
DRAFT

**Moore's Creek
Fecal Coliform TMDL
Implementation Plan**

**Prepared by the Thomas Jefferson Planning District Commission
for the
Virginia Department of Environmental Quality
and the
Virginia Department of Conservation and Recreation**

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1.0 Executive Summary

This document serves as the Total Maximum Daily Load (TMDL) implementation plan (IP) for Moore's Creek in Albemarle County and the City of Charlottesville, Virginia. The Moore's Creek watershed covers 34.92 square miles of Albemarle County and the City of Charlottesville, Virginia. The creek forms much of the southern boundary of Charlottesville, draining the southern part of the city and parts of Albemarle County to the south and west of the city. The watershed is predominantly forested, with residential areas, grasslands, and urban areas the other major land uses. The total length of the creek is approximately 11 miles; the segment listed as not meeting Virginia's fecal coliform standard for contact recreational use is a 6.37-mile reach from the intersection of US Route 29 and County Route 1106 to the confluence of Moore's Creek with the Rivanna River, of which it is a tributary. Water quality sampling on Moore's Creek between August 1991 and January 2002 found that 14.5% of the water samples violated the instantaneous fecal coliform standard of 1,000 cfu/100 ml and that the 30-day geometric mean standard of 200 cfu/100 ml was violated 59% of the time.

When streams fail to meet standards, Section 303(d) of the CWA and the U.S. Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130) requires states to develop TMDLs 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. The TMDL for Moore's Creek was prepared by the Department of Civil Engineering at the University of Virginia and the Thomas Jefferson Planning District Commission, and submitted to EPA by Virginia's Department of Environmental Quality (DEQ) and Department of Conservation and Recreation (DCR). EPA approved the Moore's Creek TMDL in May 2002. A modeling approach was used to simulate flow and the fate and transport of fecal coliform bacteria in the Moore's Creek watershed. Once the water quality model was calibrated to the observed fecal coliform concentrations, allocation scenarios were generated for the base case in 2010 and various coliform load reductions. The allocation scenario that met the TMDL target called for the removal of all non-permitted human sources (straight pipes, sewer system leakage, and failing septic systems) and all cattle from the stream, as well as reductions in grassland, residential, and urban loads. The required reduction to meet the TMDL of all nonpoint source contributions (direct to stream and land based; human controlled and background) is 31.8% compared to current contributions or 34.6% compared to the base case future contributions.

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. These measures are implemented in a staged process that is described along with specific BMPs in the IP. The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (WQMIRA), which outlines the following required components:

- Date of expected achievement of water quality objectives;
- Measurable goals;
- Necessary corrective actions;

- Associated costs, benefits, and environmental impact of addressing the impairment.

In addition, EPA has recommended specific elements of IPs, and required components of an IP in order for agencies in the affected watershed to receive Clean Water Act Section 319 nonpoint source grants.

Development of the Moore's Creek IP included two public meetings and the participation of a technical committee. Members of the technical committee included representatives from Albemarle County, the Albemarle County Service Authority (ACSA), the City of Charlottesville, the Albemarle and Virginia Farm Bureaus, The Nature Conservancy (TNC), the Rivanna Water and Sewer Authority (RWSA), the Southern Environmental Law Center, the Thomas Jefferson Soil and Water Conservation District (TJSWCD), the University of Virginia (UVA), and the Virginia Department of Health (VDH), as well as a local developer and an interested citizen from the Belmont neighborhood. Much of the Moore's Creek IP is based on plans and studies completed by the agencies represented on the committee.

Implementation actions in the IP include:

- Agricultural best management practices (BMPs)
- Stream bank protection and stabilization projects
- Stormwater best management practices
- Sanitary sewer system improvements
- Correction of failing septic systems and straight pipes
- Education programs
- Planning activities
- Maintenance activities

The TMDL calls for the removal of all cattle from the stream, and a reduction in inputs from grassland of 30% (85% for the subwatershed containing the Charlottesville stockyard). A field survey of livestock was conducted in order to determine the location of cattle and other livestock in the watershed. The results of the field survey of livestock were used to target parcels that would benefit from the application of agricultural BMPs such as alternative watering systems, stream fencing and buffer planting. Animal exclusion has a 75% bacterial removal efficiency, while installation of forested buffers results in 43-57% removal of bacteria. The owners of the identified parcels will be approached by the TJSWCD with regard to participating in the voluntary cost-share programs administered by the SWCD for the installation of BMPs. Albemarle County's Stream Assessment Program identified some additional buffer projects on pasturelands. Also, funding will be sought to provide fencing, a stream buffer, and a manure cover at the stockyard.

In addition to identifying buffer projects, Albemarle County's Stream Assessment Program made detailed assessments of stream restoration work and protection needed. It considered severity, feasibility, and consistency with master plans and community goals. The seven projects that rated highest have been listed in the IP. Stream bank protection

and stabilization projects have been found to be 40-75% efficient for bacterial removal (40% without fencing, 75% with fencing).

The TMDL calls for a reduction in contributions from urban land uses of 45-50%. One way to address runoff from urban land uses is by the use of stormwater best management practices. Both Albemarle County and Charlottesville now have ordinances that require the use of stormwater BMPs for new development. The urban part of the watershed, by its very nature of being urban and therefore tightly developed, will be challenging to retrofit. Two initiatives, the 1996 Moore's Creek Watershed Study and the 2002 Albemarle County Stormwater Management Master Plan, were unable to identify any locations for regional stormwater BMPs to mitigate existing development. On existing urban lands, the reductions called for in the TMDL will be achieved through sanitary sewer and septic system improvements (see Sections 6.4 and 6.5) and educational programs (see Section 6.6) rather than through regional stormwater BMPs. Some stormwater BMPs are planned for University of Virginia property in the watershed. It is expected that the BMPs, although primarily designed to mitigate new construction, will also in some cases provide treatment over and above that which is needed for the new construction.

The TMDL calls for 100% removal of sewer leakage. Charlottesville Public Works has several projects, both ongoing and planned, which will decrease infiltration/exfiltration and overflows. These projects include manhole relining, smoke/dye testing of sewer lines, and upgrading the line serving UVA's Scott Stadium, which is a known source of sanitary sewer overflows. UVA also recently relined the sewage surge tank located at Scott Stadium. Additionally, Charlottesville has initiated an effort (October 2004) that will provide necessary information to comply with proposed Capacity, Management, Operations and Maintenance (CMOM) requirements found in Section 122.42(e)(2) of the Federal Register.

The TMDL also calls for 100% reduction in non-point source pollution (NPS) from septic systems. One way that this may be addressed is by hooking up areas with large concentrations of failing septic systems to public sewer. The Albemarle County Service Authority (ACSA) has several projects listed in its Capital Improvement Plan (CIP) that would address areas in the Moore's Creek should they be identified as problems. The first project, involving extension of sewer to the Southwood Mobile Home Park (MHP) package plant, has already been completed. The plant is scheduled to connect to the public sewer before the end of 2004. Four potential collection system projects that would address areas with aging drainfields have also been identified, but would depend on commitments from the homeowners as well as supplemental financing to become a reality.

In order to address failing septic systems that will not be able to be addressed by public sewer hook-ups, as well as straight pipes (plumbing systems that discharge directly to a stream), detection methods and assistance plans will need to be developed. Many of the homes with failing septic systems or straight pipes may be unable to afford to correct them. Education is another need in this area; many owners are unaware of the need for

regular pumping and system maintenance. Purchasers of existing homes on septic systems may not even be aware that their homes are on them. One major concentration of known failing septic systems is located within the Southwood MHP, which is being required to pump them temporarily and to repair them within 12 months.

Albemarle, Charlottesville and UVA all have included public education and outreach as part of the control measures in their NPDES (National Pollutant Discharge Elimination System) Phase II Stormwater Permits. One of the primary activities is a collaborative one – the formation of a stormwater education partnership and website which includes Charlottesville, Albemarle, UVA, RWSA and VDOT. Other education activities include presentations to groups, development of brochures and fact sheets, and work with the schools to dovetail stormwater and water quality education with Standards of Learning. Albemarle County has contracted with the TJSWCD to fulfill its public education, outreach, and involvement components. Albemarle County will additionally be developing educational materials for BMP owners, and the TJSWCD is interested in the development of an education program for septic system owners, should funds become available. Other critical needs for education include pet waste management and appropriate wildlife interaction (for example, feeding the geese found at many of the ponds in the watershed encourages greater populations of geese than the ponds can reasonably sustain). All of these programs are currently limited in terms of the funding and staff time devoted.

Again as a result of NPDES Phase II, Charlottesville, Albemarle and UVA have increased emphasis on stormwater planning. As stated above, UVA has already developed a stormwater master plan and is in the process of implementing and integrating it into the University's long-range development plans. Albemarle is still working on a watershed master plan and watershed action lists. Charlottesville has reviewed, amended, and adopted City Code addressing improvements to the erosion and sediment control program, stream protection (including the establishment of a 100-foot buffer along Moore's Creek), stormwater management, and illicit discharge detection and elimination. All three entities are committed to using new development and redevelopment as opportunities for stream restoration and regional BMPs.

Illicit discharge detection and elimination is a required minimum control measure under NPDES Phase II. As a result, Albemarle, Charlottesville and UVA all include the enactment of an illicit discharge ordinance to prohibit non-stormwater discharges into the stormwater system, the development of a plan to detect and address non-stormwater discharges, and inspection of storm sewer outfalls during dry weather in their permits. Much of this work will be carried out by the TJSWCD for Albemarle County as part of its contract with them. NPDES Phase II also requires the establishment of pollution prevention plans for municipal and public facilities. Charlottesville and Albemarle have additionally established a pollution prevention hotline.

The ultimate goal of this implementation plan is to bring Moore's Creek into compliance with water quality standards, which will result in its removal from the 303(d) list of impaired waters. This goal will be measured by the concentration of fecal coliform and

E. coli in samples, but milestones along the way will include both water quality measurements and the implementation of best management practices. Implementation goals must keep in mind the TMDL allocation goals. The TMDL called for 100% reduction in direct cattle and straight pipe inputs, septic NPS, and sewer leakage. It also called for reductions in contributions from land uses equivalent to removal of the impact from 118 acres of low-density residential land, 827 acres of medium-density residential land, 771 acres of grassland, and 1070 acres of urban land. At the same time, practicality must be considered. For example, retrofitting urban land can be difficult and costly, as urban areas have few sites suitable for the construction of large-scale BMPs. The construction of BMPs in the urban area will be to some extent dependent on opportunities presented during redevelopment.

DEQ will monitor the creek bimonthly for fecal coliform and E. coli at its established monitoring location, which is the bridge crossing the creek at the Moore's Creek WWTP (upstream of the plant outfall). Additionally, RWSA is willing to take monthly fecal coliform samples at the same site. The StreamWatch monitoring program has expressed interest in expanding its mission to include the use of ColiScan® Easygel® for E. coli sampling throughout the Rivanna watershed, and may be another resource for sampling within the Moore's Creek watershed.

As many significant implementation activities will have been completed by 2009, it is projected that water quality will have improved at least 50% by then. However, several significant sewer hookup projects will probably occur later, and it is likely that other projects will remain outstanding as well. It is not expected that water quality standards will be met until those projects are complete.

Stakeholders are individuals who live 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 TMDL effort (i.e., improving water quality and removing Moore's Creek from the impaired waters list). Representatives of a number of stakeholder agencies were included in the technical committee for the IP.

This implementation plan has drawn directly from some existing plans and programs, and has been impacted by or may impact others. Plans and programs that were particularly important in the development of this plan include the NPDES Phase II Stormwater Permit program, ACSA's Capital Improvement Plan, Albemarle County's Stream Assessment Program and Stormwater Management Master Plan, and Charlottesville's Water Protection Ordinance.

A number of the activities outlined in this implementation plan, particularly those relating to NPDES permits, will be carried out as part of the regular budgets of Albemarle, Charlottesville, and UVA. Others, such as the sewer line extensions outlined in the ACSA Capital Improvement Plan, may eventually be accomplished through the regular budget process but could be accomplished much more quickly if outside funding were obtained. And some, such as the development of an assistance program for owners of

failing septic systems, are unlikely to occur without outside funding. Sources of outside funding include grant programs such as the Chesapeake Bay Small Watershed Grants Program and EPA's Section 319 program, cost-share programs such as the Conservation Reserve Enhancement Program and Virginia Agricultural Best Management Practices Cost-Share Program administered by the SWCDs, mitigation funds such as the Virginia Aquatic Resources Trust Fund, and loan programs such as the Virginia Water Facilities Revolving Loan Fund.

2.0 Introduction

This document serves as the Total Maximum Daily Load (TMDL) implementation plan (IP) for Moore's Creek in Albemarle County and the City of Charlottesville, Virginia. The Moore's Creek watershed covers 34.92 square miles of Albemarle County and the City of Charlottesville, Virginia. The creek forms much of the southern boundary of Charlottesville, draining the southern part of the city and parts of Albemarle County to the south and west of the city. The watershed is predominantly forested, with residential areas, grasslands, and urban areas the other major land uses. The total length of the creek is approximately 11 miles; the segment listed as not meeting Virginia's fecal coliform standard for contact recreational use is a 6.37-mile reach from the intersection of US Route 29 and County Route 1106 to the confluence of Moore's Creek with the Rivanna River, of which it is a tributary.



The creek was first listed on Virginia's 303(d) list of impaired waters list in 1998, as required by federal law. The Clean Water Act (CWA) that became law in 1972 requires that all U.S. streams, rivers, and lakes meet certain water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of beneficial uses. According to Virginia Water Quality Standards (9 VAC 25-260-10), "all state waters are designated for the following uses: recreational uses (e.g., swimming and boating); the propagation and growth of a balanced indigenous population of aquatic life, including game fish, which might be reasonably expected to inhabit them; wildlife; and the production of edible and marketable natural resources (e.g., fish and shellfish)".

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

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in the stream. These measures are implemented in a staged process that

is described along with specific BMPs in the implementation plan. The scope of this IP includes agricultural BMPs, stream buffer and restoration projects, measures to address leaking sewer systems, failing septic systems and straight pipes, and education programs. Details include measurable goals and milestones, stakeholders' roles and responsibilities, and potential funding sources.

The listing for Moore's Creek was done under the fecal coliform bacteria standard that had been in effect from 1987-2003. This standard (9 VAC 25-260-170) stated:

"...the fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a 30-day period, or a fecal coliform bacteria level of 1,000 per 100 ml at any time."

In January 2003, a new *E. coli* standard and an interim fecal coliform standard were instituted. The changes bring Virginia in line with EPA criteria issued in 1986. The interim standard states:

"Fecal coliform bacteria shall not exceed a geometric mean of 200 fecal coliform bacteria per 100 ml of water for two or more samples over a calendar month nor shall more than 10% of the total samples taken during any calendar month exceed 400 fecal coliform bacteria per 100 ml of water. This criterion shall not apply for a sampling station after the bacterial indicators described in subdivision 2 of this subsection have a minimum of 12 data points or after June 30, 2008, whichever comes first."

The applicable indicator for Moore's Creek and all freshwater bodies will ultimately be *E. coli*, with a mean of 126 and a maximum of 235 bacteria per 100 ml of water. Prior to and during the TMDL study, only fecal coliform (and not *E. coli*) was measured. During implementation, monitoring of fecal coliform will continue to allow comparisons with previously collected data. *E. coli* will also be monitored during implementation to evaluate success against the interim *E. coli* water quality standard.

3.0 State and Federal Requirements for Implementation Plans

There are a number of state and federal requirements and recommendations for TMDL IPs. This chapter has three sections that discuss the a) requirements outlined by the Water Quality Monitoring, Information, and Restoration Act (WQMIRA) that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) EPA recommended elements of IPs, and c) required components of an IP in accordance with Section 319 guidance.

3.1 State Requirements

The TMDL IP is a requirement of Virginia's 1997 Water Quality Monitoring, Information, and Restoration Act (§62.1-44.19:4 through 19:8 of the Code of Virginia), or WQMIRA. WQMIRA directs the Virginia Department of Environmental Quality (DEQ) 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;
- Associated costs, benefits, and environmental impact of addressing the impairment.

3.2 Federal Recommendations

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

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

The Guidance Manual for Total Maximum Daily Load Implementation Plans, published by the Virginia Department of Conservation and Recreation (DCR) and Virginia DEQ, strongly suggests that the EPA recommendations be addressed in the IP (in addition to the required components as described by WQMIRA).

3.3 Requirements for Section 319 Fund Eligibility

EPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to states. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003"

identifies the following nine elements that must be included in the IP to meet the 319 requirements:

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

4.0 Review of TMDL Development

Water quality sampling on Moore's Creek between August 1991 and January 2002 found that 14.5% of the water samples violated the instantaneous fecal coliform standard of 1,000 cfu/100 ml and that the 30-day geometric mean standard of 200 cfu/100 ml was violated 59% of the time. Samples were taken upstream of the Rivanna Water and Sewer Authority (RWSA) wastewater treatment plant bridge by both DEQ and RWSA. Table 4.1 summarizes the sampling done on Moore's Creek prior to TMDL development.

Table 4.1. Fecal coliform bacteria sampling in Moore's Creek 8/91 – 1/02

Entity	Sampling dates	Number of samples	Maximum value	% violations of instantaneous criterion	% violations of 30-day mean geometric criterion
DEQ	8/91 – 1/02	45	2,600 cfu/100 ml	20%	--*
RWSA	10/97 – 1/02	218	200,000 cfu/100 ml	13%	59%

*DEQ's sampling frequency was insufficient for calculation of the 30-day geometric mean.

Due to the high percentage of violations (over 10%) the stream was placed on Virginia's 1998 303(d) list of impaired waters. A 6.37-mile reach from the intersection of U.S. Route 29 and County Route 1106 to the confluence of the Rivanna River was listed as impaired due to elevated levels of fecal coliform bacteria.

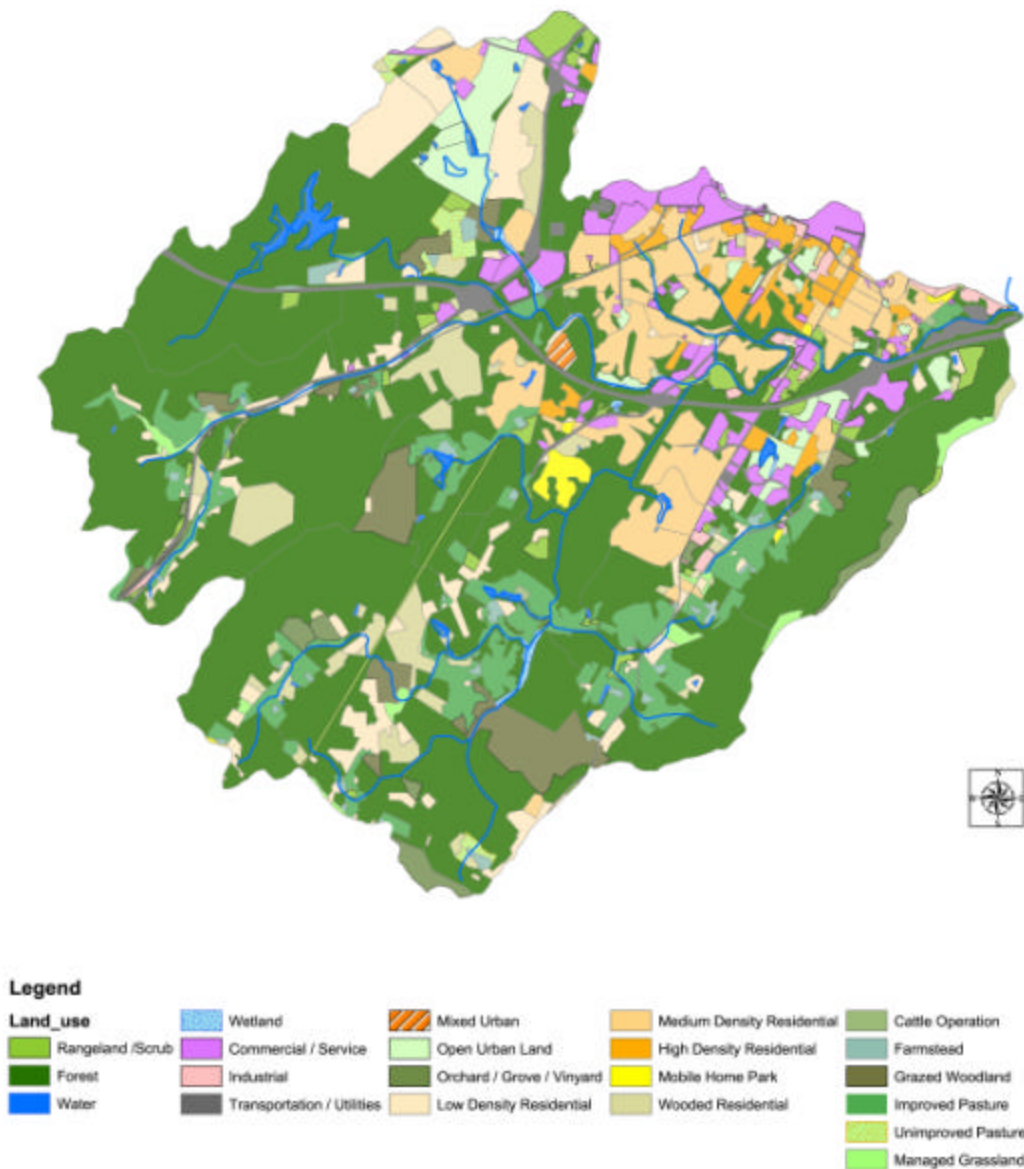
In response to the impairment, a TMDL for fecal coliform bacteria was developed for Moore's Creek. The TMDL took into account all sources of fecal coliform bacteria, including background sources, considered critical conditions and seasonal variability, and included a margin of safety. Community participation was encouraged throughout the process. The TMDL was prepared by the Department of Civil Engineering at the University of Virginia and the Thomas Jefferson Planning District Commission, and submitted to EPA by DEQ and DCR. EPA approved the TMDL for Moore's Creek in May 2002.

4.1 Bacteria Sources and Loading

Fecal coliform bacteria originate from all warm-blooded animals and can contaminate a stream from both point and nonpoint sources. In the Moore's Creek watershed, fecal coliform bacteria are discharged from two point sources, the Moore's Creek Advanced Wastewater Treatment Plant, operated by the RWSA, and Southwood Mobile Home Park, which operates its own package treatment plant. The average fecal coliform concentration in the Moore's Creek Plant effluent is 17 cfu/100 ml, and the average volume of outflow is 11 million gallons per day. This facility discharges just downstream from the state water quality monitoring site. The Southwood Mobile Home Park is located along Biscuit Run upstream of the water quality monitoring site. At the time of the TMDL, the facility was considered as maintaining its permitted discharge.

The plant has a permit limit of 200 cfu/100 ml and an average outflow of 39,000 gallons per day. The Facility is operating under a consent decree requiring the plant to hook up to the Albemarle County Service Authority (ACSA) system, thereby eliminating this point source.

Land use is varied in the Moore's Creek watershed. A digital map (Figure 4.x) was developed by TJPDC for the TMDL, based primarily on aerial photographs taken in March 2000. Land cover includes 56.2% forest, 9.8% low-density residential, 8.6% medium-density residential, 14.7% grasslands, 9.9% urban, and 0.8% water. Nonpoint sources include background wildlife, livestock, pets, and humans. Major wildlife species are deer, geese, raccoons, muskrat, and beaver. Wildlife loads were applied to both the



land surface and as direct input to the stream. Although agriculture is not intensive in the Moore's Creek watershed, cattle, horses, and goats contributed to the fecal coliform load to the land. In addition, cattle had access to the stream at two sites, where direct cattle loads to the stream can occur. Pet loads are dominated by dogs. Human nonpoint source loads come from failing septic systems, straight pipes to the stream, and leakage from sanitary sewers. A bacterial source tracking study conducted by James Madison University (Wiggins, 2001) concluded that the system was dominated by wildlife impacts, ranging from 35% to 72%. The next largest source was found to be livestock, at 12% to 30%. Dogs (4% to 24%) and humans (2% to 17%) were lower, but typically above the minimum detection levels.

4.2 Modeling

The BASINS Nonpoint Source Model (NPSM) and the Hydrologic Simulation Program-FORTRAN (HSPF) were used to simulate flow and the fate and transport of fecal coliform bacteria in the Moore's Creek watershed. These models incorporate temporal and spatial variability within the watershed.

Due to a minimal amount of flow observations from Moore's Creek, an equivalent watershed approach and synthetic flow generation were used to calibrate the hydrological component of the models. The Buck Mountain Run watershed within the Rivanna drainage system was selected as an equivalent watershed, although a little less developed. The HSPF/NPSM model was calibrated to the Buck Mountain Run watershed for the five-year period between 10/1992 and 9/1997. A synthetic flow generator that combined an artificial neural network and a maintenance of variance approach (ANN + MV) was developed and demonstrated on the Buck Mountain Run watershed. The synthetic flow generator was then applied to the Moore's Creek system to create flow predictions for the period over which significant water quality and flow observations exist (10/1996 to 8/2001). The synthetic flow predictions not only accurately reproduced the observed flows on Moore's Creek, but also provided a continuous calibration target for the NPSM/HSPF model on Moore's Creek. NPSM/HSPF parameters for the Buck Mountain Run watershed were adjusted to accurately reproduce the synthetic flows for the 5-year period.

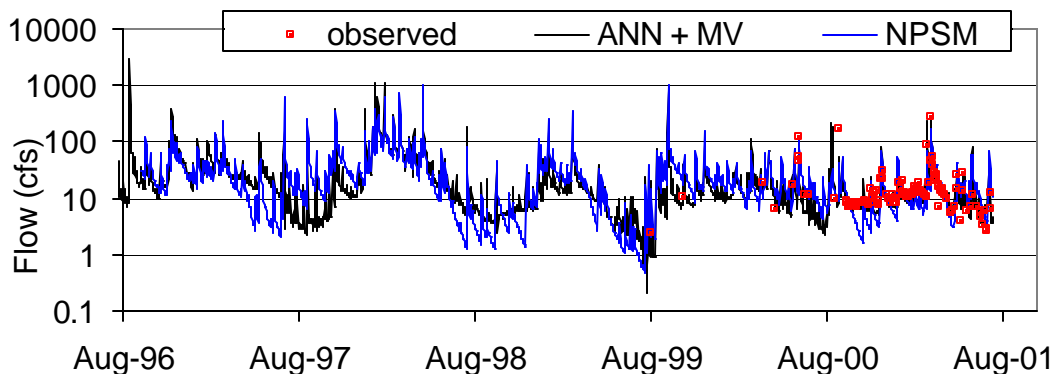


Figure 4.1 Comparison of NPSM predictions, synthetic flows and observed flows for Moore's Creek

The water quality model was then calibrated to the observed fecal coliform concentrations over the same 5-year period. The fecal coliform loads applied directly to the stream and to the land surface were calculated on a monthly basis to account for seasonal variability in wildlife populations and the varying time that cattle spend in the stream.

4.3 Results for Existing Conditions

Water quality predictions during the calibration period presented that under current conditions the instantaneous standard would be violated 18% of the time and the 30-day geometric mean criterion of 200 cfu/100ml would be violated 62.8% of the time. Of the bacteria that reached the stream, 40.1% were from wildlife, 34.1% from livestock, 19.4% from dogs, and 6.4% from human sources, although the relative proportions of these sources may shift, dependent on whether the stream was at low or high flows and with season.

4.4 Margin of Safety

The fecal coliform load in the TMDL is divided into three categories. One is the margin of safety (MOS). A margin of safety will be explicitly added by achieving concentrations 5% below the 30-day geometric mean criterion of 200 cfu/100 ml. The remaining allowable 190 cfu/100ml is divided between the allowable loading from point sources (termed the waste load allocation, WLA) and the allowable loading from nonpoint sources (termed the load allocation, LA).

4.5 TMDL Allocation Scenarios

Establishment of a TMDL is meant to provide a loading that will be protective of water quality in the future. Thus, future conditions were used for determination of the allowable load. Assumptions related to human population increase and land use changes were consistent with the current population growth rate of the county and the county development area plan.

For the base case for future land-based nonpoint source loads, the fecal coliform loading rates (counts/acre/month) for most land uses were held constant with the rates from the current conditions. The exception was for grasslands, which included pastures. Due to a rapid decline in livestock populations, the loading rate used for grasslands during the calibration period was not representative of the anticipated loading in the future. Therefore, the loading rate for grasslands for the base case was modified to be consistent with the 2002 population and distribution of livestock within the watershed. Overall, the grassland loading rates under future conditions averaged 53% of those used during the calibration period.

For the base case, future loads of coliform bacteria deposited directly in Moore's Creek will come from four sources: the two point sources and cattle and wildlife in the stream. Both point sources were modeled as discharging at their maximum permitted concentration of 200 cfu/100 ml and their expected average outflows. With the increase in population, the future average outflow from the Moore's Creek wastewater treatment

plant increases to 12 million gallons per day, while the flow volume from Southwood facility remains unchanged. The direct load from cattle in stream was also reduced due to loss of livestock from one of the stream access areas. Wildlife deposition directly to the stream was assumed unchanged from that determined for the present case simulations. Although some modifications to the wildlife populations and distribution are expected to be induced by land use alterations, some wildlife populations will decrease while others will increase. Thus changes in wildlife numbers tend to offset, leaving only a small impact, relative to the model uncertainty, on the total wildlife load deposited directly in the stream.

TMDL allocation scenarios were then generated by reducing the base case loads. The first step in building an allocation scenario was removal of all non-permitted human bacterial loads (straight pipes, sewer system leakage, and failing septic systems) and exclusion of cattle from the stream. These changes alone are insufficient to meet the TMDL goal. However, since untreated human waste should not be reaching the stream and allowing livestock access to the stream is an inappropriate management practice, these two steps were assumed in all other scenarios. Furthermore, adding extreme reductions in the remaining land-based loads from human activities was insufficient to meet the TMDL target.

In order to meet the TMDL target, a TMDL allocation that reduced both the direct wildlife loads to stream and the remaining land-based nonpoint source loads was developed. Reduction levels varied by subwatershed and by land use. Table 4.2 shows the recommended load reductions to meet the TMDL goal. As in previous scenarios, all non-permitted human sources were removed and cattle were removed from the stream. Some subwatersheds show zero reductions in one or more of these sources simply because there were no such sources in the subwatershed under base case conditions. Residential reductions were assigned to developed subwatersheds along or near the main stem of Moore’s Creek. Reductions in grassland loads were assigned to subwatersheds that still held significant numbers of livestock. The high percentage reduction to grasslands in subwatershed 9 assumes that the feral goat population will be removed and that best management practices will be put in place around the stockyard. For subwatersheds with a significant urban area, urban contributions were reduced from 45% to 50%, with the highest reductions assigned to the subwatersheds near the main stem of Moore’s Creek.

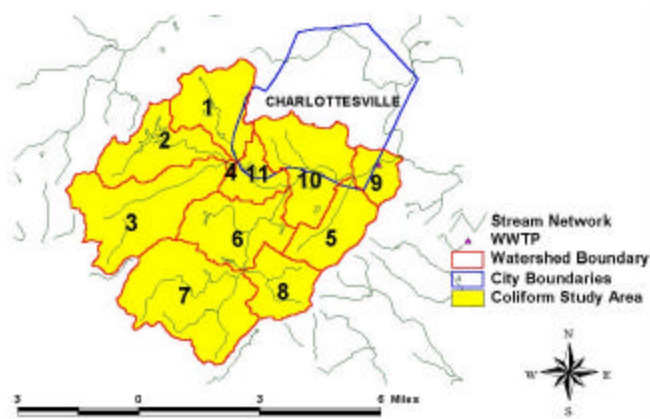


Table 4.2. TMDL load reductions for the Moore's Creek watershed. (SW# indicates subwatershed number.)

SW#	Percentage Reductions in Contributions from:					Other NPS: By Land Use				
	Direct Cattle	Straight Pipe	Septic NPS	Sewer Leakage	Direct Wildlife	Forest	Low-Density Resid.	Med-Density Resid.	Grass-land	Urban
1	0	100	100	100	40	0	0	0	0	45
2	0	0	100	0	40	0	0	0	0	45
3	100	100	100	0	40	0	0	0	30	45
4	0	0	0	0	40	0	0	0	0	0
5	0	0	100	100	40	0	30	30	30	50
6	0	100	100	100	40	0	40	40	30	45
7	0	100	100	0	40	0	0	0	30	0
8	0	0	100	0	40	0	0	0	30	0
9	0	0	100	100	40	0	50	50	85	50
10	0	0	0	100	40	0	50	50	0	50
11	0	0	0	100	40	0	50	50	0	50

The corresponding TMDL load allocations for the Moore's Creek watershed are shown in Table 4.3. The allocations are based on the total contributions to the stream. Each point source is allocated its permitted waste load allocation (WLA). The contribution from the Southwood Mobile Home Park (permit number VA0029955) load, at 200 cfu/100 ml and an average outflow of 39,000 gallons/day, is shown under WLA(SW), while the contribution from the Moore's Creek Advanced Wastewater Treatment Plant (permit number VA0025518) load, at 200 cfu/100 ml and an average flow of 12 million gallons per day, is shown under WLA(MC). These allocations require no reduction from the permitted point source loads, although any permit violations are assumed eliminated. Table 2 also shows the total allocation to nonpoint sources (SLA) and the load reserved as a margin of safety (MOS). To meet this TMDL, the required reduction of all nonpoint source contributions (direct to stream and land based; human controlled and background) is 31.8% compared to current contributions or 34.6% compared to the base case future contributions.

Table 4.3. TMDL load allocations (cfu/day)

WLA(SW)	WLA(MC)	ΣLA	MOS ^a	TMDL
0.01 x 10 ¹³	3.30 x 10 ¹³	61.41 x 10 ¹³	3.41 x 10 ¹³	68.13 x 10 ¹³

^aFive percent of the TMDL

5.0 Public Participation

Involvement in the implementation plan included two public meetings and the participation of a technical committee. Several members of the technical committee were recruited by calling appointed local government officials, telling them about the implementation plan, inviting them to the first public meeting, and asking them to name an appropriate staff person to the committee. Others joined the committee due to the IP's relationship to their work or simply due to their own interest. Formation of the technical committee began before the first public meeting.

5.1 Public Meetings

The first public meeting was held November 17, 2003 at the TJPDC offices in downtown Charlottesville. The public notice for this meeting appeared in the Virginia Register on November 3, 2003. The meeting was also advertised by posting a notice on the TJPDC website, by e-mailing a large distribution list including elected and appointed officials and representatives of numerous environmental groups, by getting listings in local events calendars, and by mailing a letter to every landowner along Moore's Creek or one of its major tributaries. Presentations by Robert Brent of DEQ, Rochelle Garwood of TJPDC, and Michael Bowman of DCR covered background information on the TMDL, the parts of an implementation plan, and elements for a successful implementation plan. About 15 people attended, primarily members of the technical committee. Copies of the presentation materials were available at the meeting and were posted on the TJPDC website afterwards. The public comment period ended on December 17, 2003. No written comments were received.

The second public meeting...

5.2 Technical Committee

Members of the technical committee included representatives from Albemarle County, the Albemarle County Service Authority (ACSA), the City of Charlottesville, the Albemarle and Virginia Farm Bureaus, The Nature Conservancy (TNC), the Rivanna Water and Sewer Authority (RWSA), the Southern Environmental Law Center, the Thomas Jefferson Soil and Water Conservation District (TJSWCD), the University of Virginia (UVA), and the Virginia Department of Health (VDH), as well as a local developer and an interested citizen from the Belmont neighborhood.

The initial technical committee meeting was a little over a week after the public meeting, on November 26, 2003. At this point the committee was still not fully formed, and one of the primary discussion topics was additional membership. Other organizational topics included the formation of subcommittees, but the technical committee members felt that the technical committee would never be sufficiently large to support breaking into smaller groups, and that too many of the members had interests that would cross subcommittee boundaries. The convening of a citizens' committee was considered as a possibility for later in the process, when the committee would have something to use as a point of discussion. The TMDL allocations by subwatershed were reviewed, sample IPs from other watersheds were discussed, and a table of allowable BMPs from the Guidance Manual for Total Maximum Daily Load Implementation Plans was distributed. Members

were encouraged to bring plans to the next meeting that their agencies had already completed that intersected with the IP.

At the next meeting, on January 7, 2004, the committee welcomed several new members. The primary topic of the meeting was Albemarle County's Stream Assessment, in which County staff walked approximately 100 miles of stream corridor, including Moore's Creek and many of its tributaries, and documented items that may contribute to stream degradation including erosional areas and questionable-looking discharge pipes.

By the February 20, 2004 meeting, a sufficient number of plans had been assembled to create a first draft of a table of BMPs for the Moore's Creek watershed. This table and possible additions were the major topics of discussion for the meeting. Members also looked over maps of bacterial counts and source tracking results from the bacterial source tracking study (Wiggins, 2001), but were baffled by the high percentage of bacteria attributed to goats. The committee concluded that the majority of bacteria attributed to goats must have been coming from elsewhere.

On April 15, 2004, the committee reviewed an expanded BMP table and discussed whether it was time to convene a citizen's committee. The consensus, however, was that there was little to be added to the table and that the most important consideration to be addressed by citizens was their receptivity to the proposed BMPs where they were directly affected. The committee decided that it was best to address that with the specific stakeholders that would be affected.

The May 5, 2004 meeting was a wrap-up on the BMP table and a discussion of funding sources. The stream buffer and restoration projects resulting from the Albemarle stream assessment appeared to have the most options for funding, with septic rehabilitation and sewer extension being among the more difficult. Results of a field survey of livestock in the watershed were reported; considerably fewer livestock were found in 2004 than had been reported in the TMDL. A subcommittee was created to look more closely at the stream buffer and restoration projects and potential livestock BMPs, some of which appeared likely to be co-located.

6.0 Implementation Actions

Because land uses in the Moore's Creek watershed cover the full range from rural to suburban to urban, implementation actions to be taken in the watershed likewise cover the full spectrum of practices. Proposed actions include agricultural BMPs, stream bank protection and stabilization, stormwater BMPs, sanitary sewer system improvements, septic problem and straight pipe detection and funding assistance programs, education programs, planning activities, and maintenance. Some of these actions are outlined in previously written plans; others are new actions proposed directly as a result of the TMDL.

6.1 Agricultural BMPs

The TMDL calls for the removal of all cattle from the stream, and a reduction in inputs from grassland of 30% (85% for the subwatershed containing the stockyard). A field survey of livestock was conducted in order to determine the location of cattle and other livestock in the watershed. The results of the field survey of livestock were used to target parcels that would benefit from the application of agricultural BMPs such as alternative watering systems, stream fencing and buffer planting. Animal exclusion has a 75% bacterial removal efficiency, while installation of forested buffers results in 43-57% removal of bacteria (TMDL Implementation Plan Guidance Manual). The owners of the identified parcels will be approached by the TJSWCD with regard to participating in the voluntary cost-share programs administered by the SWCD for the installation of BMPs. Since the field survey parcels plus the stockyard constitute all known locations of livestock in the watershed, 100% participation in the BMP programs should result in the desired reductions from cattle and grassland. Some of the parcels identified were also the sites of buffer projects identified by the Albemarle County Stream Assessment Project; additional buffer projects were identified on other pasturelands, which did not have animals in evidence at the time of the livestock survey but may be used at times.

Table 6.1 Agricultural projects identified through field survey

Animal Units	Also Identified by Albemarle County	BMPs Needed	BMP Units Needed	Sub-watershed	Cost Estimate	Potential Funding Source
16 cattle 4 horses	No	Fencing, buffer, alternative watering system		2		CREP, Cost-Share, EQIP
25 cattle	No	Fencing, buffer, alternative watering system	5050 linear ft (both sides)	3		CREP, Cost-Share, EQIP
32 cattle	Yes	Fencing, buffer, alternative watering system	2200 linear ft (both sides)	5	\$72,965 for 100' buffer	CREP, Cost-Share, EQIP

47 horses 2 donkeys	Yes	Fencing, buffer, alternative watering system	800 linear ft (both sides)	6	\$28,124 for 100' buffer	CREP, Cost-Share, EQIP
25 cattle	No	Fencing, buffer, alternative watering system	1250 linear ft of stream, 805 linear ft around pond	7		CREP, Cost-Share, EQIP
15 horses	No	Fencing, buffer, alternative watering system	312 linear ft of stream, 575 linear ft around pond	8		CREP, Cost-Share, EQIP

Table 6.2 Other projects on agricultural land

Project Location	BMPs Needed	BMP Units Needed	Sub-watershed	Estimated Cost	Potential Funding Source
Charlottesville stockyard	Fencing, stream buffer, and manure cover		9		Section 319
Pasture midway bet. Wingfield Brook & unnamed tribs	Stream buffer	800 linear ft (right side)	8	\$18,147	VA Aquatic Resources Trust Fund, Small Watershed Grants, Section 319
Pasture above conf. w/Moore's Ck	Stream buffer	400 linear ft (left side)	1	\$10,323	VA Aquatic Resources Trust Fund, Small Watershed Grants, Section 319
Pasture near Bellair	Stream buffer	300 linear ft (left side)	1	\$8,368	VA Aquatic Resources Trust Fund, Small Watershed Grants, Section 319

6.2 Stream Bank Protection and Stabilization

Stream bank protection and stabilization projects have been found to be 40-75% efficient for bacterial removal (40% without fencing, 75% with fencing; TMDL Implementation Plan Guidance Manual). Two studies, the Albemarle County Stream Assessment Program and the Rock Creek Stream Valley Master Plan, have made detailed assessments of stream restoration work and protection needed. However, the Rock Creek plan did not make assessments of feasibility or priority, and the budget for the entire stream valley of over \$1 million proved to be too much for Charlottesville and UVA, the study's sponsors. Further study would be needed to determine whether any of the restoration projects outlined in the plan would be practical. On the other hand, the Stream Assessment

program considered severity, feasibility, and consistency with master plans and community goals. Those projects that rated highest are listed below.

Table 6.3 Stream bank protection and stabilization projects from stream assessment

Proposed BMP	Description	Entity/Source	Stream Frontage	Sub-watershed	Estimated Cost
Biscuit Run erosion control	Below conf. w/Wingfield Brk	Alb Co SA & SMP	60 linear ft (left side)	6	\$24,787
Biscuit Run erosion control	Unnamed trib near Forest Lodge Ln	Alb Co SA & SMP	150 linear ft (both sides)	6	\$90,105
Morey Creek erosion control	Above conf. w/Moore's Ck	Alb Co SA & SMP	80 linear ft (left side)	1	\$26,287
Morey Creek erosion control	Near Buckingham Circle	Alb Co SA & SMP	900 linear ft (both sides)	1	\$313,637
Morey Creek erosion control	Below Bellair	Alb Co SA & SMP	500 linear ft (both sides)	1	\$124,974
Morey Creek erosion control	Near Bellair	Alb Co SA & SMP	150 linear ft (left side)	1	\$23,756
Moore's Creek erosion control	Below Azalea Park	Alb Co SA & SMP	600 linear ft (right side)	11	\$127,359

6.3 Stormwater Best Management Practices

The TMDL calls for a reduction in contributions from urban land uses of 45-50%. One way to address runoff from urban land uses is by the use of stormwater best management practices. Both Albemarle County and Charlottesville now have ordinances that require the use of stormwater BMPs for new development. The urban part of the watershed, by its very nature of being urban and therefore tightly developed, will be challenging to retrofit. Two initiatives, the 1996 Moore's Creek Watershed Study and the 2002 Albemarle County Stormwater Management Master Plan, were unable to identify any locations for regional stormwater BMPs to mitigate existing development. On existing urban lands, the reductions called for in the TMDL will be achieved through sanitary sewer and septic system improvements (see Sections 6.4 and 6.5) and educational programs (see Section 6.6) rather than through regional stormwater BMPs.

The University of Virginia, as a state agency, is required to implement stormwater BMPs for land disturbance projects and this activity is approved and monitored by the DCR. Through this program, the University developed a comprehensive stormwater management master plan for the portions of the Moore's Creek watershed that lie within the campus boundaries. This plan takes into account past, current, and planned projects and divides the watershed into sub-basins so that impacts to individual tributaries to Moore's Creek can be managed and in some cases reduced. All new development on the

university campus must meet quantity and quality limits established by this master plan. The plan also focuses on watershed restoration opportunities that can be incorporated into future development activities. The University intends to construct a number of stormwater BMPs in the Moore's Creek watershed over the next several years as the university expands its health sciences and academic facilities on the south side of the campus. As outlined in the master plan, these BMPs would likely include daylighting of streams; creation of wetlands, ponds and floodplains; vegetated buffers; and infiltration galleries. Specifics were unavailable at the time this plan was written, but it is expected that the BMPs, although primarily designed to mitigate new construction, will also in some cases provide treatment over and above that which is needed for the new construction.

6.4 Sanitary Sewer System Improvements

The TMDL calls for 100% removal of sewer leakage. Charlottesville Public Works has several projects, both ongoing and planned, which will decrease infiltration/exfiltration and overflows. These projects include manhole relining, smoke/dye testing of sewer lines, and upgrading the line serving UVA's Scott Stadium, which is a known source of sanitary sewer overflows. UVA also recently relined the sewage surge tank located at Scott Stadium. Additionally, Charlottesville has initiated an effort (October 2004) that will provide necessary information to comply with proposed Capacity, Management, Operations and Maintenance (CMOM) requirements found in Section 122.42(e)(2) of the Federal Register.

The TMDL also calls for 100% reduction in non-point source pollution (NPS) from septic systems. One way that this may be addressed is by hooking up areas with large concentrations of failing septic systems to public sewer. The Albemarle County Service Authority (ACSA) has several projects listed in its Capital Improvement Plan (CIP) that would address areas in the Moore's Creek should they be identified as problems. The first project, involving extension of sewer to the Southwood Mobile Home Park (MHP) package plant, has already been completed. The plant is scheduled to connect to the public sewer before the end of 2004. This plant serves approximately 195 mobile homes and is under a consent decree due to permit violations for flow volume, total suspended solids, and biological oxygen demand. The consent decree requires that Southwood complete repairs on the system to prevent inflow and infiltration and hook up to the public sewer no later than 180 days after plans are approved for the facility bypass. It then has 180 days to close its package plant completely.

Also in the Service Authority's CIP are collection system projects for several subdivisions in the Moore's Creek Basin. The first is within the Oak Hill subdivision, an older area that contains 75 drainfields adjacent to Biscuit Run. Although the Authority has indicated a willingness to participate in this project, construction depends on commitments from the homeowners as well as supplemental financing to become a reality. Three other projects, potentially serving 305 aging drainfields, are listed in the CIP but are also subject to homeowner and financing limitation. The total cost of all four proposed projects is estimated at \$4.7 million.

Table 6.4. Sanitary sewer system improvements

Proposed BMP	Description	Entity/Source	Scheduled	Area Treated	Sub-water shed	Estimated Cost	Potential Funding Source
Increase size of Valley Road collector line	Serves UVA Hospital area	Charlottesville Public Works	Not scheduled		10	~\$1,000,000	Charlottesville
Upgrade Stadium line	Known source of overflows	Charlottesville Public Works	First phase under design	1,080 ft	10	~\$3,200,000	Charlottesville
Manhole relining	Prevent infiltration/exfiltration	Charlottesville Public Works	Continuing	30% need relining; about 2/3 complete	10		Charlottesville
Smoke/dye testing of sewer lines		Charlottesville Public Works	Continuing	Basins 7, 8, & 9. Basin 12 approved for smoke testing. Basin 18 will be next.	10		Charlottesville
Biscuit Run oversizing/Southwood connection	Will enable connection of Southwood homes served by package plant	ACSA CIP/DEQ consent decree	Constructed 2004; connection of Southwood by 2005	180 trailers (for package plant)	6	NA	ACSA
Oak Hill sewer	Will connect failing septic	ACSA CIP & homeowners	As needed	75 drainfields	6	\$1,210,000 (may be built in sections)	
Stagecoach Rd/Forest View/Country Green/Oak Hill Trailer Park ext.	Will connect failing septic	ACSA CIP & homeowners	As needed and as funds become available	33 drainfields + 1 community drainfield for 19 trailers	6, 11	NA	
Buckingham Circle sewer	Will connect failing septic	ACSA CIP & homeowners	As needed	60 drainfields	1	\$344,000 (may be built in sections)	
Bellair Liberty Hill sewer	Will connect failing septic	ACSA CIP & homeowners	As needed	105 drainfields	1	\$1,093,000 (may be built in sections)	
Ednam Forest sewer	Will connect failing septic	ACSA CIP & homeowners	As needed	140 drainfields	1	\$2,014,000 (may be built in sections)	

6.5 Septic Systems and Straight Pipes

As previously mentioned, the TMDL called for 100% reduction in septic NPS; 100% reduction in straight pipes (pipes discharging directly to the stream) was required as well. The TMDL estimated 209 failing septic systems and seven straight pipes in the watershed. The TMDL calculated the proportion of failing septic systems according to the age of the house; using the same proportion of 40% of pre-1965 homes and 20% of homes built in 1965-1984, the projects outlined in Section 6.4 would address approximately 137 failing systems, not including the trailer park systems. This leaves an estimated 72 failing septic systems in the watershed that will not be able to be addressed by public sewer hook-ups, nor is it expected that straight pipes are to be found in the proposed sewer extension areas. Detection methods will need to be developed, as well as assistance plans, as many of the homes with failing septic systems or straight pipes may be unable to afford to correct them. The Thomas Jefferson Soil and Water Conservation District will develop an assistance program if funding can be secured. Estimated cost ranges for septic system replacement vary from \$3,000-\$7,000 (National Small Flows Clearinghouse, 1995) to \$6,000-\$20,000 to replace a failed drainfield (www.septic-info.com, citing 2002 information from U.S. Inspect). In general, drainfield system replacement costs are greater if an alternate drainfield site is not available. This is the case in a number of older subdivisions, which adds to the desirability of connecting them to the public system. If it were assumed that most of the remaining failed septic systems were on rural lots with adequate space for an alternate drainfield, a conservative estimate for the cost of replacement of the 72 septic systems and seven straight pipes would be $79 \times \$6,000 = \$474,000$. Education (addressed in the next section) is another need in this area; many owners are unaware of the need for regular pumping and system maintenance. Purchasers of existing homes on septic systems may not even be aware that their homes are on them.

A major concentration of failing septic systems is located within the Southwood MHP. Four systems serving 12-20 mobile homes have been identified to date and are being required by the Virginia Department of Health (VDH) to be pumped according to a system that sounds an alarm when the capacity of the septic tank is reached. This is a temporary solution; permanent repair must take place within 12 months. Southwood will be required to hire an engineer to assess the site and draw up plans to be approved by VDH. Because of the age of the systems, it is expected that there will be other system failures in the MHP (which contains approximately 180 mobile homes served by septic) in coming years. Connection to the sewer system appears unlikely under current ownership.

Table 6.5 Septic systems and straight pipes

Proposed BMP	Entity/Source	Area Treated	Subwatershed	Estimated Cost	Potential Funding Source
Pumping/repair of failing septic systems at Southwood	VDH, Owner	Currently about 12-20 mobile homes; others expected to be failing or		6	Owner

		on verge			
Develop funding assistance program for septic problems	TJSWCD		1-3, 5-9		Section 319
Develop plan for straight pipe detection	Albemarle, Charlottesville, TJSWCD, TJPDC, VDH		all		Albemarle, Charlottesville, Section 319

6.6 Education Programs

Albemarle, Charlottesville and UVA all have included public education and outreach as part of the control measures in their NPDES (National Pollutant Discharge Elimination System) Phase II Stormwater Permits. One of the primary activities is a collaborative one – the formation of a stormwater education partnership and website which includes Charlottesville, Albemarle, UVA, RWSA and VDOT. Other education activities include presentations to groups, development of brochures and fact sheets, and work with the schools to dovetail stormwater and water quality education with Standards of Learning. Albemarle County has contracted with the TJSWCD to fulfill its public education, outreach, and involvement components. Albemarle County will additionally be developing educational materials for BMP owners, and the TJSWCD is interested in the development of an education program for septic system owners, should funds become available. Other critical needs for education include pet waste management and appropriate wildlife interaction (for example, feeding the geese found at many of the ponds in the watershed encourages greater populations of geese than the ponds can reasonably sustain). All of these programs are currently limited in terms of the funding and staff time devoted; for example, pet waste education receives only about \$250 per year from the City of Charlottesville. The education partnership recently spent \$2,000 on a storm drain marking program designed to educate the community on where its stormwater goes. Additional funding through grants would enable the expansion of these programs to reach a greater audience.

Table 6.6. Education Programs

Proposed BMP	Entity/Source	Comments	Estimated Cost	Potential Funding Source
Public education on pet waste management	Charlottesville, Albemarle, UVA	Consider new initiatives such as putting baggies in utility bills		Charlottesville, Albemarle, UVA, Small Watershed Grants
Stormwater education partnership and website	Charlottesville, Albemarle, UVA, RWSA, VDOT, TJSWCD	TJSWCD will maintain website		Partners

Utilize website to register, track, and address citizen complaints regarding stormwater issues	TJSWCD			Albemarle
Utilize local media to promote awareness	Charlottesville, Albemarle, UVA			Charlottesville, Albemarle, UVA
Dovetail stormwater and water quality education with SOLs	Albemarle, TJSWCD, Charlottesville	Major initial effort completed (development and distribution of a Water Resources Binder to support curriculum). TJSWCD will work with Albemarle County schools.		Albemarle, Charlottesville
Develop menu of stormwater/watershed lesson plans and provide staff to guide teachers' use	TJSWCD			Albemarle
Conduct teacher workshop for incorporation of stormwater/watershed education into curriculum	TJSWCD			Albemarle
Coordinate/schedule use of watershed model in local middle schools (public & private)	TJSWCD			Albemarle
Organized education on stormwater	Charlottesville, Albemarle, UVA, TJSWCD			Charlottesville, Albemarle, UVA, Small Watershed Grants
Develop mailing list of homeowners' association contacts	TJSWCD			Albemarle
Develop brochures & fact sheets for distribution to homeowners associations, youth groups, & the development community	TJSWCD			Albemarle
Develop education program for septic owners	TJSWCD	Contingent on funding		Small Watershed Grants, Section 319

Develop educational materials for BMP owners	Albemarle County			Albemarle
Continue & expand Adopt-A-Stream Program and storm drain stenciling program with youth groups and citizen groups	TJSWCD			Albemarle

6.7 Planning Activities

Again as a result of NPDES Phase II, Charlottesville, Albemarle and UVA have increased emphasis on stormwater planning. As stated above, UVA has already developed a stormwater master plan and is in the process of implementing and integrating it into the University's long-range development plans. Albemarle is still working on a watershed master plan and watershed action lists. Charlottesville has reviewed, amended, and adopted City Code addressing improvements to the erosion and sediment control program, stream protection (including the establishment of a 100-foot buffer along Moore's Creek), stormwater management, and illicit discharge detection and elimination. All three entities are committed to using new development and redevelopment as opportunities for stream restoration and regional BMPs. As an example, UVA recently spent approximately one million dollars from a new basketball arena project to daylight and reconstruct two tributaries to Meadow Creek on the west side of campus.

Table 6.7. Planning activities

Activity	Entity	Sub-watershed	Estimated Cost	Potential Funding Source
Complete stormwater master plan and watershed action lists	Albemarle County	all		Albemarle
Reviewed and amended City code for adequate coverage of issues including erosion and sediment control, stream protection, stormwater management, and illicit discharge	Charlottesville	9, 10, 11		Charlottesville
Adopt design standards that improve erosion and sediment control, stream protection, and stormwater management	Charlottesville	9, 10, 11		Charlottesville
Continue to revise and improve stormwater master plan	UVA	10		UVA
Develop strategies for	Charlottesville	9, 10, 11		Charlottesville

watershed planning in the form of a City-wide watershed-based water quality planning effort.				
Use new development/redevelopment as opportunities for stream restoration/regional BMPs	Albemarle, Charlottesville, UVA	all		Albemarle, Charlottesville, UVA, developers

6.8 Maintenance Activities

Illicit discharge detection and elimination is a required minimum control measure under NPDES Phase II. As a result, Albemarle, Charlottesville and UVA all include the enactment of an illicit discharge ordinance to prohibit non-stormwater discharges into the stormwater system, the development of a plan to detect and address non-stormwater discharges, and inspection of storm sewer outfalls during dry weather in their permits. Much of this work will be carried out by the TJSWCD for Albemarle County as part of its contract with them. NPDES Phase II also requires the establishment of pollution prevention plans for municipal and public facilities. Charlottesville and Albemarle have additionally established a pollution prevention hotline.

Table 6.8. Maintenance activities

Activity	Entity	Estimated Cost	Potential Funding Source
Enact an illicit discharge ordinance prohibiting non-stormwater discharges into stormwater system	Albemarle County, Charlottesville (complete), UVA		Albemarle, Charlottesville, UVA
Develop a plan to detect and address non-stormwater discharges	Albemarle County, Charlottesville, UVA		Albemarle, Charlottesville, UVA
Develop, train, and coordinate volunteer network for illicit discharge detection	TJSWCD		Albemarle
Supplement the storm drain GIS with the following information: locations of all outfalls, drainage areas to point of each outfall, land use within each drainage area, locations of all inflow sites for each outfall	TJSWCD		Albemarle
Develop & maintain monitoring, tracking & reporting protocols for detection of illicit discharges from storm drain outfalls	TJSWCD		Albemarle
Provide staff for outfall monitoring and training/coordination of volunteer network to supplement staff monitoring	TJSWCD		Albemarle

Provide leadership & guidance for the existing StreamWatch Program to enhance its scope to include illicit discharge recognition	TJSWCD		Albemarle
Inspect storm sewer outfalls	Albemarle, Charlottesville, UVA		Albemarle, Charlottesville, UVA
Dedicate staff to stormwater maintenance	Albemarle, Charlottesville, UVA		Albemarle, Charlottesville, UVA
Establish pollution prevention hotline	Charlottesville, Albemarle		Charlottesville, Albemarle
Pollution prevention plans for municipal and public facilities	Albemarle, Charlottesville, UVA		Albemarle, Charlottesville, UVA

7.0 Measurable Goals and Milestones

7.1 Implementation Goals

The ultimate goal of this implementation plan is to bring Moore’s Creek into compliance with water quality standards, which will result in its removal from the 303(d) list of impaired waters. This goal will be measured by the concentration of fecal coliform and E. coli in samples, but milestones along the way will include both water quality measurements and the implementation of best management practices. Implementation goals must keep in mind the TMDL allocation goals. The TMDL called for 100% reduction in direct cattle and straight pipe inputs, septic NPS, and sewer leakage. It also called for reductions in contributions from land uses equivalent to removal of the impact from 118 acres of low-density residential land, 827 acres of medium-density residential land, 771 acres of grassland, and 1070 acres of urban land. At the same time, practicality must be considered. For example, retrofitting urban land can be difficult and costly, as urban areas have few sites suitable for the construction of large-scale BMPs. The construction of BMPs in the urban area will be to some extent dependent on opportunities presented during redevelopment.

7.2 Implementation Milestones

DEQ is recommending a staged implementation approach, such that those activities likely to have the greatest impact on the concentration of pollutants in the waterway are carried out first. This example for bacteria is given in the *TMDL Implementation Plan Guidance Manual*:

- Stage I: Eliminate direct inputs to the stream from humans and reduce direct inputs from livestock.
- Stage II: Further reductions in direct inputs from livestock and eliminate input from near-stream sources (such as loafing and feed lots, and manure storage areas) as well as inappropriate manure application near stream and failing septic systems in the near-stream areas.

- Stage III: Eliminate input from far upland sources (such as loafing and feed lots, and manure storage areas) as well as inappropriate manure application and failing septic systems in the upland areas.

In the development of this plan, staging for effectiveness of actions had to be balanced with other considerations such as cost and the timelines of other plans. For example, some of the sewer line extensions proposed would qualify as Stage II activities under the above example, but the cost of the extensions necessitates that the extensions be constructed later in the implementation process unless additional funding is obtained.

2003	
Establish pollution prevention hotline	Charlottesville, Albemarle
Pollution prevention plans for municipal and public facilities	Charlottesville, UVA
2004	
Utilize local media to promote awareness	Charlottesville, Albemarle, UVA
Dovetail stormwater and water quality education with Standards of Learning	Charlottesville
Organized education on stormwater	Charlottesville, Albemarle, UVA
Complete stormwater master plan and watershed action lists	Albemarle
Review and amend City code for adequate coverage of issues including erosion and sediment control, stream protection, and stormwater management	Charlottesville
Adopt design standards that improve erosion and sediment control, stream protection, and stormwater management	Charlottesville
Develop strategies for watershed planning	Charlottesville
Begin inspection of storm sewer outfalls	UVA
Begin developing pollution prevention plans for municipal and public facilities	Albemarle
2005	
Upgrade Stadium line	CPW
Connection of Southwood MHP	Owner
Repair of failing septic systems at Southwood MHP	Owner
Dovetail stormwater and water quality education with SOLs	Albemarle
Develop menu of stormwater/watershed lesson plans and provide staff to guide teachers' use	TJSWCD
Develop mailing list of homeowners' association contacts	TJSWCD
Develop educational materials for BMP owners	Albemarle
Continue & expand Adopt-A-Stream Program and storm drain stenciling program with youth groups and citizen groups	TJSWCD
Enact an illicit discharge ordinance prohibiting non-stormwater	Charlottesville,

discharges into stormwater system	Albemarle, UVA
Develop a plan to detect and address non-stormwater discharges	Charlottesville, Albemarle, UVA
Begin inspection of storm sewer outfalls	Charlottesville
Approach agricultural landowners regarding participation in cost-share plan	TJSWCD
Begin construction of stream protection/buffer projects	Albemarle, TJPDC
2006	
Conduct teacher workshop for incorporation of stormwater/watershed education into curriculum	TJSWCD
Coordinate/schedule use of watershed model in local middle schools (public & private)	TJSWCD
Develop brochures & fact sheets for distribution to homeowners associations, youth groups, & the development community	TJSWCD
Begin inspection of storm sewer outfalls	Albemarle
Dedicate staff to stormwater maintenance	Charlottesville, Albemarle, UVA
Complete development of pollution prevention plans for municipal and public facilities	Albemarle
Develop, train, and coordinate volunteer network for illicit discharge detection	TJSWCD
Supplement the storm drain GIS	TJSWCD
Develop & maintain monitoring, tracking & reporting protocols for detection of illicit discharges from storm drain outfalls	TJSWCD
Provide staff for outfall monitoring and training/coordination of volunteer network to supplement staff monitoring	TJSWCD
Provide leadership & guidance for the existing StreamWatch Program to enhance its scope to include illicit discharge recognition	TJSWCD
2008	
Oak Hill sewer completed with homeowner participation	ACSA & Homeowners
Agricultural cost-share projects completed	TJSWCD
Stream protection/buffer projects 50% complete	Albemarle, TJPDC?
Post 2008	
Buckingham Circle sewer completed with homeowner participation	ACSA & Homeowners
Bellair Liberty Hill sewer completed with homeowner participation	ACSA & Homeowners
Ednam Forest sewer completed with homeowner participation	ACSA & Homeowners
Stream protection/buffer projects completed	Albemarle, TJPDC?

Unscheduled	
Increase size of Valley Rd collector line	CPW
Manhole relining completed	CPW
Smoke/dye testing of sewer lines	CPW
Develop funding assistance program for septic problems	TJSWCD
Develop plan for straight pipe detection	Albemarle, Charlottesville, TJPDC, VDH
Develop education program for septic owners	TJSWCD
Continuing	
Public education on pet waste management	Charlottesville, Albemarle, UVA
Stormwater education partnership and website	Charlottesville, Albemarle, UVA, RWSA, VDOT
Utilize website to register, track, and address citizen complaints regarding stormwater issues	TJSWCD
Revise and improve stormwater master plan	UVA
Use new development/ redevelopment as opportunities for stream restoration/regional BMPs	Charlottesville, Albemarle, UVA

7.3 Water Quality Monitoring and Milestones

DEQ will monitor the creek bimonthly for fecal coliform and E. coli at its established monitoring location, which is the bridge crossing the creek at the Moore's Creek WWTP (upstream of the plant outfall). Additionally, RWSA is willing to take monthly fecal coliform samples at the same site. The StreamWatch monitoring program has expressed interest in expanding its mission to include the use of ColiScan® Easygel® for E. coli sampling throughout the Rivanna watershed, and may be another resource for sampling within the Moore's Creek watershed.

As many significant implementation activities will have been completed by 2009, it is projected that water quality will have improved at least 50% by then. However, several significant sewer hookup projects will probably occur later, and it is likely that other projects will remain outstanding as well. It is not expected that water quality standards will be met until those projects are complete.

8.0 Stakeholders' Roles and Responsibilities

Stakeholders are individuals who live 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 TMDL effort (i.e., improving water quality and removing Moore's Creek from the impaired waters list). The purpose of this chapter is to identify and define the roles of the stakeholders who will work together to implement the plan. The roles and responsibilities of some of the major stakeholders are described below.

8.1 Federal Government

U.S. Environmental Protection Agency (EPA): EPA has the responsibility of overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states.

Natural Resources Conservation Service (NRCS): NRCS administers several funding programs for water quality and stream protection, including the Wildlife Habitat Incentive Program, the Wetland Reserve Program, the Conservation Reserve Program, and the Environmental Quality Incentives Program.

8.2 State Government

In the Commonwealth of Virginia, water quality problems are addressed through legislation, incentive programs, education, and legal actions. Currently, there are a number of state agencies responsible for regulating and/or overseeing statewide activities that impact water quality in Virginia. These agencies include: DEQ, DCR, the Virginia Department of Agriculture and Consumer Services (VDACS), VDH, the Virginia Department of Forestry, and the Virginia Cooperative Extension.

DEQ: The State Water Control Law authorizes the State Water Control Board to control and plan for the reduction of pollutants impacting the chemical and biological quality of the State's waters resulting in the degradation of the swimming, fishing, shell fishing, aquatic life, and drinking water uses. For many years the focus of DEQ's pollution reduction efforts was the treated effluent discharged into Virginia's waters via the VPDES permit process. The TMDL process has expanded the focus of DEQ's pollution reduction efforts from the effluent of wastewater treatment plants to the pollutants causing impairments of the streams, lakes, and estuaries. The reduction tools are being expanded beyond the permit process to include a variety of voluntary strategies and BMPs.

DEQ is the lead agency in the TMDL process. The Code of Virginia directs DEQ to develop a list of impaired waters, develop TMDLs for these waters, and develop IPs for the TMDLs. DEQ administers the TMDL process, including the public participation component, and formally submits the TMDLs to EPA and the State Water Control Board for approval. DEQ is also responsible for implementing point source WLAs, assessing water quality across the state, and conducting water quality standard related actions.

DCR: DCR is authorized to administer Virginia's NPS pollution reduction programs in accordance with §10.1-104.1 of the Code of Virginia and §319 of the Clean Water Act. EPA is requiring that much of the §319 grant monies be used for the development of TMDLs.

Because of the magnitude of the NPS component in the TMDL process, DCR is a major participant in the TMDL process. DCR has a lead role in the development of IPs to address correction of NPSs contributing to water quality impairments. DCR also provides available funding and technical support for the implementation of NPS components of IPs. The staff resources in DCR's TMDL program focus primarily on providing technical assistance and funding to stakeholders to develop and carry out IPs, and support to DEQ in TMDL development related to NPS impacts. DCR staff will also be working with other state agencies, Soil and Water Conservation Districts, and watershed groups to gather support and to improve the implementation of TMDL plans through utilization of existing authorities and resources.

VDACS: 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 may include civil penalties. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, etc. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures.

VDH: The VDH is responsible for maintaining safe drinking water measured by standards set by the EPA. Their duties also include septic system regulation and regulation of biosolids land application. Like VDACS, VDH 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. For TMDLs, VDH has the responsibility of enforcing actions to correct failed septic systems and/or eliminate straight pipes (Sewage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq.*).

DOF: The DOF has prepared a manual to inform and educate forest landowners and the professional community on proper BMPs and technical specifications for installation of these practices in forested areas (<http://www.dof.virginia.gov/wq/index-bmp-guide.shtml>). Forestry BMPs are directed primarily to control erosion. For example, streamside forest buffers provide nutrient uptake, soil stabilization, and filtration, which can benefit water quality by reducing the amount of nutrients, sediments, and even bacteria that enter local streams.

VCE: VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and a part of the national Cooperative State Research, Education, and Extension Service, an agency of the United States

Department of Agriculture. VCE is a product of cooperation among local, state, and federal governments in partnership with citizens. VCE offers educational programs and technical resources for topics such as crops, grains, livestock, poultry, dairy, natural resources, and environmental management. VCE has issued several publications that deal specifically with TMDLs. For more information, visit <http://www.ext.vt.edu>

Thomas Jefferson Soil and Water Conservation District: The TJSWCD serves the counties of Albemarle, Fluvanna, Louisa, and Nelson. SWCDs are self-governed subdivisions of state government, funded through local and state appropriations and a variety of grants. The TJSWCD promotes soil and water conservation through providing technical expertise and education. Activities of the District include technical and financial assistance for the installation of conservation practices, development and oversight of conservation plans for agricultural lands, conservation education, administration of grant funds targeted to protect the habitat of the James River Spiny mussel, and a conservation easement program. The District will be instrumental in implementing agricultural BMPs and woodland buffers. In conjunction with ongoing education program the District will be implementing portions of Albemarle County's NPDES/VPDES Phase II Stormwater program. Three major areas the District will be working in include outreach/education, public involvement, and illicit discharge detection.

8.3 Local Government

Thomas Jefferson Planning District Commission: The TJPDC serves Albemarle, Fluvanna, Greene, Louisa and Nelson Counties, and the City of Charlottesville. Planning District Commissions were established in 1969 by Virginia's General Assembly to encourage and facilitate regional solutions to problems of area-wide significance. PDCs are made up of elected officials and citizens appointed by local governments, and receive their funding from a mix of local, state and federal sources. As water quality is frequently a regional issue, many PDCs have naturally become involved in related planning, including TMDLs and IPs. The TJPDC has been working in the Moore's Creek watershed since 1999, beginning with a bacterial source tracking study, through the development and adoption of the TMDL in 2002, and finally with the development of the IP. The TJPDC will work to obtain funding for and/or manage implementation projects that do not have commitments from other organizations. The TJPDC will also reconvene the technical committee annually to gauge progress toward implementation.

Rivanna Water & Sewer Authority: RWSA is an independent public agency providing impoundment, treatment, storage and transmission of potable water and transport and treatment of wastewater for the citizens of Charlottesville and Albemarle County. RWSA operates the wastewater treatment plant located near the mouth of Moore's Creek and owns some of the collector lines in the watershed. They also participate in the regional stormwater education partnership. RWSA's fecal coliform data for Moore's Creek contributed greatly to the development of the TMDL. RWSA anticipates resumption of fecal bacteria measurements in the creek albeit on a less-frequent basis, which will be of great service in tracking progress in water quality.

Albemarle County: Albemarle County comprises the southern and western portions of the watershed, which contain the majority of the low-density residential and agricultural areas, as well as some areas of greater density. Development of the TMDL and IP involved both the staff of the Water Resources Team in the Department of Community Development and staff from the Albemarle County Service Authority.

The Water Resources Team manages programs for stormwater master planning, groundwater, and water supply and watershed planning (in conjunction with the Rivanna Water & Sewer Authority). They are also part of the regional stormwater education partnership. The Water Resources Team will be involved in the implementation of many of the activities related to the NPDES Phase II permit, such as stormwater education and master planning and the drafting of an illicit discharge ordinance.

Albemarle County Service Authority: ACSA is a Water and Sewer Authority chartered to provide utility service in Albemarle County. It is governed by a Board of Directors appointed by the Albemarle County Board of Supervisors. ACSA provides public water and sewer service to the residents and businesses of the County in the urban area. The Authority's sole source of revenue is from the sale of water and wastewater treatment. ACSA will be involved in the expansion of service to areas with high percentages of failing septic systems should resources become available to assist in the cost of the projects.

City of Charlottesville: Charlottesville comprises much of the northern and most urban portion of the watershed. The Department of Public Works (DPW) has primary responsibility for the City's MS4 permit and is responsible for maintenance and operation of both the City's storm sewer system and the City's sanitary sewer system. The Department of Neighborhood Development Services (NDS) shares authority for the storm sewer discharge program, and is the primary program authority for the new Water Protection Ordinance that includes a stormwater program and the new stream buffer requirements. As part of their Phase II activities, Charlottesville is also involved in the regional stormwater education partnership.

University of Virginia: UVA, although technically located in Albemarle County, acts as a separate government entity in many ways, including applying for its own NPDES Phase II permit and participating separately in the stormwater education partnership. The Office of the Architect is responsible for master planning, including stormwater master planning, while UVA's Environmental Compliance Manager is responsible for environmental impact reviews and stormwater education.

8.4 For-Profit and Nonprofit Organizations and Citizens

Belmont Neighborhood Association: Both the TMDL and the IP process included some participation from members of the Belmont Neighborhood Association, one of the most active neighborhood associations in the watershed. Neighborhood associations can be key partners in education; the Belmont Neighborhood Association did a story about the Moore's Creek TMDL in their newsletter.

Farm Bureau: Representatives of the Albemarle County and Virginia Farm Bureaus were involved in the development of the TMDL and implementation plan. Their participation was critical in determining the extent and location of the livestock population in the watershed, and their connection to the agricultural community was and will continue to be extremely helpful.

The Nature Conservancy: TNC has identified the Rivanna River, of which Moore's Creek is a tributary, as one of the best remaining examples of a Piedmont stream. TNC has prepared a strategy for the Rivanna and is administering funding for its restoration, some of which may be useable for projects in the Moore's Creek watershed.

Rivanna Trails Foundation: Some of the trails of the Rivanna Trails Foundation run along the mainstem and tributaries of Moore's Creek. Although not directly participating in plan development, RTF volunteers were helpful in providing information about physical conditions. RTF regularly sponsors trail work and cleanup, which benefits Moore's Creek through trash removal and increased public exposure and "ownership."

Southern Environmental Law Center: Staff from SELC participated in the development of the TMDL and IP. SELC has been involved in the development and defense of TMDL rules since the mid-1990s.

Citizens: Ultimately, much of the implementation will be up to the citizens of the Moore's Creek watershed, whether in choosing to install vegetated buffers on their properties or using pooper-scoopers while walking their dogs. Government or community groups may assist with education, technical, or financial assistance, but it will be the goodwill of those living and working in the watershed that makes the difference.

9.0 Integration with Other Watershed Plans

This implementation plan has drawn directly from some existing plans and programs, and has been impacted by or may impact others. Plans and programs that relate to it include:

NPDES Phase II Stormwater Permits: Albemarle County, the City of Charlottesville and the University of Virginia all have stormwater permits under NPDES Phase II. The NPDES Phase II rule requires operators of small municipal separate storm sewer systems to develop a stormwater management program. Aspects of the program must include public education and outreach, public participation and involvement, illicit discharge detection and elimination, construction site runoff control, post-construction runoff control, and pollution prevention/“good housekeeping.” Many of these aspects, including public education and illicit discharge detection and elimination, relate directly to the Moore’s Creek Implementation Plan and were included as implementation measures.

ACSA Capital Improvement Plan: The Albemarle County Service Authority has identified a number of urban communities that rely on drainfields to dispose of sewerage. In anticipation of the need to extend public sewer into these communities, the subdivisions are listed in their CIP. This work will improve water quality in Moore’s Creek by replacing failing septic systems with sewer lines, and were therefore included in the Moore’s Creek IP.

Albemarle County Stream Assessment Program/Stormwater Management Master Plan: The Stream Assessment Program, completed in 2003, laid the groundwork for the ultimate development of a stormwater master plan for the County. County staff walked approximately 100 miles of stream corridor in order to document habitat conditions, impacts on the stream from specific infrastructure and problem areas, typical stream cross sections, and general stream characteristics. Community values related to the stream corridor were also considered. Streams were designated as pocket natural areas, community and private use/trails, designed urban water features, and urban/engineered. Moore’s Creek, its Biscuit Run and Ragged Mountain Creek tributaries, and the lower reaches of Morey Creek were considered to be primarily community and private use/trails with some pocket natural areas, but the upper reaches of Morey Creek, the entirety of Cow Branch, and the smaller tributaries were considered to be urban water features, which were given a lower priority for protection. The stream assessment data were used to identify high priority restoration projects. A prioritized list of buffer and erosion projects was identified based on severity, feasibility, and consistency with master plans and community goals; the highest-ranking ones for the Moore’s Creek watershed have been included in the IP. Regional stormwater facility locations were also identified as part of the Stormwater Management Master Plan, but none were in the Moore’s Creek watershed.

Rock Creek Stream Valley Master Plan: This study was jointly funded by Charlottesville and UVA in 1997 and performed by The Cox Company. It assessed the condition of, surveyed and made recommendations for stream rehabilitation and storm drainage improvements to Rock Creek, one of the primary tributaries to Moore’s Creek in the City

of Charlottesville. Unfortunately, at over \$1 million the construction cost estimate for the complete project was beyond the resources of the City or University. Implementation of some of the recommendations of the plan may still be worth considering.

Moore's Creek Watershed Study: This study was completed in 1996 by Dewberry & Davis for Albemarle County and the City of Charlottesville. It included hydrologic and hydraulic analyses, water quality data and analysis, an evaluation of various stormwater mitigation measures, and a watershed plan. The construction of regional stormwater management facilities was considered, but the only possible sites were located in the undeveloped parts of the watershed, which would offer limited benefits. Many of the immediate action items in the study have been completed, including the development of a stormwater management ordinance, a design and construction standards manual, and a watershed geographic information system (GIS), and stabilization of the banks of Moore's Creek at Azalea Park. A number of the other action items, such as culvert and bridge replacement and debris removal, were more related to flood control than to water quality improvement. The immediate construction of 100' of channel stabilization for Monticello Avenue Creek was also recommended. The secondary stormwater management plan included many thousands of dollars of stream restoration projects, including \$792,000 along Moore's Creek, \$65,000 along Monticello Avenue Creek, \$250,000 along Rock Creek, \$250,000 along a tributary to Rock Creek, \$125,000 along Pollocks Branch, and \$650,000 along Biscuit Run. These estimates were not based on detailed assessments but on a simple calculation of 30 projects per mile x X miles x an average of about \$10,500 per project. At this point, the recommendations of this study for restoration in the County part of the watershed would be superseded by the more comprehensive and more recent Albemarle County Stream Assessment Program/Stormwater Management Master Plan.

Southern Urban Area B Study: This 2004 study, jointly sponsored by Charlottesville, Albemarle and UVA, examined alternative transportation corridors and development patterns in a portion of the Moore's Creek watershed that includes UVA's Fontaine Research Park, Jefferson Park Avenue and Sunset Avenue in the City, and Sunset Avenue Extended in the County. Several of the transportation corridor alternatives examined would involve construction of a new bridge over Moore's Creek, and a major potential development area identified is that of the "Granger property," which lies to the south of the research park. In the land cover analysis performed for the TMDL, this property was identified as pasture and forestland, although the more recent Farm Bureau survey of livestock in the watershed did not find any located there. This property is the location of two of Albemarle County's proposed buffer control and erosion projects along Morey Creek. The Southern Urban Area B report foresees the possibility of significant housing development on the property (as many as 500-750 units) and/or the development of small-scale service and mixed use. As Morey Creek is an important tributary to Moore's Creek, development should be carefully planned in order to avoid further degradation of the creek.

Albemarle Comprehensive Plan: The Albemarle Comprehensive Plan covers water resources extensively in its Natural Resources chapter. Objectives include:

- Implement an ongoing educational and incentive program for the general public that emphasizes protection of surface and groundwaters and the property owner's responsibility and opportunity.
- Protect the County's surface water through a management program that recognizes the functional interrelationship of stormwater hydrology, stream buffers, flood plains, wetlands, and human management practices.
- Maintain the integrity of existing stream channels and networks for their biological functions and drainage. Protect the condition of state waters for all reasonable public uses and ecological functions. Restore degraded stream and wetland ecosystems where possible.
- Facilitate the integration of stormwater management and pollution control with other programs, policies, educational efforts, and Comprehensive Plans of jurisdictions in the region.
- Encourage BMPs to reduce nonpoint source pollution from agricultural and forestry uses.

Albemarle Water Protection Ordinance: Albemarle County adopted a Water Protection Ordinance in 1998, which consolidated and updated the Erosion and Sediment Control, Runoff Control, and Water Resources Protection Areas Ordinances, as well as the stormwater detention requirements of the Subdivision Ordinance. Stormwater management/BMP plans, which may include structural and/or nonstructural measures, are required for new development, and stream buffers along perennial streams and/or wetlands contiguous to those streams. Buffer widths vary from 25' for croplands to 100' in development areas to 200' within water supply protection areas. Within the Moore's Creek watershed, the land that drains to the Ragged Mountain Reservoir is a water supply protection area.

Charlottesville Comprehensive Plan: In its Guiding Principles Charlottesville's 2001 Comprehensive Plan states, "The Charlottesville community puts a value on trees, parks, green space, and biodiversity as adding to the livability and appearance of the city" and "balances the natural and built environments and practices sustainability in decisions." In its Vision Principles the Comprehensive Plan includes:

- We will promote and support the ideal of our City as a Park by expanding green space, the urban canopy, and improving access to our waterways.
- We will protect and enhance the quality of our air and water.
- We will endeavor to balance people's desire for convenience with viable alternatives that support or enhance our natural and built environment.

Charlottesville Water Protection Ordinance: The short-term work program outlined in the 2001 Comprehensive Plan included the amendment of the Code to protect the City's water quality, using the Albemarle Water Protection Ordinance as a model. A Stream Protection Task Force was formed and met during the development of the Moore's Creek IP; two members of the task force attended IP meetings as well. Toward the end of the IP development period, Charlottesville passed a water protection ordinance that requires 100' buffers for most new development along three major streams, including Moore's Creek. The ordinance also covers erosion and sediment control for land-disturbing activities, stormwater management plans for new development, and establishes authority to address illicit discharges.

James River Tributary Strategy: Moore's Creek is a tributary of the Rivanna River, which in turn is a tributary of the James River. The draft James River Tributary Strategy is not sufficiently specific to inform the Moore's Creek IP, but many of the types of BMPs proposed in the IP are also proposed in the Tributary Strategy, as they will contribute to the reduction of nutrients and sediment as well as bacteria. Implementation of these practices will therefore contribute to the implementation of the James River Tributary Strategy as well as of the IP.

10.0 Potential Funding Sources

A number of the activities outlined in this implementation plan, particularly those relating to NPDES permits, will be carried out as part of the regular budgets of Albemarle, Charlottesville, and UVA. Others, such as the sewer line extensions outlined in the ACSA Capital Improvement Plan, may eventually be accomplished through the regular budget process but could be accomplished more quickly if outside funding were obtained. And some, such as the development of an assistance program for owners of failing septic systems, are unlikely to occur without outside funding. Possible funding sources are listed below.

Chesapeake Bay Small Watershed Grants Program: This is a partnership between the EPA Chesapeake Bay Program and the National Fish and Wildlife Foundation that provides grants to organizations working on a local level to protect and improve watersheds in the Chesapeake Bay basin. Currently the Rivanna Conservation Society and The Nature Conservancy are the recipients of a grant for James River Spiny mussel habitat protection, for which Moore's Creek is a middle-priority stream. The RCS/TNC grant offers subgrants with a 25% match, which can be contributed labor.

Conservation Reserve Enhancement Program: The program aims to improve the Virginia's water quality and wildlife habitat by offering rental payments to farmers who voluntarily restore riparian buffers, filter strips and wetlands through the installation of approved conservation practices. CREP is an enhancement to the federal Conservation Reserve Program. State cost-share payments are administered through local SWCD offices. The state will reimburse up to 25 percent, not to exceed \$200 per acre of restored buffer or wetland, of conservation practice costs deemed eligible by the local SWCD. Federal reimbursement is made through the Farm Service Agency (FSA) for up to 50 percent of a participant's eligible expenses for implementing BMPs, such as fencing or alternative watering systems. Participants in this program are also eligible for the Virginia Agricultural BMP tax credit.

EPA Section 319 Funds: EPA develops guidelines that describe the process and criteria to be used to award Clean Water Act Section 319 NPS grants to states. Up to 20% of the funds may be used by states to develop NPS TMDLs as well as to develop watershed-based plans for Section 303(d) listed waters. The balance of funding can be used for implementing watershed-based plans for waters that have completed TMDLs. Implementation of both agricultural and residential BMPs is eligible. In Virginia, this funding is administered by DCR, which works directly with agencies interested in implementation in areas where an implementation plan has been approved.

Environmental Quality Incentives Program (EQIP): The purposes of the program are achieved through the implementation of an EQIP plan of operation, which includes structural and land management practices on eligible lands. Contracts of 5-10 years are written with eligible producers. A 75% cost-share is made available to implement one or more eligible conservation practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments

can be made to implement one or more management practices, such as nutrient management, pest management, and grazing land management.

Virginia Agricultural Best Management Practices Cost-Share Program: The program is administered by DCR to improve water quality in the state's streams, rivers, and the Chesapeake Bay. The basis of the program is to encourage the voluntary installation of agricultural best management practices, including alternative watering systems, stream fencing, forest buffers, streambank protection, and grass filter strips, to meet Virginia's NPS pollution water quality objectives. This program is funded by the state Water Quality Improvement Fund and the federal Chesapeake Bay Program Implementation Grant monies through local SWCDs and requires a 25% match from the landowner. Participants in this program are also eligible for the Virginia Agricultural BMP tax credit.

Virginia Agricultural Best Management Practices Tax Credit Program: This program supports voluntary installation of BMPs that will address Virginia's nonpoint source pollution water quality objectives. Agricultural producers with an approved conservation plan can take a credit against state income tax of 25 percent of the first \$70,000 spent on agricultural BMPs.

Virginia Aquatic Resources Trust Fund: This is a mitigation fund to offset damage to streambanks, administered by The Nature Conservancy and the U.S. Army Corps of Engineers. Although lands around populations of James River Spiny mussels are considered highest priority, the erosion control and buffer projects identified by Albemarle County staff would be eligible. This program includes easement purchase and does not require match from the landowner.

Virginia Department of Transportation: VDOT performs mitigation projects to offset stream impacts in the course of their projects. When possible, the mitigation projects are performed near the impacted areas, but other sites may be used as well. VDOT pays 100% of the cost and performs the labor.

Virginia Water Facilities Revolving Loan Fund: This program provides financial assistance in the form of low-interest loans to local governments for needed system improvements at publicly owned wastewater collection and treatment facilities.