SPOTLIGHT ON THE MATTAPONI RIVER WATERSHED

A TMDL Implementation Plan to Restore Water Quality

Photograph by David Nunnally, 2018

Virginia Department of Environmental Quality
March 2020

Overview

The Virginia Department of Environmental Quality (DEQ) has studied the Mattaponi River **watershed** and identified several stream segments with excessive levels of bacteria originating largely from agricultural, residential septic, and developed land sources. While bacteria occur naturally in the environment, larger amounts are found in local streams due to human activities. In 2016 DEQ developed a report to identify the amount of bacteria reductions needed to return the streams to a healthy condition entitled "Bacteria Total Maximum Daily Load (TMDL) Development for the Mattaponi River Watershed Located in Orange, Spotsylvania, Caroline, King William, and King and Queen Counties, Virginia."

Watershed: An area of land that drains to a common point or body of water.

DEQ has now developed a TMDL Implementation Plan (IP) to address bacteria in the Mattaponi River Watershed. The IP identifies specific actions needed throughout the watershed to rehabilitate the health of area waterways. This work was done with technical support from Streams Tech, Inc. and insights from members of the local community, including soil and water conservation district and county staff.

Protecting Water Quality

DEQ monitors Virginia's waterways to determine if they meet the water quality goals of being fishable, swimmable, and supportive of healthy aquatic life. The rivers and streams monitored and found by DEQ to exceed water quality standards (WQS) are identified as **impaired.** These impaired waters are then listed on Virginia's impaired waters list, which is reported by DEQ to the U.S. Environmental Protection Agency (EPA) every 2 years. According to Section 303(d) of the Clean Water Act (CWA), total maximum daily loads (TMDLs) must be developed for all waterbodies on the impaired waters list.

Impaired Water: A section of a waterway that does not meet water quality standards based upon monitoring data.

Total
Maximum
Daily
Load

A TMDL is a budget for pollutants in a stream, which determines the maximum amount of a pollutant that a stream can receive, while still allowing the stream to maintain water quality standards. Developing the TMDL is the first step in the process to rehabilitating the health of a waterway. A TMDL study includes analysis of sources of pollutants and development of the TMDL budget.

The TMDL program consists of a three-step path to attain WQS for impaired waters. The first step, the TMDL itself, identifies how much pollutant discharges must be reduced to meet water quality standards. The second step is to develop a TMDL IP, which identifies best management practices that can achieve the **pollutant** reduction goals for unpermitted, nonpoint sources through voluntary actions. Watershed stakeholders provide input to DEQ and participate in the development of TMDLs and TMDL implementation plans, in addition to other cooperating agencies, such as soil and water conservation districts, counties, and the Virginia Departments of Forestry, Health, and Conservation and Recreation, to name a few.

Pollutant: A substance introduced into the environment by human activity that has an undesirable effect.

The final step is to implement the TMDL through 1) issuing permits for point sources subject to permit requirements and 2) carrying out recommendations outlined in the TMDL implementation plan, for unpermitted, nonpoint sources. DEQ and its partners conduct follow-up monitoring of the water quality to determine if water quality standards are being attained.

The plan entitled "A TMDL Implementation Plan (IP) to address bacteria in the Mattaponi River Watershed" dated March 2020, encompasses the second step identified above. More information on TMDL IPs and the Section 319 grant program that promotes their implementation can be found in Section 2 of the full report (the "technical report").

Watershed Characteristics

The Mattaponi River and its tributaries are part of the York River basin. The York basin is comprised of York River, which is just 30 miles in length, and its two major tributaries, the Pamunkey and the Mattaponi Rivers. The Mattaponi River watershed addressed in this plan covers 406,332 acres (635 square miles) lying between Richmond and Fredericksburg, Virginia, as shown in **Figure 1**.

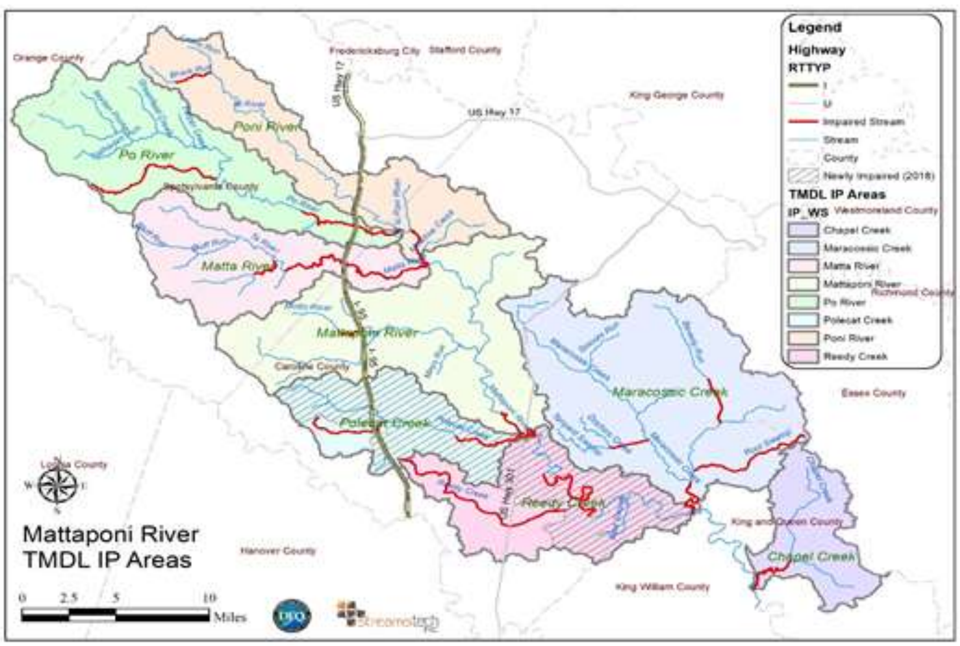


Figure 1: Impaired segments and IP Watersheds of the Mattaponi River

The majority of the watershed lies within Caroline and Spotsylvania Counties. Much of the watershed is rural in character with forest (65%) and agricultural (17%) land uses predominant, however more dense development is present in the northwestern portion of the watershed in Spotsylvania County and adjacent to Interstate 95 in Caroline County. While population growth in Spotsylvania County has been rapid, with a 7.6 percent increase to 135,100 people from 2010-2017, most of the IP watershed is much less developed. Caroline County, which is similar in size to Spotsylvania, has a population of under 30,000 and King and Queen County's population is under 10,000. The total population of the Mattaponi IP watershed is about 55,000 and the population density of 87 people per square mile is less than half the average population density in Virginia.

Additional information on watershed characteristics is provided in the technical report, Section 1.

An Impaired Stream

For freshwater streams, a high level of **E.coli** bacteria is the criterion DEQ uses to identify impairments for the recreational use of surface water. When too much E.coli bacteria is present in streams, individuals who use the stream for recreational purposes like swimming and boating may accidentally ingest or expose cuts and scrapes on their body to contaminated water. Common illnesses that result from these exposures include nausea and vomiting, abdominal cramping or pain, mild to severe cases of diarrhea, and skin infections. Action to restore the quality of impaired streams is important to protect public health.

E. coli: Escherichia (E.) coli are bacteria that normally live in the intestines of both humans and animals. While most are harmless, some cause serious illnesses. People may be infected by ingesting water contaminated by sewage, or from stormwater runoff from agricultural or urban lands.

Water samples were collected over many years at numerous locations in the Mattaponi River watershed to assess whether the Virginia water quality criterion for E.coli was exceeded. The 2016 TMDL report documented that E.coli levels at 15 monitoring locations had exceeded the maximum assessment criterion of 235 colony forming units (cfu) per 100 milliliters (100 mL) for more than 10.5 percent of the samples collected within a six year assessment period.

As a result of the DEQ sampling and analysis, portions of the streams within 14 subsections of the Mattaponi watershed were identified as impaired for recreational use on Virginia's Integrated Report and TMDLs were developed for these 14 watersheds in the 2016 report. Since development of the 2016 TMDL, additional stream segments were identified in recent Integrated Reports as impaired due to excessive E.coli levels, and those segments are also addressed in this IP report. Bacteria reduction needs for the newly impaired areas were calculated using the methodology employed for the 2016 TMDL report. A full listing of the impaired streams that are addressed in this plan is shown in **Table 1** below.

Table 1. Mattaponi IP areas, impaired streams and their location

IP Area	Stream Name	Ecoregion	County(ies) the IP Area falls within
Poni River	Brock Run	Piedmont	Spotsylvania
Poni River	Poni River	Piedmont and Southeastern Plains	Spotsylvania/Caroline
Po River	Glady Run	Piedmont	Orange/Spotsylvania
Po River	Po River	Piedmont and Southeastern Plains	Spotsylvania/Caroline
Matta River	Mat River	Piedmont	Spotsylvania
Matta River	Matta River	Piedmont and Southeastern Plains	Caroline/Spotsylvania
Mattaponi River	Motto River	Piedmont	Caroline/Spotsylvania
Mattaponi River	Mattaponi River	Piedmont and Southeastern Plains	Caroline
Polecat Creek	Polecat Creek	Piedmont and Southeastern Plains	Caroline
Reedy Creek	Reedy Creek	Southeastern Plains	Caroline
Reedy Creek	Mattaponi River	Southeastern Plains	Caroline/King William
Maracossic Creek	Beverly Run	Southeastern Plains	Caroline/King and Queen
Maracossic Creek	Doctors Creek	Southeastern Plains	Caroline
Maracossic Creek	Root Swamp	Southeastern Plains	King and Queen
Maracossic Creek	Maracossic Creek	Southeastern Plains	Caroline/King and Queen
Chapel Creek	Chapel Creek	Southeastern Plains	King and Queen

Considering Approaches to Implement the TMDL

A TMDL is the first step toward taking action to restore water quality by identifying the level of bacteria reductions needed to meet recreational use water quality standards. TMDL reports allocate pollutant reductions between point and nonpoint sources. The "Wasteload Allocation" (WLA) portion of the TMDL comprises point source discharges which are regulated and the WLA part of the TMDL is implemented through the permitting framework. The "Load Allocation" (LA) portion of the TMDL equation identifies pollutant reductions that are needed from the nonpoint sources of the watershed. In the case of the Mattaponi Bacteria TMDL, more than 99.9 percent of the bacteria reductions needed come from nonpoint sources, and must be addressed through voluntary actions guided by an **Implementation Plan.**

Implementation Plan: Identifies specific, voluntary steps to meet pollutant reduction goals for nonpoint

The IP report takes the next step toward water quality restoration, by involving local citizens and land use/environmental professionals to develop a plan that identifies specific strategies to reduce nonpoint sources of bacteria so less will enter the area's streams. The management measures (also called "best management practices", or BMPs) that are recommended in this plan are designed to restore water quality. DEQ uses water quality modeling techniques to determine a specific set of recommended BMPs for each IP area that can reduce bacteria levels to those safe for recreational uses. Given the amount of work included in a typical IP, they are often planned for a 10-15 year implementation timeline. More information on the technical analysis that supported identification of the type and amount of BMPs recommended in the IP may be found in Section 3 of the technical report.

Identifying Bacteria Allocations for Nonpoint Sources

Identifying all nonpoint sources of the pollutant is the starting point of Implementation Plan development. Once the type of nonpoint sources contributing the pollutant are known, actions and best practices can be chosen that are best suited to target those sources.

The distribution of the nonpoint sources of bacteria by source category is shown below in **Table 2**. A standard practice in Virginia TMDLs is to target a 100 percent reduction of bacteria from failing septic systems and direct deposition (defecation) by cattle into streams. The remaining bacteria sources, which are all transported to streams via stormwater runoff, have a variable reduction rate determined by water quality modeling. The bacteria reductions identified for this IP that are needed from cropland, pasture and developed lands to achieve recreational use water quality standards vary by IP watershed and range from a low of 17 percent to a high of 62 percent of their existing bacteria loads. More information on the required nonpoint source reductions is found in Section 5 of the technical report.

Table 2: Reductions required to meet delisting goals by bacteria source.

TMDL IP Area	Load Reductions (%)				
	Bacteria Sources				
	Cropland	Pasture	Developed Land (without failing septic systems)	Failing Septic Systems	Direct Deposition from Cattle
Chapel Creek	24%	24%	24%	100%	100%
Maracossic Creek	27%	28%	25%	100%	100%
Matta River	46%	46%	46%	100%	100%
Mattaponi River	29%	29%	29%	100%	100%
Po River	61%	57%	62%	100%	100%
Polecat Creek	27%	27%	27%	100%	100%
Poni River	36%	36%	36%	100%	100%
Reedy Creek	18%	18%	18%	100%	100%

Selecting Practices to Minimize Bacteria from Nonpoint Sources

Once the nonpoint sources of bacteria are identified and their loads are allocated among the various land use types, specific best practices aimed at reducing bacteria can be proposed. The best practices recommended in the plan are shown by water quality modeling to achieve water quality goals for the watershed. From experience in similar watersheds, DEQ knows that the effort to reduce bacteria in the watershed will take time and that meeting WQS is a long-term goal. The plan recommends prioritizing best practices based upon those that address the largest source of bacteria. The 2016 TMDL report identified that bacteria from pasture land is the largest source of bacteria in area streams. For the Mattaponi River watershed, streamside fencing to keep cattle out of streams, riparian buffer areas along streams, and improved pasture management are therefore top priorities.

Best practice recommendations are grouped into two phases for implementation. The measures concentrated in Phase I are those that provide the greatest bacteria reductions relative to the cost of the practice. Measures with greater representation in Phase II are additional measures required achieve water quality standards during low flow conditions, and those that have higher relative costs for their bacteria reductions. Together the measures proposed for implementation in Phases I and II are sufficient to achieve the bacteria reductions needed to fully achieve recreational use water quality standards.

Agricultural Best Practices

A comprehensive suite of agricultural best practices were identified and are categorized as Livestock Exclusion, Pasture and Cropland improvements, and Equine (Horse) BMPs. Restricting cattle access to streams eliminates direct deposition of bacteria into area streams,

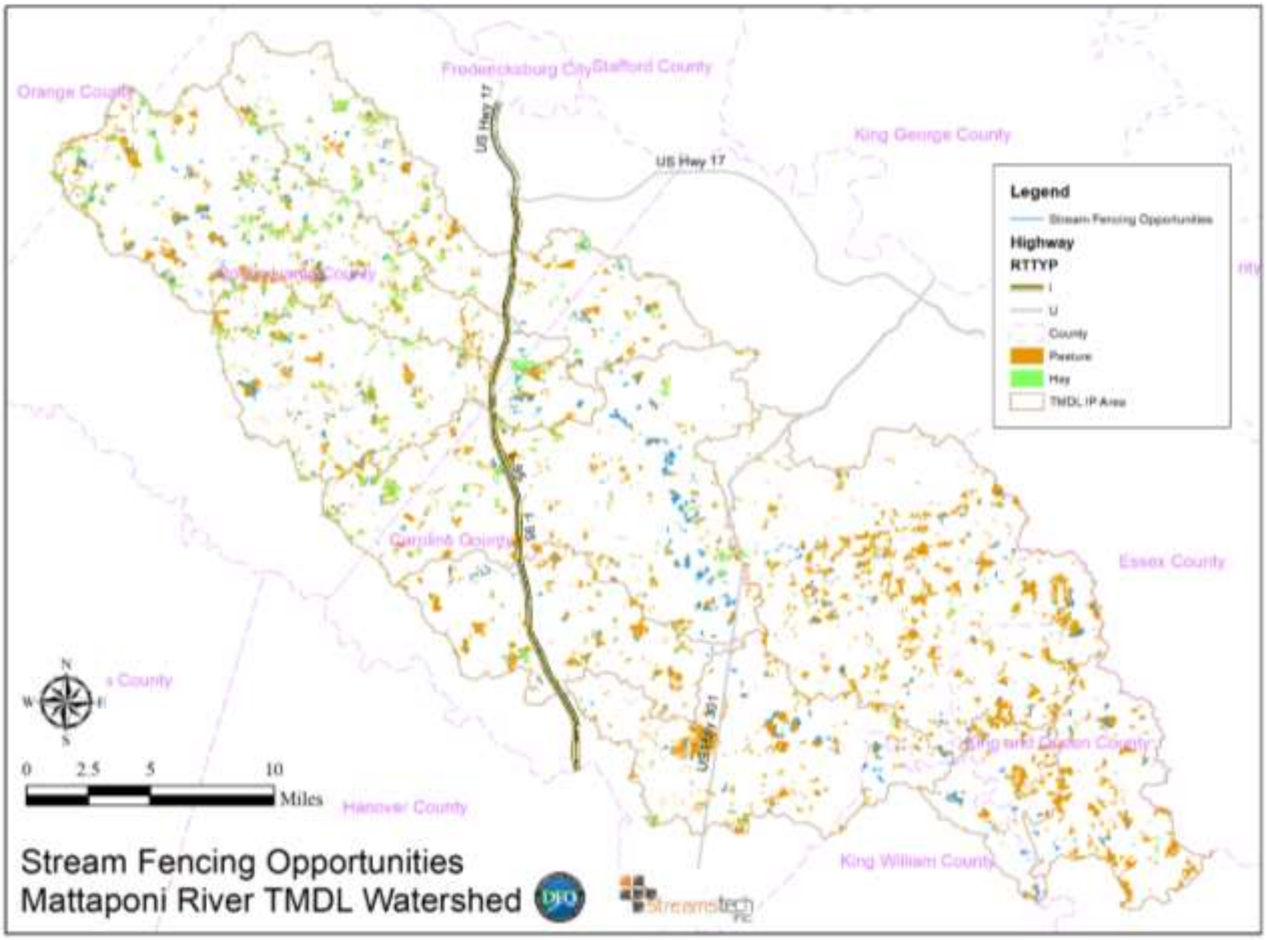
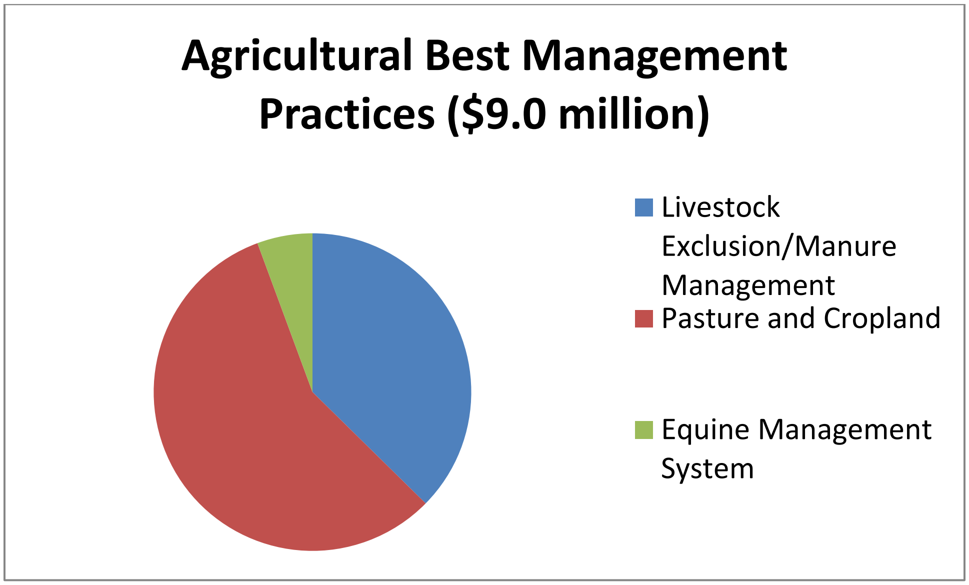


Figure 2: Location of Pasture and Hay lands within Mattaponi River Watershed

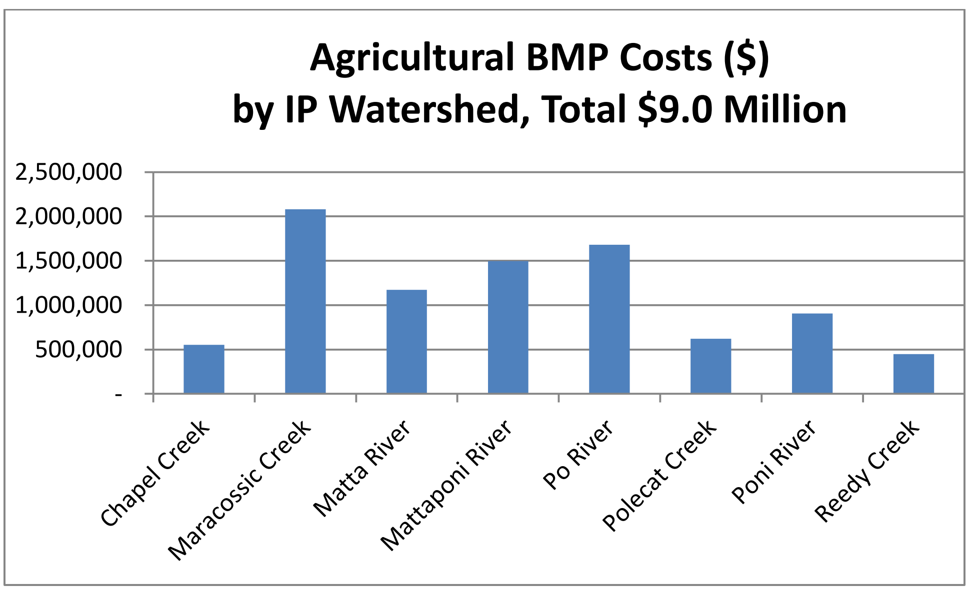
creates a riparian buffer zone between the fence and the stream, and reduces the amount of bacteria that reaches the stream through stormwater runoff from pastures. **Figure 2** above shows the location of pasture and hay fields in relation to local streams, which helps to identify the most likely areas for additional livestock exclusion fencing.

Given there is a sizable horse population in the IP area, Equine BMPs are proposed to improve manure management at horse farms and support small farm pasture improvements to reduce bacteria transported in stormwater runoff. Equine BMPs include manure composting systems and small farm grazing system improvements. Given the modest amount of these measures that are recommended, all are shown in Phase I of the IP. Overall, however, the agricultural best practices focus on livestock exclusion and land based agricultural practices because they produce the most significant and cost-effective bacteria reductions.

Pasture and cropland improvements reduce bacteria transport to streams via runoff by improving the ability of the land to infiltrate rainfall and reduce the amount of stormwater runoff that carries bacteria into area streams. Measures to improve pasture and cropland in ways that reduce bacteria runoff include cover crops, no till/conservation tillage, pasture improvement systems, and agricultural stormwater controls. The piechart below shows the relative cost of the recommended fencing, pasture and cropland, and equine best management practices for the entire IP project area, with pasture/cropland BMPs dominant.



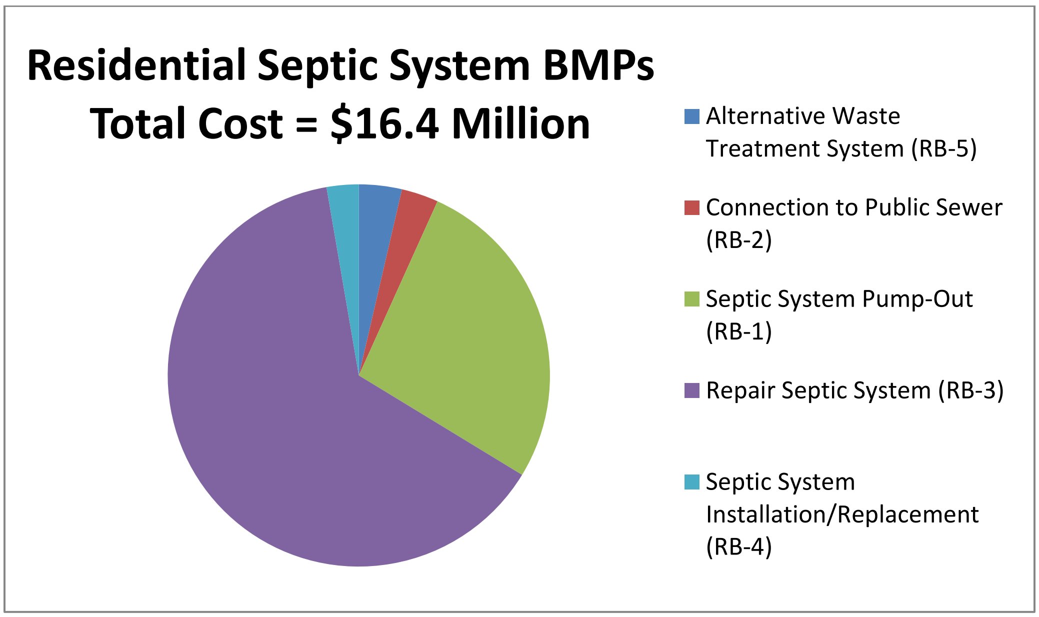
Additional information on agricultural best practices can be found in Section 5 and the detailed BMP recommendations are shown in the Tables in Section 5.1 of the technical report. The barchart below shows the cost of recommended Agricultural BMPs for the eight IP watersheds.



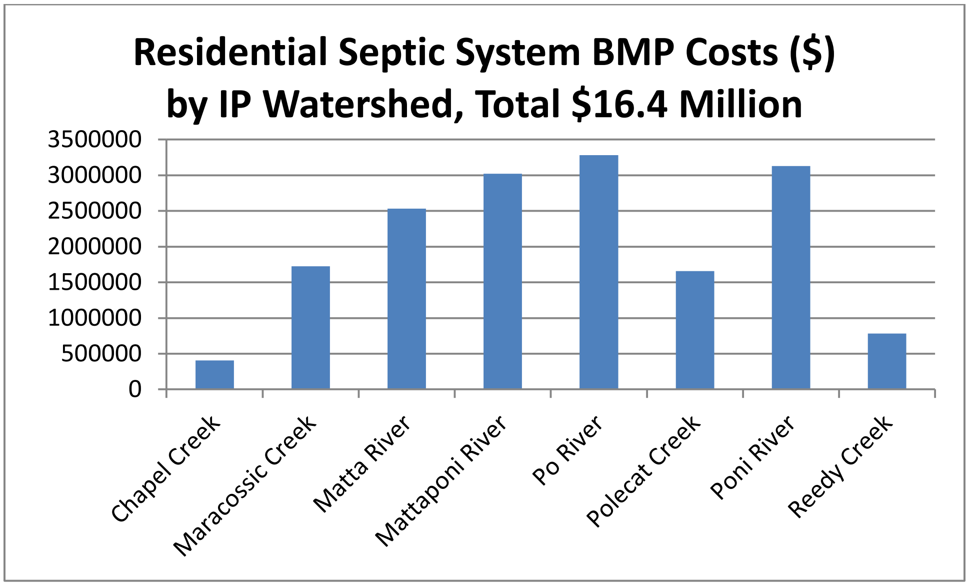
Residential Septic System Best Practices

Poorly maintained or failing septic systems can contribute significantly to bacteria contamination of surface waters, and the absence of sewage treatment (as in the case of "straight pipe" releases to streams) is even more serious. This plan was especially well informed of the number, age, and geographic distribution of septic systems across the IP watershed as a result of a detailed analysis performed by Regional Decision Systems, L.L.C. in 2018 to support preparation of the George Washington Regional Commission's input to Virginia's Chesapeake Bay TMDL Watershed Implementation Plan (WIP) III.

Using the 2018 analysis, the Mattaponi IP precisely identifies the number of septic systems within each IP watershed, and recommends a combination of septic system maintenance, repair, and system replacement BMPs, along with a modest number of potential sewer system hookups in watersheds served by existing wastewater treatment facilities. The piechart below shows the share of each of the recommended residential septic BMPs, and their cost.

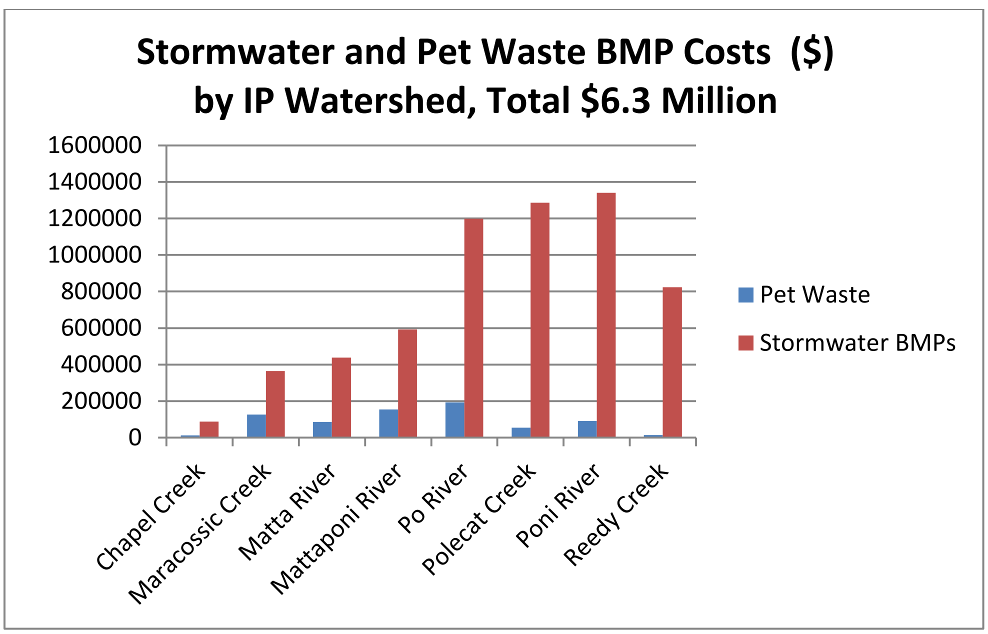


The distribution of recommended BMPs across the IP project area is shown in the barchart below, and links directly to the number of existing septic systems located within each watershed. With approval of this IP by the EPA, cost-share assistance for septic system BMPs can be included in future Section 319 grant projects. Additional information on residential septic system best practices can be found in Section 5 and the detailed BMP recommendations are shown in the Tables in Section 5.2 of the technical report.



Developed Land Best Practices

Stormwater runoff from developed land also contributes bacteria to area streams, especially where pet wastes are not properly managed. Residential workgroup members supported inclusion of pet waste BMPs and an education and outreach program to address pet waste sources of bacteria. While no specific areas were identified as top priorities, the number of BMPs varies by the estimated pet population of the IP watershed. The specific BMPs recommended are disposal bag stations and pet waste composters/digesters. The barchart below shows the cost of recommended Stormwater and Pet Waste Management BMPs for each of the eight IP watersheds.



While the relatively low levels of developed land within the IP project area make it a smaller source of bacteria than agricultural lands, the plan recommends these developed land BMPs to encourage and demonstrate opportunities to improve local environmental management, while reducing bacteria runoff. The recommended stormwater measures are distributed across the watersheds based on their amounts of developed land.

Additional information on developed land best practices, including pet waste management, is found in Section 5 of the technical report. Detailed BMP recommendations are shown in the Tables in Section 5.3.

Education and Outreach Programs

The plan recommends active education and outreach efforts to improve public understanding and support for the actions needed to reduce bacteria releases to the Mattaponi River watershed. Specific activities that are recommended are information on septic system maintenance, pet waste management, water quality educational materials and field trips for area students, and "farm day" events to demonstrate the value of agricultural conservation practices. Local soil and water conservation districts (SWCDs) are often the recipients of Section 319 grants in Virginia, and all three local SWCDs participated in the development of this plan. In addition, counties and towns, regional commissions, and non-governmental organizations are also eligible to apply for Section 319 grants to implement approved IPs. Given the large geographic scope of this IP, it includes three education and outreach programs, with the assumption that up to three separate grants may support its implementation.

Costs and Funding Needs to Support Voluntary Implementation

Given that addressing pollutants from unpermitted nonpoint sources is done voluntarily, it is critical to address the costs and benefits of the recommended practices. The best practices recommended need to be viable from an economic standpoint for the watershed or they will not be implemented.

The costs identified for each of the best practices were estimated based upon existing data for those practices. The recommended agricultural practices are included in state and federal conservation incentive programs which offer cost-share and loan funding and other incentives to landowners to encourage voluntary participation. The total costs for the Mattaponi Implementation Plan is $33.0 million, over a 15 year implementation timeframe, as shown in **Table 3** below. The greatest costs are those for Residential Septic measures ($16.4 million), with Agricultural conservation measures noticeably less in cost at $9.0 million. Developed land conservation measures are lower still, at $6.3 million.

Table 3: Total Cost of Recommended BMPs by IP Watershed ($ in Thousands)

IP Area	Agricultural BMPs	Residential Septic BMPs	Developed Lands BMPs *	TOTAL**
Chapel Creek	551,993	404,400	100,620	**1,057,013**
Maracossic Creek	2,079,930	1,725,700	491,750	**4,297,380**
Matta River	1,170,817	2,532,500	525,730	**4,229,047**
Mattaponi River	1,497,528	3,021,100	747,345	**5,265,973**
Po River	1,680,355	3,283,300	1,391,615	**6,355,270**
Polecat Creek	622,351	1,659,900	1,341,135	**3,623,386**
Poni River	904,909	3,127,500	1,432,240	**5,464,649**
Reedy Creek	448,508	605,900	289,640	**1,344,048**
Total	**8,956,391**	**16,360,300**	**6,320,075**	33,042,266

*   Pet Waste management measures ($735K) are included with Developed Lands BMPs
** Includes $55,500 in Educations and Outreach and $1,350,000 in technical assistance.

Benefits of Best Practices

The primary benefit of this plan is to reduce the amount of bacteria in the impaired streams sufficient to meet the water quality standards, restoring the recreational use of the waterway. 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 sources, 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 reducing pollutants reaching the Chesapeake Bay and thus make progress towards achieving the Chesapeake Bay TMDL goals. The Bay TMDL focuses on impairments caused by excess sediment and nutrient (nitrogen and phosphorus) pollutant inputs to the Chesapeake Bay. Many of the BMPs recommended in this “local” IP to reduce bacteria will also reduce sediment and nutrient discharges. For example, Agricultural BMPs that create riparian buffers or improve crop or pasture land management will reduce sediments and nutrients carried by stormwater runoff from agricultural lands into local streams that ultimately drain into the Chesapeake Bay. Similarly, maintaining, repairing or replacing failing septic systems will reduce nitrogen discharges to local streams (and the Bay). Addressing stormwater runoff from developed lands can reduce both sediment and nutrient runoff, some of which would otherwise reach the Chesapeake Bay.

Additional information on costs and benefits associated with the best practices is in Sections 6 and 7 of the technical report.

Staffing Needs to Assist with Implementation

Coordinating implementation of this plan will require additional technical staffing for the duration of the 15 year plan. As noted, three local SWCDs have jurisdictional responsibility for major portions of the IP project area, and significant portions of the project area are within five counties and two regional commissions. Over the two phases (Phase 1, 10 years and Phase 2, 5 additional years) it is assumed that 1.5 full time equivalent (FTE) staff per year will be needed to coordinate plan implementation, lead education, outreach and technical communications with area landowners and producers, and plan, oversee and assess BMP installations. These costs were estimated to be $60,000/FTE, which leads to a total staffing cost estimate of $ 1,350,000 for the lifespan of the plan. As with education and outreach, the technical assistance costs assume that up to three active grants may support implementation over the 15 year IP timeframe.

Funding Opportunities

As has been noted, completion of this plan (and approval by the EPA) improves funding prospects by making the IP project area eligible for Section 319 (Nonpoint Source Program) grant funds from the EPA. While Section 319 funds are limited, and the majority of funds must go to "on-the-ground projects" (BMPs), staffing needs and education and outreach activities are also eligible for Section 319 assistance. Coupled with the many other sources of funding support for the BMPs themselves, Section 319 grants can provide a great boost to plan implementation. In terms of BMP funding support, there are a very wide variety of funding opportunities that can support implementation of the plan. The most significant sources of BMP funding are the Virginia Agricultural Best Management Practices Cost-Share (VACS) Program, Virginia Conservation Assistance Program (VCAP), and USDA's Conservation Reserve Enhancement Program (CREP). A description of these programs and more than twenty other financial assistance programs relevant to this plan is provided in Section 12 of the technical report.

Goals and Milestones for Reducing Bacteria Levels

Progress toward the bacteria reduction goals of this plan will be assessed throughout its implementation. Tracking the installation of BMPs is an important "output" approach to assessing plan implementation, and it can identify progress from year 1 onward. Demonstrating progress through the desired water quality improvement "outcome" of the plan is a longer-term challenge. While installation of a single BMP can address a localized water quality problem, it will take years of sustained effort to see BMP's installed on-the-ground in sufficient numbers to result in water quality improvements needed to **delist** the impaired sections of area streams.

> **Delisting**: Removal of a waterbody from the impaired waters list based upon new data that shows WQS are met for that waterbody.

The BMPs recommended in Phase I (years 1-10) of the IP were designed to meet the *E.coli* criterion, as measured by a geometric mean value of 126 cfu/100 mL of water. The additional Phase II measures (years 11-15) are shown to result in less than a 10.5 percent exceedance rate of the maximum assessment criterion of 235 cfu/100mL At the time this plan was being developed, Virginia was in the process of developing a new criterion for bacteria. Meeting the water quality standards for *E.coli* will require satisfying both the geomean and new criterion, and listing and delisting impaired waters will be conducted in accordance with the methods established for assessing bacteria data using both criteria.

Monitoring Water Quality

DEQ will continue to monitor water quality in area streams to inform management decisions and the public about water quality conditions. DEQ monitors water quality conditions at seven "Trends" monitoring stations within the IP project area on a regular basis, and additional DEQ monitoring occurs periodically to meet specific program needs. "Implementation Monitoring" (IM) is done selectively in areas where BMPs have been implemented to determine the water quality response to actions taken and provide data to support updated water quality assessment decisions.

Citizen water quality data can greatly improve the understanding of water quality conditions over time. Two communities within the IP project area, Lake Caroline and Fawn Lake, have well established water quality monitoring programs. Additional citizen monitoring in other parts of the Mattaponi IP watershed would be helpful to supplement DEQ monitoring, and DEQ provides both training and limited financial assistance each year to promote and support citizen monitoring programs.

During plan development, DEQ learned of past work by students of Randolph-Macon College (RMC) in Ashland, Virginia to conduct detailed field analysis of localized water quality problems, providing students with opportunities to address real-world environmental management challenges. A Fall 2019 RMC freshman seminar class completed detailed field sampling for bacteria levels in the Matta and Po River IP watersheds. Their field work and data analysis/interpretation enhanced knowledge of current water quality conditions and sources of contamination in two of the eight Mattaponi IP watersheds, and will be helpful to target BMP outreach and implementation in the Matta and Po waterhseds. Also, representatives of the National Park Service and the Virginia Master Naturalists who participated in IP development meetings each indicated interest and ability to have their water quality monitoring programs give focused attention to selected IP area streams. These additional water quality monitoring efforts can enhance the knowledge of water quality conditions and trends and once implementation is underway, help to identify areas of successful BMP implementation in the Mattaponi River Watershed.

Section 9 of the technical report discusses water quality monitoring activities and plans in more detail.

Involving the Public and Stakeholders

Public participation in the TMDL Implementation Plan process informs local stakeholders of the effort and encourages their participation. Local knowledge helps to ensure the IP will be suitable for the watershed.

Development of this plan officially began with initial Public Meetings held in Spotsylvania Courthouse and Bowling Green, Virginia in July 2018. Workgroup meetings were held to seek detailed input from participants for agricultural and residential aspects of the plan in November 2018 and January 2019 and a Steering Committee met in March 2019 to provide overarching input to development of the IP report. Each of these meetings is summarized in **Table 4** below. Twenty-two people attended the Final Public Meeting in Bowling Green on September 10, 2019. At this meeting DEQ presented highlights of the draft IP, answered questions from participants and initiated the 30-day public comment period – which extended from September 11 to October 11, 2019; DEQ did not receive additional public comments during that time.

Table 4: Meetings held during the TMDL IP development process.

Date	Meeting Type	Location	Attendance
07/24/18	Initial Public Meeting in Spotsylvania Courthouse	C. Melvin Snow Library	8
07/31/18	Initial Public Meeting, with Agricultural & Residential group discussions	Bowling Green Town Hall	25
11/07/18	Agricultural Working Group Meeting	Caroline County Public Library, Bowling Green Branch	14
01/09/19	Residential Working Group Meeting	Caroline County Public Library, Ladysmith Branch	17
03/27/19	Steering Committee	Bowling Green Town Hall	12
9/10/19	Final Public Meeting	Bowling Green Town Hall	22

Voluntary implementation of best practices to address nonpoint sources depends on stakeholder participation and strong leadership by the community and local conservation organizations. DEQ helps to support implementation of voluntary best practices through its grant programs and work with local partners, and public support for plan implementation is essential. More information on the public participation process, and stakeholders and their roles in implementation can be found in Sections 4 and 10 of the technical report.

Complementary Water Quality Improvement Efforts

Efforts to address the recreational use impairment in the Mattaponi River Watershed will benefit from and complement other ongoing work to improve the water quality in downstream watersheds. This means that the best practices installed to improve the water quality in the (upper) Mattaponi River Watershed will help improve water quality further downstream in the Mattaponi, in the York River, and ultimately in the Chesapeake Bay. As noted above, many of the best practices placed in the Mattaponi River Watershed to reduce bacteria also help to address sediment and nutrient pollutant loads that need to be reduced to achieve Chesapeake Bay cleanup goals. Similarly, efforts within the Mattaponi River Watershed that are conducted to support restoration of the Bay's water quality under Virginia's WIP III will also benefit the local watershed. Developed lands measures and riparian buffer reforestation measures called for in this IP can also achieve goals contained in the George Washington Regional Commission's 2011 Green Infrastructure Plan. Information on these and other links to on-going restoration efforts is discussed in Section 11 of the technical report.

Implementation and Adaptive Management

As actions are taken to carry out the recommendations of this plan, bacteria levels from existing sources will begin to decrease in area streams. At the same time, changes in land use and increased development within the Mattaponi River watershed will bring new challenges to water quality that may require additional action. This requires ongoing or "adaptive" management to ensure progress is being made toward water quality restoration goals.

DEQ refers to the cyclical need to monitor and assess water quality, plan for pollutant reduction needs, support implementation of water quality improvement plans, and continue with additional monitoring and analysis as the Continuous Planning Process. As shown in **Figure 3** below, the process ensures that accurate water quality information is considered throughout the process to inform and guide water quality planning efforts. It recognizes the potential that plans may need to be adapted to changing circumstances or new information to achieve the goal of restoring impaired waters to meet their WQS.

Carrying out the actions recommended in this plan will required significant funding resources, local community support, and sustained efforts by many stakeholders over the next 15 or more years. The benefits of fully implementing this plan will be healthy local waters that fully support recreational use, as well as the many additional local and regional benefits previously discussed.

Figure 3: Continuous Planning Process for Water Quality Improvement