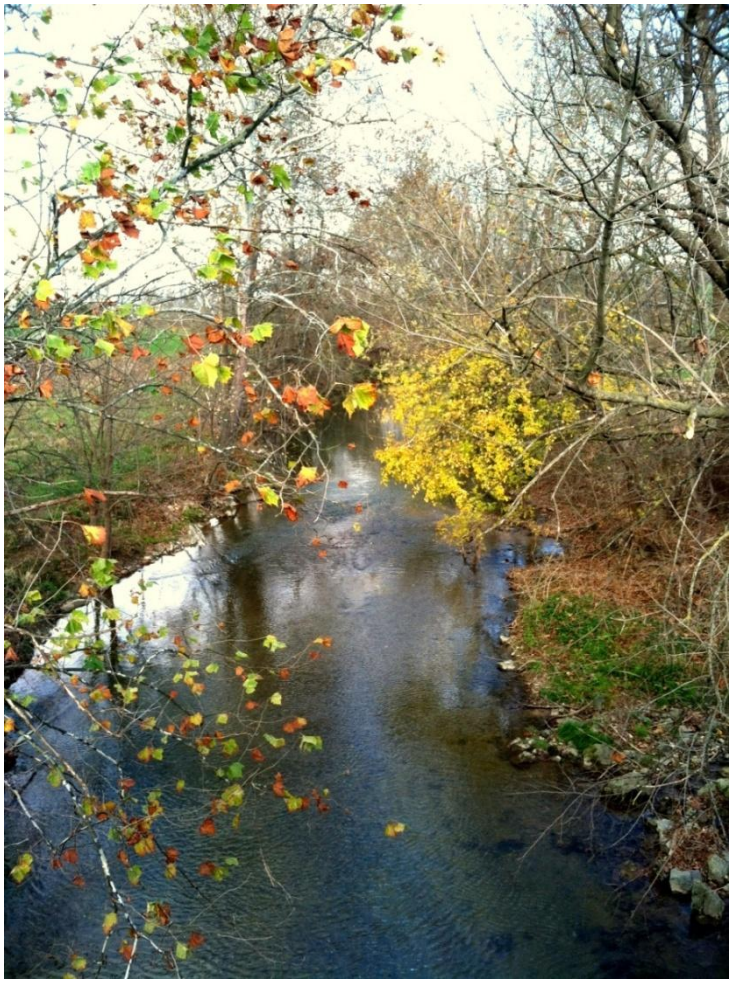
Linville Creek Watershed Implementation Plan:

A Plan to Reduce Bacteria and Sediment in the Linville Creek Watershed



Prepared for: Department of Environmental Quality

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THE LINVILLE CREEK WATERSHED PLAN: A SUMMARY

The Linville Creek watershed is located in Rockingham County, VA. A 13.49 mile segment of Linville Creek was first listed as impaired on Virginia's 1998 Section 303(d) TMDL Priority List and Report (VADEQ, 1998) due to water quality violations of both the bacteria standard (fecal coliform) and the general standard (listed as a benthic impairment which has been attributed to excess sediment in the stream). This impaired segment begins at the headwaters of Linville Creek and continues downstream to its confluence with the North Fork of the Shenandoah River. Linville Creek continues to exceed the state's bacteria standard (now based on the concentration of *E.coli* bacteria in the stream), though some slight improvements have been observed over the past 5 years (**Figure ES-1**). Linville Creek's biological community is on the rebound though. Biological monitoring conducted the Department of Environmental Quality indicates that Linville Creek is well on its way to removal from the state's impaired waters list. With just a little more work, Linville Creek's biological community could be restored!

A Total Maximum Daily Load (TMDL) study was completed for Linville Creek in March 2003, and was approved by EPA in September 2003. The study identified the bacteria reductions needed to meet the fecal coliform bacteria water quality standard. In addition, a stressor analysis was conducted as part of this study in order to determine the cause of the benthic impairment. Sediment was identified as the primary stressor of the benthic community in Linville Creek and a TMDL was developed for sediment.

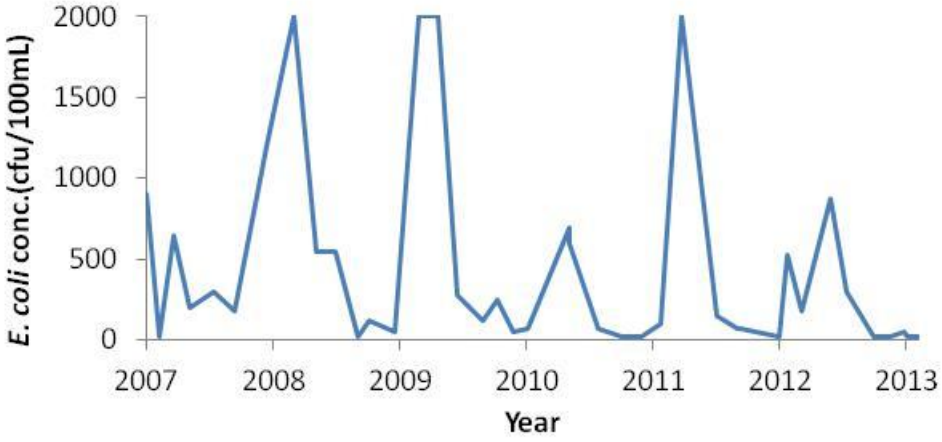


Figure ES-1 E.coli bacteria concentrations at the mouth of Linville Creek (785 Bridge) over the past 5 years.

Once TMDLs are developed, the next step is to develop a plan identifying how and when the pollutant reductions in the TMDL will be achieved. A TMDL implementation plan (IP) describes actions that can be taken by landowners in the watershed along with local government including the use of better treatment technologies and the installation of best management practices (BMPs) that will result in improved water quality in the stream.

Nonpoint sources of bacteria and sediment in the watershed were identified in the TMDL study, and are detailed in **Figures ES-2 and ES-3**.

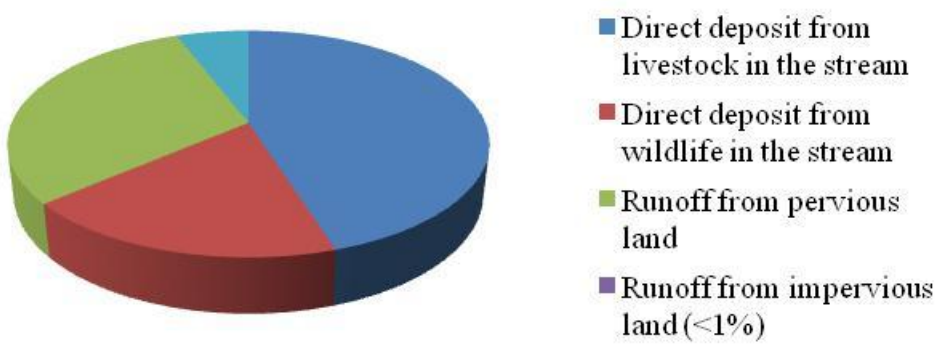


Figure ES-2 Nonpoint sources of bacteria in the Linville Creek watershed

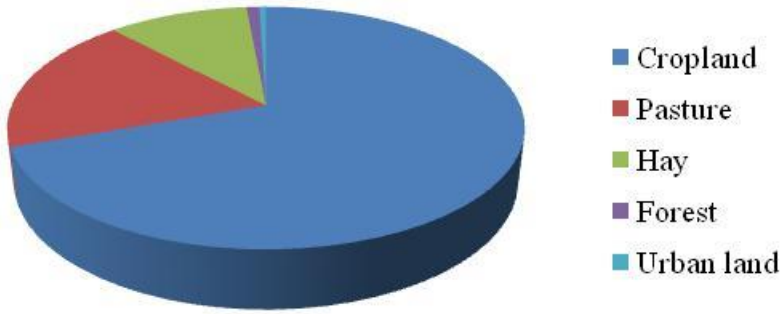


Figure ES-3 Nonpoint sources of sediment in the Linville Creek watershed

Implementation Actions

A series of implementation actions for urban, residential and agricultural land uses was compiled for this plan including BMPs and related education and outreach strategies. Input was collected from the community regarding the most appropriate actions for the Linville Creek watershed. This input was used to develop and refine a 3-stage implementation

scenario to improve water quality in Linville Creek. It is expected that this scenario will change as implementation efforts progress and more is learned about landowner needs with respect to BMPs and land use management. However, this scenario represents a good starting point for restoring water quality in Linville Creek.

Recommended residential septic implementation actions include:

- 131 repairs of failing septic systems
- 67 failing septic system replacements with conventional treatments systems
- 131 failing septic system replacements with alternative waste treatment systems
- 7 replacements of failing septic systems with connection to public sewer
- 300 septic tank pumpouts

Recommended urban/residential stormwater implementation actions include:

- 5 bioretention filters
- 8 rain gardens
- 15 acres of riparian buffers

Recommended pet waste implementation actions include:

- 4 neighborhood pet waste stations
- 49 residential pet waste composters
- 5 commercial pet waste composters (boarding facilities etc.)
- Implementation of a pet waste education program

Recommended agricultural implementation actions include:

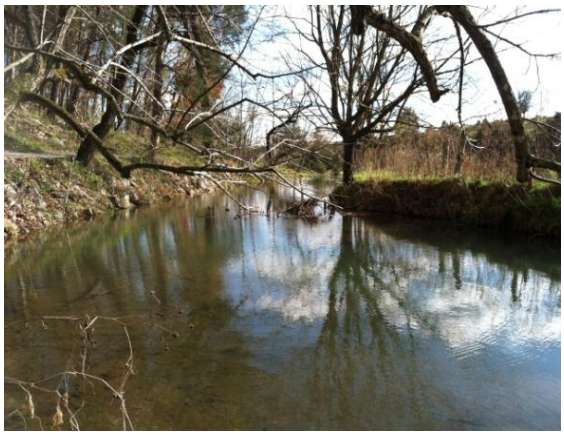
- 50 miles of livestock exclusion fencing (138 systems)
- 9,150 acres improved pasture management
- 14 loafing lot management systems
- 584 acres permanent vegetative cover on critical pasture areas
- 584 acres reforestation of erodible pasture
- 11 Manure storage facilities (beef)
- 4 Manure storage facilities (non-permitted poultry)
- 100 pasture acres treated with sediment control structures
- 188 acres permanent vegetative cover on cropland
- 2,407 acres continuous no till
- 1,584 acres cover crops
- 5 acres forested riparian buffers on cropland
- 46 acres of riparian grass filter strips on cropland

Recommended streambank erosion implementation actions include:

- 3,000 feet of streambank stabilization on agricultural and residential/urban land

Implementation Timeline

The intended implementation goal is to restore water quality in Linville Creek and its tributaries and attain the bacteria and benthic standards in the creek. Progress toward end goals will be assessed during implementation through tracking of BMP installation and



continued water quality monitoring by the Virginia Department of Environmental Quality (DEQ). Monitoring data collected by volunteer organizations including Friends of the Shenandoah River and Friends of the North Fork Shenandoah River will also be used to gage progress in meeting water quality goals.

Expected progress in implementation is established with implementation milestones and water quality improvements. Implementation milestones establish BMP installation goals for each stage of implementation, while water quality milestones establish the expected corresponding improvements in water quality. The overall timeline for the Linville Creek TMDL implementation plan is 18 years, and it broken up into three phases extending to 2031.

Stakeholder Involvement

The actions and commitments described in this plan were developed based on input from citizens in the Linville Creek watershed, the Town of Broadway, Virginia Department of Health, the Natural Resources Conservation Service, Shenandoah Valley Soil and Water Conservation District, DEQ, the Virginia Department of Conservation and Recreation (DCR) and MapTech Inc.

Public participation in the development of this plan took place on three levels:

- 2 community meetings: one to kick off the process and the other to present the draft plan to the public and collect feedback
- 2 meetings of the agricultural and residential working groups to discuss implementation actions, education and outreach strategies and implementation goals and milestones
- 1 steering committee meeting to review the draft plan prior to the final community meeting, and to collect feedback on appropriate structure and content for the final community meeting

This plan will be implemented by landowners in the watershed on a **voluntary basis**, making local landowners and residents the most important stakeholders in both the development and implementation of this plan. Without broad public support for the plan, it is unlikely that water quality goals will be reached. Landowners can participate in implementation in a number of ways, from excluding livestock from the stream to talking to their neighbors about septic system maintenance requirements.

Every citizen in the watershed is encouraged to become involved in the implementation process and to contribute to restoring the health of this shared resource.

What can you do to help restore Linville Creek?

Making small changes to our daily lives will make a **BIG** difference in Linville Creek. Everyone who lives in the Linville Creek watershed (the area of land that drains to the stream) has the ability to help restore the stream, from doing something small like picking up after your pet, or something large like restoring an eroding streambank. Below is a list of a few things you could start out with:

If you're a homeowner in the watershed:

- Regularly maintain and pump-out your septic system to make sure it is working properly. You can start by calling a local septic tank pumper and arranging a pump out (schedule every 3-5 years).
- Pick up your pet's waste. Be prepared by taking bags along with you on your walks.
- If you own land along the stream, plant a streamside buffer. If this is not something you have the time or the means to do, then you can save yourself time and money while helping the stream and just stop mowing to the water's edge (a 35-foot buffer of vegetation is best). You can skip the lawn fertilizer too!
- Install a rain garden to catch and treat stormwater coming off of your rooftop and driveway. Look for low spots in your yard where water seems to collect when it rains.

If you're a farmer in the watershed:

- Plant a streamside buffer. You can use native grasses, trees, or shrubs. Maintaining the buffer will take some time and effort at first, but as your trees and grasses grow, they will slowly out-compete undesirable invasive plants like thistles.
- Provide your livestock with an alternative water source like a well and fence them out of the stream. If a well is impractical, you could consider installing limited access points along the stream.
- Plant cover crops and reduce tillage to keep valuable soil on your fields instead of in the stream.
- Use a rotational grazing system to prevent overgrazing and maximize your forage production.

For more information on how to get started:

- Technical and financial assistance with agricultural best management practices
  Shenandoah Valley Soil and Water Conservation District
  phone: (540) 433-2853 ext. 3

- Information about septic system maintenance, repairs and replacements
  Rockingham County Health Department
  phone: (540) 574-5100

- Information about rain gardens and residential buffers
  Rockingham County Department of Community Development
  phone: (540) 564-3030

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INTRODUCTION

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

When a stream fails to meet the water quality standards, it is listed as impaired, or dirty, on the CWA's Section 303(d) list. When this occurs, the CWA and the U.S. Environmental Protection Agency (EPA) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant. A TMDL is a "pollution budget" for a stream. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. A TMDL accounts for seasonal variations and must include a margin of safety (MOS).

TMDL PROCESS

After a stream is listed on the impaired waters list, or "303(d) list," the TMDL process is initiated. This process includes three steps:

1. Conduct a TMDL study to determine which pollutants and sources are causing the stream to fail to meet its water quality standards. This step was completed for the impaired segment of Linville Creek in March 2003, and the draft study was approved by EPA in September 2003.
2. Develop an implementation plan (IP) containing the actions needed to reduce those pollutants. This establishes a framework for reducing fecal bacteria and sediment levels and achieving the water quality goals for Linville Creek. This plan outlines how the TMDL goals can be employed in the watershed to improve water quality. The IP describes corrective actions and the best management practices (BMPs) to be implemented in a staged manner.
3. Implement the actions of the plan and track the improvements in water quality.

Implementation is the most important step in the TMDL process. Finalizing this IP increases the opportunities for implementation funding, while providing guidance to the residents of this watershed on how to improve water quality in their community and enhance their natural resources. The implementation of this plan will reduce levels of

fecal bacteria and sediment in the Linville Creek watershed. The numerous benefits of implementation with respect to both the creek and the watershed community are described in detail in the *Implementation Benefits* chapter of this document.

REQUIREMENTS FOR IMPLEMENTATION PLANS

State Requirements

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

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

Federal Requirements

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

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

REVIEW OF THE TMDL

Watershed Characteristics

Linville Creek and its tributaries are located in Rockingham County, Virginia in the Shenandoah River Basin. Linville Creek flows northeast and empties into the North Fork

of the Shenandoah River. The watershed is bounded by the City of Harrisonburg to the south and the Town of Broadway to the north. Land use in the watershed is predominantly agricultural (about 71%) and forest with the majority of residential/urban development located in and around the Town of Broadway. The Linville Creek watershed is approximately 29,650 acres.

Impairment Listing

Linville Creek was first listed as impaired on Virginia's 1998 Section 303(d) TMDL Priority List and Report (VADEQ, 1998) due to water quality violations of both the bacteria standard (fecal coliform) and the general standard (listed as a benthic impairment which has been attributed to excess sediment in the stream). See **Figure 1** for a map of the Linville Creek impairments. **Table 1** describes the impairments in the Linville Creek watershed addressed in this implementation plan.

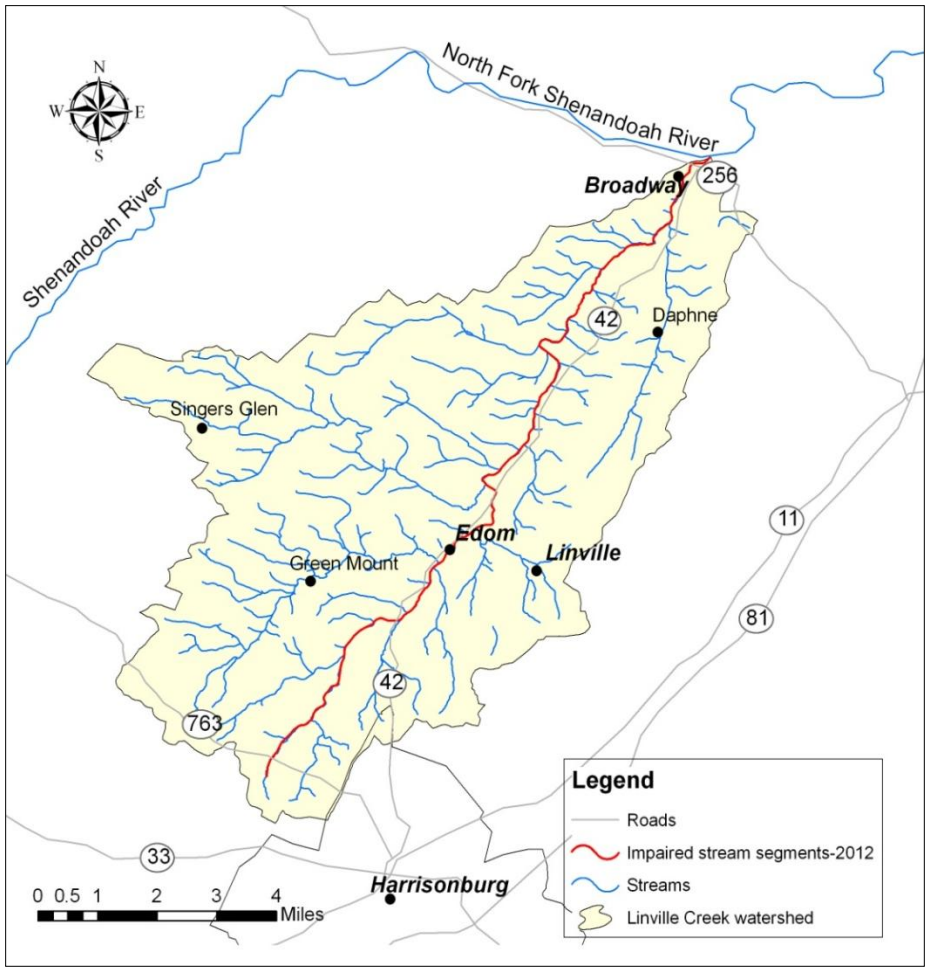


Figure 1 The Linville Creek watershed and impaired stream segments

Table 1 Impairments in the Linville Creek watershed included in this study

Impairment(s)	Initial Listing Year	2008 River Miles	2010 Listing	Impairment Location Description
Fecal Coliform/ *E. coli*	1998/ 2004	13.49	Violation rate of *E.coli* standard =54%, 73% & 85%	From the headwaters downstream to the confluence with the North Fork Shenandoah River
Benthic Macroinvertebrate	1998	13.49	Impaired: average VA Stream Condition Index Score =60.3	From the headwaters downstream to the confluence with the North Fork Shenandoah River

Pollutant Reduction Goals

A TMDL study was conducted because Linville Creek was not meeting the state water quality standards for the recreation and aquatic life uses. In order to meet the water quality goals established by the TMDL study, any fecal bacteria water sample from the stream must be equal to or less than 235 colony forming units per 100 milliliters (cfu/100mL) for *E. coli* at all times. If multiple samples are collected within a 30-day period, a geometric mean is applied and it must be equal to or less than 126 cfu/100mL.

In addition, Linville Creek was found to be in violation of the General Standard for aquatic life use and remained on the 2010 303(d) list. The General Standard**,** as defined in 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.

The General Standard use is implemented by the Virginia Department of Environmental Quality (DEQ) through application of an index called the Virginia Stream Condition Index (VASCI). The health of the benthic macroinvertebrate community is assessed through measurement of eight biometrics statistically derived from numerous reference sites in the non-coastal regions of Virginia. A stressor analysis was performed, and it was found that the aquatic life community in the Linville Creek watershed was not meeting the General Standard because of excessive levels of sediment.

The TMDL study determined the water quality goals and associated pollutant reductions needed in the implementation plan for Linville Creek. The goal of this implementation plan is to address those sources of bacteria and sediment that can be attributed to human activities. The correction of straight pipes and failing septic systems are necessary to meet the TMDL goals. In addition, the majority of livestock in the watershed will need to be excluded from the creeks. Runoff carrying *E. coli* into the creeks after rain events must also be addressed.

A 95% reduction in bacteria direct deposition by wildlife is called for in the TMDL. The Commonwealth of Virginia and USEPA are not proposing the elimination of wildlife to allow for the attainment of water quality standards in this implementation plan. The focus of this plan is on bacteria sources that can be attributed to human activities. However, due to the significant portion of the in stream bacteria concentration that can be attributed to wildlife in Linville Creek, bacteria contributions from wildlife must be considered in the context of this TMDL IP in order to evaluate progress with respect to improved water quality, and in determining the feasibility of removing Linville Creek from the impaired waters list. This issue is addressed further in the Timeline and Milestones section of this plan. A summary of the final *E. coli* allocations for the different sources in this watershed that resulted from the TMDL study is given in **Figure 2**.

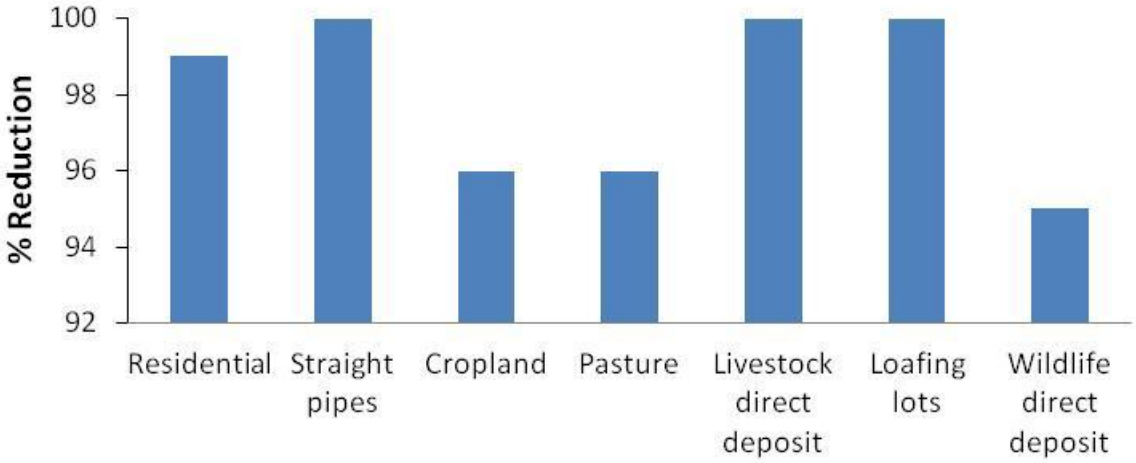


Figure 2 **Fecal bacteria load reductions allocated by the Linville Creek watershed TMDL.** ***Note: BMPs for wildlife reductions are not included in this plan.***

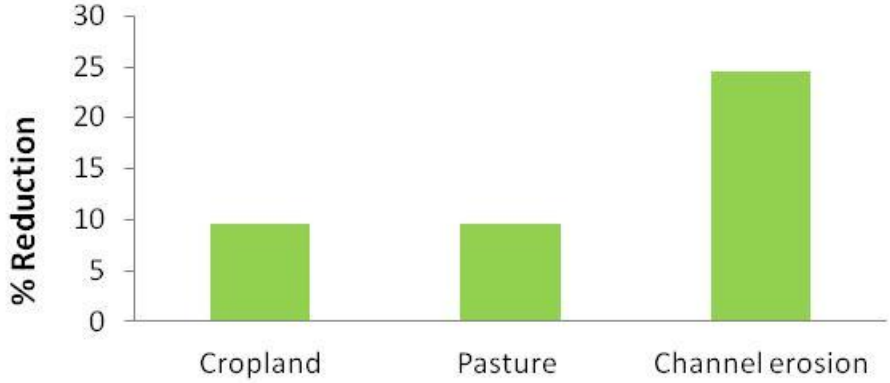


Figure 3 **Sediment load reductions allocated by the Linville Creek TMDL**

A summary of the final sediment allocations for different sources in the watershed resulting from the TMDL study is given in **Figure 3**.

Public Participation

The actions and commitments described in this document are drawn together through input from citizens of the watershed, county government, Virginia Department of Environmental Quality (DEQ), Virginia Department of Conservation and Recreation (DCR), Virginia Department of Health (VDH), Natural Resource Conservation Service (NRCS), Shenandoah Valley Soil and Water Conservation District (SVSWCD), and MapTech, Inc. Every citizen in the watershed and interested party was encouraged to become involved in the implementation process and contribute to restoring the health of the streams. Public participation in development of the plan took place on three levels: public meetings, working groups, and a steering committee.

A public meeting was held on November 27, 2012 at the Linville Edom Ruritan Hall to inform the public about the water quality impairments in the Linville Creek watershed and outline the goals for improving water quality through an implementation plan. The meeting was publicized through a press release, fliers and signs posted in the watershed, a mailing to riparian landowners, and email announcements. Approximately 75 people were in attendance. A second public meeting took place on August 21, 2013 at the Linville Edom Ruritan Hall to request feedback from citizens on the draft implementation plan.

Two specialized working groups were assembled to discuss specific implementation strategies for different sources of bacteria in this watershed and recommend actions for the plan. The working groups were divided into two focus areas: residential and agricultural. The agricultural working group met on November 27, 2012 and January 30, 2013 to discuss potential agricultural BMPs to include in the plan in addition to education and outreach strategies, an implementation timeline, and BMP costs. Participants provided feedback on the types of livestock exclusion practices to include in the plan, local interest in continuous no till and cover crops, and the need for streambank stabilization in the watershed.

The residential working group met on November 27, 2012 and again on February 5, 2013. The group discussed the need for community outreach on septic system maintenance and potential locations for pet waste and stormwater BMPs. The group reviewed potential BMP implementation scenarios and associated costs, and provided feedback on targeting and outreach strategies.

A steering committee was formed with representation from DEQ, DCR and VDH, SVSWCD and representatives from the working groups. This committee met on April 16, 2013 and reviewed recommendations from the working groups and the draft implementation plan before it was made public.

IMPLEMENTATION ACTIONS

The following BMPs are recommended to reduce the fecal bacteria and sediment pollution identified in the TMDL and to improve water quality in Linville Creek.

Reduced setback livestock exclusion.

Agricultural Practices

Agricultural Streamside Fencing

Streamside fencing is one of the best ways to reduce fecal bacteria and sediment levels in streams in agricultural watersheds. This will remove direct livestock defecation in the stream and prevent the trampling of the stream banks. The quantity of streamside fencing needed was determined through spatial analyses of land uses, the stream network, and archived data. Additionally, input from local agency representatives and citizens was used to verify the analyses.

Several fencing options are available through state, federal, and private cost share programs for watersheds with completed TMDL implementation plans:

- *Livestock Exclusion with Riparian Buffers for TMDL Implementation* (**LE-1T**) systems include streamside fencing, cross fencing, an alternative watering system, and a 35-ft buffer from the stream. It offers an 85% cost share and is only available in targeted TMDL watersheds with implementation plans.

- *Livestock Exclusion with Reduced Setback Practice for TMDL Implementation* (**LE-2T**) systems are only available in targeted TMDL areas with implementation plans. This practice requires a 10 foot setback for stream fencing, and is more flexible in fencing materials allowed. Cost share is provided for stream fencing and cross fencing, and off-stream waterers at a rate of 50%.
- The Stream Exclusion with Grazing Land Management (**SL-6T**) practice has features similar to the LE-1T practice, but offers waste storage and cost-share up to 75%.
- The *Streambank Protection for TMDL Implementation* (**WP-2T**) systems include streamside fencing, hardened crossings, and a 35-ft buffer from the stream. The WP-2T practice is only available in TMDL targeted implementation areas. This practice includes 75% cost-share and an up-front cost share payment of 50 cents per linear foot of fence installed to assist in covering anticipated fencing maintenance costs.
- The *Conservation Reserve Enhancement Program* (**CREP**) is a state-federal cost-share option. CREP systems include streamside fencing, watering troughs, and buffer-area tree plantings. It requires excluding livestock from the stream and maintaining the minimum 35-ft buffer for the length of the contract period. This practice includes up to a 75% cost-share, one-time payment of 40% of eligible

costs, a one-time sign-up payment of $100/ acre, and an annual rental payment of up to $100/ acre.

In general, cost-share of 50% - 100% is available to help pay for fencing that excludes livestock from farmland adjacent to streams, creating a riparian buffer. It is recommended that interested landowners in the Linville Creek watershed consult the personnel at the Shenandoah Valley SWCD or NRCS office located in Harrisonburg in order to choose the most applicable exclusion system and the funding sources to match. Estimates of the extent of these different fencing practices were developed for the Linville Creek watershed and are summarized in **Table 2**.

Off stream watering source for cattle.

The quantity of streamside fencing needed in the watershed was determined through spatial analyses of land uses and the stream network, and through a visual assessment of the watershed using 2011 aerial imagery. Additionally, input from local agency representatives and citizens was used to verify the analyses. Data from the VA Agricultural BMP Tracking Program was used to summarize fencing installed in the watershed to date through the state cost share program, and this number was subtracted from the total fencing needed. Once the extent of fencing needed to exclude all livestock from the stream was estimated, additional analyses were performed to develop estimates of the type and number of livestock exclusion systems needed to meet this goal.

Tax parcel data was obtained from Rockingham County, which was used to determine the number of systems needed (one system per parcel). The type of system was determined based the tax parcel acreage. For the smallest parcels (1-6 acres), it was determined that installing off stream watering would be impractical, making the WP-2T practice the most practical since it offers a limited access point on the stream for watering. For parcels 7-36 acres, the LE-2T practice was determined to be the best option since these landowners may have concerns about giving up 35 feet of land next to the stream. For larger parcels (40-89 acres), the LE-1T and SL-6T practices were determined to be the best option,

Table 2 Livestock exclusion fencing needed in the Linville Creek watershed. Note: Feet of fencing includes fencing on both sides of the stream

Description	System type				
	WP-2T	LE-1T /SL-6T	LE-2T	CREP	Total
Number of systems	19	40	48	31	138
Feet of fencing	11,516	98,196	71,441	129,116	310,269
% of total fencing needed	3.7%	31.7%	23.0%	41.6%	100%

while CREP was recommended for parcels greater than 90 acres since additional incentives for wider buffers are available through this program. These groupings were refined based on input from the agricultural working group to account for the fact that landowners in the headwaters of Linville Creek may be more interested in the limited setback allowed with the LE-2T practice since these landowners do not have to worry about frequent flooding and washing out of fencing.

The estimated length of fencing needed on perennial streams (those that flow year round) and a small portion of intermittent streams in the Linville Creek watershed is approximately 58.8 miles. This estimate is based on the fencing of all streams running through pasture in the watershed. A total of 19 fencing systems have already been installed in the watershed through the state cost share program, totaling 7.9 miles.

Agricultural land-based reduction BMPs

Due to the large reductions needed on land-based loads of *E. coli* bacteria, additional BMPs for pasture and cropland are also needed. Estimates of the needed land-based agricultural BMPs are listed in **Table 3**.

Animal waste storage unit.

Stormwater runoff from farmland picks up fecal bacteria from grazing animals as well as manure applied to pasture and cropland, and causes soil-loss and erosion of valuable land along its path to the stream. There are several BMPs, including manure storage facilities, that can be applied to farmland that will help prevent soil and bacteria from ending up in streams.

Along with the infrastructure provided by a streamside fencing system, improved pasture management includes: maintaining minimum forage height during growing season based on type of forage, application of lime and fertilizer when needed, following a nutrient management plan, controlling woody vegetation, distribution of manure through managed rotational grazing, sacrifice area for feeding during winter and summer droughts, and reseeding if necessary. These practices can produce significant economic gains to producers at a very low investment cost.

The establishment of vegetation including trees on pasture areas that are steep, eroded or barren protects the acreage from losing soil and bacteria. Practices designed for these sites include permanent vegetative cover on critical areas, and reforestation of erodible pasture. Planting generally halts erosion and helps retain moisture. Trees provide shade and windbreaks for pastured animals. Vegetating these areas consequently improves water quality.

Conservation tillage involves managing the intensity (frequency and aggressiveness) of soil-disturbing activities related to residue management, seedbed preparation, nutrient application, planting, and pest control while planting and growing crops. Employing conservation tillage helps prevent erosion, which also helps keep bacteria found in manure fertilizers from running off the land. Benefits include improved soil quality and reductions in time, fuel, and production costs.

Sediment retention ponds on pasture-land allow time for the sediment and bacteria to settle out from the captured runoff, before it flows into streams. Retention ponds have several potential benefits, including: recreational uses such as fishing, water sources, and aesthetics.

Table 3 Agricultural land based reduction BMPs

Land use	Control measure	Unit	Extent needed
Pasture	Improved pasture management	Acres	9,150
	Loafing lot management system	System	14
	Permanent vegetative cover on critical areas	Acres	584
	Reforestation of erodible pasture	Acres	584
	Manure storage facility (beef)	Facility	11
	Manure storage facility (non-permitted poultry)	Facility	4
	Sediment retention, erosion or water control structure	Acres	100
Cropland	Permanent vegetative cover on cropland	Acres	188
	Continuous no till	Acres	2,407
	Cover crops	Acres	1,584
	Riparian buffers: forested	Acres	5
	Riparian buffers: grass filter strip	Acres	46

Residential Practices

In order to achieve the necessary residential reductions, contributions of bacteria and sediment from residential land in the watershed must be addressed. This includes bacteria from failing septic systems, straight pipes and pets; and sediment carried to the stream in runoff from rooftops, driveways and roads. The Linville Creek TMDL calls for a 100% reduction in bacteria from failing septic systems and straight pipes, which state law requires homeowners to address once detected.

Septic Systems

All failing septic systems and straight pipes must be identified and replaced during implementation since a 100% load reduction from direct and non point source human waste is needed to meet the TMDL goals. In addition, straight pipes are illegal in the Commonwealth of Virginia. Residential bacteria sources estimated in consultation with the Rockingham County Department of Health (VDH) are shown in **Table 4**. The

number of estimated potential failing septic systems and straight pipes is based on census data and the age of homes in the watershed.

Table 4 Estimated residential bacteria sources

Total number of septic systems	Estimated failing septic systems	Estimated straight pipes	Pets
1,494	329	7	1,815

Input from the Residential Working Group and the Rockingham County Department of Health was used to develop estimates of the extent of failing septic systems that could be corrected with repairs (40%) and those that would need to be replaced (60%). The Residential Working Group discussed the options available for the replacement of failing septic systems including installation of a conventional septic system, an alternative waste treatment system, or connection to public sewer. Opportunities for connection to public sewer in the Linville Creek watershed are limited to homes within the Town of Broadway. The TMDL provides an estimate of the number of homes that fell within this area and could potentially connect to public sewer. This analysis yielded an estimate of approximately 2% of failing septic systems in the watershed, for a total of 7 potential connections. Since alternative waste treatment systems can be up to three times the cost of conventional septic systems, these systems are only used in cases where soils are not suitable for a conventional system, or where space constraints make the installation of a drain field impossible. With input from the working group and the Department of Health, estimates of the different types of systems that could be installed in the watershed were developed (**Table 5**).

Table 5 Septic BMPs for the Linville Creek watershed

Description	BMP			
	Repairs	Conventional septic system	Alternative waste treatment system	Connection to public sewer
Extent needed	131	67	131	7
% of failing systems and straight pipes	40%*	20%	38%	2%

**Percent repairs based only on failing septic systems, straight pipes must be replaced*

In addition to the practices shown in **Table 5**, a Septic Tank Pumpout Assistance Program could be implemented in the watershed in order to provide homeowners with cost share to pump out their septic tanks. The Residential Working Group discussed the extent of pumpouts that could be covered through this program with the understanding that it is unlikely that sufficient grant funds will be available to assist every homeowner in the watershed with a pumpout. The group agreed that a goal of pumping out 20% of septic tanks in the watershed for a total of 300 pumpouts was reasonable for this program. The group also suggested that pumpouts should be targeted to older homes that are more likely to have failing septic systems. It is expected that this type of program will raise local awareness of septic system maintenance needs and encourage homeowners to

conduct routine maintenance of their septic systems. In turn, this will help to prevent septic system failures in the future.

Pet Waste

A Community Pet Waste Education Program is recommended in Linville Creek in order to encourage pt owners to pick up after their pets. This program includes the distribution of educational materials on proper disposal of pet waste to pet owners, kennel operators, and grooming facilities. A partnership with the SPCA and local pet stores could also be an effective means of distributing educational materials. Neighborhood pet waste disposal stations and pet waste composters can also be used to encourage pet owners to pick up after their animals, thereby preventing runoff of bacteria to the stream. A pet waste composter allows a homeowner to collect their pet's waste and safely compost it outside. There are several types of composters, some requiring more maintenance than others. A septic tank composter (e.g. Doogie Dooley® system) is inserted in the ground (2-4 feet below the surface) with a lid on top. Pet waste is added to the composter along with water and a special enzyme to accelerate decomposition. Traditional composters may also be used to treat pet waste. In addition, larger scale commercial pet waste digesters may be used by facilities with a large number of pets such as groomers, boarding facilities and veterinary offices. Potential locations for these BMPs were identified within the Linville Creek watershed, primarily within and directly around the Town of Broadway where the most compact residential development has occurred. In addition, boarding facilities, groomers and veterinary offices in the watershed were identified (**Table 6**).

Stormwater

While septic and pet waste BMPs work to eliminate the runoff of pet waste and septage at the source, it will also be necessary to implement BMPs to filter and treat runoff from residential areas, carrying both sediment and bacteria to the stream. Riparian buffers are excellent filters that can be installed at a very low cost next to the stream. A basic spatial analysis of opportunities for buffers in residential areas was performed by DCR using Geographic Information Systems.

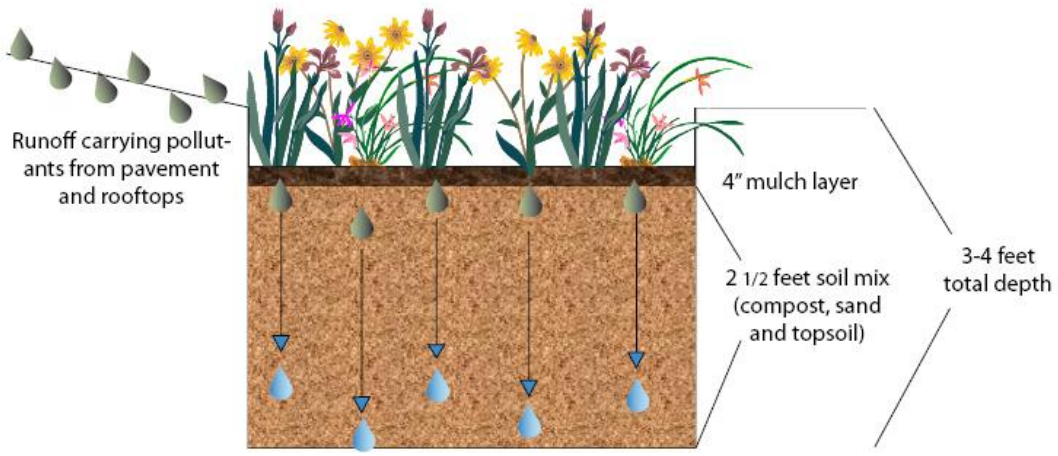
Septic tank pumpout.

Table 6 Pet waste BMPs for the Linville Creek watershed and potential locations

BMP description	Units	Extent	Potential locations
Neighborhood pet waste station	Station	4	Walnut Drive subdivision
			Alger Lane subdivision
			East Springbrook Rd subdivision
			McKinley Drive subdivision

Pet waste composter	Composter	49	Jewelry Drive subdivision
			Robin Roost Court subdivision
			Other residential lots < 2 acres
Pet waste composter (commercial)	Composter	5	Tails of Broadway
			Pet Creations
			Broadway Veterinary Hospital
			Love on a Leash Dog training
			Puppy Luv Grooming and Boarding
Pet waste education program	Program	1	Watershed-wide

Aerial imagery collected in 2011 was used to identify residential areas next to the stream lacking streamside vegetation. In addition, opportunities for the installation of bioretention filters and rain gardens were identified in this analysis. These BMPs can be used to filter and treat runoff. Highly permeable soils are used to encourage runoff to



Residential rain garden schematic: filtration of urban and residential runoff

infiltrate, allowing for pollutant filtration through the soil and groundwater recharge. Due to the karst geology in Linville Creek, Rockingham County requires that developers follow engineering guidelines regarding the design and installation of BMPs that encourage infiltration of stormwater in order to ensure that polluted runoff is not discharged into karst features like sinkholes. **Table 7** provides a summary of the extent of stormwater practices recommended for the Linville Creek watershed along with potential locations for projects. Potential project locations are generally focused on areas of concentrated developed in and around Broadway.

Table 7 Stormwater BMPs for the Linville Creek watershed

BMP description	Units	Extent needed	Potential locations
Bioretention filter	Filters	5	Broadway High School J Frank Hilyard Middle School (back side) Broadway Volunteer Fire Department Pilgrim's Pride Corporation
Rain gardens	Gardens	8	McKinley Drive subdivision Robin Roost Ct. subdivision Jewelry Drive subdivision Other residential lots < 2 acres
Riparian buffers	Acres	15	Broadway Park Behind Subway and Broadway Tire and Automotive Faith Baptist Church

Streambank Stabilization

The Linville Creek TMDL calls for a 25% reduction in sediment coming from channel erosion. An estimated 15% of streambanks in the watershed are experiencing accelerated erosion. In order to meet TMDL goals, a combination of livestock exclusion and streambank stabilization practices is recommended. The planned livestock exclusion on about 59 miles of stream provides an estimated 6% reduction in sediment from stream erosion. Fencing also provides additional reduction in land-based sediment from those sources. Based on input from the agricultural working group, there are reaches of Linville Creek that are critically in need of streambank stabilization measures. Most of these segments are located along the mainstem of the creek where the highest flows occur during storm events. Consequently, an additional 3,000 feet of streambank stabilization is recommended for urban and agricultural areas in the watershed, which is estimated to

Streambank erosion.

Table 8 Streambank stabilization BMPs for the Linville Creek watershed

BMP description	Extent needed	Agricultural Areas	Residential Areas
Streambank Stabilization	3,000 ft	2,538 ft	462 ft

be more than sufficient to meet the TMDL goals (**Table** 8**8**). When possible, in agricultural areas stabilization should be implemented in conjunction with livestock exclusion projects where significant streambank erosion has occurred.

IMPLEMENTATION COSTS

Agricultural BMP Costs

The costs of agricultural BMPs were estimated based on local data collected from the DCR Virginia Agricultural BMP Database, and the Natural Resources Conservation Services BMP Cost List (**Table 9**). Estimates were reviewed by NRCS and Shenandoah Valley SWCD staff based on their experience working with producers in the watershed.

Residential BMP Costs

The costs of residential BMPs are shown in **Table 10**. Cost estimates for septic system BMPs were developed with input from staff from the Virginia Department of Health in Rockingham County. Pet waste and stormwater BMP costs were estimated based on

Table 9 Estimated unit costs for recommended agricultural BMPs

Land use	Control measure	Unit	Average cost/unit
Streamside Livestock Access	LE-1T/SL-6T – Livestock exclusion	System	$27,232
	LE-2T– Livestock exclusion		$21,823
	WP-2T– Livestock exclusion		$6,214
	CREP– Livestock exclusion		$42,311
Pasture	Improved pasture management	Acres	$100
	Loafing lot management system	System	$109,000
	Permanent vegetative cover on critical areas	Acres	$1,200
	Reforestation of erodible pasture	Acres	$560
	Manure storage facility (beef)	Facility	$58,000
	Manure storage facility (non-permitted poultry)	Facility	$20,000
	Sediment retention, erosion or water control structure	Acres treated	$840
Cropland	Permanent vegetative cover on cropland	Acres	$175
	Continuous no till	Acres	$100
	Cover crops	Acres	$30
	Riparian buffers: forested	Acres	$1,750
	Riparian buffers: grass filter strip	Acres	$250

implementation costs reported from a number of grants awarded to organizations in the region by DCR including the Shenandoah Valley SWCD and the City of Harrisonburg.

Table 10 Estimated unit costs for recommended residential BMPs

BMP Type	BMP description	Units	Average cost/unit
Septic Systems	Septic tank pumpout	Pumpout	$250
	Conventional septic system	System	$8,000
	Septic system repair	Repair	$3,000
	Connection to public sewer	Connection	$5,600
	Alternative waste treatment system	System	$23,000
Pet Waste	Pet waste education program	Program	$1,000
	Neighborhood pet waste station	Station	$250
	Residential pet waste composter	Composter	$75
	Commercial pet waste composter	Composter	$10,000
Stormwater	Bioretention filter	Filter	$20,000
	Rain garden	Garden	$8,000
	Riparian buffer	Acres	$1,000

Streambank Stabilization BMP Costs

Streambank stabilization costs were estimated based on costs reported from a series of streambank restoration projects implemented in the City of Harrisonburg and the City of Waynesboro. An average cost of $150/linear foot of bank restoration was assumed.

Technical Assistance Costs

It is estimated that two full-time support staff are needed each year of Stages 1 and 2 to implement agricultural, residential and stormwater BMPs included in this plan. It is expected that one position would focus on agricultural BMP and streambank stabilization BMP goals, while the other would focus on residential and stormwater BMPs. These positions could be housed at the Shenandoah Valley SWCD, the Virginia Department of Health, the Town of Broadway or Rockingham County. Interested organizations could assume a collaborative approach to implement education and outreach strategies, advise landowners on BMP design and implementation, and track completion of implementation goals and related water quality improvements.

It was determined that it would require $50,000 to support the salary, benefits, travel, training and incidentals for education for one technical staff member. This estimate was developed based on existing grants for technical assistance in the region. Assuming implementation takes place over a 14 year time line, the total cost of technical assistance is expected to be $1.4M.

Table 11 shows the estimated costs of implementation for a series of three implementation stages, which are discussed further in the proceeding section of this plan, Timeline and Milestones.

Table 11 Technical assistance and BMP implementation costs for Linville Creek

BMP Type	Stage Costs ($)			Total
	Stage 1 (Years 1-7)	Stage 2 (Years 8-14)	Stage 3 (Years 15-18)	
Agricultural	$3,083,249	$4,650,799	$526,099	$8,260,147
Residential/Urban	$4,253,375	$37,500	$0	$4,290,875
Streambank stabilization	$450,000	$0	$0	$450,000
Technical assistance	$700,000	$700,000	$0	$1,400,000
TOTAL	**$8,486,624**	**$5,388,299**	**$526,099**	**$14,401,022**

TIMELINE AND MILESTONES

The goal of this implementation plan is to attain the bacteria and general water quality standards for Linville Creek and its tributaries and remove these streams from Virginia's Section 303(d) impaired waters list. Progress toward this goal will be assessed during implementation through tracking of BMP installations and continued water quality monitoring throughout implementation.

Following a phased approach, implementation will be divided into three stages, with an effort to concentrate resources and finances on the most cost-efficient control measures in the first stage (first 7 years). The extent of agricultural implementation measures included in Stage 1 was identified by the agricultural working group as what was “reasonable” to expect from farmers in the watershed. The residential working group agreed that Stage 1 should also include correction of all failing septic systems and straight pipes in the watershed due to their potential impact on human health. Stage 2 goals (second 7 years) were established based on additional practices that would reduce the bacteria in Linville Creek. A final stage (Stage 3) was developed with the maximum achievable reductions in all bacterial sources except wildlife. The overall timeline for implementation including Stage 3 is 18 years.

It is estimated that the scheduled practices will result in meeting the TMDL sediment reduction goal by the end of Stage 1. However, the reductions proposed through Stage 3 for non-wildlife sources will not improve water quality sufficiently to meet the bacteria standard. To demonstrate the impact of wildlife loads on the bacteria impairment, the TMDL model was loaded with all reductions through the Stage 3 and a 95% reduction to wildlife. The result was an estimated single sample bacteria violation rate of 11%. In other words, significant load reductions from all sources including wildlife would be

required in order to approach delisting of the impairments (achieve less than a 10.5% violation rate of the bacteria standard). The need to also address wildlife sources makes it highly unlikely that the non-wildlife implementation practices alone will produce water quality that meets the bacteria standard. Nevertheless, the practices employed over the three stages make a significant improvement in water quality. As targeted BMPs are implemented through a staged implementation process, water quality data along with level of BMP implementation will be reassessed to determine if additional BMPs are needed and can be employed to meet water quality milestones.

The Commonwealth of Virginia and USEPA are not proposing the elimination of wildlife to allow for the attainment of water quality standards in the Linville Creek watershed. Implementation should be carried out using an adaptive management strategy in which anthropogenic sources of bacteria are addressed to the maximum extent practicable while continuous water quality monitoring is used to evaluate subsequent water quality improvements. However, bacteria contributions from wildlife must be considered in the context of this TMDL IP in order to evaluate progress with respect to improved water quality, and in determining the feasibility of removing Linville Creek from the impaired waters list. Once implementation of all practicable control measures for anthropogenic bacteria sources has been exhausted, the watershed community should evaluate water quality and reassess wildlife populations in Linville Creek and existing violation rates of the *E.coli* bacteria standard. Management and control of nuisance wildlife populations (most notably Canada geese) that have flourished as a result of human behavior could be considered at this point in time. However, if violations persist at a rate well above 10.5%, the watershed community may determine that a Use Attainability Analysis (UAA) is warranted in order to evaluate next steps with respect to implementation. Completion of an UAA will allow stakeholders to consider the re-designation of the current swimming use in Linville Creek, and will include the completion of a structured scientific assessment of the factors affecting the attainment of this designated use which may include physical, chemical, biological, and economic factors as described in the federal regulations under 40 CFR §131.10(g).

Expected progress in implementation is established with two types of milestones: *implementation milestones* and *water quality milestones*. Implementation milestones establish the amount of BMPs installed each year, while water quality milestones establish the corresponding improvements in water quality that can be expected. The overall change in sediment pollution, bacteria pollution and implementation costs is graphed in **Figure 4**. Agricultural and residential implementation milestones and corresponding water quality milestones are shown by stage in **Table 12**.

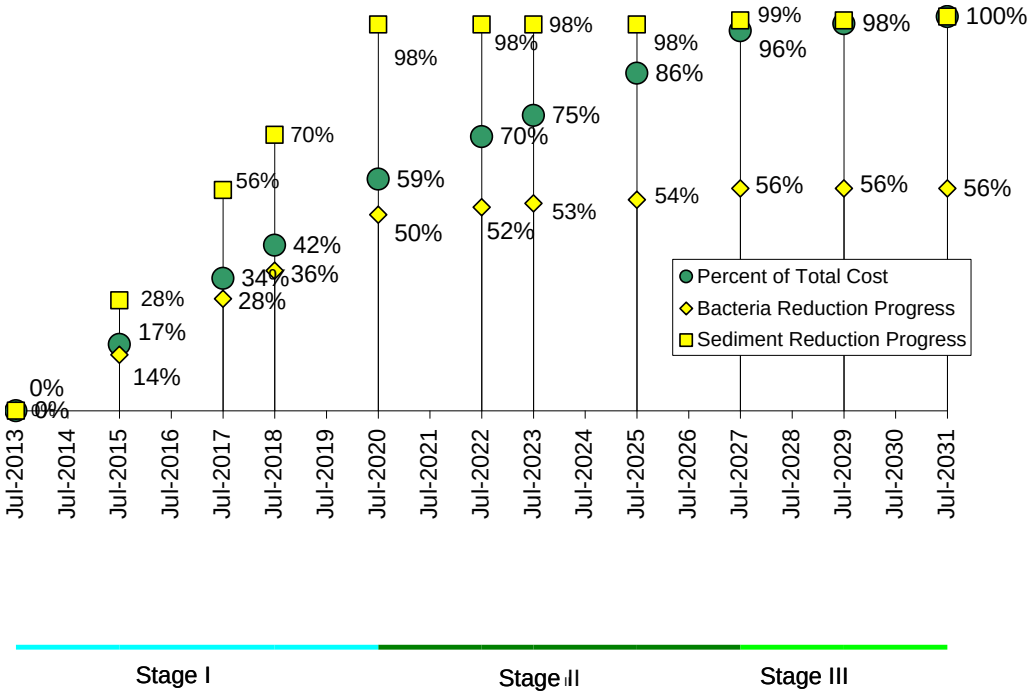


Figure 4 **18-year timeline for implementation in the Linville Creek impairment.**

Table 12 BMP implementation milestones by stage for Linville Creek (see Table 9 and Table 10 for costs)

Land Use/Source	Control measure	Unit	Stage 1	Stage 2	Stage 3	Total
Streamside livestock access	LE-1T/SL-6T – Livestock excl.	System	20.0	20.0	0.0	40
	LE-2T– Livestock Exclusion		24.0	24.0	0.0	48
	WP-2T– Livestock exclusion		9.5	9.5	0.0	19
	CREP– Livestock exclusion		15.5	15.5	0.0	31
Pasture	Improved pasture management	Acres	0	6,000	3,150	9,150
	Loafing lot management system	System	4	9	1	14
	Perm. vegetative cover on critical areas	Acres	146	438	0	584
	Reforestation of erodible pasture	Acres	146	438	0	584
	Manure storage facility (beef)	Facility	3	8	0	11
	Manure storage (non-permitted poultry)	Facility	3	1	0	4
	Sediment retention, erosion or water control structure	Ac treated	0	0	100	100
Cropland	Permanent vegetative cover on cropland	Acres	188	0	0	188
	Continuous no till	Acres	2,407	0	0	2,407
	Cover crops	Acres	1,584	0	0	1,584
	Riparian buffer: forested	Acres	5	0	0	5
	Riparian buffer: grass filter strip	Acres	46	0	0	46
Septic systems	Septic tank pumpout	Pumpout	150	150	0	300
	Septic system repair	Repair	131	0	0	131
	Conventional septic system	System	67	0	0	67
	Alternative waste treatment system	System	131	0	0	131
	Connection to public sewer	Connection	7	0	0	7
Pet waste	Neighborhood pet waste station	Station	4	0	0	4
	Residential pet waste composter	Composter	49	0	0	49
	Commercial pet waste composter	Composter	5	0	0	5
	Pet waste education program	Program	1	0	0	1
Stormwater	Bioretention filter	Filter	5	0	0	5
	Rain garden	Garden	8	0	0	8
	Riparian buffer	Acres	15	0	0	15
Streambank erosion	Streambank stabilization	Feet	3,000	0	0	3,000
Violation rate: *E.coli* instantaneous standard (current = 71%)			**41%**	**37%**	**37%**	
Sediment reduction: TMDL goal = 788 tons/yr (12.3%)			**100%**	**100%**	**100%**	

IMPLEMENTATION BENEFITS

The primary benefit of implementing this plan will be cleaner water in Linville Creek and its tributaries. Specifically, E. coli contamination in the creek will be reduced, and sediment loading will be reduced to support a healthy aquatic community and meet the water quality standard for aquatic life use. It is difficult to gauge the impact that reducing fecal contamination will have on public health, as most cases of waterborne infection are not reported or are falsely attributed to other sources. However, because of the required reductions, the incidence of infection from fecal sources, through contact with surface waters, should be considerably reduced. Additionally, because of streambank protection that will be provided through exclusion of livestock from streams, the aquatic habitat will be improved in these waters. The vegetated buffers that are established will also serve to reduce bacteria runoff to the stream from upslope locations. In addition, as trees and shrubs in vegetated buffers grow, they serve as excellent shade sources for streams. This in turn reduces water temperature in the stream and increases dissolved oxygen, thereby improving aquatic habitat for game fish and other aquatic organisms.

Benefits from Agricultural Practices

Livestock research has demonstrated a positive relationship between access to clean drinking water and performance factors such as growth, reproduction, and milk production. Livestock illnesses can be spread through contaminated water supplies. A clean water source can prevent illnesses that reduce production and incur the added expense of avoidable veterinary bills. Beef producers in several Virginia counties have reported weight gains in cattle after providing alternative water sources. Studies also show increased milk and butterfat production from dairy cattle drinking from a clean and reliable source. Taking the opportunity to initiate an improved pasture management system in conjunction with installing clean water supplies will also provide economic benefits for the producer. Improved pasture management can allow a producer to feed less hay in winter months, increase stocking rates and consequently, improve the profitability of the operation. Standing forage utilized directly by the grazing animal is always less costly and of higher quality than the same forage harvested with equipment and fed to the animal. In addition to reducing forage costs to producers, intensive pasture management can boost profits by increasing the quality and amount of forage and productivity per acre.

Benefits from Residential Practices

The residential programs will play an important role in improving water quality, since human waste can carry human viruses in addition to the bacterial and protozoan pathogens that all fecal matter can potentially carry with it. In terms of economic benefits to homeowners, an improved understanding of private sewage systems (including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance) will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. 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 five years. The cost of proper maintenance, as outlined here, is relatively inexpensive in comparison to repairing or replacing the entire system. Implementation of this plan will help foster continued local economic vitality and strength based on the recognition that clean water improves economic opportunities for Virginians, and a healthy economic base provides the resources and funding necessary to pursue restoration and enhancement activities.

In summary, the practices recommended in this document are expected to provide economic and environmental benefits to the landowner. Specifically, alternative (clean) water sources, exclusion of livestock from streams, intensive pasture management, and private sewage system maintenance will each provide economic benefits.

TARGETING IMPLEMENTATION

Implicit in the process of a staged implementation is targeting of best management practices. Targeting ensures optimum utilization of limited technical and financial resources. Due to the extent of fencing needed to meet the TMDL goals in Linville Creek, an analysis of livestock fencing was performed for each subwatershed. In order to identify areas where the greatest number of livestock could be excluded with the smallest amount of stream fencing, the subwatersheds were ranked in descending order based on the ratio of cattle per fence length along streams (**Table 13**). If feasible, an effort should be made to prioritize financial and technical resources in this order (**Figure 5**).

Table 13 Fencing priority by subwatershed (priority 1 = highest)

Subwater-shed	Beef cattle	Fencing needed (ft)	Cattle : Fence	Fencing priority
1	121	0	N/A	N/A
2	484	38,624	0.013	9
3	814	23,567	0.035	2
4	400	20,345	0.020	6
5	1,455	46,164	0.032	3
6	1,111	35,610	0.031	4
7	13	826	0.016	7
8	66	6,219	0.011	10
9	468	3,993	0.117	1
10	779	38,392	0.020	5
11	798	54,816	0.015	8

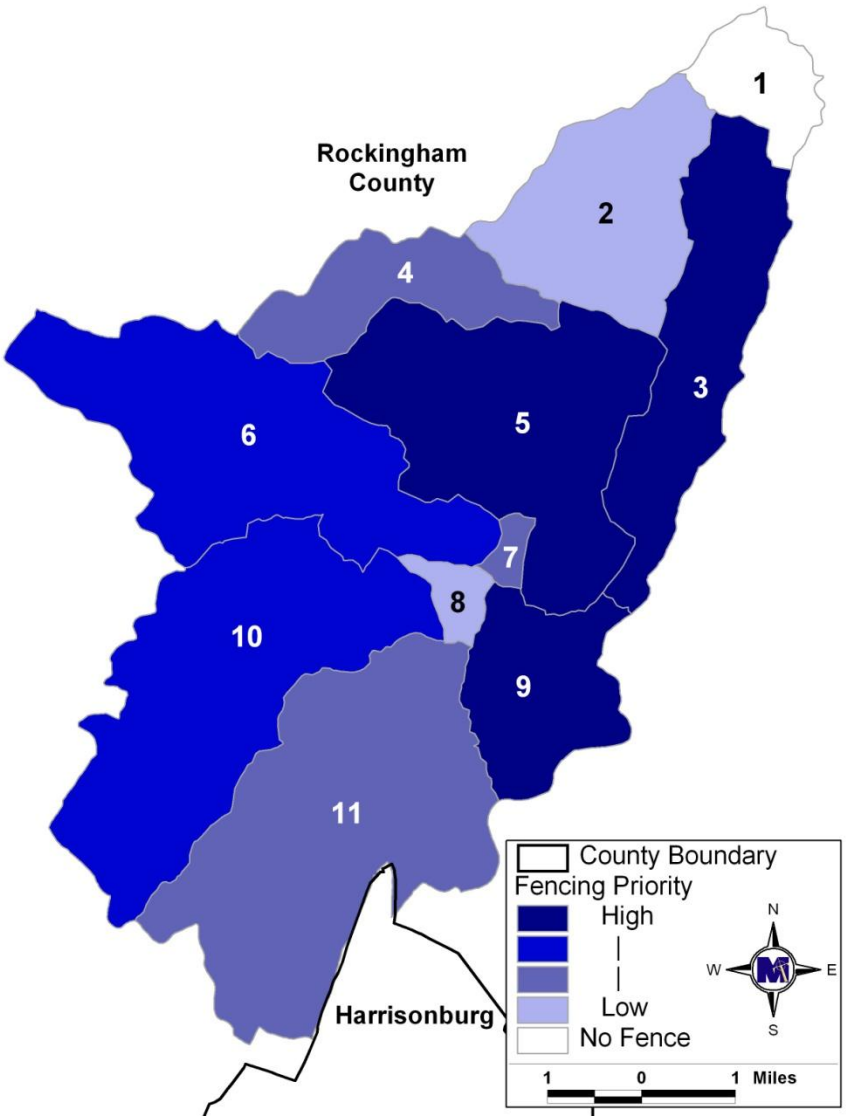


Figure 5 **Fencing priorities by subwatershed for Linville Creek. Note: Subwatershed numbers shown in Table 13 are listed on map. 1 = highest priority, 11 = lowest priority**

In addition to targeting of fencing practices, the agricultural working group worked with MapTech and DCR to identify other agricultural BMPs that should be considered high priority for Stage 1 implementation. This included cropland BMPs such as continuous no till and cover crops, as well as riparian buffers and loafing lot management systems.

The residential working group discussed targeting of septic tank pumpouts to the older homes in the watershed where the likelihood of a septic system failure is greatest. In response to this suggestion, a student intern from James Madison University assisted with the development of a mailing list based on the age of homes in the watershed using data provided by Rockingham County, which was completed in April 2013. This mailing list will be made available to organizations interested in administering pump out grants in the

watershed. This will allow organizations to conduct targeted mailings promoting technical and financial assistance available for septic system maintenance to households with the greatest need. In addition, the group discussed targeting of pet waste and stormwater BMPs to areas in and around the Town of Broadway (subwatershed 1) where the densest residential and urban development has occurred. Specific neighborhoods and properties were identified for potential pet waste stations, pet waste composters, and rain gardens/bioretention filters. These projects are identified in **Table 6** and **Table 7** in the Implementation Actions section of this plan. Should funding be pursued for residential septic and urban stormwater practices, these projects should take priority.

MONITORING

Improvements in water quality will be determined in the Linville Creek watershed through monitoring conducted by the Virginia Department of Environmental Quality's (DEQ) monitoring program. **Figure 6** shows the location of DEQ's chemical and biological monitoring stations within the watershed. In addition, the figure shows the location of a Friends of the Shenandoah River (FOSR) chemical monitoring station at the watershed outlet. Monitoring conducted at this station is part of a joint surface water basin-wide monitoring program launched by FOSR in partnership with Friends of the North Fork of the Shenandoah River (FONFSR). This program is supported through a grant from DEQ. FONFSR volunteer monitors collect water samples at the station every two weeks. Samples are analyzed for a number of parameters including nutrients and turbidity at a certified lab at Shenandoah University that is operated by FOSR. **Table 14** provides a description of the DEQ monitoring stations that will be sampled during implementation of this plan. These are subject to change annually based upon the development of the DEQ Monitoring Strategy. Typically, monitoring in an implementation area is conducted bimonthly in two-year cycles. The DEQ uses the data to determine overall water quality status, and gauge the success of implementation. Data collected by FONFSR monitors will show the impact of BMPs on other water quality parameters including nutrients and turbidity, which are expected to improve based on the capacity of the BMPs recommended in this plan to reduce and filter polluted runoff.

Table 14 Linville Creek monitoring stations: DEQ and FOSR

Monitoring type	Station ID*	Station description
DEQ- *E. coli*	1BLNV006.49	Route 789 Bridge – Linville Creek
DEQ- *E. coli*	1BLNV001.22	785 Bridge – Linville Creek
DEQ- Benthic	1BLNV000.66	Watershed outlet in Broadway – Linville Creek by Southern Railway
FOSR- Chemical	N/A	Watershed outlet in Broadway – Linville Creek by Southern Railway

**Last 4 digits of DEQ station ID is the river mile where the station is located*

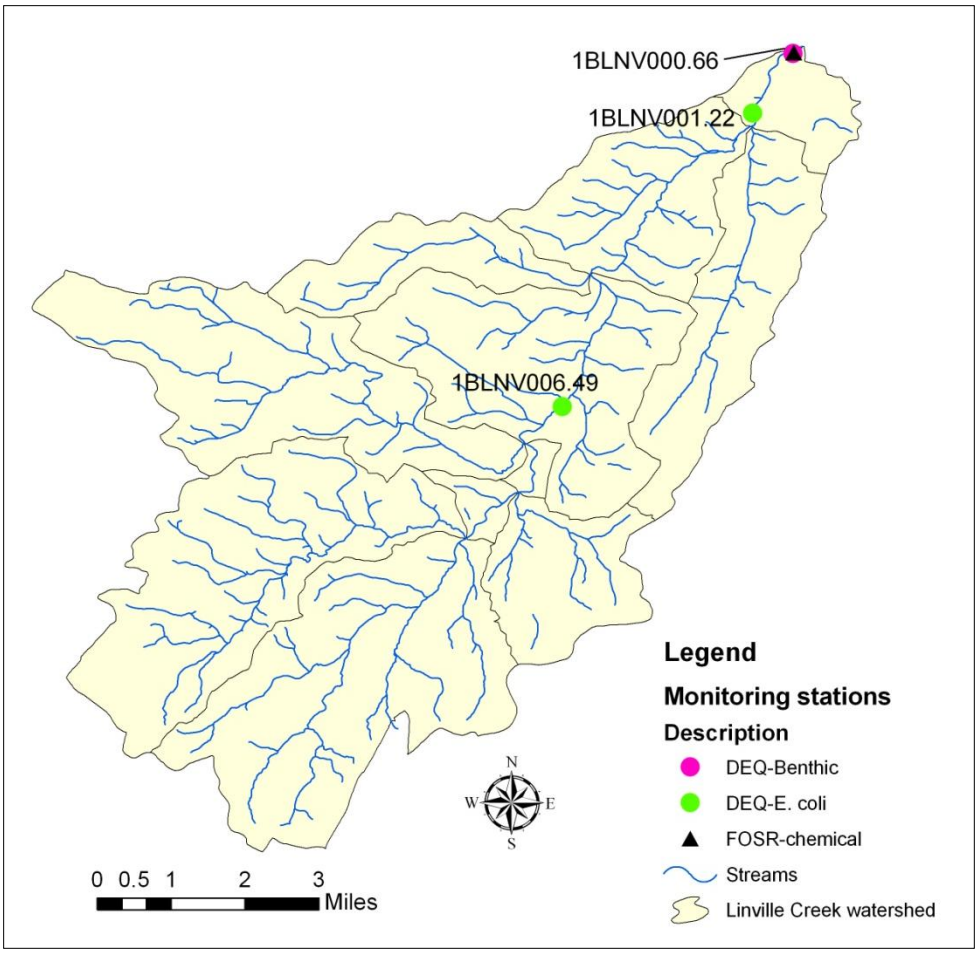


Figure 6 DEQ and FOSR monitoring stations in the Linville Creek watershed

EDUCATION AND OUTREACH

In order to get landowners involved in implementation, education, outreach and assistance with the design and installation of best management practices will be needed. A number of partner organizations in the Linville Creek watershed will be asked to assist with this effort. Personnel from the Shenandoah Valley SWCD and the Natural Resource Conservation Service will initiate contact with farmers in the watershed to encourage the installation of agricultural BMPs. The Friends of the North Fork of the Shenandoah River has also offered to provide assistance with education and outreach for septic system BMPs including mailings of informational materials and maintenance workshops held in partnership with the local Health Department. The Town of Broadway and Rockingham County could serve as key partners for outreach surrounding implementation of stormwater BMPs, working with local schools including Broadway High School to demonstrate how stormwater BMPs help to improve water quality.

Citizen monitoring can also be used to further engage local landowners, and to identify "hot spots" for *E.coli* bacteria in the watershed and areas where excessive sediment loading is occurring. Several landowners in Linville Creek expressed an interest in conducting bacteria and biological monitoring in the watershed during the process of developing this plan. Once problem areas were identified, outreach efforts could be targeted towards these reaches of the stream including neighbor to neighbor communication. An engaged citizen monitoring and outreach network could serve as a very effective and efficient means of reaching landowners in the watershed who are contributing significant amounts of bacteria and/or sediment to the creek.

Dedicated technical support staff will be needed to conduct the degree of both community and one on one outreach needed to meet the goals included in this plan. As noted in the Implementation Costs section of the plan, two positions will be needed each year to conduct this outreach (an agricultural technician and a residential technician). Based on the recommendations of the agricultural and residential working groups and input from local conservation organizations, outreach activities conducted by technical staff should include newsletters, postcard mailings, field days and presentations at the Linville Edom Ruritan Club. The technical staff should work with Virginia Cooperative Extension and organizations such as the Cattlemen's Association, Dairymen's Association, and Farm Bureau to sponsor farm tours and field days. The Broadway Timberville Young Farmers Association was identified as another key organization to collaborate with on education and outreach in order to reach the next generation of farmers in the watershed. Neighborhood associations were identified as a great target for outreach regarding pet waste BMPs including both neighborhood pet waste stations and individual pet waste composters. In addition, the potential riparian buffer project identified for the town park in Broadway could serve as an excellent site for education and outreach on riparian management strategies, which could be noted on an educational sign in the park.

The Linville Creek watershed is included in a Source Water Protection Plan (SWPP) developed by the VA Rural Water Association in 2010 (described in the Integration with Other Water Quality Programs and Activities section of this plan). This SWPP identifies a series of education and outreach strategies that would clearly support both source water protection and TMDL implementation efforts, and should therefore be considered as this plan is implemented. Recommendations from the SWPP include:

- Encourage Broadway High School to continue to participate in the Envirothon
- Invite conservation technicians from the SWCD and NRCS to present to Agriculture Department students at Broadway High School on BMPs to improve water quality

- Create articles with the Broadway Town Manager for the North Fork Journal that describe improvements in water quality that have already occurred
- Approach the Farm Bureau to request support for alternative lawn care and gardening products and informational displays
- Coordinate public demonstrations on residential lawn care, seek green lawn care for the public schools
- Partner with Friends of the North Fork to hold septic education classes in elementary schools with take home information on maintenance
- Seek funding and a coordinator from the VA Department of Forestry for a student/volunteer work and education day at Broadway Park to create a riparian buffer along Linville Creek
- Request that Broadway's future stormwater management plan include the multiple barrier practices approach so that rain gardens, grassed swales, pervious surfaces and other alternatives to storm drains and retention ponds are used
- Promote low impact development in new construction
- When the Linville Creek TMDL reaches the implementation phase, urge a residential/urban education program and see funding from Broadway and other sources to add an additional 10% cost share payment to farmers for water quality practices, and/or payment to farmers to replace streambank fencing that is flooded out in the Linville Creek watershed

STAKEHOLDER ROLES AND RESPONSIBILITIES

Stakeholders are individuals who live in, or have land management responsibilities in the watershed, including government agencies, businesses, private individuals and special interest groups. Stakeholder participation and support is essential for achieving the goals of this implementation effort.

Agricultural and Residential Property Owners

Local farmers will play a critical role in the implementation of this plan since pasture/hay and cropland make up the greatest portion of land in the watershed. Shenandoah Valley SWCD and NRCS staff will work to gain additional support of the BMPs recommended in this plan from the local farming community. As adoption of agricultural BMPs increases in the watershed, the agricultural community will have the opportunity to talk with their friends and neighbors about how these different BMPs have impacted their operations. Every farm is different, meaning that it will be important for farmers to have a clear idea of what will work best for their operation. The more examples they have available to them, and the more discussions they can have with neighbors and SWCD/NRCS staff, the greater local participation will be. Agricultural landowners will have to consider the costs of various BMPs when determining the extent that can be implemented on their farm and their own timeline for implementation. As noted by the agricultural working group, farmers in the watershed do not have unlimited resources to implement these practices, making technical and financial assistance critical in shaping their role in the implementation of this plan.

In addition to local farmers, participation from homeowners, developers, local government staff and elected officials is also critical to the success of this plan. Residential property owners will need to make significant changes in their behavior including management of pet waste, mowing and landscaping practices in riparian areas, and septic system maintenance. Although the amount of bacteria that is coming from failing septic systems and straight pipes is minimal compared to livestock, human waste carries with it pathogens that can cause serious health problems above and beyond those associated with livestock manure.

Shenandoah Valley SWCD

During the implementation project, the SWCD will continue to reach out to farmers in the watershed and provide them with technical and financial assistance with conservation practices. Their responsibilities include promoting available funding and the benefits of BMPs and providing assistance in the survey, design, and layout of agricultural BMPs. The SWCD staff will conduct outreach activities in the watershed to encourage participation in conservation programs. Such activities include mailing out newsletters and organizing field days. The Shenandoah Valley SWCD covers a large region including Rockingham and Page Counties along with the City of Harrisonburg. While additional staff would be needed in order to focus outreach activities within the Linville Creek watershed, existing conservation technicians are available to work one on one with local farmers until funding is available to hire staff.

Natural Resources Conservation Service

NRCS offers a number of conservation programs to help people reduce soil erosion, enhance water supplies, improve water quality, increase wildlife habitat, and reduce damages caused by floods and other natural disasters. Public benefits include enhanced natural resources that help sustain agricultural productivity and environmental quality while supporting continued economic development, recreation, and scenic beauty. USDA (United States Department of Agriculture) programs that could fund agricultural BMPs in the watershed area include: Conservation Reserve Enhancement Program (CREP), Conservation Reserve Program (CRP), Environmental Quality Incentives Program (EQIP), Wetland Reserve Program, and Grassland Reserve Program.

Rockingham County and the Town of Broadway

As local governments in the Linville Creek watershed, Rockingham County and the Town of Broadway can play a significant role in the implementation of this plan. The town and the county can provide assistance with education and outreach to support implementation efforts as well as technical assistance with watershed mapping and contact database development. Local government staff and elected officials can also work to develop programs and ordinances that include pollution prevention measures such as enhanced stormwater management and erosion and sediment control BMPs for new construction. In addition, local government staff could work with conservation partners to implement riparian buffers and other stormwater and pet waste BMPs on public properties such as the town park in Broadway, which can serve as demonstration projects. The residential working group also discussed the need for pet waste disposal

receptacles where neighborhood pet waste stations are installed. A partnership could be established with the town and the county to empty receptacles if grant funding were located for their installation.

Virginia Cooperative Extension

Virginia Cooperative Extension (VCE) is an educational outreach program of Virginia's land grant universities (VA Tech and Virginia State University). VCE has an extensive network of highly skilled extension agents across the state, including five agents in Rockingham County. VCE could provide assistance with the delivery of agricultural conservation information at events such as farm tours and field days. As a trusted source of information within the agricultural community, their outreach events are typically well attended by the agricultural community.

Friends of the North Fork Shenandoah River

Friends of the North Fork Shenandoah River (FONFSR) is a nonprofit organization with an extensive network of volunteers and members throughout the North Fork Shenandoah watershed (including Linville Creek). FONFSR is engaged a number of activities that will support the implementation of this plan including water quality monitoring and education and outreach. Water quality monitoring currently underway by FONFSR volunteer monitors at the watershed outlet in Broadway will help to detect water quality improvements in Linville Creek over time. The organization has also considerable experience with septic system maintenance programs in the region, and could play a key role in the implementation of a similar program in the Linville Creek watershed. In addition, FONFSR has held a number of successful rain barrel and composter workshops in the area, making them well suited to help with outreach and implementation activities associated with both pet waste and stormwater BMP implementation.

Educational Institutions

A number of educational institutions were identified as potential partners in implementation efforts during the development of this plan. Suggestions included:

- Broadway High School
- J Frank Hilyard Middle School
- Linville Edom Elementary School
- Shenandoah Valley Governor's School
- Eastern Mennonite University
- James Madison University

While some of these partners are located within the Linville Creek watershed (e.g. Broadway High School), others are located just outside the watershed boundaries (Eastern Mennonite University, James Madison University). The development of cooperative partnerships with local schools and universities will strengthen education and outreach efforts throughout the community by engaging students, parents and teachers. Internship opportunities for students at James Madison and Eastern Mennonite

Universities should be explored by partner organizations including Rockingham County, DCR and DEQ. The Environmental Department within Rockingham County's Department of Community Development has previously offered internships to college students who are interested in ordinance and policy development as it deals with the Chesapeake Bay TMDL as well as learning about water quality and environmental site design in relation to land development. Future internship opportunities could be focused on stormwater and land use management in the Linville Creek watershed. In addition, local high school students could assist with volunteer tree plantings and other community events, and could work with teachers and administrators to create outdoor classrooms through the implementation of BMPs on their campus. Opportunities for mentorship programs between high school and middle/elementary school students could also be explored, focusing on water quality and environmental stewardship.

Environmental Protection Agency

The Environmental Protection Agency (EPA) has the responsibility for overseeing the programs developed in support of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are addressed through legislation, incentive programs, education, and legal actions. Currently, there are six state agencies responsible for regulating activities that impact water quality with regard to this Implementation Plan. These agencies include: DEQ, DCR, VDH, VCE, DOF (Department of Forestry), and Virginia Department of Agriculture and Consumer Services (VDACS).

Department of Environmental Quality

The Virginia Department of Environmental Quality (DEQ) has a lead role in the development of TMDL-IPs to address non-point source pollutants such as bacteria from straight pipes, failing septic systems, pet waste, agricultural operations, and stormwater that contribute to water quality impairments. DEQ provides available grant funding and technical support for the implementation of NPS (non-point source) components of TMDL-IPs. DEQ will work closely with project partners including the Shenandoah Valley Soil and Water Conservation District to track implementation progress for best management practices. In addition, DEQ will work with interested partners on grant proposals to generate funds for projects included in the implementation plan. When needed, DEQ will facilitate additional meetings of the steering committee to discuss implementation progress and make necessary adjustments to the implementation plan.

DEQ is also responsible for monitoring state waters to determine compliance with water quality standards, and for requiring permitted point dischargers to maintain loads within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. Beginning in 1994, animal waste from confined animal facilities in excess of 300 animal units (cattle and hogs) has been managed through a Virginia General Pollution Abatement permit. These operations are required to implement a number of practices to prevent groundwater contamination. In response to increasing demand from the public to develop new regulations dealing with animal waste, the Virginia General Assembly passed legislation requiring DEQ to develop regulations

for the management of poultry waste in operations having more than 200 animal units of poultry (about 20,000 chickens) in 1999 (ELI, 1999). On January 1, 2008 DEQ assumed regulatory oversight of all land application of treated sewage sludge, commonly referred to as biosolids. DEQ's Office of Land Application Programs within the Water Quality Division manages this program.

Department of Conservation and Recreation

The Virginia Department of Conservation and Recreation (DCR) administers the Virginia Agricultural Cost Share Program, working closely with Soil and Water Conservation Districts to provide cost share and operating grants needed to deliver this program at the local level. DCR works with the SWCDs to track BMP implementation as well. In addition, DCR administers the state's Nutrient Management Program, which provides guidelines and technical assistance to producers in appropriate manure and poultry litter storage and application, as well as application of commercial fertilizer.

Virginia Department of Agriculture and Consumer Services

Through Virginia's Agricultural Stewardship Act, the VDACS Commissioner of Agriculture has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis (Pugh, 2001). If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken which can include a civil penalty up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. The enforcement of the Agricultural Stewardship Act is entirely complaint-driven. This Act is considered as a state regulatory tool that can support implementing conservation practices to addresses pollutant sources in TMDL impaired watersheds even though the Act does not specifically reference pathogens as a pollutant.

Virginia Department of Health

VDH is responsible for maintaining safe drinking water measured by standards set by EPA. Their duties also include septic system regulation and, in the past, regulation of biosolids land application. Like VDACS, VDH's program is complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation that may take many weeks or longer to effect compliance. In the scheme of this IP, VDH has the responsibility of enforcing actions to corrector eliminate failed septic systems and straight pipes, respectively. VDH staff also issue permits for the repair and installation of septic systems and the installation of alternative waste treatment systems.

INTEGRATION WITH OTHER WATER QUALITY PROGRAMS AND ACTIVITIES

Each watershed in the state is under the jurisdiction of a multitude of water quality programs and activities, many of which have specific geographic boundaries and goals. Coordination of the implementation project with these existing programs could make additional resources available and increase participation by local landowners.

Rockingham County Comprehensive Plan

Preservation of natural resources is identified as a priority in Rockingham County's Comprehensive Plan. In addition, the vision for Rockingham County featured in this plan includes the county's rivers, creeks and groundwater resources in a state of "nearly natural condition." Several actions are listed in the Strategies, Policies, and Actions section of the plan that should be considered during the implementation of this TMDL implementation plan. These include:

- Pursue better mapping of floodplains in the County and re-examine floodplain regulations to ensure safety from flood damage.

- Explore the feasibility of the County performing its own source water assessments for the public water systems of its Towns and sanitary systems that use wells, with priority in karst areas; include the delineation of well recharge areas and an inventory of potential contaminant sources within these areas.

Rockingham County Stormwater Management Ordinance

The purpose of the Rockingham County's Stormwater Ordinance is to protect the lands and waters of the county through establishment of minimum stormwater management requirements and controls that must be followed during development. The county's ordinance is directly modeled after the current state ordinance for stormwater management developed by the Department of Conservation and Recreation. All design and technical criteria refer back to the Virginia State code as well as the Virginia Stormwater Management Handbook. A copy of the ordinance is available on the county's website at: http://www.rockinghamcountyva.gov/index.aspx?NID=383

Broadway and New Market Source Water Protection Plan

A Source Water Protection Plan (SWPP) was completed for the Towns of Broadway and New Market by the VA Rural Water Association in 2010. The plan was developed in partnership with a steering committee that included representatives from the agricultural community, the Broadway WWTP, the Food Processors Water Cooperative Inc., Neff Lumber Mills, Broadway High School, and Friends of the North Fork of the Shenandoah River. This plan includes the Linville Creek watershed and identifies potential groundwater pollutants in the watershed including malfunctioning septic systems, manure, surface runoff and streambank erosion. The primary goal of the plan is to protect valuable groundwater in the watershed from contamination. The plan includes a

series of education and outreach recommendations, which are described in detail in the Education and Outreach section of this implementation plan. A concerted effort should be made to integrate these recommendations with TMDL implementation outreach activities.

Virginia's Phase II Chesapeake Bay Watershed Implementation Plan

Virginia's Watershed Implementation Plan (WIP) outlines a series of BMPs, programs and regulations that will be implemented across the state in order to meet nitrogen, phosphorous, and sediment loading reductions called for in the Chesapeake Bay TMDL, completed in December, 2010. The TMDL is designed to ensure that all pollution control measures needed to fully restore the Bay are in place by 2025, with at least 60 percent of the actions completed by 2017. A number of the BMPs included in this implementation plan are also found in Virginia's WIP. Consequently, Clarke County will be able to track and receive credit for progress in meeting Phase II WIP goals while also working towards implementation goals established in this plan to improve local water quality. For more information about Virginia's Phase II WIP, please visit DCR's Bay TMDL webpage: http://www.dcr.virginia.gov/vabaytmdl/index.shtml

Additional Natural Resource Management and Conservation Planning

There are a number of organizations working to implement natural resource management and land conservation plans in the watershed. The Virginia Department of Game and Inland Fisheries is currently working to implement the "Northern Bobwhite Quail Action Plan for Virginia," which includes a series of recommended management practices that will also help to improve water quality by reducing runoff and filtering out pollutants before they reach the stream. In addition, organizations like the Potomac Conservancy, Virginia Outdoors Foundation, Department of Forestry, Department of Historic Resources, and the Valley Conservation Council are working to preserve agricultural land in the watershed through conservation easements. These easements can include some form of riparian buffer protection, and also help to ensure the longevity of efforts made to implement conservation practices on agricultural land. Whenever possible, efforts should be made to integrate the implementation of these and other conservation-related plans that will impact water quality with this plan for Linville Creek and its tributaries.

FUNDING FOR IMPLEMENTATION

A list of potential funding sources available for implementation has been developed. Detailed descriptions can be obtained from the Shenandoah Valley SWCD, DCR, Natural Resources Conservation Service, and Virginia Cooperative Extension. While funding is being provided to the Shenandoah Valley SWCD for agricultural BMPs and technical assistance for farmers, an additional funding commitment is needed to fully implement the agricultural and residential practices included in the plan.

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state and federal monies through local SWCDs. SWCDs administer the program to encourage farmers and landowners to use BMPs on their land to better control 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 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. 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. 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 Agricultural Best Management Practices Loan Program

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

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through DEQ, 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 loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with repayment terms based on the borrower's ability to repay and the life of the equipment being purchased or the life of the BMP being implemented. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants

for point sources are administered through DEQ and grants for nonpoint sources are administered through DCR.

Conservation Reserve Program (CRP)

Through this program, cost-share assistance is available to establish cover of trees or herbaceous vegetation on cropland. 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. The payment to the participant is up to 50% of the cost for establishing ground cover.

Conservation Reserve Enhancement Program (CREP)

This program is an "enhancement" of the existing Farm Service Agency (FSA) CRP Continuous Sign-up. It has been "enhanced" by increasing the rental rates, and offering incentive payments to place the enrolled area under a 10-15 year contract. The average cost share payment in this program is 75%; however, additional incentives are available to raise this rate if a landowner is willing to install additional control measures. Pasture and cropland adjacent to streams, seeps, springs, ponds and sinkholes are eligible to be enrolled. Buffers consisting of native, warm-season grasses on cropland, and mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30% of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Federal cost-sharing (50%) 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. The Shenandoah Valley SWCD also provides a cost share payment. The State of Virginia will make an additional payment to landowners who elect to place a perpetual easement on the enrolled area.

Environmental Quality Incentives Program (EQIP)

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. The remaining 35% of the funds are directed toward statewide priority concerns of environmental needs. EQiP offers up to 10-year contracts to landowners and farmers to provide financial assistance, 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.

EPA Section 319 Grant Project Funds

Through Section 319 of the Federal Clean Water Act, Virginia is awarded grant funds to implement NPS programs. The DCR administers the money annually on a competitive grant basis to fund TMDL implementation projects, outreach and educational activities, water quality monitoring, and technical assistance for staff of local sponsor(s) coordinating implementation. In order to meet eligibility criteria established for 319 funding, all proposed project activities must be included in the TMDL implementation

plan covering the project area. In addition, this plan must include the nine key elements of a watershed based plan identified by EPA (see Guidance Manual for TMDL Implementation Plans, VA Departments of Conservation and Recreation and Environmental Quality, July 2003).

Chesapeake Bay Watershed Initiative

This initiative was authorized in the 2008 Farm Bill for 2009-2012. It provides technical and financial assistance to producers to implement practices that reduce sediment and nutrients to help protect and restore the Chesapeake Bay. Priority has been given to the Shenandoah and Potomac River Basins and selected watersheds that have impaired streams due to high levels of nutrients and sediment. Producers who live in an NRCS high priority Chesapeake Bay watershed receive additional consideration.

Wildlife Habitat Incentive Program (WHIP)

WHIP is a voluntary program for landowners who want to develop or improve wildlife habitat on private agricultural lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field borders and hedgerows.

Wetland Reserve Program (WRP)

This program is a voluntary program to restore and protect wetlands on private property. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities.

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

The mission of this project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. Staff members of other community organizations complement the SE/R-CAP 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.

National Fish and Wildlife Foundation

Grant proposals for this funding are accepted throughout the year and processed during fixed sign up periods. There are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. Grants generally range between $10,000 and $150,000. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (http://www.nfwf.org). If the project does not fall into the criteria of any special grant programs, a proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

Virginia Natural Resources Commitment Fund

This fund was established in the Virginia Code as a subfund of the Water Quality Improvement Fund in 2008. Monies placed in the fund are to be used solely for the Virginia Agricultural BMP Cost Share Program as well as agricultural needs for targeted TMDL implementation areas.

Clean Water State Revolving Fund

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

LIST OF ACRONYMS

303(d)	A section of the Clean Water Act requiring a TMDL priority list and report
319	A section of the Clean Water Act grant funds for NPS programs
BMP	Best Management Practice
CREP	Conservation Reserve and Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
CWSRF	Clean Water State Revolving Funds
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality

DOF	Virginia Department of Forestry
EPA	Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
FONFSR	Friends of the North Fork Shenandoah River
FOSR	Friends of the Shenandoah River
FSA	Farm Service Agency
IP	Implementation Plan
NFWF	National Fish and Wildlife Foundation
NPS	Nonpoint Source Pollution
NRCS	Natural Resources Conservation Service
LE-1T	Grazing Land Protection System
LE-2T	Livestock Exclusion with Reduced Setback for TMDL Implementation
SE/R-CAP	Southeast Rural Community Assistance Project
SPCA	Society for the Prevention of Cruelty to Animals
SVSWCD	Shenandoah Valley Soil and Water Conservation District
SWCD	Soil and Water Conservation District
TMDL	Total Maximum Daily Load
VASCI	Virginia Stream Condition Index
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDH	Virginia Department of Health
WHIP	Wildlife Habitat Improvement Program
WIP	Watershed Implementation Plan
WP-2T	Streambank Protection
WQMIRA	Water Quality Monitoring, Information, and Restoration Act
WRP	Wetland Reserve Program

LIST OF CONTACTS

Central Shenandoah PDC (540) 885-5174
112 MacTanly Place
Staunton, VA 24401

Friends of the North Fork of the Shenandoah River (540) 459-8550
122 S Commerce Street
Woodstock, VA 22664

Friends of the Shenandoah River (540) 665-1286
1460 University Drive/ Gregory Hall
Winchester, VA 22601

Harrisonburg NRCS (540) 433-9126
1934 Deyerle Ave.
Harrisonburg, VA 22801

Rockingham County Government 250 E. Elizabeth St. # 114 Harrisonburg, VA 22802	(540) 574-5120
Rockingham County Health Department 110 N. Mason St. Harrisonburg, VA 22802	(540) 574-5101
Shenandoah Pure Water Forum James Madison University, MSC 4102 800 South Main Street Harrisonburg, VA 22807	NA
Shenandoah Valley Soil and Water Conservation District 1934 Deyerle Ave. Harrisonburg, VA 22801	(540) 433-2853
Town of Broadway 116 Broadway Ave.; P.O. Box 156 Broadway, VA 22815	(540) 896-5152
Virginia Cooperative Extension Service, Rockingham Co. 965 Pleasant Valley Road Harrisonburg, VA 22801	(540) 564-3080
Virginia Dept. of Agriculture and Consumer Services P.O. Box 1163 Richmond, VA 23218	(804) 786-3501
Virginia Dept. of Conservation and Recreation Staunton Regional Office PO Box 1 Verona, VA 24482	(540) 332-9238
Virginia Dept. of Environmental Quality Valley Regional Office 4411 Early Rd. Harrisonburg, VA 22801	(540) 574-7800