TR-v.04/03/2018

# Upper Goose Creek, Cromwells Run, and Little River TMDL Implementation Plan

## Prepared for

Virginia Department of Environmental Quality (DEQ)
Northern Virginia Regional Office
13901 Crown Court
Woodbridge, VA 22193

in partial fulfillment of the requirements of
Contract No. 16286

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September 2017
Revised April 2018

TR-v.04/03/2018

**Cover Photo**
Photo taken in the Goose Creek watershed (June 2016).

**Disclaimer**
The opinions expressed in this report are those of the authors and should not be construed as representing the opinions or policies of the United States government or the signatories or Commissioners to the Interstate Commission on the Potomac River Basin.

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# Abbreviations

| | |
|---|---|
| ACS | American Community Survey |
| AVMA | American Veterinary Medical Association |
| AWG | Agricultural Working Group |
| BMP | Best Management Practice |
| BSLC | Bacteria Source Load Calculator |
| CBF | Chesapeake Bay Foundation |
| CCU | Confined Canine Unit |
| CDBG | Community Development Block Grant |
| CFNOVA | Community Development Fund of Northern Virginia |
| CFR | Code of Federal Regulations |
| CREP | Conservation Reserve Enhancement Program |
| CRP | Conservation Reserve Program |
| CWA | Clean Water Act |
| DCR | Virginia Department of Conservation and Recreation |
| DEQ | Virginia Department of Environmental Quality |
| DOE | Virginia Department of Education |
| DOF | Virginia Department of Forestry |
| *E. coli* | Escherichia coli |
| EDF | Environmental Defense Fund |
| EPA | U.S. Environmental Protection Agency |
| EQIP | Environmental Quality Incentives Program |
| FSA | Farm Service Agency |
| FWS | U.S. Fish and Wildlife |
| GCA | Goose Creek Association |
| GWG | Government Working Group |
| HH | Households |
| ICPRB | Interstate Commission on the Potomac River Basin |
| IP | Implementation Plan |
| IRT | Inter-Agency Review Team |
| JMSWCD | John Marshall Soil and Water Conservation District |
| LSWCD | Loudoun County Soil and Water Conservation District |
| MARE | Middleburg Agricultural Research and Extension |
| MRLC | Multi-Resolution Land Characteristics Consortium |
| N/A | Not Applicable |
| NFWF | National Fish and Wildlife Foundation |
| NHD | National Hydrology Dataset |
| NLCD | National Land Cover Dataset |
| NPS | Nonpoint Source |
| NRCS | Natural Resources and Conservation Service |
| O&M | Operation and Maintenance |
| PEC | Piedmont Environmental Council |
| PS | Point Source |
| RCPP | Regional Conservation Partnership Program |
| RRRC | Rappahannock-Rapidan Regional Commission |
| RWG | Residential Working Group |
| SC | Steering Committee |
| SER-CAP | Southeast Rural Community Assistance Project |
| SPCA | Society for the Prevention of Cruelty to Animals |
| SWCB | State Water Control Board |

| | |
|---|---|
| SWCD | Soil and Water Conservation District |
| TBD | To Be Determined |
| TMDL | Total Maximum Daily Load |
| UGC | Upper Goose Creek |
| USCC | U.S. Composting Council |
| USCB | U.S. Census Bureau |
| USDA | U.S. Department of Agriculture |
| USGS | U.S. Geological Survey |
| UT | Unnamed Tributary |
| VACS | Virginia Agriculture and Consumer Services |
| VCAP | Virginia Conservation Assistance Program |
| VCE | Virginia Cooperative Extension |
| VCWRLF | Virginia Clean Water Revolving Loan Funds |
| VDH | Virginia Department of Health |
| VGIN | Virginia Geospatial Information Network |
| VOF | Virginia Outdoors Foundation |
| VPA | Virginia Pollution Abatement |
| VPDES | Virginia Pollutant Discharge Elimination System |
| WHIP | Wildlife Habitat Incentive Program |
| WIP | Chesapeake Bay Watershed Implementation Plan |
| WLA | Wasteload Allocation |
| WQMIRA | Water Quality Monitoring, Information, and Restoration Act |
| WQMP | Water Quality Management Plan |
| WWTP | Wastewater Treatment Plant |

## Units of Measurement

| | |
|---|---|
| cfu | colony forming units |
| ft | foot |
| mL | milliliters |
| sq ft | square foot |
| yr | year |

# Acknowledgements

This plan was made possible by the dedicated stakeholders of the Upper Goose Creek planning area, especially those participating in the Agricultural Working Group, the Residential Working Group, the Government Working Group, and the Steering Committee. Special thanks to the following organizations for participating in the development of this plan as well as the numerous individuals not listed here who graciously donated their time, local knowledge, and professional expertise.

Goose Creek Association
Loudoun Water
Loudoun County
Fauquier County
John Marshall Soil and Water Conservation District
Loudoun County Soil and Water Conservation District
Virginia Department of Health
Piedmont Environmental Council

Funding and oversight for the development of this plan were provided by the Virginia Department of Environmental Quality (DEQ). In collaboration with stakeholders, DEQ also prepared the written text for the Executive Summary as well as Section 1, Section 2, Section 4, Section 9, Section 10, Section 11, and Section 12 of this plan. The Rappahannock-Rapidan Regional Commission conducted excellent stakeholder outreach and support throughout the planning process.

# Executive Summary

The plan contained in this report provides a detailed, multi-year framework to restore water quality in the Upper Goose Creek (UGC) planning area to healthy conditions. It describes current water quality status, identifies the bacteria reductions needed to achieve water quality goals, and summarizes a suite of management actions to restore water quality to attain those goals. The plan also summarizes the many programs, partners, and funding resources that can contribute to putting this plan into action.

Goose Creek and its tributaries are part of the Potomac River basin, within a watershed that covers 386 square miles in Loudoun and Fauquier Counties on the western edge of the Washington D.C. metropolitan area. The watershed is primarily rural in character, with forest and agricultural land uses predominant, and is well known for its scenic horse farms. More dense development is present in the northeastern portion of the watershed, where most of the population growth in the watershed is occurring.

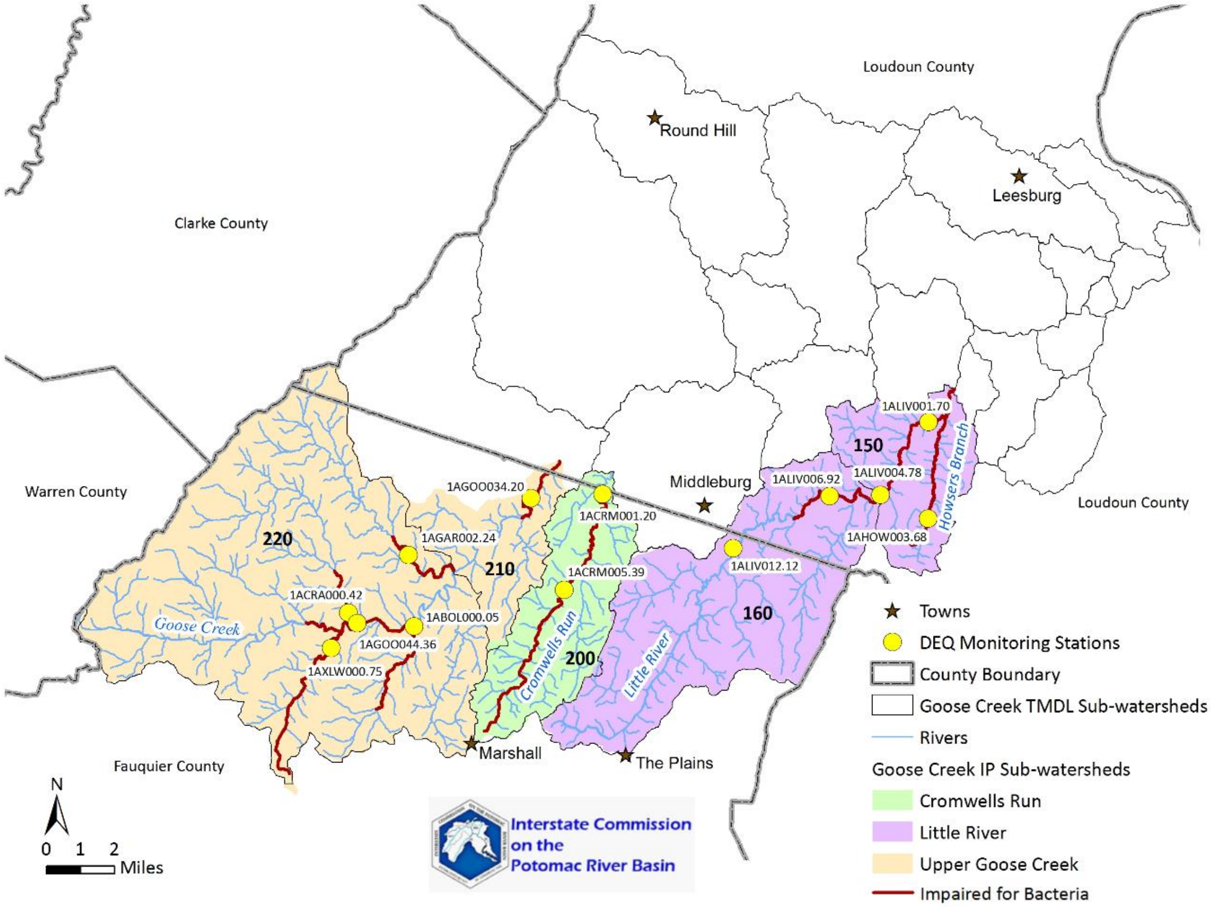
Goose Creek has been designated as a scenic river under Virginia's Scenic River Act, yet it also has degraded water quality that required management action. The mainstem of Goose Creek and six of its tributaries were listed as impaired on Virginia's 1998 and draft 2002 303(d) Total Maximum Daily Load (TMDL) Priority List and Report due to exceedances of the state's water quality standard for fecal coliform bacteria. The impaired stream segments do not meet designated uses for primary contact recreation (e.g. swimming); in other words, coming in direct contact with the Goose Creek's water could cause illnesses such as intestinal disorders.

The Virginia Department of Environmental Quality (DEQ) completed a TMDL study in 2003 for the entire Goose Creek watershed and set limits on the amount of bacteria each individual waterbody can receive and still support its designated recreational use standard. This TMDL Implementation Plan (IP) explains and quantifies the control measures, in the form of best management practices (BMPs), recommended over the next 15 years to reduce bacteria levels within the UGC watershed area (Upper Goose Creek, Cromwells Run and Little River sub-watersheds) (**Figure ES-1**) and be removed from the impaired waters list. **Figure ES-2** shows the plan area within the Goose Creek watershed.

**Figure ES-1**. A section of Little River.

The vast majority of bacteria reaching UGC watershed streams come from nonpoint sources, primarily agricultural activities. Within the sub-watersheds covered by this plan, only one point source (PS) is subject to a Virginia Pollutant Discharge Elimination System (VPDES) permit, and just three additional general permits address small businesses/residences.

**Figure ES-2**. Location of the Upper Goose Creek TMDL IP area within the Goose Creek watershed (Data Source: DEQ).




**<u>Review of the TMDL</u>:** The 2003 bacteria TMDLs called for elimination (100 percent reduction) of bacteria from failing septic systems and direct deposition from cattle into area streams. In addition, the TMDLs identified a need to reduce the bacteria loads from pastures by 98-99 percent. Given the passage of more than a decade of time since the TMDLs were prepared, planning for implementation actions required a comprehensive update of land uses within the upper watershed, as well as human, pet, and livestock populations.

The TMDL model calculations were also revisited to estimate instream delivered loads rather than the originally reported edge-of-field loads to match current DEQ practice. At the bottom-line, the water quality modeling confirmed the overall scope and distribution of reductions called for in the 2003 TMDL report, with a modest decrease in the need for bacteria reductions from pasture lands.

It is encouraging that many water quality management actions have been put into place since the TMDL was developed, and it was important that the IP consider their impact before determining the additional actions needed. An estimated 100 miles of livestock exclusion fencing has been installed along streams in the UGC watershed since 2002, and both Loudoun and Fauquier counties have active septic system programs that have repaired approximately 130 septic systems in the 2002-2016 timeframe.

DEQ analyzed the most current water quality monitoring data to identify current conditions in the plan area. DEQ's 2014 Integrated Report (DEQ 2014) documented water quality improvements across the area, using *E. coli* data collected in 2007 and 2012, but most sites continue to exceed bacteria water quality standards, and thus remain impaired for recreational uses. Current conditions call for significant additional action to restore water quality and enable the standards for bacteria to be achieved.

Finally, the original bacteria pollutant reduction scenarios contained in the 2003 TMDL report were reviewed and an alternative scenario (to the one used in the 2003 TMDLs) was selected by DEQ. The 2003 Goose Creek TMDL was one of the first bacteria TMDLs prepared in Virginia, and it called for bacteria reductions sufficient to achieve no exceedance over a ten year modeling period of the maximum assessment criterion. This would require near elimination of all major sources of bacteria throughout the watershed.

The current DEQ (and United States Environmental Protection Agency (EPA)) expectation for TMDL implementation plans is to achieve bacteria reductions that will result in no exceedance of the geometric mean criterion value, and less than a 10.5% exceedance rate of the maximum assessment criterion. These water quality end-points fully achieve the Commonwealth of Virginia's recreational use water quality standard. In light of current practices, it was appropriate to revisit the bacteria reduction allocations in the TMDL modeling and select a more viable scenario than that selected for the 2003 TMDL allocations.

The pollutant reduction scenario that is the foundation for this plan spreads load reductions more broadly by also addressing cropland, stormwater, and pet waste. This provides an opportunity to more broadly engage the local community in watershed protection and restoration. As a result, bacteria reductions needed from pasture have been reduced from the 98-99% levels called for in the TMDL to a more viable level (75%) in this plan.

**Public Participation:** Local stakeholders were broadly informed of the need for an implementation plan in a June 21, 2016 public meeting, and agricultural, residential and government workgroups were convened to seek input on how best to address bacteria contamination in UGC. Workgroup participants provided essential local knowledge throughout the process.

A Steering Committee comprised of selected workgroup members from local government agencies, local non-governmental organizations, and the John Marshall Soil and Water Conservation District (JMSCWD) provided valuable feedback on this draft plan during its May 25, 2017 meeting. DEQ held a final public meeting to present the draft plan on June 21, 2017. A 30-day public comment period followed this meeting to seek additional public input that enabled DEQ to further clarify and refine the plan before submitting it for final approvals.

**Recommended Management Measures:** A broad suite of agricultural, residential, and education and outreach actions are recommended to reduce the sources of bacteria and restore safe recreational uses of the planning area's waters. In summary, these actions include:

- 169 additional miles of livestock exclusion fencing, with riparian buffers, at an estimated cost of $5.8 million.
- 9,917 acres of pasture and cropland improvements, and sediment retention structures addressing drainage for nearly 3,800 acres, at an estimated cost of $7.3 million.
- 3,600 acres of targeted conversion of pasture/cropland to forest or permanent vegetative cover, for steep slope land and critical stream habitat areas (these costs are included in pasture/cropland).
- Three community and over 300 individual equine manure composting systems, and over 100 barnyard runoff control systems for horse farms, at an estimated cost of $3.7 million.
- Extensive residential septic system improvements, including some 6,500 septic pump-outs, 400 repairs, 80 system replacements, and 20 public sewer system hookups, costing $4.8 million.
- Demonstration projects to improve stormwater management, at an estimated cost of $83 thousand, and pet waste management actions estimated to cost between $51 and 121 thousand.
- A comprehensive 15-year education, outreach and technical assistance program, costing approximately $778 thousand.

**<u>Benefits</u>:** The direct benefit of the actions called for in this plan will be restoration of water quality to enable safe recreational uses of the area's streams. The recommended actions are designed to allow delisting of the current bacteria impairments of waters in the UGC watershed. These water quality benefits also contribute to improving the quality of downstream waters of Goose Creek, the Potomac River, and the Chesapeake Bay, while broadly enhancing the natural resource values of the watershed. This plan's actions will provide additional benefits of enhanced agricultural productivity, livestock health, and aquatic habitat within the watershed. Residential septic improvements will reduce the incidence of higher cost system failures and improved stormwater and pet waste management can reduce local flooding and improve community aesthetics.

The plan's recommended actions are proposed to be put into place over a 15-year timeframe. Strong local leadership, support from both state and federal government agencies, and a multitude of local stakeholders will be critical for success. An approved implementation plan will increase opportunities for Fauquier and Loudoun county local agencies and watershed residents to obtain funding to support their installation of the recommended BMPs. Sustained actions consistent with the recommendations of this plan are projected to allow for delisting of the impaired waters of the IP area by 2031.

# 1. Introduction

The Virginia TMDL program is designed to improve water quality and restore impaired waters in Virginia. A TMDL identifies the maximum amount of a pollutant that a water body can receive without surpassing the state water quality standards. These standards are established to protect six beneficial uses: drinking water, recreational (i.e., primary contact/ swimming), fishing, shellfishing, aquatic life, and wildlife. If the water body exceeds the water quality criteria used to measure the standard during an assessment period, Section 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Management and Planning Regulation (40 CFR Part 130) both require states to develop a TMDL for each pollutant contributing to its impairment.

**Figure 1-1**. Beef farm in the Goose Creek watershed.

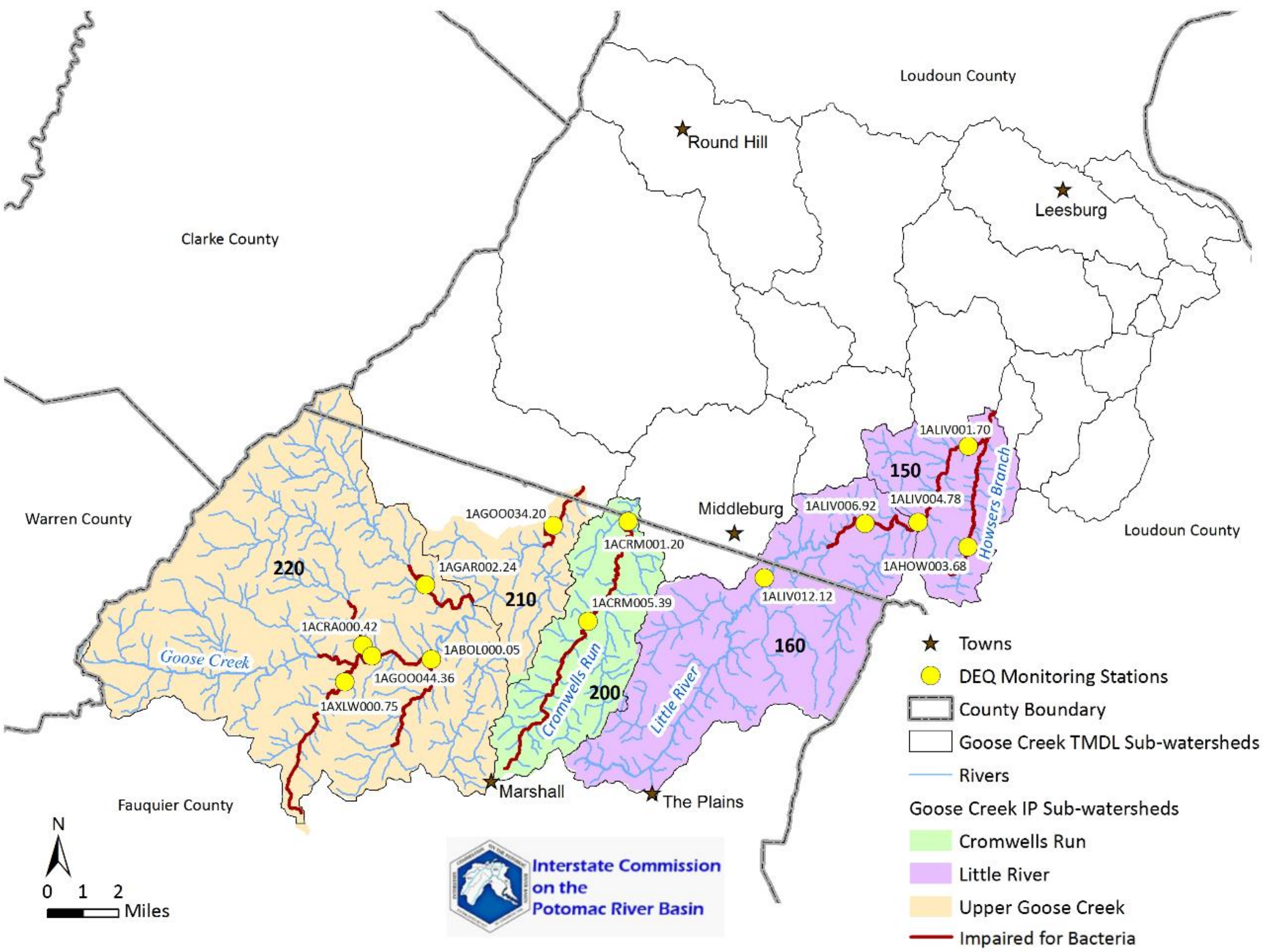
Goose Creek and its tributaries are part of the Potomac River basin. The Goose Creek watershed covers 386 square miles in Loudoun and Fauquier counties on the western edge of the Washington D.C. metropolitan area, as shown in **Figure 1-2**. The watershed is primarily rural in character (**Figure 1-1**), with forest and agricultural land uses predominant, though more dense development is present in the northeastern portion of the watershed. Goose Creek has been designated as a scenic river under Virginia's Scenic River Act.

**Figure 1-2**. Location of Goose Creek watershed in Northern Virginia.

The mainstem of Goose Creek and six of its tributaries were listed as impaired on Virginia's 1998 and 2002 303(d) TMDL Priority List and Report (DEQ 1998 and 2002) due to exceedances of the State's water quality standard for fecal coliform bacteria. The impaired stream segments did not meet designated uses for primary contact recreation (e.g. swimming). In addition, a five-mile segment of the mainstem of Goose Creek, below its impoundment to the inlet to the Potomac River, and Little River were also listed for benthic impairments in 1998, due to violation of the Commonwealth's General Standard.

After these listings, in 2003, DEQ completed a TMDL study for the Goose Creek watershed that identified bacteria sources in each sub-watershed and set limits on the amount of bacteria these waterbodies can receive and still support their designated recreational use standard. (A separate TMDL report for the benthic impairments was completed in 2004, but that is not the focus of this implementation plan.) As part of the 2003 TMDL study, additional sections of the Little River and Cromwells Run and sections of Howsers Branch, Goose Creek, Gap Run, Bolling Branch, Crooked Run and an Unnamed Tributary of Goose Creek were also listed as impaired for bacteria. All identified impairments in the UGC watershed are addressed by this plan. **Figure 1-3** shows the portion of the entire watershed that comprises the upper watershed area addressed here, which includes the Upper Goose Creek, Cromwells Run, and Little River sub-watersheds.

**Figure 1-3**. Location of the Upper Goose Creek TMDL IP area within the Goose Creek watershed (Data Source: DEQ).



The TMDL IP described in this report explains and quantifies actions needed to reduce bacteria levels to meet water quality standards and allow a delisting of the impaired waters from the Section 303(d) List. The TMDL IP describes control measures, commonly called BMPs, to be implemented in a staged process over the next 15 years. Local support and successful implementation of the plan will result in the restoration of Upper Goose Creek and enhancement of the natural resource values of the watershed more broadly. An approved IP will increase opportunities for Fauquier and Loudoun counties, other local organizations, and watershed residents to obtain funding to support installation of the recommended BMPs.

This technical document is a more detailed version of the general public document, which can be obtained at: http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLImplementation/TMDLImplementationPlans.aspx, accessed 9/28/2017.

# 2. Federal and State Requirements

Both state and federal requirements and recommendations were followed in developing this plan. 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 (DEQ 1997). WQMIRA directs the State Water Control Board (SWCB) 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 following requirements of WQMIRA:

- date of expected achievement of water quality objectives,
- measurable goals,
- necessary corrective actions, and
- associated costs, benefits, and environmental impact of addressing the impairment.

EPA regulations (40 CFR 130.33(b)(10)) require the inclusion of an implementation plan as an element of TMDL submittal. The EPA minimum elements of an approvable IP are described in EPA's 1999 *Guidance for Water Quality-Based Decisions: The TMDL Process*, and 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 TMDL IP for Upper Goose Creek fully addresses both the EPA and Virginia requirements and recommendations for TMDL implementation plans.

## 2.1 Requirements for Section 319 Funding Eligibility

The EPA has developed guidelines that describe the process and criteria used to award CWA Section 319 nonpoint source grants to States. The "*Nonpoint Source Program and Grants Guidelines for State and Territories*" (April, 2013) continues long-standing emphasis on the following nine elements for meeting Section 319 program 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 nonpoint source (NPS) management measures that will need to be implemented to achieve the identified load reductions;
4. Estimate the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement the watershed-based plan.
5. Provide an information/education component that will be used to enhance public understanding of the project and encourage the public's participation in selecting, designing, and implementing NPS management measures;
6. Provide a schedule for implementing the NPS management measures identified in the watershed-based plan;
7. Describe interim, measurable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and if progress is being made towards attaining water quality standards; if not, identify the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of implementation efforts.

Once complete, DEQ presents TMDL IPs to the SWCB for approval to guide efforts to implement pollutant allocations and reductions contained in the TMDL. DEQ also requests inclusion of new IPs in the appropriate Water Quality Management Plan (WQMP), in accordance with CWA Sec. 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning.

# 3. Goose Creek Implementation Plan TMDL Review and Update

## 3.1 Overview

Water quality samples collected by DEQ along Goose Creek from 1992 through 2001 demonstrated impairments at seven monitoring stations. Specifically, those locations had fecal coliform bacteria concentrations in violation of Virginia's maximum assessment criterion of 1,000 colony forming units (cfu)/100 milliliters (mL) more than 10 percent of the time. Due to the water quality conditions, DEQ placed these waterbodies on Virginia's 303(d) TMDL Priority List and Report in 1996, 1998, and 2002. In 2003, bacteria TMDLs were approved by the EPA for the lower mainstem of Goose Creek and portions of six tributaries (ICPRB 2003).

The 2003 TMDLs quantified the amount of bacteria the streams can receive without exceeding water quality standards and the associated reductions necessary to achieve this result; however, TMDLs do not include a description of, how, specifically and practically, the necessary bacteria reductions can be achieved. The purpose of the Upper Goose Creek, Cromwells Run, and Little River IP is to identify and develop a stakeholder-driven, practical, and implementable plan to meet water quality standards.

A plan for the successful implementation of the Goose Creek TMDLs in the three IP sub-watersheds requires a re-evaluation of watershed conditions to ensure that water quality criteria will be met as a result of implementation. This section presents a review and update of the Goose Creek TMDLs in the IP area. Namely, the study area is described in **Section 3.2**, land use is discussed in **Section 3.3**, source assessment in **Section 3.4**, water quality conditions in **Section 3.5**, and modeling updates in **Section 3.6**.

## 3.2 Study Area

The geographic area of the IP includes only a portion of the larger Goose Creek watershed including the Upper Goose Creek, Cromwells Run, and Little River sub-watersheds. **Figure 1-3** shows the drainage areas for the IP and the TMDLs. Note that the Upper Goose Creek sub-watershed boundary is different from the one used in the TMDL development as it includes only a portion of the lower TMDL segment, number 210. The difference in the boundaries is due to a modeling update described in **Section 3.6**. In many instances, data and analyses are presented according to the TMDL sub-watersheds in the IP area (Upper Goose, Upper Goose Segment 210, Cromwells Run, Upper Little River, and Little River) for direct comparison with the original TMDL analyses. **Table 3-1** lists the sub-watersheds included in the IP and their corresponding TMDL segment identification code.

**Table 3-1**. IP sub-watersheds and TMDL segment IDs.

| IP Sub-watershed | TMDL Segment ID |
|---|---|
| Upper Goose Creek | Southern portion of Segment 210 |
| | 220 |
| Cromwells Run | 200 |
| Little River | 160 |
| | 150 |

A detailed description of soils, geology, and climate in the Goose Creek watershed is provided in ICPRB (2003).

## 3.3 Land Use

Updating the TMDL land uses is an important component of determining current conditions and what work remains to meet water quality conditions as part of the IP.

The 2003 Goose Creek TMDLs extracted land cover data from the 1997 Multi-Resolution Land Characteristics Consortium (MRLC) national dataset (EPA 2002). The 1997 MRLC is a product of the EPA, U.S. Geological Survey (USGS), the Forest Service, and the National Oceanic and Atmospheric Administration. The MRLC includes 21 distinct land classes, 13 of which occur in the Goose Creek watershed.

The 2011 National Land Cover Dataset (NLCD) (Homer et al. 2015), produced from 30-meter satellite imagery, was used as part of this update to represent current watershed conditions. The 2011 NLCD was produced by the same consortium which produced the 1997 MRLC. The revised data include updates to the image classification methodology and land classes. **Table 3-2** and **Table 3-3** show the land use codes, descriptions, and abbreviations for the two datasets.

**Table 3-2.** 1997 MRLC land use classification in the Goose Creek watershed.

| Land Use Code | Land Use Description | Abbreviation |
|---|---|---|
| 21 | Low Intensity Residential | LIR |
| 22 | High Intensity Residential | HIR |
| 23 | Commercial/Industrial/Transportation | CIT |
| 32 | Quarries/Strip Mines/Gravel Pits | QSG |
| 33 | Transitional | TR |
| 41 | Deciduous Forest | DF |
| 42 | Evergreen Forest | EF |
| 43 | Mixed Forest | MF |
| 81 | Pasture/Hay | PH |
| 82 | Row Crops | RC |
| 85 | Urban/Recreational Grasses | URG |
| 91 | Woody Wetlands | WW |
| 92 | Emergent Herbaceous Wetlands | EHW |

**Table 3-3.** 2011 NLCD land use classification in the Goose Creek watershed.

| Land Use Code | Land Use Description | Abbreviation |
|---|---|---|
| 21 | Developed – Open Space | DOS |
| 22 | Developed – Low Intensity | LIR |
| 23 | Developed – Medium Intensity | MIR |
| 31 | Barren Land | TR |
| 41 | Deciduous Forest | DF |
| 42 | Evergreen Forest | EF |
| 43 | Mixed Forest | MF |
| 52 | Shrub/Scrub | SS |
| 71 | Grassland/Herbaceous | GH |
| 81 | Pasture/Hay | PH |
| 82 | Cultivated Crops | CC |
| 90 | Woody Wetlands | WW |
| 95 | Emergent Herbaceous Wetlands | EHW |

As part of the modeling process, the TMDL aggregated the 13 land classes found in the Goose Creek watershed into six land use classes using the formulas found in **Table 3-4**.

**Table 3-4.** TMDL land use classes and aggregation scheme (ICPRB 2003).

| Land Type | Model Land Use Classes | Aggregated MRLC Land Use Classes |
|---|---|---|
| Pervious Land | Forest | = DF + EF + MF +WW + EHW |
| | Cropland | = RC |
| | Pasture | = PH |
| | Developed | = 0.15*(HIR+CIT) + 0.6*(LIR) + URG |
| Impervious Land | Developed Impervious | = 0.85*(HIR+CIT) + 0.4*(LIR) |
| | Barren | = QSG + TR |

To remain consistent with the TMDL approach, the 2011 NLCD land classes were also aggregated into the six land classes using modified formulas to account for the new land use classes (**Table 3-5**).

**Table 3-5**. IP land use classes and aggregation scheme.

| Land Type | Model Land Use Classes | Aggregated NLCD Land Use Classes |
|---|---|---|
| Pervious Land | Forest | = DF + EF + MF + WW + EHW + SS |
| | Cropland | = CC |
| | Pasture | = PH + GH |
| | Developed | = 0.85*DOS + 0.7*LIR + 0.3*MIR |
| Impervious Land | Developed Impervious | = 0.15*DOS + 0.3*LIR + 0.7*MIR |
| | Barren | = TR |

The results of the land use analysis for the IP area are presented in **Figure 3-1** and **Table 3-6**. The largest changes in land use were found in cropland, pasture, and developed pervious lands. Specifically, developed pervious lands increased 472 percent and croplands increased 166 percent since 1997. Pasture, on the other hand, decreased by 12 percent, equivalent to a loss of 6,483 acres. Forest cover remained relatively constant from 1997 with only a slight increase of approximately 1 percent. Overall, the change in land cover from 1997 to 2011 is consistent with a predominately rural landscape where population growth over this time period is around 1 percent per year.

**Figure 3-1.** IP area land use comparison. The map displays the 2011 NLCD data. The pie charts compare 1997 MRLC land use percentages with 2011 NLCD land use percentages using colors that also correspond to the map legend.

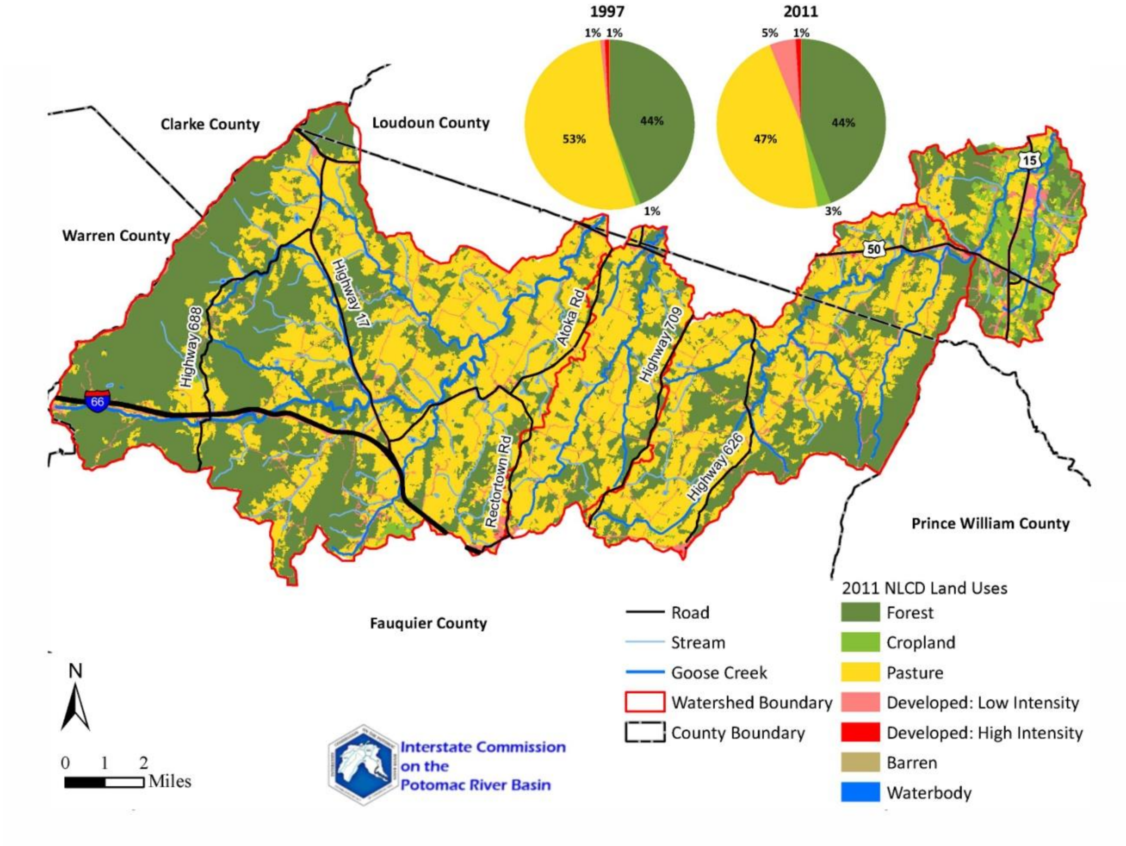



**Table 3-6**. IP area land use comparison.

| Land Use Type | | 1997 (Acres) | 2011 (Acres) | Change (Acres) | % Change |
|---|---|---|---|---|---|
| Pervious | Forest | 46,516 | 46,796 | 280 | 1 |
| | Cropland | 1,031 | 2,746 | 1,715 | 166 |
| | Pasture | 56,053 | 49,570 | -6,483 | -12 |
| | Developed Pervious | 921 | 5,264 | 4,343 | 472 |
| Impervious | Developed Impervious | 816 | 1,070 | 254 | 31 |
| | Barren | 110 | 1 | -109 | -99 |

In the Upper Goose Creek sub-watershed, the largest change in land use between 1997 and 2011 was developed pervious which increased by 2,058 acres or 458 percent. Forest cover increased by 3 percent and covers half of the watershed. Pasture land accounted for 44 percent of the watershed but decreased 9 percent from 1997 (**Figure 3-2** and **Table 3-7**).

**Figure 3-2.** Upper Goose Creek land use comparison. The map displays the 2011 NLCD data. The pie charts compare 1997 MRLC land use percentages with 2011 NLCD land use percentages using colors that also correspond to the map legend.

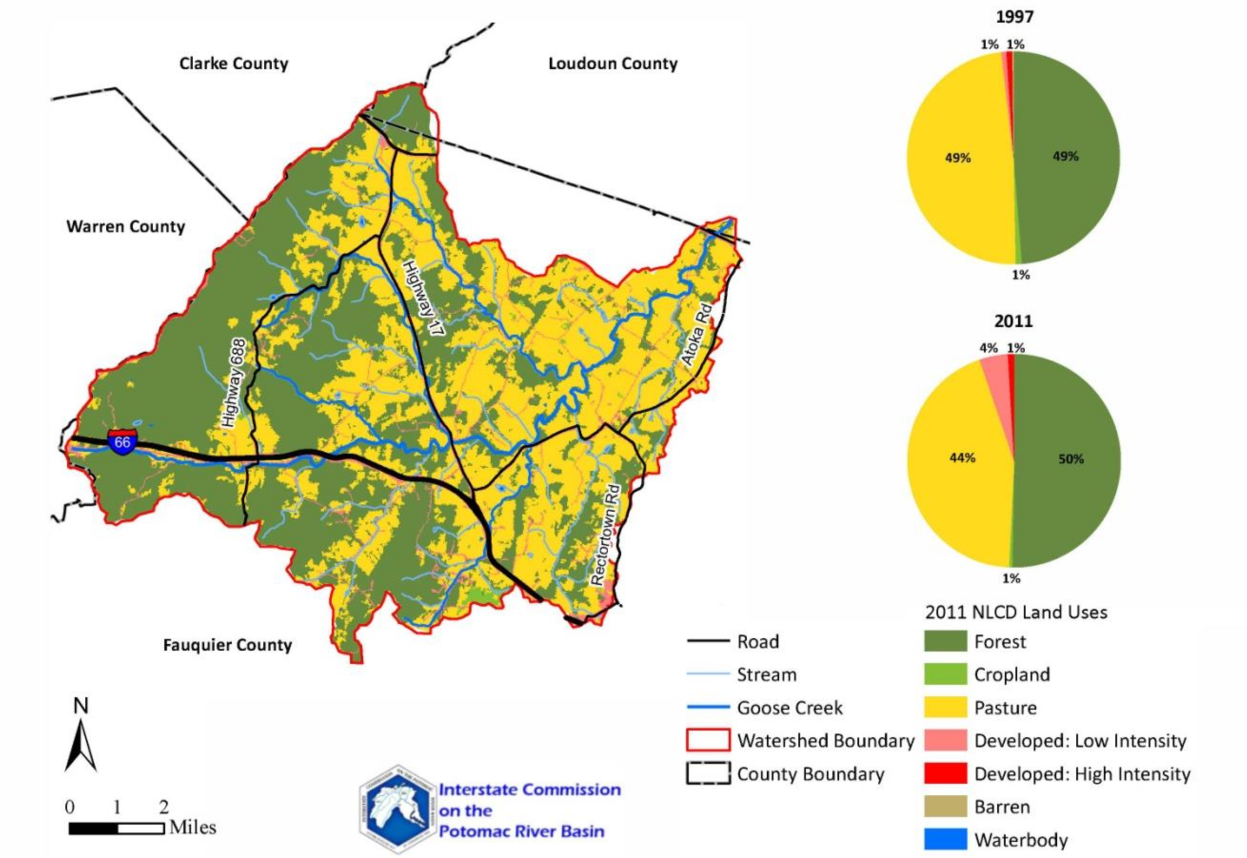



**Table 3-7**. Upper Goose Creek land use comparison.

| Land Use Type | | 1997 (Acres) | 2011 (Acres) | Change (Acres) | % Change |
|---|---|---|---|---|---|
| Pervious | Forest | 28,370 | 29,237 | 867 | 3 |
| | Cropland | 535 | 285 | -250 | -47 |
| | Pasture | 28,190 | 25,591 | -2,599 | -9 |
| | Developed Pervious | 449 | 2,507 | 2,058 | 458 |
| Impervious | Developed Impervious | 518 | 534 | 16 | 3 |
| | Barren | 93 | 0 | -93 | -100 |

Pasture land was the dominant land use in the Cromwells Run sub-watershed in 2011, covering 67 percent of the land area. This represented a modest decrease of 6 percent from 1997. Developed lands (developed pervious and developed impervious) increased by 457 acres or 244 percent. In 2011, the majority of developed lands were located at the northern and southern areas of the sub-watershed. Forest cover represented about a quarter of the land area and increased by 4 percent since 1997 (**Figure 3-3** and **Table 3-8**).

**Figure 3-3.** Cromwells Run land use comparison. The map displays the 2011 NLCD data. The pie charts compare 1997 MRLC land use percentages with 2011 NLCD land use percentages using colors that also correspond to the map legend.

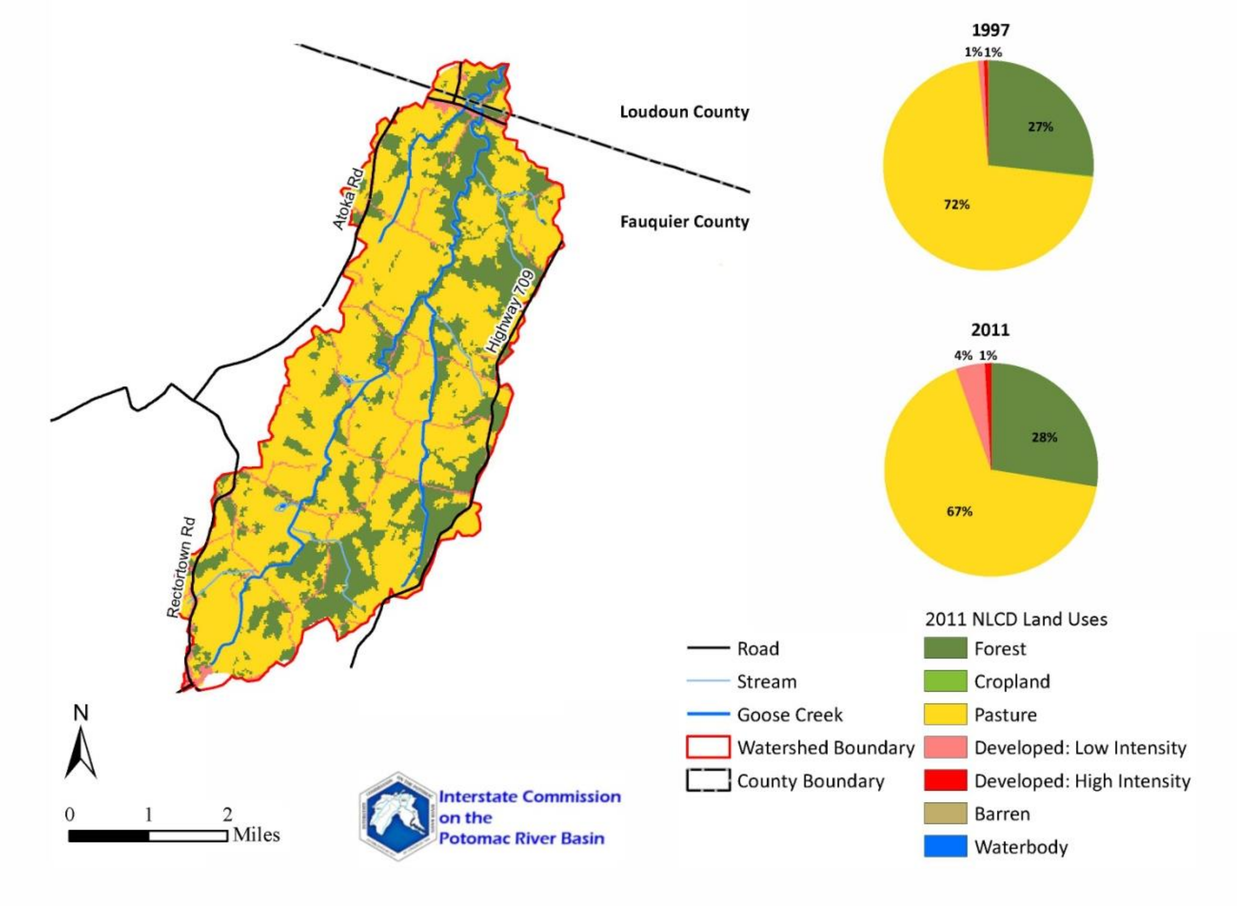



**Table 3-8**. Cromwells Run land use comparison.

| Land Use Type | | 1997 (Acres) | 2011 (Acres) | Change (Acres) | % Change |
|---|---|---|---|---|---|
| Pervious | Forest | 3,217 | 3,334 | 117 | 4 |
| | Cropland | 23 | 0 | -23 | -100 |
| | Pasture | 8,653 | 8,110 | -543 | -6 |
| | Developed Pervious | 115 | 532 | 417 | 362 |
| Impervious | Developed Impervious | 72 | 112 | 40 | 56 |
| | Barren | 8 | 0 | -8 | -100 |

The Little River sub-watershed had the largest amount of developed land use in the IP area as of 2011, accounting for 2,649 acres. The majority of developed lands were located in the northern part of the watershed along Highway 15. Developed pervious lands increased by 523 percent from 1997. Croplands also increased between 1997 and 2011 by 420 percent and now represent 7 percent of the total land area. Despite the increase in development since 1997, pasture and forest lands still make up 85 percent of the sub-watershed (45 percent pasture and 40 percent forest) (**Figure 3-4** and **Table 3-9**).

**Figure 3-4.** Little River land use comparison. The map displays the 2011 NLCD data. The pie charts compare 1997 MRLC land use percentages with 2011 NLCD land use percentages using colors that also correspond to the map legend.

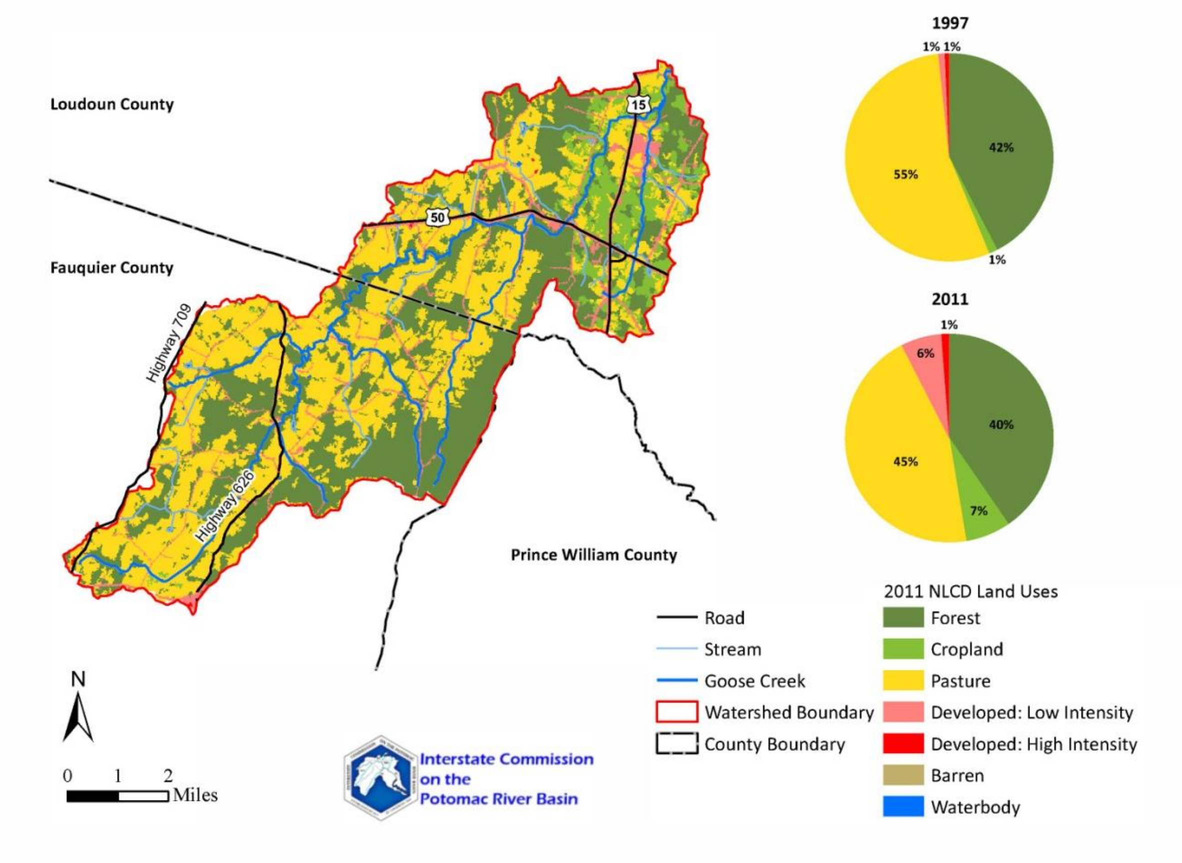



**Table 3-9.** Little River land use comparison.

| Land Use Type | | 1997 (Acres) | 2011 (Acres) | Change (Acres) | % Change |
|---|---|---|---|---|---|
| Pervious | Forest | 14,929 | 14,224 | -705 | -5 |
| | Cropland | 473 | 2,461 | 1,988 | 420 |
| | Pasture | 19,210 | 15,868 | -3,342 | -17 |
| | Developed Pervious | 357 | 2,225 | 1,868 | 523 |
| Impervious | Developed Impervious | 226 | 424 | 198 | 87 |
| | Barren | 9 | 1 | -8 | -85 |

When comparing the two land use datasets, changes may be due to several factors: 1) physical changes in land use that have occurred over time; 2) changes in the image classification methodology; and/or 3) changes in the classification scheme. Generally, when comparing land cover datasets across long time periods, a degree of uncertainty is expected. The results of the land cover change analysis is consistent with historic land use development patterns in the IP area.

The results of the land use analysis indicate the IP area is still predominately rural in character where forest and pasture are the dominant land uses. The majority of development between 1997 and 2011 occurred in the northeast corner of the Little River sub-watershed with small pockets of development along major roads across the Cromwells Run and Upper Goose Creek sub-watersheds. Developed lands account for six percent of the land area compared to two percent in 1997. Forest cover has remained constant in total land area but the Little River sub-watershed lost five percent, or 705 acres, of forested lands since 1997.

The land use analyses described in this section were used to update the source assessment, specifically the impact of pets on bacteria loads. That effort is described in more detail in **Section 3.4.7**. The land use analysis will also assist in upcoming efforts such as identifying appropriate management measures to improve water quality. Understanding the location of specific land uses allows for targeted management measures. For example, knowing the location of pastures and forest cover within riparian corridors facilitates identification of potential hotspots related to livestock in streams. Land use data are also helpful in tracking progress of management measures over time.

## 3.4 Source Assessment

The 2003 TMDL report (ICPRB 2003) included a source assessment to identify potential human, agricultural, domestic, and wildlife sources of bacteria in the Goose Creek watershed. This section provides updated information for population and number of households (**Section 3.4.1**), point sources (**Section 3.4.2**), wastewater treatment plants (**Section 3.4.3**), septic systems and straight pipes (**Section 3.4.4**), livestock (**Section 3.4.5**), wildlife (**Section 3.4.6**), pets (**Section 3.4.7**), and biosolids (**Section 3.4.8**).

### *3.4.1 Population and Number of Households*

An analysis was undertaken to determine changes in population and number of households since the development of the Goose Creek TMDLs. The TMDLs used census block level data from 2000 (USCB 2002) to estimate the population and number of households. Updated information was obtained at the census block level from the American Community Survey (ACS) 2014 population estimates (the most recent data available) (USCB 2015).

In a majority of cases, census block boundaries do not follow watershed boundaries; therefore, assumptions must be made about the distribution of population within the census blocks to estimate the total population living in the IP area and each sub-watershed. To remain consistent with the approach in the original TMDL, an even distribution of population was assumed within each census block. It is important to note that ACS does not estimate annual population at the census block level. ACS estimates are at the census tract level, a spatially courser dataset. For the purposes of this analysis, 2014 population and household estimates were disaggregated from the tract level. To accomplish this, a series of steps were taken along with several calculations, described below.

Step 1: Download 2010 census data for the IP area at the census block level (the Decennial Census provides population and household information at the block level) (USCB 2012) and calculate the ratio of land area within the IP area for each block. Assuming an even distribution of population within each block, multiply the ratio by the total population to estimate the total population living in the watershed (**Equation 3-1**).

**Equation 3-1**

$$Psw\ (2010) = Pcb * (Asw/Ab)$$

where:
Psw = 2010 Population for sub-watershed (block level)
Pcb = 2010 Population for census block
Asw = Area of census block within sub-watershed
Ab = Area of census block

Step 2: Download the ACS population estimates for 2014 at the census tract level for the IP area. To disaggregate the estimated 2014 population at the census block level, it was assumed the population distribution remains constant from the 2010 census, so, the percentage of total population was calculated at the block level in 2010 and this ratio was used to calculate 2014 population estimates (**Equation 3-2**).

**Equation 3-2**

Psw (2014) = Pp * Pacs

where:
Psw = 2014 Population for sub-watershed (block level)
Pp = Percentage of 2010 population at the block level
Pacs = 2014 Population estimates at the tract level

Since ACS does not provide information on the average household size, it was assumed that household size remained consistent with values reported in the 2010 Census. **Table 3-10** compares original TMDL population and household information with 2014 ACS estimates using this method.

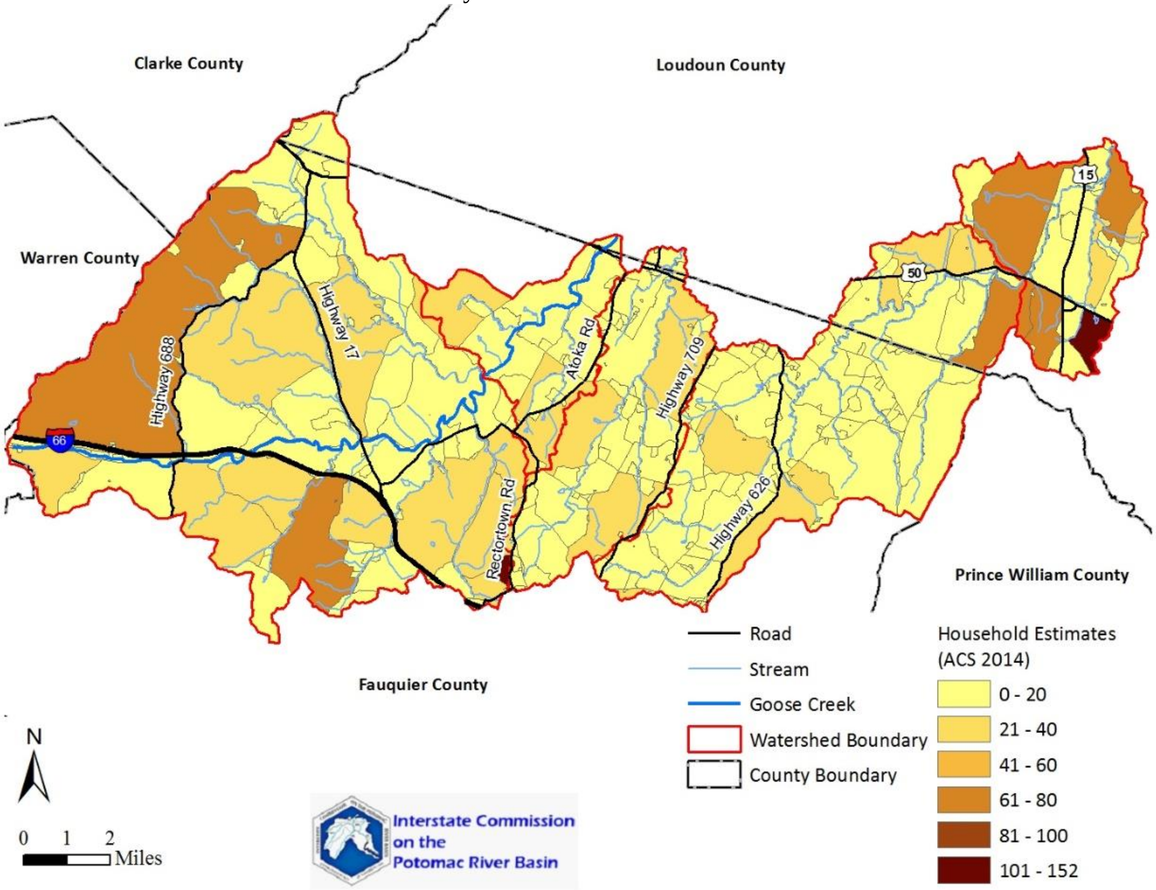
**Table 3-10.** Population and households (HH) by sub-watershed for the years 2000 and 2014.

| Sub-watershed | 2000 | | | 2014 (Estimate) | | |
|---|---|---|---|---|---|---|
| | Population | Avg HH Size | HH | Population | Avg HH Size | HH |
| Upper Goose Creek, Segment 210 | 272 | 2.36 | 115 | 238 | 2.48 | 96 |
| Upper Goose Creek | 2,349 | 2.48 | 947 | 2,495 | 2.45 | 1,003 |
| Cromwells Run | 805 | 2.40 | 335 | 657 | 2.47 | 266 |
| Upper Little River | 1,536 | 2.41 | 637 | 1,503 | 2.37 | 634 |
| Little River | 717 | 2.65 | 271 | 1,506 | 2.86 | 526 |
| **Total** | 5,679 | | 2,305 | 6,363 | | 2,525 |

Between 2000 and 2014, the IP area experienced a 12 percent population growth and a 9.5 percent growth in the number of households. Population and household growth rates were not evenly distributed across the sub-watersheds. The Cromwells Run sub-watershed saw a decrease in population and number of households during this period while the population in the Little River sub-watershed doubled. The uneven population growth rates across the sub-watersheds can be explained, in part, by county comprehensive planning and zoning policies limiting development in these largely rural portions of Loudoun and Fauquier counties (Loudoun County 2013; Fauquier County 2015). The northeast portion of the Little River sub-watershed experienced the most population growth due to its proximity to the more suburban areas of Loudoun County and the Town of Leesburg.

**Figure 3-5** presents the spatial distribution of 2014 household estimates across the IP area at the census block level. It is important to note the census blocks have been clipped to the IP boundary and show only estimated households in the planning area. In reality, many census block boundaries extend beyond the IP boundary. The portions of the block households inside and outside of the IP area were estimated using methods described above.

**Figure 3-5**. 2014 estimated number of households by census block.



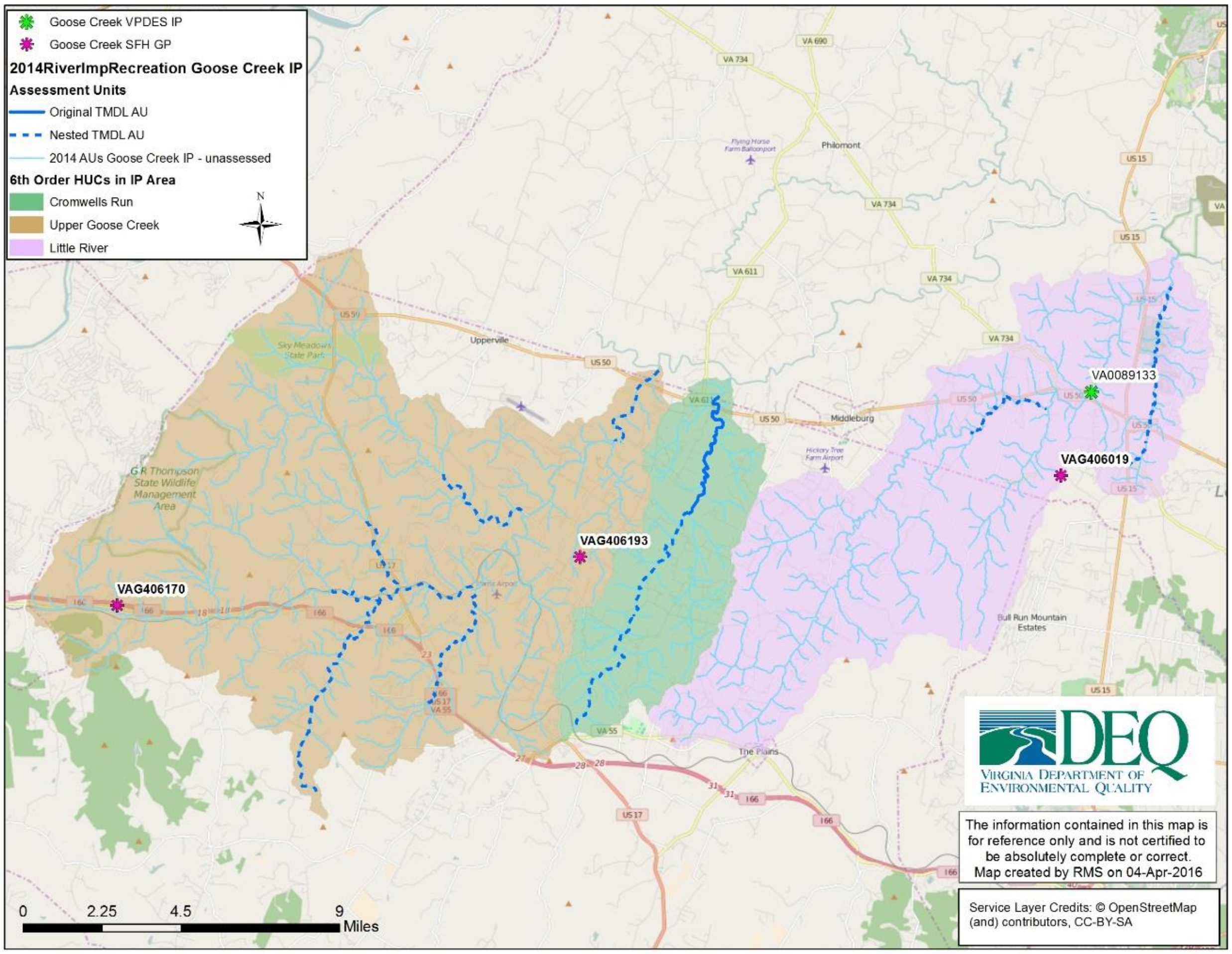

### *3.4.2 Point Sources*

The Aldie wastewater treatment plant is the only VPDES permitted PS in the IP area, discharging directly into Little River. The Aldie treatment plant is described in more detail in **Section 3.4.3**.

Three private residences in the IP area have Virginia general permits for discharging fecal coliform bacteria to surface waters (personal communication, DEQ, 5/3/2016). The permit numbers associated with these permits are VAG406019, VAG406170, and VAG406193.

The VPDES and general permit PS locations are shown in **Figure 3-6**. All of these permitted discharges were included in the ICPRB (2003) source assessment.

**Figure 3-6.** VPDES and general permit locations in the IP area. The green point is VPDES permit location. The three pink points are the general permit locations. Map produced by DEQ.

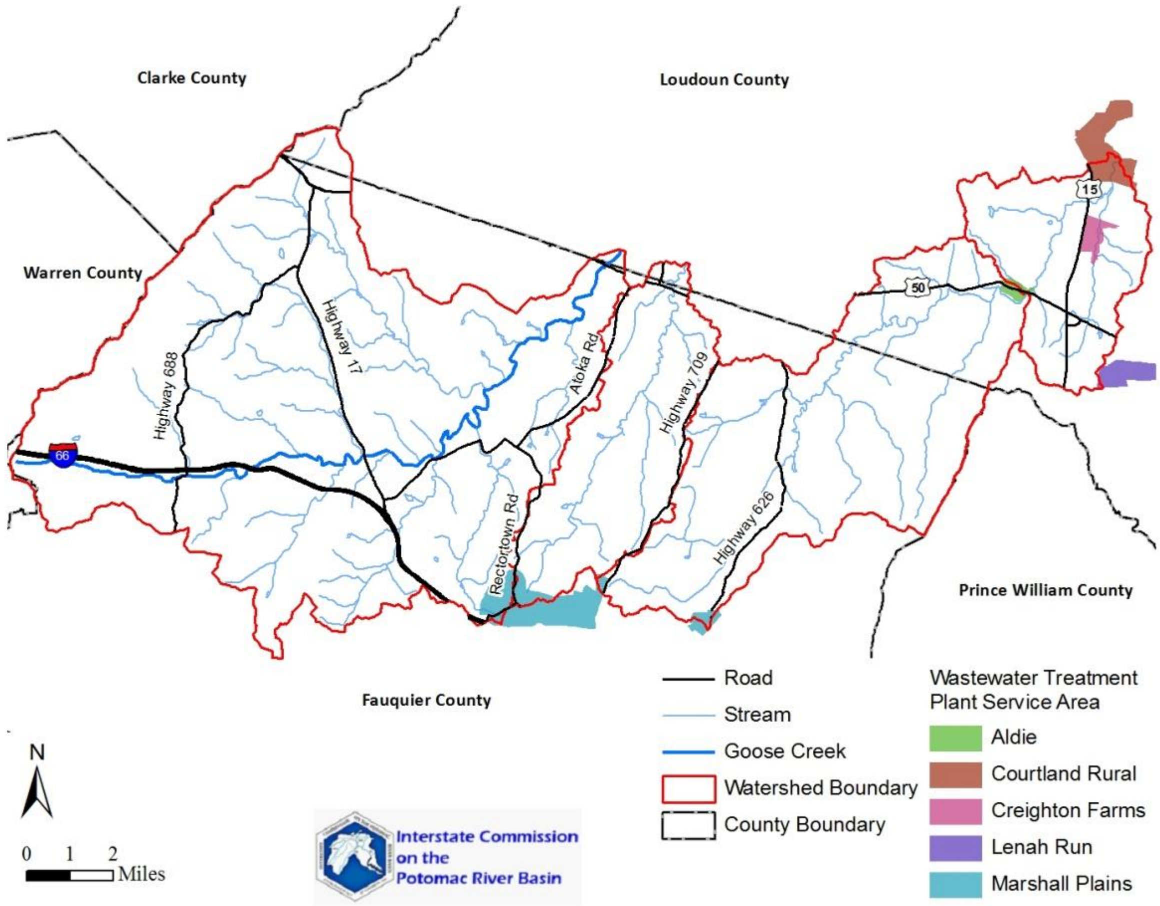



## 3.4.3 Wastewater Treatment Plants

There are four community wastewater treatment plant systems operated by Loudoun Water and one system operated by Fauquier County Water and Sanitation Authority in the IP area: Aldie, Courtland Rural Village, Lenah Run, Creighton Farms, and Marshall Plains (serving the communities of Marshall and the Plains) (**Figure 3-7**).

To understand the geographic areas served by these systems, data were obtained from the respective utilities. Loudoun Water provided service area shapefiles for Aldie, Courtland Rural, Creighton Farms, and Lenah Run. Fauquier County Water and Sanitation Authority provided locations of sewer lines and manhole covers. The service area for Marshall Plains was digitized from these datasets.

**Figure 3-7.** Wastewater treatment plant service areas in the IP area. Aldie is the only treatment plant to discharge directly to a surface waterbody in the IP area.




Information was also obtained from the utilities on the number of households served. The utility datasets do not directly indicate whether these connections were in service prior to 2014 (to coincide with the household data from the 2014 ACS). Personal communication with the utilities indicated that most of the homes were connected by 2014, but there are a handful of new connections each year (personal communication, Loudoun Water, 6/13/2016).

**Table 3-11** provides a summary of the number of households connected to sewer systems by sub-watershed. The majority of households served by sewer systems are in the Upper Goose Creek and Upper Little River sub-watersheds. In total, these systems serve 367 households in the IP area. Each of the systems is described in more detail in subsequent paragraphs.

**Table 3-11.** Number of households connected to sewer systems by sub-watershed for the year 2016.

| Sub-watershed | Households on Sewer |
|---|---|
| Upper Goose Creek, Segment 210 | 0 |
| Upper Goose Creek | 169 |
| Cromwells Run | 61 |
| Upper Little River | 104 |
| Little River | 33 |
| **Total** | 367 |

The Aldie treatment plant serves 61 connections (personal communication, Loudoun Water, 4/7/16) and discharges directly into Little River north of Highway 50. It is the only VPDES permitted discharge in the IP area as described in **Section 3.4.2**.

The Courtland Rural Village community wastewater treatment plant serves a portion of the Courtland Rural Village planned development located in the Little River sub-watershed near the confluence with Goose Creek. The 251 customers served by the treatment plant are in the "village core" located north of Goose Creek and outside the IP area. The large, rural lot portion (nine parcels) of the planned development are located in the IP area but are served by individual well and septic systems. The plant treats wastewater to Level 1 reclaimed water, per DEQ standards, for use as irrigation water at the Creighton Farms Golf Course located in the Little River sub-watershed. Reclaimed water regulations prohibit treated water from running off the site; therefore, this operation should not impact surface water quality.

Lenah Run is a small community wastewater treatment plant located west of the IP area. At the beginning of the IP planning process, the system served 260 homes, 7 of which were located in the Little River sub-watershed. Since that time, a Capital Improvement Project (CIP) connected the community to the Broad Run Water Reclamation Facility and/or to DC Water's Blue Plains Advanced Wastewater Treatment Plant both discharging outside of the IP area (personal communication, Loudoun Water, 4/19/2016 and 6/29/2017).

Creighton Farms also serves 13 households located in the Little River sub-watershed. The Creighton Farms community wastewater treatment facility was constructed in 2011 and is permitted as an alternative treatment system by Virginia Department of Health (VDH) and discharges to subsurface drainfields east of Howsers Branch.

Fauquier Water and Sanitation Authority operates the Marshall Plains wastewater treatment plant to serve the communities of Marshall and The Plains at the southern edge of the IP area. The treatment plant discharges to the Rappahannock River but serves 320 customers in the IP area, reducing the percentage of households in the IP area on septic systems (personal communication, Fauquier County Water and Sewer Authority, 4/25/2016).

### *3.4.4 Septic Systems and Straight Pipes*

A Loudoun County Sanitation Authority survey was used to estimate the number of septic systems in the Loudoun County portion of Goose Creek in 2002 as part of the development of the TMDLs (ICPRB 2003). At that time, household estimates were used to calculate the number of septic systems in the Fauquier County portion of the Goose Creek watershed. In the absence of updated septic surveys, the 2003 Fauquier County approach was used as part of this effort to estimate the number of septic systems across the IP area. To implement this methodology, the number of households were estimated for 2014 (**Section 3.4.1**). The number of households in each sewer service area (**Section 3.4.3**) were then subtracted from the number of households in the applicable IP sub-watershed(s) to estimate the number of houses on septic in each sub-watershed.

Loudoun County Department of Health records of known septic systems in the Little River sub-watershed were used as verification of the household-based septic system estimation method. There was an eight percent difference in the number of septic systems documented in the county data compared to the household-based septic system estimation method.

The average septic system failure rate was determined as part of the TMDL process using survey information for six communities in Loudoun County (ranging from 4.2 percent to 54.6 percent). Outside of the surveyed areas, a 0.5 percent failure rate was assumed based on information provided by Loudoun and Fauquier county agencies. The septic system failure rate was revised to 1.6 percent across the IP area for 2016 (personal communication, Loudoun County Health Department, 4/21/2016).

**Table 3-12** provides the results of the 2003 TMDL septic system survey and analysis. **Table 3-13** provides the estimated number of septic systems in the IP area in 2014. There was a six percent decrease in the total number of septic systems. This decrease is attributed to the expansion and construction of wastewater treatment facilities since 2003 (**Table 3-14**). Since 2003, efforts were made to address failing septic systems, particularly those systems located within 50 feet of a stream. Current land development regulations require septic systems to be installed a minimum 50 feet away from streams; therefore, failing septic systems within 50 feet of a stream are no longer a concern in the IP area (Fauquier County 2016a; Loudoun County 2015). Overall, the estimated number of failing septic systems in the IP area fell 72 percent between 2003 and 2014.

**Table 3-12.** Estimated number of septic systems by sub-watershed for the year 2002.

| Sub-watershed | No. of Septic Systems | No. of Failing Systems | No. of Failing Systems < 50 feet from a stream |
|---|---|---|---|
| Upper Goose Creek, Segment 210 | 117 | 6 | 1 |
| Upper Goose Creek | 947 | 47 | 5 |
| Cromwells Run | 335 | 17 | 2 |
| Upper Little River | 637 | 40 | 3 |
| Little River | 271 | 14 | 0 |
| **Total** | 2,307 | 124 | 11 |

**Table 3-13.** Estimated number of septic systems by sub-watershed for the year 2014.

| Sub-watershed | No. of Septic Systems | No. of Failing Systems |
|---|---|---|
| Upper Goose Creek Segment 2010 | 96 | 2 |
| Upper Goose Creek | 834 | 13 |
| Cromwells Run | 205 | 3 |
| Upper Little River | 530 | 8 |
| Little River | 493 | 8 |
| **Total** | 2,158 | 35 |

**Table 3-14**. Septic system percent change between 2003 and 2014.

| Sub-watershed | Septic Systems % Change | Failing Systems % Change |
|---|---|---|
| Upper Goose Creek, Segment 210 | -18 | -67 |
| Upper Goose Creek | -11 | -72 |
| Cromwells Run | -39 | -82 |
| Upper Little River | -17 | -70 |
| Little River | 82 | -43 |
| **Total** | -6 | -72 |

According to ICPRB (2003) there were no known straight pipes draining directly to surface waters in the Goose Creek watershed as of 2003; however, some effluent was perhaps being discharged to ditches that drain to surface waters. There is no indication that this information has changed since 2003.

### *3.4.5 Livestock*

Livestock estimates were obtained from the local Soil and Water Conservation Districts (SWCDs) as part of the development of the Goose Creek TMDLs. U.S. Department of Agriculture (USDA) census of agriculture data were obtained for the years 2002 and 2012 for Loudoun and Fauquier counties to understand changes in livestock over time in the IP area. The county data were disaggregated to the sub-watershed level using land use data from **Section 3.3** by assuming that livestock populations were evenly distributed across the pasture land use class. Using the average farm size published in the agricultural census, the number of farms were calculated for each sub-watershed in the IP area. Animal populations were estimated by calculating average number of animals per farm. **Table 3-15** and **Table 3-16** compare livestock populations between 2002 and 2012. Overall, beef cattle populations increased by eight percent while dairy cattle decreased by about one-third (35 percent). The horse population increased by three percent and sheep populations fell by 13 percent.

**Table 3-15**. Livestock population comparison between 2002 and 2012.

| Sub-watershed | Beef Cattle | | Dairy Cattle | | Sheep | | Horses | |
|---|---|---|---|---|---|---|---|---|
| | 2002 | 2012 | 2002 | 2012 | 2002 | 2012 | 2002 | 2012 |
| Upper Goose Creek | 6,042 | 6,345 | 17,808 | 12,267 | 2,862 | 1,974 | 1,431 | 1,269 |
| Cromwells Run | 1,862 | 2,025 | 5,488 | 3,915 | 882 | 630 | 441 | 405 |
| Little River | 2,790 | 3,164 | 3,162 | 1,017 | 2,511 | 2,825 | 744 | 1,017 |
| **Total** | 10,694 | 11,534 | 26,458 | 17,199 | 6,255 | 5,429 | 2,616 | 2,691 |

**Table 3-16.** Livestock population percent change between 2002 and 2012.

| Sub-watershed | Beef Cattle | Dairy Cattle | Sheep | Horses |
|---|---|---|---|---|
| Upper Goose Creek | 5% | -31% | -31% | -11% |
| Cromwells Run | 9% | -29% | -29% | -8% |
| Little River | 13% | -68% | 13% | 37% |
| **Total** | 8% | -35% | -13% | 3% |

### *3.4.6 Wildlife*

**Table 3-17** summarizes the wildlife populations in the IP area, adapted from ICPRB (2003) to account for the modified Segment 210 watershed boundary. Stakeholder comments during the IP development suggest an increase in wildlife, especially geese, since 2003. In the absence of quantitative data; however, these numbers were not updated as part of this process. It should be noted that this IP does not directly address bacteria from wildlife.

**Table 3-17**. Wildlife populations by sub-watershed.

| Sub-watershed | Deer | Raccoon | Muskrat | Beaver | Turkey | Goose | Duck |
|---|---|---|---|---|---|---|---|
| Upper Goose Creek, Segment 210 | 622 | 232 | 540 | 76 | 29 | 149 | 59 |
| Upper Goose Creek | 2,743 | 1,812 | 4,677 | 487 | 231 | 1,014 | 406 |
| Cromwells Run | 1,012 | 467 | 1,368 | 121 | 45 | 242 | 97 |
| Upper Little River | 1,403 | 1,011 | 3,487 | 243 | 110 | 517 | 207 |
| Little River | 777 | 375 | 1,147 | 98 | 38 | 187 | 75 |
| **Total** | 6,557 | 3,897 | 11,219 | 1,025 | 453 | 2,109 | 844 |

### *3.4.7 Pets*

Pet populations (dogs and cats) were estimated as part of the Goose Creek TMDLs; however, cat loads were not considered a source of bacteria due to their behavioral characteristics. Two modifications were made to the dog estimates as part of the IP update process. First, new estimates of the number of dogs were calculated. Second, a change in methodology for attributing the pet loads to specific land uses was implemented. Each of these are discussed in more detail in this section.

Consistent with the approach used for the TMDLs, the number of dogs living in the IP area were estimated by multiplying the average number of dogs per household by the number of households. The methodology used to calculate number of households is described in **Section 3.4.1**. The average number of dogs per household was obtained from the 2012 American Veterinary Medical Association (AVMA) survey (AVMA 2012) which estimated 0.584 dogs per household compared to the 0.534 dogs per household in the 2002 AVMA survey (AVMA 2002). The results indicate a 20 percent increase in the dog population across the IP area (**Table 3-18).**

**Table 3-18**. Estimated dog populations and percent change by sub-watershed in the Goose Creek IP area. Households were calculated using census data from the years 2000 and 2014 for the TMDL and IP, respectively. Average number of dogs per household were calculated using AVMA data from the years 2002 and 2012 for the TMDL and IP, respectively.

| Sub-watershed | TMDL | | IP | | % Change |
|---|---|---|---|---|---|
| | Households | Dog (#) | Households | Dog (#) | |
| Upper Goose Creek, Segment 210 | 115 | 62 | 96 | 56 | -9 |
| Upper Goose Creek | 947 | 506 | 1,003 | 586 | 16 |
| Cromwells Run | 335 | 179 | 266 | 155 | -13 |
| Upper Little River | 637 | 340 | 634 | 370 | 9 |
| Little River | 271 | 144 | 526 | 307 | 113 |
| **Total** | 2,305 | 1,230 | 2,525 | 1,474 | 20 |

The second update to the Goose Creek TMDLs pet load estimation was a change in methodology for attributing the loads to specific land uses. The original method distributed the load attributed to dogs across developed, cropland, and pasture land uses; however, the current standard practice attributes dog waste to developed land uses only. The Bacteria Source Load Calculator (BSLC) developed by researchers at Virginia Tech was utilized to estimate the total amount of fecal coliform associated with dog waste (Zeckoski et al. 2005). To directly compare the change in fecal coliform from dog waste in the IP area, a two-step approach was implemented:

1. Run the BSLC using the TMDL and the IP dog population estimates distributing dog waste across developed, cropland, and pasture land uses. This step developed TMDL BSLC estimates for direct comparison with IP BSLC estimates using the original land use application methods.
2. Run the BSLC under the revised methodology to attribute dog waste to developed lands only using the TMDL and IP dog population estimates. The second step attributed the dog loads only to developed lands for comparison between methodologies and over time.

**Table 3-19** documents the BSLC-calculated estimates of fecal coliform contribution from dogs. These outputs, calculated in Step 2 for both the TMDL and IP data, represent accumulation rates and do not estimate die-off or wash-off. The numbers, therefore, provide an indication of the magnitude of change in pet contribution between the TMDL and IP conditions, but are not directly comparable to the reported model output in the TMDLs or in **Section 3.6** of this document.

**Table 3-19.** Change over time in estimated fecal coliform contribution from dogs (cfu/year). These TMDL and IP numbers were generated using the BSLC by applying pet waste to developed lands only. Differences in the contributions are due to the two IP two updates; namely, the revised number of dogs per household and the updated number of households.

| Sub-watershed | TMDL (cfu/year) | IP (cfu/year) | % Change |
|---|---|---|---|
| Upper Goose Creek, Segment 210 | 1.01E+13 | 9.21E+12 | -9 |
| Upper Goose Creek | 8.31E+13 | 9.63E+13 | 16 |
| Cromwells Run | 2.94E+13 | 2.55E+13 | -13 |
| Upper Little River | 5.59E+13 | 6.09E+13 | 9 |
| Little River | 2.38E+13 | 5.05E+13 | 112 |
| **Total** | 2.02E+14 | 2.42E+14 | 20 |

The TMDL source assessment concluded that dog waste was not a significant contributor to bacteria loads; however, the contribution is increasing in the Upper Goose Creek (Segment 220 only), Upper Little River, and Little River sub-watersheds (**Table 3-19)**. Management measures to address dog waste may be targeted as a higher priority in these sub-watersheds. Examples of management measures to address dog waste are providing plastic bag dispensers and waste disposal bins to encourage pet owners to pick up after their dogs as well as general education and outreach campaigns.

### *3.4.8 Biosolids*

Class B biosolids may be applied to agricultural, silvicultural, and mined land reclamation sites (DEQ 2016a). ICPRB (2003) documented the average annual biosolid application rate by segment based on data from the years 1996 through 2000. At that time, application of biosolids was not reported for any segment in the IP portion of the Goose Creek watershed. Based on analysis of 2008 to 2015 DEQ data, biosolids originating at facilities across the region are now being applied in the Upper Goose Creek sub-watershed of the IP area. **Table 3-20** shows the total monthly and annual Class B biosolid application rates in Upper Goose Creek sub-watershed between 2008 and 2015. The average annual application during this period is 3,899 tons. Monthly applications vary widely with the highest amounts applied in the summer and the lowest amounts applied in the winter. Due to the DEQ permit requirements for biosolid applications, biosolids are not expected to impact surface water quality.

**Table 3-20.** Estimated monthly and annual biosolid application rates in the Upper Goose Creek sub-watershed (dry tons/year).

| Year | Jan | Feb | Mar | Apr | May | Jun | Jul | Aug | Sep | Oct | Nov | Dec | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 2008 | 0 | 0 | 0 | 0 | 0 | 923 | 1,294 | 186 | 0 | 0 | 386 | 0 | 2,789 |
| 2009 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2010 | 0 | 0 | 0 | 576 | 509 | 1,562 | 1,703 | 1,621 | 663 | 0 | 0 | 1 | 6,636 |
| 2011 | 0 | 97 | 242 | 1 | 482 | 582 | 3,777 | 1,050 | 0 | 8 | 2,462 | 0 | 8,700 |
| 2012 | 2 | 0 | 2 | 1,326 | 249 | 2 | 619 | 112 | 0 | 1 | 88 | 83 | 2,483 |
| 2013 | 0 | 83 | 0 | 1,712 | 1,021 | 482 | 1 | 499 | 2,080 | 1,421 | 79 | 68 | 7,445 |
| 2014 | 0 | 0 | 0 | 0 | 1 | 489 | 769 | 675 | 667 | 58 | 0 | 0 | 2,661 |
| 2015 | 0 | 1 | 0 | 194 | 55 | 231 | 0 | 0 | 0 | 0 | 0 | 0 | 481 |
| **Avg** | 0 | 23 | 30 | 476 | 290 | 534 | 1,020 | 518 | 426 | 186 | 377 | 19 | 3,899 |

## 3.5 Water Quality Conditions

Since development of the Goose Creek TMDLs in 2003, changes in watershed conditions such as land use and population in combination with implementation of management measures have likely changed water quality conditions. To provide reasonable assurance that the suite of management measures recommended in the IP will achieve water quality standards, it is necessary to first understand existing water quality conditions and how conditions have changed over time.

The DEQ 2014 Integrated Report found improvement in water quality across the IP area using *E. coli* data collected between 2007 and 2012; however, most sites still did not meet water quality standards. The DEQ water quality monitoring summary table is provided in **Attachment A**.

Using water quality monitoring data provided by DEQ, instances of bacteria violations were counted for monitoring locations in the IP area for two time periods, pre-TMDLs (before 2003) and present (defined by the draft DEQ 2016 Integrated Report, 2013-2016). By comparing the number of violations between the two time periods, a sense of water quality changes over time can be obtained.

DEQ has collected both fecal coliform and *E. coli* data in the IP area. For the purposes of comparison, fecal coliform concentrations were converted to *E. coli* concentrations using **Equation 3-3**.

**Equation 3-3**

$$\text{Log2 (EC)} = -0.0172 + 0.91905 * \text{Log2 (FC)}$$

where:
EC = *E. coli* concentration
FC = fecal coliform concentration

Improvements in water quality have been observed across the IP area (**Table 3-21** and **Table 3-22)**.

**Table 3-21.** Comparison of bacteria water quality standard violations pre-TMDLs (before 2003) and present (2013-April 2016). Raw data provided in **E. coli*, **fecal coliform, or +both. Cells with "-" denote no samples were taken, "0" denotes no samples were in violation of water quality standards.

| Station ID | Sub-watershed | Pre-TMDL (Before 2003) | | Present (2013-April 2016) | |
|---|---|---|---|---|---|
| | | Number of Samples | Number of Samples in Violation | Number of Samples | Number of Samples in Violation |
| 1ACRM001.20 | Cromwells Run | 42** | 17 | 15* | 3 |
| 1AGAR002.24 | Upper Goose Creek | 5** | 3 | 9* | 4 |
| 1AGOO036.61 | Upper Goose Creek | 2** | 0 | 12* | 2 |
| 1AGOO039.63 | Upper Goose Creek | - | - | 1* | 0 |
| 1AGOO044.36 | Upper Goose Creek | 136** | 43 | 19* | 3 |
| 1ALIV004.78 | Little River | 46+ | 25 | 12* | 3 |
| 1ALIV004.79 | Little River | - | - | 1* | 1 |
| 1ALIV012.12 | Little River | 1** | 0 | 12* | 5 |

**Table 3-22.** Comparison of bacteria water quality standard violation rates pre-TMDLs (before 2003) and present (2013-April 2016). Cells with "-" denote no samples were collected, "0" denotes no samples were in violation of water quality standards.

| Station ID | Sub-watershed | Pre-TMDL (Before 2003) | Present (2013-April 2016) |
|---|---|---|---|
| | | Violation Rate | Violation Rate |
| 1ACRM001.20 | Cromwells Run | 40% | 20% |
| 1AGAR002.24 | Upper Goose Creek | 60% | 44% |
| 1AGOO036.61 | Upper Goose Creek | 0% | 17% |
| 1AGOO039.63 | Upper Goose Creek | - | 0% |
| 1AGOO044.36 | Upper Goose Creek | 32% | 16% |
| 1ALIV004.78 | Little River | 54% | 25% |
| 1ALIV004.79 | Little River | - | 100% |
| 1ALIV012.12 | Little River | 0% | 42% |

Understanding current water quality conditions as well as apparent trends over time is important for developing and targeting implementation strategies as part of the IP process. Specifically, geographic areas with successful past implementation can be identified as well as areas needing additional, targeted efforts.

## 3.6 Modeling Update

### *3.6.1 Scenario Selection*

The original bacteria pollutant reduction scenarios contained in the 2003 TMDL report were reviewed and an alternative scenario (to the one used in the 2003 TMDLs) was selected by DEQ. The 2003 Goose Creek TMDL was one of the first bacteria TMDLs prepared in Virginia, and it called for bacteria reductions sufficient to achieve no exceedance over a ten year modeling period of the maximum assessment criterion. The modeling scenario (Scenario 8 in the 2003 TMDL report) that was the basis of the 2003 TMDL allocations called for 100% reduction of direct deposition of bacteria from cattle in streams, 100% reduction of bacteria from failing septic systems, and 98-99% (varied by sub-watershed) reduction of bacteria runoff from pasture; essentially, this equates to near elimination of all major sources of bacteria throughout the watershed.

The current DEQ bacteria TMDL development process is to present load allocation reductions that will result in no exceedances of the geometric mean criterion value. In addition, one or more load allocation scenarios are provided that will result in less than a 10.5% exceedance rate of the maximum assessment criterion. This (latter) value is used by DEQ to identity bacteria impaired waters and to remove waters from the impaired waters list as water quality improvements are attained. DEQ uses a phased implementation approach in bacteria TMDL implementation plans to achieve the water quality milestones that are described.

The current DEQ (and EPA) expectation for TMDL implementation plans is to achieve bacteria reductions that will result in no exceedance of the geometric mean criterion value, and less than a 10.5% exceedance rate of the maximum assessment criterion. These water quality end-points fully achieve the Commonwealth of Virginia's recreational use water quality standard. In light of current practices, it was appropriate to revisit the bacteria reduction allocations in the TMDL modeling and select a more viable scenario than that selected for the 2003 TMDL allocations.

The pollutant reduction scenario (Scenario 9 in the 2003 TMDL report) that is the foundation for this plan lessens the required pasture bacteria reductions from 98-99% to 75%, and adds cropland and developed land reductions of 75%. This shift reduces pasture land management controls to a more viable level, and also spreads load reductions more broadly by also requiring cropland, stormwater, and pet waste management actions. The revised allocations provide an opportunity to more broadly engage the local community in watershed protection and restoration by requiring more management actions on developed lands.

### *3.6.2 Methodology Revisions*

The original TMDLs were developed at about the time Virginia adopted *E. coli* criteria to protect the primary contact recreation use. The Goose Creek TMDLs and their 2006 modifications were expressed as edge-of-stream fecal coliform loads. Wasteload allocations (WLAs) were also expressed as point-of-discharge *E. coli* loads. Since that time, it has become standard practice in Virginia bacteria TMDLs to express the overall TMDL as in-stream *E. coli* loads at the outlet of the impaired segment. WLAs are still expressed as *E. coli* loads at the point-of-discharge. The load allocation for nonpoint sources is the difference between instream TMDL and WLA.

Presented here are baseline loads and TMDL allocations for Upper Goose Creek, Cromwells Run, and Little River, expressed according to the current standard practice in Virginia. The method by which the loads and allocations were calculated is also documented.

Baseline loads and allocations were calculated using the fecal coliform computer simulation models for the 2006 TMDL modifications. Following the original Goose Creek bacteria TMDL (ICPRB 2003) and the 2006 modifications, baseline loads are defined to be 1) permitted discharges at their WLAs, and 2) nonpoint sources at their current loads, with minor modifications discussed in ICPRB (2003). The Upper Goose Creek sub-watershed, as defined by the IP, did not match the model segmentation of the original TMDL. The original model Segment 210 was divided into two sections, and the lower section used to calculate the loads and allocations for the Upper Goose Creek watershed. The land use was divided between the upper and lower segments, based on the 1997 MRLC data and the land use classification scheme used in ICPRB (2003). Impervious mountain rock layers were assigned to the upper segment, outside of the Upper Goose Creek sub-watershed. The lower section was simulated using the same loading rates as the original Segment 210, but individual permits were assigned to the lower and upper sections of Segment 210 based on their locations.

To express baseline loads as instream *E. coli* loads at the watershed outlet, the following steps were performed:

1. Calculate daily *E. coli* loads at the watershed outlet from daily simulated flows and simulated fecal coliform concentrations under baseline conditions and the Virginia equation for converting fecal coliform concentrations into *E. coli* concentrations using **Equation 3-3**.

2. For each nonpoint source, run the model without the contribution of that source and on a daily basis subtract the daily fecal coliform concentrations of that simulation from the baseline scenario. The remaining concentration is the contribution of that source to the total fecal coliform load. Convert that concentration to a fraction of the baseline concentration on a daily basis.
3. On a daily basis, normalize the fractions so they add to one by dividing by the sum of the original fractions.
4. On a daily basis, subtract the WLA from the total baseline *E. coli* load. The remaining load is the load from nonpoint sources.
5. On a daily basis, multiply the load in Step 4 by the fractions in Step 3. This gives the *E. coli* load for each nonpoint source shown as the baseline load in the Load Allocation (LA) tables.

LA's were calculated by source and the overall TMDL by multiplying baseline loads by Scenario 9 percent reductions from ICPRB (2003). Percent reductions in bacteria loads for Scenario 9 are provided in Table 5.5 of ICPRB (2003). Scenario 9 is expected to meet requirements needed for delisting of the waters from the IP area (see ICPRB 2003 Table 5.6).

**Table 3-23** shows the overall TMDL expressed as instream *E. coli* loads at the watershed outlet for the Upper Goose Creek sub-watershed. It includes the TMDL (Scenario 8) and IP (Scenario 9) WLA for comparison. **Table 3-24** shows the WLA by source, expressed as point-of-discharge *E. coli* loads, for the Upper Goose Creek sub-watershed. The individual WLAs have not changed from the 2006 modification, but they were not reported together for the Upper Goose Creek sub-watershed. **Table 3-25** shows the LA by source, expressed as instream *E. coli* loads at the watershed outlet for the Upper Goose Creek sub-watershed. **Table 3-26**, **Table 3-27**, and **Table 3-28** present the same information for Cromwells Run and **Table 3-29**, **Table 3-30**, and **Table 3-31** present the information for Little River.

**Table 3-23**. Elements of the *E. coli* TMDL for Upper Goose Creek under 2003 TMDL scenario and 2017 IP scenario.

| Waterbody | Parameter | TMDL (cfu/yr) | TMDL WLA Scenario 8 (cfu/yr) | IP WLA Scenario 9 (cfu/yr) | LA (cfu/yr) | MOS (cfu/yr) |
|---|---|---|---|---|---|---|
| Upper Goose Creek | *E. coli* | 1.24 E+13 | 3.48E+09 | 8.47E+13 | 1.24E+13 | Implicit |

**Table 3-24**. *E. coli* wasteload allocation for Upper Goose Creek.

| Permit Number | Facility | Baseline Load (cfu/ yr) | Allocated Load (cfu/yr) |
|---|---|---|---|
| VAG406170 | Residence | 1.74E+09 | 1.74E+09 |
| VAG406193 | Residence | 1.74E+09 | 1.74E+09 |
| **Total Wasteload Allocation** | | 3.48E+09 | 3.48E+09 |

**Table 3-25**. *E. coli* load allocation for Upper Goose Creek.

| Source | Baseline Load (cfu/yr) | IP Allocated Load (cfu/yr) | IP Reduction |
|---|---|---|---|
| Forest | 1.23E+12 | 1.23E+12 | 0% |
| Cropland | 8.58E+10 | 2.15E+10 | 75% |
| Pasture | 3.30E+14 | 8.25E+13 | 75% |
| Developed Land (without failing septic systems) | 7.70E+10 | 1.93E+10 | 75% |
| Failing Septic Systems | 1.16E+12 | 0 | 100% |
| Straight Pipes / Septic Systems within 50 ft of Surface Water | 6.05E+04 | 0 | 100% |
| Direct Deposition from Cattle | 1.11E+14 | 0 | 100% |
| Direct Deposition for Wildlife | 9.56E+11 | 9.56E+11 | 0% |
| **Total Load Allocation** | 4.44E+14 | 8.47E+13 | 81% |

**Table 3-26**. Elements of the *E. coli* TMDL for Cromwells Run under 2003 TMDL scenario and 2017 IP scenario.

| Waterbody | Parameter | TMDL (cfu/yr) | TMDL WLA Scenario 8 (cfu/yr) | IP WLA Scenario 9 (cfu/yr) | LA (cfu/yr) | MOS (cfu/yr) |
|---|---|---|---|---|---|---|
| Cromwells Run | *E. coli* | 4.10E+12 | 6.17E+10 | 2.41E+13 | 4.04E+12 | Implicit |

**Table 3-27.** *E. coli* wasteload allocation for Cromwells Run. At the time of the TMDL, there were no permitted discharges in the Cromwells Run sub-watershed. The allocated load is based on a hypothetical one percent growth.

| Permit Number | Facility | Baseline Load (cfu/ yr) | Allocated Load (cfu/yr) |
|---|---|---|---|
| | | | 6.17E+10 |
| **Total Wasteload Allocation** | | | 6.17E+10 |

**Table 3-28.** *E. coli* load allocation for Cromwells Run.

| Source | Baseline Load (cfu/yr) | IP Allocated Load (cfu/yr) | IP Reduction |
|---|---|---|---|
| Forest | 1.60E+12 | 1.60E+12 | 0% |
| Cropland | 1.40E+10 | 3.50E+09 | 75% |
| Pasture | 8.80E+13 | 2.20E+13 | 75% |
| Developed Land (without failing septic systems) | 3.73E+10 | 9.33E+09 | 75% |
| Failing Septic Systems | 5.38E+11 | 0 | 100% |
| Straight Pipes / Septic Systems within 50 ft of Surface Water | 2.82E+05 | 0 | 100% |
| Direct Deposition from Cattle | 9.28E+12 | 0 | 100% |
| Direct Deposition for Wildlife | 4.98E+11 | 4.98E+11 | 0% |
| **Total Load Allocation** | 9.99E+13 | 2.41E+13 | 76% |

**Table 3-29**. Elements of the *E. coli* TMDL for Little River under 2003 TMDL scenario and 2017 IP scenario.

| Waterbody | Parameter | TMDL (cfu/yr) | TMDL WLA Scenario 8 (cfu/yr) | IP WLA Scenario 9 (cfu/yr) | LA (cfu/yr) | MOS (cfu/yr) |
|---|---|---|---|---|---|---|
| Little River | *E. coli* | 1.60E+13 | 1.40E+11 | 1.28E+14 | 1.58E+13 | Implicit |

**Table 3-30**. *E. coli* wasteload allocation for Little River.

| Permit Number | Facility | Baseline Load (cfu/ yr) | Allocated Load (cfu/yr) |
|---|---|---|---|
| VAG406019 | Residence | 8.69E+09 | 8.69E+09 |
| VA0089133 | Aldie WWTP | 1.31E+11 | 1.31E+11 |
| **Total Wasteload Allocation** | | 1.40E+11 | 1.40E+11 |

**Table 3-31**. *E. coli* load allocation for Little River.

| Source | Baseline Load (cfu/yr) | IP Allocated Load (cfu/yr) | IP Reduction |
|---|---|---|---|
| Forest | 2.78E+12 | 2.78E+12 | 0% |
| Cropland | 3.37E+11 | 8.43E+10 | 75% |
| Pasture | 4.94E+14 | 1.24E+14 | 75% |
| Developed Land (without failing septic systems) | 1.61E+11 | 4.03E+10 | 75% |
| Failing Septic Systems | 2.39E+12 | 0 | 100% |
| Straight Pipes / Septic Systems within 50 ft of Surface Water | 3.42E+05 | 0 | 100% |
| Direct Deposition from Cattle | 5.51E+13 | 0 | 100% |
| Direct Deposition for Wildlife | 1.33E+12 | 1.33E+12 | 0% |
| **Total Load Allocation** | 5.56E+14 | 1.28E+14 | 77% |

# 4. Public Participation

Collecting input from the public on conservation and outreach strategies to include in the TMDL IP is a critical step in the planning process. Since these plans are implemented primarily by watershed stakeholders on a voluntary basis (often with financial incentives), local input and support are the primary factors that will determine success in carrying out the IP's recommended actions.

A public meeting to formally begin development of the implementation plan was held on the evening of June 21, 2016 at the Wakefield school in The Plains, Virginia (**Table 4-1**). The public meeting was publicized through email announcements, fliers, and signs posted throughout the watershed; in total 27 people attended, including private citizens, government agency representatives, local business interests, and representatives from several area non-profit organizations. This meeting served as an opportunity for local residents to learn more about the condition of local streams, and to work together to identify ideas to protect and restore water quality in their community. The meeting began with a brief presentation on existing water quality conditions in the streams, updates to the 2003 Goose Creek watershed TMDL, and the types of actions and information that could be included in an implementation plan to improve water quality. The public participation process that DEQ uses in developing these plans was also described to attendees. **Attachment B** provides a summary of the public comments received following the first public meeting as well as the responses by DEQ staff. **Attachment C** includes the comment letters received following the first public meeting.

**Table 4-1**. Meetings held during the TMDL IP development process.

| Date | Meeting Type | Location | Attendance |
|---|---|---|---|
| 06/21/16 | Public Meeting | The Wakefield School | 27 |
| 06/21/16 | Agricultural & Residential Working Group #1 | The Wakefield School | 17 |
| 09/08/16 | Governmental Working Group | Tri County Feeds | 19 |
| 09/22/16 | Agricultural & Residential Working Group #2 | The Wakefield School | 15 |
| 05/25/17 | Steering Committee | Tri County Feeds | 11 |
| 06/21/17 | Final Public Meeting | The Wakefield School | 17 |

A local farmer shared his experience with using a variety of BMPs on farmland he leased near the meeting location, which gave participants a better understanding of water quality management measures for agricultural lands. Following the presentation, attendees split into two working groups: a residential group and an agricultural group.

The working groups discussed how residential and agricultural land use practices are affecting the quality of local streams, and reviewed different management practices that could be included in the IP. These discussions were facilitated by staff from DEQ, the Rappahannock-Rapidan Regional Commission (RRRC), and the Interstate Commission on the Potomac River Basin (ICPRB).

The final public meeting was held on June 21, 2017 in The Plains, Virginia. The primary purpose of this meeting was to present the final TMDL IP. A presentation was given describing the implementation plan and its major components. Maps with land use, topographic features, and analysis of BMPs recommended for each watershed were displayed and discussed during the presentation.

There were questions and discussion of how the 75% bacteria reductions from pasture would be obtained and about stream exclusion fencing needs. It was noted that riparian buffers and improved pasture management practices will help address the load reductions needed for pasture land by filtering runoff from farm fields before it enters streams. Several participants stressed the need to “ground-truth” estimated stream exclusion fencing needs in light of fencing already installed and land use changes. DEQ clarified that during project implementation such validation/corrections can be made, and that technical assistance funded with CWA §319 grants could address this need. Additional discussion stressed the importance of addressing horse farm sources of bacteria, and conveyed participants’ perspective that wildlife populations (especially deer and geese) seem to be increasing. **Attachment D** provides a summary of the public comments received following the final public meeting as well as responses by DEQ staff. **Attachment E** includes the comment letters received following the final public meeting.

## 4.1 Agricultural Working Group

The role of the Agricultural Working Group (AWG) is to review potential conservation practices and outreach strategies from a local agricultural perspective, identify any obstacles (and solutions) related to BMP implementation, and provide input on the type, number, and costs of BMPs. During the first AWG meeting on June 21, 2016, the group began to consider stream fencing opportunities within the watershed. The group discussed the need to ground-truth potential fencing areas identified through data analysis the JMSWCD had begun for the plan area. The group also discussed the challenge of enhancing conservation measures for leased properties.

The AWG thought it would be valuable to include groups like Goose Creek Association (GCA) in outreach efforts. Farm tours could provide information about the multiple benefits of BMPs, including water quality and wildlife habitat improvements and improved livestock health and agricultural productivity. They discussed portable watering systems as a promising way to enhance participation in rotational grazing. There is a substantial number of existing conservation easements in the area and the workgroup discussed potential easement program changes to require stream fencing in future easement agreements. Hobby farms, in particular those with horses, may need to be offered composting opportunities at the regional scale, given the cost to install individual small-farm composting.

A second AWG meeting was held on September 22, 2016. This meeting included a presentation about the Gilberts Corner Farm Project, which addressed bacterial sources comprehensively using SWCD cost-share programs to create multiple benefits. At a total cost of $125,000, more than two miles of stream fencing, two hardened stream crossings, and water piping for six watering tank vaults were installed. Benefits of improved agricultural production, enhanced wildlife habitat, and water quality were discussed. Participants of the second AWG meeting completed a BMP scoring sheet to determine which conservation measures would be the most applicable and popular with area farmers. In order of popularity with AWG members, the results were as follows:

1. Streamside livestock exclusion fencing,
2. Rotational grazing/Grazing land management, tied with
3. Forested streamside buffers,
4. Grassed streamside buffers,
5. Manure composting/storage facilities (equine),
6. Continuous no-till/Conservation tillage,
7. Forestation of crop, pasture or hayland.

Meeting participants then identified, in priority order, the following obstacles that will need to be addressed to achieve the desired level of stream exclusion:

1. Cost of installing fencing and creating off-stream water supplies,
2. Concern (economic) of giving up production of 35 linear feet for a stream buffer zone,
3. Grazing land is often rented with short-term leases,
4. Fence maintenance is costly and time-consuming.

Some participants also observed that low levels of government trust impede participation in cost-share programs.

## 4.2 Residential Working Group

The primary role of the Residential Working Group (RWG) was to discuss methods needed to reduce human and pet sources of bacteria entering the creeks, recommend methods to identify and correct or replace failing septic systems and straight pipes, and provide input on the residential BMPs to include in the plan. The June 21, 2016 meeting participants discussed recent Fauquier and Loudoun county data on septic systems repairs in each county. Recent septic system improvements have informed estimates of the need for additional septic system repairs and replacements in the implementation plan.

Both Loudoun and Fauquier counties have ordinances requiring that septic systems be pumped out every five years, and septic haulers report actual pump outs to the respective health departments. The group agreed that more education is needed for septic system owners, especially for owners of newer homes which frequently have alternative septic systems. RWG participants identified realtors as a group that could help with septic maintenance educational outreach during real estate transactions. There was also discussion of the recent upgrades completed for the Broad Run Wastewater Treatment Facility to accommodate increased septic waste volume at the plant (regularly 20+ trucks per day) since Loudoun County established its septic system pump-out requirements. Any changes to septic pump-out programs triggered by the TMDL IP will need to account for the ability of local wastewater treatment facilities to handle increased loadings.

Options for pet waste BMPs were discussed; including composters, bag stations, leash bag holders, and confined canine units for kennel and hunt club operations. Information was shared about diseases that can affect both humans and pets when pet waste is not collected and allowed to run off into area streams. The group discussed some popular dog walking areas and homeowner associations that may be viable locations for new pet waste bag stations. The Parks and Recreation departments in both counties could provide maintenance of those stations on public property.

There are some good examples of proper pet waste management in the area, such as the Fauquier Society for the Prevention of Cruelty to Animals (SPCA). Special septic systems are needed to treat dense dog wastes, and they are expensive; less expensive dry stack composting methods may be more likely to be installed. Fauquier County requires kennel operations to provide plans for pet waste management when they apply for a kennel license. The RWG also discussed special consideration and practices relevant to horses. Educating the many area horse owners on barnyard and pasture management techniques is important. Educational materials could be provided at kiosks along horse trails in the area. The residential work group participants believe there would be interest among local horse owners in a regional manure composting facility, as an alternative to individual farm manure composting units.

A second RWG meeting was held on September 22, 2016. The group continued and built-upon its previous discussions of septic system issues, pet waste, and equine topics. It was observed that while both counties have strong septic program requirements, Loudoun County has a stronger inspection program. Nevertheless, most area residents don't understand septic and alternative septic system maintenance needs. RWG participants see value in a septic pump out program, with no exclusions for those at greater distances from streams, and also believed there will be opportunities for more public wastewater system connections in the future within Loudoun County. Turning to the pet waste issue, several promising locations for pet waste stations were identified and some saw potential for successful introduction of pet waste composters if an effective educational program is included. Finally, there was brief discussion of opportunities to address equine waste, perhaps most effectively in partnership with the Middleburg Agricultural Research and Extension (MARE) Center.

## 4.3 Government Work Group

The goals of the Government Working Group (GWG) were to identify water quality controls currently in place in the watersheds (e.g. livestock stream exclusion fencing and sewer line connections), to identify existing programs and technical resources that may enhance implementation efforts, and to propose additional programs that would support implementation. A single GWG meeting was held with local government and conservation agency representatives on September 8, 2016. The group discussed a number of issues and ideas, including:

- Potential that nutrient trading may increase interest in reforestation of crop/pasture lands.
- Fine-tuning the projected number of conservation practices for small acreage grazing, including equine operations, and the opportunities and challenges given their small economic scale relative to requirements of agricultural cost-share programs.
- Septic system work will be affected by changes underway in the manner that septic repair vs. upgrade are defined, and this may affect residential BMP participation.
- Alternative septic system maintenance needs seem to be poorly understood and should be addressed in the IP.
- It may be valuable to direct some Section 319 funding to conduct research on BMPs for confined canine units.

The final portion of the GWG meeting included a presentation by the USGS of holistic water budget modeling work they are performing for Fauquier County. The monitoring stations this initiative includes may present opportunities to contribute to water quality monitoring for the TMDL IP.

## 4.4 Steering Committee

The Steering Committee (SC) consisted of eleven representatives from the AWG, RWG, and GWG; GCA; Piedmont Environmental Council (PEC); JMSWCD; RRRC; DEQ; and ICPRB. Its members evaluated recommendations from working groups, reviewed BMP quantification and cost estimates, provided input to refine the draft implementation plan document, and evaluated materials and presentations for final public meeting.

The Loudoun County member of the SC provided additional input on the County's program for steam exclusion fencing for horse farms, their Water and Wastewater Community Assistance Program, and Loudoun County's conservation easement and riparian planting buffer programs. SC members also clarified goals of the Goose Creek Scenic River Advisory Committee and water quality monitoring work by GCA, Loudoun Wildlife Conservancy, and the JMSWCD. The JMSWCD representative also stressed the importance of verifying estimated needs for livestock exclusion fencing and offered to oversee work to complete a field survey of true needs.

The PEC member updated the committee on their conservation easement program work, which is approaching its goal that 50 percent of the land in the watershed be enrolled in a conservation easement program. The Loudoun Water representative clarified conventional and alternative septic systems inspection and maintenance requirements, and requested consultation on plans to increase septic system pump-outs so they can plan for increased wastewater treatment needs. Finally, several members commented on the increased number of resident geese in the watershed, and suggested it would be valuable to include some measures – such as vegetated buffers around ponds – targeted to reducing the bacteria that geese add to local waters.

# 5. Implementation Actions

Implementation actions (aka BMPs or management measures) are the heart of the UGC IP (**Figure 5-1**). Individual actions will incrementally improve water quality and, in sufficient quantities and combinations, will enable the streams in the plan area to be removed from the impaired waters list.

**Figure 5-1**. Road sign, The Plains, Virginia (June 2016).


An assessment was conducted for the IP area, in coordination with residents, government agencies, and other community groups, to identify and quantify bacteria reduction measures to enable the impaired stream segments to be removed from the Virginia impaired waters list at the end of the 15-year implementation period (see **Section 7** for a detailed description of the implementation timeline). The proposed management measures are voluntary and are designed to be flexible to react to changes in water quality over the course of the 15-year implementation period. This section (**Section 5**) describes the types of management measures recommended to address bacteria loads described in the 2003 TMDLs (ICPRB 2003).

This IP does not address bacteria sources from wildlife. While the proposed bacteria reduction measures are expected to reduce bacteria pollution from wildlife, this plan only addresses anthropogenic sources. To quantify estimated bacteria reductions for each management measure, bacteria associated with wildlife was disaggregated from the total bacteria load.

**Table 5-1** summarizes the necessary bacteria reductions to meet delisting goals. **Table 5-2** lists the management measures needed to achieve water quality goals along with their bacteria reduction efficiencies and average cost per unit. Each category and related management measure will be discussed in more detail in subsequent sections of this document.

**Table 5-1**. Reductions required to meet delisting goals by bacteria source.

| Load Reductions (%) | Bacteria Sources | | | | |
|---|---|---|---|---|---|
| | Cropland | Pasture | Developed Land (without failing septic systems) | Failing Septic Systems | Direct Deposition from Cattle |
| Upper Goose, Cromwells Run, and Little River sub-watersheds | 75 | 75 | 75 | 100 | 100 |

**Table 5-2**. Summary of management measures, average unit cost, and bacteria reduction efficiency.

| Control Measure | Unit | Average Unit Cost ($) | Reduction Efficiency (%) |
|---|---|---|---|
| Livestock Exclusion | | | |
| Livestock Exclusion System (CREP, CRSL-6) | System | 18,000 | 50 (100)[1] |
| Livestock Exclusion System (EQIP) | System | 15,000 | 50 (100)[1] |
| Stream Exclusion with Grazing Land Management (SL-6) | System | 36,000 | 50 (100)[1] |
| Livestock Exclusion with Riparian Buffers (LE-1T) | System | 36,000 | 50 (100)[1] |
| Livestock Exclusion with Reduced Setback (LE-2 / LE-2T) | System | 12,000 | 50 (100)[1] |
| Stream Exclusion (CCI-SE-1) | Linear Feet | 1 | (100)[1] |
| Stream Protection (WP-2 / WP-2T) | System | 2,500 | 50 (100)[1] |
| Pasture and Cropland | | | |
| Reforestation of Erodible Cropland and Pastureland (FR-1) | Acres | 450 | 99 |
| Woodland Filter Buffer Area (FR-3) | Acres | 1,500 | 40 |
| Streambank Stabilization (WP-2A) | Linear Feet | 150 | N/A |
| Grazing Land Management (SL-9) | Acres | 165 | 50 |
| Pasture Management for TMDL Implementation (SL-10T / EQIP 528) | Acres | 75 | 50 |
| Permanent Vegetative Cover on Critical Areas (SL-11) | Acres | 2,440 | 99 |
| Conservation Tillage (SL-15A) | Acres | 100 | 61 |
| Cover Crops (SL-8B) | Acres | 50 | 20 |
| Grass Riparian Buffers (WQ-1) | Acres | 165 | 40 |
| Support for Extension of CREP Watering Systems (SL-7) | System | TBD | 50 |
| Sediment Retention, Erosion, or Water Control Structure (WP-1) | Drainage Area (acres) | 870 | 75 |
| Permanent Vegetative Cover on Cropland (SL-1) | Acres | 175 | 75 |
| Forage and Biomass Planting (EQIP – 512) | Acres | TBD | 75 |
| Equine | | | |
| Community Manure Composting Facility | System | 215,000 | 80 |
| Equine Manure Storage / Composting | System | 1,200 | 80 |
| Barnyard Runoff Controls | System | 20,000 | 100 |
| Small Acreage Grazing Systems (SL-6AT) | System | 9,000 | 100 |
| On-Site Sewage Disposal Systems | | | |
| Septic Tank Pump-out (RB-1) | System | 300 | 10 |

| Control Measure | Unit | Average Unit Cost ($) | Reduction Efficiency (%) |
|---|---|---|---|
| Septic Connection to Public Sewer System (RB-2) | System | 12,500 | 100 |
| Septic System Repair (RB-3) | System | 3,500 | 100 |
| Septic System Installation / Replacement (RB-4) | System | 6,000 | 100 |
| Septic System Installation / Replacement with Pump (RB-4P) | System | 8,000 | 100 |
| Alternative On-Site Systems (RB-5) | System | 25,000 | 100 |
| Pet Waste Management | | | |
| Pet Waste Stations | System | 500 | 75 |
| Pet Waste Composters | System | 50 | 100 |
| Confined Canine Unit (CCU) | System | 6,000 – 20,000 | 100 |
| Pet Waste Education | Program | 5,000 | 70 |
| Stormwater Management | | | |
| Vegetative Riparian Buffers (Residential) | Drainage Area (acres) | 3,500 | 40 |
| Rain Barrels | System | 150 | 90 |
| Redirecting Residential Downspouts | Roof Area | 100 | 70 |
| Porous Pavement | Area Treated (sq ft) | 7.5 | 50 |
| Rain Gardens | Area Treated (sq ft) | 4 | 70 |
| Infiltration Trench | Area Treated (acres) | 11,300 | 90 |
| Education and Outreach | | | |
| Septic System Education | Program | 2,500 | N/A |
| Septic System Education for Area Realtors | Program | 625 | N/A |
| Work with Local School District to Incorporate Water-Related Curriculum into the Classroom | Program | 1,000 | N/A |
| Organize Field Trips to Demonstrate Water Quality BMPs for Students | Program | 1,000 | N/A |
| Organize a "Farm Day" Event with Local Landowners to Demonstrate Agricultural BMPs | Program | 1,000 | N/A |
| Distribute Education Materials at the Farmer's Market | Program | 625 | N/A |
| Horse Pasture Management Education | Program | 2,500 | N/A |
| Technical Assistance | | | |
| Agricultural and Residential | Full time Equivalent | 50,000 / yr | N/A |

[1]Direct load reduction efficiency in parenthesis

## 5.1 Agricultural Implementation Needs

Approximately 99 percent of the bacteria reductions needed to meet delisting requirements come from the agricultural sector (cropland, pasture, and direct deposition from cattle). Seventy-nine percent of the needed bacteria reductions come from pasture alone. Agricultural sources are presented in subsequent sections in the following groups: direct deposition of bacteria from cattle (livestock exclusion fencing), pasture and cropland, and equine. For each category, the methodology to quantify the effects of the proposed management measures is summarized along with the associated implementation actions.

### *5.1.1 Livestock Exclusion Fencing*

Removing livestock from riparian corridors and limiting access to surface waterbodies is viewed as a priority management measure (**Figure 5-2**). The 2003 TMDLs set forth a 100 percent reduction goal for bacteria of direct deposition from livestock (**Table 5-1**). This amounts to about 32 percent of total bacteria reductions needed. Studies show restricting livestock access to streams increases their productivity and reduces incidence of disease through improved water quality and improved pasture quality. Distributing water systems across pasture increases forage utilization and in some cases allow farmers to increase animal density (Zeckoski and Lunsford 2007).

There are 269 miles of streams in the IP area that may have livestock access. According to the Department of Conservation and Recreation (DCR) database of agricultural practices (DCR 2016a), JMSWCD and Loudoun County Soil and Water Conservation District (LSWCD) worked with landowners to install 100 miles of livestock exclusion fencing since 2002. To achieve the reduction target, it is currently estimated that 169 additional miles of livestock exclusion fencing is needed (**Figure 5-3**).

**Table 5-3** provides a summary of the livestock exclusion opportunity analysis conducted and the amount of livestock exclusion fencing needed in each sub-watershed in the IP area. **Figure 5-4** identifies the stream segments where livestock exclusion fencing is needed. **Figure 5-5** is a closer look at this analysis along Goose Creek.

**Figure 5-2**. Livestock exclusion fencing in the IP area (June 2016).

**Figure 5-3**. Since 2002, 100 miles of livestock exclusion fencing has been installed in the IP area. Additional fencing is needed to eliminate livestock from streams entirely. Cattle observed in stream along Gap Run (August 2016).

**Table 5-3**. Summary of livestock exclusion opportunity by sub-watershed.

| Description | Upper Goose Creek | Cromwells Run | Little River | Total |
|---|---|---|---|---|
| Length of total streambank fencing opportunities (feet) | 807,449 | 233,513 | 377,634 | 1,418,596 |
| Length of streambank fencing installed since 2002 (feet) | 294,550 | 53,940 | 176,538 | 525,028 |
| Length of remaining streambank fencing opportunities (feet) | 512,899 | 179,573 | 201,096 | 893,568 |

**Figure 5-4**. Location of livestock exclusion fencing opportunities.

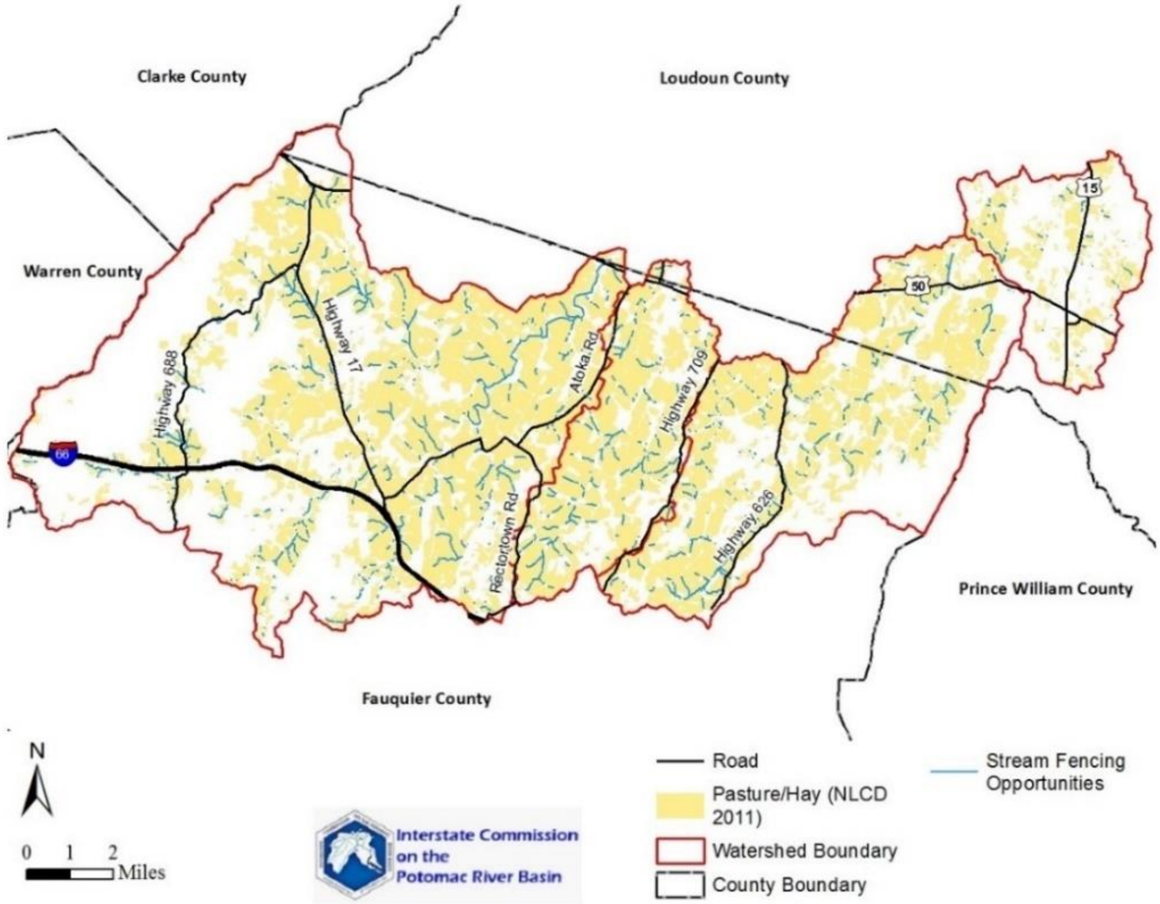


**Figure 5-5**. A large-scale map of the livestock exclusion opportunity analysis along Goose Creek using 2014 satellite imagery (VGIN 2014).


## Methodology

Livestock exclusion fencing opportunities were calculated using the methodology outlined by DEQ's Guidance Manual for TMDL Implementation Plans (DEQ 2003). Perennial and intermittent streams were identified using the National Hydrology Dataset (NHD). Pasture and hay were isolated using the 2011 NLCD and intersecting stream segments were extracted (Homer et al. 2015). The length of those stream segments defines the total livestock exclusion opportunity. In consultation with JMSWCD and LSWCD districts, the methodology was revised to assume livestock exclusion is needed on both sides of the stream regardless of land use (personal communication, JMSWCD and LSWCD, 7/14/2016). The results of this spatial analysis were validated with satellite imagery and in conversations with JMSWCD, LSWCD, and the AWG.

Using information from DCR's BMP database (DCR 2016a), the total length of stream fencing installed between 2002 and 2016 was calculated and subtracted from the total livestock exclusion opportunity. The difference is the remaining opportunity required to meet TMDL load allocations from direct deposition from livestock.

To calculate bacteria reductions from proposed livestock exclusion fencing measures, the total bacteria load was divided by the total livestock exclusion opportunity to get an average bacteria load per linear foot of stream. Total linear feet of livestock exclusion fencing installed since 2002 multiplied by the average bacteria load per linear foot of stream estimates the bacteria reductions achieved since 2002. Remaining reductions were calculated using number of units of each proposed measure installed multiplied by the average bacteria load per linear foot of stream.

## Implementation Actions

Multiple cost-share programs are available through DCR and DEQ to help off-set the capital costs of installing livestock exclusion fencing in Fauquier and Loudoun counties. Management measures to achieve the necessary load reductions from direct deposition from cattle are presented in **Table 5-4**. A typical livestock exclusion practice requires a 35-foot riparian buffer. Hardened stream crossings may be required to allow livestock to move from one pasture to another and are incorporated into fencing plans (**Figure 5-6**). Management measures LE-2 and LE-2T allow for a reduced setback (10 feet) and are recommended for limited use along smaller tributaries or on smaller parcels. Areas adjacent to G.R. Thompson State Wildlife Management Area and Sky Meadows State Park along with the headwater streams of Cromwells Run and Little River are high priority for fencing. Many streams in these areas have full or partial livestock exclusion already installed and filling gaps or extending fencing systems further downstream will help maintain water quality conditions as flows move downstream from conservation areas or forested lands.

**Figure 5-6**. Livestock exclusion fencing with hardened stream crossing schematic.

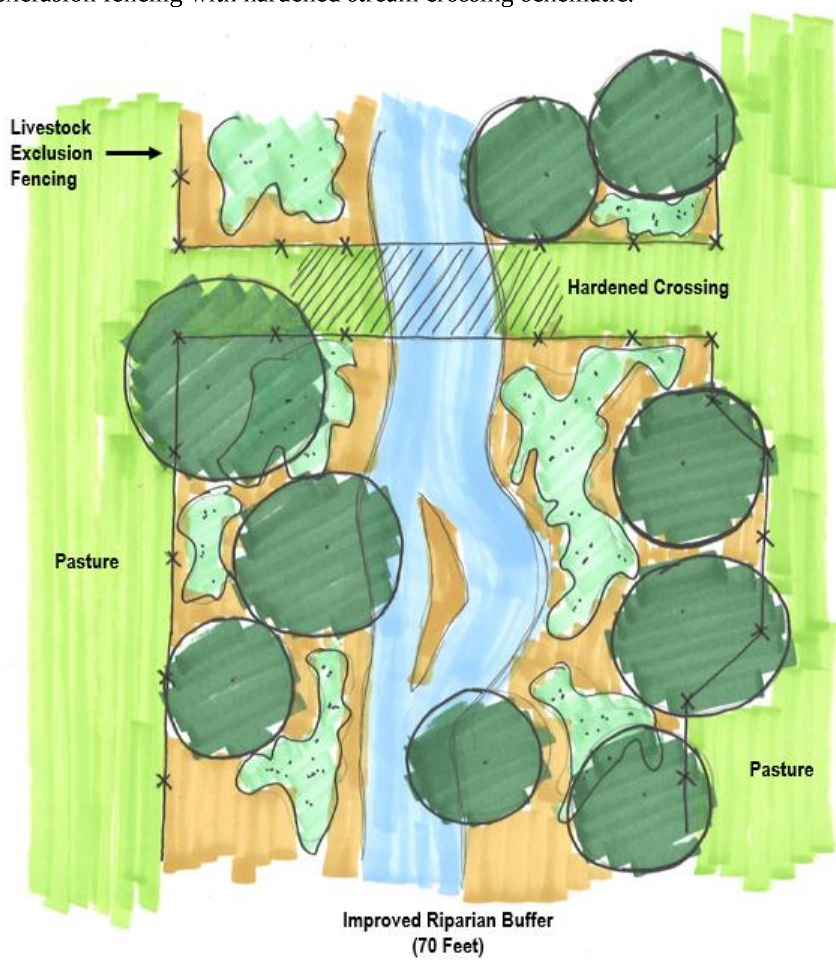


**Table 5-4**. Livestock exclusion management measures, average length (ft) per unit, average unit cost ($), and program division.

| Livestock Exclusion System | Program Division (%) | Average Unit Cost ($) | Average Streamside Fencing (ft) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Livestock Exclusion System (CREP, CRSL-6) | 8 | 18,000 | 2,900 | 18 | 324,000 | 6 | 108,000 | 2 | 36,000 | 26 | 468,000 |
| Livestock Exclusion System (EQIP) | 11 | 15,000 | 4,080 | 18 | 270,000 | 4 | 60,000 | 2 | 30,000 | 24 | 360,000 |
| Stream Exclusion with Grazing Land Management (SL-6) | 20 | 36,000 | 3,680 | 28 | 1,008,000 | 10 | 360,000 | 11 | 396,000 | 49 | 1,764,000 |
| Livestock Exclusion with Riparian Buffers (LE-1T) | 30 | 36,000 | 3,680 | 42 | 1,512,000 | 15 | 540,000 | 16 | 576,000 | 73 | 2,628,000 |
| Livestock Exclusion with Reduced Setback (LE-2 / LE-2T) | 14 | 12,000 | 3,400 | 22 | 264,000 | 8 | 96,000 | 8 | 96,000 | 38 | 456,000 |
| Stream Exclusion (CCI-SE-1) | 14 | 1 | N/A | 47,268 | 47,268 | 23,634 | 23,634 | 55,146 | 55,146 | 126,048 | 126,048 |
| Stream Protection (WP-2 / WP-2T) | 2 | 2,500 | 2,691 | 3 | 7,500 | 1 | 2,500 | 2 | 5,000 | 6 | 15,000 |
| **Total Estimated Cost ($)** | N/A | N/A | N/A | N/A | 3,432,768 | N/A | 1,190,134 | N/A | 1,194,146 | N/A | 5,817,048 |

An average 100-foot buffer (WP-2 / WP-2T) along the main stem of Goose Creek is strongly encouraged to the extent feasible. A 100-foot buffer is consistent with state scenic river goals to enhance and protect rivers of importance along with their corridors (DCR 2016b). A 100-foot buffer will also provide bacteria reduction benefits from pasture as the larger riparian buffer can remove more bacteria and nutrients from runoff. Hardened crossings are an effective way to allow livestock to cross the stream while minimizing negative water quality impacts and maintaining positive impacts of installed buffers (**Figure 5-7**).

**Figure 5-7**. Hardened stream crossing (Fauquier Now 2016).

While not a requirement of livestock exclusion systems, improvements to riparian buffers are encouraged through planting of native plant species and tree plantings (**Figure 5-8** and **Figure 5-9**). An improved riparian buffer will increase bacteria and nutrient removal efficiencies providing additional water quality and habitat benefits. Landowners can partner with local watershed organizations, such as GCA, or schools to help improve the newly established riparian buffers.

**Figure 5-8.** Recently improved riparian buffer in Upper Goose Creek sub-watershed (February 2016).

### *5.1.2 Pasture and Cropland*

Bacteria runoff from pasture and cropland accounts for about 79 percent of bacteria reductions required to achieve water quality goals in the IP area. In the Upper Goose Creek, Cromwells Run, and Little River sub-watersheds, bacteria load from pasture account for 74 percent, 88 percent, and 89 percent of the total baseline load, respectively. There are two primary ways to reduce bacteria runoff from pasture or cropland: improved pasture or cropland management or land use conversion.

**Figure 5-9.** A mature forested riparian buffer in the IP area (June 2016).

Since 2002, BMPs through state cost-share programs have benefited 10,770 acres across the IP area (DCR 2016a). The majority of BMPs were installed in the Upper Goose Creek sub-watershed. In spring 2016, the Edgecliff farm was certified as a nutrient mitigation bank under the State of Virginia Nonpoint Source Nutrient Credit Trading Program. The Edgecliff farm converted 520 acres of agricultural land to native forest and will sell nutrient credits for nitrogen and phosphorus through the state exchange. While designed to address nitrogen and phosphorus pollution, the conversion of agriculture land to forest will also reduce bacteria loads by an estimated 99 percent.[1] Progress to reduce bacteria loads in the watershed has

[1] The 99 percent efficiency was determined by calculating the difference in the pasture and forest loading rates used in the 2003 TMDLs.

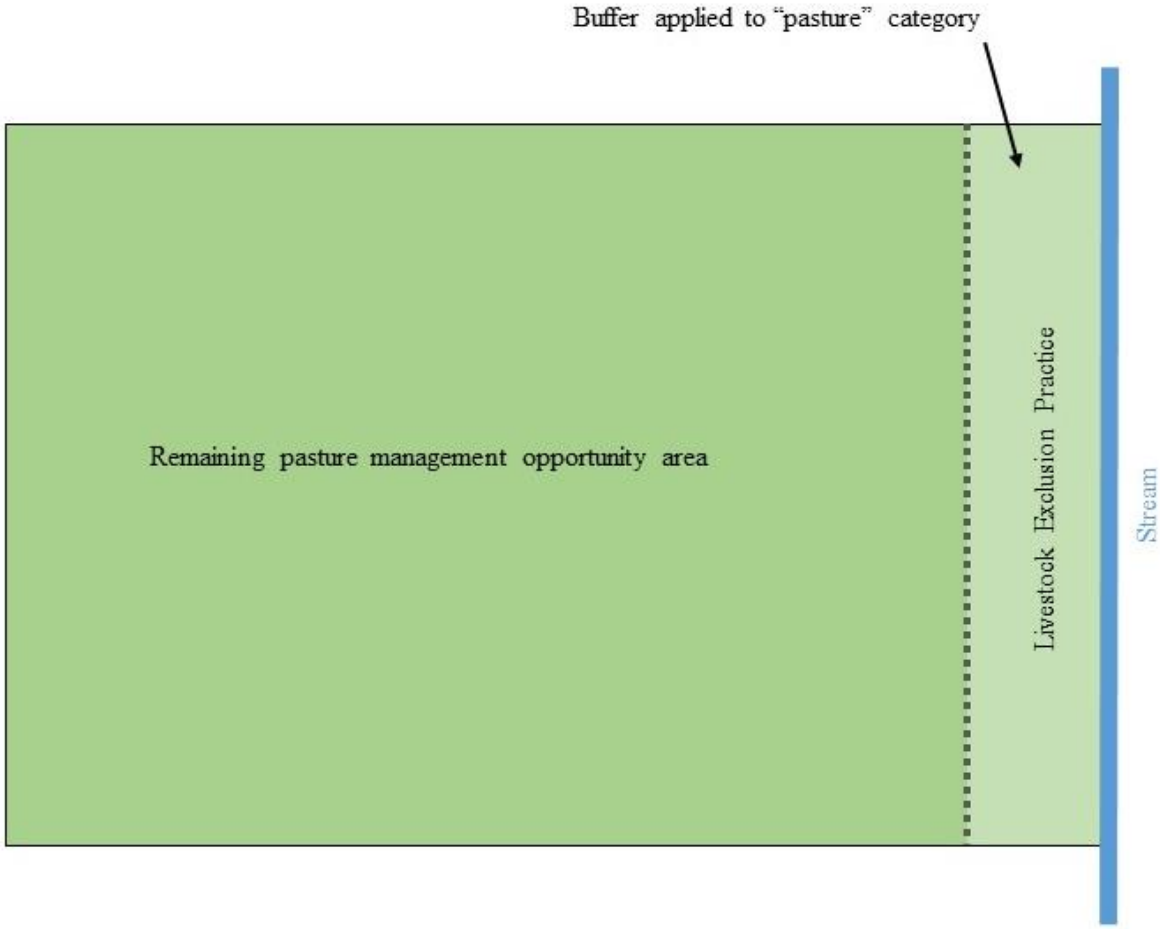
been steady since 2002, however, significant work remains to achieve water quality goals. Efforts to reduce bacteria runoff from pasture between 2002 and 2016 yielded an estimated bacteria reduction of less than five percent of necessary reductions.

Cropland contributes a small percentage (less than one percent) of overall bacteria to Upper Goose Creek, Cromwells Run, and Little River; however, there are management measures to help reduce bacteria runoff from fields. Frequent crop rotation and conversion from cropland to pasture to hay provides a challenge to implementing crop specific management measures in the IP area. In many cases, a single farm may have crops and pasture on the same land during different parts of the year (personal communication, JMSWCD and LSWCD, 7/14/2016). The 2011 NLCD identified 2,700 acres of cropland; however, that is likely to change from year to year.

## Methodology

Pasture was identified using the 2011 NLCD and an average bacteria loading rate per acre was calculated by dividing the total bacteria load by the total area of pasture within each sub-watershed. Using bacteria reduction efficiencies attributed to specific proposed management measures, total bacteria reductions were calculated to ensure reduction targets are met. It is important to note that individual bacteria reduction efficiencies may vary from farm to farm. Livestock exclusion fencing also provides a benefit to pasture and therefore was included in calculating total bacteria reductions. Reductions associated with livestock exclusion fencing were calculated prior to calculating reductions from additional pasture management measures as illustrated in **Figure 5-10**.

**Figure 5-10.** Bacteria reductions from the riparian buffer created from livestock exclusion fencing, attributed to pasture.




The efficiency of management measures recommended in this IP to remove bacteria from runoff from pasture range from 50 to 99 percent. Most of the improved pasture measures have bacteria reduction efficiencies of 50 percent; therefore, the distribution of specific improved pasture measures on individual parcels can be adapted to meet parcel specific constraints and opportunities while bacteria reductions can still be met. Management measures that achieve 99 percent reduction are considered land use conversion practices. For example, management measure FR-1 converts erodible pastureland to forest through tree plantings and other restoration activities and, thus is considered a change in land use.

## Implementation Actions

**Table 5-5** provides a list of management measures to reduce bacteria runoff from pasture and cropland. The combination of management measures (SL-9, SL-10T, EQIP 528, and SL-7) may be mixed and matched depending on the individual circumstances of each landowner and the resources available. Working together, the local SWCDs and stakeholders can find the optimal, site-specific combination of practices for each farm. Because the bacteria efficiency for each of these measures is 50 percent, the actual ratio of implementation across the IP area is not important to meet water quality goals.

**Table 5-5**. Management measures for pasture and cropland.

| Pasture and Cropland Measures | Units for Tracking | Average Unit Cost ($) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Reforestation of Erodible Cropland and Pastureland (FR-1) | Acres | 450 | 2,600 | 1,170,000 | -- | -- | 400 | 180,000 | 3,000 | 1,350,000 |
| Woodland Filter Buffer Area (FR-3) | Acres | 1,500 | 10 | 15,000 | -- | -- | -- | -- | 10 | 15,000 |
| Streambank Stabilization (WP-2A) | Linear Feet | 150 | 33 | 4,950 | 33 | 4,950 | 33 | 4,950 | 99 | 14,850 |
| Grazing Land Management (SL-9) | Acres | 165 | 4,010 | 661,650 | 462 | 76,230 | 238 | 39,270 | 4,710 | 777,150 |
| Pasture Management for TMDL Implementation (SL-10T / EQIP 528) | Acres | 75 | 3,773 | 282,975 | 439 | 32,925 | 793 | 59,475 | 5,005 | 375,375 |
| Permanent Vegetative Cover on Critical Areas (SL-11) | Acres | 2,440 | 520 | 1,268,800 | -- | -- | 80 | 195,200 | 600 | 1,464,000 |
| Conservation Tillage (SL-15A) | Acres | 100 | 77 | 7,700 | 24 | 2,400 | 0 | 0 | 101 | 10,100 |
| Cover Crops (SL-8B) | Acres | 50 | 77 | 3,850 | 24 | 1,200 | 0 | 0 | 101 | 5,050 |
| Grass Riparian Buffers (WQ-1) | Acres | 165 | 5 | 825 | 5 | 825 | 0 | 0 | 10 | 1,650 |
| Support for Extension of CREP Watering Systems (SL-7) | System | TBD | 8 | -- | 7 | -- | -- | -- | 15 | -- |
| Sediment Retention, Erosion, or Water Control Structure (WP-1) | Drainage Area (acres) | 870 | 3,750 | 3,262,500 | -- | -- | 36 | 31,320 | 3,786 | 3,293,820 |
| Permanent Vegetative Cover on Cropland (SL-1) | Acres | 175 | 10 | 1,750 | 10 | 1,750 | 10 | 1,750 | 30 | 5,250 |
| Forage and Biomass Planting (EQIP - 512) | Acres | TBD | 5 | -- | 5 | -- | 5 | -- | 15 | -- |
| **Total Estimated Cost ($)** | N/A | N/A | N/A | 6,680,000 | N/A | 120,280 | N/A | 511,965 | N/A | 7,312,245 |

A spatial analysis identified approximately 3,600 acres of pasture land on slopes greater than ten percent (**Figure 5-11**). Lands meeting these criteria are located primarily in Upper Goose Creek and Little River sub-watersheds. Reforestation projects (FR-1 and SL-11) should be prioritized on these areas to stabilize slopes thereby reducing erosion and sedimentation of adjacent streams. The University of Virginia conducted a green infrastructure study for Fauquier County in 2012 and identified several key areas as priorities for landscape restoration (SL-11) to maintain habitat cores and wildlife corridors (University of Virginia 2012). An area to the west of Bull Run Mountain (Little River sub-watershed) was identified as a priority restoration zone. A wildlife corridor from G.R. Thompson State Wildlife Management Area crossing southeast across the IP area was also identified (**Figure 5-12**). Restoration and conservation projects within these areas is a priority. Woodland filter buffers (FR-3) are strongly recommended where feasible to improve the bacteria reduction efficiency of livestock exclusion practices. Improving the stream buffer area along the main stem of Goose Creek is a priority to create a contiguous riparian corridor in the IP area. These management measures (FR-1, SL-11, and FR-3) are considered land use conversion measures which achieve 99 percent reductions in bacteria from runoff.

**Figure 5-11**. Location of pasture land on greater than ten percent slope.

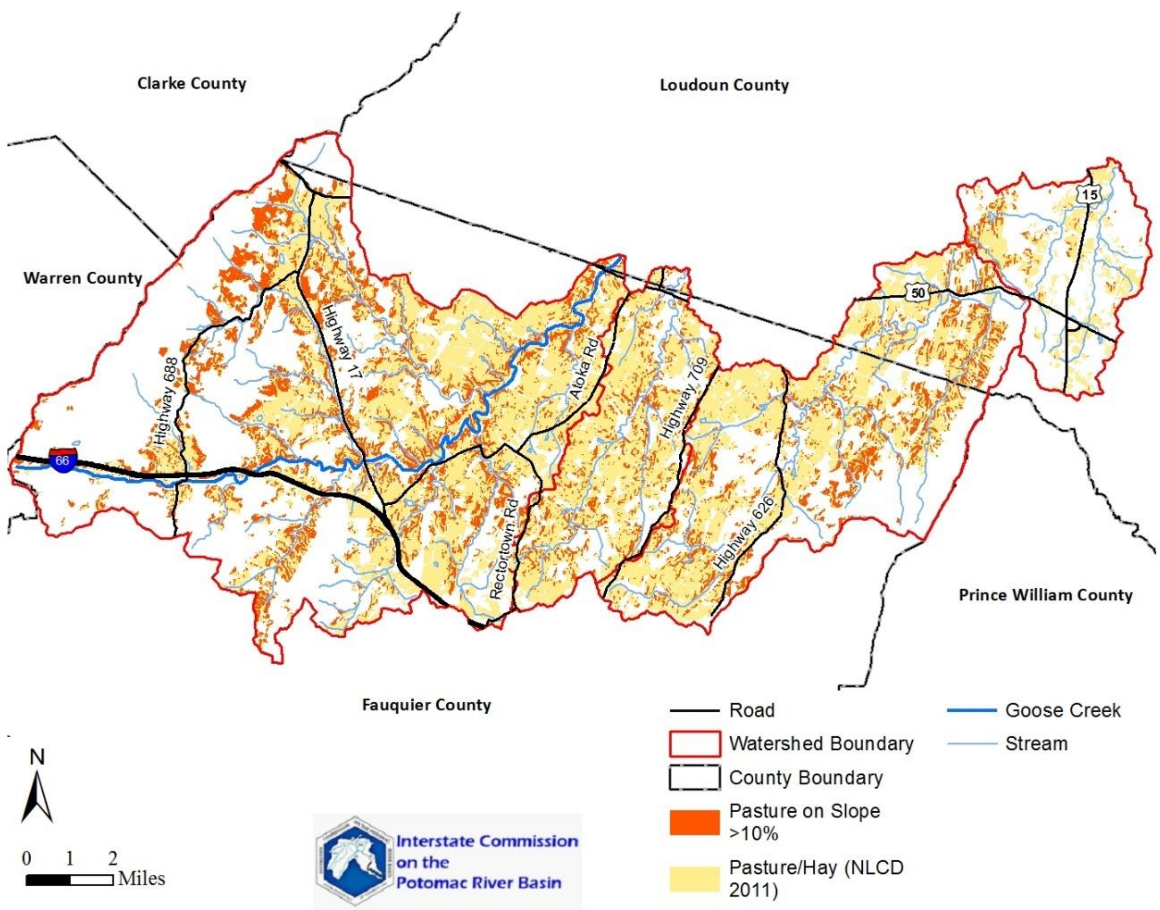
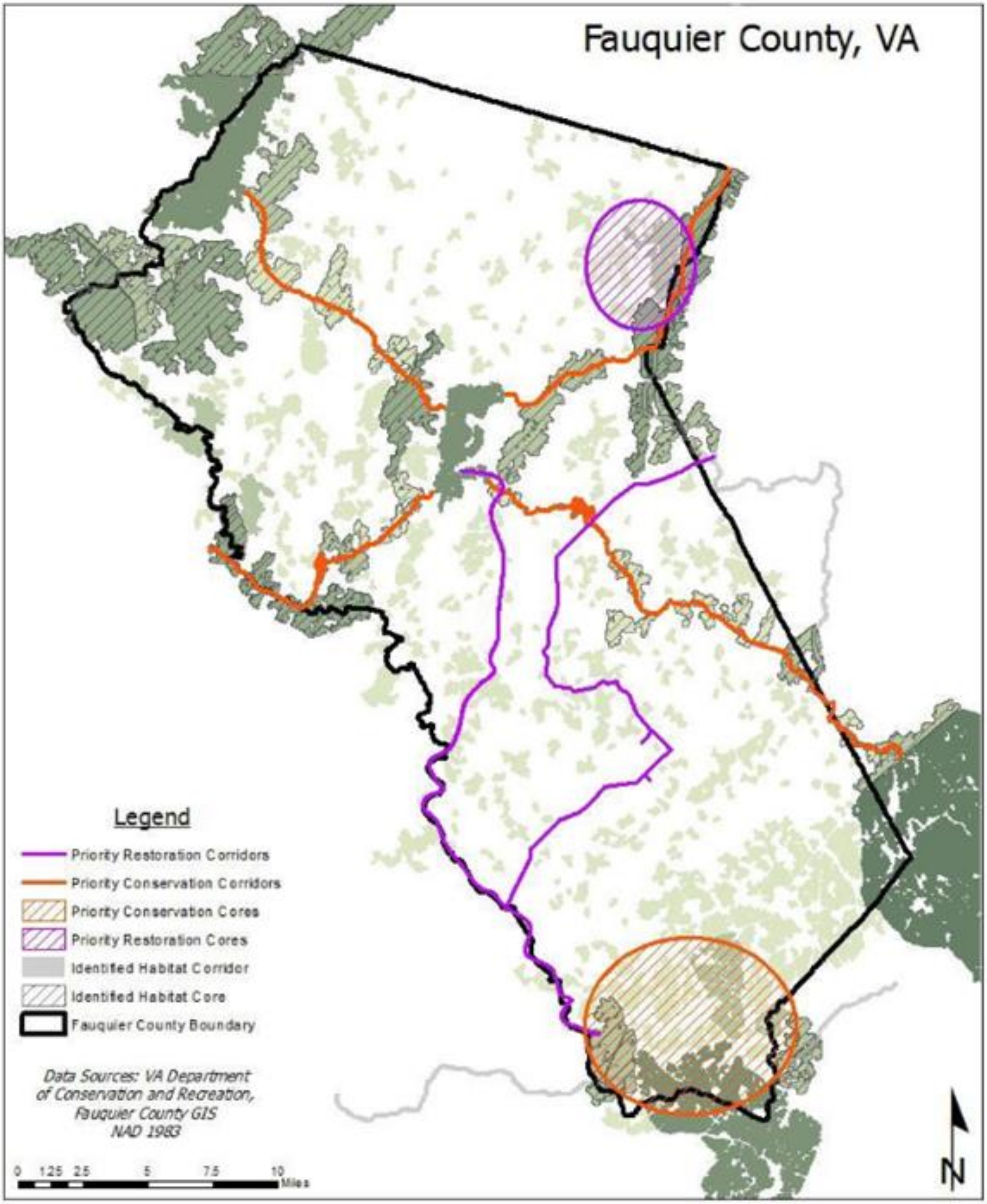


**Figure 5-12**. Priority restoration zones and wildlife corridors in Fauquier County (University of Virginia 2012).



Stormwater management infrastructure (WP-1) can also be applied in agricultural settings to help manage runoff and prevent bacteria from entering local streams. Constructing stormwater infrastructure to manage runoff from pasture or fields has an estimated 75% bacteria removal efficiency, but can be cost prohibitive and, therefore, should be considered when other management measures are either insufficient or contextually inappropriate.

Permanent best management measures to address bacteria runoff from cropland are less appropriate in the IP area because of the rotational nature of cropland, but conservation tillage (SL-15A) and cover crops (SL-8B) are an effective alternative. The integrity of riparian corridors should also be maintained (FR-3 and WQ-1). Mowing or plowing along swales is discouraged and, where possible, native vegetation should be allowed to return to improve the effectiveness of bacteria reduction (**Figure 5-13**).

**Figure 5-13**. Grass buffer along a stream in the IP area. Where possible, maintain the integrity of existing riparian buffers and reintroduce native

### *5.1.3 Equine Management*

Fauquier and Loudoun counties are known for their bucolic horse farms nestled among historic sites along the foothills to the Blue Ridge Mountains. Since 2002, the area has seen a three percent growth in equestrian activities and the trend is expected to continue, putting increased pressure on the watersheds (personal communication, IP agricultural and government working groups, 2016). Proactively working with owners and boarding operations to properly manage horse manure will help ensure bacteria is kept out of area streams. The contribution to bacteria loads from equine in the IP area is less than one percent in Upper Goose Creek, three percent in Cromwells Run, and one percent in Little River, respectively; however, equine sources may become a larger contributor to bacteria in local waterways unless proactively managed. Proposed equine management measures were separated from the other agriculture BMPs to assist in identifying opportunities for implementation and obtaining funding assistance.

**Figure 5-14**. Horse manure composting micro-bins (McCormick Environmental, Inc n.d.).

### Methodology

To calculate bacteria reductions from equine, bacteria attributed to equine provided by the 2003 TMDLs was divided by the estimated number of horses provided USDA’s agriculture census to determine the average bacteria load per horse. It was assumed the average horse farm had five horses. Due to the relatively small contribution of bacteria from horses in the IP area to the total bacteria load, the proposed management measures fully address bacteria runoff from horse pastures.

## Implementation Actions

**Table 5-6** provides a list of management measures to address bacteria runoff specifically from horse farms that were identified at the AWG meeting and in discussions with local stakeholders. Composting in combination with improved pasture management is strongly encouraged. Composting facilities can vary in size and capital costs depending on the number of horses present at an individual farm. Small composting systems designed to handle manure from three to five horses cost about $1,200 to construct three micro-bins (**Figure 5-14**) while more horses will require larger systems. **Figure 5-15** provides an example of a composting system for larger farms or boarding operations.

Use of composted manure in gardening applications has many environmental benefits, but warrants care as well. In 2013, the U.S. Composting Council (USCC) has documented harm (extensive damage to garden vegetables and crops) caused by compost contaminated with persistent herbicides, and called for regulatory action to ban their use (USCC 2013). This concern needs to be factored into planning for construction of the community composting facilities recommended in this plan.

Barnyard runoff controls are structures which collect and divert runoff from barnyard or associated buildings into areas of low environmental impact. These structures are similar to stormwater management practices applied in a barnyard setting (**Figure 5-16**). The purpose is to store and filter NPS pollution related to equine or other livestock.

During the first AWG meeting, a community composting program was suggested as a way to provide options for smaller farms that lack room for on-site composting infrastructure. Such a program will help reduce capital costs to individual farms while providing a greater benefit to the environment and community. The Marshall Livestock Exchange and MARE Center were identified as potential sites for a pilot project. Under a proposed composting program, manure is collected at a central composting facility and then sold or distributed. The Gardner's Gold program (Prince William Soil and Water Conservation District 2013) links horse owners with homeowners to provide composting for gardening. A similar program in Fauquier and Loudoun counties could be designed to link homeowners both inside and outside the IP area. **Figure 5-17** is an example of the scale of a proposed community composting facility. Further studies and discussion are required to determine the appropriate size of a facility and collection methods.

**Figure 5-15**. Horse manure composting structure (Washington State University Cooperative Extension 2016).

**Figure 5-16**. Example barnyard runoff control system (Outagamie County 2016).

**Figure 5-17**. Community composting facility with stormwater BMP ($O_2$Compost 2016).

**Table 5-6**. Management measures to address bacteria runoff from equestrian facilities.

| Equine Measures | Average Unit Cost ($) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|
| | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Community Manure Composting Facility | $215,000 | 1 | 215,000 | 1 | 215,000 | 1 | 215,000 | 3 | 645,000 |
| Equine Manure Storage / Composting | $1,200 | 152 | 182,400 | 49 | 58,800 | 122 | 146,400 | 323 | 387,600 |
| Barnyard Runoff Controls | $20,000 | 50 | 1,000,000 | 16 | 320,000 | 40 | 800,000 | 106 | 2,120,000 |
| Small Acreage Grazing Systems (SL-6AT) | $9,000 | 30 | 270,000 | 15 | 135,000 | 15 | 135,000 | 60 | 540,000 |
| **Total Estimated Cost ($)** | N/A | N/A | 1,667,400 | N/A | 728,800 | N/A | 1,296,400 | N/A | 3,692,600 |

## 5.2 Residential Implementation Needs

Non-agriculture sources of bacteria are considered residential in nature and include sources from septic systems, pets, and stormwater. Bacteria contributions from residential sources are less than one percent of the total bacteria load in the IP area. While not a large contributor to bacteria, reducing residential sources will improve water quality and can help address issues such as localized flooding through implementation of stormwater BMPs.

### *5.2.1 Septic Systems*

The majority of the IP area is served by private septic systems due to the rural nature of the region. To this end, proper design and maintenance of these systems is required to prevent bacteria from entering surface water and groundwater resources.

Using updated population and household data, an estimated 2,158 septic systems existed in the IP area in 2014. According to the county health departments, the septic system failure rate is 1.6 percent (35 septic systems per year). There are no known straight pipes in the IP area; however, it is possible that graywater straight pipes exist (personal communication, RWG, 2016). Since 2002, Fauquier County has repaired or replaced 129 systems. In addition to the repaired or replaced septic systems, more households connected to existing or expanded municipal sewer treatment plants. If Fauquier and Loudoun counties continue repairing and replacing septic systems at their current rates, bacteria reduction targets from septic systems will be achieved.

#### Methodology

The number of septic systems in the IP area were calculated from the number of households. To update the number of households from the 2003 TMDLs, an analysis was undertaken to determine changes in population and number of households. The TMDL used census block level data from 2000 (USCB 2002) to estimate the population and number of households. Updated information was obtained at the census block level from the ACS 2014 population estimates (the most recent data available) (USCB 2015).

In general, census block boundaries do not follow watershed boundaries; therefore, assumptions were made about the distribution of population within the census blocks to estimate the total population living in the IP area and each sub-watershed. To remain consistent with the approach in the original TMDLs, an even distribution of population was assumed within each census block. It is important to note that ACS does not estimate annual population at the census block level. ACS estimates are at the census tract level, a spatially courser dataset. For the purposes of this analysis, 2014 population and household estimates were disaggregated from the tract level.

## Implementation Actions

**Table 5-7** describes management measures to help support existing county programs. These measures were identified in consultation with the GWG and in consultation with local stakeholders. Fauquier and Loudoun county municipal codes require homeowners to pump-out their septic systems once every five years (Fauquier County 2016a; Loudoun County 2015). Proper septic system maintenance will prevent bacteria from reaching local waterways. Distributing proper maintenance guidelines and pump-out reminders can help remind homeowners of their obligations and prevent septic system failure.

Households located in a municipal wastewater treatment service area should be encouraged to connect to the public sewer system. Over the course of the 15-year implementation planning timeline, there may be opportunities to connect residents to existing sewer treatment systems. The management measure RB-2 can help offset the capital cost of a sewer connection when and if there is an opportunity to connect a resident to the community sewer system. This IP does not identify specific parcels for sewer connection but estimates the potential for 21 new connections based on the number of existing connections and total parcels within the sewer service areas. Additional low income assistance should be made available through other grant or micro-loan programs when possible.

**Table 5-7**. Management measures to address bacteria loads from septic systems.

| On-Site Sewage Disposal System Measures | Program Division (%) | Average Unit Cost ($) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Septic Tank Pump-out (RB-1) | 100* | 300 | 2,790 | 837,000 | 615 | 184,500 | 3,069 | 920,700 | 6,474 | 1,942,200 |
| Septic Connection to Public Sewer System (RB-2) | 4 | 12,500 | -- | -- | -- | -- | 21 | 262,500 | 21 | 262,500 |
| Septic System Repair (RB-3) | 76 | 3,500 | 188 | 658,000 | 9 | 31,500 | 208 | 728,000 | 405 | 1,417,500 |
| Septic System Installation / Replacement (RB-4) | 7 | 6,000 | 12 | 72,000 | 12 | 72,000 | 12 | 72,000 | 36 | 216,000 |
| Septic System Installation / Replacement with Pump (RB-4P) | 8 | 8,000 | 15 | 120,000 | 15 | 120,000 | 15 | 120,000 | 45 | 360,000 |
| Alternative On-Site Systems (RB-5) | 5 | 25,000 | 10 | 250,000 | 4 | 100,000 | 10 | 250,000 | 24 | 600,000 |
| **Total Estimated Cost ($)** | N/A | N/A | N/A | 1,937,000 | N/A | 508,000 | N/A | 2,353,200 | N/A | 4,798,200 |

*All septic systems are required by the counties to be pumped out at least every five years.

### *5.2.2 Pet Waste*

Pet waste, specifically from dogs, accounts for approximately 20 percent of bacteria entering local waterways from residential sources. Many pet owners do not always make the connection between pet waste and local water quality (**Figure 5-18**). During rain events, bacteria from dog waste can run off of lawns into local streams. Proper disposal of dog waste will eliminate associated bacteria from reaching local waterways and keep public parks and gathering places clean.

**Figure 5-18**. Pet waste can contribute to poor water quality if it is not picked up and properly disposed.

#### Methodology

The number of dogs living in the IP area was calculated using number of households multiplied by the average number of dogs per household according to the AVMA's 2012 survey (AVMA 2012).

#### Implementation Actions

**Table 5-8** lists the management measures to address pet waste in the IP area. Mickie Gordon Memorial Park, along Main Street in The Plains, West Main Street and Community Center in Marshall are recommended locations to install pet waste stations. Installing waste stations and signage in Sky Meadows State Park and G.R. Thompson State Wildlife Management Area parking lots is another opportunity to remind pet owners to pick up after their pets. Neighborhood homeowner associations are encouraged to install pet waste stations when possible.

**Table 5-8**. Management measures to address bacteria runoff from pet waste.

| Pet Waste Measures | Average Unit Cost ($) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|
| | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Pet Waste Stations | 500 | 2 | 1,000 | 2 | 1,000 | 6 | 3,000 | 10 | 5,000 |
| Pet Waste Composters | 50 | 9 | 400 | 8 | 400 | 8 | 400 | 25 | 1,200 |
| Confined Canine Unit (CCU) | 6,000-20,000 | 2 | 12,000-40,000 | 2 | 12,000-40,000 | 1 | 6,000-20,000 | 5 | 30,000-100,000 |
| Pet Waste Education | 5,000 | 1 | 5,000 | 1 | 5,000 | 1 | 5,000 | 3 | 15,000 |
| **Total Estimated Cost ($)** | N/A | N/A | 18,400-46,400 | N/A | 18,400-46,400 | N/A | 14,400-28,400 | N/A | 51,200-121,200 |

There are five kennel operations in the IP area. Kennels have a higher concentration of pet waste due to the nature of their business and; therefore, ensuring proper waste disposal could have a greater benefit to water quality. Several approaches to managing waste are available to business owners including dry stackers, septic systems, and hauling waste directly to landfills. Costs of these measures varies depending on the selected approach (see CCU's in **Table 5-8**).

A robust education and outreach campaign is recommended to inform pet owners of the importance of picking up after their pet. Distributing dog waste bag leash holders is an inexpensive and popular program to spread the message. Opportunities to distribute educational materials include events at the Upperville Showgrounds, Warrenton Horse Show, and local farmers markets.

### *5.2.3 Stormwater*

**Figure 5-19**. Bioswale to catch runoff from parking lot, Marshall, Virginia (September 2016).

Stormwater BMPs can help achieve numerous water quality objectives by filtering and retaining pollutants during and after storm events. These management measures can be installed in both urban and agricultural settings. Overall, stormwater runoff from developed land accounts for less than one percent of the total bacteria load and the majority of this bacteria is linked to pet waste. Pet waste is addressed in **Section 5.2.2**. Stormwater BMPs to address runoff from pasture or croplands are addressed in **Section 5.1.2**. Measures to address the remaining urban stormwater loads are described in this section. As bacteria in the urban stormwater is a nominal contributor to the impairments (less than 0.05 percent), the measures described are pilot projects to serve as community demonstrations of best practices.

#### Methodology

Bacteria loads from developed lands (not including failing septic systems) from the 2003 TMDLs were divided by the total acres of impervious developed land to estimate a bacteria loading rate per acre. Proposed management measures were multiplied by treatment area and reduction efficiency to estimate total bacteria reductions.

**Figure 5-20**. Stormwater retention pond behind commercial development, Marshall, Virginia (September 2016).

#### Implementation Actions

The proposed management measures in **Table 5-9** are meant to serve as demonstration projects to educate residents of the benefits of stormwater BMPs. A few highly visible BMPs can increase awareness of the benefits of these systems to address water quality, flooding, and streetscape concerns across the IP area (**Figure 5-19** and **Figure 5-20**). County government facilities such as schools may provide ideal locations for installation of demonstration stormwater BMPs especially when capital improvements are planned. For example, permeable pavement can be installed when parking lots need resurfacing.

In the long-term, reducing impervious surfaces in the IP area would reduce the transport of pollutants in stormwater. Impervious surfaces can be reduced through adoption of county policies, voluntary actions taken as a result of citizen education campaigns, and through public investment in alternative infrastructure (e.g. porous pavement and other low-impact development measures).

**Table 5-9**. Management measures to address bacteria pollution from stormwater.

| Stormwater Measures | Units for Tracking | Average Unit Cost ($) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Vegetative Riparian Buffers (Residential) | Drainage Area (acres) | 3,500 | -- | -- | -- | -- | 20.5 | 71,750 | 20.5 | 71,750 |
| Rain Barrels | System | 150 | 1 | 150 | 1 | 150 | 1 | 150 | 3 | 450 |
| Redirecting Residential Downspouts | Roof Area (acres) | 100 | 0.6 | 60 | 0.2 | 20 | 0.7 | 70 | 1.5 | 150 |
| Porous Pavement | Area Treated (sq ft) | 7.5 | 250 | 1,875 | 250 | 1,875 | 500 | 3,750 | 1,000 | 7,500 |
| Rain Gardens | Area Treated (sq ft) | 4 | 250 | 1,000 | 250 | 1,000 | 500 | 2,000 | 1,000 | 4,000 |
| Infiltration Trench | Area Treated (acres) | 11,300 | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |
| **Total Estimated Cost ($)*** | N/A | N/A | N/A | 3,085 | N/A | 3,045 | N/A | 77,720 | N/A | 83,850* |

*These values do not include costs associated with infiltration trenches

## 5.3 Education and Outreach

Education and outreach programs are important to the successful implementation of proposed management measures. Informing residents of the importance of protecting local water quality and increasing awareness of the programs available to help with capital costs of installing management measures will assist in successful implementation and meeting bacteria reductions targets over the 15-year planning horizon. Education and outreach also provides an opportunity for residents and stakeholders to provide feedback for understanding what programs are working and whether adjustments will need to be made to meet reduction goals.

### Implementation Actions

**Table 5-10** provides a list of the proposed education and outreach programs. Some programs currently exist such as the local fall farm tours (Fauquier County 2016b; Loudoun County 2016), but could benefit from integration with other watershed protection efforts. Also provided is a brief description of the proposed education and outreach programs. In addition to the following programs, information can be distributed through a variety of communication mediums including social media, print media, newsletters, and radio advertisements. Working with local veterinarians to spread the message about cost-share programs and benefits of improved pasture management and livestock exclusion may be another educational opportunity.

**Septic System Education and Septic System Education for Area Realtors:** Under this program, information about proper septic system maintenance and obligations of septic system owners under the municipal code can be disseminated as mailers in utility bills, refrigerator magnets, or similar materials. Specific outreach to area realtors to help inform prospective homeowners of their obligations and proper maintenance of septic systems when purchasing a home with a system should be included. Information about cost-share programs to help offset capital costs should also be distributed particularly to lower income households.

**Incorporate Water-Related Curriculum into Area Classrooms**: The Virginia Department of Education (DOE) requires watershed-related curriculum as part of 3$^{rd}$ through 6$^{th}$ grade science education (DOE 2016). As part of addressing water quality concerns in the IP area, local watershed organizations like GCA can continue to ensure students are receiving a "meaningful watershed experience" (CBF 2004). Expansion of existing programs and promotion of locale-specific efforts promotes a "sense of place" in children, engages parents in local water quality problems, and brings communities together to find solutions.

**Student Field Trips:** In collaboration with GCA and other local watershed groups, organize student field trips to areas in the IP area where management measures have been installed to support the lessons taught in the classroom.

**Farm Days:** Both Fauquier and Loudoun counties organize a farm day event to promote local farmers and provide an opportunity for residents to meet their local farmer and learn how their food is produced. These events are opportunities to highlight farms that have incorporated BMPs.

**Distribute Educational Materials at Farmers Market:** Farmers markets provide a great venue to inform stakeholders on water quality improvement measures. A booth can be setup a few times a year to distribute materials to local stakeholders.

**Horse Pasture Management Education:** This outreach effort is designed to develop and distribute educational materials specifically for horse pasture management. Information on the potential adverse effects of persistent herbicides in composted manure should be included in these education and outreach materials. Distributing information through a variety of education and outreach campaigns, horse owners can be informed of opportunities to meet multiple, complementary objectives. Opportunities to engage residents include the Marriot

Ranch spring event, farm demonstration days, livestock auctions, organized community hunts, and the Cattleman's Association.

**Table 5-10**. Education and outreach programs.

| Education and Outreach Measures | Units for Tracking | Average Unit Cost ($) | Upper Goose Creek | | Cromwells Run | | Little River | | Total Units | Total Estimated Cost ($) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Units | Estimated Cost ($) | Units | Estimated Cost ($) | Units | Estimated Cost ($) | | |
| Septic System Education | Program | 2,500 | 1 | 2,500 | 1 | 2,500 | 1 | 2,500 | 3 | 7,500 |
| Septic System Education for Area Realtors | Program | 625 | 1 | 625 | 1 | 625 | 1 | 625 | 3 | 1,875 |
| Incorporate Water-Related Curriculum into Area Classrooms | Program | 1,000 | 1 | 1,000 | 1 | 1,000 | 1 | 1,000 | 3 | 3,000 |
| Organize Student Field Trips to observe BMPs | Program | 1,000 | 1 | 1,000 | 1 | 1,000 | 1 | 1,000 | 3 | 3,000 |
| Organize Farm Day Events | Program | 1,000 | 1 | 1,000 | 1 | 1,000 | 1 | 1,000 | 3 | 3,000 |
| Distribute Education Materials at the Farmers Market | Program | 625 | 1 | 625 | 1 | 625 | 1 | 625 | 3 | 1,875 |
| Horse Pasture Management Education | Program | 2,500 | 1 | 2,500 | 1 | 2,500 | 1 | 2,500 | 3 | 7,500 |
| **Total Estimated Cost ($)** | N/A | N/A | N/A | 9,250 | N/A | 9,250 | N/A | 9,250 | N/A | 27,750 |

# 6. Cost of Implementation

The total estimated costs for measures recommended as part of Phase I come to $12.3 million. The additional measures that constitute Phase II of this IP cost another $10.3 million, for a total IP cost estimate of $22.6 million. Total costs are summarized for agricultural and residential measures in **Table 6-1**. Unit costs are summarized by measure in **Section 1** and by implementation phase in **Table 8-2**.

**Table 6-1.** Estimated cost of recommended agricultural and residential management actions (in $thousands) by sub-watershed.

| BMP Type | Upper Goose Creek | Cromwells Run | Little River | TOTAL |
|---|---|---|---|---|
| Agricultural | $11,780 | $2,054 | $ 3,002 | $ 16,836 |
| Residential | $1,995 | $ 566 | $ 2,468 | $ 5,029 |
| **Total** | $13,775 | $ 2,620 | $ 5,470 | $ 22,615* |

*Includes $750K in technical assistance which is not allocated across sub-watersheds.

# 7. Benefits

The primary objective of this plan is to meet the delisting requirements for bacteria in the plan area. Resolving the bacteria impairment, however, will improve more than just pollution from bacteria. Numerous direct and indirect improvements made through implementation of the management measures include economic benefits to local agricultural producers, improved ecosystem health and habitat creation, cleaner drinking water, enhanced recreation and tourism sectors of the local economy, and a more engaged, proactive community. Further, the measures implemented as a part of this IP will have the added benefit of protecting the Chesapeake Bay and making progress towards meeting the Chesapeake Bay TMDL. Benefits of agricultural, residential, and education and outreach practices are discussed in more detail in the sections below.

## 7.1 Agricultural Practices

Agricultural management measures (e.g. livestock exclusion, pasture and cropland, and equine practices) have numerous potential benefits in addition to reducing instream bacteria. Keeping livestock out of the stream through installation of watering systems, stream fencing and crossings, riparian buffers, and other measures has the added benefit of preventing the spread of cattle diseases like *E. coli*, salmonella, leptospirosis, and mastitis (Nordstrom 2016). Additional livestock benefits of increased access to clean water can include weight gain, increased milk production, and decreased foot rot (DEQ 2016b). Benefits like these have been documented in the IP area where BMPs have already been installed (personal communication, first IP public meeting, 6/21/2016).

Stabilizing streambanks, installing sediment retention structures, creating vegetative buffers, and reforestation of erodible lands reduce pollutant transport to the stream, thereby improving aquatic habitat and preventing costly water quality treatment for downstream drinking water utilities. These measures also create and/or improve existing aquatic and terrestrial wildlife habitats, while directly addressing the additional water quality impairments caused by excess sediment releases in the Goose Creek watershed.

Pasture and cropland management measures can increase profitability for the producer by reducing the amount of purchased feed required (DEQ 2016b).

### 7.2 Residential Practices

Although residential contributions to the bacteria impairment are nominal in the IP area (contributing less than one percent of the total bacteria load), residential measures like repair and replacement of septic systems, implementation of pet waste controls, and stormwater management efforts have a number of additional benefits. For example, proper septic tank maintenance extends the life of the system, saving the homeowner money. In addition, stormwater measures can help address issues such as localized flooding. Rain gardens and rain barrels can decrease water bills by reducing the amount of potable water used for irrigation. Residential measures also encourage community involvement and education, discussed below.

### 7.3 Education and Outreach

Participation of a wide range of local stakeholders will be required to fully implement the plan and achieve water quality goals. This wide-reaching involvement necessitates education and outreach. By providing the local community with awareness of the problem, knowledge of the issues, and skill and knowledge of actions that need to be taken, the community is more likely to act on these and other problems now and in the future (Hungerford and Volk 1990).

# 8. Measurable Goals and Milestones for Attaining Water Quality Standards

Delisting the impaired waters in the plan area is the ultimate goal of this plan. Water segments ("Assessable Units") within the plan area where water quality monitoring results show less than a 10.5% exceedance rate of the maximum assessment criterion of 235 colony forming units of *E. coli* per 100 milliliters (cfu/100mL) can be delisted from Virginia's impaired waters list. Full attainment of the recreational use water quality standard would be demonstrated by a geometric mean value based on at least four samples in a single month of no more than 126 cfu/100mL.

As noted, the IP will be carried out in two phases. Phase I covers the first ten years of implementation (Years 1-10). The measures selected for Phase I are considered those most important to achieving near-term improvements in water quality. Phase II is the final five years (Years 11-15), and will seek to fully achieve the water quality standard for recreational use. Management measures by implementation phase are shown in **Table 8-1** along with associated costs in **Table 8-2**.

**Table 8-1**. Management measure by implementation phase.

| Control Measure | Upper Goose Creek | Cromwells Run | Little River |
|---|---|---|---|
| Livestock Exclusion | | | |
| Livestock Exclusion System (CREP, CRSL-6) | I & II | I & II | I & II |
| Livestock Exclusion System (EQIP) | I & II | I & II | I & II |
| Stream Exclusion with Grazing Land Management (SL-6) | I & II | I & II | I & II |
| Livestock Exclusion with Riparian Buffers (LE-1T) | I & II | I & II | I & II |
| Livestock Exclusion with Reduced Setback (LE-2 / LE-2T) | I & II | I & II | I & II |
| Stream Exclusion (CCI-SE-1) | I & II | I & II | I & II |
| Stream Protection (WP-2 / WP-2T) | I | I | I |
| Pasture and Cropland | | | |
| Reforestation of Erodible Cropland and Pastureland (FR-1) | I & II | N/A | I & II |

| Control Measure | Upper Goose Creek | Cromwells Run | Little River |
|---|---|---|---|
| Woodland Filter Buffer Area (FR-3) | I | N/A | N/A |
| Streambank Stabilization (WP-2A) | I & II | I & II | I & II |
| Grazing Land Management (SL-9) | I & II | I & II | I & II |
| Pasture Management for TMDL Implementation (SL-10T / EQIP 528) | I & II | I & II | I & II |
| Permanent Vegetative Cover on Critical Areas (SL-11) | I & II | N/A | I & II |
| Conservation Tillage (SL-15A) | I | I | N/A |
| Cover Crops (SL-8B) | I | I | N/A |
| Grass Riparian Buffers (WQ-1) | I | I | N/A |
| Support for Extension of CREP/EQIP Watering Systems (SL-7) | I & II | I & II | N/A |
| Sediment Retention, Erosion, or Water Control Structure (WP-1) | I & II | I & II | I & II |
| Permanent Vegetative Cover on Cropland (SL-1) | I | I | I |
| Forage and Biomass Planting (EQIP – 512) | I | I | I |
| Equine | | | |
| Community Manure Composting Facility | I & II | I & II | I & II |
| Equine Manure Storage / Composting | I & II | I & II | I & II |
| Barnyard Runoff Controls | I & II | I & II | I & II |
| Small Acreage Grazing Systems (SL-6AT) | I & II | I & II | I & II |
| On-Site Sewage Disposal Systems | | | |
| Septic Tank Pump-out (RB-1) | I & II | I & II | I & II |
| Septic Connection to Public Sewer System (RB-2) | N/A | N/A | I & II |
| Septic System Repair (RB-3) | I & II | I & II | I & II |
| Septic System Installation / Replacement (RB-4) | I & II | I & II | I & II |
| Septic System Installation / Replacement with Pump (RB-4P) | I & II | I & II | I & II |
| Alternative On-Site Systems (RB-5) | I & II | I & II | I & II |
| Pet Waste Management | | | |
| Pet Waste Stations | I | I | I |
| Pet Waste Composters | I | I | I |
| Confined Canine Unit (CCU) | I | I | I |
| Pet Waste Education | I & II | I & II | I & II |
| Stormwater Management | | | |
| Vegetative Riparian Buffers (Residential) | I | I | I |
| Rain Barrels | I | I | I |
| Redirecting Residential Downspouts | I | I | I |
| Porous Pavement | I | I | I |
| Rain Gardens | I | I | I |
| Infiltration Trench | TBD | TBD | TBD |
| Education and Outreach | | | |
| Septic System Education | I & II | I & II | I & II |
| Septic System Education for Area Realtors | I & II | I & II | I & II |
| Work with Local School District to Incorporate Water-Related Curriculum into the Classroom | I & II | I & II | I & II |

| Control Measure | Upper Goose Creek | Cromwells Run | Little River |
|---|---|---|---|
| Organize Field Trips to Demonstrate Water Quality BMPs for Students | I & II | I & II | I & II |
| Organize a "Farm Day" Event with Local Landowners to Demonstrate Agricultural BMPs | I & II | I & II | I & II |
| Distribute Education Materials at the Farmer's Market | I & II | I & II | I & II |
| Horse Pasture Management Education | I & II | I & II | I & II |
| Technical Assistance | | | |
| Agricultural and Residential | I & II | I & II | I & II |

**Table 8-2**. Cost breakdown by implementation phase.

| Control Measure | Phase I Cost ($) | Phase II Cost ($) | Total ($) |
|---|---|---|---|
| Livestock Exclusion | | | |
| Livestock Exclusion System (CREP, CRSL-6) | 288,000 | 180,000 | 468,000 |
| Livestock Exclusion System (EQIP) | 225,000 | 135,000 | 360,000 |
| Stream Exclusion with Grazing Land Management (SL-6) | 1,008,000 | 756,000 | 1,764,000 |
| Livestock Exclusion with Riparian Buffers (LE-1T) | 1,620,000 | 1,008,000 | 2,628,000 |
| Livestock Exclusion with Reduced Setback (LE-2 / LE-2T) | 276,000 | 180,000 | 456,000 |
| Stream Exclusion (CCI-SE-1) | 75,629 | 50,419 | 126,048 |
| Stream Protection (WP-2 / WP-2T) | 15,000 | -- | 15,000 |
| **Total ($), Livestock Exclusion** | 3,507,629 | 2,309,419 | 5,817,048 |
| Pasture and Cropland | | | |
| Reforestation of Erodible Cropland and Pastureland (FR-1) | 405,000 | 945,000 | 1,350,000 |
| Woodland Filter Buffer Area (FR-3) | 15,000 | -- | 15,000 |
| Streambank Stabilization (WP-2A) | 9,600 | 5,250 | 14,850 |
| Grazing Land Management (SL-9) | 441,540 | 335,610 | 777,150 |
| Pasture Management for TMDL Implementation (SL-10T / EQIP 528) | 236,550 | 138,825 | 375,375 |
| Permanent Vegetative Cover on Critical Areas (SL-11) | 439,200 | 1,024,800 | 1,464,000 |
| Conservation Tillage (SL-15A) | 10,100 | -- | 10,100 |
| Cover Crops (SL-8B) | 5,050 | -- | 5,050 |
| Grass Riparian Buffers (WQ-1) | 1,650 | -- | 1,650 |
| Support for Extension of CREP Watering Systems (SL-7) | TBD | TBD | TBD |
| Sediment Retention, Erosion, or Water Control Structure (WP-1) | 823,890 | 2,469,930 | 3,293,820 |
| Permanent Vegetative Cover on Cropland (SL-1) | 5,250 | -- | 5,250 |
| Forage and Biomass Planting (EQIP – 512) | TBD | -- | TBD |
| **Total ($), Pasture and Cropland*** | 2,392,830 | 4,919,415 | 7,312,245 |
| Equine | | | |
| Community Manure Composting Facility | 430,000 | 215,000 | 645,000 |
| Equine Manure Storage / Composting | 255,600 | 132,000 | 387,600 |
| Barnyard Runoff Controls | 1,400,000 | 720,000 | 2,120,000 |
| Small Acreage Grazing Systems (SL-6AT) | 360,000 | 180,000 | 540,000 |
| **Total ($), Equine** | 2,445,600 | 1,247,000 | 3,692,600 |

| Control Measure | Phase I Cost ($) | Phase II Cost ($) | Total ($) |
|---|---|---|---|
| On-Site Sewage Disposal Systems | | | |
| Septic Tank Pump-out (RB-1) | 1,294,800 | 647,400 | 1,942,200 |
| Septic Connection to Public Sewer System (RB-2) | 212,500 | 50,000 | 262,500 |
| Septic System Repair (RB-3) | 934,500 | 483,000 | 1,417,500 |
| Septic System Installation / Replacement (RB-4) | 144,000 | 72,000 | 216,000 |
| Septic System Installation / Replacement with Pump (RB-4P) | 240,000 | 120,000 | 360,000 |
| Alternative On-Site Systems (RB-5) | 425,000 | 175,000 | 600,000 |
| **Total ($), On-Site Sewage Disposal Systems** | 3,250,800 | 1,547,400 | 4,798,200 |
| Pet Waste Management | | | |
| Pet Waste Stations | 5,000 | -- | 5,000 |
| Pet Waste Composters | 1,200 | -- | 1,200 |
| Confined Canine Unit (CCU) | 100,000 | -- | 100,000 |
| Pet Waste Education | 10,000 | 5,000 | 15,000 |
| **Total ($), Pet Waste Management** | 116,200 | 5,000 | 121,200 |
| Stormwater Management | | | |
| Vegetative Riparian Buffers (Residential) | 71,750 | -- | 71,750 |
| Rain Barrels | 450 | -- | 450 |
| Redirecting Residential Downspouts | 150 | -- | 150 |
| Porous Pavement | 7,500 | -- | 7,500 |
| Rain Gardens | 4,000 | -- | 4,000 |
| Infiltration Trench | TBD | TBD | TBD |
| Total ($), Stormwater Management* | 83,850 | 0 | 83,850 |
| Septic System Education | 3,750 | 3,750 | 7,500 |
| Septic System Education for Area Realtors | 937.5 | 937.5 | 1,875 |
| Work with Local School District to Incorporate Water-Related Curriculum into the Classroom | 1,500 | 1,500 | 3,000 |
| Organize Field Trips to Demonstrate Water Quality BMPs for Students | 1,500 | 1,500 | 3,000 |
| Organize a “Farm Day” Event with Local Landowners to Demonstrate Agricultural BMPs | 1,500 | 1,500 | 3,000 |
| Distribute Education Materials at the Farmer’s Market | 937.5 | 937.5 | 1,875 |
| Horse Pasture Management Education | 3,750 | 3,750 | 7,500 |
| **Total ($), Education and Outreach** | 13,875 | 13,875 | 27,750 |
| Technical Assistance | | | |
| Agricultural and Residential | 500,000 | 250,000 | 750,000 |
| **Total ($)** | 12,310,784 | 10,292,109 | 22,602,893 |

*These costs do not include estimates for TBD categories.

**Table 8-3** shows the water quality outcomes that are projected once Phase I and Phase II BMPs are in-place. Specifically, there will be significantly reduced levels of exceedance of the maximum assessment criterionin each watershed after Phase I (12% for Upper Goose Creek, 7% for Comwells Run, and 13% for Little River). At the end of Phase II, each sub-watershed is projected to have < 10.5% exceedance rate of the maximum assessment criterion, and 0% exceedance of the geometric mean standard of 126 cfu/100 mL. Phase II water quality outcomes are projected by the TMDL model, and Phase I outcomes are calculated based on the share of all BMPs that are included in Phase I of the implementation plan.

To best ensure ultimate success, the recommended management measures should be reevaluated toward the end of Phase I, in light of water quality monitoring results. Based on this reevaluation, Phase II BMPs may be altered or not implemented depending on the water quality improvements achieved through the implementation of Phase I measures.

Progress toward end goals can be assessed during the implementation process through tracking of control measure installations and continued water quality monitoring. The implementation timeline is divided into two phases with two types of milestones, implementation milestones and water quality milestones. Implementation milestones establish the percentage of implementation actions installed within specified timeframes. Water quality milestones establish the corresponding improvements in water quality that is expected as the implementation milestones are met. Both milestones are inextricably linked because the implementation of proposed management measures are expected to improve water quality.

## 8.1 Prioritizing Agricultural Actions

As stated in **Section 5.1**, "Approximately 99% of the bacteria reductions needed to meet delisting requirements come from the agricultural sector…". Given that, increasing implementation of agricultural conservation measures is essential to improving water quality to meet the State's standards discussed above.

Since livestock exclusion fencing eliminates 100% of direct deposits of bacteria into streams from cattle (see **Table 5-2**), while the buffer zone further reduces (by approximately 50%) bacteria reaching the streams in pasture runoff, this is the top priority management measure during plan implementation. The exclusion fencing needs that are the basis of recommended management measures within each of the sub-watersheds were estimated through data analysis. Several participants in the stakeholder meetings that informed plan development stressed that it would be important to "ground-truth" this fencing data analysis to guide implementation. Accordingly, it is recommended that an on-the-ground assessment of exclusion fencing needs, and relative priorities among the identified areas, be completed in the initial stage of implementation. This assessment should be used to focus outreach to individual producers in a way that will best assure BMP cost-share assistance achieves the greatest near-term bacteria reductions and water quality improvements.

It was observed earlier (in **Section 4.1**) that a relatively high percentage of land within each of the three sub-watersheds has been enrolled into a conservation easement program. Some of these easements are on large parcels of agricultural lands, and many of the existing easements do not have water quality protection requirements (like stream fencing) written into the easement. Conducting targeted outreach to easement property owners to encourage addition of water quality protections where they are needed should also be a priority for attention early in plan implementation.

Given that the greatest single source of bacteria in the IP watershed is pasture lands (see **Table 3-25**, **Table 3-28**, and **Table 3-31**), it will also be essential to give high priority to pasture improvements. This plan recommends a suite of pasture management practices for implementation, and notes that the specific practices are "interchangeable", as they all have estimated bacteria reduction efficiencies of 50%. Outreach to encourage implementation of whatever form of pasture management is of greatest interest to individual agricultural producers should be given a high priority in the early years of implementation.

During Phase I, the priority is to improve pasture management and remove livestock from streams and rivers. Approximately two-thirds (65 percent) of total livestock exclusion fencing required should be installed by the end of Phase I. Measures for improved pasture management (SL-9, SL-10T, EQIP 528, and SL-7) should be prioritized over FR-1 and SL-11 during Phase I. Opportunities to transition pasture to permanent forest or other native vegetation as part of nutrient banking should be taken advantage of when present, however, aggressive implementation during Phase II after other management measures have been implemented is recommended based on monitoring results and tracking towards the implementation objectives.

Measures to reduce equine bacterial loads should be implemented evenly across Phases I and II. The complexities and high capital costs of establishing a community composting program make it unlikely to complete the three planned composting facilities before the end of Phase II, with one regional composting facility coming online every five years beginning in 2021. Measures to improve barnyard runoff NPS pollution should be implemented beginning in Phase I.

## 8.2 Prioritizing Non-Agricultural Actions

As described in **Section 5.2.1**, Fauquier and Loudoun counties are sufficiently addressing failing septic systems across the IP area. The counties should continue to implement their current programs to repair or replace failing systems during Phases I and II. These programs can be supplemented by residential septic BMPs that would be a normal component of Sec. 319 grants that may be awarded to support implantation of the actions recommended in this plan.

New funding assistance for residential septic systems may result in the greatest bacteria reduction benefits if it is targeted to older homes located in areas with soils that are poorly suited for drainage. Especially when these homes are occupied by low-income residents, needed septic system maintenance, repair or replacement may be deferred to the point of contributing to water quality impairments. It is recommended that Fauquier and Loudoun Counties, the Virginia Department of Health, and JMSWCD and LSWCD collaborate to conduct analysis of high priority areas for septic system education and outreach to help target future residential septic cost-share assistance to the areas of greatest need.

Stormwater BMP pilot projects as proposed in **Section 5.2.3** should be installed within the first five years of Phase I depending on the availability of funding. As the projects are meant to spur interest in implementing these measures in other areas of the IP area, it is recommended that projects are installed early in the implementation planning timeline. Delay in installing stormwater management measures will not delay meeting water quality goals. Management measures to address bacteria from dogs should be implemented during Phase I, however, extending implementation through Phase II will not delay meeting the implementation plan goals.

Finally, education and outreach programs and technical assistance will be on-going in Phases I and II. In some cases, education and outreach programs currently exist or have existed in the past. Working with local organizations and other partners to increase and improve citizen-led monitoring efforts is needed during Phase I and II.

Management measures by implementation phase are shown in **Table 8-1**. The costs of phased implementation, as described, is summarized in **Table 8-2** and the number of units needed in each phase of implementation is provided in **Table 8-3**.

**Table 8-3**. Number of management measure units per phase by sub- watershed and exceedance rates by implementation phase.

| Control Measure | Upper Goose Creek | | Cromwells Run | | Little River | | Total | |
|---|---|---|---|---|---|---|---|---|
| | Phase I Units | Phase II Units | Phase I Units | Phase II Units | Phase I Units | Phase II Units | Phase I Units | Phase II Units |
| Livestock Exclusion | | | | | | | | |
| Livestock Exclusion System (CREP, CRSL-6) | 11 | 7 | 4 | 2 | 1 | 1 | 16 | 10 |
| Livestock Exclusion System (EQIP) | 11 | 7 | 3 | 1 | 1 | 1 | 15 | 9 |
| Stream Exclusion with Grazing Land Management (SL-6) | 16 | 12 | 6 | 4 | 6 | 5 | 28 | 21 |
| Livestock Exclusion with Riparian Buffers (LE-1T) | 26 | 16 | 9 | 6 | 10 | 6 | 45 | 28 |
| Livestock Exclusion with Reduced Setback (LE-2 / LE-2T) | 13 | 9 | 5 | 3 | 5 | 3 | 23 | 15 |
| Stream Exclusion (CCI-SE-1) | 28,361 | 18,907 | 14,180 | 9,454 | 33,088 | 22,058 | 75,629 | 50,419 |
| Stream Protection (WP-2 / WP-2T) | 3 | -- | 1 | -- | 2 | -- | 6 | -- |
| Pasture and Cropland | | | | | | | | |
| Reforestation of Erodible Cropland and Pastureland (FR-1) | 780 | 1,820 | -- | -- | 120 | 280 | 900 | 2,100 |
| Woodland Filter Buffer Area (FR-3) | 10 | -- | -- | -- | -- | -- | 10 | -- |
| Streambank Stabilization (WP-2A) | 21 | 12 | 21 | 12 | 21 | 12 | 63 | 36 |
| Grazing Land Management (SL-9) | 2,284 | 1,726 | 259 | 203 | 133 | 105 | 2,676 | 2,034 |
| Pasture Management for TMDL Implementation (SL-10T / EQIP 528) | 2,377 | 1,396 | 277 | 162 | 500 | 293 | 3,154 | 1,851 |
| Permanent Vegetative Cover on Critical Areas (SL-11) | 156 | 364 | -- | -- | 24 | 56 | 180 | 420 |
| Conservation Tillage (SL-15A) | 77 | -- | 24 | -- | -- | -- | 101 | -- |
| Cover Crops (SL-8B) | 77 | -- | 24 | -- | -- | -- | 101 | -- |
| Grass Riparian Buffers (WQ-1) | 5 | -- | 5 | -- | -- | -- | 10 | -- |
| Support for Extension of CREP Watering Systems (SL-7) | 5 | 3 | 4 | 3 | -- | -- | 9 | 6 |
| Sediment Retention, Erosion, or Water Control Structure (WP-1) | 938 | 2,812 | -- | -- | 9 | 27 | 947 | 2,839 |
| Permanent Vegetative Cover on Cropland (SL-1) | 10 | -- | 10 | -- | 10 | -- | 30 | -- |
| Forage and Biomass Planting (EQIP - 512) | 5 | -- | 5 | -- | 5 | -- | 15 | -- |
| Equine | | | | | | | | |
| Community Manure Composting Facility | -- | 1 | 1 | -- | 1 | -- | 2 | 1 |
| Equine Manure Storage / Composting | 100 | 52 | 32 | 17 | 81 | 41 | 213 | 110 |
| Barnyard Runoff Controls | 33 | 17 | 11 | 5 | 26 | 14 | 70 | 36 |
| Small Acreage Grazing Systems (SL-6AT) | 20 | 10 | 10 | 5 | 10 | 5 | 40 | 20 |

| **Control Measure** | **Upper Goose Creek** | | **Cromwells Run** | | **Little River** | | **Total** | |
|---|---|---|---|---|---|---|---|---|
| | **Phase I Units** | **Phase II Units** | **Phase I Units** | **Phase II Units** | **Phase I Units** | **Phase II Units** | **Phase I Units** | **Phase II Units** |
| On-Site Sewage Disposal Systems | | | | | | | | |
| Septic Tank Pump-out (RB-1) | 1,860 | 930 | 410 | 205 | 2,046 | 1,023 | 4,316 | 2,158 |
| Septic Connection to Public Sewer System (RB-2) | -- | -- | -- | -- | 17 | 4 | 17 | 4 |
| Septic System Repair (RB-3) | 124 | 64 | 6 | 3 | 137 | 71 | 267 | 138 |
| Septic System Installation / Replacement (RB-4) | 8 | 4 | 8 | 4 | 8 | 4 | 24 | 12 |
| Septic System Installation / Replacement with Pump (RB-4P) | 10 | 5 | 10 | 5 | 10 | 5 | 30 | 15 |
| Alternative On-Site Systems (RB-5) | 7 | 3 | 3 | 1 | 7 | 3 | 17 | 7 |
| Pet Waste Management | | | | | | | | |
| Pet Waste Stations | 2 | -- | 4 | -- | 4 | -- | 10 | -- |
| Pet Waste Composters | 8 | -- | 8 | -- | 8 | -- | 24 | -- |
| Confined Canine Unit (CCU) | 1 | -- | 2 | -- | 2 | -- | 5 | -- |
| Pet Waste Education | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 0.5 | 2 | 2 |
| Stormwater Management | | | | | | | | |
| Vegetative Riparian Buffers (Residential) | -- | -- | -- | -- | 20.5 | -- | 20.5 | -- |
| Rain Barrels | 1 | -- | 1 | -- | 1 | -- | 3 | -- |
| Redirecting Residential Downspouts | 0.6 | -- | 0.2 | -- | 0.7 | -- | 1.5 | -- |
| Porous Pavement | 250 | -- | 250 | -- | 500 | -- | 1,000 | -- |
| Rain Gardens | 250 | -- | 250 | -- | 500 | -- | 1,000 | -- |
| Infiltration Trench | TBD | TBD | TBD | TBD | TBD | TBD | TBD | TBD |

| Exceedance Rate (%) | | | | |
|---|---|---|---|---|
| DEQ Monitoring Station | | 1AGAR002.24 | 1ACRM001.20 | 1ALIV004.78 |
| Maximum Assessment Criterion Exceedance Rate (%) of 235 cfu/100 mL | Pre-TMDL (before 2003) | 60 | 40 | 54 |
| | Present (2013-April 2016) | 44 | 20 | 25 |
| | IP Phase I | 12 | 7 | 13 |
| | IP Phase II | <10.5 | <10.5 | <10.5 |
| Geometric Mean Bacteria Standard Exceedance Rate (%) of 126 cfu/100 mL | IP Phase II | 0 | 0 | 0 |

Note: The TMDL model indicates that the maximum assessment criterion exceedance rates of less than 10.5% and geometric mean bacteria standard exceedance rates of 0% will be achieved under Scenario 9 for all segments modeled under the original impairments. Phase 1 exceedance rates are calculated based on percent implementation expected to be complete by the end of the phase.

Note: Education and outreach and technical assistance categories are not included in this table as they are expected to proceed continuously throughout implementation.

# 9. Water Quality Monitoring

The proposed monitoring program builds on ongoing efforts to facilitate evaluation of trends over time and assess progress towards achieving the water quality standard. DEQ, in collaboration with local partners, will periodically evaluate the monitoring data to determine progress towards implementation goals. Proposed monitoring includes 1) continued DEQ monitoring, 2) citizen monitoring, and 3) additional monitoring. Each of these is discussed in more detail below.

## 9.1 DEQ Monitoring

DEQ regularly conducts monitoring in the IP area as part of its overall water quality monitoring program for the Commonwealth. Within the plan area, there is one DEQ monitoring program "Trend" station, at which water quality monitoring samples are taken bi-monthly every year, and two more Trend stations are located on Goose Creek below the IP area. In addition to these high frequency monitoring stations, on a five-year cycle DEQ samples other sites as a part of its probabilistic monitoring program, and other DEQ monitoring occurs periodically to meet specific program needs. These monitoring efforts will continue and be adapted as necessary to evaluate progress towards meeting the bacteria water quality criteria. DEQ's current network of monitoring stations within the IP watersheds is shown in **Figure 1-3**. Data collected by DEQ are used in the water quality assessment, which determines whether waters are meeting water quality standards. Assessment results are submitted as an Integrated Report to the EPA every two years, as required by the CWA.

## 9.2 Citizen Monitoring

Citizen water quality data can greatly improve the understanding of water quality conditions over time. For almost 15 years, the GCA has conducted water quality monitoring at many locations throughout the entire Goose Creek watershed, including within the plan area. This monitoring has included both chemical and benthic community parameters, with sustained monitoring of benthic community health. Bacteria data collected by GCA have been designated as Level II data through the DEQ citizen water quality monitoring program. Level II data may be used to educate the community, assist the SWCDs in prioritizing BMPs for implementation, and track performance of TMDL implementation.

These data are submitted to DEQ and may be used to identify waters for DEQ follow-up monitoring. While these data are a part of the water quality assessment, Level II data are not used by DEQ to directly determine whether waters are meeting their water quality standards. Citizen monitoring data must be designated as Level III, and collected with protocols that are equivalent to those used by the DEQ water quality monitoring program, to be used for water quality assessment determinations. DEQ and GCA will collaborate on the location of monitoring sites to optimize coverage and avoid unnecessary duplication in future monitoring efforts to track performance under this TMDL IP.

## 9.3 Additional Monitoring

Site specific monitoring efforts may assist in evaluation of management measure effectiveness and add flexibility within an adaptive implementation framework. To this end, collaboration with partners to design additional monitoring efforts will assist in the successful implementation of this plan. During the course of stakeholder discussions, several existing groups including USGS and Fauquier County's Emergency Management Planning mentioned an interest in contributing to the water quality monitoring efforts (personal communication, GWG meeting, 9/8/2016). USGS is conducting a five-year project with Fauquier County to assist in developing a holistic water budget for the county. Although this project is focused on water quantity – specifically how changes in precipitation affect the water budget – there may be opportunities for a collaborative effort to assist in obtaining water quality measurements. Fauquier County's Emergency Management Planning may be able to assist with basic water quality monitoring efforts if funding is identified. In addition, JMSWCD has technical capability and interest to conduct supplement water quality monitoring grant projects.

# 10. Stakeholder Roles and Responsibilities

## 10.1 Agricultural and Residential Landowners

Since nonpoint sources of runoff to streams is the dominant cause of the bacteria impairment of the Upper Goose Creek watershed, action by the many local landowners within the watershed is essential to achieving the water quality restoration goals of this plan. While actions are required by many, and the cost of these actions can be significant, government agencies are able to provide both technical and financial assistance to support landowner efforts. Local government, SWCD, and Natural Resources and Conservation Service (NRCS) staff are uniquely positioned to serve as a liaison between individual landowners and the government agencies and programs that can assist them in addressing the sources of bacteria pollution. Their personal knowledge of the local communities, local economy, and natural resources positions them well to foster the collective actions required to achieve this plan's goals.

## 10.2 John Marshall Soil and Water Conservation District and Loudoun Soil and Water Conservation District

The JMSWCD and LSWCD staff have considerable technical assistance capabilities to offer landowners within the watershed. Together with NRCS, the local SWCDs continually reach out to farmers within their watersheds to provide conservation practice technical expertise. In the absence of this plan, these Districts would not have the ability to dedicate staff focused solely on the Upper Goose Creek watershed and this would limit the ability to achieve the ambitious BMP implementation measures called for. With dedicated staffing for the local watersheds, local SWCDs can provide agricultural BMP design and layout assistance to individual producers. Their staff will more broadly communicate with landowners in the watersheds to help advance environmental education and encourage participation in conservation programs, both agricultural and residential programs that focus on septic systems, pet waste and stormwater management. This IP meets the requirements for funding eligibility under EPA's Section 319 program, for which JMSWCD and LSWCD may apply for grant assistance to enable them to target their expertise to landowners.

## 10.3 Fauquier and Loudoun Counties

Decisions made by local government staff and elected officials regarding land use and zoning will play an important role in the implementation of this plan. This makes Fauquier and Loudoun county governments key partners in long term implementation efforts. Approximately 84 percent of the upper watershed area falls within Fauquier County, so it will have a relatively greater role in the plan's implementation. Both Fauquier and Loudoun counties administer conservation programs which have helped to encourage land conservation across the counties. Since 1979 when both counties created their Agricultural and Forestal District Programs, Fauquier County has established 13 districts covering over 78,000 acres and Loudoun County has established 22 districts with over 43,000 acres located throughout the county (Fauquier County 2016b; Loudoun County 2017).

Based on feedback from the public meeting and working group discussions, residential land development is a significant issue in the eastern portion (Little River) of the watershed, with the number of working farms in the area declining in recent years. Local government support of land conservation will become increasingly important as greater numbers of conservation measures are implemented across the watersheds.

As has been noted earlier, both counties have very active and effective residential septic system programs, as well as limited plans to expand wastewater treatment facility capacity and connections. Also, both counties will serve as key partners in residential stormwater BMP outreach and implementation and may assist with the promotion of pet waste BMPs including composters and pet waste stations.

## 10.4 Virginia Department of Environmental Quality

DEQ has a lead role in the development of TMDL implementation plans. DEQ also provides available grant funding and technical support for TMDL implementation, and will work closely with project partners to track implementation progress. In addition, DEQ will work with interested partners on grant proposals to provide grant funds for projects included in the implementation plan.

DEQ is also responsible for monitoring state waters to determine compliance with water quality standards. DEQ will continue monitoring water quality in the Upper Goose Creek, Cromwells Run, and Little River sub-watersheds and their tributaries in order to assess water quality and determine when restoration has been achieved and the streams can be removed from Virginia's list of impaired waters.

## 10.5 Virginia Department of Conservation and Recreation

DCR administers the Virginia Agricultural Cost Share Program, working closely with the SWCDs to provide cost share and operating grants needed to deliver this program at the local level and track implementation. In addition, DCR administers the state's Nutrient Management Program, which provides technical assistance to producers in appropriate manure storage and manure and commercial fertilizer.

## 10.6 Virginia Department of Forestry

The Virginia Department of Forestry (DOF) has prepared a manual to inform and educate forest landowners and the professional forest community on proper BMPs and technical specifications for installation of these practices in forested areas (http://dof.virginia.gov/infopubs/BMP-Technical-Guide_pub.pdf, accessed 5/15/2017). Forestry BMPs are primarily directed to control erosion. For example, streamside forest buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amounts of nutrients and sediments that enter local streams. Although the DOF's BMP program is intended to be voluntary, it becomes mandatory for any silvicultural operation occurring within state waters (VA Silvicultural Water Quality Law 10.1-1181.2). *For more information:* visit Chapter 10 in the aforementioned manual.

## 10.7 Virginia Department of Health

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

## 10.8 Other Potential Local Partners

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

#### *10.8.1 Virginia Cooperative Extension*

Both Fauquier and Loudoun counties have local offices of Virginia Cooperative Extension (VCE). These offices in Warrenton (Fauquier) and Leesburg (Loudoun) connect residents to Virginia's land-grant universities, Virginia Tech and Virginia State University. Through educational programs based on research and developed with input from local stakeholders, VCE offices help improve local communities with programs in Agriculture and Natural Resources, Family and Consumer Sciences, 4-H Youth Development, and Community Viability. *For more information:* http://ext.vt.edu/, accessed 5/15/2017.

#### *10.8.2 Piedmont Environmental Council*

PEC was formed in 1972 and works with the citizens of its nine-county region to conserve land, create high-quality communities, strengthen rural economies, celebrate historic resources, protect air and water quality, build smart transportation networks, promote sustainable energy choices, restore wildlife habitat, and improve people's access to nature. PEC works to empower citizens to protect what makes the Piedmont a wonderful place and encourage them to pursue a positive vision for the region's future. PEC has a long history of working with land owners to conserve their land through easements. Forty percent of the entire Goose Creek watershed is under conservation easement currently, and many properties in the UGC planning area have been protected. PEC is now working to strengthen older easements to improve their water quality protections and increase the percentage of eased land in the watershed to fifty percent in the near-term, with a long-term target of seventy to eighty percent under easement in the watershed. *For more information:* http://www.pecva.org/, accessed 5/15/2017.

#### *10.8.3 Goose Creek Association*

The GCA was founded in 1970 to fight the discharge of sewage effluent into Goose Creek. Today the association addresses a broad array of issues, with an active board charged with monitoring stream water quality, proposed developments, legislation, zoning changes and other actions. Maintaining and improving the quality of the Goose Creek watershed is the overarching goal of the Association's efforts. GCA works together with many other conservation and preservation efforts to provide a unified voice for conservation/preservation–minded citizens in the area. *For more information:* http://www.goosecreek.org/, accessed 5/15/2017.

# 11. Integration with Other Planning Initiatives

## 11.1 Fauquier County Groundwater Study

In January 2016, USGS and the Virginia Water Science Center presented a Groundwater Resource Assessment and Monitoring Proposal to the Fauquier County Board of Supervisors. This proposal was endorsed and a study has been initiated to achieve the following objectives: (1) develop a county-wide water budget model to characterize hydrologic conditions affecting county aquifers; (2) couple groundwater and surface water monitoring to enable an assessment of the relationship of groundwater withdrawals and base stream flows; and (3) begin to collect data and develop tools to estimate the impacts of the county's population growth on its water resources. Fauquier County has initiated the five year USGS project and completed the water balance model.

## 11.2 Fauquier County Natural Resources Plan

In May 2016, the Fauquier County BOS adopted Chapter 2, Section A "Natural Resources" policy. Among its objectives are the following:

- Develop and implement a broad-based and robust water management program,
- encourage the establishment of stream buffers for water quality protection,

- seek to reduce pollution to our natural waters and stormwater systems, and
- identify fully functioning and healthy surface waters and explore means to sustain and maintain these baseline conditions.

### 11.3 Loudoun County Comprehensive Watershed Management Plan

In 2006-08, Loudoun County pursued an ambitious overall plan for watershed management, with technical assistance (via EPA and National Fish and Wildlife Foundation (NFWF) grants) from the University of Virginia and CH2M Hill. The proposed comprehensive framework for county-wide watershed management was presented to the Board of Supervisors in March 2009, with recommendations for implementation. In 2014 a detailed watershed plan for Upper Broad Run was completed under this framework. Additional watersheds, including parts of the Goose Creek watershed, may be the focus of future detailed plans.

### 11.4 Goose Creek Scenic River Advisory Committee

This committee, which is formally sanctioned by the Commonwealth of Virginia, actively reviews proposed land use changes and development activities in the Goose Creek watershed. The Committee works to promote environmental enhancements in development proposals, including increased use of riparian buffers. Ideally planted in trees and bushes, these buffers help to retain scenic views, reduce stream bank erosion, reduce flooding, and enhance habitat values and water quality.

### 11.5 Northern Virginia Regional Commission

In January 2012 NVRC issued a report titled “Conservation Corridor Planning” (NVRC 2012). This report presents important data analysis that informed the identification of regional conservation “cores” and “corridors” and opportunities for regional collaboration to protect and restore these resources. The Route 15 “Journey Through Hallowed Ground” is within one of the Plan’s five top priority corridors, and falls within the eastern section of the Upper Goose Creek plan area. The NVRC plan’s strategies are consistent with the goals of this IP, including enhancing ecosystem functions with good management and restoring degraded or missing (corridor) connections.

## 12. Funding for Implementation

A list of potential funding sources available for implementation is listed and discussed below. Detailed descriptions can be obtained from the parent agencies and the websites shown. While funding is currently being provided to the JMSWCD for agricultural BMPs and technical assistance for farmers, additional funding commitments are needed to fully implement the agricultural, residential, and urban practices included in the plan.

### 12.1 Loudoun County Non-Qualifying Livestock Exclusion (Horse Fencing) Cost Share Program

For the past three years, Loudoun County Government has dedicated approximately $50,000 annually to provide funding for fencing and water systems for small farms, primarily horse farms, that do not qualify for the State’s stream exclusion fencing cost-share program. The funds provide a 75 percent cost share, and in the most recent year, supported 14 projects totaling 6,037 feet of new stream fencing, and the maintenance of additional previously installed fencing in need of repair.

## 12.2 Loudoun County Water and Wastewater Community Assistance Program

This program was created to respond to the ongoing problem of failing septic systems in Loudoun County. The program is designed to help prevent and solve community water and wastewater issues by administering a comprehensive program that addresses multiple types of water and wastewater issues, and provides funds to ensure that citizens have a safe, adequate, and proper means of sewage disposal. Potential at-risk communities are described in the *Loudoun County Water and Wastewater Needs Assessment*, *2011*. *For more information:* https://www.loudoun.gov/DocumentCenter/View/113279, accessed 6/9/2017 or https://www.loudoun.gov/index.aspx?NID=3650, accessed 6/9/2017.

## 12.3 Loudoun Non-Agricultural Stream Buffer Planting Project

The LSWCD and Loudoun County jointly administer a program to reimburse riparian land owners (individuals, commercial/residential businesses, and home owner associations) who plan riparian areas of a minimum of 35 feet in width. This voluntary program is currently funded at $35,000 annually and reimburses property owners for the cost of purchasing and planting native deciduous trees, with options for evergreen trees and shrubs. *For more information:* www.lswcd.org, accessed 6/9/2017.

## 12.4 Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market, who has in place a soil conservation plan approved by the local SWCD, is allowed a credit against the tax imposed by Section 58.1-320 of the Code of Virginia equaling 25 percent of the first $70,000 expended for agricultural BMPs by the individual. The amount of the credit cannot exceed $17,500 or the total amount of the tax imposed by this program (whichever is less) in the year the project was completed. This program can be used in conjunction with other cost-share programs on the landowner’s portion of BMP costs. It is also approved for use in supplementing the cost of repairs to streamside fencing. *For more information:* http://lfswcd.org/best-management-practices, accessed 5/15/2017.

## 12.5 Virginia Agricultural Best Management Practices Loan Program

Loan requests are accepted through DEQ. The interest rate is three percent per year and the term of the loan coincides with the life span of the practice. To be eligible for the loan, the BMP must be included in a conservation plan approved by the local SWCD Board. The minimum loan amount is $5,000 with no maximum limit. Eligible BMPs include structural practices such as animal waste control facilities and grazing land protection systems. Loans are administered through participating lending institutions. *For more information:* http://www.deq.virginia.gov/programs/water/cleanwaterfinancingassistance/agriculturalbmp.aspx, accessed 5/15/2017.

## 12.6 Virginia Conservation Assistance Program

The Virginia Conservation Assistance Program (VCAP) is a relatively new program that can provide reimbursements to landowners who install stormwater BMPs. The program is administered by the SWCDs, who accept and review BMP plans submitted by landowners, verify project eligibility, and issue and track reimbursements for completed projects. All non-agricultural property owners in eligible districts may apply. This includes businesses, public, and private lands. A manual has been developed for the program, which includes standards and specifications for BMPs eligible for reimbursement. The JMSWCD and LSWCD may have staff members available to apply for funds through this program in order to work with interested property owners on residential/urban stormwater BMPs. *For more information:* http://vaswcd.org/vcap, accessed 5/15/2017.

## 12.7 Virginia Small Business Environmental Assistance Fund Loan Program

This fund, administered through DEQ, is used to make or guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, or equipment and structures to implement agricultural BMPs. Loans are available up to $50,000 and will carry an interest rate of three percent, with repayment terms based on the borrower's ability to repay and the life of the equipment or BMP. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act. *For more information:* http://www.deq.virginia.gov/portals/0/deq/air/smallbusinessassistance/autobody/appendix13.pdf, accessed 5/15/2017.

## 12.8 Community Development Block Grant Program

"The Virginia Community Development Block Grant (CDBG) program provides funding to eligible units of local government for planning and implementing projects that address critical community development needs, including housing, infrastructure and economic development. The goal of the CDBG Program is to improve the economic and physical environment in Virginia's communities through activities which primarily benefit low- and moderate-income persons, prevent or eliminate slums and blighting conditions or meet urgent needs which threaten the welfare of citizens." *For more information:* http://www.dhcd.virginia.gov/index.php/community-partnerships-dhcd/76-community-development-block-grant-cdbg-competitive-grants.html, accessed 5/15/2017.

## 12.9 Virginia Water Quality Improvement Fund

This is a permanent, non-reverting fund established by the Commonwealth of Virginia in order to assist local stakeholders in reducing point and nonpoint nutrient loads to surface waters. Eligible recipients include local governments, SWCDs, and individuals. Grants for point and nonpoint sources are administered through DEQ. *For more information:* http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/WaterQualityImprovementFund.aspx, accessed 5/15/2017.

## 12.10 Virginia Forest Stewardship Program

The program is administered by the DOF to protect soil, water, and wildlife and to provide sustainable forest products and recreation. *For more information:* http://dof.virginia.gov/manage/stewardship/index.htm, accessed 5/15/2017.

## 12.11 USDA Conservation Reserve Program

Through the USDA Conservation Reserve Program (CRP), cost-share assistance is available to establish trees or herbaceous vegetation covers on cropland. To be eligible for consideration, the following criteria must be met: 1) cropland was planted or considered planted in an agricultural commodity for two of the five most recent crop years, and 2) cropland is classified as "highly-erodible" by NRCS. The payment to the participant is up to 50 percent of the cost for establishing ground cover. *For more information:* http://www.nrcs.usda.gov/wps/portal/nrcs/main/va/programs/, accessed 5/15/2017.

## 12.12 USDA Conservation Reserve Enhancement Program

The USDA Conservation Reserve Enhancement Program (CREP) is an "enhancement" of the existing Farm Service Agency (FSA) CRP Continuous Signup. It has been "enhanced" by increasing the rental rates, and offering incentive payments to place the enrolled area under a 10-15-year contract. The average cost share payment in this program is 75 percent; however, additional incentives are available to raise this rate if a landowner is willing to install additional control measures. Buffers consisting of native, warm-season grasses on cropland, and mixed hardwood trees on pasture, must be established in widths ranging from the minimum of 30 percent of the floodplain or 35 feet, whichever is greater, to a maximum average of 300 feet. Federal cost-sharing (50 percent) is available to help pay for fencing to exclude livestock from the riparian buffer, watering facilities, hardwood tree planting, filter strip establishment, and wetland restoration. The State of Virginia will make an additional payment to landowners who elect to place a perpetual easement on the enrolled area. *For more information:* https://www.fsa.usda.gov/Internet/FSA_File/va_crep_infosheet.pdf, accessed 5/15/2017.

## 12.13 USDA Environmental Quality Incentives Program

Approximately 65 percent of the USDA Environmental Quality Incentives Program (EQIP) funding for the state of Virginia is directed toward "Priority Areas." These areas are selected from proposals submitted by a locally led conservation work group. The remaining 35 percent of the funds are directed toward statewide priority concerns of environmental needs. EQIP offers up to 10-year contracts to landowners and farmers to provide financial assistance, and/or incentive payments to implement conservation practices and address the priority concerns statewide or in the priority area. Eligibility is limited to persons who are engaged in agricultural production. *For more information:* http://www.nrcs.usda.gov/wps/portal/nrcs/main/va/programs/financial/eqip/, accessed 5/15/2017.

## 12.14 USDA Regional Conservation Partnership Program

The USDA Regional Conservation Partnership Program (RCPP) is a five-year program that promotes coordination between NRCS and its partners to deliver conservation assistance to producers and landowners. NRCS provides assistance to producers through partnership agreements and through program contracts or easement agreements. The RCPP competitively awards funds to conservation projects designed by local partners specifically for their region. Partners such as SWCDs and nonprofit organizations can then work with interested landowners to utilize these funds for BMP implementation. The Chesapeake Bay watershed is one of eight "Critical Conservation Areas" identified in this program. *For more information:* http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/programs/farmbill/rcpp/?cid=stelprdb1254053, accessed 5/15/2017.

## 12.15 USDA Wildlife Habitat Incentive Program

The USDA Wildlife Habitat Incentive Program (WHIP) is a voluntary program for landowners who want to develop or improve wildlife habitat on private agricultural lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A ten-year contract provides cost-share and technical assistance to carry out the plan. Cost-share assistance of up to 75 percent of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Types of practices include: prescribed burning, converting fescue to warm season grasses, and creating habitat for waterfowl. *For more information:* http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/whip/, accessed 5/15/2017.

## 12.16 EPA Section 319 Grant Project Funds

Through Section 319 of the Federal CWA, Virginia is awarded grant funds to implement NPS programs. DEQ administers the money annually on a competitive grant basis to fund TMDL implementation projects, outreach and educational activities, water quality monitoring, and technical assistance for staff of local sponsor(s) coordinating implementation. In order to meet eligibility criteria established for 319 funding, all proposed project activities must be included in the TMDL implementation plan covering the project area. In addition, this plan must include the nine key elements of a watershed based plan (noted in **Section 2.1**). *For more information:* http://www.deq.virginia.gov/Programs/Water/CleanWaterFinancingAssistance/NonpointSourceFunding.aspx, accessed 5/15/2017.

## 12.17 EPA/VA Clean Water State Revolving Fund

EPA awards grants to Virginia for its Clean Water Revolving Loan Funds (VCWRLF). The VCWRLF make loans for priority water quality activities throughout the Commonwealth. As recipients make payments, money is available for new loans to be issued to other recipients. Eligible projects include PS, NPS, and estuary protection projects. PS projects typically include building wastewater treatment facilities, combined sewer overflow and sanitary sewer overflow correction, urban stormwater control, and water quality aspects of landfill projects. NPS projects include agricultural, silvicultural, rural, and some urban runoff control; on-site wastewater disposal systems (septic tanks); land conservation and riparian buffers; leaking underground storage tank remediation, etc. *For more information:* http://www.deq.virginia.gov/programs/water/cleanwaterfinancingassistance.aspx, accessed 5/15/2017.

## 12.18 Southeast Rural Community Assistance Project

The mission of the Southeast Rural Community Assistance Project (SER-CAP) project is to promote, cultivate, and encourage the development of water and wastewater facilities to serve low-income residents at affordable costs and to support other development activities that will improve the quality of life in rural areas. They can provide (at no cost): on-site technical assistance and consultation, operation and maintenance/management assistance, training, education, facilitation, volunteers, and financial assistance. Financial assistance includes $1,500 toward repair/replacement/ installation of a septic system and $2,000 toward repair/replacement/installation of an alternative waste treatment system. Funding is only available for families making less than 125 percent of the federal poverty level. *For more information:* http://www.sercap.org/se_loan_fund.htm, accessed 5/15/2017.

## 12.19 National Fish and Wildlife Foundation

The NFWF administers the Chesapeake Bay Stewardship Fund, which is dedicated to the protection and restoration of the Chesapeake Bay. The Stewardship Fun is supported through partnerships with government agencies and private corporations, and typically awards $8 million to $12 million per year through two competitive grant programs (Innovative Nutrient and Sediment Reduction Grants and Small Watershed Grants) and a technical assistance program. A request for proposals is typically issued in the spring and awards are made in the fall. *For more information:* http://www.nfwf.org/chesapeake/Pages/home.aspx, accessed 5/15/2017.

## 12.20 Wetland and Stream Mitigation Banking

Mitigation banks are sites where aquatic resources such as wetlands, streams, and streamside buffers are restored, created, enhanced, or in exceptional circumstances, preserved for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources. Mitigation banking is a commercial venture that provides compensation for aquatic resources. Mitigation banks are required to be protected in perpetuity, to provide financial assurances, and long term stewardship. The mitigation banking processes is overseen by the Inter-Agency Review Team (IRT) consisting of state and federal agencies and chaired by DEQ and the Army Corps of Engineers. *For more information:* http://www.deq.virginia.gov/Programs/Water/WetlandsStreams/Mitigation.aspx, accessed 5/15/2017.

## 12.21 Additional Sources of Funding

Participants in the working group meetings also identified the following programs as additional potential sources of funding:

- Virginia Outdoors Foundation (VOF). *For more information:* http://www.virginiaoutdoorsfoundation.org/, accessed 5/15/2017.
- Virginia Nutrient Mitigation Bank Program. *For more information:* http://www.deq.virginia.gov/Programs/Water/PermittingCompliance/PollutionDischargeElimination/NutrientTrading.aspx/, accessed 5/15/2017.
- Community Development Fund of Northern Virginia (CFNOVA). *For more information:* http://www.cfnova.org, accessed 5/15/2017.
- U.S. Fish and Wildlife Service (FWS) Conservation Grant Program. *For more information:* https://www.fws.gov/grants/, accessed 5/15/2017.
- USDA Agricultural Conservation Easement Program. *For more information:* https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/easements/acep/, accessed 5/15/2017.
- Trout Unlimited (TU). *For more information:* http://www.tu.org/connect/groups/9va-virginia, accessed 5/15/2017.
- Environmental Defense Fund (EDF). *For more information:* https://www.edf.org/, accessed 5/15/2017.
- Ducks Unlimited. *For more information:* http://www.ducks.org/, accessed 5/15/2017.
- Potomac Conservancy. *For more information:* https://potomac.org/mission-programs/, accessed 5/15/2017

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# Attachment A – DEQ Water Quality Monitoring Data Summary

A DEQ water quality monitoring data summary is provided in **Table A-1**.

**Table A-1**. DEQ water quality assessment (2014), DEQ and citizen monitoring stations.

| IP Sub-watershed | HUC12 Name (Code) | Water Name | VAHU6 | 2014IR DEQ Assessment Unit ID | 2014IR Impairment Length (miles) | 2014IR Impairment Length Description | 2014IR Citizen Monitoring Station (DEQ Station Name) | 2014IR DEQ Listing Station | 2014IR: Recreation Use |
|---|---|---|---|---|---|---|---|---|---|
| Little River | Little River (020700080701) | Bartons Creek | PL13 | VAN-A08R_BAO01A06 | 4.81 | headwaters downstream to confluence with Little River | 16 (1aBAO-16-SOS) | --- | Observed effect** |
| | | Howsers Branch | | VAN-A08R_HOW01A08‡ | 5.10 | headwaters downstream to confluence with Little River | --- | 1aHOW003.68 | Impaired |
| | | Hungry Run | | VAN-A08R_HUN01A06 | 6.23 | headwaters downstream to confluence with Little River (rivermile 6.25) | 17 (1AHUN-17a-SOS) | --- | Observed effect** |
| | | Little River | | VAN-A08R_LIV02A06‡ | 2.48 | confluence with UT* downstream to confluence with Hungry Run (~1.5 rivermiles upstream from Route 50 near Aldie) | --- | 1aLIV006.92 | Impaired |
| | | | | VAN-A08R_LIV01A00 | 6.41 | confluence with Hungry Run (~1.5 rivermiles upstream from Route 50 near Aldie) downstream to confluence with Goose Creek | -- | 1aLIV001.70<br>1aLIV004.78<br>1aLIV004.79 | Fully Supporting (delisted 2010) |
| | | | | VAN-A08R_LIV02B10 | 4.36 | Confluence with Bartons Creek downstream to confluence with UT | -- | 1aLIV012.12 | Fully Supporting |
| | | | | VAN-A08R_LIV03A06 | 5.86 | confluence with UT* to Little River (~0.6 rivermile upstream from the Route 705 crossing) downstream to confluence with Bartons Creek | 12 (1aLIV-12-SOS) | --- | Observed effect** |
| | | | | | | | 23 (1aLIV-23-SOS) | --- | Observed effect** |
| Cromwells Run | Cromwells Run (020700080504) | Cromwells Run, UT* | PL09 | VAN-A05R_XMI01A12 | 4.11 | headwaters downstream to confluence with Cromwells Run | 14 (1aXMI-14-SOS) | --- | Observed effect** |
| | | Cromwells Run | | VAN-A05R_CRM02A06‡ | 6.76 | headwaters downstream to confluence with UT* XMI (at rivermile 4.61) | 15 (1aCRM-15A-SOS) | 1aCRM005.39 | Impaired |
| | | | | VAN-A05R_CRM01A00† | 3.81 | confluence with UT* to Cromwells Run (~0.78 rivermile downstream from Route 715) downstream to confluence with Rocky Creek (~0.4 rivermile downstream from Route 50) | --- | 1aCRM001.20 | Impaired |
| Upper Goose Creek | Goose Creek-Mitchell Branch (020700080501) | Goose Creek, UT* | PL06 | VAN-A04R_GOO01B00‡ | 4.31 | confluence with Kettle Run downstream to confluence with Bolling Branch | 5 (1aGOO-5-SOS) | 1aGOO044.36 | Impaired |
| | | | | VAN-A04R_XLW01A14‡ | 5.91 | headwaters downstream to the confluence with Goose Creek (at rivermile 45.10) | --- | 1aXLW000.75 | Impaired |
| | | Goose Creek | | VAN-A04R_GOO02A04 | 8.11 | headwaters downstream to confluence with Kettle Run | 6 (1aGOO-6-SOS) | --- | Observed effect** |
| | | | | | | | 7 (1aGOO-7-SOS) | --- | Observed effect** |

| IP Sub-watershed | HUC12 Name (Code) | Water Name | VAHU6 | 2014IR DEQ Assessment Unit ID | 2014IR Impairment Length (miles) | 2014IR Impairment Length Description | 2014IR Citizen Monitoring Station (DEQ Station Name) | 2014IR DEQ Listing Station | 2014IR: Recreation Use |
|---|---|---|---|---|---|---|---|---|---|
| Upper Goose Creek | Goose Creek-Crooked Run- Gap Run (0207000805) | Gap Run | PL07 | VAN-A04R_ GAR01A04[‡] | 3.21 | confluence with a UT* to Gap Run (just downstream from Route 712) downstream to confluence with Goose Creek | 8 (1aGAR-8-SOS) | 1aGAR002.24 | Impaired |
| | | Bolling Branch | PL07 | VAN-A04R_ BOL01A04[‡] | 3.64 | confluence with UT* to Bolling Branch (just upstream from Route 723) downstream to confluence with Goose Creek | 9 (1aBOL-9-SOS) 18 (1aBOL-18-SOS) | 1aBOL000.05 | Impaired |
| | | Crooked Run | | VAN-A04R_ CRA01A04[‡] | 1.85 | confluence with a UT* to Crooked Run (just downstream from Route 724) downstream to confluence with Goose Creek | --- | 1aCRA000.42 | Impaired |
| | | | | VAN-A04R_ CRA02A08 | 3.58 | confluence UT* to Crooked Run (rivermile 5.23) downstream to confluence with another UT* to Crooked Run (just downstream from Route 724) | 10 (1aCRA-10-SOS) | --- | Observed effect** |
| | | Goose Creek | | VAN-A04R_ GOO01A08 | 3.51 | confluence with Bolling Branch downstream to confluence with Gap Run | 4 (1aGOO-4-SOS) | --- | Observed effect** |
| | | Goose Creek | | VAN-A05R_ GOO02B06[‡] | 2.68 | confluence with UT* to Goose Creek (rivermile 35.28) downstream to confluence with Panther Skin Creek | 2 (1aGOO-2-SOS) | 1aGOO034.20 | Impaired |
| | | | | VAN-A05R_ GOO02C04 | 3.27 | confluence with Gap Run downstream to confluence with UT* to Goose Creek (rivermile 35.28) | 3 (1aGOO-3-SOS) | 1AGOO036.61 | Observed effect** |
| | | | | VAN-A05R_ GOO02C04 | 3.27 | confluence with Gap Run downstream to confluence with UT* to Goose Creek (rivermile 35.28) | 11 (1aGOO-11-SOS) | 1AGOO036.61 | Observed effect** |

[†]Assessment unit impaired at the time of TMDL development
[‡]Assessment unit impaired after TMDL development
*UT: unnamed tributary
**Insufficient information with an observed effect for bacteria

# Attachment B – First Public Meeting Comments and Responses

**Summary of Public Comments following the First Public Meeting (June 21, 2016) and Staff Responses**

Total Maximum Daily Load Implementation Plan Report for the Upper Goose Creek Watershed

August 21, 2017

Two written comments were received by DEQ following the June 21, 2016 first public meeting for the draft UGC TMDL IP. The substantive issues raised in these comments are presented below followed by STAFF's response. A copy of the full comments follows in **Attachment C**.

**Commenter 1:** Jeff Sledjeski, Upper Goose Creek watershed resident

**Comment 1 - Private Citizen**: *Mr. Sledjeski asked that the meeting record identify him as a watershed resident, and not a representative of his employer.*

**Staff Response**: This correction has been made.

**Comment 2 - Workgroups:** *Mr. Sledjeski recommended that there be a single workgroup for Agriculture and Residential interests, given the relatively few residential developments in the plan area.*

**Staff Response:** The initial Agricultural and Residential workgroup meetings were held in separate breakout groups immediately following the first public meeting (on June 16, 2016). The second/final workgroup meetings were held sequentially on the same date (Sept. 22, 2016), so that those attending could participate in all discussions.

**Comment 3 - Septic Systems**: *Mr. Sledjeski shared his view that the Chesapeake Bay Watershed Implementation Plan (WIP) call for a 50% reduction in nitrogen output from on-site septic systems can only be achieved through use of alternative onsite septic systems, and they should either be required by legislation or the WIP should be amended to admit the nitrogen reduction goal for septic cannot be achieved with use of conventional onsite septic systems.*

**Staff Response:** This comment has been shared with DEQ's Chesapeake Bay office, and will be considered during development of the Phase 3 Watershed Implementation Plan for the Bay TMDL over the next year. In addition, it is noted that this implementation plan is focused on addressing the bacteria impairments within the Upper Goose Creek watershed, and does not specifically address nutrient and other pollutants that are the focus of the Chesapeake Bay TMDL and WIP.

**Comment 4 - Agricultural Erosion, Sediments and Stormwater Controls**: *Mr. Sledjeski noted the high cost of residential property development stormwater, erosion and sediment controls, and observed that the amount of pollutant reductions they provide is trivial in comparison to the pollutant loadings contributed by agricultural activities. He commented that it is time to rethink the exemptions given to agriculture from erosion and sediments controls and stormwater management.*

**Staff Response**: The concern raised is not within the scope or purview of the TMDL IP development process, which is based on current statutes, policies and regulations. Legislative authorization would be needed to modify current regulatory requirements in the manner advocated.

**Comment 5 - Wire Mesh Fencing**: *Mr. Sledjeski commented that he has observed wire mesh fencing extending to the ground used in livestock exclusion fencing at the Piedmont Environmental Council's Gilbert's Corner demonstration farm, and in areas nearby his residence. He recommended that when used, a 1-2 foot gap be left above the ground to allow for movement of small animals.*

**Staff Response**: This comment has also been shared with a representative of the Piedmont Environmental Council. DEQ staff has discussed the use of wire mesh fencing with DCR, and understands it is generally considered undesirable for use in livestock exclusion fencing in areas prone to flooding, as many riparian buffer areas are (open wiring that doesn't trap debris is best used in such areas). Staff also raised this concern to the attention of the local NRCS and SWCD leads in the Upper Goose Creek plan area. They do not share the commenter's perspective that wire mesh fencing is commonly or increasingly used for livestock exclusion purposes, but appreciated this concern being raised to their attention. When wire mesh is used, the JMSWCD recommends use of short width woven wire fence to allow 10-12 inches for animals to pass under. The LSWCD observed that for sheep producers who have trouble with dogs and coyotes, keeping the fence very close to the ground is appropriate as a deterrent for predators and to keep lambs from getting under the fence.

**Comment 6 - Reduced Set-back Requirements**: *Mr. Sledjeski raised concern with a proposed decrease in setback requirements for livestock exclusion fencing.*

**Staff Response**: There is no proposed reduction in setback requirements. Existing cost-share program BMPs allow for both standard 35' setback fencing, at a 70% cost-share rate, and a reduced 15' setback, at a 50% cost-share rate. Standard fencing is preferred as it provides greater bacteria runoff reductions, but where a producer is not willing to decrease pasture size by the amount needed to create a 35' buffer, the lower cost-share option for a 15' buffer is preferable to allowing free access of livestock to streams.

**Comment 7 - Septic System Maintenance:** *Mr. Sledjeski observed that many septic system owners are not knowledgeable of and attentive to the operation and maintenance (O&M) requirements of their septic systems. He recommended that at the time of land transfers, owners should be required to sign a notarized statement acknowledging their sole responsibility for septic system O&M with the local health district. Health districts would keep these on file and send annual reminder postcards to all septic system owners.*

**Staff Response:** DEQ staff discussed this comment with Loudoun Water, as local governments have the authority to address this recommendation. Loudoun County has a very active septic system oversight program, and requires conventional septic system owners to certify that they have pumped out their system every five years. If certifications are not received, reminders are sent and fines may be assessed. Similarly, owners of alternative septic systems are required to certify they have had their system inspected annually, and Loudoun Water notifies and may fine owners who do not comply with this requirement. DEQ recommends the commenter contact the Virginia Department of Health, who has state-wide responsibility for public health and environmental issues associated with the use of septic systems.

**Comment 8 - Stormwater Management/Rain Barrels**: *Mr. Sledjeski commented that a 1000 square foot roof generates 600 gallons of stormwater in a 1" rainstorm, and that use of 55 gallon rain barrels is not a meaningful way to address residential stormwater, and more effective measures (rain harvesting and vegetative roofs) are too expensive for residential uses. He concluded that no discussion of stormwater was warranted in the UGC IP, since rural and agricultural areas are exempt from stormwater management requirements.*
**Staff Response:** Including a modest suite of stormwater management measures in the plan can raise awareness of the benefits of effectively managing stormwater runoff. The measures recommended in the plan represent less

than 0.5% of the total estimated cost of the UGC IP control measures. The potential benefits of increased environmental awareness and voluntary improvements in stormwater management are worth this modest investment.

**Comment 9 – Ban on Horses and Cattle from Floodplains:** *Mr. Sledjeski expressed concern that residential stormwater requirements are extremely expensive and provide small incremental benefits in pollutant reductions, while agricultural producers are the dominant source of nutrient and bacteria pollutants, yet have little or no pollutant reduction requirements. Mr. Sledjeski suggested that as a starting point, there should be a ban on all horses and cattle from floodplains, and that a setback should be required from perennial streams.*

**Staff Response:** The concern raised is not within the scope or purview of the TMDL IP development process, which is based on current statutes, policies and regulations. Changes of the nature recommended would require action by the legislature.

**Commenter #2:** Lynn Crump, Virginia Department of Conservation and Recreation

**Comment:** *Ms. Crump had been asked to comment on a report on a Goose Creek water withdrawal increase, since it is a Virginia Scenic River. She asked if there was a connection to the water withdrawal permit and the UGC IP process, and commented that the water quality chemical and biologic concerns would increase if the amount of water in the creek went down.*

**Staff Response:** The DEQ Office of Water Supply is aware of the concerns over the Goose Creek withdrawals and previously commented on this particular matter.

There is little, if any connection between the Upper Goose Creek Implementation Plan project area and the water withdrawal issue in Goose Creek, for the following reasons:

1. The Goose Creek IP project is located in different sub-watersheds from the water withdrawal. The farthest downstream point for the IP project is where the Little River enters the Goose Creek main stem, and the reservoir is ~6-7 miles downstream of their confluence.
2. Downstream withdrawals should not affect the IP project's projected flows or bacteria loads. The model used to simulate flow is sequential - flow starts upstream moving from headwaters to downstream. Withdrawal effects won't be seen until the point of withdrawal and downstream of that point and therefore do not change the results of modeled loads.

Should an Implementation Plan be developed for the lower portions of the Goose Creek watershed in the future, the matter of withdrawals of water from the overall system will be important to consider at that time.

# Attachment C – First Public Meeting Comment Letters

Jeff Siedjeski
6308 Herringdon Road
The Plains, VA 20198
July 4, 2016

Comments on Upper Goose Creek, Cromwells Run, and Little River Implementation Plan Public Meeting

I enjoyed participating in the meeting and have some comments to make on the discussions.

I would like to correct the record that has me listed as attending as a representative of Soil Tech, Inc. In this case I am attending as a resident of this Implementation Plan area. All my comments and opinions are my own and are not meant to be representative of my company.

Working Groups –

It is my opinion that there should be 1 Working Group for this IP area. There are relatively few traditional residential developments and those that do exist are newer and already comply with the Chesapeake Bay Act. The rest of the residents are living on land zoned Agricultural and have the same issues as the actual farmers. The pet waste issue is not a major issue here, unless you are talking about pet horses and cattle.

Septic Systems –

I was disappointed that there were no representatives from the Loudoun and Fauquier Dept. of Environmental Health. Their input would have been very helpful.

The Chesapeake Bay Watershed Implementation Plan calls for a 50% reduction in Nitrogen output from onsite septic systems. This can only be achieved thru use of Alternative Onsite Septic Systems. If legislation does not address this, then we either need to amend the WIP or just admit that the reduction will never be met as long as there are Conventional Onsite Septic Systems.

Agriculture and Stormwater Management –

Due to the Chesapeake Bay Preservation Act, there have been historic changes over the last couple of years in the enforcement of stormwater management in Virginia. The biggest has been the requirement for SWM for all individual small scale (1/2 acre of less) residential projects. This has added thousands of properties in suburban and urban areas. Based on my company's work, these requirements have added $20,000 - $40,000 or more to the cost of new home construction or any major remodeling project. This cost mitigates 2 – 3 ounces of phosphorus per year that is calculated to be produced for the residence. In Mr. Jennings excellent presentation, he notes that a single steer produces 60 lbs. of manure a day. Using the most conservative value I could find this results in 2 – 3 ounces of phosphorus per day being produced by a single steer or horse.

I doubt any residential property owner would be content to being forced to pay ten of thousands of dollars for their yearly discharge of a pollutant into the Bay while at the same time that an agricultural property owner not only does not have to pay anything but instead get rewarded with cost sharing and tax breaks for adding an equivalent amount of pollutant in a day per animal to the Bay.

My point is that I believe the time has come to rethink the exemptions given to agriculture from erosion and sediments controls and stormwater management or at least redefine what the practice of agriculture is. I am under no illusions that this would be simple; there are many well-funded special interest groups who would oppose any regulations that would impact their members. But at least the conversation can be started.

Jeff Sledjeski
6308 Herringdon Road
The Plains, VA 20198
October 15, 2016

Comments on Upper Goose Creek, Cromwells Run, and
Little River Implementation Plan Public Meeting

I am proud to be a Virginian. I love the entire Commonwealth, from the Appalachians to the Eastern Shore. I feel particularly blessed to be a resident of The Plains the past 25 years. I consider myself lucky to live a mile or so from Augustus McCrae's cattle ranch. I enjoy sharing the dirt road I live on with past and future Olympians on horseback. I have developed a deep love for the pageantry of foxhunting. I am tickled pink that I live in one of the few places on Earth where you can get your yard trashed by both Beagles and Hounds during a Hunt. I relish the amazing beef, lamb and pork that is raised here.

My work takes me back and forth on Route 50 everyday. From Lenah Road to Gilbert's Corner I see a half dozen new subdivisions being built before I get to the Hallowed Ground that runs along Rt.15. Even though new home construction is my business, the last thing I want to see is more cookie cutter McMansions with their sterile landscaping ruining the viewshed. But, because of my work, I am very cognizant of the actual toll in pollutants that is produced by this development that affects the Chesapeake Bay Watershed. With the tools provided by DEQ it is possible to measure these pollutants down to 1/100 of a pound. And sadly I have come to the conclusion that of all the different types of Land Uses (Residential, Commercial/Industrial, Agricultural) the worst for the waters of the Chesapeake is Bovine and Equine Livestock. I have not had the time to confirm this, but if you were to add up the total Nitrogen and Phosphorus for all the houses being built on this stretch of road, it would still be less than what is produced by a half dozen cows on the PEC property at Gilberts Corner. While the developers are forced to spend hundreds of thousands of dollars for sewage disposal and stormwater management to mitigate their pollutant load, the cattle owners are exempt from any E&S controls or required to avoid perennial streams. What fencing they do put up is reimbursed through cost sharing. And while the residences will be generating thousands of dollars in taxes, the agricultural land is for most part exempt.

This is the dilemma I see everyday. And I have come to the conclusion that the Implementation Plans being developed here and elsewhere around the Commonwealth are inadequate. Education, Cost Sharing and Viewshed Easements do not provide any real reduction in the Pollutants reaching the Chesapeake Bay, which I believe is the whole point of these meetings. We have lulled ourselves into thinking that as long as there are no new houses for people to move into we have somehow saved the Environment. I have a hard time justifying the tens of thousands of dollars that my clients spend on stormwater BMPs for their houses when the horse I see riding along the Little River is producing exponentially more pollutants into the water without any restrictions.

If we are going to take this project seriously we need to directly address the problem. It is time to recognize the harm created by Agriculture and not just ignore them. I have brought many of the poor land use decisions of my neighbors to the attention of various government agencies (John Marshall SWCD, Fauquier Building & Inspections, DCR, Dept. of Agriculture, VOF) and they all tell me the same thing, that everything they do is considered agricultural use and is exempt from any enforcement. When I try to bring it to my friends and neighbors attention, they tell me that their land use attorneys and the government all tell them that what they are doing is allowed and legal. That needs to stop. It is time for a paradigm shift in how livestock are dealt with. Just starting with a ban on all horses and cattle from floodplains would be a straightforward start. Requiring a setback from any perennial streams would also be highly beneficial. The huge amount of Nitrogen and Phosphorus removed from the Bay would be a lifesaver for the ecosystem. And even though no one has the funds to determine where all the fecal coliforms are coming from, I bet they would drop precipitously as well.

Of course, the practice of Foxhunting would be expressly exempt from all this. I know it's selfish of me, but I think the crabs and oysters can survive alongside the Hunt.

Jeff Sledjeski
6308 Herringdon Road
The Plains, VA 20198

Meeting Comments

PEC - Gilberts Corner

I have noticed both there and where I live an increasing use of Wire Mesh fencing for livestock exclusion. If possible, can there be a requirement to provide a minimum 1 - 2 foot separation between the bottom of the mesh and the ground? I am concerned that this practice is also excluding the free movement of all mammalian, reptilian and amphibious life. This is having the unintended consequence of destroying needed habitat and harming the ecosystem. My other issue is the reliance on using Round Up along the bottom of theses fences for landscaping purposes only. This practice is very obvious along Route 626 between Middleburg and The Plains.

I also have issues with the proposed decrease in setback requirement. Any onsite wastewater disposal system that pretreats waste and uses the natural onsite soils as a Receiving Environment is required to be at least 50 feet from any perennial stream. It seems logical that direct dispersal of waste to the ground surface with no pretreatment would require at least the same setback if not more.

Septic Systems

As I mentioned during the meeting, there are already numerous sources of information available to homeowners about their septic system. Based upon my decades of involvement in septic, the sad truth is that everyone is willfully ignorant of what happens to their waste once they flush. This is true for all systems, conventional and alternative. I believe the best thing is that any land transfer involving onsite septic should require the purchaser to sign a notarized statement that the care and maintenance of it is their sole financial responsibility. The local Health District would keep a copy on file and mail it to the Owner once a year as a reminder. Then they might take advantage of all the available educational resources.

Concentrating solely on overtly failing septic systems ignores another major issue with onsite septic. While repairing these systems keeps the effluent from flowing directly into streams, it ignores the fact that there are still coliforms, nitrogen and phosphorous reaching our aquifers. Many existing conventional septic systems (including mine) do not meet the required setbacks to water table that are part of our Code. The Health Department realizes this and instead of confronting the issue they try to mask it by coming up with "Voluntary Upgrades" that will allow basic mechanical repairs without fixing the underlying problem.

Stormwater Management

A good rule of thumb I use frequently at work is that 1 inch of rain on 1000 square feet of roof produces 600 gallons of stormwater runoff. Since the average rain barrel holds 55 gallon you can see why I was so dismissive of all the local SWCD reliance on them for stormwater management. And while DEQ's solution of Rainwater Harvesting and Vegetative Roofs make for great demonstration projects for large commercial and industrial project, they are useless for single family homes.

I do not see the need to even discuss Stormwater Management in our IP area since the regulations have been written to specifically exempt all rural and agricultural areas at the expense of the urban.

Thanks again for this opportunity to participate in this dialogue.

# Attachment D – Final Public Meeting Comments and Responses

**Summary of Public Comments and Staff Responses**

**Draft Total Maximum Daily Load Implementation Plan Report for the Upper Goose Creek Watershed**

August 21, 2017

Two written comments were received by DEQ during the June 21-July 21, 2017 public comment period for the draft UGC IP. The substantive issues raised in these comments are presented below followed by DEQ's response. A copy of the full comments can be found in **Attachment E**.

**Commenter #1**: Jeff Sledjeski, Upper Goose Creek watershed resident

**Summary:** Mr. Sledjeski provided brief final comments, which referenced and appended earlier comments he had submitted (on July 4 and October 15, 2016) following the initial Public Meeting and Workgroup meetings. His aggregate comments touched on many aspects of water pollution control, with a focus on the disparity between rigorous and costly residential property stormwater regulatory controls and the broad exemption of bovine and equine agriculture from regulatory pollution controls. Those included in the final comment letter are discussed below, and topics only raised in his earlier letters are addressed in **Attachment B.**

**Comment 1**: *Mr. Sledjeski expressed concern that many stakeholders are under the belief that since bovine and equine livestock operations are specifically exempted from Virginia's Stormwater and Erosion control regulations, there is no need to be concerned about their waste management.*

**DEQ Response**: Addressing the runoff of bacteria pollutants from bovine livestock is at the heart of the UGC IP, and significant attention is given to bacteria from equine operations as well. As the commenter has correctly observed, bovine and equine livestock agricultural activities are not subject to Virginia's Stormwater and Erosion control regulations (which focus on land development and construction), and their waste management largely occurs through voluntary programs. This Implementation Plan has been developed to identify the scope and type of voluntary measures that can reduce bacteria in streams from nonregulated sources within the plan area to achieve Virginia's recreational use water quality standard.

In addition to the voluntary measures that are the subject of this plan, the Virginia Pollution Abatement (VPA) Regulation and General Permit for Animal Feeding Operations and Animal Waste Management (9VAC25-192-20) governs the pollutant management activities at animal feeding operations having 300 or more animal units utilizing a liquid manure collection and storage system not covered by a VPDES permit and animal waste utilized or stored by animal waste end-users. More specific information about this general permit can be found at: http://law.lis.virginia.gov/admincode/title9/agency25/chapter192/

**Comment 2**: *Mr. Sledjeski expressed concern that Virginia's TMDL IP development process is overly standardized and does not effectively engage watershed residents. He shared his perception that different IPs across the Commonwealth are too similar in terms of their substance, and that participation in meetings was dominated by special interest groups and government agency staff.*

**DEQ Response**: Virginia develops TMDL IPs to both satisfy eligibility requirements for CWA Section 319 nonpoint source grant funding, and to guide voluntary and collaborative efforts under local leadership to reduce pollutants from nonregulated sources that impair water quality. Meeting the requirements for Section 319 funding is done by addressing the nine elements of EPA's watershed planning guidelines, and results in plans across the Commonwealth having a very similar structure and content. Virginia also has standard expectations for public engagement in IP development, holding Initial and Final Public Meetings, and convening work groups and an overall SC to provide input, make recommendations, and provide feedback to DEQ in the course of plan development. DEQ broadly publicizes these opportunities for engagement in the planning process, using local press and radio, local organization websites, email distribution lists and more.

**Comment 3**: *Mr. Sledjeski expressed concern that livestock exclusion fencing could not realistically achieve a 75% reduction in bacteria reaching streams from pasture lands.*

**DEQ Response**: As represented in **Table 5-2**, livestock exclusion fencing is estimated to eliminate (100% reduction) the **direct** deposition of bacteria into streams by livestock and reduce the overland movement of bacteria by 50% from pastures into streams. These bacteria reduction efficiency estimates are accepted average values by DCR. The 50% bacteria reduction from pastures is a composite estimate based on a comprehensive search of peer-reviewed academic studies of reductions in bacteria transported to streams when exclusion fencing using a 35 foot buffer is in place. Actual reductions vary by soil type, pasture conditions, and the width and vegetative cover in the stream buffer.

**Comment 4:** *Mr. Sledjeski recommended an expansion of Virginia's Nutrient Credit Program to provide double or triple credit for removing cattle and horses from a watershed, or credit for removing horse trails and paddocks from floodplains and along streams. He said this would produce more pollutant reductions than the approaches taken in TMDL implementation plans.*

**DEQ Response:** The concern raised is not within the scope or purview of the TMDL IP development process. The commenter may obtain more information, including contacting information, on the Nutrient Credit/Trading program at:
http://www.deq.virginia.gov/Programs/Water/PermittingCompliance/PollutionDischargeElimination/NutrientTrading.aspx

**Commenter #2**: Gem Bingol, Piedmont Environmental Council

**Summary**: Ms. Bingol's comments explained the long-standing role that PEC has played in promoting conservation of rural lands, educating landowners about agricultural BMPs, and securing funding to support residential BMPs. General comments acknowledged the significant pollution that has resulted over generations from the agricultural sector, while noting concern for the more permanent impacts developed land with impervious surfaces can have on streams and watersheds. The comments concluded with strong support for the measures called for in the draft UGC IP, including the key role of education for watershed residents, and committed to partnering with others to attract funding for implementation of the plan. A few more specific comments follow:

**Comment #1:** *The Northern Virginia Regional Commission's 2012 report "Conservation Corridor Planning" includes a priority corridor for conservation ("Journey Through Hallowed Ground") that lies partly within the Upper Goose Creek plan area. This report should be mentioned in the IP in light of overlapping goals.*

**DEQ Response:** In response to your comment, a summary of the "Conservation Corridor Planning" report has been added to the UGC IP section "Integration with Other Planning Initiatives" (**Section 11.5**).

**Comment #2**: *A typographical error was identified, "daily" should be "dairy" on p. 5 of the draft IP.*
**DEQ Response**: This error has been fixed.

**Comment #3:** *In the context of the draft plan recommendations for three regional-scale equine manure composting facilities, the commenter shared a U.S. Composting Council position paper from 2013 on persistent herbicides. The issue discussed in this paper relates to four herbicides sold under 20 trade names that were identified to have toxic effects on plant growth if present in compost. The commenter wished to raise DEQ's awareness of this issue for consideration relative to the plan's recommendations for equine manure composting.*

**DEQ Response:** This matter is highly germane to the UGC IP. We have begun follow up discussions within DEQ and with other Virginia agencies that may have an interest in this matter – including VDH; DCR; and Agriculture and Consumer Services (VACS). We also will note this issue has been raised to DEQ's attention in **Section 5.1.3** ("Equine Management") and **Section 5.3.1** ("Education and Outreach: Horse Pasture Management Education"). Additionally, DEQ will ensure this issue is addressed in any future grants awarded to provide cost-share funding for manure composting facilities.

# Attachment E – Final Public Meeting Comment Letters

Piedmont Environmental Council

*Safeguarding the landscape, communities and heritage of Virginia's Piedmont by involving citizens in related public policy and land conservation*

July 21, 22017

David Evans
Nonpoint Source Coordinator
Water Quality Planning Program
Northern Regional Office
Department of Environmental Quality
13901 Crown Court
Woodbridge, Virginia 22193

Dear Mr. Evans:

We appreciate having had the opportunity to participate in the Stakeholder Committee for the Upper Goose Creek, Cromwell's Run, Little River TMDL Implementation Plan (IP). The Piedmont Environmental Council (PEC) has had a long-standing commitment to maintaining and improving the health of Goose Creek and its tributaries in Fauquier and Loudoun counties. PEC has taken a multi-faceted approach to watershed protection, working—for example-- to promote permanent conservation of rural land that limits impervious surfaces; educating landowners about and facilitating implementation of agricultural best management practices (BMPs), and securing funding to assist homeowner associations implement residential BMPs. These approaches address the specific impacts from pollutants such as the bacterial pollution that is the target of this Implementation Plan, but also seek to address more comprehensively the overall health of the watershed.

The IP indicates that agricultural practices are a contributor to impaired water quality in the Upper Goose Creek watershed, a finding that is similar in impaired streams across the nation. None of these problems are the result of a single farmer or even one generation of farmers but come from hundreds of years of accumulated impacts.

Residential development has also had a negative impact on streams and watersheds. While more limited in connection with this IP, when farmland is converted to residential uses, changes to the hydrology, vegetative cover and impervious cover create a host of additional impacts. One of our goals has been to minimize the sprawl that creates these conditions. While it is challenging and time-consuming to reverse the accumulated impacts of traditional agricultural practices, once land is developed, the challenges are even higher, and unlikely to be reversed.

We support the measures in this IP to offset all of these impacts in a holistic way. As such, PEC supports working with the entire community, not just with farmers, to communicate how local actions have cascading impacts on nearby streams, to communities downstream, and finally all the way to the Chesapeake Bay.

The focus on stewardship and shared ownership is critical for the short and long term and we commend that approach. Keeping the land rural is critical to improving and maintaining its water quality. Everyone in the community needs to know and appreciate this basic fact and help to support that goal as no single sector of the community can bear that burden alone. The role of education is key, and as a partner, we understand that we must help in that effort in order to achieve the clean water goal.

Main Office: PO Box 460 Warrenton, VA 20188 • T: 540.347.2334 • F: 540.349.9003 • www.pecva.org

Specific to this IP are several points of note:

- Significant reductions in bacterial pollution from 100 miles of livestock exclusion BMPS installed to date, but bacterial exceedances still persist and it will take all of the measures in combination to achieve the water quality standards
    - Soil and Water Conservation Districts have been major force in the progress to date
        - If 100% of fencing BMPs are complete, it only contributes to the overall pollution reduction by 20%.
        - Going forward in Loudoun there are FEMA-based stumbling blocks to installing fencing and planting trees in the 100 year floodplain, practices that are critical to reestablishing robust forested riparian buffers. The FEMA barriers to implementing these practices must be resolved and eliminated
        - Riparian buffer plantings play an important role in decreasing pasture runoff.
            - Riparian buffer plantings will help accomplish multiple goals related to habitat and wildlife corridors, and county green infrastructure goals as well as runoff reduction.
    - Septic system inspection programs have been successful in reducing the number of failing septic systems
- Pasture- associated runoff accounts for 79% of the needed reductions to meet the IP goals
    - This requires a significant amount of education (and funding) to help farmers understand, implement and reap the economic benefits of alternative pasture management practices
        - PEC is ready to partner to help accomplish this goal.
- An increase in equine population has warranted a focus on manure management and composting systems
    - One issue of note is the use of new and persistent chemicals that are now creating long-term problems for the reuse of compost. These chemicals persist through the composting process and have the ability to destroy the positive benefits of the compost for reuse.
        - The chemicals include Clopyralid, Aminopyralid, Aminocyclopyrachlor and Picloram (fact sheet attached)
        - This potential problem should be noted and a plan to avoid it should be incorporated into plans for community composting facilities.
- Increased human population has brought significant (but more limited in scope) development-related impacts
    - A 12% increase in human population has resulted in an increase in impervious cover by 87% and developed pervious vegetative cover by 362% or 5,264 acres as of 2011.
        - On the developed lands, it would be helpful to include the percentage of the overall residential development impacts that comes from septic systems, from stormwater runoff and pet waste, impervious cover and pervious cover.
        - Further, it would be very helpful to have figures or references that state the relative cost of implementing residential BMPs at the time of development versus through retrofits to help support appropriate county regulations.
        - Landowner education can help to reverse negative property management impacts and increase the water quality benefits of pervious developed areas.
        - Stormwater ponds associated with development generally have inadequate buffers which have contributed to an increase in the goose population and increased pollution loads. Such BMPs would be important to include in the plan.
    - This points to the critical importance of maintaining the watershed in minimal development to protect long-term water quality and why PEC is committed to land conservation in this watershed.
        - Note that when landowners put conservation easements on their land, these are permanent deed restrictions (see pg. 10)

Public participation in the IP development has been very limited. To be successful, the level of awareness, education and involvement must be much higher.

PEC is committed to the goals of the IP. Using PEC's Roundabout Meadows property at Gilberts Corner as a demonstration site, PEC is and will continue to educate students, landowners, and the general public about the water quality, wildlife habitat, and agricultural productivity benefits of implementing BMPs and a suite of other rural land management practices.

Unfortunately, the cost of clean-up is substantial, and success won't come without the needed funding. PEC is also committed to partnering to attract funding to support the IP, and to keep the watershed healthy and rural in the long-term.

A couple of minor notes on the draft IP:

- In January 2012, the Northern Virginia Regional Commission published a report entitled "Conservation Corridor Planning." The report appears to include some of the Goose Creek watershed areas subject to the IP. Note page 12, Corridor D in the report. Mention of this plan should be included in the IP due to overlapping goals.

- Edit on page 18, 2nd paragraph, the daily cow population should be dairy cow

Thank you for the opportunity to provide input.

Sincerely,

Gem Bingol

Gem Bingol
Field staff for Loudoun & Clarke Counties

Jeff Sledjeski
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July 20, 2017

Comments on Upper Goose Creek, Cromwells Run, and
Little River Implementation Plan Public Meeting

To keep these comments as brief as possible, I am attaching my previous comments from 7/4/2016 and 10/15/2016. These comments cover most of the concerns I had then that are still the same today with the latest draft IP. This process has been a great learning experience for me and I appreciate the work done by the agencies in charge.

The presentations and discussions have been revelatory for me. My decades of work in the private sector analyzing soils for onsite wastewater disposal systems and stormwater management has helped me reach an unfortunate conclusion. Of all the possible land uses adjacent to the waters of the Chesapeake Bay (Residential, Commercial, Industrial, Agricultural, etc...) the worst possible use is Bovine and Equine Livestock. Not only are they enormous producers of the pollutants we are most concerned about, they are also the least regulated. As I pointed out in earlier comments the hundreds of houses being constructed on Route 50 between Lenah Road and Route 15 combined will result in less pollutants flowing into the Chesapeake Bay than the PEC's herd of cattle at Gilbert's Corner.

Unfortunately, the stakeholders seem to be under the belief that since Bovine and Equine Livestock are specifically exempted from all Stormwater Management and Erosion controls regulations there is no need to be concerned about waste management. One telling moment for me was during a discussion of this issue, a representative of one of the local environmental commented that they "chain harrow their horse pasture and let God take care of it". This is a huge mistake. This practice only helps move the effluent into the waterways quicker during rain events. God has not had direct interest in the Chesapeake Bay since his little boo-boo in celestial mechanics 35 million years ago that created the Bay.

These IP meetings throughout the Commonwealth are less about protecting the Bay and more about meeting the criteria of the TMDL IP Guidance Manual. This partially explains every IP Plan I have read is almost exactly the same with the exceptions of photos of the local flora and fauna. The meetings have little participation by local residents; instead are controlled by special interest groups whose main concern is preventing any regulations that might affect their members along with government officials whose attendance is mandatory.

The belief that Livestock Exclusion fencing will decrease pollutants by 75% is highly misleading. All research I have reviewed is based upon treated livestock waste being applied to cropland following explicit procedures for biosolids. This is inapplicable to untreated livestock waste randomly deposited next to a wire fence. If this were the case, then there should not be any concern about failed septic systems as long as they are more than 35 feet from a stream. And yet the main concern of these IP meetings is to find new funding sources to pay farmers to do what they should be doing in the first place.

The solution will not come from these meetings. The solution will come from expansion of the Nutrient Credit Program. By doubling or tripling the amount of credits given for removing Cattle and Horses from the Watershed as well as including more ways to earn credits (i.e. removing horse trails and paddocks from floodplains and along streams) there should be an actual decrease in most types of pollutants. This expansion will be necessary to meet the demands for phosphorous removal for Urban single family homes that are impossible to meet using DEQ's BMP Clearinghouse.

In conclusion, I believe we should all heed the words of the great 20th century visionary Marcus Garvey.

*Emancipate yourselves from mental slavery, none but ourselves can free our minds!*