Water Quality Implementation Plan for the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks

Public Report

(Shellfish Areas Listed Due to Bacterial Contamination)

Photo: Dana Gonzalez

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Photo: Dana Gonzalez

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EXECUTIVE SUMMARY

This document includes restoration activities for five TMDL watersheds (The Gulf, Barlow Creek, Mattawoman Creek, Jacobus Creek, and Hungars Creek) located in Northampton County, Virginia that all drain into the Lower Chesapeake Bay. Impairments in these watersheds were identified in four TMDL reports that were approved by EPA between 2007 and 2010. Restoration activities for an additional four subwatersheds within Hungars Creek (Subwatersheds 1, 2, 6, and 10), which were not included in the 2008 Hungars Creek TMDL document, were also included in this plan. Recent impairments in subwatershed 1 make these additional restoration activities relevant in the area.

Photo: Dana Gonzalez

All of the creeks, except for Barlow, do not support Virginia's bacteria standards for the production of edible and marketable seafood. Although Barlow Creek was removed from the Impaired Waters List in 2012, it was included in this plan to address actions that can be used to prevent future unacceptable fecal coliform loading in the watershed. The applicable fecal coliform bacteria standard specifies that the 90th percentile fecal coliform value for a sampling station not exceed an MPN (most probable number) of 49 per 100 milliliters. For every impaired water body on the 303(d) list, the Clean Water Act and the U.S. Environmental Protection Agency (EPA) both require that states develop a Total Maximum Daily Load (TMDL) for each pollutant (40 CFR Part 130). TMDLs establish the reduction in loads needed to restore these waters. The Virginia Water Quality Monitoring, Information and Restoration Act (WQMIRA) directs the State Water Control Board (SWCB) to "develop and implement a plan to achieve fully supporting status for impaired waters."

Review of TMDL Development

DEQ used a simplified tidal volumetric model along with bacterial source tracking to aid in identifying sources (i.e. human, livestock, pet, and wildlife) of fecal contamination in the development of the TMDLs. The TMDLs for the Gulf, Barlow Creek, Mattawoman Creek, Jacobus Creek, and Hungars Creek watersheds are based on the 30-sample 90th percentile concentration, which was determined to represent the critical condition and require greater reductions. As part of this plan, DEQ re-assessed sources in the watersheds and worked in concert with VIMS to re-assign bacteria load reductions in each of the watersheds and four additional subwatersheds in Hungars Creek (Table ES-1).

Table ES-1. Bacteria loads and reductions required in each watershed.

Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
The Gulf	6.07E+11	8.59E+10	86%
Barlow Creek	2.14E+11	1.25E+10	94%
Mattawoman Creek	6.13E+11	1.14E+11	81%
Jacobus Creek	6.90E+11	1.70E+11	75%
Hungars Creek TMDL Region	2.96E+11	5.38E+10	82%
Hungars Creek non-TMDL Subwatershed 1	1.54E+11	1.58E+10	90%
Hungars Creek non-TMDL Subwatershed 2	1.27E+11	2.42E+10	81%
Hungars Creek non-TMDL Subwatershed 6	2.99E+10	5.64E+09	81%
Hungars Creek non-TMDL Subwatershed 10	9.08E+10	1.27E+10	86%

Public Participation

Public meetings were held to inform the public about the end goals and status of the IP process as well as to provide a means for soliciting participation in the smaller, more targeted meetings (i.e., working groups). Initially, two working groups were formed at the beginning of the planning process: an agricultural/residential working group and a government working group. However, because both groups shared similar interests, they were ultimately combined into one single working group. The working groups focused primarily on the source reassessment as well as assignment of best management practices within the watersheds. Throughout the public participation process, a major emphasis was placed on addressing septic system problems, increasing education/outreach, and methods for obtaining implementation funding.

Assessment of Implementation Action Needs

Field surveys in the watershed and analysis of aerial imagery were used along with the workgroup process and the TMDL studies to reassess bacterial sources to the creeks and evaluate alternative BMPs and strategies to reduce the bacteria loads. The various practices were discussed by the workgroup regarding costs, effectiveness, and appropriateness for the specific circumstances in the watersheds. Overall, the implementation needs for the five year phase 1 implementation period were identified and are shown in Tables ES-2 and ES-3, while education needs for both phase 1 and phase 2 are identified in Table ES-4.

Cost estimates for agricultural, residential, and educational programs in this plan were calculated by multiplying the unit cost by the number of BMP units in each watershed. The unit cost estimates for the agricultural BMPs were derived from the Department of Conservation and Recreation's Agricultural Cost-Share Database. Average costs for BMP installations in Virginia were used once the workgroup confirmed that they were reliable estimates. The unit costs for residential practices were developed through discussions with local health departments, the TMDL IP working groups and estimates from previous TMDL implementation plans. Estimates for education programs were based on target audience size and experience in other plans.

The total phase 1 (years 1-5) cost estimate for all of the watersheds combined was estimated to be $1,877,650 and was distributed as follows:

The Gulf: $420,600
Barlow Creek: $136,800
Mattawoman Creek: $373,450
Jacobus Creek: $390,850
Hungars Creek: $217,600
Subwatershed 1 in Hungars Creek: $198,550
Subwatershed 2 in Hungars Creek: $60,700
Subwatershed 6 in Hungars Creek: $16,650
Subwatershed 10 in Hungars Creek: $62,450

Additional Phase 2 (years 6-10) implementation costs for all of the watersheds combined was estimated to be $332,700 and was distributed as follows:

The Gulf: $81,000
Barlow Creek: $23,100
Mattawoman Creek: $61,800
Jacobus Creek: $76,500
Hungars Creek: $22,200
Subwatershed 1: $43,800
Subwatershed 2: $7,200
Subwatershed 6: $1,500
Subwatershed 10: $15,600

Table ES-2. Agricultural BMPs to be included during phase 1 (Years 1-5) in each watershed.

			Agricultural BMPs_Estimated Units Needed									
Control Measure	**Unit**	**Unit Cost ($)**	**The Gulf**	**Barlow Creek**	**Mattawoman Creek**	**Jacobus Creek**	**Hungars Creek**	**Hungars Subwatershed 1**	**Hungars Subwatershed 2**	**Hungars Subwatershed 6**	**Hungars Subwatershed 10**	**Total**
Woodland Buffer Filter Area (FR-3)	Acres	700	21	10	25	21	9	3	9	2	2	102
Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)	System	15,000	1	1	1	1	1	0	0	0	0	5
Livestock Exclusion with Reduced Setback (LE-2T)	System	10,000	1	1	1	1	1	0	0	0	0	5
Small Acreage Grazing System (SL-6AT)	System	1,500	2	0	0	1	2	0	0	0	1	6
Small Grain Cover Crop (SL-8B) (VACS Funding)	Acres	100	112	58	140	140	50	20	52	12	10	594
Pasture Management (Livestock/horse) (SL-10T)	Acres	75	100	100	100	100	100	0	0	0	0	500
Pasture Management (Sheep/Goats) (SL-10T)	Acres	75	0	0	10	0	20	0	8	0	0	38
Sediment Retention, Erosion, or Water Control Structures (WP-1)	Acres	4,300	11	6	14	11	5	2	5	1	1	56

Table ES-3. Residential BMPs to be included during phase 1 (Years 1-5) in each watershed.

			Residential BMPs_Estimated Units Needed									
Control Measure	Unit	Unit Cost ($)	The Gulf	Barlow Creek	Mattawoman Creek	Jacobus Creek	Hungars Creek	Hungars Subwatershed 1	Hungars Subwatershed 2	Hungars Subwatershed 6	Hungars Subwatershed 10	Total
Phase 1 (Years 1-5) Septic Tank Pumpout (RB-1)	System	300	237	60	178	225	49	134	22	4	48	957
Phase 2 (Years 6-10) Septic Tank Pumpout (RB-1)	System	300	258	65	194	243	62	146	24	5	52	1049
Septic System Repair (RB-3)	System	3,000	5	1	3	3	3	2	1	1	1	20
Septic System Replacement/Installation (RB-4)	System	6,000	8	3	7	8	5	5	1	0	3	40
Septic System Replacement/Installation with Pump (RB-4P)	System	6,500	4	1	3	4	3	2	0	0	1	18
Alternative On-Site System (RB-5)	System	25000	4	0	3	3	2	2	0	0	0	14
Pet Waste Composter	System	50	80	20	60	75	20	45	10	3	15	328
Pet Waste Station (facility/signage/supplies)		600	7	3	5	5	2	4	1	0	2	29
Vegetated Buffer on Residential Land	Acres	400	5	2	5	5	2	5	1	1	1	27
Rain Garden	Acres	5,000	8	3	8	9	4	8	2	1	2	45

Table ES-4. Education programs needed for all watersheds (cost split among all watersheds).

		Education programs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Total cost per program ($)**	**Practice**
1	1	3,000	Recreational Boater Education Program
1	1	2,500	Residential Education Program (pet, septic)
1	1	2,500	Aquaculture (Oyster Gardening) Education Program
	1	10,000	Wildlife Education/Management Program

The primary benefit of this implementation is cleaner water in the Gulf, Barlow Creek, Mattawoman Creek, Jacobus Creek, and Hungars Creek. The goal is to implement the IP so that fecal contamination may be reduced and allow for the removal of the condemnation of the shellfish growing areas. The principal benefit to the oyster growers in these creeks would be that once the water quality is restored, they would no longer need to transport their floats to clean water to depurate oysters prior to consumption. It is important to note that there are substantial aquaculture activities in Cherrystone Inlet, which is less than 6 miles south of the Gulf. All of these creeks already meet the state water quality standards for safe swimming. However, further reducing fecal contamination levels in these creeks, particularly from human sources will improve public health by reducing the risk of infection from fecal sources through contact with surface waters.

Photo: Dana Gonzalez

The residential programs will play an important role in improving water quality, but there may also be additional return on the investment in terms of economic benefits to homeowners. An improved understanding of private on-site sewage systems (including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance) will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The replacement of failing on-site sewage disposal systems with new septic or alternative treatment systems will have a direct and substantial impact by improving property values and improving the local economy.

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians, and a healthy economic base enhances the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document are expected to provide economic benefits, as well as environmental benefits, to the property owners in these watersheds.

INTRODUCTION

Background

The Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks are located within Northampton County on Virginia's Eastern Shore. These tidal creeks all drain into the Lower Chesapeake Bay. The primary land use types within the watersheds are forest, grassland, and agriculture; little development of the land has occurred in these watersheds. A listing of acreages for the 15 National Land Cover Dataset (NLCD 2011) land uses for each of the 5 Northampton Creeks is shown below in Table 1. The acreages of 4 additional subwatersheds in the Hungars Creek area that will also be addressed in this plan are shown in Table 2.

Table 1. NLCD (2011) distribution of each land use type (acres) for 5 Northampton County creeks with impaired shellfish growing areas.

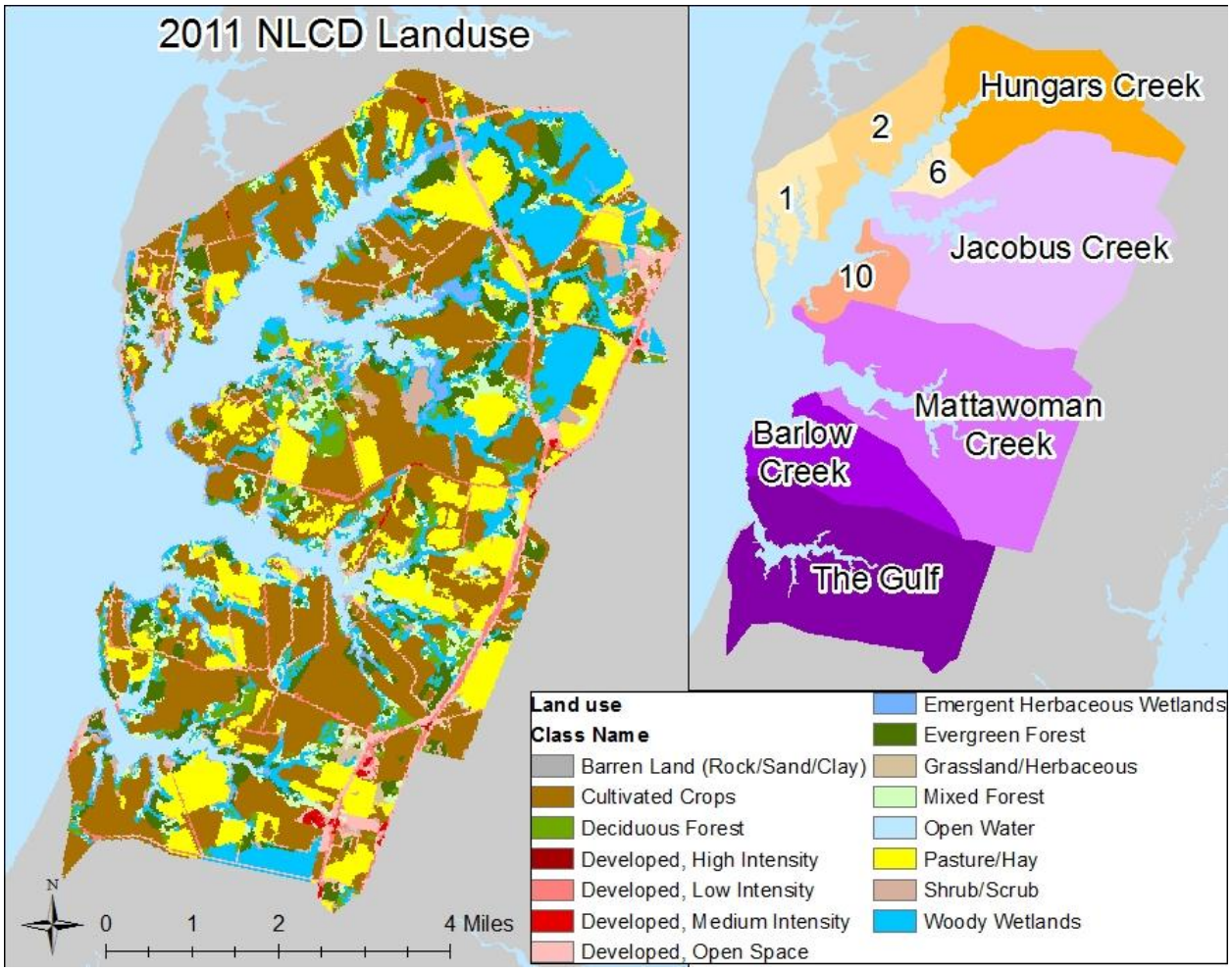
Land use Name	Hungars Creek	Jacobus Creek	Mattawoman Creek	Barlow Creek	The Gulf
Open Water	8.23	30.47	66.94	31.36	74.50
Developed, Open Space	104.53	231.51	165.91	60.71	166.57
Developed, Low Intensity	9.34	62.27	93.41	27.58	72.50
Developed, Medium Intensity	2.22	8.01	6.67	0.00	30.02
Developed, High Intensity	0.00	0.00	0.00	0.00	1.56
Barren Land	0.00	0.00	0.00	1.11	1.78
Deciduous Forest	48.48	195.26	170.80	28.69	105.41
Evergreen Forest	173.24	266.43	216.61	66.72	229.96
Mixed Forest	71.17	220.39	253.75	68.94	159.01
Shrub/Scrub	26.46	196.82	82.06	16.90	65.83
Grassland/Herbaceous	1.11	8.90	3.34	0.00	33.58
Pasture Hay	382.96	459.47	716.11	133.88	521.74
Cultivated Crops	503.94	1142.66	1394.85	565.77	1126.20
Woody Wetlands	513.95	813.52	283.11	109.42	290.67
Emergent Herbaceous Wetlands	31.36	91.63	50.26	26.24	34.47
Totals:	1877.01	3727.32	3503.82	1137.32	2913.81

Table 2. NLCD (2011) distribution of each land use type (acres) for 4 additional subwatersheds in the Hungars Creek Watershed.

Land use Name	Subwatershed 1	Subwatershed 2	Subwatershed 6	Subwatershed 10
Open Water	16.68	9.56	8.23	11.79
Developed, Open Space	76.95	5.34	9.56	25.35
Developed, Low Intensity	8.23	20.24	0	1.11
Developed, Medium Intensity	0	1.11	0	0
Developed, High Intensity	0	0	0	0
Barren Land	3.56	0	0	0
Deciduous Forest	10.01	13.57	9.34	38.70
Evergreen Forest	84.73	20.91	5.34	34.03
Mixed Forest	20.91	54.04	10.90	49.59
Shrub/Scrub	29.80	11.56	19.57	30.91
Grassland/Herbaceous	1.11	2.00	0	0
Pasture Hay	31.36	92.52	0	80.51
Cultivated Crops	209.50	517.51	114.98	97.85
Woody Wetlands	42.48	76.73	10.23	62.72
Emergent Herbaceous Wetlands	20.68	30.25	11.56	10.90
Totals:	555.99	855.33	199.71	443.46

A map showing the land use in the watersheds based on the 2011 NLCD is displayed in Figure 1. The health of these waters is important for both recreation and aquaculture and is closely linked to the enjoyment of those who live nearby and visit the creeks.

Figure 1. Land use within the five TMDL watersheds based on the 2011 NLCD. Numbered areas indicate the additional subwatersheds that were not included in the Hungars Creek TMDL, but will be addressed in this plan.



The Clean Water Act (CWA), which became law in 1972, requires that all U.S. streams, rivers, and lakes meet certain water quality standards. The CWA also requires that states conduct monitoring to identify polluted waters or those that do not meet standards. Through this required program, the state of Virginia has found that many stream segments do not meet state water quality standards for protection of the five beneficial uses, which are fishing, swimming, shellfish, aquatic life, and drinking. Virginia submits a list on the health of all its waters to Congress every two years. No waterbody can be removed from the list until:

- Its problems are solved and standards are achieved or
- The designated uses not being achieved are removed after a detailed analysis clearly shows that they cannot be obtained.

When water bodies fail to meet standards, Section 303(d) of the CWA and the US Environmental Protection Agency's (EPA) Water Quality Management and Planning Regulation (40 CFR Part 130)

require states to develop TMDLs for each pollutant. A TMDL is a "pollution budget" for a waterbody. That is, it sets limits on the amount of pollution that a stream can tolerate and still maintain water quality standards. In order to develop a TMDL, background concentrations, point source loadings, and non-point source loadings are considered. A TMDL accounts for seasonal variations and must include a margin of safety. Through the TMDL process, states establish water-quality based controls to reduce pollution and meet water quality standards.

Once a TMDL is developed and approved by EPA, measures must be taken to reduce pollution levels in streams. These measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), are implemented in a staged process that will be described, along with specific BMPs in this IP. CWA regulations prohibit new discharges that "will cause or contribute to the violation of water quality standards."

Applicable Water Quality Standards

Water quality standards are designed to protect public health or welfare, enhance the quality of water and serve the purposes of the State Water Control Law (§62.1-44.2 et seq. of the Code of Virginia) and the federal Clean Water Act (33 USC § 1251 et seq.). Virginia Water Quality Standard 9 VAC 25-260-10 (Designation of uses.) states:

A. *All state waters, including wetlands, are designated for the following uses: recreational uses, e.g., swimming and boating; the propagation and growth of a balanced, indigenous population of aquatic life, including game fish, which might reasonably be expected to inhabit them; wildlife; and the production of edible and marketable natural resources, e.g., fish and shellfish.*

E. *At a minimum, uses are deemed attainable if they can be achieved by the imposition of effluent limits required under §§301(b) and 306 of the Clean Water Act and cost-effective and reasonable best management practices for nonpoint source control.*

G. *The [State Water Control Board] board may remove a designated use which is not an existing use, or establish subcategories of a use, if the board can demonstrate that attaining the designated use is not feasible because:*

    1. *Naturally occurring pollutant concentrations prevent the attainment of the use;*
    6. *Controls more stringent than those required by §§301(b) and 306 of the Clean Water Act would result in substantial and widespread economic and social impact.*

(For a complete listing of this legislative reference regarding the Designation of Uses in Virginia waters, please go to: http://leg1.state.va.us/cgi-bin/legp504.exe?000+reg+9VAC25-260-10)

For a shellfish supporting waterbody to be in compliance with Virginia's bacteria standards for the production of edible and marketable natural resource use, the Virginia Department of Environmental Quality (DEQ) specifies the following criteria (9VAC 25-260-160):

> *"In all open or estuarine waters capable of propagating shellfish or in specific areas where public or leased private shellfish beds are present, and including those waters on which condemnation or restriction classifications are established by the State Department of Health, the following criteria for fecal coliform shall*

apply; the geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) or MF (membrane filtration using mTEC culture media) of 14 per 100 milliliters (ml). The estimated 90th percentile shall not exceed an MPN of 43 per 100 ml for a 5-tube decimal dilution test or an MPN of 49 per 100 ml for a 3-tube decimal dilution test or MF test of 31 CFU (colony forming units) per 100 ml"

For those waters that do not meet the criteria, Chapter 310 of the Administrative Code describes the process by which shellfish grown in restricted (condemned) waters can enter the commercial market, a process referred to as depuration or relaying.

Fecal Bacteria Impairments

Fecal coliform bacteria detection in exceedence of the shellfish use standard constitutes an impairment in Virginia shellfish growing waters. This group of bacteria is used as an indicator of the presence of fecal contamination; a common member of the fecal coliform group is *Escherichia coli*. Fecal coliform bacteria are associated with fecal material derived from humans and warm-blooded animals, and their presence in aquatic environments is an indication that the water may have been contaminated by pathogens or disease-producing bacteria or viruses. Waterborne pathogenic diseases include typhoid fever, viral and bacterial gastroenteritis, and hepatitis A. Pathogens are concentrated in filter-feeding shellfish and can cause disease when eaten uncooked. Therefore, the presence of elevated numbers of fecal coliform bacteria is an indicator that a potential health risk exists for individuals consuming raw or undercooked shellfish. Fecal contamination can occur from point source inputs of treated sewage or from nonpoint sources of human waste (e.g., malfunctioning septic systems), and waste from livestock, pets, and wildlife.

Photo: Dana Gonzalez

The shellfish impairments of the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks are based on restrictions placed on commercial shellfish harvest to protect public health. Condemnations in Growing Area 86-136 and Growing Area 187-174 were issued by the Virginia Department of Health, Division of Shellfish Sanitation (VDH-DSS) based on monthly monitoring data. VDH-DSS collects monthly fecal coliform bacteria samples from each of its sampling stations in Virginia's tidal estuaries. They then calculate geometric means based on the most recent 30 months of sampling data to determine condemnation areas.

This IP outlines a strategy for reducing anthropogenic loadings of bacteria to a level that complies with each TMDL. With completion of the IP, Virginia has identified a plan for meeting the water quality goals within the 5 creeks and a means to enhance local natural resources. Additionally, approval of the IP will enhance opportunities for funding during implementation.

STATE AND FEDERAL REQUIREMENTS FOR IMPLEMENTATION PLANS

There are a number of state and federal requirements and recommendations for TMDL IPs. The goal of this chapter is to clearly define these and explicitly state if the elements are a required component of an approvable IP or are merely a recommended topic that should be covered in a thorough IP. This chapter has three sections that discuss the a) requirements outlined by the Water Quality Monitoring, Information, and Restoration Act (WQMIRA) that must be met in order to produce an IP that is acceptable and approvable by the Commonwealth, b) EPA recommended elements of IPs, and c) required components of an IP in accordance to Section 319 guidance.

State Requirements

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

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

Federal Requirements

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

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

Requirements for Section 319 Fund Eligibility

EPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 nonpoint source grants to States. Congress amended the CWA in 1987 to establish the Section 319 Nonpoint Source Management Program. Under Section 319, States, Territories, and Indian Tribes receive grant money, which supports a wide variety of activities, including the restoration of impaired waters. The guidance is subject to revision and the most recent version should be considered for IP development. The "Supplemental Guidelines for the Award of Section 319 Nonpoint Source Grants to States and Territories in FY 2003" identifies the following nine elements that must be included in the IP to meet the 319 requirements:

1. Identify the causes and sources of 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 NPS management procedures 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, measureable milestones for determining whether NPS management measures or other control actions are being implemented;
8. Identify a set of criteria for determining if loading reductions are being achieved and progress is being made towards attaining water quality standards, and if not, the criteria for determining if the watershed-based plan needs to be revised; and
9. Establish a monitoring component to evaluate the effectiveness of the implementation efforts.

The process of incorporating these state and federal guidelines into an IP consists of three major components:

1. Public participation
2. Implementation actions
3. Measurable goals and milestones.

Once developed, DEQ will present the IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs. DEQ will also request that the plan be included in the appropriate Water Quality Management Plan (WQMP), in accordance with the CWA's Section 303(e) and Virginia's Public Participation Guidelines for Water Quality Management Planning. As stated in the Memorandum of Understanding (MOU) between EPA and DEQ, DEQ

will also submit a draft Continuous Planning Process to EPA where DEQ commits to regular updates of the WQMPs. Therefore, the WQMPs will be the repository for all TMDLs and the TMDL IPs developed within a river basin. The IP will also be presented to the EPA Nonpoint Source Program for approval.

REVIEW OF TMDL DEVELOPMENT

Water quality monitoring data, bacteria source assessments and the allocated reductions in the TMDL studies for each of the creeks were reviewed to determine the implications of the TMDLs on IP development.

As part of TMDL development, bacterial source tracking (BST) sampling was conducted by DEQ in the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks. Bacterial source tracking is intended to aid in identifying sources (i.e. human, livestock, pet, and wildlife) of fecal contamination in water bodies. The studies used the antibiotic resistance approach (ARA) for the analysis, which is based on the premise that bacteria from different sources have different patterns of resistance to a variety of antibiotics. Samples were collected and analyzed on a monthly basis from October 2003 to September 2004. The BST results were used to estimate the percentage of the bacteria load coming from each of the source sectors: wildlife, human, livestock, and pet. It should be noted that BST and ARA have advantages and disadvantage and the results from studies using these methodologies should be used in conjunction with other knowledge of the watershed. BST is not a quantitative tool and was only intended to be used to identify and estimate potential source loads to the study area.

A simplified tidal volumetric model was used in the development of the TMDLs. This method uses the volumes of the creeks being studied and the monitored fecal coliform concentrations to calculate the current load conditions. The creek volume and the state water quality standard were used to calculate the allowable load. The difference between the current load and the allowable load was then used to calculate the required reduction for each creek. The TMDLs for the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks are based on the 30-sample 90th percentile concentration, which was determined to represent the critical condition. The resulting loads and reductions from the analysis are shown in Table 3. Please note that for this implementation plan bacterial concentrations were based on the more recent mTEC methodology that VDH-DSS began using in 2008. See the Current Load Changes section that follows for details.

Table 3. Bacteria load and required reductions for the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks from TMDL reports.

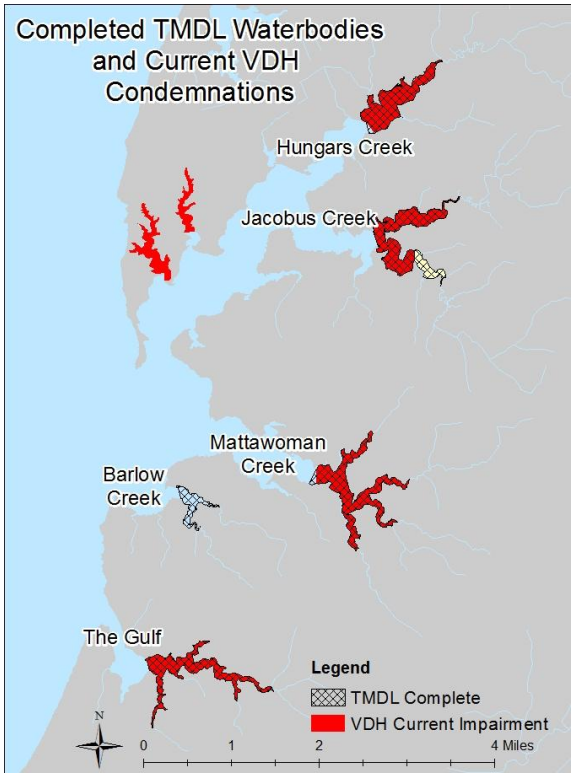
Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
The Gulf	7.11E+11	8.59E+10	88%
Barlow Creek	3.80E+10	1.25E+10	67%
Mattawoman Creek	5.59E+11	1.14E+11	79%
Jacobus Creek	1.38E+12	1.70E+11	88%

Hungars Creek	2.71E+11	5.38E+10	80%

The fecal bacteria TMDLs for these creeks were developed by DEQ. The TMDL studies titled *Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacterial Contamination The Gulf* that was approved in 2007, *TMDL Report for Chesapeake Bay Shellfish Waters: Mattawoman Creek Bacterial Impairment in Northampton County, VA* that was approved in 2010, *Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacterial Contamination Barlow and Jacobus Creeks* that was approved in 2009, and *Bacterial Total Maximum Daily Load (TMDL) Development for the Hungars Creek Watershed* that was approved in 2008 are available on the internet via the DEQ website, http://www.deq.virginia.gov/Programs/Water/WaterQualityInformationTMDLs/TMDL/TMDLDevelopment/ApprovedTMDLReports.aspx. These TMDLs used the 90th percentile standard of 49 MPN/100 ml because it was the more stringent condition for assessing water quality in each creek.

Although Barlow Creek was removed from the Impaired Waters List in 2012, it was included in this IP to address corrective actions that can be used to prevent future unacceptable fecal coliform loadings in the watershed. In addition, two additional areas within Hungars Creek have become impaired since the approval of the TMDL; these sections will be addressed by BMP implementation in subwatershed 1. Figure 2 shows the water bodies that were covered in each of the completed TMDLs as well as current VDH impairments.

Figure 2. Water bodies covered in previously completed TMDLs and current VDH impairments.



CURRENT LOAD CHANGES

Bacterial concentrations in coastal embayments have high seasonal and interannual variation and depend strongly on hydrological conditions. The TMDLs that were developed for the creeks addressed in this IP, used data prior to 2008. The current load is expected to change. Since 2008 VDH-DSS has used a membrane filtration technique (mTEC) that uses direct plate counts to measure fecal coliform concentrations instead of the multiple tube fermentation method. The new method reduces statistical uncertainty and provides a more accurate measurement of bacterial concentrations. In addition, this new method is associated with a new water quality standard (31 CFU per 100 mL). Table 4 shows the average geomean and 90th percentile concentrations measured using the new membrane filtration method (mTEC) after 2008 as well as the geomean and 90th percentile values that were used to calculate loads in the EPA approved TMDL reports.

Table 4. Comparison of average membrane filtration (mTEC) concentrations and multiple tube fermentation data reported in the TMDL study. Note that Virginia water quality standards require that the geometric mean not exceed 14 MPN/100 mL and the 90th percentile not exceed 49 MPN/100 mL for a 3-tube dilution test and 31 CFU/100 mL for a membrane filtration test.

Condemnation Area	mTEC Mean of Geomean	mTEC Mean of 90th Percentile	Geomean (Previously reported TMDL)	90th Percentile (Previously reported TMDL)
Jacobus Cr.	9.28	52.28	44.9	398
Hungars Cr	7.5	47.8	30	203
Barlow Cr.	5	25.2	19.4	148.6
The Gulf	7.48	40.36	49.2	405.6
Mattawoman Creek	11.4	52.7	46.6	239

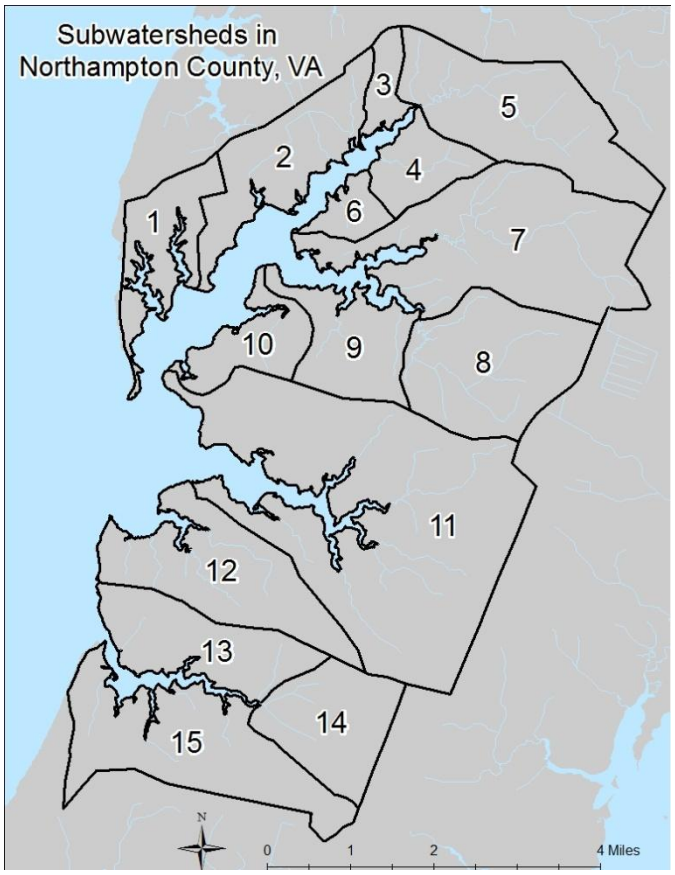
SOURCE REASSESSMENT

Photo: Dana Gonzalez

This section explains the source reassessment that was conducted for each of the five watersheds. This reassessment was conducted to quantify bacteria loadings contributed by human, livestock, pets, and wildlife on various landuses and to develop BMP implementation strategies to address direct and indirect bacteria inputs to shellfish waters. In order to more accurately address bacterial impairments and land use variations within each of the watersheds, the five watersheds were split up into 15 subwatersheds (Figure 3). Although subwatersheds 1, 2, 6, and 10 were not initially included in the Hungars Creek TMDL assessment, calculations for each of these subwatersheds were included in this implementation plan in order to address corrective actions that can be used to reduce fecal coliform loadings in these areas. On 26 August 2014, VDH announced a shellfish condemnation of the growing areas within 2 creeks in subwatershed 1.

It is important that loads and applicable BMPs be assigned to these additional subwatersheds as part of this plan, however, it should be noted that BMP implementation in these 4 subwatersheds will have lower priority than those in the 5 TMDL watersheds.

Figure 3. Fifteen subwatersheds located in Northampton County, VA.



Reassessment of nonpoint fecal sources from residential sewage disposal systems, livestock, wildlife and pets were estimated using census data, local input, and habitat availability.

Livestock sources within each watershed were obtained using workgroup reported numbers and VDH Shoreline Sanitary Survey reports. Members of the workgroup were able to point out specific locations and numbers of each type of livestock on watershed maps. This information was combined with data reported in Shoreline Sanitary Surveys to create the livestock reassessment dataset.

Septic system estimates within the watersheds were compiled using information from VDH, the Northampton County Department of Planning, and workgroup input. VDH representatives reported that all residential structures in the watersheds had septic systems. This information was used in concert with a map of all residential structures within the watersheds, which was provided by the Northampton County Department of Planning, to determine the total number of septic systems. The combined working group agreed that this was the best way to determine the number of septic systems in the area. A 5% five-year failure rate of septic systems was estimated with the help of VDH representatives, who reported that no septic systems in the five watersheds were failing at the time of this report.

Dog and cat estimates in the watersheds were determined using updated American Veterinary Medical Association calculations that were based on the number of houses within each watershed. Dog estimates assumed that 36.5% of households had 1.6 dogs (0.365 * 1.6 * Number of houses) and cat estimates assumed that 30.4% of households had 2.1 cats (0.304 * 2.1 * Number of houses). Based on internet searches, observations in the watershed, and stakeholder knowledge, no kennels or hunt clubs were included in the dog estimates.

Wildlife estimates were based on previously reported TMDL data, habitat availability, and stakeholder input. Duck and geese numbers were taken from each of the TMDL reports; for information on how these numbers were calculated, refer to the appendices of the TMDL reports. The workgroup, which included land owners and government officials, reported that deer and raccoon numbers from the TMDL reports were too low to reflect current populations. In addition, no estimates of muskrat populations were reported in the TMDL reports.

Therefore, deer, muskrat, and raccoon populations were estimated based on the acreage of available habitat and the animal densities found in those habitats. This method has been used in many recent TMDLs. Animal density numbers were taken from a nearby TMDL written on the Eastern Shore for Red Bank Creek and Machipongo River (2014) that used numbers based on data provided by VDGIIF and FWS (http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/drftmdls/redbankmachipongo.pdf). Deer habitat included forest, harvested forest land, orchards, grazed woodland, urban grassland, cropland, pasture, wetlands, transitional land, low density residential, and medium density residential land uses. Because these land use types accounted for at least 97% of each of the watersheds, the deer densities (animals/acre) were multiplied by the total watershed acreage in each watershed. As was done in the Red Bank Creek and Machipongo River TMDL, densities of muskrat were multiplied by the acreage of the watershed that fell within 308 ft of water bodies. This is because muskrat are most prevalent in this 308 ft buffer region. Raccoon habitat was categorized as the region within 7,920 ft of water bodies in the Red Bank Creek and Machipongo River TMDL. However, when this large of a buffer was calculated for each of the watersheds covered in this IP, nearly the entire watershed area was included. Therefore, raccoon densities were multiplied by the total acreage within each watershed.

The revised source assessment numbers were used to calculate daily fecal coliform loading to each of the creeks.

Because each land use has different properties in terms of hydrology, a portion of the flow and bacteria will be lost due to infiltration and decay. The delivery transport rates of bacteria from different land uses to the receiving waters do, in fact, differ. The portion of flow and bacteria discharged to receiving waters can be quantified using runoff coefficients and bacterial delivery rates.

The runoff coefficient is a dimensionless coefficient that relates the amount of runoff to the amount of precipitation in a drainage area. This coefficient is larger for land uses that have low infiltration and high runoff (pavement, steep gradient), and is lower for permeable, well vegetated land uses

(forest, flatland). The runoff coefficient is a function of the land use, soil type, and drainage basin slope. The amount of runoff in a watershed can be estimated using runoff coefficients for different land uses.

The bacterial delivery rate is the ratio of the amount of discharge of bacteria to the amount of bacteria received for a drainage area. This differs for each type of land use and varies significantly for different soil permeabilities. Using the delivery rate of a specific land use type, the bacterial loading for the land use can be correctly estimated by multiplying the delivery rate and the total amount of loading to the drainage area.

In order to estimate both the runoff coefficient and bacteria delivery rate for each land use, VIMS collaborators used a watershed model previously developed for Onancock Creek and other Eastern Shore watersheds (Shen et al., 2008; Wang, 2005). The modeling approach was based on the premise that pollutants from various sources (livestock, wildlife, septic systems, etc.) accumulate on the land surface and are subject to runoff during rain events, whereas they will die off gradually during dry periods. In addition, different land uses are associated with various hydrological processes that determine the potential bacteria load from each land use type. The watershed model is driven by hourly precipitation; therefore, the bacterial loading variations due to variations in hydrological processes can be accurately simulated. Using previously calibrated hydrological and bacterial decay parameters for watersheds on the Eastern Shore, VIMS conducted 7-year model simulations for each land use type and determined mean delivery rates of bacteria for each land use category in the region.

Because each bacterial source (e.g., livestock, pet, wildlife) can accumulate differently on alternate land uses (e.g., wetland, urban land, cropland, etc), the total loading for a particular bacterial source was determined using areally weighted land use delivery rates based on the source distribution. By computing the load for each bacterial source, the total loading from the drainage basin was estimated.

Using these results, new TMDL load reductions were calculated (Table 5). The BMP needs in the watersheds were based on these revised loads.

Table 5. Revised current loading and required reductions for the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks based on the source reassessment, runoff coefficients, and bacteria delivery rate. Load allocations for subwatersheds 1, 2, 6, and 10 were calculated based on their coverage in relation to the Hungars Creek TMDL region.

Watershed	Current Load (MPN/day)	Load Allocation (MPN/day)	Reduction Needed (%)
The Gulf (Subwatersheds 13, 14, 15)	6.07E+11	8.59E+10	86%
Barlow Creek (Subwatershed 12)	2.14E+11	1.25E+10	94%

Mattawoman Creek (Subwatershed 11)	6.13E+11	1.14E+11	81%
Jacobus Creek (Subwatershed 7, 8, 9)	6.90E+11	1.70E+11	75%
Hungars Creek TMDL Region (Subwatershed 3, 4, 5)	2.96E+11	5.38E+10	82%
Hungars Creek non-TMDL Subwatershed 1	1.54E+11	1.58E+10	90%
Hungars Creek non-TMDL Subwatershed 2	1.27E+11	2.42E+10	81%
Hungars Creek non-TMDL Subwatershed 6	2.99E+10	5.64E+09	81%
Hungars Creek non-TMDL Subwatershed 10	9.08E+10	1.27E+10	86%

PUBLIC PARTICIPATION

Public input on restoration and outreach strategies for this IP was an important part of this planning process. Since the plan will be implemented primarily by watershed stakeholders on a voluntary basis with some financial incentives, local input and support are the primary factors that will determine the success of this plan. The actions and commitments compiled in this document were developed by citizens in the watershed, Northampton County government officials, the Eastern Shore Soil & Water Conservation District, the USDA Natural Resources Conservation Service, DCR, DEQ, VDH, VIMS, and the Eastern Shore of Virginia Resource Conservation and Development Council. All citizens and interested parties in the watershed are encouraged to put the IP into action and contribute to the restoration of these creeks.

Public Meetings for Mattawoman, Hungars, Jacobus, the Gulf, and Barlow Creeks

Public meetings were held to inform the public regarding the end goals and status of the IP project as well as to provide a means for soliciting participation in the smaller, more targeted meetings (i.e., working groups). At the first public meeting, it was decided that two workgroups would be formed: an agricultural/residential workgroup and a government workgroup. However, because the separate workgroups had similar interests, they were combined into one single working group. Representatives of DEQ attended each working group in order to facilitate the process and integrate information collected from the various attendees.

The first public meeting was held on February 27, 2014 at the Barrier Island Center, which is located at 7295 Young Street, Machipongo, VA. The meeting was publicized in *The Virginia Register* and

emails were sent to contacts that had been established in the area during previous work. This initial meeting was attended by a total of 27 people, including local landowners, farmers, academics, and government officials. During the meeting DEQ and VIMS representatives explained the TMDL and IP development processes, bacterial loading models, and the purpose of each type of workgroup. The group decided that 2 working groups would be formed, one agricultural/residential working group and one government working group. However, the group elected to meet as one large working group during the later portion of this meeting.

The final public meeting was held on January 20, 2015 at the Barrier Island Center, which is located at 7295 Young Street, Machipongo, VA. The meeting was publicized in *The Virginia Register* and emails were sent to contacts that had been established in the area during previous work.

Working Groups

Although two working groups were initially formed in the first public meeting (agriculture/residential and government), these two groups merged into one combined group after the separate working groups met on June 24, 2014, and expressed similar interests. Overall, there were a total of 5 working group meetings and 1 steering committee meeting during the development of the Implementation Plan.

The first working group meeting was held at the end of the first public meeting on February 27, 2014 at the Barrier Island Center. The group, which consisted of 27 people, elected to remain as one large working group for this meeting rather than splitting into two separate working groups. The discussion during this meeting covered current knowledge gaps, the potential for agricultural and residential BMP installation, and education opportunities in the watersheds.

The government working group met on June 24, 2014 in the Northampton County Boardroom in the County Administration Building, 16404 Courthouse Road, Eastville, VA. A total of 12 government representatives attended this meeting. The workgroup first discussed whether to use the NOAA 2006 or the 2011 NLCD land cover datasets. It was decided that the 2011 NLCD dataset would be preferable. VDH representatives explained that all of the on-site sewage deficiencies that had previously been noted in a 2006 Sanitary Shoreline Survey for Hungars, Mattawoman, Barlow, and Jacobus Creeks had since been addressed. A new Sanitary Shoreline Survey for these creeks was issued in April 2014. The Sanitary Shoreline Survey for the Gulf was last updated in 2006. During this workgroup, source assessment numbers for livestock, wildlife, and pets were discussed. Workgroup members pointed out livestock locations on watershed maps and noted that the wildlife numbers reported in the TMDL documents were too low.

The agriculture/residential working group also met on June 24, 2014 in the Northampton County Board Room. A total of seven people attended this meeting; of these seven people, two were residents and the remaining five were government representatives. At the beginning of this meeting, VDH representatives were present to discuss the Sanitary Shoreline Surveys for the 5 watersheds and provided the same information as they did in the government working group. Agriculture/residential workgroup members also discussed source assessment numbers for

livestock, wildlife, and pets. The workgroup members informed DEQ representatives of livestock locations on watershed maps and felt that the wildlife source assessment numbers from the TMDL documents were too low.

The fourth working group meeting was held on September 25, 2014 in the Northampton County Board Room. A total of seven people attended this meeting. The workgroup discussed updated source assessment data for household/septic systems, livestock, wildlife, and pet numbers. The group agreed that the most accurate household numbers were those provided by the Northampton County Planning Office. In addition, the group agreed that the livestock numbers were accurate. DEQ staff explained that in order to address concerns over wildlife numbers being too low in the previous workgroup meeting, the numbers were re-calculated based on habitat availability in the watershed and animal densities that were used in a previous TMDL written for two nearby watersheds (Red Bank Creek and Machipongo River). The group agreed that the estimates based on these calculations for muskrat, deer, and raccoons looked accurate, but the numbers calculated for geese and ducks in the TMDL documents for the watersheds should also be considered. The group evaluated the list of potential BMPs that was provided by DEQ. It was noted by the group that some of the agricultural BMPs may not be widely used in the watersheds due to the reduced number of livestock. However, these less used BMPs were left in the implementation plan in order to ensure that they will be available if they are needed in the future.

The fifth working group meeting was held on Dec 4, 2014 in the Northampton County Board Room. A total of nine people attended the meeting. The workgroup discussed the selection of BMPs to be included in the implementation plan, future plans for funding, and education needs in the watersheds. VDH representatives offered feedback on changes needed regarding septic system BMPs in each of the watersheds. In addition, the group discussed timelines for future funding requests in the area and the need for small, tailored education programs in each community.

The steering committee meeting was held on January 8, 2015 in the Northampton County Board Room. A total of twelve people attended the meeting. The committee expressed a need for septic tank inspections and molecular source tracking to be included in the plan. These changes were reflected in the plan through a more thorough explanation of septic BMPs and a brief description of how molecular source tracking could be used in the watersheds to prioritize BMP implementation efforts.

ASSESSMENT OF IMPLEMENTATION ACTION NEEDS

Since the development of the TMDLs, various BMPs have been installed in the watersheds. Agricultural BMPs that were installed between the completion of the first TMDL in June 2007 (*Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacterial Contamination The Gulf*) and the most updated record of BMPs on the Virginia Agricultural BMP and CREP Database (current as of 07/30/2014; http://dswcapps.dcr.virginia.gov/htdocs/progs/BMP_query.aspx) were

used to credit those BMPs that were installed after the development of the watershed TMDLs. The information obtained from the database contained all BMPs installed within the Virginia 6th Order National Watershed Boundary Dataset (NWBD) Unit in the region (CB45). In order to relate this larger scale data to each of the watersheds, the total number of BMP acres within CB45 was multiplied by the proportional area of each watershed (i.e., Watershed Acreage/CB45 Acreage).

Although several types of BMPS have been installed since the TMDLs were written, credit was only assessed for those BMPs that reduce bacterial loads and have been proposed in this implementation plan. The only BMP that fit these criteria was Small Grain Cover Crop for Nutrient Management and Residue Management (SL-8B). A tabulation of the total number of SL-8B credited acres within each (sub)watershed can be found in Table 6.

Table 6. Total number of SL-8B acres installed between June 1, 2007 and July 30, 2014 within each watershed.

Watershed	Units	Number of SL-8B Units Installed
The Gulf	Acres	278
Barlow Creek	Acres	108
Mattawoman Creek	Acres	334
Jacobus Creek	Acres	355
Hungars Creek	Acres	179
Hungars Creek non-TMDL Subwatershed 1	Acres	53
Hungars Creek non-TMDL Subwatershed 2	Acres	82
Hungars Creek non-TMDL Subwatershed 6	Acres	19
Hungars Creek non-TMDL Subwatershed 10	Acres	42

The four TMDL studies, along with census data, analysis of wildlife habitat availability based on GIS land cover, VDH-DSS Sanitary Shoreline Surveys, and input from stakeholder workgroups were used to evaluate the various BMPs and strategies that would be effective in reducing bacteria loading to the creeks. The workgroup considered BMPs by reflecting on cost estimates, effectiveness, and appropriateness based on the characteristics and needs of the watershed.

It should also be noted that stakeholders in the watershed expressed interest in a molecular source tracking study being conducted in the impaired watersheds in order to effectively prioritize BMP implementation. A novel polymerase chain reaction (PCR) based technique called quantitative PCR

(qPCR) has been used in the region to identify prominent sources of fecal contamination in impaired watersheds (Noble et al. 2012). The costs of molecular methodologies are considerably higher than other methods and would require an independent funding search and subsequent study that is outside the scope of the TMDL implementation planning process.

The BMP and corrective action needs in the watershed are divided into three major categories below: agricultural, residential, and education programs.

Agricultural BMPs

Agricultural lands in the watersheds are predominantly row crops. The fields are generally well buffered according to the Eastern Shore Soil and Water Conservation District.

Field surveys and stakeholder workgroups revealed very few livestock or horses in the watersheds. BMPs to address these small pastures and cropland include buffers, livestock exclusion, pasture management, and cover crops. The livestock exclusion with riparian buffers and reduced setback BMP (LE-1T, SL-6T, LE-2T), the small acreage grazing system BMP (SL-6AT), the woodland buffer filter area BMP (FR-3), the small grain cover crop BMP (SL-8B), the Sediment Retention, Erosion, or Water Control Structures BMP (WP-1), and the pasture management BMP (SL-10T) are cost-shared practices in the Virginia Agricultural Cost-Share Programs for TMDL implementation areas. All agricultural BMPs will be implemented in phase 1 (Years 1-5) of this plan. See Table 7 for a summary of the Agricultural BMPs in each of the watersheds.

Livestock exclusion
(Photo: https://pubs.ext.vt.edu/442/442-766/442-766_pdf.pdf)

Table 7. Agricultural BMPs and costs within each watershed.

			Agricultural BMPs_Estimated Units Needed									
Control Measure	**Unit**	**Unit Cost ($)**	**The Gulf**	**Barlow Creek**	**Mattawoman Creek**	**Jacobus Creek**	**Hungars Creek**	**Hungars Subwatershed 1**	**Hungars Subwatershed 2**	**Hungars Subwatershed 6**	**Hungars Subwatershed 10**	**Total**
Woodland Buffer Filter Area (FR-3)	Acres	700	21	10	25	21	9	3	9	2	2	102
Livestock Exclusion with Riparian Buffers (LE-1T, SL-6T)	System	15,000	1	1	1	1	1	0	0	0	0	5
Livestock Exclusion with Reduced Setback (LE-2T)	System	10,000	1	1	1	1	1	0	0	0	0	5
Small Acreage Grazing System (SL-6AT)	System	1,500	2	0	0	1	2	0	0	0	1	6
Small Grain Cover Crop (SL-8B) (VACS Funding)	Acres	100	112	58	140	140	50	20	52	12	10	594
Pasture Management (Livestock/horse) (SL-10T)	Acres	75	100	100	100	100	100	0	0	0	0	500
Pasture Management (Sheep/Goats) (SL-10T)	Acres	75	0	0	10	0	20	0	8	0	0	38
Sediment Retention, Erosion, or Water Control Structures (WP-1)	Acres	4,300	11	6	14	11	5	2	5	1	1	56

Residential BMPs

Rain garden (http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf)

Residential BMPs will focus on maintenance and repair of septic systems, identification and elimination of illegal "straight pipe" sewage discharges, the replacement of failed septic systems, and the installation of alternative waste treatment systems. In addition, minimization of pet waste runoff from homeowner's yards through education, pet waste composters, and installing vegetated buffers, rain gardens and pet waste collection facilities in public areas with high usage are included in the plan. For addition information on rain garden design and construction, see http://www.fairfaxcounty.gov/nvswcd/raingardenbk.pdf.

Pet Waste Station
(dogwastedepot.com)

Based on workgroup knowledge, internet searches, and observations in the watersheds, no kennels or hunt clubs were identified in the area and therefore no confined canine waste control has been proposed in this plan. However, the workgroup agreed that public pet waste disposal stations could be useful in the area. Specific locations that were suggested include fast food parking lots, welcome centers, campgrounds, and state parks. These waste stations could be maintained by property owners and/or maintenance employees where they are erected or by volunteer groups in the community. Increased availability of public pet waste stations coupled with residential education programs should result in expanded use of this BMP by the public.

Residential BMPs will be implemented in phase 1 (Years 1-5) and phase 2 (Years 6-10) of this plan. See Table 8 for a summary of all residential BMPs within the watersheds.

Septic Failure Rate and Alternative On-Site Systems

Failing septic system
(www.kingcounty.gov/healthservices/health/ehs/wastewater/owners/failure.aspx)

A 5% five-year septic system failure rate was estimated with the help of VDH representatives, who reported that no septic systems in the five watersheds were failing at the time of this report. In addition, it was estimated that 3% of the houses in the watersheds lacked septic systems.

During workgroup meetings, local stakeholders stated that septic system inspections to detect impending failures should be included in the plan. Note that the RB-1 Septic Tank Pumpout Practice proposed in this plan is described in the TMDL cost-share manual as a practice aimed at "maintenance of septic tank system by having septic tank pumped to remove solids and inspection of the septic tank." In addition, cost-share is authorized in the RB-3 Septic Tank System Repair Practice included in this plan for inspection of the distribution box in failing septic systems.

This plan recognizes the need for alternative on-site septic systems where site conditions do not permit a traditional septic system. A GIS analysis was performed that compared the current position of residential structures and the location of soils that are unfavorable for conventional septic system installation (Figure 4). The number of residential structures on these unfavorable soil types was then multiplied by the 5% five-year septic failure rate. This provided an estimate of the total number of alternative on-site waste systems that would be needed within each watershed. Based on this analysis, a total of 15 alternative on-site septic systems may be needed within the entire implementation region. A similar calculation was made in a recent implementation plan for a neighboring watershed and can be found at: http://www.deq.virginia.gov/Portals/0/DEQ/Water/TMDL/ImplementationPlans/Kings_Creek_IP_Technical_Report.pdf.

Figure 4. Map of soils unfavorable for conventional septic systems and locations of residential structures.

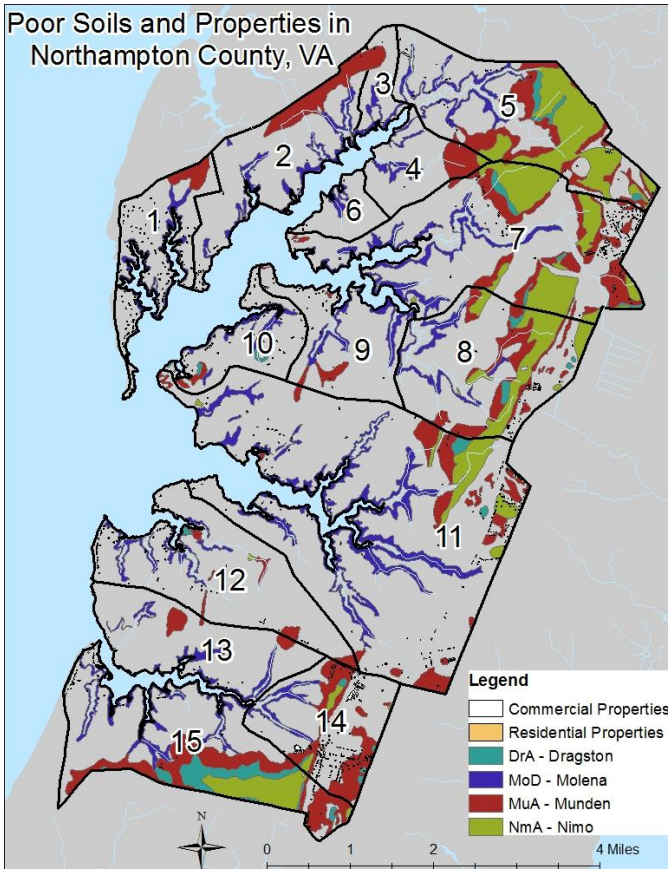


Table 8. Residential BMPs needed per watershed and unit costs.

			Residential BMPs_Estimated Units Needed									
Control Measure	Unit	Unit Cost ($)	The Gulf	Barlow Creek	Mattawoman Creek	Jacobus Creek	Hungars Creek	Hungars Subwatershed 1	Hungars Subwatershed 2	Hungars Subwatershed 6	Hungars Subwatershed 10	Total
Phase 1 (Years 1-5) Septic Tank Pumpout (RB-1)	System	300	237	60	178	225	49	134	22	4	48	957
Phase 2 (Years 6-10) Septic Tank Pumpout (RB-1)	System	300	258	65	194	243	62	146	24	5	52	1049
Septic System Repair (RB-3)	System	3,000	5	1	3	3	3	2	1	1	1	20
Septic System Replacement/Installation (RB-4)	System	6,000	8	3	7	8	5	5	1	0	3	40
Septic System Replacement/Installation with Pump (RB-4P)	System	6,500	4	1	3	4	3	2	0	0	1	18
Alternative On-Site System (RB-5)	System	25000	4	0	3	3	2	2	0	0	0	14
Pet Waste Composter	System	50	80	20	60	75	20	45	10	3	15	328
Pet Waste Station (facility/signage/supplies)		600	7	3	5	5	2	4	1	0	2	29
Vegetated Buffer on Residential Land	Acres	400	5	2	5	5	2	5	1	1	1	27
Rain Garden	Acres	5,000	8	3	8	9	4	8	2	1	2	45

Education Programs

In addition to standard BMPs, several target audiences were identified for educational outreach efforts. The first group was recreational boaters that use the public boat ramps and marinas in the watersheds along with other boaters that may enter the creek for recreational purposes. The focus of this educational effort will be to inform boaters about the availability of sanitary pump out facilities in the area and the detrimental impact overboard discharge of human waste can have on water quality.

Another educational program will focus on aquaculture education, or "oyster gardening." Funds may be used to support educational efforts aimed at helping homeowners set up their own dockside oyster floats and offering a lecture series on the latest research in oyster culture. Oyster gardening can build stronger connections to local water quality. The Anheuser-Busch Coastal Research Center (ABCRC), which is located near Oyster, Virginia, regularly offers oyster gardening workshops (http://www.abcrc.virginia.edu/siteman1/?q=Teachers). More information about oyster gardening can be found on the DEQ website (http://www.deq.virginia.gov/programs/coastalzonemanagement/czmissuesinitiatives/oysters/gardening.aspx).

Finally there will be several education outreach efforts to residential property owners in the watersheds. Educational materials will address managing nuisance wildlife, pet waste management, and proper care and maintenance of septic systems. Proper septic system maintenance includes: knowing the location of the system components and protecting them (*e.g.,* not driving or parking on top of septic tanks or drain fields, not planting trees where roots could damage the system), keeping hazardous chemicals out of the system, minimizing or eliminating the use of garbage disposals, pumping out the septic tank every five years, and knowing how to identify system problems. Resources from the "Septic Smart" program, which was created by EPA, can be used to education homeowners in the watersheds (www.epa.gov/septicsmart). Education for regional plumbers and septic professionals on how to properly inspect septic system components was identified by stakeholders as an additional area that would be useful in the watershed.

Because all of the watersheds in this implementation plan are in close proximity to one another, one allocation of educational and wildlife management program money has been proposed for the entire area. The implementation costs included for these programs within each watershed reflect a proportion of the total cost for the entire area; however it should be noted that these funds may be moved around between watersheds based on funding needs. For example, although recreational boater education was allotted $3,000 as part of this plan, each of the 5 TMDL watersheds was assigned $600 ($3,000/5 TMDL watersheds = $600 per TMDL watershed). The total amount allotted for residential education was $2,500 ($500 per TMDL watershed), the total amount allotted for aquaculture education was $2,500 ($500 per TMDL watershed), and the total amount allotted for wildlife education and management was $10,000 ($2,000 per TMDL watershed). Education and

wildlife program funds were not included in the budgets for subwatersheds 1, 2, 6, and 10 in Hungars Creek because they were already accounted for in the budgets for the TMDL watersheds; however, the potential fecal coliform reduction associated with these programs were factored into the overall reductions in the subwatersheds. Education programs will be incorporated into phase 1 (Years 1-5) and phase 2 (Years 6-10) of this plan. See Table 9 for a summary of education programs within each phase.

Table 9. Education programs needed for all watersheds (cost split among all watersheds).

		Education programs	
Phase 1 (Years 1-5)	**Phase 2 (Years 6-10)**	**Total cost per program ($)**	**Practice**
1	1	3,000	Recreational Boater Education Program
1	1	2,500	Residential Education Program (pet, septic)
1	1	2,500	Aquaculture (Oyster Gardening) Education Program
	1	10,000	Wildlife Education/Management Program

Phased Implementation

Initial implementation efforts (Phase 1) will focus on the most cost effective BMPs and educational programs that reduce human, pet, and livestock sources of contamination. Upon completion of Phase 1, water quality will be re-assessed to determine if water quality standards are attained. If water quality standards are not being met, additional actions, including continuation of Phase 1 educational programs and wildlife control education may be implemented in Phase 2. In addition, local citizens may elect to move forward with wildlife management plans to address fecal coliform contributions. These plans typically evaluate wildlife populations and explore control options in order to maintain sustainable wildlife levels based on local citizen objectives.

Information regarding nuisance wildlife laws and conflict resolution can be found on the Virginia Department of Game and Inland Fisheries (VDGIF) website (http://www.dgif.virginia.gov/wildlife/problems/).

The US Fish and Wildlife Service has revised federal regulations to include depredation orders relating to resident Canada geese that can cause injury to people, property, agricultural crops, or other interests. The Nest and Egg Depredation Order allows for the destruction of resident Canada geese nests and eggs by landowners, homeowners associations, public land managers, and local governments once they have registered the land they own on the Resident Canada Goose Nest and Egg Registration Site (https://epermits.fws.gov/eRCGR/geSI.aspx?ReturnUrl=%2feRCGR). The Agricultural Depredation Order allows agricultural producers to control resident Canada geese using certain lethal methods when the geese are damaging crops. For details and permitting information for this practice, see the VDGIF website (http://www.dgif.virginia.gov/wildlife/problems/canada-geese/).

There are several non-lethal deer management options recommended by VDGIF: fencing, keeping dogs in areas where deer are unwanted, loud noises, and chemicals that will taste or smell bad to deer. If these management techniques are unsuccessful, there are five programs available to landowners: the Deer Management Assistance Program (DMAP), Damage Control Assistance Program (DCAP), kill permits, Deer Population Reduction Program (DPOP), and the urban archery season. For details on these five programs, see the VDGIF website (http://www.dgif.virginia.gov/wildlife/problems/deer/).

If water quality standards are still not met, a use attainability analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. The outcome of the UAA may lead to the determination that the designated uses of the waters may need to be changed to reflect the attainable uses.

Table 10. Projected bacterial load reductions during Phase 1 and Phase 2 implementation within each watershed.

Watershed	Proportion of Bacteria Reduction to be Completed by End of Phase 1 (%)[a]	Proportion of Bacteria Reduction to be Completed by End of Phase 2 (%)[b]
The Gulf	42.8	100
Barlow Creek	45.5	100
Mattawoman Creek	46.9	100
Jacobus Creek	34.7	100
Hungars Creek	22.7	100
Hungars Creek non-TMDL Subwatershed 1	46.3	100
Hungars Creek non-TMDL Subwatershed 2	14.1	100
Hungars Creek non-TMDL Subwatershed 6	15.7	100
Hungars Creek non-TMDL Subwatershed 10	30.0	100

[a] These percentages indicate progress towards the overall bacteria load reductions; they should not be confused with the overall percent reductions reported earlier in Table 5.
[b] A 100% in this column indicates that all required bacteria reductions should be completed by the end of Phase 2.

COST / BENEFIT ANALYSIS

Cost estimates of the agricultural, residential, and other BMPs in this plan were calculated by multiplying the unit cost by the number of BMP units in each watershed. The unit cost estimates for the agricultural BMPs were derived from DCR's Agricultural Cost Share Database. Average costs for BMP installations were used. The unit costs for residential practices were developed through estimates from previous TMDL IPs and discussions with the workgroups. Cost share septic system

funding was also useful for determining practice costs. Estimates for education programs were based on target audience size and experiences in other TMDL IPs. See Tables 11-19 for summaries of implementation actions in each of the watersheds. The total phase 1 (years 1-5) cost estimate for the entire area was $1,877,650 and is broken down by watershed below:

The Gulf: $420,600
Barlow Creek: $136,800
Mattawoman Creek: $373,450
Jacobus Creek: $390,850
Hungars Creek: $217,600
Subwatershed 1 in Hungars Creek: $198,550
Subwatershed 2 in Hungars Creek: $60,700
Subwatershed 6 in Hungars Creek: $16,650
Subwatershed 10 in Hungars Creek: $62,450

Additional Phase 2 (years 6-10) implementation costs for all of the watersheds combined was estimated to be $332,700 and was distributed as follows:

The Gulf: $81,000
Barlow Creek: $23,100
Mattawoman Creek: $61,800
Jacobus Creek: $76,500
Hungars Creek: $22,200
Subwatershed 1 in Hungars Creek: $43,800
Subwatershed 2 in Hungars Creek: $7,200
Subwatershed 6 in Hungars Creek: $1,500
Subwatershed 10 in Hungars Creek: $15,600

When looking at the amount of money allotted for education programs on a per unit basis in the following tables, please note that the educational and wildlife management budgets can be shifted between each of the watersheds as long as the total budget for all of the watersheds combined is not exceeded. For example, although recreational boater education was allotted $3,000 as part of this plan, each of the 5 TMDL watersheds was assigned $600 ($3,000/5 TMDL watersheds = $600 per TMDL watershed). The total amount allotted for residential education was $2,500 ($500 per TMDL watershed), the total amount allotted for aquaculture education was $2,500 ($500 per TMDL watershed), and the total amount allotted for wildlife education and management was $10,000 ($2,000 per TMDL watershed). Education and wildlife program funds were not included in the budgets for subwatersheds 1, 2, 6, and 10 in Hungars Creek because they were already accounted for in the budgets for the TMDL watersheds; however, the potential FC reduction associated with these programs were factored into the overall reductions in the subwatersheds.

Table 11. Implementation costs for the Gulf.

The Gulf Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
21	Woodland Buffer Filter Area	FR-3	$700	$14,700
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Livestock Exclusion with Reduced Setback	LE-2T	$10,000	$10,000
2	Small Acreage Grazing System	SL-6AT	$1,500	$3,000
112	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$11,200
100	Pasture Management (Livestock/horse)	SL-10T	$75	$7,500
11	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$47,300
237	Septic Tank Pump Out - MANDATORY	RB-1	$300	$71,100
5	Septic System Repair	RB-3	$3,000	$15,000
8	Septic System Installation/Replacement	RB-4	$6,000	$48,000
4	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$26,000
4	Alternative on Site Systems	RB-5	$25,000	$100,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
5	Vegetated Buffer on Residential Land		$400	$2,000
8	Rain Garden		$5,000	$40,000
80	Residential Pet Waste Composters		$50	$4,000
7	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$4,200
Phase 1 Total				$420,600
Optional - Phase 2 Implementation Costs				
258	Septic Tank Pump Out - MANDATORY	RB-1	$300	$77,400
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$2,000
Optional - Phase 2 Total				$81,000
Total The Gulf				$501,600

Table 12. Implementation costs for Barlow Creek.

Barlow Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
10	Woodland Buffer Filter Area	FR-3	$700	$7,000
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Livestock Exclusion with Reduced Setback	LE-2T	$10,000	$10,000
58	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$5,800
100	Pasture Management (Livestock/horse)	SL-10T	$75	$7,500
6	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$25,800
60	Septic Tank Pump Out - MANDATORY	RB-1	$300	$18,000
1	Septic System Repair	RB-3	$3,000	$3,000
3	Septic System Installation/Replacement	RB-4	$6,000	$18,000
1	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$6,500
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
2	Vegetated Buffer on Residential Land		$400	$800
3	Rain Garden		$5,000	$15,000
20	Residential Pet Waste Composters		$50	$1,000
3	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$1,800
Phase 1 Total				$136,800
Optional - Phase 2 Implementation Costs				
65	Septic Tank Pump Out - MANDATORY	RB-1	$300	$19,500
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$2,000
Optional - Phase 2 Total				$23,100
Total Barlow Creek				$159,900

Table 13. Implementation costs for Mattawoman Creek.

Mattawoman Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
25	Woodland Buffer Filter Area	FR-3	$700	$17,500
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Livestock Exclusion with Reduced Setback	LE-2T	$10,000	$10,000
140	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$14,000
100	Pasture Management (Livestock/horse)	SL-10T	$75	$7,500
10	Pasture Management (sheep)	SL-10T	$75	$750
14	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$60,200
178	Septic Tank Pump Out - MANDATORY	RB-1	$300	$53,400
3	Septic System Repair	RB-3	$3,000	$9,000
7	Septic System Installation/Replacement	RB-4	$6,000	$42,000
3	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$19,500
3	Alternative on Site Systems	RB-5	$25,000	$75,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
5	Vegetated Buffer on Residential Land		$400	$2,000
8	Rain Garden		$5,000	$40,000
60	Residential Pet Waste Composters		$50	$3,000
5	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$3,000
Phase 1 Total				$373,450
Optional - Phase 2 Implementation Costs				
194	Septic Tank Pump Out - MANDATORY	RB-1	$300	$58,200
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$2,000
Optional - Phase 2 Total				$61,800
Total Mattawoman Creek				$435,250

Table 14. Implementation costs for Jacobus Creek.

Jacobus Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
21	Woodland Buffer Filter Area	FR-3	$700	$14,700
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Livestock Exclusion with Reduced Setback	LE-2T	$10,000	$10,000
1	Small Acreage Grazing System	SL-6AT	$1,500	$1,500
140	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$14,000
100	Pasture Management (Livestock/horse)	SL-10T	$75	$7,500
11	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$47,300
225	Septic Tank Pump Out - MANDATORY	RB-1	$300	$67,500
3	Septic System Repair	RB-3	$3,000	$9,000
8	Septic System Installation/Replacement	RB-4	$6,000	$48,000
4	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$26,000
3	Alternative on Site Systems	RB-5	$25,000	$75,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
5	Vegetated Buffer on Residential Land		$400	$2,000
9	Rain Garden		$5,000	$45,000
75	Residential Pet Waste Composters		$50	$3,750
5	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$3,000
Phase 1 Total				$390,850
Optional - Phase 2 Implementation Costs				
243	Septic Tank Pump Out - MANDATORY	RB-1	$300	$72,900
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$2,000
Optional - Phase 2 Total				$76,500
Total Jacobus Creek				$467,350

Table 15. Implementation costs for Hungars Creek.

Hungars Creek Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
9	Woodland Buffer Filter Area	FR-3	$700	$6,300
1	Livestock Exclusion with Riparian Buffers	LE-1T	$15,000	$15,000
1	Livestock Exclusion with Reduced Setback	LE-2T	$10,000	$10,000
2	Small Acreage Grazing System	SL-6AT	$1,500	$3,000
50	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$5,000
100	Pasture Management (Livestock/horse)	SL-10T	$75	$7,500
20	Pasture Management (sheep)	SL-10T	$75	$1,500
5	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$21,500
49	Septic Tank Pump Out - MANDATORY	RB-1	$300	$14,700
3	Septic System Repair	RB-3	$3,000	$9,000
5	Septic System Installation/Replacement	RB-4	$6,000	$30,000
3	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$19,500
2	Alternative on Site Systems	RB-5	$25,000	$50,000
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
2	Vegetated Buffer on Residential Land		$400	$800
4	Rain Garden		$5,000	$20,000
20	Residential Pet Waste Composters		$50	$1,000
2	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$1,200
Phase 1 Total				$217,600
Optional - Phase 2 Implementation Costs				
62	Septic Tank Pump Out - MANDATORY	RB-1	$300	$18,600
1	Recreational Boater Education Programs		$600	$600
1	Residential Education Programs (pet, septic, horse/sheep)		$500	$500
1	Aquaculture Education Workshops (public/restaurant)		$500	$500
1	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$2,000
Optional - Phase 2 Total				$22,200
Total Hungars Creek				$239,800

Table 16. Implementation costs for Subwatershed 1 in Hungars Creek. The costs associated with education and wildlife programs were factored into the five TMDL watershed budgets and therefore are not included in the costs associated with this subwatershed.

Subwatershed 1 (Hungars Creek) Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
3	Woodland Buffer Filter Area	FR-3	$700	$2,100
20	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$2,000
2	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$8,600
134	Septic Tank Pump Out - MANDATORY	RB-1	$300	$40,200
2	Septic System Repair	RB-3	$3,000	$6,000
5	Septic System Installation/Replacement	RB-4	$6,000	$30,000
2	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$13,000
2	Alternative on Site Systems	RB-5	$25,000	$50,000
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
5	Vegetated Buffer on Residential Land		$400	$2,000
8	Rain Garden		$5,000	$40,000
45	Residential Pet Waste Composters		$50	$2,250
4	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$2,400
Phase 1 Total				$198,550
Optional - Phase 2 Implementation Costs				
146	Septic Tank Pump Out - MANDATORY	RB-1	$300	$43,800
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$0
Optional - Phase 2 Total				$43,800
Total Subwatershed 1 (Hungars Creek)				$242,350

Table 17. Implementation costs for Subwatershed 2 in Hungars Creek. The costs associated with education and wildlife programs were factored into the five TMDL watershed budgets and therefore are not included in the costs associated with this subwatershed.

Subwatershed 2 (Hungars Creek) Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
9	Woodland Buffer Filter Area	FR-3	$700	$6,300
52	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$5,200
8	Pasture Management (Goats)	SL-10T	$75	$600
5	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$21,500
22	Septic Tank Pump Out - MANDATORY	RB-1	$300	$6,600
1	Septic System Repair	RB-3	$3,000	$3,000
1	Septic System Installation/Replacement	RB-4	$6,000	$6,000
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
1	Vegetated Buffer on Residential Land		$400	$400
2	Rain Garden		$5,000	$10,000
10	Residential Pet Waste Composters		$50	$500
1	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$600
Phase 1 Total				$60,700
Optional - Phase 2 Implementation Costs				
24	Septic Tank Pump Out - MANDATORY	RB-1	$300	$7,200
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$0
Optional - Phase 2 Total				$7,200
Total Subwatershed 2 (Hungars Creek)				$67,900

Table 18. Implementation costs for Subwatershed 6 in Hungars Creek. The costs associated with education and wildlife programs were factored into the five TMDL watershed budgets and therefore are not included in the costs associated with this subwatershed.

Subwatershed 6 (Hungars Creek) Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
2	Woodland Buffer Filter Area	FR-3	$700	$1,400
12	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,200
1	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$4,300
4	Septic Tank Pump Out - MANDATORY	RB-1	$300	$1,200
1	Septic System Repair	RB-3	$3,000	$3,000
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
1	Vegetated Buffer on Residential Land		$400	$400
1	Rain Garden		$5,000	$5,000
3	Residential Pet Waste Composters		$50	$150
Phase 1 Total				$16,650
Optional - Phase 2 Implementation Costs				
5	Septic Tank Pump Out - MANDATORY	RB-1	$300	$1,500
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$0
Optional - Phase 2 Total				$1,500
Total Subwatershed 6 (Hungars Creek)				$18,150

Table 19. Implementation costs for Subwatershed 10 in Hungars Creek. The costs associated with education and wildlife programs were factored into the five TMDL watershed budgets and therefore are not included in the costs associated with this subwatershed.

Subwatershed 10 (Hungars Creek) Implementation Costs				
Units	Practice	Practice Number	Per Unit Cost	Estimated Cost
2	Woodland Buffer Filter Area	FR-3	$700	$1,400
1	Small Acreage Grazing System	SL-6AT	$1,500	$1,500
10	Small Grain Cover Crop for NM (VACS Funding)	SL-8B	$100	$1,000
1	Sediment Retention, Erosion, or Water Control Structures	WP-1	$4,300	$4,300
48	Septic Tank Pump Out - MANDATORY	RB-1	$300	$14,400
1	Septic System Repair	RB-3	$3,000	$3,000
3	Septic System Installation/Replacement	RB-4	$6,000	$18,000
1	Septic System Installation/Replacement with Pump	RB-4P	$6,500	$6,500
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
1	Vegetated Buffer on Residential Land		$400	$400
2	Rain Garden		$5,000	$10,000
15	Residential Pet Waste Composters		$50	$750
2	Public Pet Waste Collection Facility/Trash Can/Signage/Supplies		$600	$1,200
Phase 1 Total				$62,450
Optional - Phase 2 Implementation Costs				
52	Septic Tank Pump Out - MANDATORY	RB-1	$300	$15,600
	Recreational Boater Education Programs		$600	$0
	Residential Education Programs (pet, septic, horse/sheep)		$500	$0
	Aquaculture Education Workshops (public/restaurant)		$500	$0
	Wildlife Education/Mgmt. Program (~95% of required wildlife load)		$2,000	$0
Optional - Phase 2 Total				$15,600
Total Subwatershed 10 (Hungars Creek)				$78,050

The primary benefit of this implementation is cleaner water in the Gulf, Barlow Creek, Mattawoman Creek, Jacobus Creek, and Hungars Creek. The goal is to implement the IP so that fecal contamination may be reduced and allow for the removal of the condemnation of the shellfish

Photo: Dana Gonzalez

growing areas. The principal benefit to the oyster growers in these creeks would be that once the water quality is restored, they would no longer need to transport their floats to clean water to depurate oysters prior to consumption. It is important to note that there are substantial aquaculture activities in Cherrystone Inlet, which is less than 6 miles south of the Gulf. All of these creeks already meet the state water quality standards for safe swimming. However, further reducing fecal contamination levels in these creeks, particularly from human sources will improve public health by reducing the risk of infection from fecal sources through contact with surface waters.

The residential programs will play an important role in improving water quality, but there may also be additional return on the investment in terms of economic benefits to homeowners. An improved understanding of private on-site sewage systems (including knowledge of what steps can be taken to keep them functioning properly and the need for regular maintenance) will give homeowners the tools needed for extending the life of their systems and reducing the overall cost of ownership. The replacement of failing on-site sewage disposal systems with new septic or alternative treatment systems will have a direct and substantial impact by improving property values and improving the local economy.

An important objective of the implementation plan is to foster continued economic vitality and strength. This objective is based on the recognition that healthy waters improve economic opportunities for Virginians, and a healthy economic base enhances the resources and funding necessary to pursue restoration and enhancement activities. The agricultural and residential practices recommended in this document are expected to provide economic benefits, as well as environmental benefits, to the property owners in these watersheds.

TARGETING

The priority order for implementation activities within each of the watersheds is as follows:

Highest priority: The Gulf, Hungars Creek (Subwatersheds 3, 4, 5), Jacobus Creek, and Mattawoman Creek have the highest implementation priority because they all have EPA approved TMDLs and current shellfish bed closures.

Medium priority: Hungars Subwatershed 1 has a medium implementation priority because it was not initially included in the Hungars Creek TMDL, but does have current shellfish bed closures.

Lower priority: Implementation in Subwatersheds 2, 6, and 10 in Hungars Creek will have a lower priority because they were not included in the Hungars Creek TMDL and there are no current impairments in these watersheds. In addition, implementation in Barlow Creek will be of lower priority because there are currently no shellfish closures in this watershed.

STAKEHOLDER ROLES AND RESPONSIBILITIES

Stakeholders are individuals who live or have land management responsibilities in the watershed, including government agencies, businesses, private citizens, and special interest groups. Achieving the goals of the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creek TMDL IP efforts (i.e. improving water quality and removing these waters from the impaired waters list) is dependent on stakeholder participation. Both the local stakeholders who are charged with the implementation of control measures and the government stakeholders who are responsible for overseeing human health and environmental programs must first acknowledge there is a water quality problem, and then make the needed changes in operations, programs, and legislation to address the pollutants.

The **EPA** has the responsibility for overseeing the various programs necessary for the success of the Clean Water Act. However, administration and enforcement of such programs falls largely to the states. In the Commonwealth of Virginia, water quality problems are dealt with through legislation, incentive programs, education, and legal actions. Currently, there are five state agencies responsible for regulating and providing educational outreach for activities that impact water quality with regard to this implementation plan. These agencies include: the Department of Environmental Quality, the Department of Conservation and Recreation, the Department of Health, the Department of Agriculture and Consumer Services (VDACS), and VA Cooperative Extension (VCE).

DEQ is responsible for monitoring the waters to determine compliance with state standards, and for requiring permitted point source dischargers to maintain pollutant loads and concentrations within permit limits. They have the regulatory authority to levy fines and take legal action against those in violation of permits. Additionally, DEQ is responsible for presenting this IP to the SWCB for approval as the plan for implementing pollutant allocations and reductions contained in the TMDLs. DEQ is responsible for addressing nonpoint sources (NPS) of pollution as of July 1, 2013.

Historically, most **DCR** programs dealt with agricultural NPS pollution through education and voluntary incentive programs. These cost-share programs were originally developed to meet the needs of voluntary partial participation and not the TMDL-required 100% participation of stakeholders. To meet the needs of the TMDL program and achieve the goals set forth in the CWA, the incentives under this program have been adjusted to account for 100% participation. It should be noted that DCR does not have regulatory authority over the majority of NPS issues addressed in

this document. Their Division of Chesapeake Bay Local Assistance enforces compliance with the Chesapeake Bay Preservation Act, including septic pump out requirements and the protection of Resource Protection Areas (RPAs) and Resource Management Areas (RMAs).

Through Virginia's Agricultural Stewardship Act, the **VDACS Commissioner of Agriculture** has the authority to investigate claims that an agricultural producer is causing a water quality problem on a case-by-case basis. If deemed a problem, the Commissioner can order the producer to submit an agricultural stewardship plan to the local soil and water conservation district. If a producer fails to implement the plan, corrective action can be taken, which can include a civil penalty up to $5,000 per day. The Commissioner of Agriculture can issue an emergency corrective action if runoff is likely to endanger public health, animals, fish and aquatic life, public water supply, ect. An emergency order can shut down all or part of an agricultural activity and require specific stewardship measures. The enforcement of the Agriculture Stewardship Act is entirely complaint driven.

VDH is responsible for maintaining safe drinking water measured by standards set by EPA. Their duties also include On-Site Sewage Disposal regulation. Like VDACS, VDH's program is complaint-driven. Complaints can range from a vent pipe odor that is not an actual sewage violation and takes very little time to investigate, to a large discharge violation from a failed septic system that may take many weeks or longer to achieve compliance. VDH has the responsibility of enforcing actions to correct or eliminate failed systems and straight pipes (Swage Handling and Disposal Regulations, 12 VAC 5-610-10 *et seq.*). Their Division of Shellfish Sanitation (DSS) is responsible for protecting the health of shellfish consumers by ensuring that growing waters are properly classified for harvesting. DSS monitors water quality in shellfish growing areas and provides shellfish closings and sanitary surveys to identify deficiencies along the shoreline. They also administer the Clean Marina Program to address the proper operation of pump out facilities and boater education.

VCE is an educational outreach program of Virginia's land grant universities (Virginia Tech and Virginia State University), and is a part of the national Cooperative State Research, Education and Extension Service, an agency of the United States Department of Agriculture. VCE is a product of cooperation among local, state and federal governments in partnership with local citizens. VCE offers educational outreach and technical resources on topics such as crops, grains, livestock, dairy, horse pasture management, natural resources and environmental management. VCE has several publications related to TMDLs and promotes water quality education and outreach methods to citizens, businesses, and developers regarding necessary pet waste reductions. For more information on publications and county extension offices, visit www.ext.vt.edu.

VDOF (Virginia Department of Forestry) 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. Forestry BMPs are intended to primarily control erosion. For example, streamside buffers provide nutrient uptake and soil stabilization, which can benefit water quality by reducing the amount of nutrients and sediment that enter local streams.

The **NRCS** (Natural Resources Conservation Service) is the federal agency that works hand-in-hand with the American people to conserve natural resources on private lands. NRCS assists private landowners with conserving their soil, water, and other natural resources. Local, state, and federal agencies along with policymakers rely on the expertise of the NRCS staff. NRCS is a major funding stakeholder for impaired water bodies through the CREP and EQIP programs.

The **Eastern Shore Soil and Water Conservation District (ESSWCD)** works with many agricultural producers in the region to improve agricultural practices and minimize impacts to the area waterways. In addition to the farming community, they work with citizens on erosion and sediment related compliance concerns and encourage innovative techniques for dealing with stormwater.

The **Eastern Shore Roundtable** has been facilitated by the **Eastern Shore Resource Conservation and Development Council** (ES RC&D) since 2009. The roundtable conducts quarterly meetings in which they discuss water quality concerns and ongoing programs. They are heavily focused on education and outreach to local landowners and farmers and as such conduct many workshops throughout the year that are focused on water quality improvement.

State government has the authority to establish state laws that control delivery of pollutants to local waters. Local governments, in conjunction with the state, can develop ordinances involving pollution prevention measures. In addition, they can take a leading role in water quality and pet owner education through mailings to landowners, but would need assistance from the Steering Committee and other area groups for the content of these mailed materials. The county will be a key partner in seeking grant funds to repair/replace failing on-site sewage disposal systems and to fund the various education programs proposed in the IP.

Successful implementation depends on stakeholders taking responsibility for their role in the process. While the primary role falls on the landowner, local, state, and federal agencies also have a stake in seeing that Virginia's waters are clean and provide a healthy environment for citizens. While it is unreasonable to expect that the natural environment (*e.g.,* streams and rivers) can be made 100% free of risk to human health, it is possible and desirable to minimize pollution related to humans. Virginia's approach to correcting NPS pollution problems has been, and continues to be, primarily encouragement of participation through education and financial incentives. It is noted that while this IP has been prepared for bacteria impairments in the watersheds, many of the BMPs will also result in reductions in nutrients and sediment reaching the Chesapeake Bay and therefore contribute also to improvements called for in the Chesapeake Bay Watershed Implementation Plan.

Table 20. Implementation responsibilities for the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creek plans.

Practice	Implementation Responsibility	Oversight Responsibility	Potential Funding
Livestock Exclusion/Buffers	Landowners, SWCD, NRCS	SWCD	Cost-Share

Small Acreage Grazing	Landowners, SWCD, NRCS	SWCD	Cost-Share
Vegetated Buffer on Cropland	Landowners, SWCD, NRCS	SWCD	Cost-Share
Cover Crops on Agricultural Lands	Landowners, SWCD, NRCS	SWCD	Cost-Share
Pasture Management	Landowners, SWCD, NRCS	SWCD	Cost-Share
Septic Tank Pump Out	Landowners, A-NPDC	County, VDH	Private, Grant
Septic System Repair	Landowners, A-NPDC	County, VDH	Private, Grant
Septic System Installation/Replacement	Landowners, A-NPDC	County, VDH	Private, Grant
Septic System Installation/Replacement with Pump	Landowners, A-NPDC	County, VDH	Private, Grant
Alternative On-site Systems	Landowners, A-NPDC	County, VDH	Private, Grant
Educational Programs	Local Citizen Groups, ES Roundtable/ES RC&D, VCE, nearby University organizations, SWCD, NRCS	None	Grant
Vegetated Buffers on Residential Land	Landowners, VDOF	County	Grant
Residential Pet Waste Composters	Landowners, SWCD, ES Roundtable/ES RC&D	None	Grant
Public Pet Waste Collection Facility/Signage/Supplies	Local Citizen Groups, ES Roundtable/ES RC&D, SWCD, State Parks, Private Property Owners, Campgrounds	None	Grant

MEASURABLE GOALS AND MILESTONES FOR ATAINING WATER QUALITY STANDARDS

Timeline and Milestones

The goals of implementation are restored water quality in the Gulf, Barlow, Mattawoman, Jacobus, and Hungars Creeks, the removal of the shellfish growing areas from Virginia's Section 303(d)

impaired waters list, and the lifting of the shellfish condemnations on the creeks. Progress toward the end goals will be assessed during implementation through tracking of BMP installations and continued water quality monitoring. Phase 1 implementation is estimated to take five years. The septic BMPs identified in the implementation plan, including repairs, replacements, and pump outs, will be continuous over a five year maintenance cycle.

Year 1 will include implementation of septic system BMPs, including pump outs, repairs, replacement, and installation of alternative septic systems where they are needed. Septic tank pump outs will be prioritized for residents identified as reaching the five year point since their last documented service. In addition, residential education programs focused on septic system maintenance, pet waste management, and nuisance wildlife management will occur in year 1.

Year 2 of implementation will continue septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more). Residential education programs focused on pet waste management, vegetated buffers, and rain gardens will occur in year 2. Pet waste composters will be distributed as part of this education effort. Livestock exclusion and grazing system BMP opportunities will be included in year 2 activities.

Year 3 will include residential boater education and aquaculture education programs. In addition, septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more) will continue in year 3. Pet waste stations will be installed in high traffic locations and areas frequented by dog walkers. In addition, agricultural BMP practices will be implemented in year 3.

Year 4 of implementation will include increased establishment of residential and woodland buffers and rain gardens. Continued septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more) will occur in year 4.

Year 5 of implementation will provide an opportunity to complete any BMPs or education programs that were not completed in previous years as scheduled. In addition, septic repairs, replacements, and pump outs (especially for households that have not been serviced in five years or more) will continue. Residential and woodland buffer establishment and rain garden construction will be continued in year 5.

Upon completion of the five year Phase 1 implementation period, all of the BMPs and education programs identified in this plan should have been implemented, thereby addressing all human sources of bacteria. Assuming that these reduced loads are maintained and no new bacteria sources are added, the creeks should be on track for delisting. However, it is possible that wildlife loads may still need to be addressed to meet TMDL reductions.

Upon completion of Phase 1 implementation, water quality will be reassessed to determine if the water quality standard is attained. If water quality standards are not being met, the local citizens may elect to move forward with Phase 2 (years 6-10) implementation to address the fecal coliform contribution from wildlife through a wildlife management plan and additional education. A UAA

may be initiated to reflect the presence of naturally high bacteria levels due to uncontrolled sources. The outcomes of the UAA may lead to the determination that the designated use(s) of the waters may need to be changed to reflect the attainable use(s).

Tracking Implementation

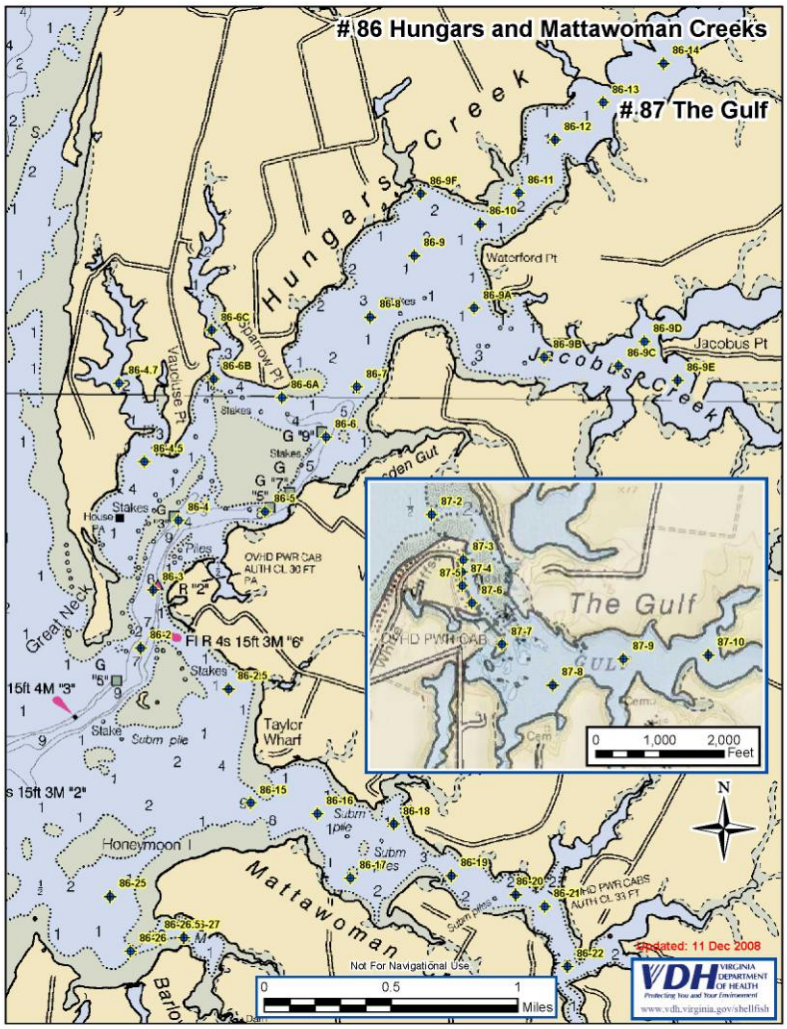
Tracking of BMP implementation will serve as an interim measure of progress toward improving water quality in these creeks. Agricultural BMPs installed through the Virginia Agricultural Cost-Share Program will be tracked in the Agricultural Cost-Share Database. Repairs or replacements of onsite septic systems and straight pipes identified in the shoreline sanitary survey can be tracked through the VDH and can be monitored on their website at http://www.vdh.state.va.us/EnvironmentalHealth/Shellfish/documents/shoreline_survey.pdf. Northampton County may track pump out notices and associated compliance rates as part of their CBPA strategy.

Monitoring

Improvements in water quality and implementation progress will ultimately be determined through monitoring conducted by VDH-DSS at established bacteriological monitoring stations in accordance with its shellfish monitoring program. DEQ will continue to use data from these monitoring stations and related ambient monitoring stations to evaluate improvements in the bacterial community and the effectiveness of TMDL implementation in attainment of the general water quality standard. VDH-DSS water quality monitoring can be accessed using the agency's GIS Data Viewing tool which uses Google Earth at: http://www.vdh.state.va.us/EnvironmentalHealth/Shellfish/documents/ShellfishSanitation.kml. In addition, see Figure 5 for the locations of VDH-DSS monitoring stations within the watersheds.

Photo: Dana Gonzalez

Figure 5. Locations of fecal coliform measurement stations monitored by VDH-DSS.



Additional monitoring may be conducted by citizen monitors to better identify bacterial sources and the effectiveness of implementation actions. Funding through DEQ for a Citizen Monitoring Program to track implementation progress and refine targeting of bacterial sources that need corrective actions can be pursued.

INTEGRATION WITH OTHER WATERSHED PLANS AND PROJECTS

Virginia's watersheds are managed under a variety of individual, though related, water quality programs and activities, many of which have specific geographical boundaries and goals. These include, but are not limited to the Chesapeake Bay TMDL and Watershed Implementation Plan, TMDLs, Watershed Roundtables, Water Quality Management Plans, Watershed Management Plans,

Erosion and Sediment Control regulations, Stormwater Management Program, Source Water Assessment Program, Green Infrastructure Plans, and local comprehensive plans.

Current on-going watershed projects or programs within Northampton County/Eastern Shore to be integrated with this IP include:

- Northampton County Comprehensive Plan
- Northampton County Septic Tank Pump-Out and Inspection
- Northampton County Chesapeake Bay Preservation Ordinance
- Accomack-Northampton Planning District Commission (A-NPDC) Septic System Pump-Out Assistance Program
- Eastern Shore of Virginia Groundwater Committee
- Eastern Shore Soil and Water Conservation District Agricultural Cost Share Program
- Eastern Shore Watershed Roundtable

POTENTIAL FUNDING SOURCES

Potential funding sources available during implementation were identified during IP development. A brief description of the programs and their requirements are provided in this chapter. Detailed descriptions can be obtained from the Eastern Shore Soil and Water Conservation District (ESSWCD), Virginia Department of Conservation and Recreation (DCR), Virginia Department of Environmental Quality (DEQ), Natural Resources Conservation Service (NRCS), Virginia Cooperative Extension (VCE) and others listed below. It is recommended that participants discuss funding options with experienced personnel at these agencies in order to choose the best option.

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 and sediment loads to surface waters. Eligible recipients include local governments, SWCDs, and non-profit organizations. Grants for nonpoint sources are administered through VADEQ. Most WQIF grants provide matching funds on a 50/50 cost-share basis.

Virginia Agricultural Best Management Practices Cost-Share Program

The cost-share program is funded with state funding administered through local SWCDs. Locally, the ESSWCD administers the program to encourage farmers to use BMPs on their land to better control sediment, nutrient loss, and transportation of pollutants into surface water and groundwater due to excessive surface flow, erosion, leaching, and inadequate animal waste management. Cost-share is typically 75% of the actual cost, not to exceed the various cost share caps, but there are also some that offer 50% or offer an incentive payment per acre.

Virginia Agricultural Best Management Practices Tax Credit Program

For all taxable years, any individual or corporation engaged in agricultural production for market that has a soil conservation plan in place and approved by the local SWCD, shall be allowed a credit against the tax imposed by Section 58.1-320 of an amount equaling 25% of the first $70,000 expended for agricultural best management practices by the individual. Any practice approved by the local SWCD Board shall be completed within the taxable year in which the credit is claimed. If the amount of the credit exceeds the taxpayer's liability for such a taxable year, the excess may be carried over for credit against income taxes in the next five taxable years. The credit shall be allowed only for expenditures made by the taxpayer from funds of his/her own sources. This program can be used independently or in conjunction with other cost-share programs in the stakeholder's portion of BMP costs.

Virginia Small Business Environmental Assistance Fund Loan Program

The Fund, administered through VADEQ, is used to make loans or to guarantee loans to small businesses for the purchase and installation of environmental pollution control equipment, equipment to implement voluntary pollution prevention measures, or equipment and structures to implement agricultural BMPs. The equipment must be needed by the small business to comply with the federal Clean Air Act, or it will allow the small business to implement voluntary pollution prevention measures. The loans are available in amounts up to $50,000 and will carry an interest rate of 3%, with favorable repayment terms based on the borrower's ability to repay and the useful life of the equipment being purchased or the life of the BMP being implemented. There is a $30 non-refundable application processing fee. The Fund will not be used to make loans to small businesses for the purchase and installation of equipment needed to comply with an enforcement action. To be eligible for assistance, a business must employ 100 or fewer people and be classified as a small business under the federal Small Business Act.

Federal Clean Water Act Section 319 Incremental Funds

USEPA develops guidelines that describe the process and criteria to be used to award CWA Section 319 NPS grants to states. States may use up to 20% of the Section 319 incremental funds to develop NPS TMDLs as well as develop watershed based plans for Section 303(d) listed waters. The balance of funding can be used to implement watershed based plans that have TMDLs. Funds can be used for residential and agricultural BMPs, and for technical and program staff to administer the BMP programs.

Community Development Block Grant Program

The Department of Housing and Urban Development sponsors this program, which is intended to develop viable communities by providing decent housing, a suitable living environment, and expanded economic opportunities primarily for persons of low and moderate income. Recipients may initiate activities directed toward neighborhood revitalization, economic development, and provision of improved community facilities and services. Specific activities may include public

services, acquisition of real property, relocation and demolition, rehabilitation of structures, and provision of public facilities and improvements, such as new or improved water and sewer facilities.

Conservation Reserve Program (CRP)

Offers are accepted and processed during fixed signup periods that are announced by the Farm Services Agency (FSA). All eligible (cropland) offers are ranked using a national ranking process. If accepted, contracts are developed for a minimum of 10 and not more than 15 years. Payments are based on a per-acre soil rental rate. Cost-share assistance is available to establish the conservation cover of tree or herbaceous vegetation. The per-acre rental rate may not exceed the Commodity Credit Corporation's maximum payment amount, but producers may elect to receive an amount less than the maximum payment rate, which can increase the ranking score. Application evaluation points can be increased if certain tree species, spacing, and seeding mixtures that maximize wildlife habitats are selected. Land must have been owned or operated by the applicant for at least 12 months prior to the close of the signup period. The payment to the participant is up to 50% of the cost for establishing ground cover. Incentive payments for wetlands hydrology restoration equal 25% of the cost of restoration.

Environmental Quality Incentives Program (EQIP)

This program is administered by the NRCS and includes cropland erosion control, nutrient management, forest management, animal waste management, grazing land practices, and wildlife habitat on eligible lands. Contracts up to 10 years are written with eligible producers in order to achieve an EQIP plan of operation that includes structural and land management practices. Cost-share is made available to implement one or more eligible conservation practices and incentive payments can be made to implement one or more management practices.

Wildlife Habitat Incentives Program (WHIP)

WHIP is a voluntary program for landowners and land users who want to develop or improve wildlife habitat on private agriculture-related lands. Participants work with NRCS to prepare a wildlife habitat development plan. This plan describes the landowner's goals for improving wildlife habitat and includes a list of practices and a schedule for installation. A 10-year contract provides cost-share and technical assistance to carry out the plan. In Virginia, these plans will be prepared to address one or more of the following high priority habitat needs: early grassland habitats that are home to game species such as quail and rabbit as well as other non-game species like meadowlark and sparrows; riparian zones along streams and rivers that provide nesting and cover habitats for migrating songbirds, waterfowl, and shorebird species; and decreasing natural habitat systems that are environmentally sensitive and have been impacted and reduced through human activities. Cost-share assistance of up to 75% of the total cost of installation (not to exceed $10,000 per applicant) is available for establishing habitat. Applicants will be competitively ranked within the state and certain areas and practices will receive higher ranking based on their value to wildlife. Types of practices include: disking, prescribed burning, mowing, planting habitat, converting fescue to warm season grasses, establishing riparian buffers, creating habitat for waterfowl, and installing filter strips, field

borders, and hedgerows. For cost-share assistance, USDA pays up to 75% of the cost of installing wildlife practices.

Wetland Reserve Program (WRP)

This program is a voluntary program to restore and protect wetlands on private property. The program benefits include providing fish and wildlife habitat, improving water quality, reducing flooding, recharging groundwater, protecting and improving biological diversity, and furnishing recreational and esthetic benefits. Sign-up is on a continuous basis. Landowners who choose to participate in WRP may receive payments for a conservation easement or cost-share assistance for a wetland restoration agreement. The landowner will retain ownership but voluntarily limits future use of the land. The program offers landowners three options: permanent easements, 30-year easements, and restoration cost-share agreements for a minimum of 10 years. Under the permanent easement option, the landowner may receive the agricultural value of the land up to a maximum cap and 100% of the cost of restoring the land. For the 30-year option, a landowner will receive 75% of the easement value and 75% cost-share on the restoration. A ten-year agreement is also available and pays 75% of the restoration cost. To be eligible for WRP, land must be suitable for restoration (formerly wetland and drained) or connect to adjacent wetlands. A landowner continues to control access to the land and may lease the land for hunting, fishing, or other undeveloped recreational activities. At any time, a landowner may request that additional activities be added as compatible uses. Land eligibility is dependent on length of ownership, whether the site has been degraded as a result of agriculture, and the land's ability to be restored. Restoration agreement participants must show proof of ownership. Easement participants must have owned the land for at least one year and be able to provide clear title.

National Fish and Wildlife Foundation

Offers are accepted throughout the year and processed during fixed signup periods. The signup periods are in a year-round, revolving basis, and there are two decision cycles per year. Each cycle consists of a pre-proposal evaluation, a full proposal evaluation, and a Board of Directors' decision. An approved pre-proposal is a pre-requisite to the submittal of the full proposal. Grants generally range between $10,000 and $150,000. Projects are funded in the US and any international areas that host migratory wildlife from the U.S. Grants are awarded for the purpose of conserving fish, wildlife, plants, and their habitats. Special grant programs are listed and described on the NFWF website (www.nfwf.org). If the project does not fall into the criteria of any special grant programs, the proposal may be submitted as a general grant if it falls under the following guidelines: 1) it promotes fish, wildlife, and habitat conservation, 2) it involves other conservation and community interests, 3) it leverages available funding, and 4) project outcomes are evaluated.

Accomack-Northampton Planning District Commission

The Accomack-Northampton Planning District Commission provides full financial assistance to low-to-moderate income households in order for them to comply with septic pump-out requirements of the Chesapeake Bay Act.

Virginia Department of Forestry

Through the US Forest Service Watershed Forestry Program, VDOF has developed a **Virginia Trees for Clean Water** program designed to improve water quality by planting buffers and trees in neighborhoods and communities. A request for proposal was issued on October 30, 2014 for projects in spring/early fall 2015.

Southeast Rural Community Assistance Project, SERCAP

Southeast RCAP is a non-profit organization that offers grants and loans to low income households in rural regions to help upgrade their water and wastewater facilities. Funding is also used to assist with projects run my small, rural governments, develop small businesses, and assist with hook-up costs.

Eastern Shore Roundtable

The Eastern Shore watershed roundtable is run by the Eastern Shore Research and Development Council and includes volunteers representing many organizations, including the Chesapeake Bay Foundation, National Resource Conservation Service, Accomack-Northampton Planning District Commission, Eastern Shore Soil and Water Conservation District, Virginia Institute of Marine Science, Virginia Tech Eastern Shore AREC, and the Eastern Shorekeeper. The roundtable focuses on education and outreach to local communities as well as BMP installation in the region. The roundtable maintains a website (www.shorewatersheds.net) where they report recent outreach activities.

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Wang, T. 2005. Hypoxia in shallow coastal waters: A case study in Onancock Creek, Virginia. MS Thesis, Virginia Institute of Marine Science, College of William and Mary. 129 pp.

LIST OF ACRONYMS

A-NPDC	Accomack-Northampton Planning District Commission
ARA	Antibiotic Resistance Approach
BMP	Best Management Practice
BST	Bacterial Source Tracking

CBPA	Chesapeake Bay Preservation Act
CREP	Conservation Reserve Enhancement Program
CRP	Conservation Reserve Program
CWA	Clean Water Act
DCAP	Damage Control Assistance Program
DCR	Department of Conservation and Recreation
DEQ	Department of Environmental Quality
DMAP	Deer Management Assistance Program
DPOP	Deer Population Reduction Program
DSS	Division of Shellfish Sanitation
EPA	Environmental Protection Agency
ES RC&D	Eastern Shore Resource Conservation and Development Council
ESSWCD	Eastern Shore Soil and Water Conservation District
EQIP	Environmental Quality Incentives Program
FR-3	Woodland Buffer Filter Area
FWS	Fish and Wildlife Service
GIS	Geographic Information System
IP	TMDL Implementation Plan
LE-1T	Livestock Exclusion with Riparian Buffers
LE-2T	Livestock Exclusion with Reduced Setback
MOU	Memorandum of Understanding
MPN	Most Probable Number
NLCD	National Land Cover Dataset
NOAA	National Oceanic and Atmospheric Administration
NPS	Nonpoint Source
NRCS	Natural Resource Conservation Service
NWBD	National Watershed Boundary Dataset
RB-1	Septic Tank Pump Out
RB-3	Septic System Repair
RB-4	Septic System Installation/Replacement
RB-4P	Septic System Installation/Replacement with Pump
RB-5	Alternative Waste Treatment System
RPA	Resource Protection Area
RMA	Resource Management Area
SERCAP	Southeast Rural Community Assistance Project
SL-6AT	Small Acreage Grazing System
SL-6T	Stream Exclusion with Grazing Land Management for TMDL Implementation
SL-8B	Small Grain Cover Crop for Nutrient Management
SL-10T	Pasture Management
SWCB	State Water Control Board
TMDL	Total Maximum Daily Load

UAA	Use Attainability Analysis
USDA	US Department of Agriculture
VCE	Virginia Cooperative Extension
VDACS	Virginia Department of Agriculture and Consumer Services
VDGIF	Virginia Department of Game and Inland Fisheries
VDH	Virginia Department of Health
VDOF	Virginia Department of Forestry
VIMS	Virginia Institute of Marine Science
WHIP	USDA Wildlife Habitat Incentives Program
WP-1	Sediment Retention, Erosion, or Water Control Structures
WQIF	Water Quality Improvement Fund
WQMIRA	Virginia's 1997 Water Quality Monitoring, Information and Restoration Act
WQMP	Water Quality Management Plan
WRP	USDA Wetland Reserve Program

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VA Department of Conservation and Recreation
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Northampton County VA Cooperative Extension
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VA Department of Environmental Quality
Tidewater Regional Office
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VA Department of Forestry
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22213 Edgar Thomas Road
Accomac, VA 23301
757-787-5812

Northampton County Health Department
7114 Lankford Highway
PO Box 248
Nassawadox, VA 23413
757-442-6228
www.vdh.state.va.us/lhd/easternshore

VA Department of Health – Division of Shellfish Sanitation
Accomac Field Office
23177 Front Street
PO Box 88
Accomac, VA 23301
757-787-5864 ext.221
www.vdh.state.va.us/environmentalhealth/shellfish