unit Cost[1] ($)	Estimated Units Needed (#)										Total
			Garth Run	Rippin Run	Marsh Run	Blue Run	Beautiful Run	Poplar Run	UT to Rapidan River #1	UT to Rapidan River #2	Rapidan River #1	Rapidan River #2	
Failing Septic Systems													
Septic Tank Pump-out	System	300	26	142	136	214	141	71	17	44	113	639	**1,543**
Connection of OSDS to Public Sewer	System	12,500	0	0	0	0	0	30	0	0	0	0	**30**
Septic System Repair	System	3,500	18	99	95	150	99	37	12	31	80	447	**1,068**
New Conventional Septic System	System	6,000	4	36	34	54	35	3	4	11	28	160	**369**
New Conventional Septic System with Pump	System	8,000	3	4	4	6	4	1	1	1	3	19	**46**
Alternative On-site Sewage Disposal System	System	25,000	1	3	3	4	3	0	0	1	2	13	**30**
Straight Pipes													
Septic Tank Pump-out	System	300	11	3	11	38	20	14	4	5	7	57	**170**
New Conventional Septic System	System	6,000	5	2	9	30	16	12	3	4	6	45	**132**
New Conventional Septic System with Pump	System	8,000	5	1	1	4	2	1	0	1	1	6	**22**
Alternative On-site Sewage Disposal System	System	25,000	1	0	1	4	2	1	1	0	0	6	**16**
Pet Waste Management													
Pet waste education program[5]	Program	2,500	1	1	1	1	1	1	1	1	1	1	**10**
Pet Waste Disposal Station	System	500	1	1	1	1	1	4	4	1	1	1	**16**
Pet waste digester	System	50	1	6	5	15	4	12	3	1	8	30	**85**
Confined Canine Unit Waste Treatment System	System	12,300	0	0	1	1	0	1	0	0	1	1	**5**
Residential/Urban Best Management Practices													
Vegetated Buffers	Acres[2]	400	2	4	4	10	3	10	1	1	4	21	**60**
Bioretention	Acres[3]	15,000	0	3	1	2	1	1	0	0	1	6	**15**
Infiltration Trench	Acres[3]	11,300	0	1	1	2	1	1	0	0	1	3	**10**
Technical Assistance													
On-site Sewage Disposal Systems	FTE[4]	60,000											**1.6/yr**
Pet Waste Management & Residential BMPs	FTE[4]	60,000											**0.4/yr**

[1] Unit cost = installation or one-time incentive payment; [2] Acres installed; [3] Acres treated; [4] Full time equivalent; [5] Programs divided between Greene, Madison, Orange, and Albemarle Counties

Table 6. Estimation of control measures with unit cost (average) needed to meet residential and onsite sewage disposal systems bacteria load reduction Stage II (years 13-15) implementation goals.

Control Measure	Unit	Unit Cost[1] ($)	Estimated Units Needed (#)										Total
			Garth Run	Rippin Run	Marsh Run	Blue Run	Beautiful Run	Poplar Run	UT to Rapidan River #1	UT to Rapidan River #2	Rapidan River #1	Rapidan River #2	
Failing Septic Systems													
Septic Tank Pump-out	System	300	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Connection of OSDS to Public Sewer	System	10,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Septic System Repair	System	3,500	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
New Conventional Septic System	System	6,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
New Conventional Septic System with Pump	System	8,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Alternative On-site Sewage Disposal System	System	25,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Straight Pipes													
Septic Tank Pump-out	System	300	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
New Conventional Septic System	System	6,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
New Conventional Septic System with Pump	System	8,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Alternative On-site Sewage Disposal System	System	25,000	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Pet Waste Management													
Pet waste education program[5]	Program	2,500	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Pet Waste Disposal Station	System	500	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Pet waste digester	System	50	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Confined Canine Unit Waste Treatment System	System	12,300	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**n/a**
Residential/Urban Best Management Practices													
Vegetated Buffers	Acres[2]	400	0	2	2	4	1	3	1	1	2	5	**21**
Bioretention	Acres[3]	15,000	1	0	1	1	0	1	1	0	0	4	**9**
Infiltration Trench	Acres[3]	11,300	1	1	1	1	0	1	1	0	0	2	**8**
Technical Assistance													
Pet Waste Management & Residential BMPs	FTE[4]	60,000											**1.0/yr**

[1] Unit cost = installation or one-time incentive payment; [2] Acres installed; [3] Acres treated; [4] Full time equivalent; [5] Programs divided between Greene, Madison, Orange, and Albemarle Counties

Other Potential Implementation Needs

Implicit in the TMDL is the need to avoid increased delivery of pollutants from sources that have not been identified as needing a reduction and from sources that may develop over time. Future residential development was identified as a potential source to deliver bacteria to streams through additional septic systems and pets. Care should be taken to monitor these activities and the impact on water quality. This needs to be carefully considered during permit issuance, site plans, and development.

Stormwater Runoff Control Structure

Assessment of Technical Assistance Needs

To determine the number of full time equivalents (FTE) considered necessary for agricultural and residential technical assistance during implementation, the average cost-share amount of practices needed to be installed per year during implementation was divided by an average cost-share amount that one FTE can process in a year. Coupling the number of BMPs processed historically and estimates provided by the SWCDs and Steering Committee, two agricultural FTE per year and two residential FTE per year are needed during implementation. For Stage I, the residential FTE was divided between OSDS (80%) and pet waste management program and residential BMPs (20%) resulting in 1.6 FTE per year for OSDS and 0.4 FTE per year for pet waste management program and residential BMPs technical assistance, respectively (Tables 3 through 6). One residential FTE per year was estimated for pet waste management program and residential BMPs technical assistance.

Rotational Grazing System

Cost Analysis

Associated unit cost estimations for each implementation action during Stages I and II are shown in Tables 3 through 6. Table 7 lists installation and technical assistance costs to implement agricultural and residential programs for implementation Stages I & II. Focusing on Stage I, the total average installation cost for livestock exclusion systems and improved pasture management is $14.3 million. The total installation cost for planting cover crops, converting cropland to permanent vegetative cover and forest, incorporating manure, and installing animal waste control facilities is estimated at $0.5 million. Accordingly, total agricultural corrective action costs equal $14.8 million. Estimated corrective action costs needed to replace straight pipes and fix failing septic systems totals $9.3 million. The cost to implement the pet waste reduction strategies totals an estimated $0.1 million. Cost to install vegetated buffers, rain gardens, and infiltration trenches during Stage I equal $0.4 million.

Bioretention (Rain Garden)

It was determined by the CSWCD, TJSWCD, VADEQ, VDH, GWG, and Steering Committee members that it would require $60,000 to support one technical FTE per year. The total cost to provide assistance in the agricultural and residential programs during Stage I implementation are expected to be both equal to $1.4 million (Table 7). The total Stage I implementation cost including technical assistance is $27.4 million with the agricultural cost being $16.2 million and residential cost $11.2 million (Table 7). The total costs to provide assistance in the agricultural and residential programs during Stage II implementation are expected to be equal to $0.4 million and $0.2 million, respectively. The total Stage II implementation cost including technical assistance is $12.4 million with the agricultural cost being $12.0 million and residential cost $0.4 million (Table 7). The Technical Report lists Stage I and II costs for each impairment watershed.

Table 7. Implementation cost associated with percentage of practices to be installed along with technical assistance addressing agricultural and residential needs in the Upper Rapidan River watersheds during Stages I & II of implementation.

Year	Agricultural				Residential					Total Cost
	Pasture & Livestock Access	Cropland	Technical Assistance	Total	On-site Sewage Disposal System	Pet Waste	Residential BMPs	Technical Assistance	Total	
	($)	($)	($)	($)	($)	($)	($)	($)	($)	**($)**
1	956,000	11,000	120,000	**1,087,000**	445,000	0	4,000	120,000	**569,000**	**1,656,000**
2	1,057,000	61,000	120,000	**1,238,000**	789,000	17,000	4,000	120,000	**930,000**	**2,168,000**
3	1,625,000	60,000	120,000	**1,805,000**	945,000	3,000	30,000	120,000	**1,098,000**	**2,903,000**
4	1,155,000	86,000	120,000	**1,361,000**	560,000	16,000	28,000	120,000	**724,000**	**2,085,000**
5	1,081,000	61,000	120,000	**1,262,000**	838,000	13,000	28,000	120,000	**999,000**	**2,261,000**
6	1,683,000	60,000	120,000	**1,863,000**	982,000	16,000	31,000	120,000	**1,149,000**	**3,012,000**
7	1,121,000	11,000	120,000	**1,252,000**	541,000	3,000	32,000	120,000	**696,000**	**1,948,000**
8	1,112,000	86,000	120,000	**1,318,000**	926,000	3,000	32,000	120,000	**1,081,000**	**2,399,000**
9	1,414,000	22,000	120,000	**1,556,000**	1,009,000	3,000	34,000	120,000	**1,166,000**	**2,722,000**
10	897,000	11,000	120,000	**1,028,000**	497,000	16,000	32,000	120,000	**665,000**	**1,693,000**
11	864,000	11,000	120,000	**995,000**	848,000	5,000	53,000	120,000	**1,026,000**	**2,021,000**
12	1,318,000	22,000	120,000	**1,460,000**	947,000	4,000	55,000	120,000	**1,126,000**	**2,586,000**
13	3,698,000	11,000	120,000	**3,829,000**	0	0	58,000	60,000	**118,000**	**3,947,000**
14	3,702,000	11,000	120,000	**3,833,000**	0	0	59,000	60,000	**119,000**	**3,952,000**
15	4,201,000	22,000	120,000	**4,343,000**	0	0	109,000	60,000	**169,000**	**4,512,000**
Stage I Total (1-12)	**14,283,000**	**502,000**	**1,440,000**	**16,225,000**	**9,327,000**	**99,000**	**363,000**	**1,440,000**	**11,229,000**	**27,454,000**
Stage II Total (13-15)	**11,601,000**	**44,000**	**360,000**	**12,005,000**	**0**	**0**	**226,000**	**180,000**	**406,000**	**12,411,000**
Total (1-15)	**25,884,000**	**546,000**	**1,800,000**	**28,230,000**	**9,327,000**	**99,000**	**589,000**	**1,620,000**	**11,635,000**	**39,865,000**

Benefit Analysis

Vegetated Buffer (No Mow Zone)

The primary benefit of implementation is cleaner waters in Virginia, where bacteria levels in the Garth Run, Rippin Run, Marsh Run, Blue Run, Beautiful Run, Poplar Run, UT to Rapidan River #1, UT to Rapidan River #2, Rapidan River #1, and Rapidan River #2 impairments will be reduced to meet water quality standards. Actions during implementation can improve human and livestock herd health, local economies, aquatic ecosystem health, and improved opportunities for recreation. In Orange County's Comprehensive Plan, the "thriving equestrian economy" is highlighted, as is the importance of protecting the quality and supply of surface waters and other valuable environmental resources. Madison County contains the headwaters of the Shenandoah National Park, an area visited by many people who add to the local economies. Greene County states in their Comprehensive Plan that they are committed to maintaining clean water not only for the drinking water purposes of citizens but also to preserve the fish habitat and the natural course of waterways both within the county and for communities downstream. Albemarle County, with their objective for "clean and abundant water resources" in their Comprehensive Plan, also recognizes the benefits of healthy stream buffers through their Watershed Protection Ordinance which protects 100-feet buffers along streams, ponds and wetlands to provide protection from erosion and stormwater runoff and offer shading and habitat for aquatic life. With the exception of Greene County, all of these counties have active TMDL implementation projects and are beginning to see the benefits at the individual and community level.

Human Health

It is hard to gauge the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, the incidence of infection from fecal sources, through contact with surface waters, should be reduced considerably. The residential programs will play an important role in improving water quality, since human waste can carry with it human viruses in addition to the bacterial and protozoan pathogens potentially found in all fecal matter.

Livestock Herd Health

A clean water source coupled with exclusionary fencing has been shown to improve weight gain; decrease stress; reduce herd health risks associated with increased exposure to water-transmitted diseases, bacteria, virus and cysts infections; reduce mastitis and foot rot; and decrease herd injuries associated with cattle climbing unstable streambanks or being stuck in mud. VCE publication ***STREAMSIDE LIVESTOCK EXCLUSION: A tool for increasing farm income and improving water quality***

available at http://www.dcr.virginia.gov/stormwater_management/documents/streamsideexcl.pdf or at SWCDS further illustrates these benefits.

Economics

An important objective of the IP is to foster continued economic vitality and strength. Healthy waters can improve economic opportunities for Virginians, and a healthy economic base can provide the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document will provide economic benefits to the landowner, along with the expected environmental benefits on-site and downstream. For example, installing a livestock stream exclusion system with an alternative (clean) water source for livestock watering, improving pasture condition, performing sewage system maintenance, and improving aesthetics throughout the watershed can have an economic benefit on the local economy. Additionally, money spent by landowners, government agencies, and non-profit organizations in the process of implementing the IP will stimulate the local economy.

The benefit of a Stream Exclusion with Grazing Land Management BMP is improved profit through more efficient utilization and harvest of forage by grazing animals. 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. Several factors contribute to greater profitability: stocking rate can usually be increased by 30% to 50%; high-quality, fresh, and unsoiled vegetative growth available throughout the grazing system increases weight gain per acre; vigor of the pasture sod is improved; and handling and checking grazing animals is easier. More accurate estimates of the amount of forage available, greater uniformity in grazing of pastures, flexibility of harvesting and storing forage not needed for grazing, and extending the length of the grazing season while providing a more uniform quality and quantity of forage throughout the season are important benefits afforded by this system.

In terms of economic benefits to homeowners, an improved understanding of private OSDS, including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. In addition, investment in the home is protected with a properly functioning sewage disposal system. A home's value can be decreased up to 40% with a failed septic system. The average septic system will last 20-25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them by not driving or parking on top of them, not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every three to five years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing an entire system.

On-site Sewage Disposal System

Improved aesthetics in public areas (*e.g.*, parks) and surrounding businesses provided by control measures (*e.g.*, pet waste kiosks and bioretention) has the potential to draw local citizens and visitors to these areas. In addition, a healthy waterway is vital to the public's recreational enjoyment of the area.

Aquatic Community Improved

Stream bank protection provided through exclusion of livestock including horses from streams will improve the aquatic habitat in these streams. Vegetated buffers that are established will also help reduce sediment and nutrient transport to the stream from upslope locations. The installation of improved pasture management systems should also reduce soil and nutrient losses and increase infiltration of precipitation, thereby decreasing peak flows downstream. Local initiatives, such as riparian easements and stream buffer protection, will additionally be complemented by actions performed during TMDL implementation.

MEASUREABLE GOALS AND MILESTONES FOR ATTAINING WATER QUALITY STANDARDS

The end goals of implementation are:

1) Restored water quality in the impaired waters, and
2) Subsequent de-listing of streams from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report.

Progress toward end goals will be assessed during implementation through tracking of control measure installations by CSWCD; TJSWCD; NRCS; VADCR; VADEQ; VDH; RRRC; along with Orange, Madison, Greene and Albemarle Counties. The VADEQ will continue to monitor and assess water quality for improvement and compliance with Virginia's Water Quality Standards through its Water Quality Monitoring and Assessment Program. Other monitoring project activities in the watershed (*e.g.* citizen monitoring) will be coordinated to augment the VADEQ monitoring program. Implementation will be assessed based on reducing exceedances of the bacteria water quality standard, thereby improving water quality.

Implementation of control measures is scheduled for 15 years and will be assessed in two stages. Stage I is based on meeting source allocations that translate to a single sample maximum standard exceedance rate of 10.5% or less resulting in removal of streams from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report. The Stage II goal is meeting the specified TMDL load allocation based on single sample maximum and geometric mean water quality standard criteria. After implementation inception, five milestones will be met in three-year increments until streams are removed from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report.

Stream Buffer Establishment

Implementation in years one through 12 for agricultural source reductions focuses on installing livestock stream exclusion systems, improving pasture management, cropland conversion, planting cover crops, manure incorporation, and constructing animal waste storage facilities (Table 8). BMPs installed in years 13 through 15 are based on additional treatment of bacteria load not treated during Stage I from pasture and cropland using improved pasture management, cropland conversion, manure incorporation into soil, and sediment retention structures (Table 8). Sediment retention structures are more costly and are logistically more difficult to design and locate on individual farms. Implementation in years one through 12 for residential bacteria loads focuses on performing septic tank pump-outs, identifying and removing straight pipes, repairing or replacing failed septic systems, instituting pet waste control education program, and installing pet waste disposal stations, pet waste enzyme digesting composters, confined canine unit waste treatment systems, vegetated buffers, rain gardens, and infiltration trenches (Table 8). Vegetated buffer, rain garden, and infiltration trench installations are expected to rise over the last three years (Table 8).

Livestock Exclusion Fencing

Table 9 lists the cumulative progress towards the TMDL endpoint as implementation milestones are met. Based on water quality modeling projections, the impairments would be in a probable position to be de-listed from the Virginia Water Quality Assessment 305(b)/303(d) Integrated Report at the fourth milestone. Considering the dynamics of a stream ecosystem and the inherent difficulties that may arise preventing implementation, the final milestone of TMDL allocation attainment was set at 15 years following implementation commencement.

Riparian Buffer

The process of staged implementation implies targeting of control measures, ensuring optimum utilization of resources. In quantifying agricultural BMPs through the use of aerial photography, land use, and stream network Geographic Information System (GIS) layers, maps were formulated showing potential livestock stream access, pastures, and crop fields. Known problem areas, clusters of older homes, or houses in close proximity to streams known by the VDH will be targeted for on-site sewage disposal system control measures. The steps outlined in pet waste BMP stages results in targeting of source type and resources. Significant exposure to rain garden and/or infiltration trench projects would be attained if installed at schools, county administration buildings, or shopping centers in the watershed. Spatial analysis targeting results are located in the Technical Report.

Table 8. Targeted implementation stages for control measures installation.

Control Measure	Garth Run	Rippin Run	Marsh Run	Blue Run	Beautiful Run	Poplar Run	UT to Rapidan River #1	UT to Rapidan River #2	Rapidan River #1	Rapidan River #2
Livestock Exclusion and Pasture Management										
Livestock Exclusion System (CREP)	I	I	I	I	I	I	I	I	I	I
Livestock Exclusion System (EQIP)	I	I	I	I	I	I	I	I	I	I
Stream Exclusion with Grazing Land Management (SL-6/6T, and LE-1T)	I	I	I	I	I	I	I	I	I	I
Small Acreage Grazing System (SL-6AT)	I	I	I	I	I	I	I	I	I	I
Livestock Exclusion with Reduced Setback (LE-2/2T)	I	I	I	I	I	I	I	I	I	I
Stream Protection (WP-2/2T)	I	I	I	I	I	I	I	I	I	I
Stream Exclusion (CCI-SE-1)	I	I	I	I	I	I	I	I	I	I
Forested Riparian Buffer (CCI-FRB-1)	I	I	I	I	I	I	I	I	I	I
Improved Pasture Management	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Sediment Retention, Erosion, or Water Control Structure (WP-1)	II	II	II	II	II	II	II	II	II	II
Cropland										
Permanent Vegetative Cover on Cropland (SL-1)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Aforestation of Crop, Hay and Pastureland (FR-1)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Woodland Buffer Filter Area (FR-3)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Cover Crops (SL-8)	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Manure / Litter Incorporation into Soil	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Animal Waste Control Facilities (WP-4)	I	I	I	I	I	I	I	I	I	I
Failing Septic Systems and Straight Pipes										
Septic Tank Pump-out (RB-1)	I	I	I	I	I	I	I	I	I	I
Connection to Public Sewer (RB-2)	N/A	N/A	N/A	N/A	N/A	I	N/A	N/A	N/A	N/A
Septic Tank System Repair (RB-3)	I	I	I	I	I	I	I	I	I	I
Septic Tank System Installation/Replacement (RB-4)	I	I	I	I	I	I	I	I	I	I
Septic Tank System Installation/Replacement w/ Pump (RB-4P)	I	I	I	I	I	I	I	I	I	I
Alternative On-site Waste Treatment System (RB-5)	I	I	I	I	I	I	I	I	I	I
Pet Waste Management										
Pet waste education program	I	I	I	I	I	I	I	I	I	I
Disposal Stations (PW-1)	I	I	I	I	I	I	I	I	I	I
Pet waste digesters (PW-2)	I	I	I	I	I	I	I	I	I	I
Confined Canine Unit Waste Treatment System	I	I	I	I	I	I	I	I	I	I
Stormwater Runoff Best Management Practices										
Vegetated Buffer	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Rain Garden	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II
Infiltration Trench	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II	I & II

Stage I = first 12 years of implementation for a 15-year timeline

Stage II = last three years of implementation for a 15-year timeline

Table 9. Cumulative implementation of control measures milestones.

Control Measure	Unit	Progress Since TMDL Study	Milestone 1 Completed by Year 3	Milestone 2 Completed by Year 6	Milestone 3 Completed by Year 9	Milestone 4 Completed by Year 12	Milestone 5 Completed by Year 15
Pasture							
Livestock Exclusion System (CREP)	System[1]	8	5	20	40	62	62
Livestock Exclusion System (EQIP)	System[1]	N/A	4	12	20	27	27
Livestock Exclusion System (Sl-6/6T, LE-1T)	System[1]	8	49	97	136	159	159
Livestock Exclusion System (SL-6AT)	System[1]	N/A	1	4	4	6	6
Livestock Exclusion System (LE-2/2T)	System[1]	N/A	11	26	40	50	50
Livestock Exclusion System (WP-2/2T)	System[1]	N/A	1	6	8	10	10
Stream Exclusion (CCI-SE-1)	Feet	N/A	108,150	216,300	324,450	432,600	432,600
Forested Riparian Buffer (CCI-FRB-1)	Acres - Installed	N/A	87	174	261	348	348
Improved Pasture Management	Acres - Installed	N/A	9,875	19,750	29,625	39,500	49,361
Sediment Retention, Erosion, or Water Control Structure (WP-1)	Acres - Treated	N/A	0	0	0	0	11,464
Cropland							
Permanent Vegetative Cover on Cropland (SL-1)	Acres - Installed	128	9	17	26	34	43
Reforestation of Erodible Crop & Pastureland (FR-1)	Acres - Installed	8	9	17	26	34	43
Cover Crops (SL-8)	Acres - Installed	N/A	653	1,305	1,958	2,611	3,266
Manure Incorporation into Soil	Acres - Treated	N/A	178	357	535	714	892
Animal Waste Storage Facility (WP-4)	System	N/A	2	5	6	6	6
On-site Sewage Disposal Systems							
Septic Tank Pump-out (RB-1)	System	N/A	414	846	1,286	1,713	1,713
Connection to Public Sewer (RB-2)	System	N/A	7	14	22	30	30
Septic System Repair (RB-3)	System	N/A	262	530	799	1,068	1,068
New Conventional Septic System (RB-4)	System	N/A	123	249	377	501	501
New Conventional Septic System with Pump (RB-4P)	System	N/A	14	32	52	68	68
Alternative Sewage Disposal System (RB-5)	System	N/A	8	21	36	46	46
Pet Waste Management							
Pet waste education program	System	N/A	2	4	7	10	10
Pet Waste Disposal Stations (PW-1)	System	N/A	4	10	13	16	16
Pet waste digesters (PW-2)	System	N/A	14	29	55	85	85
Confined Canine Unit Waste Treatment System	System	N/A	1	4	4	5	5
Residential/Urban Best Management Practices							
Vegetated Buffers	Acres - Installed	N/A	16	32	47	63	81
Bioretention	Acres - Treated	N/A	2	5	9	15	24
Infiltration Trench	Acres - Treated	N/A	1	3	6	10	18

[1] System typically includes stream exclusion and cross fencing, water trough, well, distribution piping, and riparian buffer

Monitoring

Implementation progress will be evaluated through water quality monitoring conducted by VADEQ through the agency's monitoring program and any additional monitoring support (*i.e.*, citizen monitoring) that may develop as implementation progresses. Monitoring stations are subject to change based upon the development of the VADEQ Monitoring Strategy. Typically, post-IP monitoring begins 2-5 years after BMPs are established. The VADEQ uses the data to determine water quality improvement and gauge the success aimed at reducing the amount of pollutants in the stream of the Garth Run, Rippin Run, Marsh Run, Blue Run, Beautiful Run, Poplar Run, UT to Rapidan River #1, UT to Rapidan River #2, Rapidan River #1, and Rapidan River #2 watersheds.

Thirteen VADEQ monitoring stations were utilized to assess water quality in the Garth Run, Rippin Run, Marsh Run, Blue Run, Beautiful Run, Poplar Run, UT to Rapidan River #1, UT to Rapidan River #2, Rapidan River #1, and Rapidan River #2 watersheds (Figure 4). Stations are classified as a "trend station" or "watershed station". Trend stations are historically located, long-term water quality monitoring stations used to assess changes in water quality over long periods of time and are sampled every year, either monthly or bimonthly. Watershed stations are typically located near the mouth of a watershed, designed to provide a monitoring presence in smaller watersheds, and sampled 12 times over a consecutive two-year period (sampling occurs every other month) within a six-year rotational cycle. Station 3-RAP045.08 on the Rapidan River is a trend station and the remaining stations are watershed stations. Several stations in the watershed were in the 2014 monitoring plan and will continue to be monitored according to the rotating schedule. Other stations in the watershed won't be monitored again until BMPs have been in place.

The citizen monitoring program can be utilized to supplement samples collected through VADEQ's monitoring program. The Coliscan Easygel method is a simple to use and relatively inexpensive method that measures total coliform and *E. coli*. The Coliscan Easygel method was compared to laboratory analysis and found to be an acceptable tool for screening purposes although the data cannot be used directly by VADEQ for water quality assessments. This method is important because it can assist in locating "hot spots" for fecal contamination, assess implementation progress, and target areas for more extensive monitoring. CSWCD, Old Rag Master Naturalists, Center for Natural Capital, and Shenandoah National Park have conducted physical, chemical, and biological monitoring in the area for some time and could assist with additional monitoring needs during the implementation phase.

The AWG, RWG, GWG, and Steering Committee request that monitoring continue at the trend stations and TMDL impairment listing stations for the following parameters: *E. coli* bacteria, temperature, dissolved oxygen, pH, specific conductivity, total nitrogen, total phosphorus, and total suspended solids. Monitoring stations for Garth Run, Rippin Run, Marsh Run, Blue Run, Beautiful Run, Poplar Run, UT to Rapidan River #1, UT to Rapidan River #2, Rapidan River #1, and Rapidan River #2 impairments are listed in Table 10 and Figure 4.

Table 10. Monitoring station identification, station location, last sampled, and draft Integrated Report (IR) exceedance rate for VADEQ monitoring stations in the watershed.

Impairment	Station ID	Station Location	Last Sampled	Draft 2014 IR Exceedance Rate
Garth Run	3-GAR000.95	Route 665	Dec. 2012	6 of 11 samples (54%)
Rippin Run	3-RIP000.22	Route 609	Jan. 2011	3 of 11 samples (27%)
Marsh Run	3-MAS001.55	Route 644	Dec. 2012	4 of 11 samples (36%)
Blue Run	3-BLU000.80	Route 641	Dec. 2014	2 of 12 samples (17%)
	3-BLU002.60	Route 20	Dec. 2014	Not included, sampled in 2005
	3-BLU008.33	U.S. Highway 33	Dec. 2014	2 of 5 samples (40%)
Beautiful Run	3-BFL000.90	Route 620	Dec. 2014	4 of 5 samples (80%)
	3-BFL002.90	Route 616	Sep. 2011	5 of 12 samples (42%)
Poplar Run	3-POL000.10	Route 633	Dec. 2012	3 of 10 samples (30%)
UT to Rapidan River #1	3-XBO000.26	Route 621	Dec. 2014	5 of 7 samples (71%)
UT to Rapidan River #2	3-XEZ000.12	Private Road	Dec. 2014	4 of 5 samples (80%)
Rapidan River #1	3-RAP045.08	U.S. Highway 15	Dec. 2014	8 of 32 samples (25%)
Rapidan River #2	3-RAP055.84	Route 231	Dec. 2014	2 of 10 samples (20%)

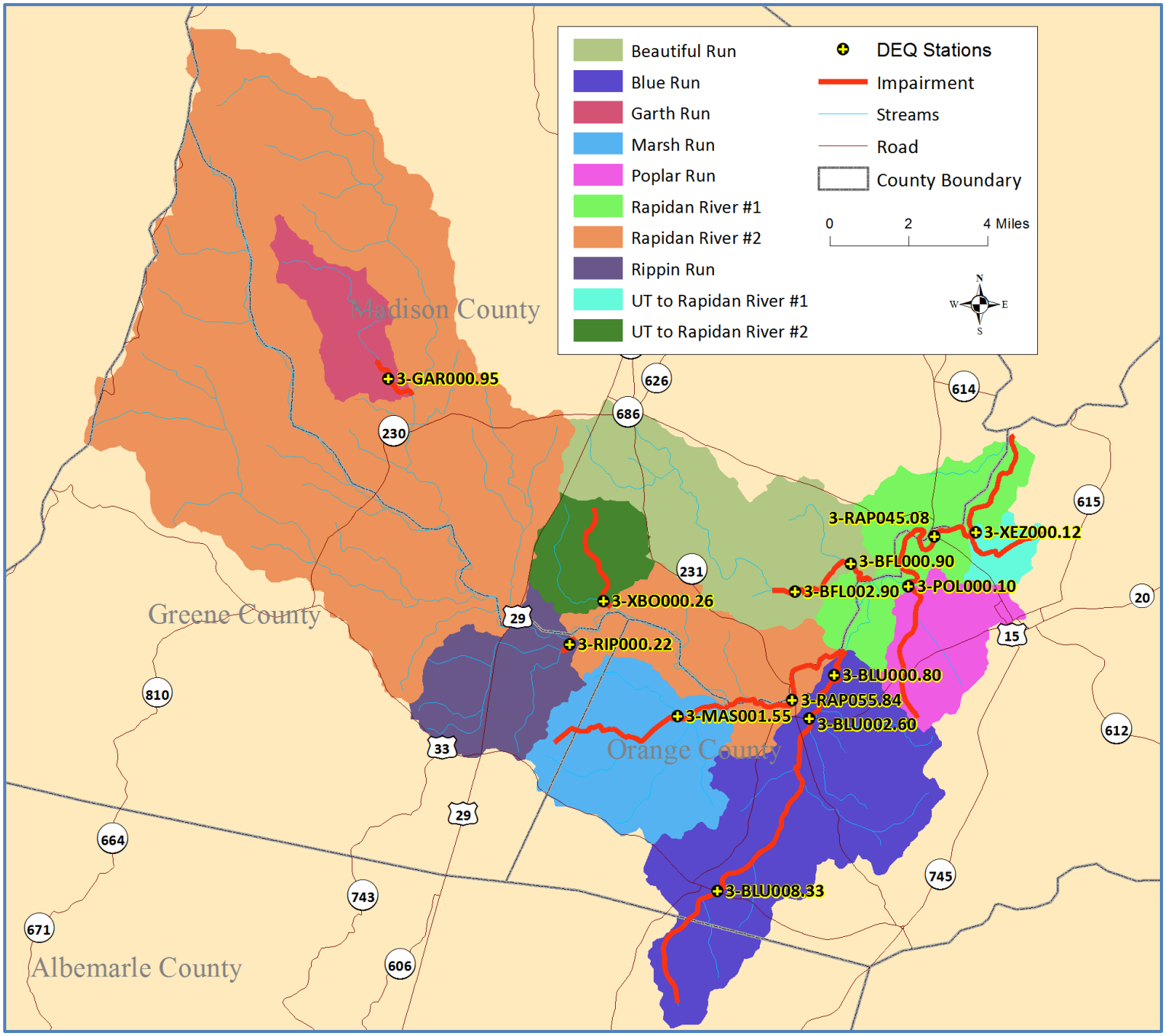
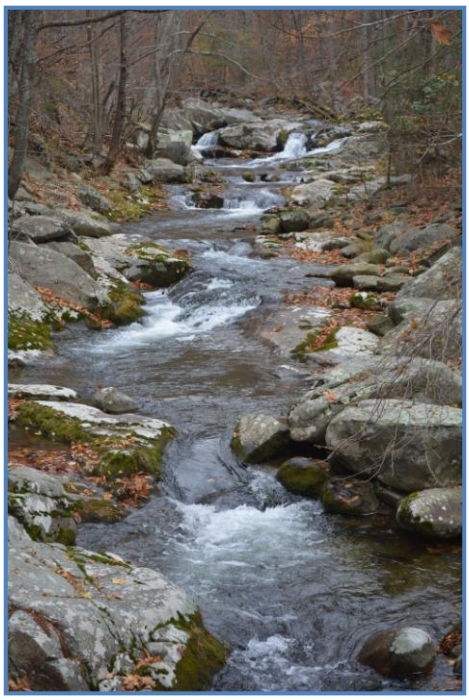


Figure 4. Location of VADEQ monitoring stations in the watersheds.

STAKEHOLDER'S ROLES & RESPONSIBILITIES

Stakeholders are individuals who live or have land management responsibilities in the watershed, including private individuals, businesses, government agencies, and special interest groups. 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, citizens, businesses, and community watershed groups. However, local, state, and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for its citizens. Regional and 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.

CSWCD and TJSWCD will have prominent roles during implementation. CSWCD and TJSWCD will provide cost-share funds, lead education and technical assistance efforts, and track best management practice implementation for the agricultural and residential programs. The RRRC will lead education and outreach efforts, coordinate funding distribution to homeowners, and report best management practice implementation for the pet waste program. Other partners may assist with implementation of educational programs.



Rapidan River

In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments in conjunction with the state can develop ordinances involving pollution prevention measures. State agencies conducting regulatory, education, or funding procedures related to water quality in Virginia include: VADEQ, VADCR, VDH, VADACS, VDGIF, VADOF, VCE, and VOF. Governmental, agricultural, residential action items during implementation are included in Tables 11 through 13, respectively. List of acronyms used in tables can be found on page 47.

Table 11. Governmental implementation action items.

Source Issues	Actions & Support	Potential Funding Source	Who will assist?
Continual baseline water quality monitoring	Water quality monitoring: ambient/benthic	VADEQ	VADEQ
Supplemental ambient/benthic monitoring	Water quality monitoring: ambient/benthic; coliscan (bacteria monitoring)	VADEQ, VA Naturally,Grants	SWCD, Citizen Volunteers, Shenandoah National Park, Old Rag Master Naturalists, Center for Natural Capital
Local government incentives	Ordinance/code options to improve water quality	Local Government, Grants	Local Government, PDC, SWCD
Inadequate tracking of on-site sewage disposal systems	Develop tracking and reporting system for non-cost shared practices	VDH, Local Government, VADEQ, WQIF	VDH, SWCD

Table 12. Agricultural implementation action items.

Source Issues	Corrective Actions	Potential Funding Source	Who will assist?
Livestock in stream	Livestock exclusion best management practices, Water development upslope	Ag BMP Cost-Share, WQIF, Section 319 Funds, NRCS	SWCD, NRCS
Cropland runoff	Cropland best management practices	Ag BMP Cost-Share, NRCS	SWCD, NRCS
Pasture runoff	Pasture management best management practices	Ag BMP Cost-Share, NRCS	SWCD, NRCS
Streamside runoff	Improved buffers (grass, shrubs, trees)	CREP, EQIP, VDGIF, VADOF, Ag. BMP Cost-Share	VDGIF, VADOF, SWCD, NRCS
Lack of BMP knowledge	Ag BMP education, outreach events	WQIF, VCE, NRCS	SWCD, VCE, NRCS
Livestock access to water	Alternate water source	Ag BMP, VADEQ (low interest loan), NRCS	SWCD, VADEQ, NRCS
Targeting locations for fencing	Ground truthing, stream walks	WQIF, grants	SWCD, Community Interest Groups

Table 13. Residential/urban implementation action items.

Source Issues	Corrective Actions	Potential Funding Source	Who will assist?
Lack of septic system maintenance	Regular maintenance	WQIF, Homeowners, Section 319 Funds	VDH, SWCD, PDC
Septic system failure and/or straight pipes	Septic system repairs, replacement, hook-ups, & maintenance	WQIF, Homeowners, Block Grants, Section 319 Funds	VDH, Local Government, SWCD, PDC, SERCAP
No septic system pump out tracking	Computerized tracking system	VDH	VDH, Local Government, SWCD
Need information on system location at time of home sale	State requirement – initiated by Board of Realtors	Homeowners	VDH
Education needed on septic system function	Septic system education program	WQIF	Realtors, Teachers, VDH, School Groups, Community Interest Groups, PDC, SWCD
No pet waste management	Education, bag stations, composters, structural practices in concentrated canine areas (kennels)	SWCD, WQIF, NFWF grant, Roundtables	Interest Groups, Local Governments, Hunt Clubs, Veterinarians, SPCA, PDC, HOWS
Stormwater runoff BMPs	Targeting locations for runoff reduction BMPs	Grants, VCAP	Citizens, Volunteers, Landowners, SWCD
Waterfowl impact to ponds	Buffer ponds to discourage waterfowl, especially geese	HOAs, NFWF grant, VDGIF	VADOF, Landowners
Runoff from streamside properties - non-agricultural	Low impact development techniques, install grass/shrub/tree buffers along streams, education on proper land management including erosion control and fertilizer	VCAP, Homeowners, Developers, NFWF grant, VADOF, Private Foundations	Local Government, Interest Groups, SWCD
Best management practices education for horse owners	Pasture management education; alternative watering sources, livestock exclusion	Ag BMPs, VCE, WQIF	SWCD, VCE, Interest Groups

The roles and responsibilities of some of the major stakeholders on a local, state, and federal level are as follows:

CSWCD and **TJSWCD**: The Culpeper and Thomas Jefferson Soil and Water Conservation Districts are local units of government responsible for the soil and water conservation work within Orange, Madison, Greene, and Albemarle Counties. The district's overall 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. Specific to the IP, the district will provide agricultural cost-share funds, lead education and technical assistance efforts, and track best management practice implementation for the agricultural and residential programs.

Orange, Madison, Greene, and Albemarle Government Departments: Government staff work closely with local and state agencies to develop and implement the TMDL. Staff will administer the erosion & sediment control and stormwater programs, provide mapping assistance, and may also help to promote education and outreach to citizens, businesses, and developers to introduce the importance of the TMDL process.

Citizens & Businesses: The primary role of citizens and businesses is simply to get involved in implementation. This may include participating in public outreach, implementing BMPs to help restore water quality, and partnering with other stakeholders to improve water quality.

Community Civic Groups: Community civic groups take on a wide range of community service including environmental projects. Such groups include the Ruritan, 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.

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 landowners, not only in rural areas, but in residential areas as well.

FOR (Friends of the Rappahannock): A group of dedicated employees and volunteers committed to environmental advocacy and education and engaged in restoration projects involving the rivers within the Rappahannock River watershed. FOR may assist with educational programs, stormwater installations, and monitoring.

HOWS (Houses of Wood and Straw): Community service project helping to provide more appropriate shelter for dogs kept outside all year long by their owners. The organization and their volunteers provide wooden dog houses, straw, and other assistance to aid these animals in Greene, Orange, and Albemarle Counties. A big part of their program is educating dog owners on their dog's needs. HOWS has agreed to participate in the pet waste educational aspect of this project.

ORMN (Old Rag Master Naturalists): The Old Rag Chapter of the Virginia Master Naturalist program is based in Madison, Virginia and serves the Rapidan–Upper Rappahannock Watershed. The service area includes the counties of Culpeper, Rappahannock, Madison, Greene, Orange, and the western portions of

Fauquier. The large geographic area of these counties, rural in nature, includes major natural resources rich in biodiversity. Among these are the headwaters and tributaries of the Rapidan and Rappahannock Rivers, Shenandoah National Park, and two Virginia Wildlife Management Areas. ORMN is a knowledgeable group of volunteer educators and citizen scientists. ORMN volunteers may participate in a stream monitoring efforts and other educational efforts in the area.

PEC: Piedmont Environmental Council safeguards the landscapes, communities and heritage of the Piedmont by involving citizens in related public policy and land conservation.

Rappahannock-Rapidan Regional Commission: Environmental planning is a long-standing area of emphasis of the RRRC, which is complementary to the TMDL process. RRRC continues to promote efficient development of the environment by assisting and encouraging local governmental agencies to plan for the future. RRRC will support pet waste control measure implementation with assistance from localities and SWCDs. Additionally, RRRC will continue to work with VADEQ and the Steering Committee to periodically revisit implementation progress and suggest plan revisions as needed.

Shenandoah National Park(SNP): SNP encompasses part of the Blue Ridge Mountains in the Virginia. This national park is long and narrow, with the broad Shenandoah River and Valley on the west side, and the rolling hills of the Virginia Piedmont on the east. The headwaters of the Upper Rapidan watershed are in the SNP. Staff from their Air and Water Quality program conduct monitoring and many other natural resource research that not only provide information for the park but also the adjacent communities. SNP will work with partner groups on efforts to provide educational information to the general public.

VADEQ: The State Water Control Law authorizes the SWCB to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the recreation, fishing, shellfishing, aquatic life, wildlife, and drinking water uses. For many years the focus of VADEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of VADEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs. VADEQ is the lead agency in the TMDL process. The Code of Virginia directs VADEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. VADEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs and IPs to USEPA and the SWCB for approval. VADEQ administers Section 319 Program providing funding and technical support for the implementation of NPS components of IPs. VADEQ is also responsible for implementing point source WLAs, regulation of biosolids applications, assessing water quality across the state, and conducting actions related to Virginia's Water Quality Standards. Under the Virginia Stormwater Management Program, VADEQ is also responsible for the issuance, denial, revocation, termination, and enforcement of National Pollutant Discharge Elimination System (NPDES) permits for the control of stormwater discharges from municipal separate storm sewer systems (MS4) and land disturbing activities, as well as the management of some local stormwater programs.

VADCR: Because of the magnitude of the NPS component in the TMDL process, VADCR is an important participant in the TMDL process. VADCR staff will be working with other state agencies, local governments,

soil and water conservation districts, watershed groups, and citizens to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources. Their primary role in the TMDL program is through the implementation of agricultural BMPs and coordination with the 47 SWCDs.

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

VADACS: The Virginia Department of Agriculture and Consumer Services Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis. If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local SWCD. If a producer fails to implement the plan, corrective action can be taken, which may include civil penalties. An emergency corrective action can be issued 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.

VDGIF: Virginia Department of Game and Inland Fisheries manages Virginia's wildlife and inland fish to maintain optimum populations of all species to serve the needs of the Commonwealth; provides opportunity for all to enjoy wildlife, inland fish, boating and related outdoor recreation; and promotes safety for persons and property in connection with boating, hunting, and fishing. The VDGIF has responsibility for administering certain U.S. Fish and Wildlife Service funding programs. Personnel participate, review, and comment on projects to insure consideration for fish and wildlife populations and associated habitats.

VADOF: Virginia Department of Forestry 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 (www.dof.state.va.us/wq/wq-bmp-guide.htm). Forestry BMPs are intended to primarily control erosion. For example, streamside 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.

VCE: Virginia Cooperative Extension 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 USDA. 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. For more information on these publications and to find the location of county extension offices, visit www.ext.vt.edu.

VOF: The Virginia Outdoors Foundation was established 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 mechanism for accomplishing VOF's mission is through open-space easements. Open-space easements allow land to continue to be privately owned but restricted to serve and protect land for the public good.

USEPA: The United States Environmental Protection Agency 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. USEPA provides funding to implement TMDLs through Section 319 Incremental Funds.

NRCS: The Natural Resources Conservation Service is the federal agency that works hand-in-hand 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 along with policymakers also rely on the expertise of NRCS staff. NRCS is a major funding stakeholder for impaired water bodies through the CREP and EQIP programs.

INTEGRATION WITH OTHER WATERSHED PLANS

Each watershed within the state is under the jurisdiction of a multitude of individual yet related water quality programs and activities, many of which have specific geographical boundaries and goals. These include but are not limited to Watershed Implementation Plans, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control Regulations, Stormwater Management Program, Source Water Assessment Program, and local comprehensive plans. The progress of these planning efforts needs continuous evaluation to determine possible effects on implementation goals. Coordination of local programs can increase participation in implementation activities and prevent redundancy. Several planned initiatives coinciding with TMDL implementation in this watershed include:

- Updates to Orange, Madison, Greene, and Albemarle Counties Comprehensive Plans
- Madison County Asset Management Plan
- Chesapeake Bay Watershed Implementation Plan
- Robinson River / Little Dark Run, Upper Hazel River, Upper York River, and Moores Creek TMDL Implementation Plans
- Piedmont Environmental Council Strategic Plan
- Trout Unlimited Strategic Plan
- Upper Rapidan Brook Trout Restoration Initiative

The implementation actions proposed in this plan will enhance these community improvement initiatives by improving water quality and making the river more attractive to visitors for tourism and recreational activities. Combined, these efforts can contribute to improvements in the area economy and residents' quality of life.

Recreational Activities: Canoeing, Kayaking, and Fishing

POTENTIAL FUNDING SOURCES

Potential funding sources available during implementation were identified in the course of plan development. An approved Watershed Implementation Plan makes these watersheds eligible for competitively awarded TMDL Implementation grants currently awarded through VADEQ. Detailed description of each funding source (*i.e.*, eligibility requirements, specifications, incentive payments) can be obtained from the CSWCD, TJSWCD, RRRC, VADCR, VDH, VADEQ, VADGIF, VCE, VOF, and NRCS. Table 14 illustrates various financial opportunities that exist from selected cost-share programs for agricultural and residential implementation needs. Sources include:

Federal Sources

- Federal Clean Water Act Section 319 Incremental Funds
- U.S. Department of Agriculture (USDA) Conservation Reserve Enhancement Program (CREP)
- USDA Conservation Reserve Program (CRP)
- USDA Environmental Quality Incentives Program (EQIP)
- USDA Agricultural Conservation Easement Program (ACEP)
- USDA Regional Conservation Partnership Program (RCPP)
- U.S. Fish and Wildlife Service Conservation Grants
- U.S. Fish and Wildlife Service Private Stewardship Program

Virginia Sources

- Virginia Agricultural Best Management Practices Cost-Share Program
- Virginia Agricultural Best Management Practices Tax Credit Program
- Virginia Conservation Assistance Program (VCAP)
- Virginia Water Quality Improvement Fund
- Virginia Forest Stewardship Program
- Virginia Small Business Environmental Compliance Assistance Fund
- Virginia Clean Water Revolving Loan Fund (VCWRLF)
- Virginia Outdoors Foundation
- Virginia Trees for Clean Water
- Community Development Block Grant Program

Regional and Private Sources

- Southeast Rural Community Assistance Project (Southeast RCAP)
- National Fish and Wildlife Foundation
- Skyline Community Action Partnership
- Trout Unlimited
- Center for Natural Capital

Table 14. Control measures with estimated cost-share program and landowner costs.

Control Measure	Program Code	Unit	Cost-share	Average Cost/Unit to State or Federal Program ($)	Average Cost/Unit to Landowner ($)[1]
Livestock exclusion with 35 ft or greater buffer	CREP	System	90% + varied incentive	16,200	1,800
	EQIP	System	75%	11,250	3,750
	SL-6	System	80%	28,400	7,100
Small Acreage Grazing System with 35 ft setback	SL-6A	System	50%	4,500	4,500
Livestock exclusion with 10 ft setback	LE-2	System	50%	6,000	6,000
Stream Protection	WP-2	System	75%	1,875	625
Pasture and hayland re-planting	512	Acres	$165/ac	165	130
Prescribed grazing	528	Acres	$30/ac	30	40
Stream exclusion	CCI-SE-1	Feet	$1/ft	1	0
Forested riparian buffer	CCI-FRB-1	Acre	$100/ac	100	0
Animal waste control facilities	WP-4	System	75% (NTE $70,000)	70,000	30,000
Permanent vegetative cover on cropland	SL-1	Acres	75% + $35/ac incentive	298	52
Aforestation of crop, hay and pastureland	FR-1	Acres	$25/ac	25	425
Woodland buffer filter area	FR-3	Acres	$100/ac	100	350
Cover crops	SL-8B	Acres	$40/acre	40	10
Grazing land management	SL-9	System	50%	5,000	5,000
Manure / biosolids soil incorporation	N/A	Acres	N/A	0	25
Retention ponds	N/A	Acres[2]	N/A	0	150
Septic Tank Pump-out	RB-1	System	50%	150	150
Connection to Public Sewer	RB-2	System	75% - 50%	7,500 – 5,000	2,500 - 5,000
Septic Tank System Repair	RB-3	System	75% - 50%	2,625 – 1,750	875 - 1,750
Septic Tank System Installation / Replacement	RB-4	System	75% - 50%	4,500 – 3,000	1,500 - 3,000
Septic Tank System Installation / Replacement w/ Pump	RB-4P	System	75% - 50%	6,000 – 4,000	2,000 - 4,000
Alternative On-site Waste Treatment System	RB-5	System	75% - 50%	18,750 – 12,500	6,250 - 12,500
Pet waste disposal station	PW-1	System	75%	375	125
Pet waste digester	PW-2	System	75%	37	13
Confined Canine Unit Waste Treatment System	N/A	System	N/A	0	20,000
Confined Canine Unit Dry Stacking/Composter System	N/A	System	N/A	0	4,600
Vegetated Buffers	N/A	Acres[2]	N/A	0	400
Bioretention	N/A	Acres[3]	N/A	0	15,000
Infiltration Trench	N/A	Acres[3]	N/A	0	11,300

[1] Does not include tax credit or in-kind service; [2] Acres treated; [3] Acres installed

LIST OF ACRONYMS

ACEP	Agricultural Conservation Easement Program
AWG	Agricultural Working Group
BMP	Best Management Practice
BRES	Blue Ridge Environmental Solutions, Inc.
CCU	Confined Canine Unit
CREP	Conservation Reserve and Enhancement Program
CRP	Conservation Reserve Program
CSWCD	Culpeper Soil and Water Conservation District
CWA	Clean Water Act
EQIP	Environmental Quality Incentive Program
FSA	Farm Service Agency
FTE	Full Time Equivalent
GWG	Government Working Group
HOA	Homeowners Association
IP	Implementation Plan
LID	Low Impact Development
NFWF	National Fish and Wildlife Foundation
NPS	Nonpoint Source
NRCS	Natural Resources Conservation Service
OSDS	On-Site Sewage Disposal System
PDC	Planning District Commission
RCPP	Regional Conservation Partnership Program
RRRC	Rappahannock- Rapidan Regional Commission
RWG	Residential Working Group
SWCB	State Water Control Board
TJSWCD	Thomas Jefferson Soil and Water Conservation District
TMDL	Total Maximum Daily Load
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
VADACS	Virginia Department of Agriculture and Consumer Services
VADCR	Virginia Department of Conservation and Recreation
VADEQ	Virginia Department of Environmental Quality
VADOF	Virginia Department of Forestry
VCE	Virginia Cooperative Extension
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VOF	Virginia Outdoors Foundation
WQMIRA	Water Quality Monitoring, Information and Restoration Act

GLOSSARY

303(d) List - is short for the list of impaired and threatened waters (stream/river segments, lakes) that the Clean Water Act requires all states to submit for USEPA approval every two years on even-numbered years.

Anthropogenic - involving the impact of humans on nature; specifically items or actions induced, caused, or altered by the presence and activities of humans.

Assimilative Capacity - a measure of the ability of a natural body of water to effectively degrade and/or disperse chemical substances. Assimilative capacity is used to define the ability of a waterbody to naturally assimilate a substance without impairing water quality or degrading the aquatic ecosystem. Numerically, it is the amount of pollutant that can be discharged to a specific waterbody without exceeding water quality standards.

Best Management Practices (BMPs) - reasonable and cost-effective means to reduce the likelihood of pollutants entering a water body. BMPs include riparian buffer strips, filter strips, nutrient management plans, conservation tillage, etc.

Cost-share Program - a program that allocates funds to pay a percentage of the cost of constructing or implementing a BMP. The remaining costs are paid by the producer(s).

Delisting - the process by which an impaired waterbody is removed from the Section 303(d) Impaired Waters List. To remove a waterbody from the Section 303(d) list, the state must demonstrate to USEPA, using monitoring or other data, that the waterbody is attaining the water quality standard.

E. coli- type of bacteria found in the feces of various warm-blooded animals that is used as indicator of the possible presence of pathogenic (disease causing) organisms.

Failing septic system - septic systems in which drain fields have failed such that effluent (wastewater) that is supposed to percolate into the soil, now rises to the surface and ponds on the surface where it can flow over the soil surface to streams or contribute pollutants to the surface where they can be lost during storm runoff events.

Full Time Equivalent (FTE) - Is a way to estimate staff needed for a project. A FTE of 1.0 means that the position is equivalent to a full-time worker, while a FTE of 0.5 indicates a part-time worker.

Geographic Information System (GIS) - a system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. An example of a GIS is the use of spatial data for Emergency Services response (E-911). Dispatchers use GIS to locate the caller's house, identify the closest responder, and even determine the shortest route. All these activities are automated using the electronic spatial data in the GIS.

Impaired waters - those waters with chronic or recurring monitored violations of the applicable numeric and/or narrative water quality standards.

Modeling - a system of mathematical expressions that describe both hydrologic and water quality processes. When used for the development of TMDLs, models can estimate the load of a specific pollutant to a waterbody and make predictions about how the load would change as remediation steps are implemented.

Monitoring - periodic or continuous sampling and measurement to determine the physical, chemical, and biological status of a particular medium like air, soil, or water.

Nonpoint source pollution - pollution originating from multiple sources on and above the land. Examples include runoff from fields, stormwater runoff from urban landscapes, roadbed erosion in forestry, and atmospheric deposition.

Nutrient - any substance assimilated by living things that promotes growth. The term is generally applied to nitrogen and phosphorus in wastewater, but is also applied to other essential and trace elements.

Point source pollution - pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial treatment facilities or any conveyance such as a ditch, tunnel, conduit or pipe from which pollutants are discharged. Point sources have a single point of entry with a direct path to a water body. Point sources can also include pollutant loads contributed by tributaries to the main receiving stream or river.

Riparian - pertaining to the banks of a river, stream, pond, lake, etc., as well as to the plant and animal communities along such bodies of water

Runoff - that part of precipitation, snowmelt, or irrigation water that does not infiltrate but flows over the land surface, eventually making its way to a stream, river, lake or an ocean. It can carry pollutants from the land and air into receiving waters.

Septic system - an on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives liquid and solid wastes from a residence or business and a drainfield or subsurface absorption system consisting of a series of tile or percolation lines for disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

Single Sample Maximum Water Quality Standard - is the value of the water quality standard that should not be exceeded at any time. For example, the Virginia single sample maximum water quality standard for E.coli is 235 cfu/100 mL. If this value is exceeded at any time, the water body is in exceedance of the state water quality standard.

Stakeholder - any person or organization with a vested interest in development and implementation of a local watershed water quality implementation plan (e.g., farmer, landowner, resident, business owner, or government official)

Straight pipe - delivers wastewater directly from a building, e.g., house or milking parlor, to a stream, pond, lake, or river.

Total Maximum Daily Load (TMDL) - a pollution "budget" that is used to determine the maximum amount of pollution a waterbody can assimilate without violating water quality standards. The TMDL includes waste load allocations (WLAs) for permitted point sources, load allocations (LAs) for nonpoint and natural background sources, plus a Margin of Safety (MOS). A TMDL is developed for a specific pollutant and can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.

Water quality standards - a group of statements that constitute a regulation describing specific water quality requirements. Virginia's water quality standards have the following three components: designated uses, water quality criteria to protect designated uses, and an anti-degradation policy.

Watershed - area that drains to, or contributes water to, a particular point, stream, river, lake or ocean. Larger watersheds are also referred to as basins. Watersheds range in size from a few acres for a small stream, to large areas of the country like the Chesapeake Bay Basin that includes parts of six states.

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