A Water Quality Improvement Plan
to reduce bacteria and sediment in
Chestnut Creek

Prepared by the

Virginia Department of Environmental Quality

In Cooperation with

Local Stakeholders

Department of Biological Systems Engineering,
Virginia Tech Center for Watershed Studies

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This is a copy of the final report with website links removed. To receive the non-redacted copy, please refer to the VA DEQ website.

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Executive Summary

Chestnut Creek is a scenic stream with the headwaters located near the Blue Ridge Parkway in Alleghany County, North Carolina and Carroll County, Virginia. From there the stream meanders north to the city of Galax, and then parallels the linear New River Trail State Park from Galax through Grayson County to its confluence with the New River.

In 1996 Chestnut Creek was placed on Virginia's list of impaired streams because it does not support a healthy and diverse population of aquatic life. In addition, in 2004 Chestnut Creek was also listed with an *E. coli* impairment because water quality monitoring has shown that the stream has elevated levels of fecal bacteria. A study of the stream was completed in by the Virginia Department of Environmental Quality in 2006 to determine the stressor(s) on the aquatic life and the sources of bacteria. It was determined that the most probable stressor to the aquatic life in Chestnut Creek is sediment and the primary sources of the sediment include runoff from pasture, cropland, hay land and developed areas, and stream channel erosion. Bacteria sources include failing or malfunctioning septic systems, straight pipes (pipes directly discharging untreated sewage into the stream), livestock (including manure application loads), wildlife, and domestic pets.

This clean-up plan serves as a guide for local citizens to reduce *E. coli* bacteria and sediment and improve water quality in Chestnut Creek. The development of this plan relied heavily on Community Participation. Knowledge contributed by local citizens and stakeholder organizations guided the identification of conservation and outreach strategies included in this plan.

Introduction

The **Clean Water Act (CWA)** requires that all of our streams, rivers, and lakes meet state water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters that do not meet their standards. Through monitoring, the state of Virginia has found that many streams do not meet state water quality standards for protection of the five beneficial **designated uses**: recreation, the production of edible and marketable natural resources, aquatic life, wildlife, and drinking. When streams fail to meet standards they are placed on the state's impaired waters list, and the state must then develop a **Total Maximum Daily Load (TMDL)** for each pollutant. A TMDL is a "pollution budget" for a stream, meaning that it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. Non-point source pollution occurs when rain transports pollutants from multiple sources across the land to a body of water. Point source pollution discharges directly into streams. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

The Virginia Department of Environmental Quality (VADEQ) developed TMDLs for Chestnut Creek in 2006 after water quality monitoring showed:

1) Levels of bacteria observed in Chestnut Creek violate the water quality standard protecting primary contact recreation activities like swimming. This standard is based on the concentration of ***Escherichia coli (E. coli)*** in the water. The standard states that the *E. coli* bacteria count should not exceed a geometric mean of 126 cfu per 100 mL for two or more samples taken over a 30-day period, and it should not exceed 235 cfu per 100 mL in any one sample.
2) Chestnut Creek violated the **general standard** for aquatic life use. This standard states that all state waters should support "the propagation and growth of a balanced indigenous population of aquatic life…" (State Water Control Board, 2006). Based on biological monitoring of the benthic macroinvertebrate community conducted by VADEQ, it was concluded that Chestnut Creek did not meet this designation. After an in-depth review and analysis of available data, sediment was identified as the primary stressor on the benthic community in Chestnut Creek.

Once a TMDL is developed and approved by the **Environmental Protection Agency (EPA)**, measures must be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technology and the installation of **best management practices (BMPs)**, are implemented in a staged process described in an Implementation Plan (IP). This IP characterizes implementation actions that will achieve water quality goals in the Chestnut Creek watershed.

One goal of an IP is to identify funding needs and options. A common resource for funding TMDL projects is CWA Section 319 nonpoint source (NPS) grants awarded to states by the EPA. The

EPA develops guidelines to describe the process and criteria used to award these CWA Section 319 nonpoint source (NPS) grants. An Implementation Plan must include nine components to be eligible for this funding.

Implementation Plan Requirements for 319 Funding

1. Identify the causes and sources or groups of similar sources that will need to be controlled to achieve the load reductions estimated in the watershed-based plan;
2. Estimate the load reductions expected to achieve water quality standards;
3. Describe the nonpoint source (NPS) management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan;
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

Review of TMDL Development

Description of Watershed and Impairments

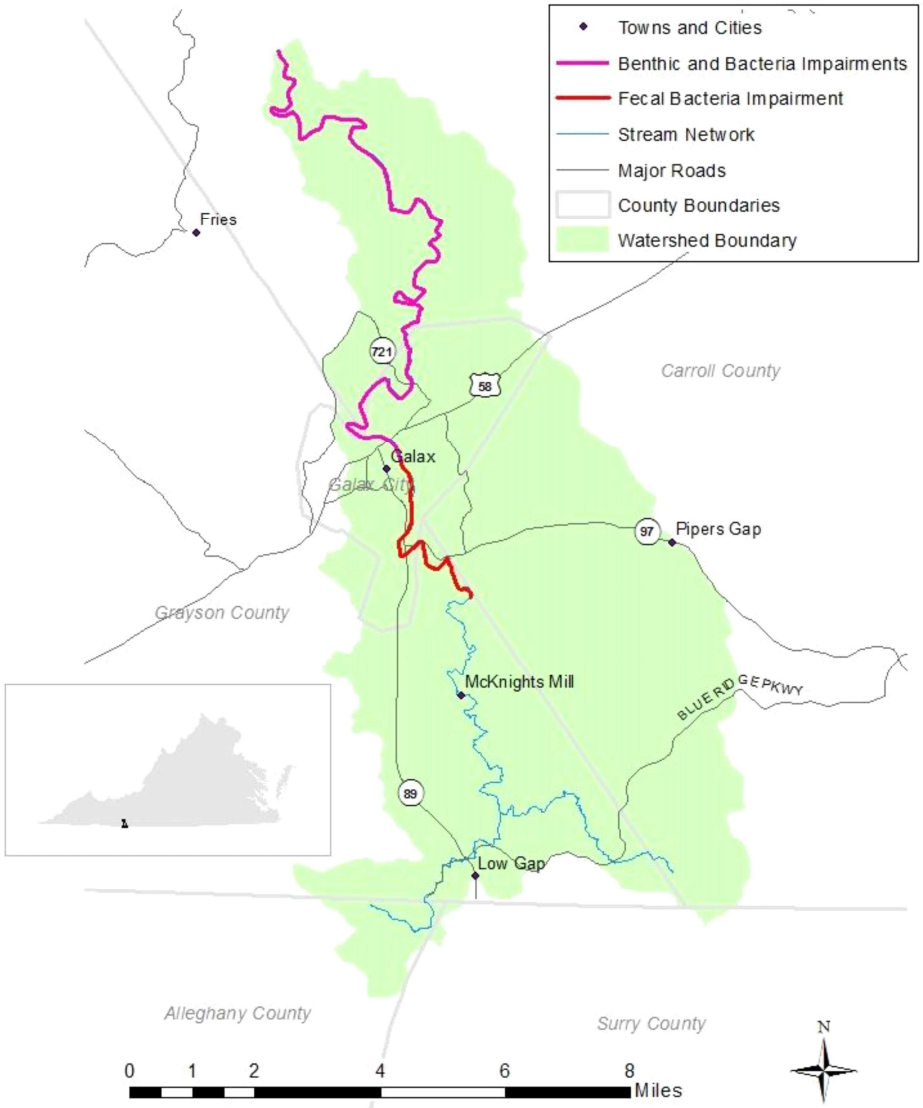

Figure 1. Location of the Chestnut Creek watershed and its stream impairments.

The Chestnut Creek watershed is located in Virginia's Carroll and Grayson counties, North Carolina's Surry and Alleghany counties, and the city of Galax, Virginia. It flows generally north to its confluence with the New River. The Chestnut Creek watershed comprises approximately 39,000 acres of land area with 7% characterized as developed, 36% agriculture and 57% forested according to the 2006 TMDL report (VADEQ, 2006). Only 3.7% of the watershed is located in North Carolina. As shown in Figure 1, Chestnut Creek is impaired for violations of the *E. coli* bacteria water quality standard from the confluence with Coal Creek to the New River confluence, and impaired for violations of the General Standard (benthic) from the Galax raw water intake to the confluence with New River.

Sources of Bacteria

Potential sources of fecal bacteria include both point and non-point sources. Point sources, including individual residences, can contribute bacteria to streams through their permitted discharges. During the TMDL study there were two identified point sources permitted to discharge bacteria in the Chestnut Creek watershed. Non-point sources of bacteria in the watershed include failing or malfunctioning septic systems, straight pipes (pipes directly discharging untreated sewage into the stream), livestock (including manure application loads to pasture and cropland), wildlife, and domestic pets. The 2006 TMDL identified the primary sources of bacteria in Chestnut Creek as agricultural runoff, followed by residential runoff and runoff from forested areas.

Goals for Reducing Bacteria

The focus of planning efforts for this project is removing Chestnut Creek from the impaired waters list. The TMDL study completed for Chestnut Creek identified goals for reducing bacteria from the different sources in the watershed. The goals shown in Table 1 are based on what it would take to remove Chestnut Creek from the impaired waters list and meet the single sample maximum criterion. This occurs when the single sample criterion for *E. coli* (235 cfu/100mL) is violated no more than 10.5% of the time. While greater reductions in non-point source pollution would be needed in order to achieve the final TMDL load reductions as identified in the TMDL study (98% reduction from all non-point source loads from agricultural and residential areas), this implementation plan will focus on the practices that are practicable. The final TMDL load reductions are based on 0% violations of the geometric mean criterion of 126 cfu/100 ml and the single sample maximum criterion

Table 1. Bacteria reduction goals for removal of Chestnut Creek from the impaired waters list.

Impaired Watershed	*E. Coli* Reduction from Source Category (%)			
	Livestock in Stream	Loads from Agricultural Areas	Straight Pipes	Loads from Residential Areas
Chestnut Creek	65	87	100	87

Sources of Sediment

Based on the TMDL study, the major source of sediment in Chestnut Creek is runoff from pasture (an estimated 62% of the total sediment load). This is partly due to the fact that next to forest, pasture makes up the greatest amount of acreage in the watershed. In addition, pasture is particularly susceptible to erosion when vegetative cover is minimal such as when overgrazing occurs or denuded areas develop where livestock frequently congregate (such as where hay is fed). Other nonpoint sources of sediment in the watersheds include runoff from cropland and hayland, forested areas, and developed areas. Stream channel erosion also contributes sediment to the stream. In addition, during the TMDL study there were four types of point sources in the watershed identified that were permitted to discharge sediment to the stream; two permitted domestic sewage

treatment permits, one industrial VPDES permit, nine industrial stormwater permits, and two construction stormwater permits. At the time of the TMDL study, these point sources were permitted to discharge up to an average18.90 tons of sediment each year, which is approximately 0.2% of the total sediment load. As of May 2015, there are still two permitted domestic sewage treatment permits, one industrial VPDES permit, only eight industrial stormwater permits, and no construction stormwater permits.

Goals for Reducing Sediment

The Chestnut Creek TMDL study includes an assessment of the sources of sediment in the watershed as well as the reductions that are needed from each source in order to restore the benthic community in the creek. Three potential scenarios were developed for the TMDL, Scenarios 1, 2, and 3 in Table 2. During Implementation Plan development, stakeholders identified an alternative scenario (IP Scenario in table below) which corresponds closer with the bacteria reduction scenario.

Table 2. Sediment source reduction scenarios for meeting the sediment TMDL.

Scenario	Sediment Reduction from Source Category (%)							
	Disturbed Forest	Unimproved Pasture	Overgrazed Pasture	High Till Row Crop	Low Till Row Crop	Streambank Erosion	Straight Pipes	Residential/ Urban
Scenario 1	34	33	34	34	0	34	100	0
Scenario 2	0	40	42	40	0	0	100	0
Scenario 3	39	39	38	38	0	0	100	0
IP Scenario	0	38	40	35	20	5	100	1

Changes and Progress since the TMDL Study

Land Use Changes

According to the TMDL report (VADEQ, 2006), satellite images taken between 1990 and 1994 were used to identify the land use coverage in Chestnut Creek. A comparison of the land use area used in the TMDL study with more recent land use data from the 2011 National Land Cover Database (NLCD) shows that agricultural and forest land uses have decreased slightly and developed land use has increased. Table 3 lists the land use change estimates for the watershed. It was determined that the change in land use is not significant for the development of the implementation plan.

Table 3. Land use changes in the Chestnut Creek watershed.

Land Use	Chestnut Creek TMDL		2011 NLCD Land Use Layer	
	Acres	%	Acres	%
Virginia - Agriculture	13,741	35	13,657	35
Virginia - Developed	2,523	6	3,376	9
Virginia – Forest and Wetlands	20,893	54	20,124	52
North Carolina	1,375	4	1,375	4

Water Quality Monitoring

VADEQ has continued to assess water quality in Chestnut Creek since the development of the TMDL. Results of fecal bacteria monitoring since the TMDL study show that the stream is still impaired (Table 4).

Table 4. Recent *E. coli* monitoring results in Chestnut Creek and violation rates of the *E. coli* single sample maximum criterion.

Station ID	Stream Name	# of samples	Violation Rate	Sampling Period
9-CST002.64	Chestnut Creek	19	16%	12/2005-11/2010
9-CST016.82	Chestnut Creek	19	26%	9/2005-11/2008

Biological monitoring of the benthic macroinvertebrate community conducted by VADEQ since the development of the TMDL indicate that the aquatic life community in Chestnut Creek is improving. VADEQ's biological assessment method is based on the Virginia Stream Condition Index (VSCI) for Virginia's non-coastal areas (Tetra Tech, 2003). This multi-metric index is based on 8 biomonitoring metrics that are based on the diversity, pollution tolerance, and abundance of organisms identified during a taxa inventory of each sample. VSCI has a scoring range of 0-100, where a maximum score of 100 represents the best benthic community sites. The current threshold criteria defines "non-impaired" sites as those with a VSCI of 60 or above, and "impaired" sites as

those with a score below 60. The VSCI scores for Chestnut Creek are shown in Figure 2. The VSCI scores for all three monitoring sites show improvements over time.

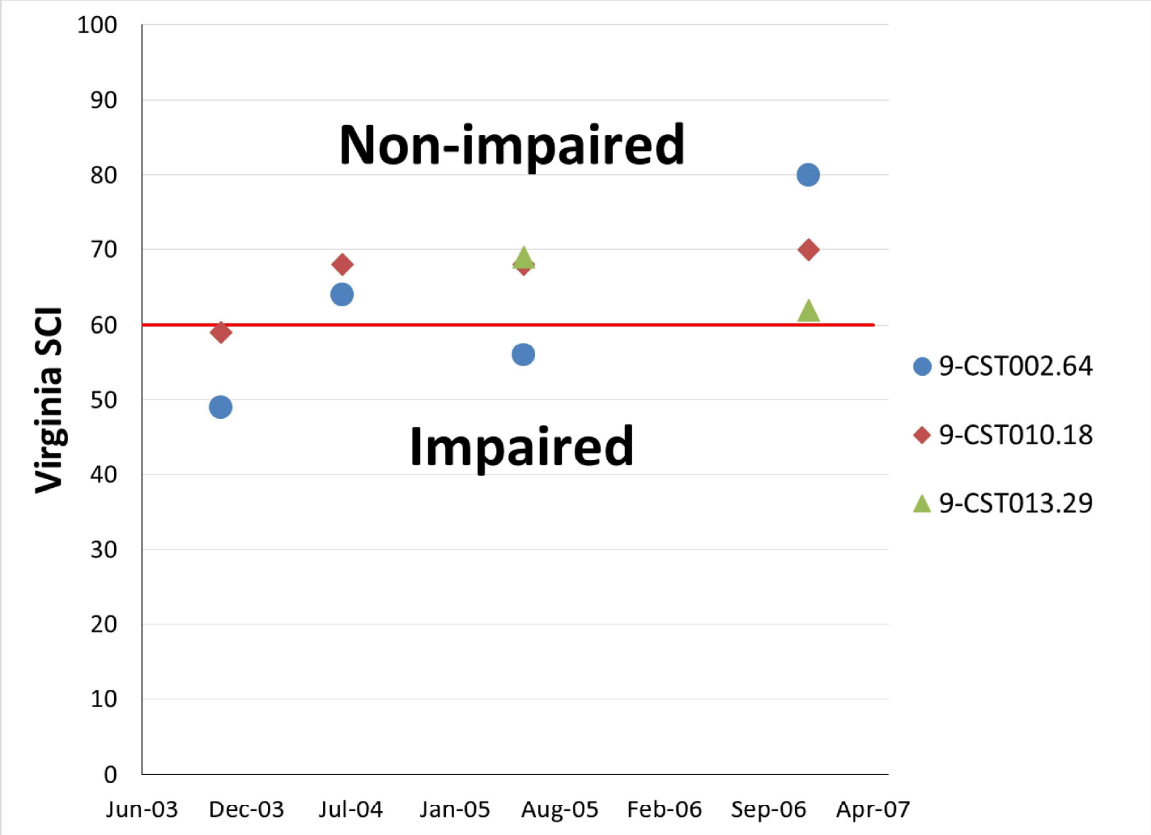

Figure 2. VSCI scores for Chestnut Creek (CST).

BMP Implementation

Since the 2006 TMDL, progress has been made in the Chestnut Creek watershed to reduce both bacteria and sediment pollution through the implementation of new BMPs (Table 5). Information on agricultural BMPs installed since 2006 was gathered from the Virginia Agricultural Cost Share Tracking Program and represents BMPs implemented since 2006 that have also received cost-share funding. It does not represent additional agricultural BMPs that landowners have decided to implement voluntarily without participation in a state and/or federally sponsored cost-share program. In addition to agricultural BMPs, the City of Galax is managing stormwater runoff within the City as required by Virginia's mandatory stormwater regulations, and the City is constantly working on upgrades of the City's sewer systems.

Table 5. BMPs installed in the Chestnut Creek watershed since the 2006 TMDL study.

BMP Name	BMP Code	Extent Installed	
		Units	Amount
CREP grazing land protection	CRSL-6	linear feet	17,422
CREP riparian forest buffer planting	CRFR-3	acres	34
Extension of CREP watering systems	SL-7	acres	56
Livestock exclusion with reduced setback	LE-2	linear feet	886
Permanent vegetative cover on critical areas	SL-11	acres	5
Permanent vegetative cover on cropland	SL-1	acres	72
Protective cover for specialty crops	SL-8	acres	136
Small grain cover crop for nutrient management	SL-8B	acres	1,721
Stream exclusion with grazing land management	SL-6	linear feet	28,727

Community Participation

The development of this clean-up plan relied heavily on input collected from the local community. Knowledge contributed by local citizens and stakeholder organizations guided the identification of conservation and outreach strategies included in this plan. This collaborative process also helped build understanding and trust among participants who need to maintain close working relationships in order to meet the plan's water quality goals.

Four meetings were held during the development of the Chestnut Creek Implementation Plan (Table 6). The initial or kickoff meeting was a public meeting that introduced stakeholders, including members of the community, to the TMDL process and the need for local input. The next two meetings were conducted to develop specific parts of the IP relevant to specific BMPs and other issues. Members of the public were invited to these meetings but mostly included relevant agency personnel and the steering committee. A final public meeting was held on May 26, 2015 where the final draft of the public document was shared with the public and opened a 30-day comment period.

Table 6. Schedule of meetings held during the development of the Chestnut Creek Implementation Plan.

Date	Meeting Type	Attendance
23 September, 2014	Kickoff Public Meeting, Working Group	12
19 November, 2014	Agricultural, Residential, and Government Working Group	14
7 April, 2015	Steering Committee	13
26 May, 2015	Final Public Meeting	13

The first public meeting was held on the evening of September 23, 2014 at the Department of Forestry Office in Galax to kick off the development of the implementation plan. The meeting was publicized through a press release published in local papers, email announcements, and flyers posted throughout the watersheds. Approximately 12 people attended the meeting. The meeting served as an opportunity for local residents to learn about water quality in Chestnut Creek, become familiar with the TMDL and clean-up process, and provide feedback on local watershed concerns and opportunities.

A government, agricultural and residential working group was formed to discuss implementation and outreach strategies suitable for different land uses in the watershed. The working group consisted of stakeholders who were familiar with land use management issues in the specific focus areas. The working group met on September 23, 2014 following the Kickoff Public Meeting to to focus on agricultural and residential issues.

A working group meeting was held on November 19, 2014 at the Galax Recreation Center. During this meeting the residential, agricultural, and government working group was able to discuss relevant topics and provide or verify estimates for model parameter. First, the group reviewed conservation practices and outreach strategies from an agricultural perspective. The group discussed changes that may have occurred in the watershed since the TMDL was published in 2006. Suspected changes included land cover/land use, number of cattle, and new BMPs implemented in the watershed. Much of the conversation focused on livestock exclusion practices, including how to best contact potential participants. Additional BMPs considered for the Chestnut Creek watershed included municipal stormwater, and riparian buffer width. The stakeholders also noted that only one dairy is located in the watershed and that the IP could credit the City of Galax and landowners for BMPs implemented during the period between the TMDL and the IP.

Next, the working group identified strategies to reduce bacteria from human sources and pet waste as well as to reduce sediment from residential and urban settings. The group talked about known stormwater and wastewater issues within the City of Galax and work being done by the City to address these issues. They emphasized stream stabilization as a way to address stormwater scour and flooding issues. The group agreed that 97 straight pipes seemed high for the area and discussed ways to educate the public about a residential septic program.

Also at the November meeting, the focus on government issues led to a conversation about water quality in the Chestnut Creek watershed between local governments, regional organizations and representatives of state and federal agencies. Representatives from Galax discussed flooding issues and agreed stream stabilization could be an effective and popular strategy to decrease flooding in the City. The group reviewed conservation practices and outreach strategies as well as identified technical and financial resources needed to carry out implementation. They discussed septic systems and straight pipes at length, specifically barriers to reaching potential participants and strategies for fine-tuning the estimates for both numbers and practices needed to address the problem. The group also discussed the timeline for funding, potential for delisting Chestnut Creek and alleviating bacterial impairment, and the potential for bringing new customers to existing sewer lines.

The Steering Committee met on April 7 to discuss plans for a final meeting and to review a draft of the implementation plan. A final public meeting was held on May 26 at the Galax Recreation Center in Galax.

Implementation Actions

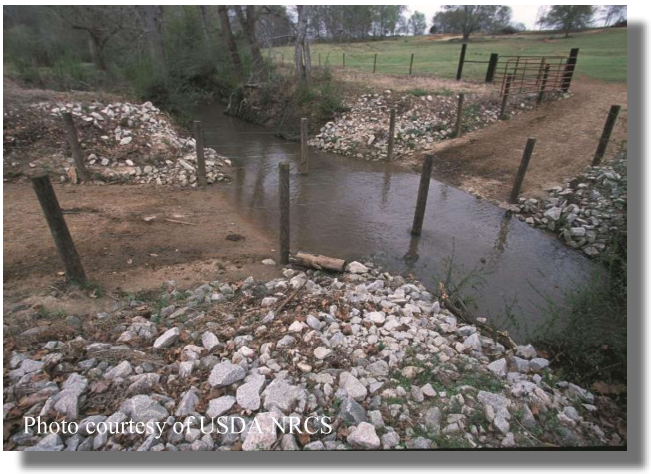
Photo courtesy of USDA NRCS

An important part of the implementation plan is the identification of specific actions that will improve water quality in the watersheds.

This section provides a summary of what is needed to achieve the bacteria and sediment reductions specified in the Chestnut Creek TMDL study. Since this plan is designed to be implemented by landowners on a voluntary basis, it is necessary to identify actions including management strategies that are both financially and technically realistic and suitable for this particular community. As part of this process, the costs and benefits of these actions must be examined and assessed. Once the best actions were identified for implementation, estimates of the number of each action that would be needed in order to meet water quality goals were developed.

Management Actions selected through Stakeholder Review

While management actions such as livestock exclusion and replacement of straight pipes reduce the direct loads to the stream described in the TMDL, a number of additional measures are needed to control bacteria and sediment coming from land-based sources. Various scenarios were developed and presented to the working group, who reviewed both economic costs and the water quality benefits. The majority of these best management practices (BMPs) are included in state and federal agricultural cost share programs that promote conservation. In addition, innovative management practices suggested by local stakeholders and technical conservation staff were considered. The final set of practices identified and the efficiencies used in this study are listed in Table 7. It should be noted that an adaptive management strategy will be utilized in the implementation of this plan. BMPs that are easiest to implement, provide the greatest water quality benefits, and offer the greatest economic return to landowners will be implemented first. The effectiveness of these practices will be continually evaluated, and adjustments of actions will be made as appropriate. As new technologies and innovative BMPs to address bacteria become available, these practices should also be evaluated for implementation in the watersheds.

Table 7. Bacteria and sediment reduction efficiencies for best management practices.

BMP Type	Description	Bacteria Reduction	Sediment Reduction	Reference
Livestock stream exclusion	Livestock exclusion from waterway	100%	LU Change	1, 4
Streambank stabilization	Streambank stabilization	0.075%	44.88 lbs./ft./yr.	5, 6
Pasture	Streamside buffer (35-100 feet)	52.57%	52.57%	2, 5
	Improved pasture management	50%	30%	3, 5
	Permanent vegetative cover on critical areas	LU Change	LU Change	4
	Reforestation of highly erodible pasture/cropland	LU Change	LU Change	4
	Loafing lot management	40%	40%	2, 5
	Manure storage facility	80%	N/A	3
	Water control structure	88%	49%	7
Cropland	Continuous no-till	64%	64%	2, 5
	Small grain cover crops	20%	20%	2, 5
Straight pipes and septic systems	Septic tank pump-out	5%	N/A	6
	Septic system repair	100%	N/A	1
	Septic system replacement	100%	N/A	1
	Alternative waste treatment system	100%	N/A	1
Pet waste	Public pet waste collection facility/signage	75%	N/A	8
	Pet waste education program	25%	N/A	8
Urban/Residential stormwater	Rain gardens	90%	90%	2, 5
	Riparian buffers	50%	50%	2, 5

References

1. Removal efficiency is defined by the practice
2. Bacteria efficiency assumed to be equal to sediment efficiency.
3. VADCR and VADEQ. 2003. Guidance manual for Total Maximum Daily Load Implementation Plans.
4. Based on differential loading rates to different land uses.
5. Chesapeake Assessment Scenario Tool - BMP effectiveness values by land use and HGMR and pollutant
6. Bacteria efficiency assumed equal to nitrogen removal efficiency - Chesapeake Assessment Scenario Tool - BMP effectiveness values by land use and HGMR and pollutant
7. Center for Watershed Protection. 2007. National Pollutant Removal Performance Database, Version 3.
8. adapted from Swann, C. 1999. A survey of residential nutrient behaviors in the Chesapeake Bay. Widener Burrows, Inc. Chesapeake Bay Research Consortium. Center for Watershed Protection. Ellicott City, MD. 112pp.

Straight Pipes and Failing Septic Systems

Since state law requires that failing septic systems and straight pipes be corrected once identified, a 100% reduction in bacteria from these sources is needed.

Table 8 shows the estimated number of households in the Chestnut Creek watershed with failing septic systems and straight pipes as identified in the 2006 TMDL. The failing septic system estimate factored in the age of homes in the watershed, and in the case of straight pipes, the proximity of homes to streams. Estimates of needed repairs and replacements of failing systems with conventional and alternative systems were based on input from the Virginia Department of Health and the working group. The working group also identified the cost of connecting to sewer as a practice that could be bolstered by the availability of cost-share funding. Based on this feedback, it was estimated that 2 failing septic systems could be replaced by connections to public sewer. Based on existing conditions in the watershed, it was estimated that 50% of failing septic systems would require repairs, 45% replacements with a conventional system, 4.8% replacement with an **alternative waste treatment system** and 0.2% replacement with a connection to public sewer. It is assumed that 90% of straight pipe corrections will be conventional septic systems and 10% will be alternative waste treatment systems.

Table 8. Residential wastewater treatment BMPs.

Failing Septic Systems	Straight Pipes	Pump-outs	Connection to Sewer	Repairs	Septic System Replacements	Alternative Waste Treatment Systems
1,280	97	105	2	640	663	72

Stakeholders identified septic system pump-outs as a practice to offer residents as an educational tool and as a way to further identify failing systems. This program could receive cost-share funding as an incentive for homeowner participation; it could also target homeowners closest to identified streams or those with financial burdens. The number of pump outs listed in Table 8 was calculated as 4% of the 2006 estimate of households.

Pet Waste

In order to address bacteria from domestic pets in the streams, some form of pet waste management is needed.

Left on the ground, pet waste can easily be washed by runoff into storm drains or nearby waterbodies. Pet waste not only harbors bacteria, viruses, and parasites that can threaten the health of humans and wildlife, but it can also contain excess nutrients that promote extreme algal growth. Studies show that up to 95% of fecal matter could potentially be eliminated from an urban watershed if all dog owners simply picked up after their pets (Alderserio et al. 1996; Trail et al. 1993).

A pet waste education program increases public awareness about these water quality issues and encourages pet owners to properly dispose of their pet's waste at home and in public dog walking areas. A fully implemented **pet waste education program** will include the development and distribution of educational materials, installation of **pet waste stations** in key locations (two in City parks and one on the New River Trail State Park). The City of Galax already has signage in City parks and a City Code requiring pet owners to clean up after their pets. The addition of a pet waste education program will be a reasonable next step in reducing pet waste from entering Chestnut Creek.

In order to treat bacteria and sediment running off of urban and residential land, BMPs to reduce and filter stormwater will be necessary.

Due to the largely agricultural land base of the watershed, opportunities for stormwater BMPs are relatively limited. However, members of the working group discussed the potential for low impact development BMPs in the City of Galax. **Low impact development (LID)** is about managing rainfall at the source using smaller-scale controls rather than the traditional method of channeling stormwater through pipes to large-scale holding areas. The group suggested that rain gardens and vegetative riparian buffers could be installed in residential, commercial and public areas by homeowners, businesses, and the City (Table 9).

Table 9. Urban and residential stormwater BMPs.

BMP	Units	Extent Required
Rain Gardens	acres-treated	18
Riparian Buffers	acres-installed	4.5

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Rain gardens are landscaped gardens of trees, shrubs, and plants located in commercial or residential areas in order to treat stormwater runoff through temporary collection of the water before infiltration. They are slightly depressed areas into which stormwater runoff is channeled by pipes, curb openings, or gravity.

Riparian buffers contain vegetation that physically separates a waterbody from surrounding development. Buffers can provide economic, environmental, recreational, and aesthetic value to a community. They preserve the floodplain, encourage infiltration, filter pollutants, capture sediment, provide wildlife habitat, and regulate water temperature.

Streambank Stabilization and Restoration

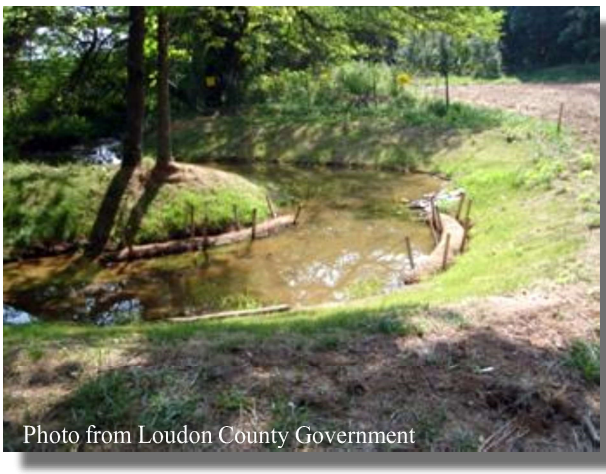


Photo from Loudon County Government

According to the Chestnut Creek TMDL, approximately 10% of sediment in the stream is coming from bank erosion, making streambank restoration important.

Streambank erosion is a natural process, but alterations to the stream system can greatly accelerate the process resulting in erosion rates far greater than those typically seen. Streambank erosion is estimated to contribute about 10% of the sediment reaching Chestnut Creek from nonpoint sources, making streambank stabilization efforts critical. Significant reductions could be made through the implementation of improved stormwater management in urban areas, installation of riparian buffers throughout the watershed, and livestock exclusion from streams. However, additional stream mitigation will be needed to meet the in-stream channel erosion reductions identified in the Chestnut Creek TMDL. The total stream restoration length necessary to achieve the sediment load reductions was calculated as **1,985 linear feet.**

Due to the variability in streambank form and needs, streambank stabilization and restoration techniques must be selected on a site-by-site basis. Resource needs will depend on the specific technique(s), ranging from low tech, landowner friendly projects (live plantings) to relatively high-cost designs requiring professional design services (channel re-shaping). The 2004 Virginia Stream Restoration and Stabilization Best Management Practices Guide provides an in-depth review of the permitting issues, planning and design principles, costs, and best management practices associated with stream restoration projects (VADCR 2004).

Livestock in the Streams


Photo courtesy of USDA NRCS

The TMDL study specifies a 65% reduction in the direct deposit of waste in the stream by livestock, making some form of livestock exclusion via stream fencing necessary.

When livestock, especially cattle, have uncontrolled access to streams, they often deposit their feces nearby or directly into the stream. Their waste contains fecal bacteria, an indicator of other disease-causing bacteria that can harm human health. Additionally, the livestock tend to congregate around the water source and available shade, trampling the stream banks and overgrazing the riparian vegetation which further contributes to stream sedimentation issues. The 2006 TMDL study specified a 65% reduction in the direct deposition of waste into the stream by livestock. This will be accomplished by limiting livestock access to streams with fencing and providing alternative water sources.

A GIS analysis of stream segments that flow through or are adjacent to pasture was conducted to assess potential fencing needs. While not every pasture has grazing livestock all the time, it was assumed that all pasture areas have the potential for livestock access, meaning that livestock exclusion fencing should be installed. The Virginia Department of Conservation and Recreation (VADCR) Agricultural BMP Database was utilized in conjunction with input from New River Soil and Water Conservation District (SWCD) staff to determine typical characteristics (e.g., average length of fencing installed per fencing project) of the different livestock exclusion systems offered through the state and federal agricultural cost share programs so that the number of different systems needed could be accurately estimated. In addition, data on stream fencing already in place was collected for each watershed and subtracted from the total fencing needed. An estimated 44 miles of fencing (includes fencing on both sides of stream where applicable) will be needed to remove the streams from the impaired waters list (Table 10).

Landowners who wish to exclude their livestock from the stream have several options through state and federal cost share programs. A summary of cost share programs is provided in the Potential Funding Sources section. Incentive payments vary based on the width of the streamside buffer that is installed between the fence and the stream, and the type of fencing that is installed. The portion of fencing that will be accomplished using a series of available fencing practices was based on historical data and input from agricultural conservation professionals.

Table 10. Fencing needs assessment.

	Linear Feet	Linear Miles
Total potential fencing	437,773	83
Perennial	*182,216*	*35*
Intermittent	*255,557*	*48*
Fencing installed to date	53,003	10
Fencing installed before TMDL study	*5,968*	*1*
Fencing installed since TMDL study	*47,035*	*9*
Remaining fencing needed (65% livestock exclusion)	233,638	44

Farmers who cannot afford to give up 35 feet or more for a streamside buffer can receive 50% cost share for the installation of exclusion fencing with a ten foot setback, cross fencing, and to provide an alternative water source for their livestock. It is estimated that **20%** of total fencing in the watersheds will be installed using this practice (code LE-2T). If a landowner can afford to give up 35 feet for a buffer along the stream, then they are eligible to receive cost share at a rate of 75% to 85% to cover the costs of the stream fencing, cross fencing and providing alternative water. It is estimated that **70%** of the total fencing in the watersheds will be installed using this particular practice (codes LE-1T and SL-6T/SL-6). In cases where a watering system already exists, a WP-2T system is a more appropriate choice. This system includes streamside fencing and a 35-ft buffer from the stream. This practice includes an up-front cost share payment of 50 cents per linear foot of fence installed to assist in covering fencing maintenance costs. Since financial assistance with development of alternative water sources is a significant incentive for farmers to install fencing, this practice is used infrequently because it does not provide cost share for the installation of a well. Consequently, it was estimated that only **5%** of fencing in the watersheds would be accomplished using this practice. For those who are willing to install a 35 foot buffer or larger and plant trees in the buffer, the Conservation Reserve Enhancement Program (CREP) is an excellent option. This practice provides cost share and incentive payments ranging from 50% to 115% for fencing, planting materials, and alternative water source development (code CRSL-6). It is estimated that **5%** of fencing in the watersheds will be installed through this program. Table 11 shows the fencing required for the impaired watershed in order to meet the livestock exclusion goal.

Table 11. Livestock exclusion BMPs (feet and number of exclusion systems).

Fencing by Exclusion System Type (linear feet and # of practices							
LE-2T		LE-1T/SL-6T/SL-6		WP-2T		CREP	
Feet	# Systems	Feet	# Systems	Feet	# Systems	Feet	# Systems
46,728	39	163,546	149	11,682	7	11,682	5

Implementation Actions for Pasture

Runoff from pastures can carry with it sediment from exposed ground and bacteria from manure deposited on the pasture on its way to the stream.

Pasture lands provide forage for grazing by domestic livestock, commodities which contribute largely to Virginia's economic prosperity (VDACS 2015). Improper pasture management can lead to soil compaction and overgrazing which encourage erosion and runoff. Grazing animals deposit manure on any available pastureland, but waste tends to be most concentrated near feeding and watering areas. Poorly located or managed areas can quickly become barren, increasing the possibility of contaminated runoff (Alderfer and Robinson 1947). Pasture runoff carries both bacteria from the livestock waste and sediment from the eroding soils to nearby streams. Pasture BMPs can greatly reduce these pollutant loads as well as improve overall pasture production.

Improved pasture management through the implementation of a prescribed grazing system can prevent overgrazing by livestock, thereby reducing runoff, increasing filtration and vegetative uptake of pollutants, and allowing farmers to better utilize their pasture acreage. This practice includes: maintaining minimum forage height during the growing season, application of lime and fertilizer when needed, following a nutrient management plan, controlling woody vegetation, distributing manure through managed rotational grazing, a sacrifice area for feeding during winter and summer droughts, and reseeding if necessary. Vegetated buffers act as filters, trapping pollutants before they run into the stream. Farmers can utilize state and federal cost share programs to convert highly erodible pasture such as areas with steep slopes and poor vegetative cover to forest. These types of pasture typically produce a lower yield of forage for livestock making them less optimal for grazing or cutting hay. Water retention structures have the capacity to treat large volumes of runoff before it enters the stream. Table 12 shows pasture BMPs needed in order to reduce bacteria and sediment to a level at which the streams can be removed from the impaired waters list.

Table 12. Pasture BMPs.

BMP	Units	Extent Required
Improved Pasture Management	acres	11,615
Reforestation of Erodible Pasture	acres	1,800
Permanent Vegetative Cover on Critical Areas	acres	95
Loafing Lot Management	system	3
Waste Storage Facility (beef)	system	1
Water Retention Structures	acres-treated	7,387

Implementation Actions for Cropland

Bacteria and sediment can run off of cropland when soils fertilized with manure are exposed to rainfall. These pollutants will make their way to the stream unless filtering practices are in place to trap it.

Bacteria and sediment from cropland can end up in a stream unless the appropriate management practices are in place. Runoff of bacteria from manure spread on cropland can be reduced either by decreasing the source of the bacteria (spreading less manure or storing it longer so that bacteria will die off) or by the use of filtering practices. Reducing tillage of the soil, increasing soil organic content and allowing better cover will reduce the degree of runoff and soil loss from cropland during rain events. Many farmers in the Chestnut Creek watershed are already using some form of reduced tillage and cover crops on cropland. Consequently, this plan includes a modest amount of continuous no till and cover crops since they are already commonly used. Table 13 shows the estimated extent of cropland BMPs needed in order to remove the streams from the impaired waters list.

Table 13. Cropland BMPs.

BMP	Units	Extent Required
Continuous No-till	acres	8
Small Grain Cover Crop	acres	206
Permanent Vegetative Cover on Cropland	acres	2

Education and Outreach

Education, outreach and assistance with the design and installation of best management practices will be needed in order to get landowners involved in implementation.

In order to get landowners involved in implementation, it will be necessary to initiate education and outreach strategies and provide technical assistance with the design and installation of various best management practices. There must be a proactive approach to contact farmers and residents to identify the practices that will help meet the goal of improved water quality while also meeting their needs as private landowners. Economic costs and benefits must be considered in this process. The working group recommended several education/outreach techniques, which can be utilized during implementation.

The following tasks associated with outreach programs were identified:

Agricultural Programs

- Make contact with landowners in the watersheds to make them aware of implementation goals, cost-share assistance, and voluntary options that are available to agricultural producers interested in conservation
- Provide technical assistance for agricultural programs (e.g., survey, design, layout)
- Develop and distribute educational materials through bulk mailings, Galax Farmers Market, Carroll County Fair, Grayson County Youth Livestock Show, local businesses (e.g., Southern States, Galax Farm Supply), Grayson-Carroll Farm Service Agency (FSA) and Virginia Cooperative Extension (VCE) newsletters, etc.
- Organize educational programs (e.g., farm tours, presentations at VCE events or club events)

Residential Programs

- Identify straight pipes and failing septic systems (e.g., contact landowners in older homes near the streams, septic pump-out program)
- Develop and distribute educational materials (e.g., septic system maintenance guide, pet waste disposal brochure)
- Organize educational programs (e.g., demonstration septic pump-outs, pet waste control)
- Partner with VCE's Master Gardeners of the Blue Ridge to provide educational programs targeted to reduce residential stormwater (e.g., rain gardens, stream restoration)

Staffing Needed for Outreach and Technical Assistance

A critical component in the successful implementation of this plan is the availability of knowledgeable staff to work with landowners on implementing conservation practices. While this plan provides a general list of practices that can be implemented in the watershed, property owners face unique management challenges including both design challenges and financial barriers to implementation of practices. Consequently, technical assistance from trained conservation professionals is a key component to successful BMP implementation. Technical assistance includes helping landowners identify suitable BMPs for their property, designing BMPs and locating funding to finance implementation.

The staffing level needed to implement the agricultural and residential components of the plan was estimated based on discussions with stakeholders and the staffing levels used in similar projects. Staffing needs were quantified using full time equivalents (FTE), with one FTE being equal to one full-time staff member. It was determined that 1.5 FTEs would be needed to provide the technical assistance needed for agricultural and residential BMPs over two stages of implementation, with each stage covering a ten year period. Should funding become available, the New River SWCD could house an agricultural technician to manage outreach and technical assistance with design and implementation of agricultural BMPs. The position of a residential coordinator to conduct outreach and work with landowners to address failing septic systems, straight pipes, pet waste, residential stormwater, and stream restoration could also be housed at the New River SWCD.

Implementation Costs


North Dakota State Univ. Extension (2012)

Virginia DCR

Residential BMP Costs

The costs of recommended residential BMPs for treating failing septic systems, straight pipes, and pet waste were estimated using input from local Virginia Department of Health (VDH) staff and the New River SWCD as well as information from other recent TMDL Implementation Plans in Virginia. These costs are shown in Table 14 with VADCR BMP cost-share codes included.

Table 14. Estimated residential BMPs and costs.

Control Measure	BMP Code	Units	Unit Cost	Total Units	Total Cost
Failing Septic Systems					
Septic Tank Pump-out	RB-1	system	$300	105	$31,500
Connection to Public Sewer	RB-2	system	$5,000	2	$10,000
Septic Tank System Repair	RB-3	system	$3,500	640	$2,240,000
Septic Tank System Installation/Replacement	RB-4/RB-4P	system	$5,000	576	$2,880,000
Alternative On-site Waste Treatment System	RB-5	system	$15,000	62	$930,000
Straight Pipes					
Septic Tank System Installation/Replacement	RB-4/RB-4P	system	$5,000	87	$435,000
Alternative On-site Waste Treatment System	RB-5	system	$15,000	10	$150,000
Pet Waste Management					
Public Pet Waste Collection Facility/Signage/Supplies[1]		system	$3,000	3	$9,000
Pet Waste Education Program		program	$4,000	1	$4,000
TOTAL ESTIMATED COST					**$6,689,500**

[1] Unit cost based on purchasing system as well as the estimated cost of trash can liners, waste bags, and maintenance for 10 years

Stormwater BMP Costs

Stormwater BMP cost estimates were developed using stakeholder input, information from other recent Implementation Plans and other available literature. The estimated total cost for stormwater BMPs is $92,250. Table 15 lists the various urban and residential stormwater BMPs and their associated costs. Stormwater BMPs installed will meet the sediment reduction goal from residential and urban areas, and combined with the Residential BMPs will meet the bacteria goals from residential and urban sources.

Table 15. Estimated urban and residential stormwater BMP costs.

Control Measure	Units	Unit Cost	Total Units	Total Cost
Rain Gardens	acres treated	$5,000	18	$90,000
Riparian Buffers	acres installed	$500	4.5	$2,250
TOTAL ESTIMATED COST				**$92,250**

Streambank Stabilization BMP Costs

Streambank stabilization estimates shown in Table 16 were based on similar watershed clean-up plans and input from the Chestnut Creek working groups. The estimated total cost for streambank stabilization efforts is $595,500. All streambank stabilization practices have been prioritized for implementation during the first stage of work based on stakeholder feedback. Streambank stabilization practices are applicable to all land uses in the watershed. More complex stream restoration projects would be applicable in the watershed to support sediment reduction efforts and stakeholders estimated the cost of full stream channel restoration at $200-$300 per linear foot. However, the increased unit cost may result in a greater sediment removal rate than just basic stabilization efforts, making restoration projects a potentially cost-effective option.

Table 16. Streambank stabilization estimates for the Chestnut Creek watershed.

Control Measure	Units	Unit Cost	Total Units	Total Cost
Streambank Stabilization	linear ft.	$300	1,985	**$595,500**

Agricultural BMP Costs

The costs of agricultural best management practices included in the implementation plan were estimated based on data for Carroll and Grayson Counties from the VADCR Agricultural BMP Database, the USDA Natural Resources Conservation Service (NRCS) cost list, and considerable input from the New River SWCD staff. These costs are shown in Table 17 with VADCR and VADEQ TMDL BMP cost-share codes included.

Table 17. Estimated agricultural BMPs and costs.

Control Measure	BMP Code	Units	Unit Cost	Total Units	Total Cost
Livestock Exclusion					
Livestock Exclusion with Riparian Buffers	CRSL-6	system	$30,000	5	$150,000
	SL-6, SL-6T, LE-1T	system	$25,000	149	$3,725,000
Livestock Exclusion with Reduced Setback	LE-2T	system	$20,000	39	$780,000
Stream Protection System	WP-2T	system	$10,000	7	$70,000
Pasture					
Improved Pasture Management	SL-7T, SL-9, SL-10T	acres	$75	11,615	$871,125
Reforestation of Erodible Pasture	FR-1	acres	$120	1,801	$216,120
Permanent Vegetative Cover on Critical Areas	SL-11	acres	$2,000	95	$190,000
Loafing Lot Management System	WP-4B	system	$20,000	3	$60,000
Animal Waste Control Facility	WP-4	system	$150,000	1	$150,000
Sediment Retention, Erosion or Water Control Structures	WP-1	acres-treated	$140	7,233	$1,012,620
Cropland					
Continuous No-till	SL-15A	acres	$20	8	$160
Protective Cover for Specialty Cropland	SL-8	acres	$25	14	$350
Small Grain Cover Crop	SL-8B	acres	$25	192	$4,800
Permanent Vegetative Cover on Cropland	SL-1	acres	$175	2	$350
TOTAL ESTIMATED COST					$7,230,525

The total cost of livestock exclusion systems includes not only the costs associated with fence installation and maintenance, but also the cost of developing alternative water sources for SL-6, SL-6T, LE-1T, LE-2T, and CREP practices. It should be noted that CREP does not pay for cross fencing to establish a rotational grazing system; however, this program is commonly combined with state funded practices such as SL-7T to help cover these costs. Financial assistance with maintaining fences is available through the WP-2T practice which includes an upfront incentive payment of $0.50 per linear foot. However, this practice has not been used in the watershed since it does not provide cost share for alternative water systems. A state tax credit of 25% for stream fencing maintenance costs is available through the state cost-share program (practice code WP-2D).

The majority of agricultural practices recommended in this plan are included in state and federal cost share programs. These programs offer financial assistance with implementing the practices and might also provide landowners with an incentive payment to encourage participation. However, it should be noted that these programs typically cover 75% of the cost of a BMP and require that the landowner cover the full cost of the practice up front and then receive reimbursement. Reimbursements are usually issued quickly and there is a low interest loan program available through VADEQ; however, this may still be an obstacle for some landowners interested in participating.

Technical Assistance Costs

Technical assistance costs were estimated using a cost of $60,000/position per year for a full time position. This figure is based on the existing staffing costs included in the Virginia Department of Conservation and Recreation's grant agreements with the Soil and Water Conservation Districts across the state to provide technical assistance to landowners in TMDL implementation watersheds. Based on the twenty year timeline of this plan (described in detail in the Measurable Goals and Milestones section of this plan), 1.5 full time positions are needed for two stages each covering 10 years, making the total cost of technical assistance approximately $1,800,000.

Total Implementation Cost

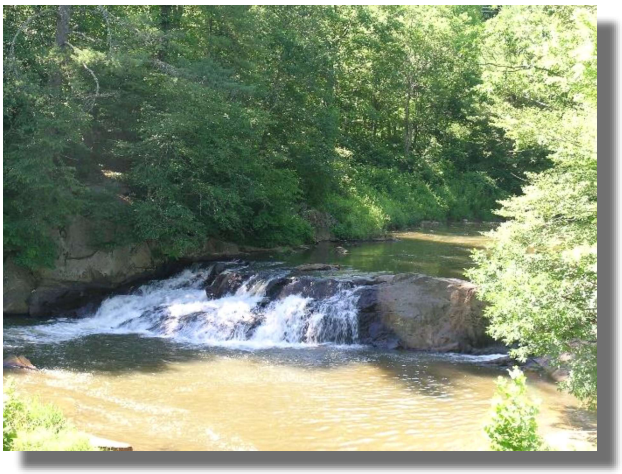
Implementation of the measures outlined in this plan will occur in stages. Implementation of practices included in Stage 1 is expected to result in meeting the sediment TMDL goal and full support of the aquatic life use standard in Chestnut Creek. Stage 2 includes additional practices needed to reduce bacteria to a level at which Chestnut Creek can be removed from Virginia's impaired waters list. The staged implementation is described in more detail in the Measurable Goals and Milestones section.

In total, it is estimated that it will cost about **$16.4M** to remove Chestnut Creek from the impaired waters list (Table 18). These costs are broken down into the two stages of implementation as well as into five basic categories: residential, stormwater, streambank stabilization, agricultural, and technical assistance.

Table 18. BMP implementation costs by stage.

Stage	Residential	Stormwater	Streambank Stabilization	Agricultural	Technical Assistance	TOTAL
Stage 1	$2,441,500	$92,250	$595,500	$5,826,705	$900,000	$9,855,955
Stage 2	$4,248,000	-	-	$1,403,820	$900,000	$6,551,820
TOTAL ESTIMATED COST	$6,689,500	$92,250	$595,500	$7,230,525	$1,800,000	$16,407,775

Implementation Benefits



The primary benefit of implementing this plan will be cleaner water in Chestnut Creek. This may lead to enhanced quality of life for the local community as well as potential economic benefits.

Specifically, *E. coli* contamination in the creek will be reduced to meet water quality standards. In addition, sediment levels in Chestnut Creek will be reduced to a level that allows the stream to host a healthy and diverse population of aquatic life. It is hard to gage the impact that reducing *E. coli* 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 *E. coli* sources through contact with surface waters should be reduced considerably following the implementation of the measures outlined in this plan. The restoration of the aquatic community in Chestnut Creek through reductions in sediment loading to the creek may result in improvements to quality of life for local residents. Recreational opportunities like fishing and birdwatching may be enhanced as improvements to the aquatic community make their way up the food chain.

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

Benefits: Agricultural Practices

It is recognized that every farmer faces unique management challenges that may make implementation of some BMPs more cost effective than others. Consequently, costs and benefits of the BMPs recommended in this plan must be weighed on an individual basis. The benefits highlighted in this section are based on general research findings.

Restricting livestock access to streams and providing them with clean water source has been shown to improve weight gain and milk production in cattle (Zeckoski et al, 2007). Studies have shown that increasing livestock consumption of clean water can lead to increased milk and butterfat production and increased weight gain (Landefeld et al, 2002). Table 19 shows an example of how this can translate into economic gains for producers. In addition, keeping cattle in clean, dry areas has been shown to reduce the occurrence of mastitis and foot rot. The VCE (1998) reports that mastitis costs producers $100 per cow in reduced quantity and quality of milk produced. Installation of streamside fencing and well managed loafing areas will reduce the amount of time that cattle have access to these areas. Implementing a prescribed grazing management strategy in conjunction with a providing livestock with a clean water source will also provide economic benefits for the producer. Standing forage utilized directly by the grazing animal is less costly and of higher quality than forage harvested with equipment and fed to the animal.

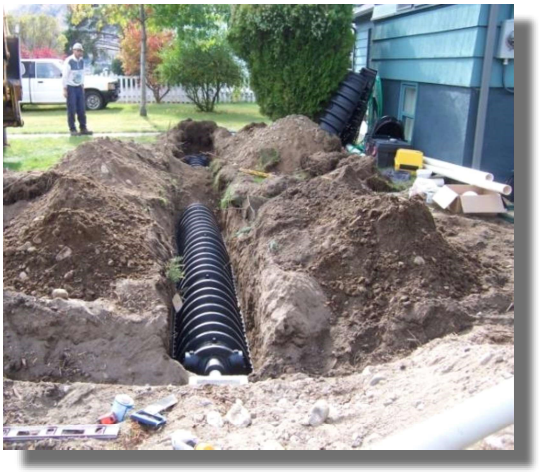
Table 19. Example of increased revenue due to installing off-stream waterers (Surber et al., 2005)

Typical calf sale weight	Additional weight gain due to off-stream waterer	Price	Increased revenue due to off-stream waterer
500 lb./calf	5% or 25 lb.	$0.60 per lb.	$15 per calf

Note: Table from Zeckoski et al. (2007)

Benefits: Residential Practices

The residential program will play an important role in improving water quality since human waste can carry human viruses in addition to bacterial and protozoan pathogens. In terms of economic benefits to homeowners, an improved understanding of on-site sewage treatment systems, including knowledge of what steps can be taken to keep them functioning properly, will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The average septic system will last 20 to 25 years if properly maintained. Proper maintenance includes: knowing the location of the system components and protecting them (e.g., not driving or parking on top of them), not planting trees where roots could damage the system, keeping hazardous chemicals out of the system, and pumping out the septic tank every 3 to 5 years. The cost of proper maintenance, as outlined here, is relatively inexpensive ($300 per pump-out) in comparison to repairing or replacing a system ($5,000 to $15,000).



Benefits: Urban Stormwater Practices

Opportunities for enhanced stormwater management have been identified in the Chestnut Creek watershed. The primary benefits of stormwater management practices to private property owners include flood mitigation and improved water quality. In addition, urban BMPs have a number of

economic benefits to localities. Increased retention of stormwater on site can lower peak discharges, thereby reducing the drainage infrastructure needed to prevent flooding. This can result in cost savings to local governments through reduced engineering and land acquisition costs, and reduced materials and installation costs for stormwater culverts and streambank armoring to prevent scour. Stormwater infrastructure that keeps stormwater runoff on site can reduce losses from flood damage by $6,700-$9,700 per acre (Medina et al, 2011.) Lastly, implementation of urban BMPs greatly reduces soil erosion and sediment transport to our rivers, streams and lakes. A 1993 study of the economic cost of erosion-related pollution showed that national off-site damages from urban sediment sources cost between $192 million and $2.2 billion per year in 1990 dollar values (Paterson et al, 1993). This cost range would be far greater today if adjusted for inflation.

Benefits: Watershed Health

Focusing on reducing bacteria and sediment in Chestnut Creek will have associated watershed health benefits. Reductions in streambank erosion, excessive nutrient runoff, and water temperature are additional benefits associated with streamside buffer plantings. In turn, reduced nutrient loading and erosion and cooler water temperatures improves habitat for fisheries, which provides benefits to anglers and the local economy. Riparian buffers can also improve habitat for wildlife such as ground-nesting quail and other sensitive species. Data collected from Breeding Bird Surveys in Virginia indicate that the quail population declined 4.2% annually between 1966 and 2007. Habitat loss has been cited as the primary cause of this decline. As a result, Virginia has experienced significant reductions in economic input to rural communities from quail hunting. The direct economic contribution of quail hunters to the Virginia economy was estimated at nearly $26 million in 1991, with the total economic impact approaching $50 million. Between 1991 and 2004, the total loss to the Virginia economy was more than $23 million from declining quail hunter expenditures (VDGIF, 2009). Funding is available to assist landowners in quail habitat restoration (see Funding Sources section).

Benefits: Community Economic Vitality

Once the IP is complete, organizations in the watershed will be eligible to apply for competitive funding to help cover some of the costs associated with installing the BMPs. These potential funds along with matching funds from other sources will benefit many local contractors involved in the repair and installation of septic systems, building of fencing systems, and installation of stormwater structures. In a 2009 study, researchers estimated that every $1 million invested in environmental efforts such as reforestation, land and watershed restoration, and sustainable forest management, would create approximately 39 jobs (Heintz et al, 2009).

Measurable Goals and Milestones

The end goal of implementation is restored water quality in Chestnut Creek. It is expected that this will occur over a 20-year period.

Two types of milestones will be used to evaluate progress over a 20 year period: *implementation milestones* and *water quality milestones*. The implementation milestones establish goals for the extent of the different best management practices installed within certain time frames, while the water quality milestones establish the corresponding goals for improvements in water quality.

The proposed timeline for achieving restored water quality in Chestnut Creek has been divided into two stages with each stage spanning a period of ten years. This staged approach will concentrate efforts and finances on the most cost-efficient control measures with the most interest from stakeholders first. For example, the TMDL study indicated that over 75% of the total estimated bacteria and sediment loads in Chestnut Creek are from agricultural sources. Concentrating resources on livestock exclusion fencing systems and pasture management practices within the first several years may provide the highest return on water quality improvement with the least cost to landowners.

The focus of this plan is to remove Chestnut Creek from Virginia's impaired waters list. Based on input from the working group regarding BMP adoption rates, it is estimated that it would take a total of 20 years to implement the BMPs needed to achieve this goal. The overall timeline for implementation has been divided into two stages: Years 1-10 and Years 11-20. Implementation of practices included in Stage 1 is expected to result in full support of the aquatic life use standard in Chestnut Creek. Stage 2 goals will result in Chestnut Creek being removed from the impaired water list due to fecal bacteria. Tables 20 and 21 show the water quality improvement goals, and costs in each implementation stage. Table 22 shows the implementation milestones in two-year increments for each stage.

Greater reductions in non-point source pollution would be needed in order to achieve the final TMDL with 0% violations of both the single sample and geometric mean *E. coli* standards. However, this would require a 98% reduction from all non-point source loads from agricultural and residential areas. Therefore, this implementation plan focuses on the practices in which

anthropogenic sources of bacteria are addressed to the maximum extent practicable to remove Chestnut Creek from the impaired waters list.

Table 20. Practices needed to meet the bacteria and sediment milestones in Stage 1.

BMP Type	BMP	Units	Extent	Cost
Direct Deposition	Livestock Exclusion with Riparian Buffers	system	154	$3,875,000
	Livestock Exclusion with Reduced Setback	system	39	$780,000
	Stream Protection System	system	7	$70,000
Pasture	Improved Pasture Management	acres	11,615	$871,125
	Reforestation of Erodible Pasture	acres	291	$34,920
	Permanent Vegetative Cover on Critical Areas	acres	95	$190,000
	Loafing Lot Management	system	-	-
	Animal Waste Control Facility	system	-	-
	Water Control Structures	acres-treated	-	-
Cropland	Continuous No-till	acres	8	$160
	Harvestable Cover Crop	acres	14	$350
	Small Grain Cover Crop	acres	192	$4,800
	Permanent Vegetative Cover on Cropland	acres	2	$350
Streambank Stabilization	Streambank Stabilization	feet	1,985	$595,500
Pet Waste	Pet Waste Education Program	program	1	$4,000
	Pet Waste Stations	system	3	$22,500
Septic	Septic Tank Pump-out	system	105	$31,500
	Connection to Public Sewer	system	2	$10,000
	Septic Tank System Repair	system	192	$672,000
	Septic Tank System Installation/Replacement	system	259	$1,295,000
	Alternative On-site Waste Treatment System	system	28	$420,000
Urban Stormwater	Rain Gardens	acres-treated	18	$90,000
	Riparian Buffer	acres-installed	4.5	$2,250
	Extended Detention	acres-treated	-	-
	Manufactured BMPs	acres-treated	-	-
	Infiltration	acres-treated	-	-
	Vegetated Open Channels	acres-treated	-	-
Average annual *E. coli* load (cfu/yr) (Existing = 8.25 x 10^{15} cfu/yr)			**1.74 x 10^{14}**	
% Violation of Single Sample *E. coli* standard (235 cfu/100mL) (Existing = 24%)			**20.40**	
% Violation of Geometric mean *E. coli* standard (126 cfu/100mL) (Existing = 81%)			**29.6**	
Average annual sediment load (T/yr) (Existing = 9,167) (TMDL goal = 6,618)			**6,617**	
% Reduction in sediment load (TMDL goal = 28%)			**28**	
Total Cost for Stage 1 (including Technical Assistance)			**$9,855,955**	

Table 21. Practices needed to meet the bacteria and sediment milestones in Stage 2.

BMP Type	BMP	Units	Extent	Cost
Direct Deposition	Livestock Exclusion with Riparian Buffers	system	-	-
	Livestock Exclusion with Reduced Setback	system	-	-
	Stream Protection System	system	-	-
Pasture	Improved Pasture Management	acres	-	-
	Reforestation of Erodible Pasture	acres	1,510	$181,200
	Permanent Vegetative Cover on Critical Areas	acres	-	-
	Loafing Lot Management	system	3	$60,000
	Animal Waste Control Facility	system	1	$150,000
	Water Control Structures	acres-treated	7,233	$1,012,620
Cropland	Continuous No-till	acres	-	-
	Harvestable Cover Crop	acres	-	-
	Small Grain Cover Crop	acres	-	-
	Permanent Vegetative Cover on Cropland	acres	-	-
Streambank Stabilization	Streambank stabilization	feet	-	-
Pet Waste	Pet Waste Education Program	program	-	-
	Pet Waste Stations	system	-	-
Septic	Septic Tank Pump-out	system	-	-
	Connection to Public Sewer	system	-	-
	Septic Tank System Repair	system	448	$1,568,000
	Septic Tank System Installation/Replacement	system	404	$2,020,000
	Alternative On-site Waste Treatment System	system	44	$660,000
Urban Stormwater	Rain Gardens	acres-treated	-	-
	Riparian Buffer	acres-installed	-	-
	Extended Detention	acres-treated	-	-
	Manufactured BMPs	acres-treated	-	-
	Infiltration	acres-treated	-	-
	Vegetated Open Channels	acres-treated	-	-
Average annual *E. coli* load (cfu/yr)			**6.47×10^{13}**	
% Violation of Single Sample *E. coli* standard (235 cfu/100mL)			**10.34**	
% Violation of Geometric mean *E. coli* standard (126 cfu/100mL)			**0**	
Average annual sediment load (T/yr) (TMDL goal = 6,618)			**3,732**	
% Reduction in sediment load (TMDL goal = 28%)			**59**	
Total Cost for Stage 2 (including Technical Assistance)			**$6,551,820**	

Table 22. Implementation milestones at two-year increments.

Control Measure	Units	Stage 1					Stage 2				
		Yrs 1-2	Yrs 3-4	Yrs 5-6	Yrs 7-8	Yrs 9-10	Yrs 11-12	Yrs 13-14	Yrs 15-16	Yrs 17-18	Yrs 19-20
Livestock Exclusion with Riparian Buffers	system	42	31	31	26	24	-	-	-	-	-
Livestock Exclusion with Reduced Setback	system	6	6	9	9	9	-	-	-	-	-
Stream Protection System	system	3	1	1	1	1	-	-	-	-	-
Grazing Land Management System	acres	4,000	3,000	1,800	1,800	1,015	-	-	-	-	-
Reforestation of Erodible Pasture	acres	60	60	60	60	51	80	80	80	500	670
Permanent Vegetative Cover on Critical Areas	acres	20	20	20	20	15	20	20	20	20	20
Continuous No-till	acres	5	3	-	-	-	-	-	-	-	-
Cover Crop	acres	50	40	40	40	36	-	-	-	-	-
Permanent Vegetative Cover on Cropland	acres	0.4	0.4	0.4	0.4	0.4	-	-	-	-	-
Loafing Lot Management	system	-	-	-	-	-	1	1	1	-	-
Waste Storage Facility (beef)	system	-	-	-	-	-	-	-	-	1	-
Water Retention Structures	acres-treated	-	-	-	-	-	1,100	1,100	1,100	1,900	2,033
Streambank Stabilization	linear feet	397	397	397	397	397	-	-	-	-	-
Septic Tank Pump-out	system	21	21	21	21	21	-	-	-	-	-
Connection to Public Sewer	system	1	1	-	-	-					
Septic Tank System Repair	system	39	39	38	38	38	90	90	90	89	89
Septic Tank System Installation/Replacement	system	52	52	52	52	51	81	81	81	81	80
Alternative On-site Waste Treatment System	system	6	6	6	5	5	9	9	9	9	8
Pet Waste Education Program	number	---------- 1 ----------					-	-	-	-	-
Pet Waste Stations	number	3	-	-	-	-	-	-	-	-	-
Rain Gardens	acres-treated	4	4	4	3	3	-	-	-	-	-
Urban Riparian Buffers	acres-treated	1	1	1	1	0.5	-	-	-	-	-

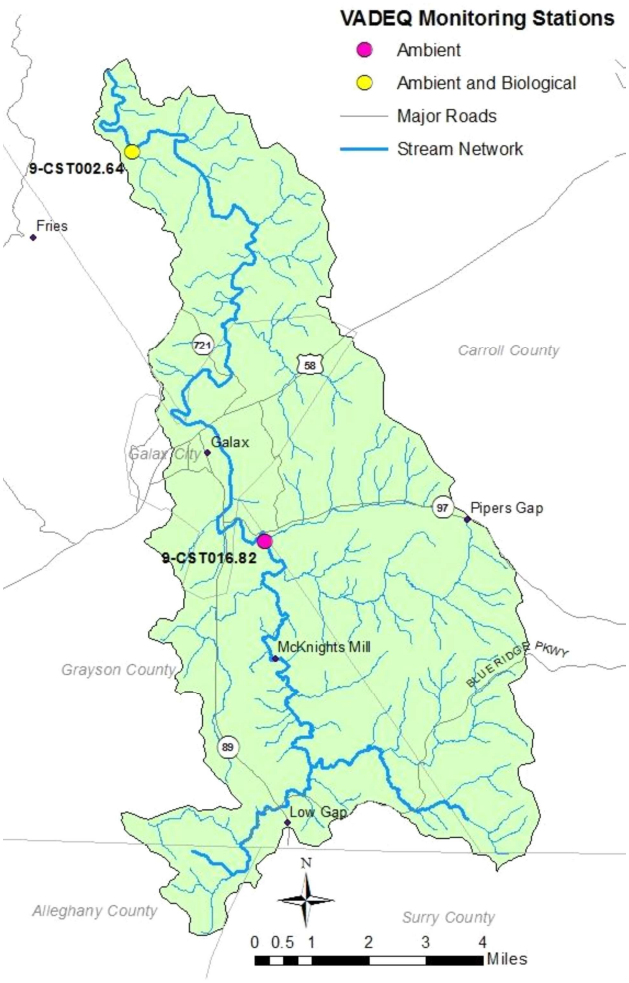


Figure 3. VADEQ monitoring stations.

Implementation monitoring will help evaluate the effectiveness of implemented BMPs and progress toward the water quality milestones listed in this plan. VADEQ will begin ambient monitoring no sooner than the second odd numbered calendar year following the initiation of TMDL implementation efforts. This will allow for the water quality improvements to be detectable following the application of BMPs. At a minimum, the frequency of sample collections will be every other month for two years. After two years of bi-monthly ambient monitoring an assessment will be made to determine if the segments are no longer impaired. VADEQ will focus its monitoring resources on the stations shown in Figure 3 and described in Table 23. In addition to the ambient monitoring, biological monitoring will be conducted at station 9-CST002.64 in the fall and spring of each year.

Table 23. VADEQ monitoring stations in the Chestnut Creek watershed.

VADEQ Station ID	Station Type	Description
9-CST002.64	Ambient, Biological	Bridge # 6002 on Rt. 793 off Rt. 607, off Rt. 721
9-CST016.82	Ambient	Private Bridge off Rt. 608, off Rt. 97

Additional monitoring beyond what VADEQ can provide with its limited resources may be conducted in Chestnut Creek. Citizen monitoring is a useful tool for measuring improvements in water quality. These efforts are encouraged and stakeholders should work together to distribute monitoring resources throughout the watershed to best capture implementation needs and progress. The New River Conservancy's citizen science program is one source that offers support for citizen monitoring efforts. Virginia Save Our Streams is a program of the Izaak Walton League of America that trains individuals in biological monitoring methods.

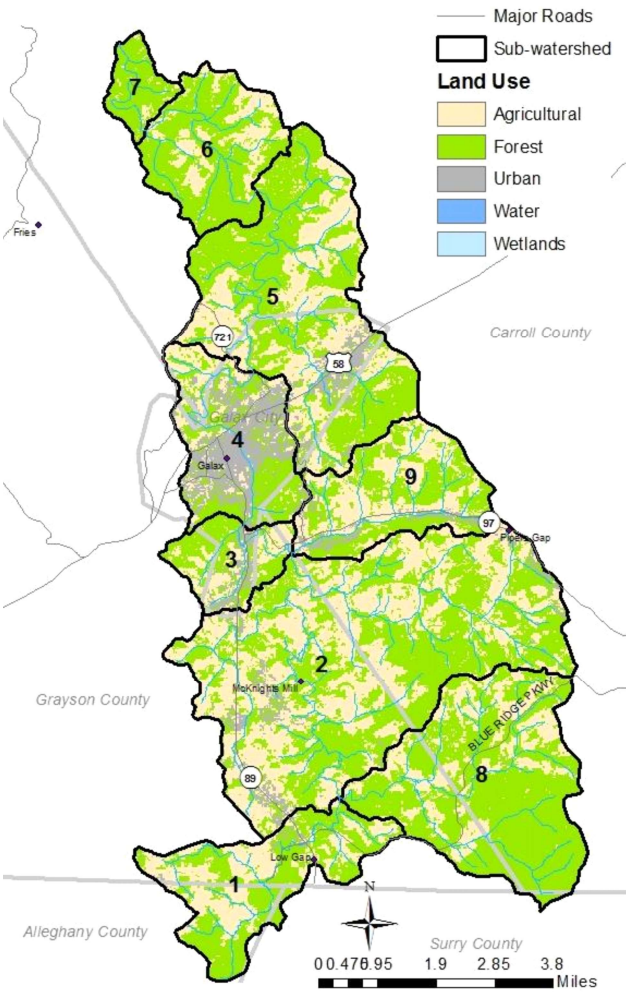


Figure 4. Delineated sub-watersheds in the Chestnut Creek watershed.

Staged implementation implies the process of targeting BMPs to get the "most bang for the buck" in the watershed. Targeting different BMPs across the stages optimizes the use of limited resources by focusing on the most cost-efficient practices and those that present the least obstacles (acceptance by landowners, available cost-share, etc.). For example, stream exclusion practices (SL-6, SL-6T, LE-1T, LE-2T, and WP-2T) are considered 100% effective at removing bacteria entering the stream through direct deposition by livestock. Thus, the stream exclusion systems needed to protect perennial streams have been prioritized in Stage 1. Targeting of critical areas for livestock exclusion fencing was accomplished through analysis of livestock bacteria loads and the estimated fencing requirements for each sub-watershed. An effort should be made to prioritize financial and technical resources for livestock exclusion fencing in sub-watershed 2, followed by sub-watersheds 5 and 8 (Figure 4). Sub-watersheds 4, 6, and 7 have the lowest priority since they have the least pasture area next to streams.

Similarly, practices that reduce bacteria from residential septic systems and straight pipes are also considered 100% efficient. The cost of these practices can often be offset by the procurement of grant funding, making them even more popular with local residents who directly benefit from maintaining or fixing their systems. Watershed inventory and modeling efforts suggest prioritizing sub-watershed 2, followed by sub-watersheds 1 and 5, to reduce bacteria loads from failing systems and straight pipes. Because sub-watersheds 6, 7, and 8 have very little residential area, they have the lowest priority.

Additional targeting for education and outreach efforts could be refined through GIS analysis. One option may be to utilize the Conservation Prioritization Project developed by the New River Land Trust (NRLT). Using ESRI's ArcGIS ModelBuilder, NRLT could identify key properties within the watershed based on characteristics such as location, presence of active agricultural production, size, erodibility of soils, slope, etc. Their model is based on a similar study done in South Carolina's Catawba River Basin which used GIS analysis to target education and outreach efforts

to specific types of properties. During development of the Crab Creek TMDL Implementation Plan (VADEQ, 2014), NRLT estimated the cost of such an effort, including staff time and actual outreach materials, to be around $9,300. This cost estimate is not included in the overall IP cost.

Table 24 lists the order of priorities by source category for Chestnut Creek watershed for each stage of implementation. For example, in Stage 1, addressing the human sources of bacteria has a higher priority over other sources in the Residential category, while livestock exclusion has a higher priority in addressing the bacteria and sediment sources in the Agricultural category. Factors used to develop BMP priorities were human and livestock health risks, effectiveness of practice, stakeholder interest, costs, and ease of installation. The distribution of implementation milestones listed in Table 22 correspond with these priorities.

Table 24. Priorities for implementation efforts in the Chestnut Creek watershed.

Stage 1 Priorities	Stage 2 Priorities
Residential • Straight pipes • Failing septic systems • Urban/residential stormwater • Pet waste **Agricultural** • Livestock exclusion systems • Grazing land management • Permanent vegetative cover on critical areas • Reforestation of erodible pasture • Continuous no-till • Cover crops **Stream Restoration** • Streambank stabilization **Other** • Agricultural and residential technical assistance • Outreach and education	**Residential** • Failing septic systems **Agricultural** • Loafing lot management • Permanent vegetative cover on critical areas • Reforestation of erodible pasture • Animal waste storage facility • Water control structures **Other** • Agricultural and residential technical assistance • Outreach and education

Partners and Their Role in Implementation

Agricultural Landowners

SWCD and NRCS conservation staff often consider characteristics of farms and farmers in the watersheds that will affect the decisions farmers make when it comes to implementing conservation practices. For example, the average size of farms is an important factor to consider, since it affects how much cropland or pasture a farmer can give up for a riparian buffer. The age of a farmer may also influence their decision to implement best management practices. Table 25 provides a summary of relevant characteristics of farms and producers in Carroll and Grayson Counties from the 2012 Agricultural Census. These characteristics were considered when developing implementation scenarios, and should be utilized to develop suitable education and outreach strategies.

Table 25. Characteristics of farms and farmers in Carroll and Grayson Counties.

Characteristic		Carroll	Grayson
Number of farms		980	764
Land in farms (acres): full owners		43,639	46,718
Land in farms (acres): part owners	Rented land in farms	49,718	45,644
	Owned land in farms	43,128	35,024
Tenants		44	42
Operators identifying farming as their primary occupation		384	338
Operators identifying something other than farming as their primary occupation		596	426
Average age of primary operator		58.3	58.9
Average size of farm (acres)		143	173
Average value of farmland ($/acre)		$3,406	$4,195
Average net cash farm income of operation ($)		$3,146	$3,762
Average farm production expenses ($)		$43,021	$39,928
Farms with internet access		590	446

Residential Landowners

In addition to local farmers, participation from homeowners is also critical to the success of this plan. Residential property owners will need to ensure that their septic systems are regularly pumped and inspected (every 3-5 years). Though the amount of bacteria that is coming from failing septic systems and straight pipes is minimal compared to livestock, human waste needs to be

removed since it carries with it pathogens that can cause health problems above and beyond those associated with livestock manure. Residential property owners can also improve water quality by eliminating pet waste runoff from yards and implementing practices, such as rain gardens and riparian buffers, to reduce stormwater carrying bacteria and sediment to Chestnut Creek.

Carroll and Grayson Counties, City of Galax

Decisions made by local governments regarding land use will play an important role in the implementation of this plan. This makes the Grayson and Carroll County Boards of Supervisors, the Galax City Council, and the three jurisdictional Planning Commissions key partners in long term implementation efforts. Currently, both counties have land use policies in place that support the preservation of agricultural land and encourage good stewardship of natural resources. Local government support of land conservation will become increasingly important as greater numbers of conservation measures are implemented across the watersheds. Ensuring the protection of land in agriculture and forest will allow the practices installed to continue to benefit water quality. The City of Galax Public Works Department is another key local government partner with respect to identifying opportunities to connect homes with failing septic systems to public sewer.

New River Conservancy

The New River Conservancy works with landowners and citizens to conserve critical lands, restore riparian areas, and advocate for the protection of the New River throughout its multi-state watershed.

Mount Rogers Planning District Commission

The Mount Rogers Planning District serves the local governments in the counties of Bland, Carroll, Grayson, Smyth, Washington, and Wythe and the Cities of Bristol and Galax and their citizenry by providing a number of different services ranging from economic development to transportation planning. The purpose of the planning district commission is to promote regional cooperation, to coordinate the activities and policies of member local governments, and to provide planning assistance to local governments. The commission is financed by a combination of local, state, and federal funds. The commission could serve as a grant project partner and/or manager during implementation.

New River SWCD and NRCS

During project implementation, the New River Soil and Water Conservation District and the local NRCS office should continue and if possible expand outreach efforts in Chestnut Creek to both agricultural producers and community members. These organizations will be the primary technical and financial resource for implementing the agricultural practices in this plan. Their responsibilities include promoting BMP funding and benefits and assisting with BMP development on individual properties. Outreach activities should specifically encourage participation of Chestnut Creek farmers in the BMPs outlined in this plan to reduce bacteria and

sediment loads. Outreach activities may include mailing newsletters, planning field days, and giving presentations. The New River SWCD works throughout the counties of Grayson and Carroll and the city of Galax. It is recommended that a technician be hired and devoted at least part-time to water quality efforts in the Chestnut Creek watershed.

Virginia Department of Environmental Quality

The Virginia Department of Environmental Quality has a lead role in the development of TMDL implementation plans. VADEQ also provides available grant funding and technical support for TMDL implementation. VADEQ will work closely with project partners including the New River Soil and Water Conservation District to track implementation progress for best management practices. In addition, VADEQ will work with interested partners on grant proposals to generate funds for projects included in the implementation plan. When needed, VADEQ will facilitate additional meetings of the steering committee to discuss implementation progress and make necessary adjustments to the implementation plan. VADEQ staff can also provide support with education and outreach related to water quality.

VADEQ is also responsible for monitoring state waters to determine compliance with water quality standards. VADEQ will continue monitoring water quality in Chestnut Creek and its tributaries in order to assess water quality and determine when restoration has been achieved and the streams can be removed from Virginia's impaired waters list.

Virginia Department of Conservation and Recreation

The Virginia Department of Conservation and Recreation (VADCR) will work closely with project partners including the New River Soil and Water Conservation District to track implementation progress and provide cost share for agricultural best management practices through the Virginia Agricultural Cost Share Program. In addition, VADCR will provide support to improve the implementation process through utilization of existing authorities and resources.

Virginia Department of Health

The Virginia Department of Health (VDH) is responsible for adopting and implementing regulations for onsite wastewater treatment and disposal. The Sewage Handling and Disposal Regulations require homeowners to secure permits for handling and disposal of sewage (e.g. repairing a failing septic system or installing a new treatment system). VDH staff provide technical assistance to homeowners with septic system maintenance and installation, and respond to complaints regarding failing septic systems and straight pipes.

Other Potential Partners

There are numerous additional opportunities for future partnerships in the implementation of this plan and the partnership noted above. Additional potential partners in implementation include:

- County and city schools
- Master Gardeners of the Blue Ridge
- New River-Highlands RC&D
- New River Land Trust
- Trout Unlimited
- Virginia Cooperative Extension (VCE)
- Virginia Department of Forestry
- Virginia Department of Game and Inland Fisheries
- Virginia Farm Bureau
- Virginia Outdoors Foundation
- Virginia Save Our Streams

Integration with Other Watershed Plans

Like most watersheds in Virginia, water quality in the Chestnut Creek watershed is a component of many different organizations, programs and activities. Such efforts include, but are not limited to, watershed implementation plans, TMDLs, Roundtables, Water Quality Management Plans, Erosion and Sediment Control Regulations, Stormwater Management Programs, Source Water Protection Plans, local comprehensive and strategic plans, and local environmentally-focused organizations. These efforts should be evaluated to determine their potential impacts on the implementation goals outlined in this clean-up plan. Often, these efforts are related or collaborative, but this is not always the case. Coordination of local programs can increase participation and prevent redundancy.

Potential Funding Sources

This list of potential funding resources is a compilation of sources from other Virginia Implementation Plans as well as ideas from local stakeholders. Detailed descriptions of the agricultural cost-share programs can be obtained from the New River SWCD, VA Department of Conservation and Recreation, Natural Resources Conservation Service and the Virginia Cooperative Extension.

Federal

Federal Clean Water Act Section 319 Incremental Funds

Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds to implement the nonpoint source programs. VADEQ reports annually to the EPA on the progress made in nonpoint source pollution prevention and control. Stakeholder organizations can apply annually, on a competitive basis, for 319 grants to implement BMPs and educational components included in a TMDL IP.

USDA – Farm Service Agency

Conservation Reserve Program (CRP)

Through this program, cost-share assistance is available to establish cover of trees or herbaceous vegetation on cropland. Offers for the program are ranked, accepted and processed during fixed signup periods that are announced by the FSA. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years and 2) cropland is classified as "highly-erodible" by NRCS. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing USDA CRP Continuous Sign-up. It has been "enhanced" by increasing the cost-share rates from 50% to 75% and 100%, increasing the rental rates, and offering a flat rate incentive payment to place a permanent "riparian easement" on the enrolled area. Pasture and cropland (as defined by USDA) adjacent to streams, intermittent streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Cost-sharing (75% - 100%) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. In addition, a 40% incentive payment upon completion is offered and an average rental rate of $70/acre on stream

buffer area for 10-15 years. The State of Virginia will make an additional incentive payment to place a perpetual conservation easement on the enrolled area. Landowners can obtain and complete CREP application forms at their local FSA center.

USDA - NRCS

Conservation Stewardship Program

The Conservation Stewardship Program (CSP) is a voluntary program that encourages agricultural and forestry producers to address resource concerns by (1) undertaking additional conservation activities and (2) improving and maintaining existing conservation systems. CSP provides financial and technical assistance to help land stewards conserve and enhance soil, water, air, and related natural resources on their land. CSP is available to all producers, regardless of operation size or crops produced. Eligible lands include cropland, grassland, prairie land, improved pastureland, rangeland, nonindustrial private forest land, and agricultural land. NRCS makes CSP available on a nationwide basis through continuous sign-up, with announced cut-off dates for ranking and funding applications. CSP pays participants for conservation performance—the higher the performance, the higher the payment. It provides two possible types of payments. An annual payment is available for installing new conservation activities and maintaining existing practices. A supplemental payment is available to participants who also adopt a resource conserving crop rotation.

Environmental Quality Incentives Program (EQIP)

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

Agricultural Conservation Easement Program (ACEP)

The 2014 Farm Bill authorized $1 billion in funding for the new Agricultural Conservation Easement Program (ACEP), which consolidates the former Farm and Ranch Lands Protection Program (FRPP), Grassland Reserve Program (GRP) and Wetlands Reserve Program (WRP) into

a single program. This program will provide grants to purchase conservation easements that permanently restrict development on important farmland and reward landowners who participate in the program with permanent tax breaks.

United States Fish and Wildlife Service

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

State

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state and federal monies through local Soil and Water Conservation Districts (SWCDs). SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control transportation of pollutants into our waters due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Program participants are recruited by SWCDs based upon those factors, which have a great impact on water quality. Cost-share is typically 75% of the actual cost, not to exceed the local maximum.

Virginia Agricultural Best Management Practices Loan Program

The purpose of the Virginia Land Conservation Loan Program is to provide a long term source of low interest financing for the conservation of land in Virginia in order to improve and/or protect the water resources of the Commonwealth. Additional benefits of the program include the protection of open space or natural values of the properties and/or the assurance of the availability of the land for agricultural, forest, recreation, or open space use. Although these other benefits are of value, the principle focus and utilization of the Fund is on beneficial impact to water quality.

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

Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. Any practice approved by the local

SWCD Board must be completed within the taxable year in which the credit is claimed. The credit is only allowed for expenditures made by the taxpayer from funds of his/her own sources. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. If the amount of the credit exceeds the taxpayer's liability for such taxable year, the excess may be carried over for credit against income taxes in the next five taxable years until the total amount of the tax credit has been taken. This program can be used independently or in conjunction with other cost-share programs on the stakeholder's portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing.

Virginia Clean Water Revolving Loan Fund

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

Virginia Department of Environmental Quality Citizen Water Monitoring Grant Program

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

Virginia Forest Stewardship Program

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

their land in a productive and healthy condition. The planning assistance offered through the Forest Stewardship Program may also provide landowners with enhanced access to other USDA conservation programs and/or forest certification programs.

Private nonindustrial forest lands that are managed under existing Federal, State, or private sector financial and technical assistance programs are eligible for assistance under the Forest Stewardship Program. Forest resource management activities on such forest lands must meet, or be expanded or enhanced to meet the requirements of the Forest Stewardship Program. Participation in the Forest Stewardship Program is voluntary. To enter the program, landowners agree to manage their property according to an approved Forest Stewardship Management Plan. Landowners also understand that they may be asked to participate in future management outcome monitoring activities.

Virginia Outdoors Foundation (VOF)

Conservation easements are voluntary agreements that allow individuals or groups to limit the type or amount of development on their property. Easements typically describe the resource they are designed to protect (e.g., agricultural, forest, historic, or open space). Conservation easements may indirectly contribute to water quality protection due to the restrictions on future development. The Virginia Outdoors Foundation is the state's largest holder of conservation easements. While their easements do not require riparian buffers, they do strongly encourage them along all streams, rivers, or other significant water resources on a conserved property. A gift of a permanent open-space easement may qualify as a charitable gift and be eligible for certain state and federal tax benefits. In addition, there may be local property tax reductions and federal estate tax exemptions. VOF also administers the *Open Space Lands Preservation Trust Fund*, which assists landowners with the costs of conveying open-space easements and purchases all or part of the value of easements. Priority for funding is given to applications on family farms and for those with demonstrated financial need.

Virginia Small Business Environmental Assistance Fund Loan Program

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

action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Stormwater Assistance Fund (SLAF)

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

Virginia Water Quality Improvement Fund (WQIF)

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point sources and nonpoint sources are administered through VADEQ. Most WQIF grants provide matching funds on a 50/50 cost-share basis.

Regional and Private Sources

Community Development Block Grants (CDBG)

The Community Development Block Grant (CDBG) program is a flexible program that provides communities with resources to address a wide range of unique community development needs. Over a 1, 2, or 3-year period, as selected by the grantee, not less than 70 percent of CDBG funds must be used for activities that benefit low- and moderate-income persons. In addition, each activity must meet one of the following national objectives for the program: benefit low- and moderate-income persons, prevention or elimination of slums or blight, or address community development needs having a particular urgency because existing conditions pose a serious and immediate threat to the health or welfare of the community for which other funding is not available.

Five Star and Urban Waters Restoration Grant Program

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

Funding priorities for this program include:

- On-the-ground wetland, riparian, in-stream and/or coastal habitat restoration
- Meaningful education and training activities, either through community outreach, participation and/or integration with K-12 environmental curriculum
- Measurable ecological, educational and community benefits
- Partnerships: Five Star projects should engage a diverse group of community partners to achieve ecological and educational outcomes

Norcross Wildlife Foundation

The Norcross Wildlife Sanctuary in Monson, Massachusetts was founded in 1939 by Arthur Norcross and the Norcross Wildlife Foundation was founded in 1964 after his passing. The Foundation provides grants to environmental conservation NGOs primarily for the purchase of office and field equipment as well as publications and other educational materials that have a practical, immediate use. Grant requests may be up to $10,000, but awards generally average less than $5,000. Examples of funded projects include computers, cameras, GPS units, GIS software, data loggers, and water quality testing materials.

Southeast Rural Community Assistance Project (SERCAP)

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

Virginia Environmental Endowment

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

Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources such as wetlands, streams and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture that provides compensation for aquatic resources in financially and environmentally preferable ways. Not every site or property is suitable for mitigation banking. Mitigation banks are required to be protected in perpetuity, to provide financial assurances and long term stewardship. The mitigation banking process is overseen by an Inter-Agency Review Team made up of state and federal agencies and chaired by VADEQ and Army Corps of Engineers.

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Glossary

Alternative Waste Treatment Systems - on-site technologies for treating domestic sewage where conventional means (public sewer or septic tank with drainfield) are not available; generally, the alternative systems will be more expensive than conventional septic systems and the operation of alternative systems in Virginia requires an annual inspection and maintenance contract

Benthic macroinvertebrates "benthos"– small animals without backbones that live on the rocks, logs, sediment and aquatic plants at the bottom of a waterbody during a period in their life

Best Management Practices (BMPs) - those methods or techniques determined to be the most efficient, practical, and cost-effective measures identified to guide a particular activity or to address a particular problem, as in this case, the reduction or control of water pollutant(s)

Clean Water Act – passed in 1972, this is the primary federal law in the United States regulating water pollution. The CWA established the goals of eliminating releases of high amounts of toxic substances into water, eliminating additional water pollution by 1985, and ensuring that surface waters would meet standards necessary for human recreation by 1983.

Continuous No-Till – a crop planting and management practice in which soil disturbance by plows, disk or other tillage equipment is eliminated; in most cases, large amounts of crop residue are left on the surface to protect the soil from storm events.

Cover Crop - a crop such as grasses, legumes, or small grains planted primarily to manage soil fertility, soil quality, water, weeds, pests, diseases, biodiversity and wildlife on agricultural fields

Designated uses – a function of, or activity in, a water that is supported by a level of water quality and specified in state or tribal water quality standards regulations for each water body or segment (whether or not they are currently being attained

Ecosystem services – the benefits humans obtain from functioning ecosystems

EPA - The United States Environmental Protection Agency (EPA or sometimes USEPA) is an agency of the U.S. federal government which was created for the purpose of protecting human health and the environment by writing and enforcing regulations based on laws passed by Congress.

***E. coli* (*Escherichia coli*)** – a bacterium commonly found in the intestines of warm-blooded organisms of which some strains can cause serious gastrointestinal stress in humans

Fecal coliform – bacterium that live in the digestive tracks of warm-blooded animals, including humans, and are excreted in the feces; in water, can help indicate the potential presence of other harmful pathogens

General Standard – the general standard, as defined by Virginia state law 9 VAC 25-260-20, states: all state waters, including wetlands, shall be free from substances attributable to sewage, industrial waste, or other waste in concentrations, amounts, or combinations which contravene

established standards or interfere directly or indirectly with designated uses of such water or which are inimical or harmful to human, animal, plant, or aquatic life."

Low Impact Development (LID) - an approach to land development (or re-development) that works with nature to manage stormwater as close to its source as possible; LID employs principles such as preserving and recreating natural landscape features, minimizing effective imperviousness to create functional and appealing site drainage that treat stormwater as a resource rather than a waste product

Mastitis – inflammation of the mammary gland and udder tissue in dairy cows usually occurring as an immune response to bacterial invasion

Total Maximum Daily Load (TMDL) - a calculation of the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards and an allocation of that load among the various sources of that pollutant.

Virginia Stormwater BMP Clearinghouse - a web site administered by VADEQ and the Virginia Water Resources Research Center to serve several key purposes: disseminate the design standards and specifications of all stormwater best management practices (BMPs) approved for use in Virginia to control the quality and/or quantity of stormwater runoff, disseminate the results of Virginia's process to evaluate and certify the performance claims of manufactured/ proprietary BMPs approved for use in Virginia; and provide information and links to related websites to those who must comply with the Virginia Stormwater Management Law and Regulations.

Watershed – the area of land where all of the water that is under it or drains off of it goes into the same place