Total Maximum Daily Load (TMDL) Report for Shellfish Areas Listed Due to Bacterial Contamination

Great Wicomico River

DEQ
VIRGINIA DEPARTMENT OF ENVIRONMENTAL QUALITY

VDH VIRGINIA DEPARTMENT OF HEALTH
Protecting You and Your Environment

Great Wicomico River Watershed Total Maximum Daily Load (TMDL) Report for Shellfish Condemnation Areas Listed Due to Bacteria Contamination

Virginia Department of Environmental Quality

April 2006

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Total Maximum Daily Load Executive Summary

Total Maximum Daily Load Process

Management of water quality is a process intended to protect waters for a variety of uses. The first step in the process is the identification of desired uses for each waterbody. There are typically a number of physical, chemical and/or biological conditions that must exist in a waterbody to allow for a desired use to exist. In Virginia, most inshore tidal waters are identified as potential shellfish growing waters. In order to support shellfish propagation without risk to human consumers, shellfish waters must have very low levels of pathogenic organisms. Virginia, as most other states, uses fecal coliforms (FC) as an indicator of the potential presence of pathogenic organisms. To maintain the use of a waterbody for direct shellfish harvesting, the goal is to ensure the concentration of fecal coliforms entering the waterbody does not exceed a "safe" level. The safe level is set as the standard against which water quality monitoring samples are checked.

When water quality monitoring detects levels of fecal coliforms above allowable, "safe" levels, managers must identify the potential sources and plan to control them. The prescribed method for figuring out what must be controlled to attain the water quality standard is the calculation of a total maximum daily load (TMDL). The TMDL is the amount of fecal coliforms that may be introduced by each potential source without exceeding the water quality standard for fecal coliforms in shellfish growing waters.

The process of developing a shellfish water TMDL may be generalized in the following manner:

1. Water quality monitoring data are used to determine if the bacterial standard for shellfish have been violated;
2. Potential sources of fecal bacteria loading within the contributing watershed are identified;
3. The necessary reductions in fecal bacteria pollutant load to achieve the water quality standard are determined;
4. The TMDL study is presented to the public to garner comment;
5. An implementation strategy to reduce fecal bacteria loads is written into a plan and subsequently implemented;
6. Water quality monitoring data are used to determine if the bacterial standard is being met for shellfish waters.

Different approaches can be used to determine the sources of fecal pollution in a waterbody. Two distinctly different approaches are watershed modeling and bacterial source tracking (BST). Watershed modeling begins on the land, identifying potential sources based on information about conditions in the watershed (e.g. numbers of residents, estimated wildlife populations, estimated of livestock, etc.). BST begins in the water, identifying sources of fecal coliforms, specifically the dominant fecal coliform *Escherichia coli*, to shellfish waters based on either genetic or phenotypic characteristics of the coliforms. Virginia's Department of Environmental Quality has decided to utilize BST, and specifically to use a method called antibiotic resistance analysis (ARA). This method allocates the fecal bacteria found into four sources: humans, wildlife, livestock, and domestic animals

These bacteria from the four source categories will all differ in their reactions to antibiotics. Thus, when samples of fecal bacteria collected in the water quality monitoring program are exposed to specific antibiotics the pattern of responses allows matching similarities to the response patterns of bacteria from known sources which have been accumulated in a "source library". Through this analysis investigators also estimate the relative proportion of the fecal bacteria derived from each of the four general source classes and assumes this proportion reflects the relative contribution from the watershed..

The resulting estimates of the amount of fecal coliform pollution coming from each type of source can then be used to allocate reductions necessary to meet the water quality standard for shellfish growing waters. Identifying and agreeing on the means to achieve these reductions represent the TMDL implementation plan.

Continued water quality monitoring will tell whether the efforts to control sources of fecal coliforms in the watershed have succeeded.

Fecal Coliform Impairment

This document details the development of bacterial TMDLs for five segments in the Great Wicomico River watershed in Northumberland County, Virginia. The five condemned areas in the watershed include condemnation number 89A - portions of the Great Wicomico River VAP-C01E-01), 89B - portions of Balls Creek VAP-C01E-02), 89C – portions of Tipers Creek VAP-C01E-03), 89E – portions of Warehouse Creek VAP-C01E-06), and 89F – portions of Whays Creek VAP-C01E-05).

The condemned portion of Barrett Creek, 89D – was delisted in 2004 based on additional water quality monitoring data indicated that waters met water quality standards.

The applicable state standard specifies that the number of fecal coliform bacteria shall not exceed a maximum allowable level of geometric mean of 14 most probable number (3-tube MPN) per 100 milliliters (ml) and a 90th percentile geometric mean value of 49 MPN/100ml. (Virginia Water Quality Standard 9-VAC 25-260-5). In development of this TMDL, the 90th percentile 49 MPN/100 ml was used, since it represented the more stringent standard.

Sources of Fecal Coliform

Potential sources of fecal coliform consist primarily of non-point source contributions, as there are no permitted point source discharges in the watershed. Non-point sources include wildlife; livestock; land application of bio-solids; recreational vessel discharges; failed, malfunctioning, or non-operational septic systems, and uncontrolled discharges (straight pipes conveying gray water from kitchen and laundry areas of private homes, etc.).

Water Quality Modeling

A volumetric tidal model was used for this TMDL study because the character of the waterbodies to be modeled is relatively simple from a hydrologic perspective: for example, small in area and volume with a single, unrestricted connection to receiving waters. This approach uses the volume of the waterbody and adjusts for tidal flushing, freshwater inflow and bacterial decay in order to establish the existing and allocation conditions.

Determination of Existing Loadings

To assist in partitioning the loads from the diverse sources within the watershed, water quality samples of fecal coliform bacteria were collected for one year and evaluated using an antibiotic resistance analysis in a process called bacterial source tracking. These samples were compared to a reference library of fecal bacteria samples from known sources. The resulting data were used to assign portions of the bacteria loads within the watershed to wildlife, humans, livestock or pets. The results of this analysis indicated that the primary source of fecal coliforms for each condemnation zone is as follows:

- 89A is human with livestock as secondary contributor followed by pets and wildlife.

- 89B is human with pets as a secondary contributor followed by livestock and wildlife.

- 89C is human with livestock as a secondary contributor followed by wildlife and pets.

- 89D was DELISTED in 2004 after additional water quality monitoring.

- 89E is human with livestock as a secondary contributor followed by wildlife and pets.

- 89F is human with livestock as a secondary contributor followed by pets and wildlife.

The presence of a large signature attributable to one component is sufficient to establish potential directions for remediation under a future implementation plan.

Load Allocation Scenarios

The next step in the TMDL process was to determine the appropriate water quality standard to be applied. This was set as the 90th percentile standard because the data established that the 90th percentile required the greater reduction. Calculated results of the model for each segment were used to establish the existing load in the system. The load necessary to meet water quality standards was calculated in a similar fashion using the water quality standard criterion in place of the ambient water quality value. The difference between these two numbers represents the necessary level of reduction in each segment.

Finally the results of the BST developed for each segment were used to partition the load allocation that would meet water quality standards according to source. The results of the model, the BST source partitioning and the reductions necessary for each segment are shown below.

Margin of Safety

In order to account for uncertainty in modeled output, a margin of safety (MOS) was incorporated into the TMDL development process by making very conservative choices. A margin of safety can be incorporated implicitly in the model through the use of conservative estimates of model parameters, or explicitly as an additional load reduction requirement. Individual errors in model inputs, such as data used for developing model parameters or data used for calibration, may affect the load allocations in a positive or a negative way. The purpose of the MOS is to avoid an overall bias toward load allocations that are too large for meeting the water quality target. An implicit MOS was used in the development of this TMDL through selection of a water quality standard providing a high level of protection, utilization of entire segment volumes for model calculations, averaging extreme high and low values to ensure that the more protective condition with the largest available data set was addressed and emphasizing watershed-based implementation measures.

Recommendations for TMDL Implementation

The goal of this TMDL was to develop an allocation plan that achieves water quality standards during the implementation phase. Virginia's 1997 Water Quality Monitoring, Information and Restoration Act states in section 62.1-44.19.7 that the "Board shall develop and implement a plan to achieve fully supporting status for impaired waters".

Reduction based upon 90TH PERCENTILE Standard
Growing Area 13: Great Wicomico River Condemnation Zones 89 (1997)

Condemnation Area	Source	BST Allocation % of Total Load	Current Load (MPN/ day)	Load Allocation (MPN/ day)	Reduction Needed
89-A Great Wicomico River	Livestock	30 %	**1.69E+11**	**1.28E+11**	**24%**
	Wildlife	16 %	**9.01E+10**	**9.01E+10**	**0%**
	Human	32 %	**1.80E+11**	**0.00E+00**	**100%**
	Pets	22 %	**1.24E+11**	**1.24E+11**	**0%**
	Total	100 %	**5.63E+11**	**3.42E+11**	**39%**
89-B Balls Creek	Livestock	23 %	**4.80E+10**	**2.12E+09**	**96%**
	Wildlife	15 %	**3.13E+10**	**3.13E+10**	**0%**
	Human	39 %	**8.13E+10**	**0.00E+00**	**100%**
	Pets	24 %	**5.00E+10**	**2.50E+09**	**95%**
	Total	101%	**2.08E+11**	**3.59E+10**	**83%**
89-C Tipers Creek	Livestock	31 %	**5.02E+10**	**3.45E+10**	**31%**
	Wildlife	13 %	**2.11E+10**	**2.11E+10**	**0%**
	Human	47 %	**7.62E+10**	**0.00E+00**	**100%**
	Pets	8 %	**1.30E+10**	**1.30E+10**	**0%**
	Total	99 %	**1.62E+11**	**6.86E+10**	**58%**
89-E Warehouse Creek	Livestock	24 %	**3.26E+10**	**3.26E+10**	**0%**
	Wildlife	19 %	**2.58E+10**	**2.58E+10**	**0%**
	Human	50 %	**6.79E+10**	**3.68E+10**	**46%**
	Pets	7 %	**9.50E+09**	**9.50E+08**	**90%**
	Total	100 %	**1.36E+11**	**9.61E+10**	**29%**
89-F Whays Creek	Livestock	18 %	**1.12E+10**	**1.12E+10**	**0%**
	Wildlife	8 %	**4.98E+09**	**4.98E+09**	**0%**
	Human	59 %	**3.67E+10**	**1.77E+10**	**52%**
	Pets	16 %	**9.95E+09**	**9.95E+09**	**0%**
	Total	101 %	**6.22E+10**	**4.38E+10**	**30%**

The TMDL developed for the Great Wicomico River watershed impairments provides allocation scenarios that will be a starting point for developing implementation strategies. Additional monitoring aimed at targeting the necessary reductions is critical to implementation development. Once established, continued monitoring will aid in tracking success toward meeting water quality milestones.

Public participation is critical to the implementation process. Reductions in non-point source loading is the crucial factor in addressing the problem. These sources cannot be addressed without public understanding of and support for the implementation process. Stakeholder input will be critical from the onset of the implementation process in order to develop an implementation plan that will be truly effective.

Public Participation

During development of the TMDL for the Great Wicomico River watershed, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first public meeting was held on January 26, 2006. A basic description of the TMDL process and the agencies involved was presented and a discussion was held to regarding the source assessment input, bacterial source tracking, and model results. This meeting was followed by development of the final draft TMDL and a review by the stakeholders.

Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process.

The second public meeting was held on March 20, 2006. The results of the TMDL study were presented and discussed. Public participation and involvement in the TMDL implementation planning process was encouraged.

1.0 Introduction

This document details the development of bacterial Total Maximum Daily Load (TMDL) for five segments in the Great Wicomico River watershed in Northumberland County, Virginia which are listed as impaired on Virginia's 1998 303(d) Total Maximum Daily Load Priority List. The TMDL is one step in a multi-step process that includes a high level of public participation in order to address water quality issues that can affect public health and the health of aquatic life.

1.1 Listing of Water Bodies under the Clean Water Act

Water quality standards are regulations based on federal or state law that set numeric or narrative limits on pollutants. Water quality monitoring is performed to measure these pollutants and determine if the measured levels are with the bounds of the limits set for the uses designated for the waterbody. The waterbodies which have pollutant levels above the designated standards are considered impaired for the corresponding designated use (e.g. swimming, drinking, shellfish harvest, etc.). The impaired waterways are listed on the §303 (d) list reported to the Environmental Protection Agency. Those waters placed on the list require the development of a TMDL intended to eliminate the impairment and bring the water into compliance with the designated standards.

TMDLs represent the total pollutant loading that a water body can receive without violating water quality standards. The TMDL process establishes the allowable loading of pollutants for a water body based on the relationship between pollution sources and in-stream water quality conditions. By following the TMDL process, states can establish water quality based controls to reduce pollution from both point and non-point sources to restore and maintain the quality of their water resources (EPA, 1991).

Fecal coliform bacteria are the most common cause for the impairments in Virginia shellfish growing waters. This group of bacteria is considered an indicator of the presence of fecal contamination. The most common member of the fecal coliform groups is *Escherichia coli*. Fecal coliforms are associated with the fecal material derived from humans and warm-blooded animals. The presence of fecal coliform bacteria 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. Filter-feeding shellfish can concentrate these pathogens which can be transmitted and 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 shellfish. Fecal contamination can occur from point source inputs of domestic sewage or from nonpoint sources of human, (e.g., malfunctioning septic systems) or animal wastes.

Because the fecal coliform indicator does not provide information on the source or origin of fecal contamination, Agencies of the Commonwealth, including the Department of Environmental Quality (DEQ), the Virginia Department of Health – Division of Shellfish sanitation (VDH-DSS) and the Department of Conservation and Recreation (DCR) have worked together with state universities, the U.S. Geological Survey and the U.S. Environmental Protection Agency to develop methods to assess sources of fecal coliforms to assist in development of TMDLs in impaired shellfish waters.

As a group these methods are usually called bacterial or microbial source tracking (BST or MST). This study utilizes bacteria source tracking (BST) to determine the most probable sources of fecal coliform in the water.

To assist with the analysis and development of the TMDLs for impaired shellfish waters, the Department of Environmental Quality has contracted the Virginia Institute of Marine Science (VIMS).

1.2 Overview of the TMDL Development Process

A TMDL study for shellfish waters is the first part of a phased process aimed at restoring water quality. This study is designed to determine how much of the pollutant input needs to be reduced in order to achieve water quality standards. The second step in the process is the development of an implementation plan that identifies which specific control measures are necessary to achieve those reductions, their timing for implementation and at what cost. The implementation plan will also outline potential funding sources. The third step will be the actual implementation process. Implementation will typically occur in stages that allow a review of progress in reducing pollutant input, refine bacteria loading estimates based upon additional data and to make any identified changes to pollutant control measures.

The TMDL development process also must account for seasonal and annual variations in precipitation, flow, land use, and pollutant contributions. Such an approach ensures that TMDLs, when implemented, do not result in violations under a wide variety of scenarios that affect bacterial loading.

2.0 Applicable Water Quality Standard

Water quality standards are provisions of state or federal law which consist of a designated use or set of uses for the waters and water quality criteria based upon such uses. Water quality standards are to protect the 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.). According to Virginia Water Quality Standards (9 VAC 25-260-5), the term *"water quality standards means provisions of state or federal law which consist of a designated use or uses for the waters of the Commonwealth and water quality criteria for such waters based upon such uses. Water quality standards are to protect the 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.)."*

2.1 Designated Uses and Criteria

Generally, all tidal waters in Virginia are designated as shellfish waters. The identification of the applicable river reaches can be found in the river basin tables at 9VAC25-260-390 et seq. For a shellfish supporting water body to be in compliance with Virginia bacterial standards, VADEQ specifies the following criteria (9 VAC 25-260-160): *"In all open ocean 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 bacteria shall apply; The geometric mean fecal coliform value for a sampling station shall not exceed an MPN (most probable number) of 14 per 100 milliliters. The 90th percentile shall not exceed an MPN of 43 for a 5 tube, 3 dilution test or 49 for a 3 tube, 3 dilution test."*

2.2 Classification of Virginia's Shellfish Growing Areas

The Virginia Department of Health, Division of Shellfish Sanitation (DSS) is responsible for classifying shellfish waters and protecting the health of bivalve shellfish consumers. The VDH- DSS follows the requirements of the National Shellfish Sanitation Program (NSSP), which is regulated by the U.S. Food and Drug Administration. The NSSP specifies the use of a shoreline survey as its primary tool for classifying shellfish growing waters. Fecal coliform concentrations in water samples collected in the immediate vicinity of the shellfish beds function to verify the findings of the shoreline survey, and to define the border between approved and condemned (unapproved) waters. Much of the DSS effort is focused on locating fecal contamination, and in this manner minimizing the introduction of human pathogens to shellfish waters.

DSS designs and operates the shoreline survey to locate sources of pollution within the watersheds of shellfish growing areas. This is accomplished through a property-by-property inspection of the onsite sanitary waste disposal facilities of most properties on un-sewered sections of watersheds, and investigations of other sources of pollution such as wastewater treatment plants (WTP), marinas, livestock operations, landfills, etc. The information is compiled into a written report with a map showing the location of the sources of real or potential pollution found and sent to the various agencies that are responsible for regulating these concerns in the city or county. Once an onsite problem is identified, local health departments (LHDs), and/or other state and local agencies may play a role in the process of correcting the deficiencies.

The VDH-DSS collects monthly seawater samples at over 2,000 stations in the shellfish growing areas of Virginia. Though they continuously monitor sample data for unusual events, they formally evaluate shellfish growing areas on an annual basis. The annual review uses data from the most recent 30 samples (typically 30 months), collected randomly with respect to weather. The data are assessed to determine whether the water quality standards are met. If the water quality standards are exceeded, the shellfish area is closed for the harvest of shellfish that go directly to market. Those areas that marginally exceed the water quality standard and are closed for the direct marketing of shellfish are eligible for harvest of shellfish under permit from the Virginia Marine Resources Commission and VDH-DSS. The permit establishes controls that in part require shellfish be allowed to depurate for 15 days in clean growing areas or specially designed licensed on shore facilities. Shellfish in growing areas that may be highly polluted, such as those in the immediate vicinity of a wastewater treatment facility (prohibited waters), are not allowed to be moved to clean waters for self purification.

3.0 Watershed Characterization

The Great Wicomico River watershed is located within Northumberland County. The five condemned areas in the watershed include condemnation number 89A - portions of the Great Wicomico River, 89B - portions of Balls Creek, 89C – portions of Tipers Creek, 89E – portions of Warehouse Creek, and 89F – portions of Whays Creek.

The condemned portion of Barrett Creek, 89D – was delisted in 2004 based on additional water quality monitoring data that indicated that waters met water quality standards.

The condemnation notices can be found in Appendix A. The watershed occupies a landscape position along the western shore of the Chesapeake Bay and the eastern portion of Northumberland County, south of US-360 (Figure 3.0). The watershed is bounded on the south by Virginia routes 615 and 609 in Northumberland County. The communities of Burgess, Walkers Store, Howland, Wicomico Church and Reedville are located within the watershed. Virginia route 200 runs north to south through the watershed.

The drainage area of the Great Wicomico River watershed is approximately 59.1 square miles. Population estimated by the 2000 US Census is 3103.

A map of the land use in the watershed is shown in Figure 3-1. Almost 64 % of the land use in the watershed is undeveloped forest (See Figure 3-2). As the land use area within the watershed is based upon surface area, the 11 % water reflects that portion of the watershed area occupied by the Great Wicomico River. Agriculture occupies the next greatest area. Developed lands, termed urban and commercial, occupy only about 1 % of the landscape. Estimations of the populations of livestock and wildlife, as well as numbers of septic systems within the watershed are shown in Table 3-1. Appendix B: Supporting Documentation and Watershed Assessment, provides a description of data and list of data sources for Table 3-1.

Table 3-1 Animal Populations and Septic Systems
Growing Area 13*

Fecal Coliform Sources	89A Great Wicomico River	89B Balls Creek	89C Tipers Creek	89E Warehouse Creek	89F Whays Creek
Cattle	82	9	4	11	4
Chicken	24	3	0	0	0
Deer	490	63	42	31	10
Dog	525	68	45	32	11
Duck	276	62	107	94	92
Geese	191	43	74	65	63
Horse	4	0	0	0	0
Raccoon	300	118	86	44	13
Estimated Septic Systems	886	118	77	55	18

* These numbers are derived from County-wide population statistics. Further explanation is provided in the Appendix.

Figure 3.0

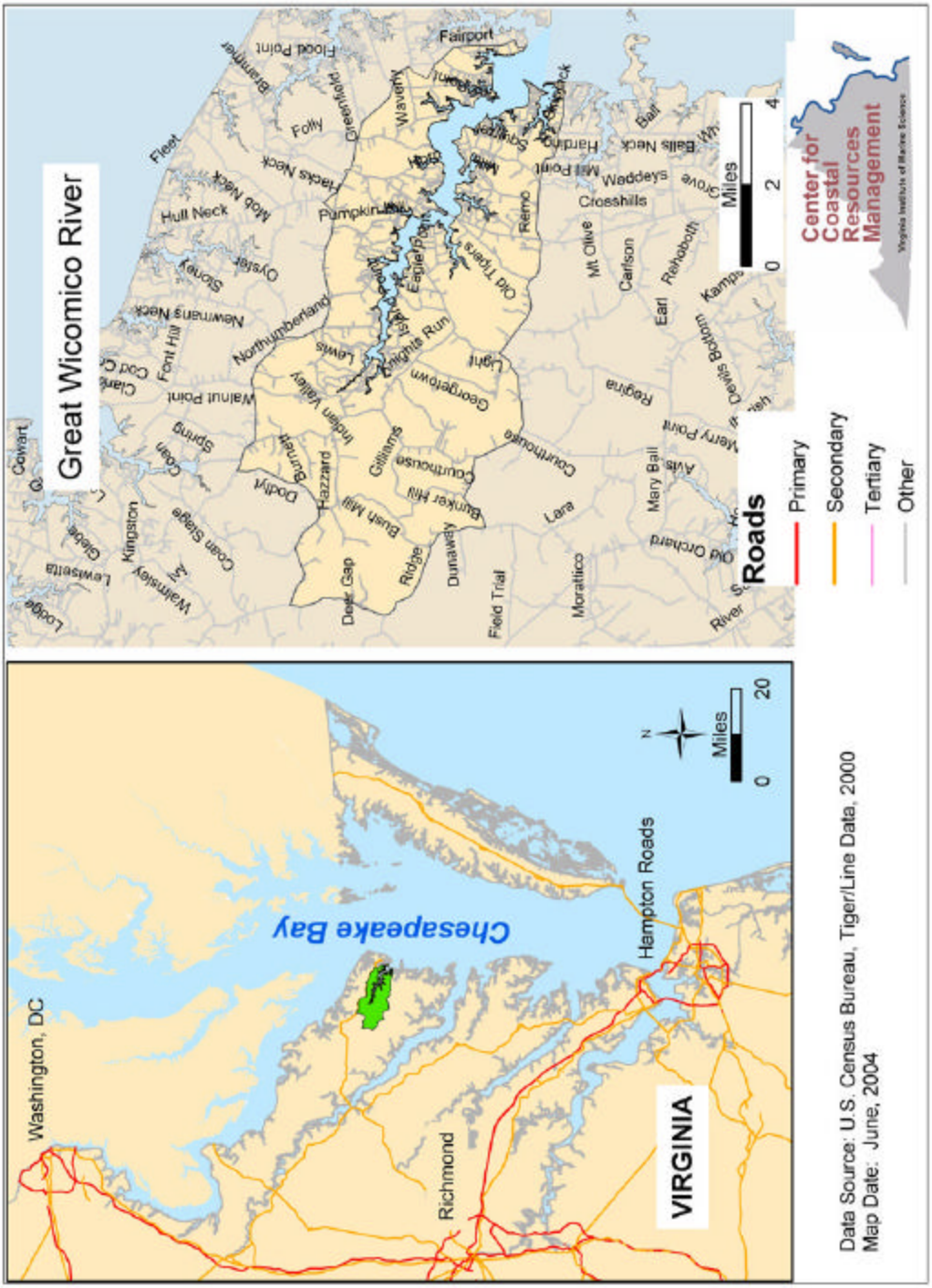
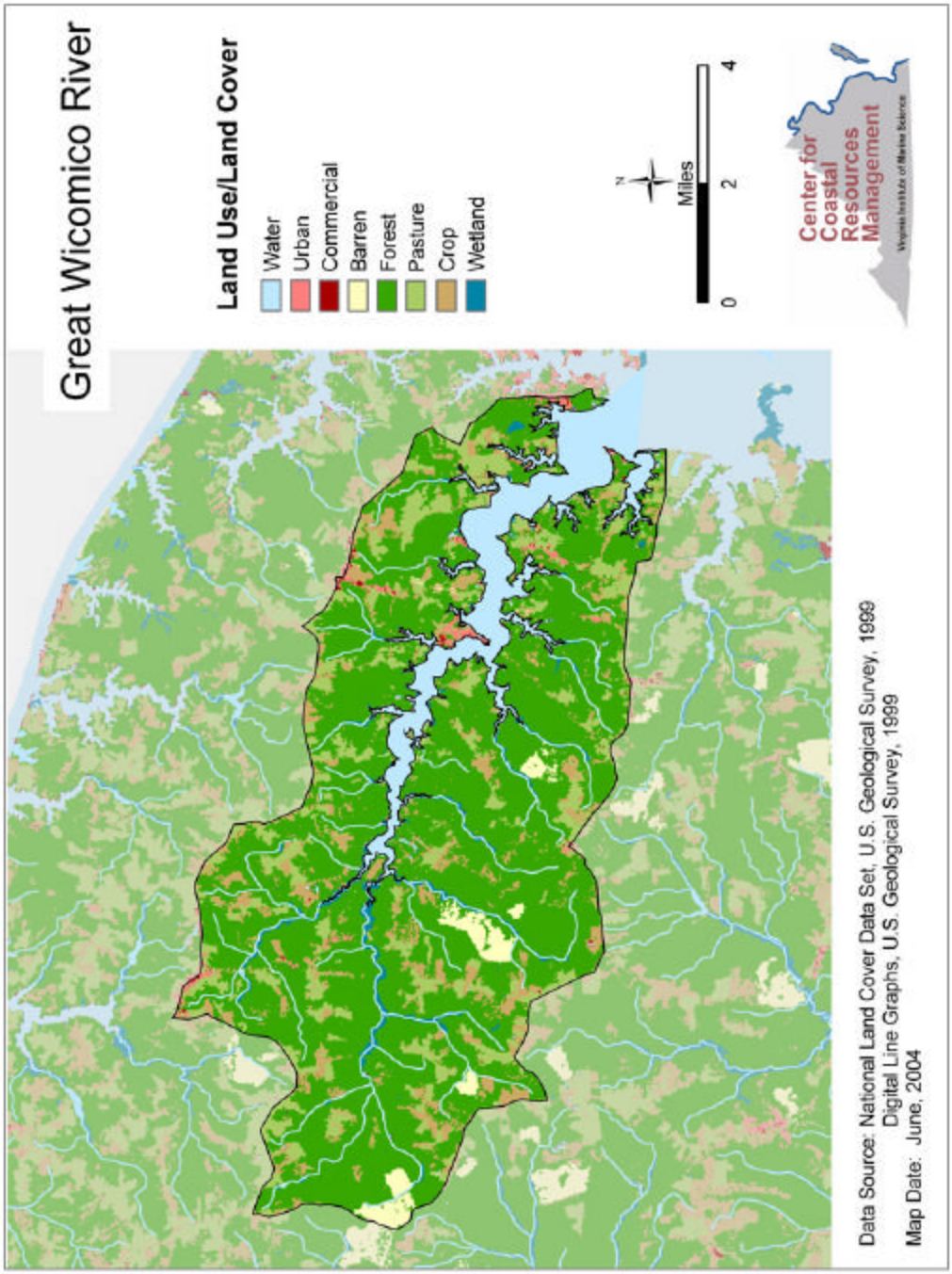

Great Wicomico River
Washington, DC
Chesapeake Bay
Richmond
Hampton Roads
VIRGINIA
Miles
0
20
Fairport
Roads
Primary
Secondary
Tertiary
Other
Center for Coastal Resources Management
Data Source: U.S. Census Bureau, Tiger/Line Data, 2000
Map Date: June, 2004

Figure 3.1


Great Wicomico River
Land Use/Land Cover
Water
Urban
Commercial
Barren
Forest
Pasture
Crop
Wetland
N
Miles
0
2
4
Center for Coastal Resources Management
Data Source: National Land Cover Data Set, U.S. Geological Survey, 1999
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

4.0 Water Quality Impairment and Bacterial Source Assessment

4.1 Water Quality Monitoring

The water quality monitoring network consists of 20 monitoring stations. These stations are monitored by the VDH-DSS for fecal bacteria. The locations of the water quality monitoring stations are shown in Figure 4.1. This TMDL study examined bacterial monitoring data at these stations for a period of time from 1995 through August 2003. A summary of water quality data for the monitoring period preceding the TMDL study is shown in Table 4.1. Graphs depicting the geometric mean and 90th percentile are shown in Figures 4.3A, 4.3B and 4.3C. In Table 4.1, a station outside the closure area(s) that shows a maximum value for either the geometric mean, 90th percentile, or both that exceeds the standard, may be due to the inclusion of data collected after 1998. This may provide an indication of water quality issues in the watershed since the time of the 1998 impaired waters listing of areas in this watershed. Only data for those stations associated with a condemnation from 1998, as indicated by a condemnation number in Table 4.1 are used for the TMDLs in this study.

The closures in the growing areas are characterized based on all monitoring stations (see Figure 4-1) in the closed area. To facilitate an effective assignment of the appropriate level of protection for this system, the water quality data were averaged across all stations in the condemned area. This treats high and low values equally and provides a target that can be easily comprehended and uniformly implemented while retaining the necessary protection for the affected waters.

Figure 3-2

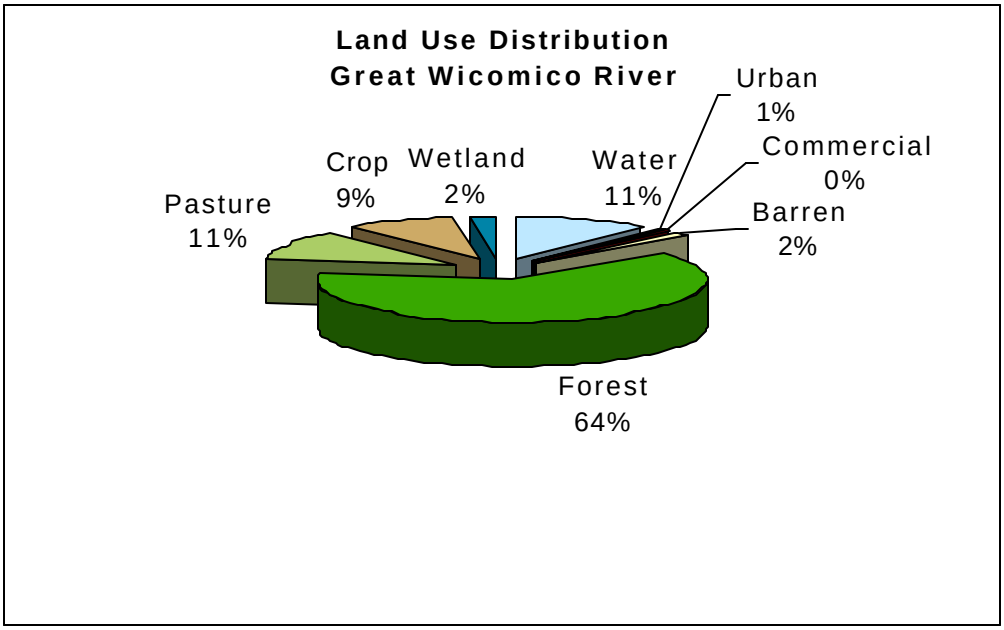


Figure 4.1

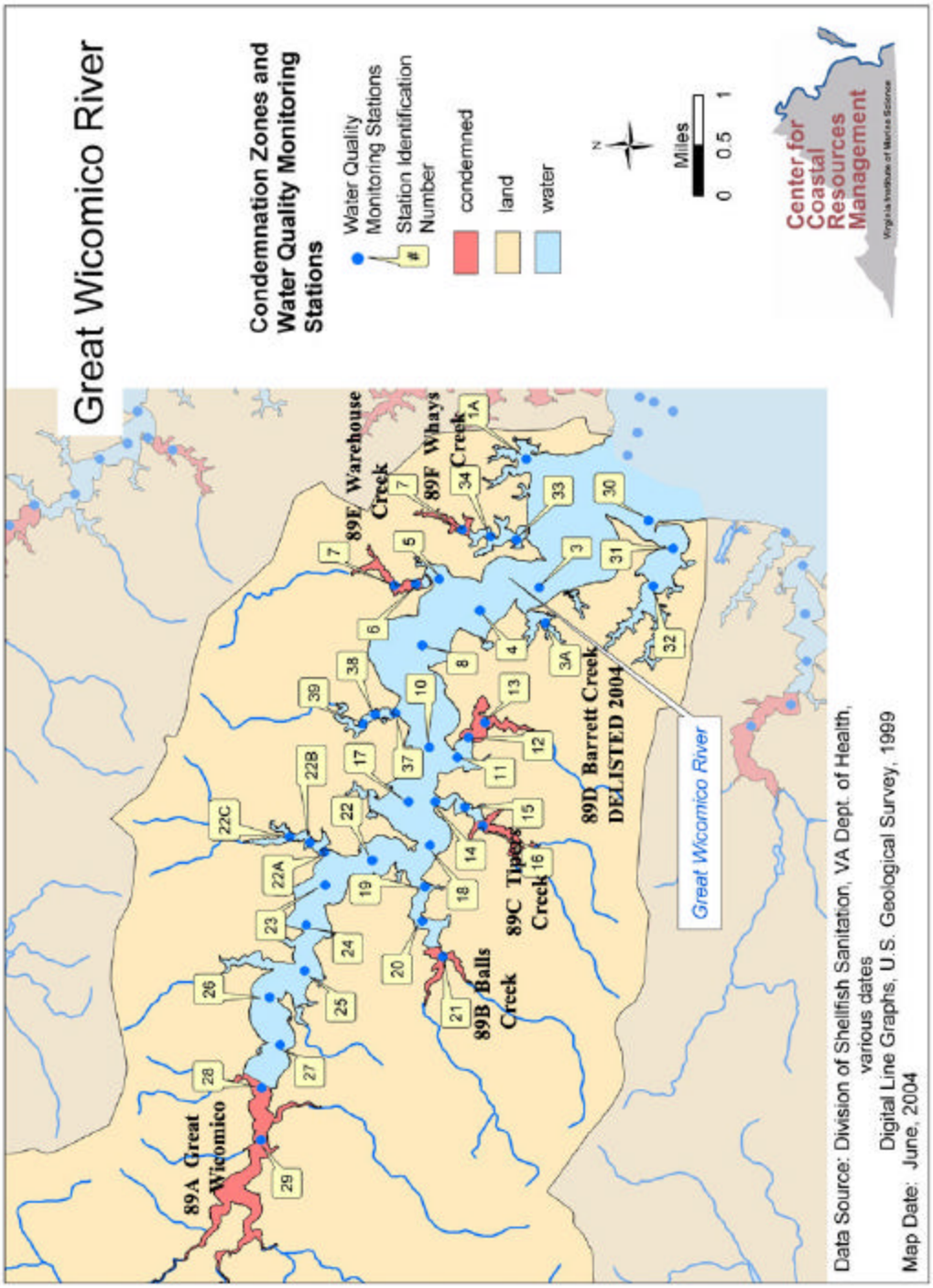

Great Wicomico River
Condemnation Zones and Water Quality Monitoring Stations
Water Quality Monitoring Stations
Station Identification Number
condemned
land
water
N
Miles
0 0.5 1
Center for Coastal Resources Management
Virginia Institute of Marine Science
89A Great Wicomico
89B Balls Creek
89C Tipers Creek
89D Barrett Creek DELISTED 2004
89E Warehouse Creek
89F Whays Creek
Great Wicomico River
Data Source: Division of Shellfish Sanitation, VA Dept. of Health, various dates
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

Figure 4.2

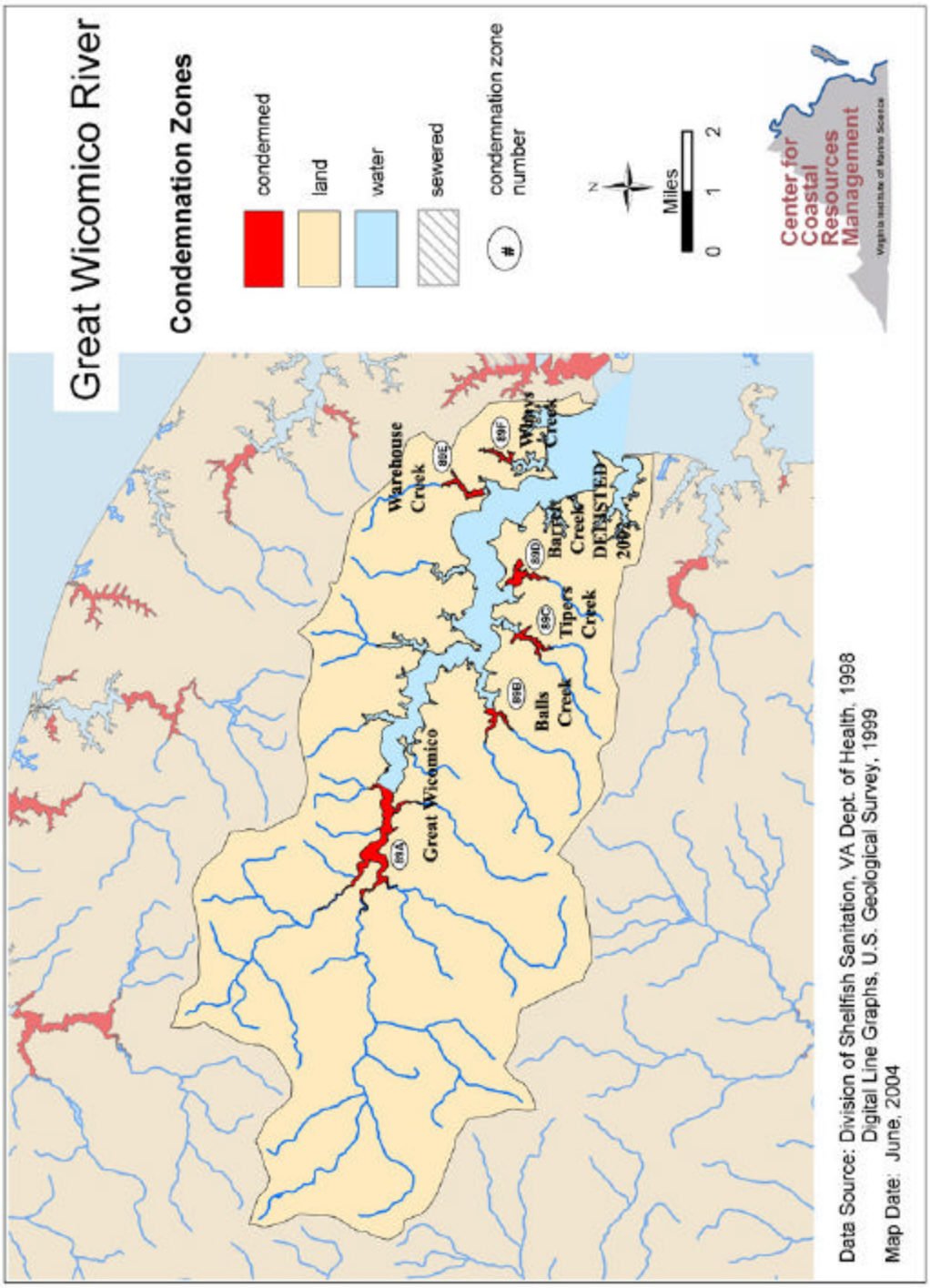

Great Wicomico River
Condemnation Zones
condemned
land
water
sewered
condemnation zone number
#
N
Miles
0
1
2
Center for Coastal Resources Management
Virginia Institute of Marine Science
Warehouse Creek
Great Wicomico
Balls Creek
Tipers Creek
Barrett Creek
DELISTED 2002
Wilkins Creek
Data Source: Division of Shellfish Sanitation, VA Dept. of Health, 1998
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

Table 4-1 Water Quality Data Summary: Growing Area 13 Great Wicomico River

Station	Condemnation Area	Total Observations	Geometric Mean	Station Violates Geometric Standard: (14 MPN)	90th Percentile	Station Violates 90th Percentile Standard: (49 MPN)
13-1A	89	110	7.4	No	33.1	No
13-3	89	159	4.4	No	9.8	No
13-3A	89	17	8.9	No	42.6	No
13-4	89	160	4.3	No	9.1	No
13-5	89	161	8.0	No	28.4	No
13-6	89E	160	20.9	Yes	110.9	Yes
13-7	89E	157	36.0	Yes	207.8	Yes
13-8	89	161	4.0	No	9.8	No
13-10	89	161	5.2	No	12.9	No
13-11	89	161	7.7	No	30.4	No
13-12	89D	158	10.4	No	55.0	Yes
13-13	89D	158	21.6	Yes	107.3	Yes
13-14	89	161	9.5	No	48.2	No
13-15	89	161	19.3	Yes	88.8	Yes
13-16	89C	157	29.1	Yes	130.2	Yes
13-17	89	161	5.6	No	20.9	No
13-18	89	161	6.1	No	20.7	No
13-19	89	161	13.8	No	77.7	Yes
13-20	89	154	17.4	Yes	80.8	Yes
13-21	89B	152	34.3	Yes	348.2	Yes
13-22	89	160	6.1	No	30.0	No
13-22A	89	8	11.4	No	53.7	Yes
13-22B	89	6	12.3	No	78.8	Yes
13-22C	89	8	17.3	Yes	125.3	Yes
13-23	89	160	7.5	No	28.4	No
13-24	89	160	7.2	No	31.3	No
13-25	89	160	8.6	No	42.5	No
13-26	89	160	8.6	No	45.0	No
13-27	89	157	11.8	No	79.9	Yes
13-28	89A	157	16.0	Yes	100.9	Yes
13-29	89A	156	27.2	Yes	183.5	Yes

Station	Condemnation Area	Total Observations	Geometric Mean	Station Violates Geometric Standard: (14 MPN)	90th Percentile	Station Violates 90th Percentile Standard: (49 MPN)
13-30	89	155	4.3	No	13.2	No
13-31	89	155	4.7	No	13.9	No
13-32	89	155	8.4	No	28.3	No
13-33	89	157	13.1	No	62.0	Yes
13-34	89	155	12.9	No	61.7	Yes
13-35	89F	154	24.2	Yes	153.8	Yes
13-37	89	63	15.5	Yes	82.9	Yes
13-38	89	60	18.7	Yes	143.2	Yes
13-39	89	60	17.5	Yes	69.5	Yes

Figure 4.3-A Great Wicomico River

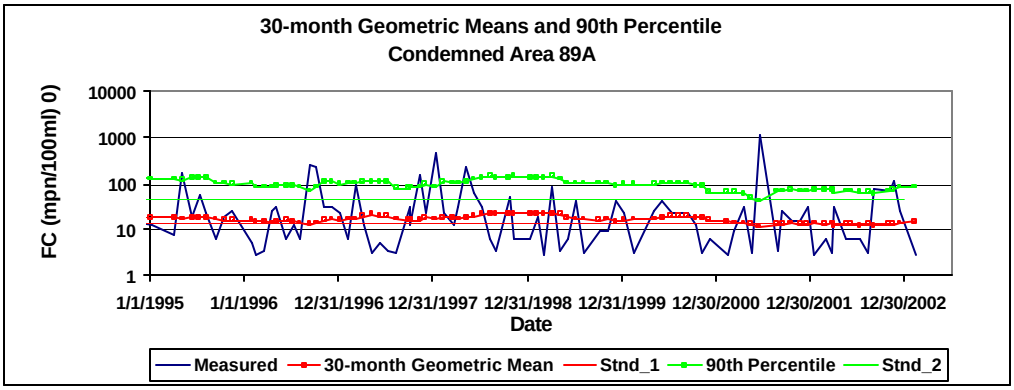


Figure 4.3-B Balls Creek

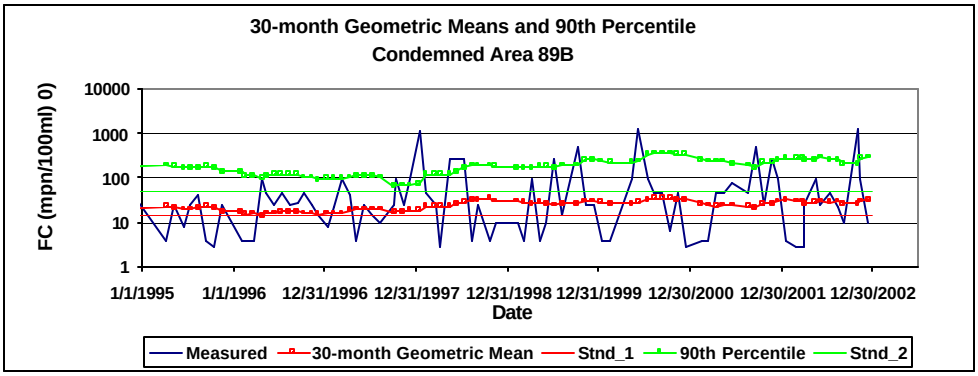


Figure 4.3-C Tipers Creek

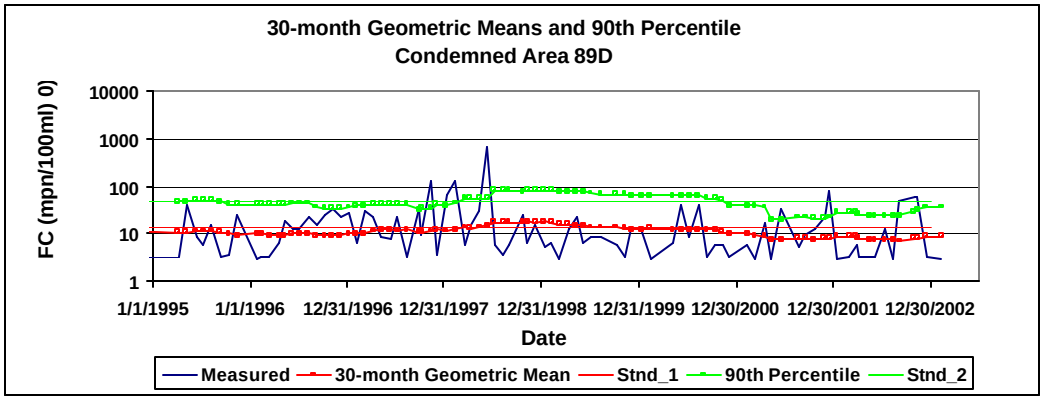


Figure 4.3-E Warehouse Creek

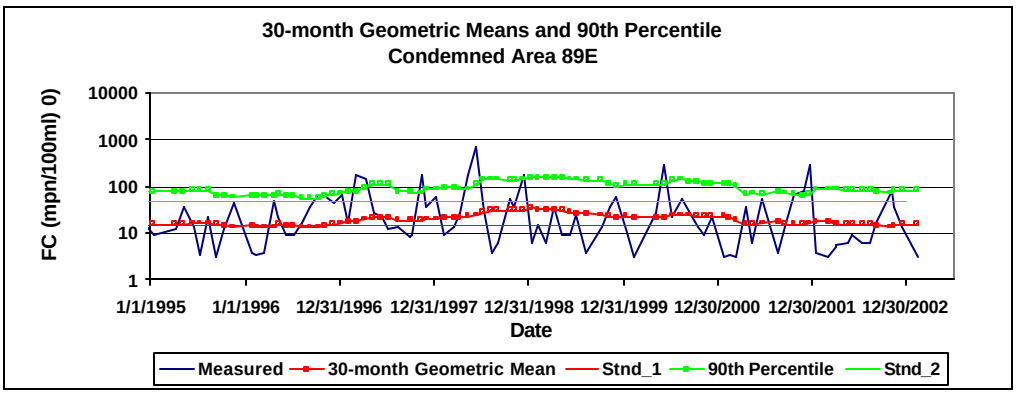
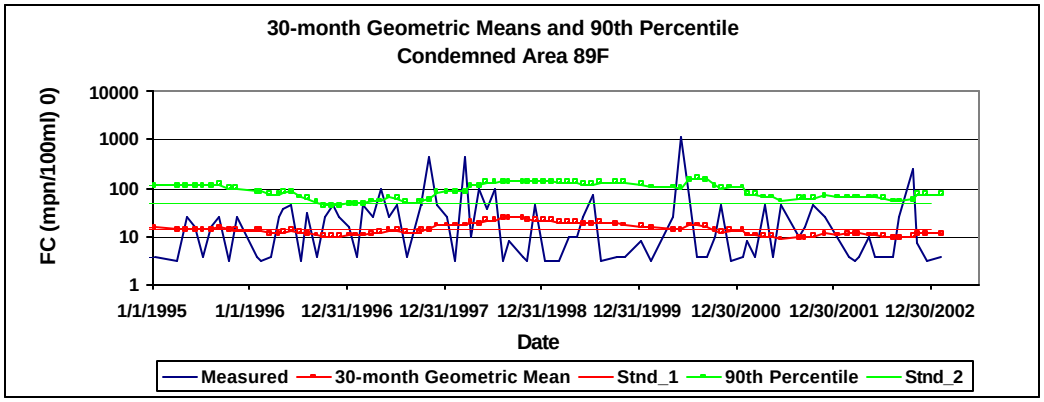


Figure 4.3-F Whays Creek



4.2 Condemnation Areas

Five segments in tributaries and in the upper Great Wicomico River were listed as impaired on Virginia's 1998 303(d) water quality standard for fecal coliform bacteria in shellfish supporting waters. These impairments included condemnation number 89A - portions of the Great Wicomico River (VAP-C01E-01), 89B - portions of Balls Creek VAP-C01E-02), 89C – portions of Tipers Creek VAP-C01E-03), 89E – portions of Warehouse Creek VAP-C01E-06), and 89F – portions of Whays Creek VAP-C01E-05).

The condemned portion of Barrett Creek VAP-C01E-04?), 89D – was delisted in 2004 based on additional water quality monitoring data that indicated that waters met water quality standards.

Detailed maps of the shellfish condemnation areas and their associated water quality stations are available from the Virginia Department of health, Division of Shellfish Sanitation. A map of the five condemnation areas is shown in Figure 4.2. Copies of the condemnation notices may be found in Appendix A.

4.3 Fecal Coliform Bacteria Source Assessment

The locations of shoreline deficiencies from the DSS shoreline survey and wastewater treatment facilities (if any), are shown in Figure 4.4.

A. Point Source

As indicated in Figure 4.4, there is one VPDES permitted wastewater treatment plant point source contribution to the watershed: VA0020877, Northumberland High School, design flow 0.008 MGD, discharging to an unnamed tributary of Crabbe Mill Stream.

B. Non-Point Source Contributions

Nonpoint sources of fecal coliform do not have one discharge point but may occur over the entire length of the receiving water. Fecal coliform bacteria deposited on the land surface can build up over time. During rain events, surface runoff transports water and sediment and discharges to the waterway. Sources of fecal coliform bacteria include grazing livestock, concentrated animal feeding operations, manure application and wildlife and pet excretion. Direct contribution to the waterway occurs when livestock or wildlife defecate into or immediately adjacent to receiving waters. Nonpoint source contributions from humans generally arise from failing septic systems and associated drain fields, moored or marina vessel discharges, storm water management facilities, pump station failures and ex-filtration from sewer systems. Contributions from wildlife, both mammalian and avian, are natural conditions and may represent a background level of bacterial loading. There is only a small portion of the Great Wicomico watershed on sewer. It is therefore likely that human loading is due to failures in septic waste treatment systems and/or potential pollution from recreational vessel discharges.

The shoreline survey is used as a tool to identify nonpoint source contribution problems and locations. Figure 4.4 shows the results of the DSS sanitary shoreline survey dated April 2005.

A copy of the textual portion of this survey has been included as Appendix A. The survey identified 97 deficiencies. 22 were on-site sewage deficiencies, 30 were related to boating, 28 were potential pollution, 9 were related to animal pollution. The Northumberland High School sewage treatment facility was not included in this tally of deficiencies because it is a VPDES facility permitted and inspected by Virginia DEQ. The remaining deficiencies were related to non-sewage waste. The number of deficiencies displayed on the map may not agree with the total because of the scale of the map and the possibility of multiple deficiencies at one location.

4.4 Bacterial Source Tracking

Bacterial Source tracking is used to identify sources of fecal contamination from human as well as domestic and wild animals. The BST method used in Virginia is based on the premise that *Escherichia coli (E. Coli)* found in human, domestic animal, and wild animals will have significantly different patterns of resistance to a variety of antibiotics. The Antibiotic Resistance Approach (ARA), uses fecal streptococcus or *E. coli* and patterns of antibiotic resistance for separation of sources of the bacterial contribution. The BST analysis used for this TMDL classified the bacteria into one of four source categories: human, pets, livestock, and wildlife. However, BST analysis is an experimental, not approved, technique that is under evaluation and the error involved in correctly assigning *E. coli* isolates to the appropriate fecal sources is unknown.

Figure 4.1 shows the TMDL study stations, which are the BST monitoring stations for the Great Wicomico River Growing areas. The data developed for the watershed show that the dominant contributions are as follows:

89-A, the upper Great Wicomico River the dominant contribution is **human** followed by livestock, pets and wildlife.

89-B, Balls Creek the dominant contribution is **human** followed by pets, livestock and wildlife.

89-C, Tipers Creek the dominant contribution is **human** followed by livestock, wildlife and pets.

89-D, Barrett Creek – **Delisted** based on additional water quality monitoring data.

89-E, Warehouse Creek the dominant contribution is **human** followed by livestock, wildlife and pets.

89-F, Whays Creek the dominant contribution is **human** followed by livestock, pets and wildlife.

Figures 4.5-A, -B,-C,-E and -F show the mean distribution by month for the source categories and the annual means are shown in Figures 4.6-A, -B, -C, -E, and -F. The BST sampling period was October 2002 through August 2003. The target sampling interval was once monthly, if the graph does not show 11 months, that means that there were months for which data was not available. This data is shown in tabular form in Table 4.2. These values are used for the source allocation in deriving the Total Maximum Daily Loads for the Great Wicomico River Growing areas.

Figure 4.4

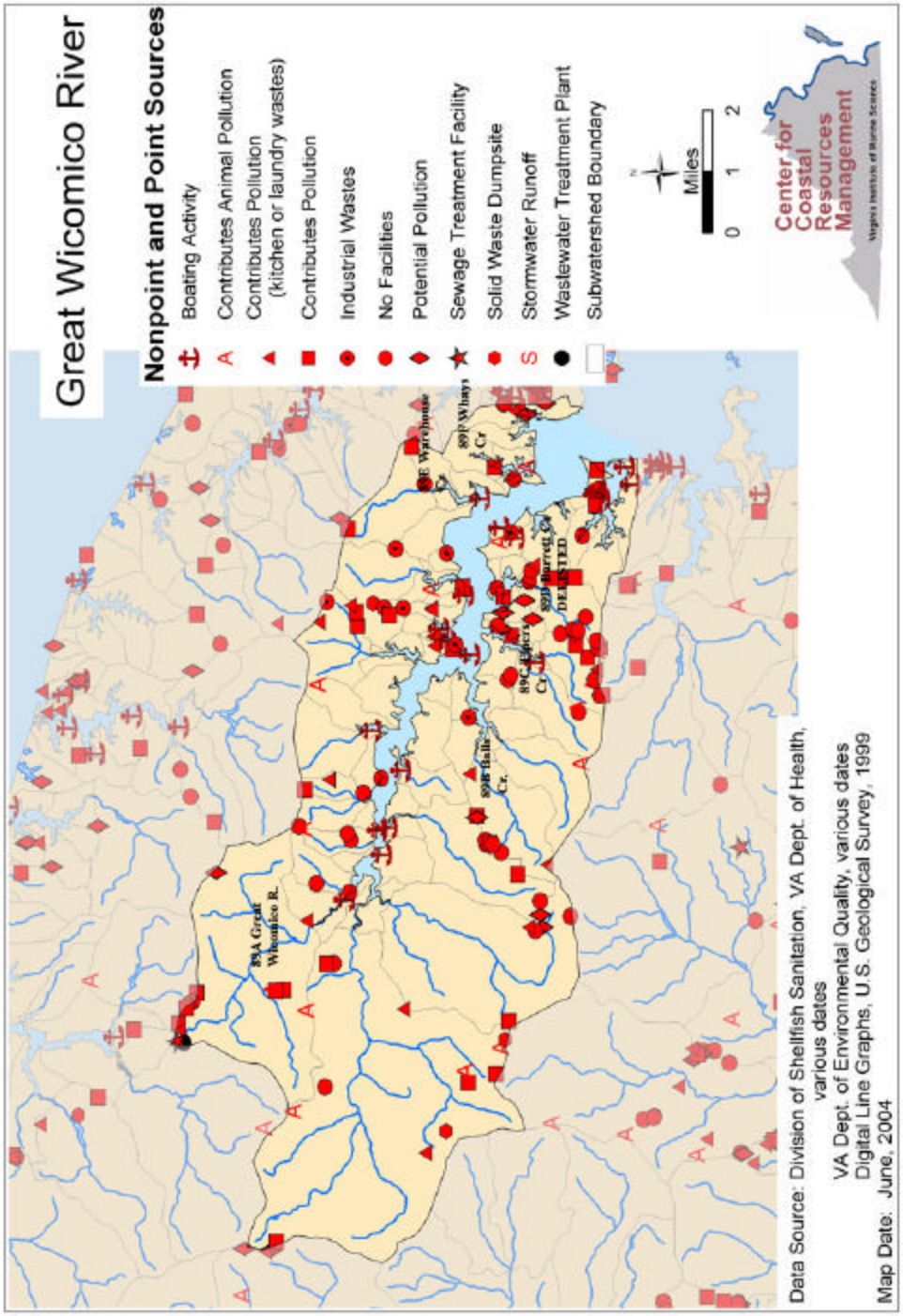

Great Wicomico River
Nonpoint and Point Sources
Boating Activity
Contributes Animal Pollution
Contributes Pollution (kitchen or laundry wastes)
Contributes Pollution
Industrial Wastes
No Facilities
Potential Pollution
Sewage Treatment Facility
Solid Waste Dumpsite
Stormwater Runoff
Wastewater Treatment Plant
Subwatershed Boundary
Miles
0 1 2
Center for Coastal Resources Management
Virginia Institute of Marine Science
89A Great Wicomico R.
89E Warehouse
89F Whays Cr
89B Balls Cr.
89C Cockrell Cr.
89D Barrett Cr
DELISTED
Data Source: Division of Shellfish Sanitation, VA Dept. of Health, various dates
VA Dept. of Environmental Quality, various dates
Digital Line Graphs, U.S. Geological Survey, 1999
Map Date: June, 2004

Figure 4.5-A Great Wicomico River

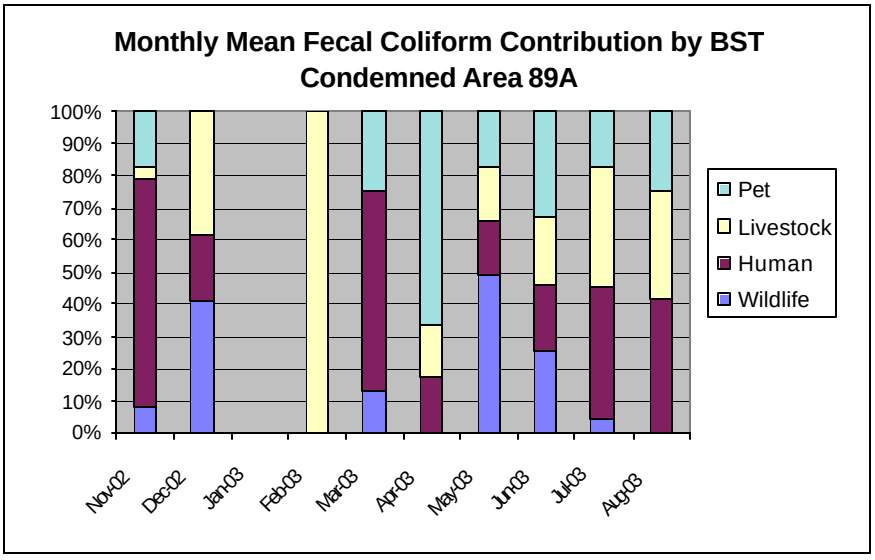


Figure 4.5-B Balls Creek

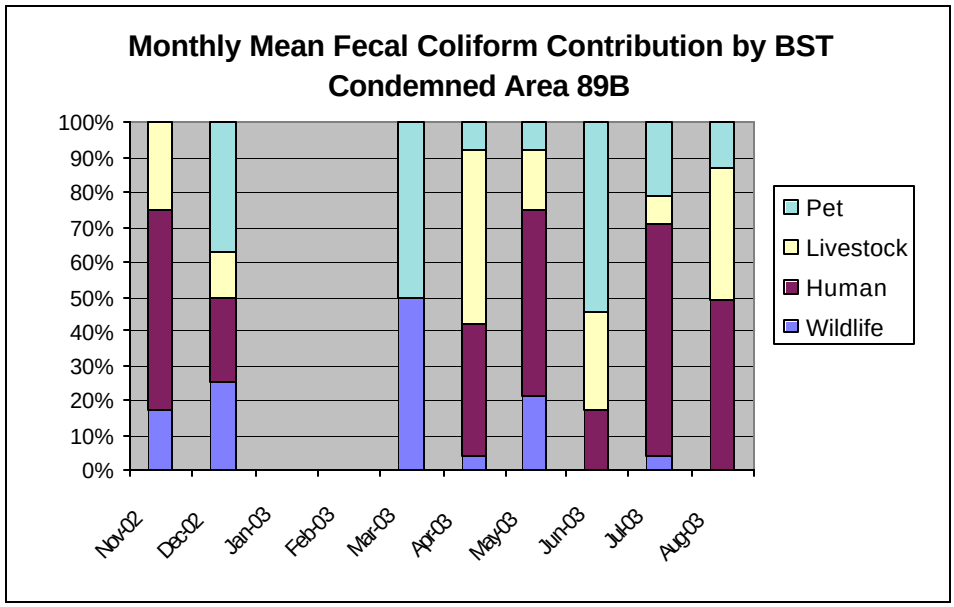


Figure 4.5-C Tipers Creek

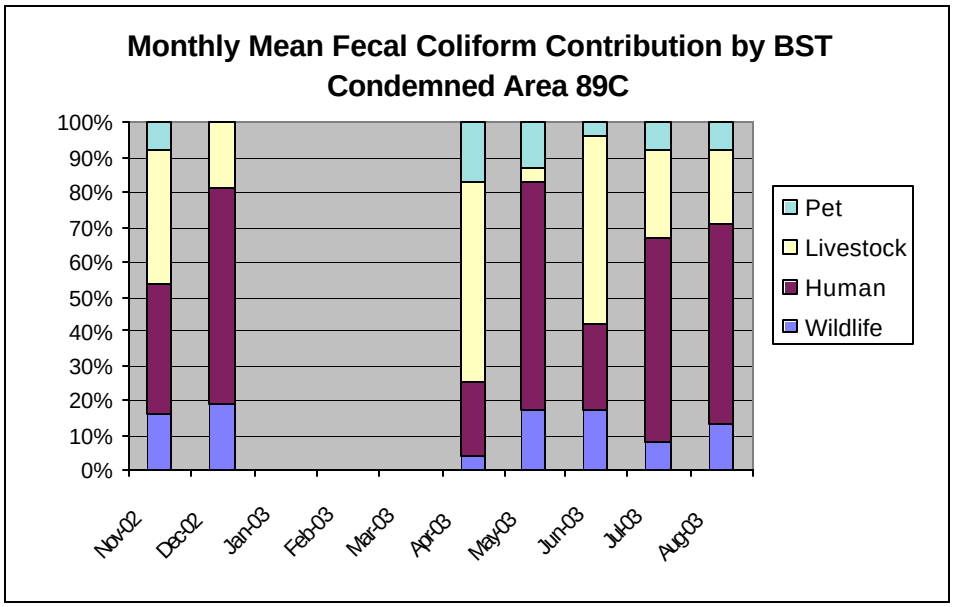


Figure 4.5-E Warehouse Creek

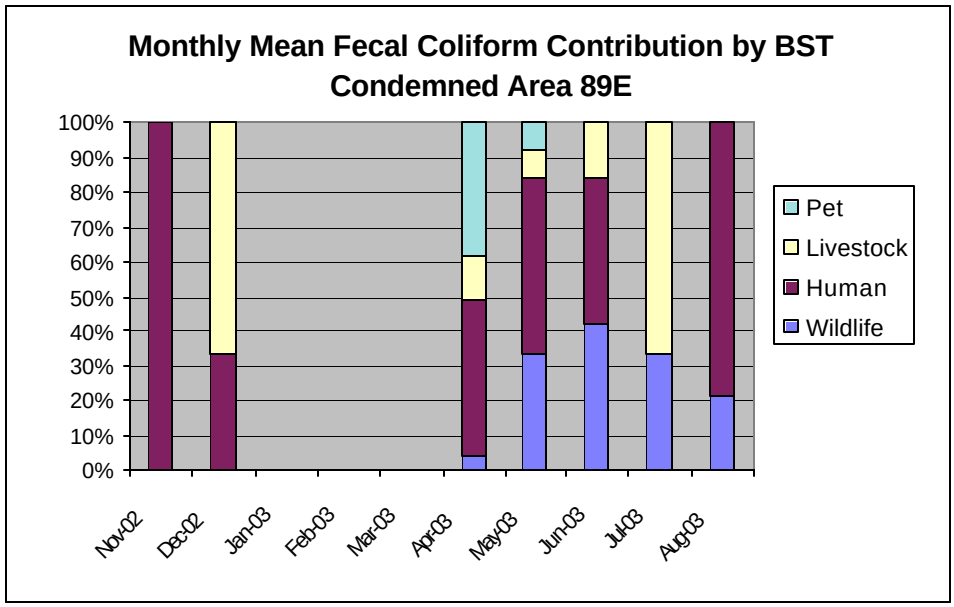


Figure 4.5-F Whays Creek

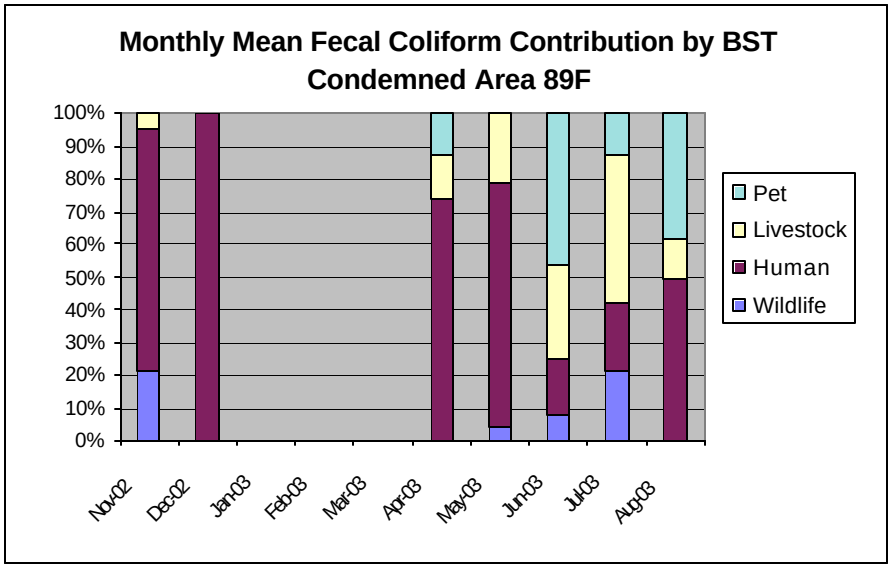


Table 4.2 Non-point Source Load Distribution using BST Growing area 13: Great Wicomico River

Condemnation Area	Livestock	Wildlife	Human	Pet
89A Great Wicomico River	0.30	0.16	0.32	0.22
89B Balls Creek	0.23	0.15	0.39	0.24
89C Tipers Creek	0.31	0.13	0.47	0.08
89E Warehouse Creek	0.24	0.19	0.50	0.07
89F Whays Creek	0.18	0.08	0.59	0.16

Figure 4.6A 13-89A Great Wicomico River

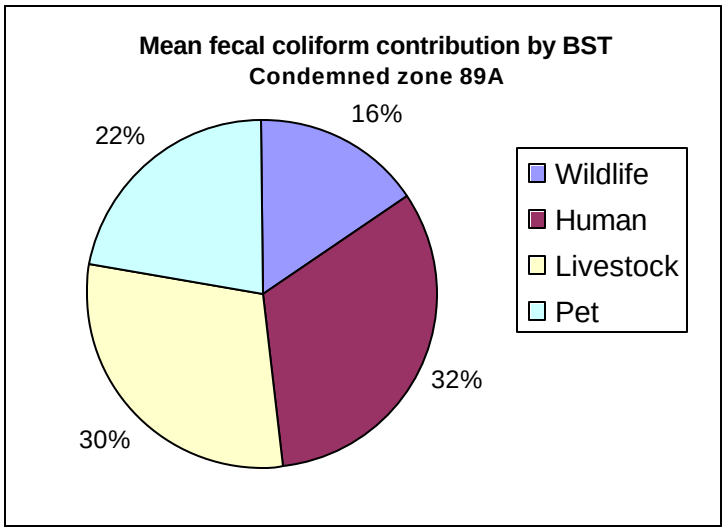


Figure 4.6B 13-89B Balls Creek

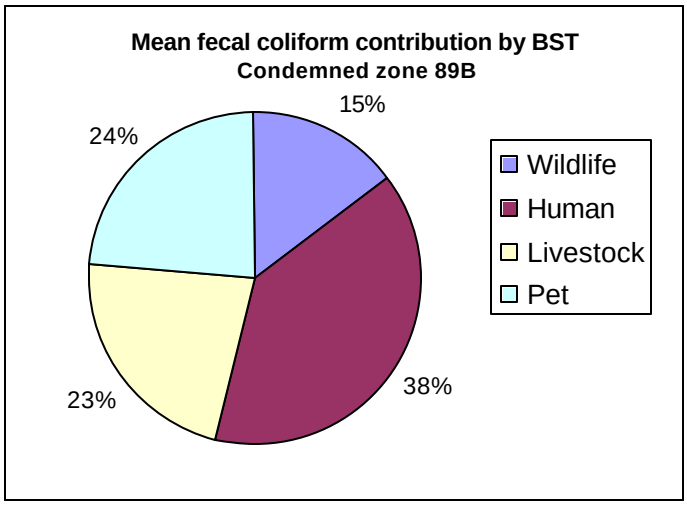


Figure 4.6C 13-89C Tipers Creek

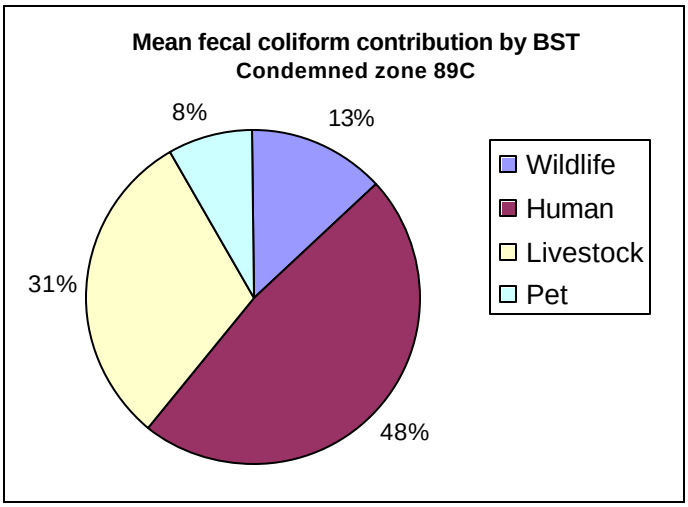


Figure 4.6D 13-89E Warehouse Creek

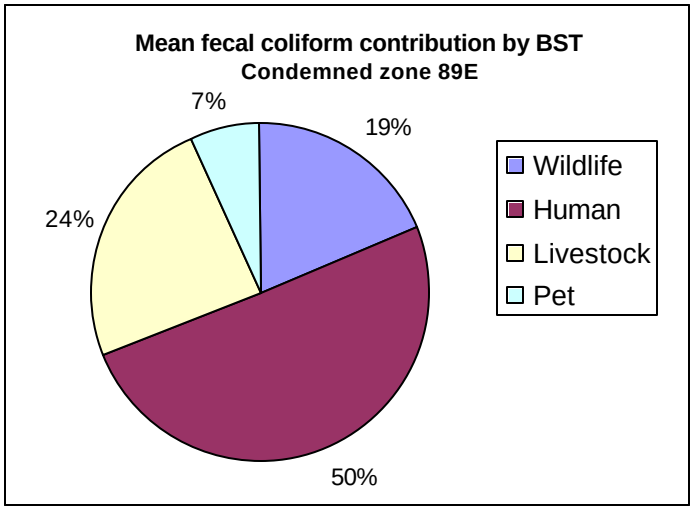
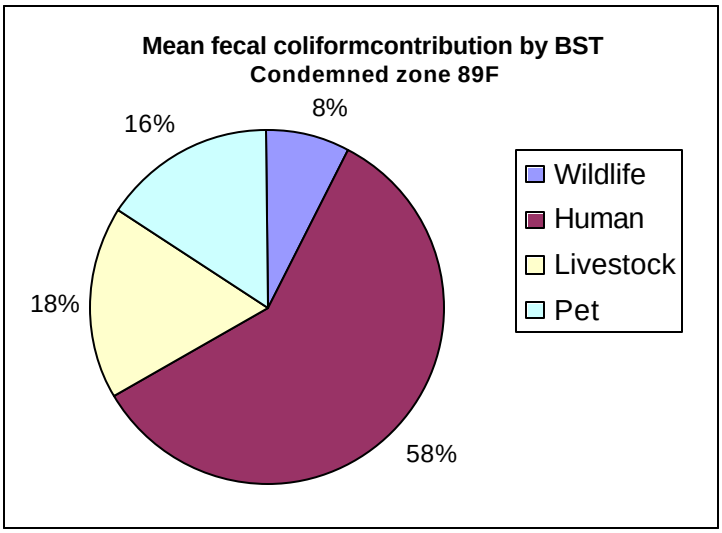


Figure 4.6E 13-89F Whays Creek



5.0 TMDL Development

5.1 Simplified Modeling Approach (Tidal Volumetric Model):

Personnel from EPA, Virginia DEQ, Virginia Department of Conservation and Recreation (DCR), Maryland Department of the Environment (MDE), Virginia DSS, Virginia Institute of Marine Sciences (VIMS), United States Geological Survey, Virginia Polytechnic University, James Madison University, and Tetra Tech composed the shellfish TMDL workgroup and developed a procedure for developing TMDLs using a simplified approach for the development of the TMDL. The goal of the procedure is to use bacteriological source tracking (BST) data to determine the sources of fecal coliform violations and the load reductions needed to attain the applicable criteria.

5.2 The TMDL Calculation

To meet the water quality standards for both geometric mean and 90th percentile criteria, TMDLs for the impaired segments in the watershed are defined for the geometric mean load and the 90th percentile load. The TMDL for the geometric mean essentially represents the allowable average limit and the TMDL for the 90th percentile is the allowable upper limit. If observed data were available for more than one monitoring station in a condemned area, the volume-weighted values for each condemned area were used to represent the embayment concentration.

A. Current Fecal Coliform Condition

The fecal coliform concentration in an embayment varies due to the changes in biological, hydrological and meteorological conditions. The current condition was determined based on the 30-sample geometric mean and 90th percentile of volume-weighted fecal coliform values of each condemned area. The period of record for the monitoring data used to determine the current condition is 1995 to 2002. This interval was chosen to ensure inclusion of the data that represents the conditions at the time the waters were first listed as impaired in 1998. As the regulatory requirement for assessment is based upon 30 (month) sample intervals and the waters were first listed as impaired in 1998, the current condition has been determined using monitoring data for that time interval of 3 years preceding the 1998 list date to the time of the BST analysis. The maximum values for geometric mean and 90th percentile were used to represent the current loads. Therefore, the current loads represent the worse case scenario.

B. Geometric Mean Analysis:

The current 30-sample geometric mean was used for the load estimation. The corresponding 30-sample geometric mean from the station outside the condemned area was used as the boundary condition. The current load was estimated using steady state tidal prism model. The allowable load was calculated using the water quality standard of 14 MPN/100ml. This value was also used as boundary condition for the calculation. The load reduction needed for the attainment of the water quality standard was determined by subtracting the allowable load from the current load. The process may be described by the word equation as follows. The calculated results are listed in table 5-2.

The load reduction is estimated as follows:

Geometric Mean Value (X MPN/100ml) x (volume) = Existing Load

Criteria Value (14 MPN/100ml) x (volume) = Allowable Load

$$\textbf{Load Reduction} = \frac{\textbf{Current Load} - \textbf{Allowable Load}}{\textbf{Current Load}} \times 100\ \%$$

Table 5.1 Geometric Mean Analysis of Current Load and Estimated Load Reduction – Great Wicomico River

Geometric Mean Calculation for Growing Area 13 Great Wicomico River						
Condemnation Area	Volume (m^3)	Fecal Coliform (MPN/100ml)	Water Quality Standard MPN/100 ml	Current Load (MPN/day)	Allowable Load (MPN/day)	Required Reduction (%)
89A Great Wicomico River (VAP-C01E-01)	679770	12.8	14	8.93E+10	9.77E+10	0%
89B Balls Creek (VAP-C01E-02)	73260	32.9	14	2.41E+10	1.03E+10	57%
89C Tipers Creek (VAP-C01E-03)	139950	19.3	14	2.70E+10	1.96E+10	27%
89E Warehouse Creek (VAP-C01E-06)	196200	11.9	14	2.33E+10	2.75E+10	0%
89F Whays Creek (VAP-C01E-05)	89370	10.6	14	9.47E+09	1.25E+10	0%

C. 90th Percentile Analysis

The current 30-sample 90th percentile concentration was used for load estimation. The corresponding 30-sample geometric mean from the station outside the condemned area was used as the boundary condition. The current load was estimated using steady state tidal prism model. The allowable load was calculated based on the water quality standard of 49 MPN/100ml. This value was also used as boundary condition for the calculation. The calculated results are listed in Table 5-3.

The load reduction is estimated as follows:

$$\textbf{Load Reduction} = \frac{\textbf{Current Load} - \textbf{Allowable Load}}{\textbf{Current Load}} \times 100\ \%$$

Table 5.2 90th Percentile Analysis of Current Load and Estimated Load Reduction

Condemnation Area	Volume (m^3)	Fecal Coliform (MPN/100mL)	Current Load (MPN/day)	Allowable Load (MPN/day)	Required Reduction (%)
89A Great Wicomico River (VAP-C01E-01)	697770	81	5.63E+11	3.42E+11	39%
89B Balls Creek (VAP-C01E-02	73260	285	2.08E+11	3.59E+10	83%
89C Tipers Creek (VAP-C01E-03)	139950	116	1.62E+11	6.86E+10	58%
89E Warehouse Creek (VAP-C01E-06)	196200	69	1.36E+11	9.61E+10	29%
89F Whays Creek (VAP-C01E-05)	89370	70	6.22E+10	4.38E+10	30%

5.3 Load Allocation

A comparison of the reductions based on geometric mean load and on the 90th percentile load shows that the 90th percentile load is the critical condition. This is consistent with water quality analysis. The 90th percentile criterion is most frequently exceeded. Therefore the 90th percentile loading is used to allocate source contributions and establish load reduction targets among the various contributing sources that will yield the necessary water quality improvements to attain the water quality standard.

Based on source assessment of the watershed, the percent loading for each of the major source categories is estimated. These percentages are used to determine where load reductions are needed. The loadings for each source are determined by multiplying the total current and allowable loads by the representative percentage. The percent reduction needed to attain the water quality standard or criterion is allocated to each source category. This is shown in Table 5-4 and serves to fulfill the TMDL requirements by ensuring that the criterion is attained.

Table 5.3 Reduction and Allocation Based Upon 90th Percentile Standard: Growing Area 13 Great Wicomico River

Condemnation Area	Source	BST Allocation % of Total Load	Current Load MPN/ day	Load Allocation MPN/ day	Reduction Needed
89 A Great Wicomico River	Livestock	30 %	**1.69E+11**	**1.28E+11**	**24%**
	Wildlife	16 %	**9.01E+10**	**9.01E+10**	**0%**
	Human	32 %	**1.80E+11**	**0.00E+00**	**100%**
	Pets	22 %	**1.24E+11**	**1.24E+11**	**0%**
	Total	100 %	**5.63E+11**	**3.42E+11**	**39%**
89B Balls Creek	Livestock	23 %	**4.80E+10**	**2.12E+09**	**96%**
	Wildlife	15 %	**3.13E+10**	**3.13E+10**	**0%**
	Human	39 %	**8.13E+10**	**0.00E+00**	**100%**
	Pets	24 %	**5.00E+10**	**2.50E+09**	**95%**
	Total	100 %	**2.08E+11**	**3.59E+10**	**83%**
89C Tipers Creek	Livestock	31 %	**5.02E+10**	**3.45E+10**	**31%**
	Wildlife	13 %	**2.11E+10**	**2.11E+10**	**0%**
	Human	47 %	**7.62E+10**	**0.00E+00**	**100%**
	Pets	8 %	**1.30E+10**	**1.30E+10**	**0%**
	Total	100 %	**1.62E+11**	**6.86E+10**	**58%**
89E Warehouse Creek	Livestock	24 %	**3.26E+10**	**3.26E+10**	**0%**
	Wildlife	19 %	**2.58E+10**	**2.58E+10**	**0%**
	Human	50 %	**6.79E+10**	**2.82E+10**	**59%**
	Pets	7 %	**9.50E+09**	**9.50E+09**	**0%**
	Total	100 %	**1.36E+11**	**9.61E+10**	**29%**
89F Whays Creek	Livestock	18 %	**1.12E+10**	**1.12E+10**	**0%**
	Wildlife	8 %	**4.98E+09**	**4.98E+09**	**0%**
	Human	59 %	**3.67E+10**	**1.77E+10**	**52%**
	Pets	16 %	**9.95E+09**	**9.95E+09**	**0%**
	Total	100 %	**6.22E+10**	**4.38E+10**	**30%**

The TMDL seeks to eliminate 100% of the human derived fecal component regardless of the allowable load determined through the load allocation process. Human derived fecal coliforms are a serious concern in the estuarine environment and discharge of human waste is precluded by state and federal law. Through an iterative implementation of actions to reduce the controllable loads, subsequent monitoring may indicate that further reductions are not necessary, or that revisions in implementation strategies may be appropriate. Continued violations may result in the process of Use Attainment Analysis, UAA, for the waterbody (see Chapter 6 for a discussion of UAA). The allocations presented demonstrate how the TMDLs could be implemented to achieve water quality standards; however, the state reserves the right to allocate differently, as long as consistency with the achievement of water quality standards is maintained.

5.3.1 Development of Wasteload Allocations

There is one permitted point source discharge in the watershed, VA0020877, Northumberland High School, design flow 0.008 MGD, discharging to an unnamed tributary of Crabbe Mill Stream. The VA Department of Health – Division of Shellfish Sanitation (VDH-DSS) models the effects of wastewater treatment facilities to shellfish growing areas for protection of human health. Areas potentially affected by sewage treatment plants are permanently prohibited from shellfish harvesting. Wastewater treatment kills bacteria in the effluent, but has little effect on human viruses, which can be transferred to shellfish. These viruses are difficult for shellfish to purge, so these areas are permanently prohibited from harvesting. Because the High School is located outside of the shellfish impairment area, a wasteload allocation is not necessary.

5.4 Consideration of Critical Conditions and Seasonal Variation

EPA regulations at 40 CFR 130.7 (c)(1) require TMDLs to take into account critical conditions for stream flow, loading, and water quality parameters. The intent of this requirement is to ensure that the water quality of the waterbody is protected during times when they are most vulnerable.

Critical conditions are important because they describe the factors that combine to cause a violation of water quality standards and will help in identifying the actions that may have to be undertaken to meet water quality standards. The current loading to the waterbody was determined using a long-term record of water quality monitoring (observation) data. The period of record for the data was 1995 to 2002. The resulting estimate is quite robust.

A comparison of the geometric mean values and the 90th percentile values against the water quality criteria will determine which represents the more critical condition or higher percent reduction. If the geometric mean values dictate the higher reduction, this suggests that, on average, water sample counts are consistently high with limited variation around the mean. If the 90th percentile criterion requires a higher reduction, this suggests an occurrence of the high fecal coliform due to the variation of hydrological conditions. For this study, the 90th percentile criterion is the most critical condition. Thus, the final load reductions determined using the 90th percentile represent the most stringent conditions and it is the reductions based on these bacterial loadings that will yield attainment of the water quality standard. Seasonal variations involve changes in surface runoff, stream flow, and water quality as a result of hydrologic and climatologic patterns. Variations due to changes in the hydrologic cycle as well as temporal variability in fecal coliform sources, such as migrating duck and goose populations are accounted for by the use of the long-term data record to estimate the current load.

5.5. Margin of Safety

A Margin of Safety (MOS) is required as part of a TMDL in recognition of uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is

incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural water bodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

A sensitivity analysis of the model parameters indicates that fecal coliform decay rate is the most sensitive of model parameters. The decay rate is a lumped parameter that includes die-off due to temperature, salinity, and light. It also includes the influence of re-suspension and other factors. The value of the decay rate varies from between 0.3 and 3.0 in salt water (Thomann and Mueller, 1987). A value of 0.35 per day was used in the TMDL calculation consistent with other regulatory programs.

The selected decay rate is a conservative estimate in the TMDL calculation. Therefore, the MOS is implicitly included in the calculation.

5.6 TMDL Summary

To meet the water quality standards for both geometric mean and 90th percentile criteria, TMDLs for Rappahannock River: Lagrange and Robinson Creeks are defined for the geometric mean load and the 90th percentile load. The TMDLs are summarized in the table 5.4 and 5.5.

Table 5.4 TMDL Summary for Five Closures in the Great Wicomico River watershed (geometric mean)

Condemnation Area	Pollutant Identified	TMDL MPN/day	Waste Load Allocation MPN/day	Load Allocation MPN/day	Margin of Safety
89 A Great Wicomico River (VAP-C01E-01)	Fecal Coliform	14	N/A	9.77E+10	Implicit
89B Balls Creek (VAP-C01E-02)	Fecal Coliform	14	N/A	1.03E+10	Implicit
89C Tipers Creek (VAP-C01E-03)	Fecal Coliform	14	N/A	1.96E+10	Implicit
89E Warehouse Creek (VAP-C01E-06)	Fecal Coliform	14	N/A	2.75E+10	Implicit
89F Whays Creek (VAP-C01E-05)	Fecal Coliform	14	N/A	1.25E+10	Implicit

Table 5.5 TMDL Summary for Five Closures in the Great Wicomico River watershed (90th percentile)

Condemnation Area	Pollutant Identified	TMDL MPN/day	Waste Load Allocation MPN/day	Load Allocation MPN/day	Margin of Safety
89 A Great Wicomico River (VAP-C01E-01)	Fecal Coliform	49	N/A	3.42E+11	Implicit
89B Balls Creek (VAP-C01E-02)	Fecal Coliform	49	N/A	3.59E+10	Implicit
89C Tipers Creek (VAP-C01E-03)	Fecal Coliform	49	N/A	6.86E+10	Implicit
89E Warehouse Creek (VAP-C01E-06)	Fecal Coliform	49	N/A	9.61E+10	Implicit
89F Whays Creek (VAP-C01E-05)	Fecal Coliform	49	N/A	4.38E+10	Implicit

6.0 TMDL Implementation

The goal of the TMDL program is to establish a three-step path that will lead to attainment of water quality standards. The first step in the process is to develop TMDLs that will result in meeting water quality standards. This report represents the culmination of that effort for the bacteria impairments in the Rappahannock River: Lagrange and Robinson watershed. The second step is to develop a TMDL implementation plan. The final step is to implement the TMDL implementation plan, and to monitor water quality to determine if water quality standards are being attained.

Once a TMDL has been approved by EPA, measures must be taken to reduce pollution levels in the waterbody. These measures, which can include the use of better treatment technology and the installation of best management practices (BMPs), are implemented in an iterative process that is described along with specific BMPs in the implementation plan. The process for developing an implementation plan has been described in the recent "TMDL Implementation Plan Guidance Manual", published in July 2003 and available upon request from the DEQ and DCR TMDL project staff or at http://www.deq.state.va.us/tmdl/implans/ipguide.pdf With successful completion of implementation plans, Virginia will be well on the way to restoring impaired waters and enhancing the value of this important resource. Additionally, development of an approved implementation plan will improve a locality's chances for obtaining financial and technical assistance during implementation.

6.1 Staged Implementation

In general, Virginia intends for the required reductions to be implemented in an iterative process that first addresses those sources with the largest impact on water quality. For example, in agricultural areas of the watershed, the most promising management practice is livestock exclusion from waterbodies. This has been shown to be very effective in lowering fecal coliform concentrations in waterbodies, both by reducing the cattle deposits themselves and by providing additional riparian buffers.

Additionally, in both urban and rural areas, reducing the human fecal loading from failing septic systems should be a primary implementation focus because of its health implications. This component could be implemented through education on septic tank pump-outs as well as a septic system repair/replacement program and the use of alternative waste treatment systems. In urban areas, reducing the loading from leaking sewer lines could be accomplished through a sanitary sewer inspection and management program.

The iterative implementation of BMPs in the watershed has several benefits:

1. It enables tracking of water quality improvements following BMP implementation through follow-up monitoring;
2. It provides a measure of quality control, given the uncertainties inherent in computer simulation modeling;
3. It provides a mechanism for developing public support through periodic updates on BMP implementation and water quality improvements;
4. It helps ensure that the most cost effective practices are implemented first; and
5. It allows for the evaluation of the adequacy of the TMDL in achieving water quality standards.

Watershed stakeholders will have opportunity to participate in the development of the TMDL implementation plan. Specific goals for BMP implementation will be established as part of the implementation plan development.

6.2 Link to ongoing Restoration Efforts

Implementation of this TMDL will contribute to on-going water quality improvement efforts aimed at restoring water quality in the Chesapeake Bay. A tributary strategy has been developed for the Rappahannock River Basin. Up-to-date information on tributary strategy development can be found at http://www.snr.state.va.us/Initiatives/TributaryStrategies/york.cfm.

6.3 Reasonable Assurance for Implementation

6.3.1 Follow-Up Monitoring

VDH-DSS will continue sampling at the established bacteriological monitoring stations in accordance with its shellfish monitoring program. VADEQ 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.

6.3.2. Regulatory Framework

While section 303(d) of the Clean Water Act and current EPA regulations do not require the development of TMDL implementation plans as part of the TMDL process, they do require reasonable assurance that the load and wasteload allocations can and will be implemented. Additionally, Virginia's 1997 Water Quality Monitoring, Information and Restoration Act (the "Act") directs the State Water Control Board to "develop and implement a plan to achieve fully supporting status for impaired waters" (Section 62.1-44.19.7). The Act also establishes that the implementation plan shall include the date of expected achievement of water quality objectives, measurable goals, corrective actions necessary and the associated costs, benefits and environmental impacts of addressing the impairments. EPA outlines the minimum elements of an approvable implementation plan in its 1999 "Guidance for Water Quality-Based Decisions: The TMDL Process." The listed elements include implementation actions/management measures, timelines, legal or regulatory controls, time required to attain water quality standards, monitoring plans and milestones for attaining water quality standards.

Once developed, DEQ intends to incorporate the TMDL implementation plan into the appropriate Water Quality Management Plan (WQMP), in accordance with the Clean Water Act's Section 303(e). In response to a Memorandum of Understanding (MOU) between EPA and DEQ, DEQ also submitted a draft Continuous Planning Process to EPA in which DEQ commits to regularly updating the WQMPs. Thus, the WQMPs will be, among other things, the repository for all TMDLs and TMDL implementation plans developed within a river basin.

6.3.3. Implementation Funding Sources

One potential source of funding for TMDL implementation is Section 319 of the Clean Water Act. Section 319 funding is a major source of funds for Virginia's Non-point Source Management Program. Other funding sources for implementation include the U.S. Department of Agriculture's Conservation

Reserve Enhancement and Environmental Quality Incentive Programs, the Virginia State Revolving Loan Program, and the Virginia Water Quality Improvement Fund. The TMDL Implementation Plan Guidance Manual contains additional information on funding sources, as well as government agencies that might support implementation efforts and suggestions for integrating TMDL implementation with other watershed planning efforts.

6.3.4 Addressing Wildlife Contributions

In some waters for which TMDLs have been developed, water quality modeling indicates that even after removal of all of the sources of bacteria (other than wildlife), the stream will not attain standards under all flow regimes at all times. **However, neither the Commonwealth of Virginia, nor EPA are proposing the elimination of wildlife to allow for the attainment of water quality standards.** This is obviously an impractical and wholly undesirable action. While managing over-populations of wildlife remains as an option to local stakeholders, the reduction of wildlife or changing a natural background condition is not the intended goal of a TMDL.

Based on the above, EPA and Virginia have developed a TMDL strategy to address the wildlife issue. The first step in this strategy is to develop a reduction goal. The pollutant reductions for the interim goal are applied only to controllable, anthropogenic sources identified in the TMDL, setting aside any control strategies for wildlife. During the first implementation phase all controllable sources would be reduced to the maximum extent practicable using the staged approach outlined above. Following completion of the first phase, DEQ would re-assess water quality in the stream to determine if the water quality standard is attained. This effort will also evaluate if the technical assumptions were correct. If water quality standards are not being met, a UAA may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable sources. In some cases, the effort may never have to go to the second phase because the water quality standard excursions attributed to wildlife may be very small and fall within the margin of error.

If water quality standards are not being met, a special study called a Use Attainability Analysis (UAA) may be initiated to reflect the presence of naturally high bacteria levels due to uncontrollable 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). To remove a designated use, the state must demonstrate 1) that the use is not an existing use, 2) that downstream uses are protected, and 3) that the source of bacterial contamination is natural and uncontrollable by effluent limitations and by implementing cost-effective and reasonable best management practices for non-point source control (9 VAC 25-260-10). All site-specific criteria or designated use changes must be adopted as amendments to the water quality standards regulations. Watershed stakeholders and EPA will be able to provide comment during this process. Additional information can be obtained at http://www.deq.state.va.us/wqs/WQS03AUG.pdf

7.0. Public Participation

During development of the TMDL for the Great Wicomico River watershed, public involvement was encouraged through a public participation process that included public meetings and stakeholder meetings.

The first public meeting was held on January 26, 2006. A basic description of the TMDL process and the agencies involved was presented and a discussion was held to regarding the source assessment input, bacterial source tracking, and model results. This meeting was followed by development of the final draft TMDL and a review by the stakeholders.

Input from these meetings was utilized in the development of the TMDL and improved confidence in the allocation scenarios and TMDL process.

The second public meeting was held on March 20, 2006. The results of the TMDL study were presented and discussed. Public participation and involvement in the TMDL implementation planning process was encouraged.

8.0 Glossary

303(d). A section of the Clean Water Act of 1972 requiring states to identify and list water bodies that do not meet the states' water quality standards.

Allocations. That portion of receiving water's loading capacity attributed to one of its existing or future pollution sources (nonpoint or point) or to natural background sources. (A wasteload allocation [WLA] is that portion of the loading capacity allocated to an existing or future point source, and a load allocation [LA] is that portion allocated to an existing or future nonpoint source or to natural background levels. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting loading.)

Ambient water quality. Natural concentration of water quality constituents prior to mixing of either point or nonpoint source load of contaminants. Reference ambient concentration is used to indicate the concentration of a chemical that will not cause adverse impact on human health.

Anthropogenic. Pertains to the [environmental] influence of human activities.

Bacteria. Single-celled microorganisms. Bacteria of the coliform group are considered the primary indicators of fecal contamination and are often used to assess water quality.

Bacterial source tracking (BST). A collection of scientific methods used to track sources of fecal contamination.

Best management practices (BMPs). Methods, measures, or practices determined to be reasonable and cost-effective means for a landowner to meet certain, generally nonpoint source, pollution control needs. BMPs include structural and nonstructural controls and operation and maintenance procedures.

Clean Water Act (CWA). The Clean Water Act (formerly referred to as the Federal Water Pollution Control Act or Federal Water Pollution Control Act Amendments of 1972), Public Law 92-500, as amended by Public Law 96-483 and Public Law 97-117, 33 U.S.C. 1251 et seq. The Clean Water Act (CWA) contains a number of provisions to restore and maintain the quality of the nation's water resources. One of these provisions is section 303(d), which establishes the TMDL program.

Concentration. Amount of a substance or material in a given unit volume of solution; usually measured in milligrams per liter (mg/L) or parts per million (ppm).

Contamination. The act of polluting or making impure; any indication of chemical, sediment, or biological impurities.

Cost-share program. A program that allocates project funds to pay a percentage of the cost of constructing or implementing a best management practice. The remainder of the costs is paid by the producer(s).

Critical condition. The critical condition can be thought of as the "worst case" scenario of environmental conditions in the waterbody in which the loading expressed in the TMDL for the pollutant of concern will continue to meet water quality standards. Critical conditions are the combination of environmental factors (e.g., flow, temperature, etc.) that results in attaining and maintaining the water quality criterion and has an acceptably low frequency of occurrence.

Designated uses. Those uses specified in water quality standards for each waterbody or segment whether or not they are being attained.

Domestic wastewater. Also called sanitary wastewater, consists of wastewater discharged from residences and from commercial, institutional, and similar facilities.

Drainage basin. A part of a land area enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into a receiving water. Also referred to as a watershed, river basin, or hydrologic unit.

Existing use. Use actually attained in the waterbody on or after November 28, 1975, whether or not it is included in the water quality standards (40 CFR 131.3).
Fecal Coliform. Indicator organisms (organisms indicating presence of pathogens) associated with the digestive tract.
Geometric mean. A measure of the central tendency of a data set that minimizes the effects of extreme values.
GIS. Geographic Information System. A system of hardware, software, data, people, organizations and institutional arrangements for collecting, storing, analyzing and disseminating information about areas of the earth. (Dueker and Kjerne, 1989)
Infiltration capacity. The capacity of a soil to allow water to infiltrate into or through it during a storm.
Interflow. Runoff that travels just below the surface of the soil.
Loading, Load, Loading rate. The total amount of material (pollutants) entering the system from one or multiple sources; measured as a rate in weight per unit time.
Load allocation (LA). The portion of a receiving waters loading capacity attributed either to one of its existing or future nonpoint sources of pollution or to natural background sources. Load allocations are best estimates of the loading, which can range from reasonably accurate estimates to gross allotments, depending on the availability of data and appropriate techniques for predicting the loading. Wherever possible, natural and nonpoint source loads should be distinguished (40 CFR 130.2(g)).
Loading capacity (LC). The greatest amount of loading a water body can receive without violating water quality standards.
Margin of safety (MOS). A required component of the TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water body (CWA section 303(d)(1)©). The MOS is normally incorporated into the conservative assumptions used to develop TMDLs (generally within the calculations or models) and approved by EPA either individually or in state/EPA agreements. If the MOS needs to be larger than that which is allowed through the conservative assumptions, additional MOS can be added as a separate component of the TMDL (in this case, quantitatively, a TMDL = LC = WLA + LA + MOS).
Mean. The sum of the values in a data set divided by the number of values in the data set.
Monitoring. Periodic or continuous surveillance or testing to determine the level of compliance with statutory requirements and/or pollutant levels in various media or in humans, plants, and animals.
Narrative criteria. Non-quantitative guidelines that describe the desired water quality goals.
Nonpoint source. Pollution that originates from multiple sources over a relatively large area. Nonpoint sources can be divided into source activities related to either land or water use including failing septic tanks, improper animal-keeping practices, forest practices, and urban and rural runoff.
Numeric targets. A measurable value determined for the pollutant of concern, which, if achieved, is expected to result in the attainment of water quality standards in the listed waterbody.
Point source. Pollutant loads discharged at a specific location from pipes, outfalls, and conveyance channels from either municipal wastewater treatment plants or industrial waste treatment facilities. Point sources can also include pollutant loads contributed by tributaries to the main receiving water waterbody or river.
Pollutant. Dredged spoil, solid waste, incinerator residue, sewage, garbage, sewage sludge, munitions, chemical wastes, biological materials, radioactive materials, heat, wrecked or discarded equipment, rock, sand, cellar dirt, and industrial, municipal, and agricultural waste discharged into water. (CWA section 502(6)).

Pollution. Generally, the presence of matter or energy whose nature, location, or quantity produces undesired environmental effects. Under the Clean Water Act, for example, the term is defined as the man-made or man-induced alteration of the physical, biological, chemical, and radiological integrity of water.

Privately owned treatment works. Any device or system that is (a) used to treat wastes from any facility whose operator is not the operator of the treatment works and (b) not a publicly owned treatment works.

Public comment period. The time allowed for the public to express its views and concerns regarding action by EPA or states (e.g., a Federal Register notice of a proposed rule-making, a public notice of a draft permit, or a Notice of Intent to Deny).

Publicly owned treatment works (POTW). Any device or system used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This definition includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment.

Raw sewage. Untreated municipal sewage.

Receiving waters. Creeks, streams, rivers, lakes, estuaries, ground-water formations, or other bodies of water into which surface water and/or treated or untreated waste are discharged, either naturally or in man-made systems.

Riparian areas. Areas bordering streams, lakes, rivers, and other watercourses. These areas have high water tables and support plants that require saturated soils during all or part of the year. Riparian areas include both wetland and upland zones.

Riparian zone. The border or banks of a stream. Although this term is sometimes used interchangeably with floodplain, the riparian zone is generally regarded as relatively narrow compared to a floodplain. The duration of flooding is generally much shorter, and the timing less predictable, in a riparian zone than in a river floodplain.

Runoff. That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface water. It can carry pollutants from the air and land into receiving waters.

Septic system. An on-site system designed to treat and dispose of domestic sewage. A typical septic system consists of a tank that receives waste from a residence or business and a drain field or subsurface absorption system consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.

Sewer. A channel or conduit that carries wastewater and storm water runoff from the source to a treatment plant or receiving stream. Sanitary sewers carry household, industrial, and commercial waste. Storm sewers carry runoff from rain or snow. Combined sewers handle both.

Slope. The degree of inclination to the horizontal. Usually expressed as a ratio, such as 1:25 or 1 on 25, indicating one unit vertical rise in 25 units of horizontal distance, or in a decimal fraction (0.04), degrees (2 degrees 18 minutes), or percent (4 percent).

Stakeholder. Any person with a vested interest in the TMDL development.

Surface area. The area of the surface of a waterbody; best measured by planimetry or the use of a geographic information system.

Surface runoff. Precipitation, snowmelt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions; a major transporter of nonpoint source pollutants.

Surface water. All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.) and all springs, wells, or other collectors directly influenced by surface water.

Topography. The physical features of a geographic surface area including relative elevations and the positions of natural and man-made features.
Total Maximum Daily Load (TMDL). The sum of the individual wasteload allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, plus a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard.
VADEQ. Virginia Department of Environmental Quality.
VDH. Virginia Department of Health.
Virginia Pollutant Discharge Elimination System (NPDES). The national program for issuing, modifying, revoking and re-issuing, terminating, monitoring, and enforcing permits, and imposing and enforcing pretreatment requirements, under sections 307, 402, 318, and 405 of the Clean Water Act.
Wasteload allocation (WLA). The portion of a receiving waters' loading capacity that is allocated to one of its existing or future point sources of pollution. WLAs constitute a type of water quality-based effluent limitation (40 CFR 130.2(h)).
Wastewater. Usually refers to effluent from a sewage treatment plant. See also **Domestic wastewater**.
Wastewater treatment. Chemical, biological, and mechanical procedures applied to an industrial or municipal discharge or to any other sources of contaminated water to remove, reduce, or neutralize contaminants.
Water quality. The biological, chemical, and physical conditions of a waterbody. It is a measure of a waterbody's ability to support beneficial uses.
Water quality criteria. Levels of water quality expected to render a body of water suitable for its designated use, composed of numeric and narrative criteria. Numeric criteria are scientifically derived ambient concentrations developed by EPA or states for various pollutants of concern to protect human health and aquatic life. Narrative criteria are statements that describe the desired water quality goal. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.
Water quality standard. Law or regulation that consists of the beneficial designated use or uses of a waterbody, the numeric and narrative water quality criteria that are necessary to protect the use or uses of that particular waterbody, and an antidegradation statement.
Watershed. A drainage area or basin in which all land and water areas drain or flow toward a central collector such as a stream, river, or lake at a lower elevation.
WQIA. Water Quality Improvement Act.

9.0 Citations

Kuo, A., Butt, A., Kim, S. and J. Ling (1998). Application of a tidal prism water quality model to Virginia Small Coastal Basins. SRAMSOE No. 348.

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Thomann, R. V. and J. Mueller (1987). Principles of surface water quality modeling and control. Harper Collins Publishers.

US EPA Shellfish Workshop Document (2002).

VA DEQ 1998 303(d) List of Impaired Waters.

10.0 Appendices

Appendix A Growing Area 13: Shoreline Sanitary Survey and Condemnation Notices

Appendix B Supporting Documentation and Watershed Assessment

Appendix C Water Quality Data

Appendix D 1) Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.
2) 33 CFR Volume 2, Parts 120 to 199. Revised as of July 1, 2000

Appendix F Public Comments

Appendix A: Growing Area 13: 1) Shoreline Sanitary Survey

COMMONWEALTH of VIRGINIA
Department of Health
DIVISION OF SHELLFISH SANITATION
109 Govenor Street, Room 614-B
Richmond, VA 23219

Ph: 804-864-7487
Fax: 804-864-7481

GREAT WICOMICO
Growing Area #13
Northumberland County

Date: July 18, 2005
Survey Period: April 25, 2005 to June 14, 2005
Total Number of Properties Surveyed: 1808
Surveyed By: D.R. Beuchelt, D.B. Geeson, R.S. Morris, and R.M. Thomas

SECTION A: GENERAL

This survey area extends from Reference Point 13 beginning at Cockrell Point to Reference Point 14 which ends at the end of State Route 609 extended to Ingram Bay, including the Ingram Bay shoreline between these two points, Great Wicomico River [Reason Creek, Whays Creek, Warehouse Creek, Horn Harbor, Coles Creek, Betts Mill Creek, Blackwell Creek, Crabbe Mill Stream, Bush Mill Stream (Head River Branch), Knight Run, Balls Creek, Tipers Creek, Barrett Creek, Penny Creek, Gougher, Creek, Shell Creek], and their tributaries (within the designated boundary line drawn by the Division of Shellfish Sanitation).

The topography of the area surveyed begins with an elevation of 5' at the mouth of the great Wicomico River and reaches 113' at the highest elevation at the outer western edge within the survey boundary.

Meteorological data indicated the 0.93" of rain fell March 25 – 31, 2.33" May 1 -31, 2.42" June 1 – 14 for a total rainfall of 10.27" for the survey period.

Several new businesses have been established along the main corridors of Jessie Dupont Memorial Highway (Route 200) and Northumberland Highway (Route 360). Recreation activities have increased since the last survey which has promoted the need for service oriented businesses such as boat repair, dock installation as well as new housing and the conversion of primary residencies to vacation properties.

Agriculture is still an important part of the counties economy. Grain farms, vineyards, and farmlands are located within the boundary line. During this survey, it has been noted that the area was inhabited by large numbers of waterfowl during the planting and harvest seasons. On occasion, it was found that many of these waterfowl resided on the fields were corn was planted. Some of the fields affected are located at the headwaters of Reason Creek, Whays Creek, and Warehouse Creek.

At another location, outside of the boundary line for this survey, but in close proximity to a first order stream of the Great Wicomico River, and across the road from 12858 Northumberland Highway on Route 360, mounds of dried sludge had been dumped onto the field. Until the sludge was worked into the ground, flies and vultures frequented that area. Even though permits are obtained from the county to apply dried sludge onto the farmland, it is important to note that sludge contains a high level of nutrients which can promote the growth of algae. Sludge can also contain toxic metals and chemicals that will contaminate shellfish. Another concern is fertilizers

that have been used heavily on lawns in some areas. It has been documented that "red tides" can be caused by the increased and out-of-balance nutrient levels from sludge and fertilizers.

It is important to note that since new boundary lines have been established, the Tri-County Landfill, (closed on 7/1/93), and located on Route 600 in Heathsville, is no longer included in this survey area. However, it is located just above the headwaters of Bush Mill Stream which empties into the Great Wicomico River.

Boating activity is currently monitored at 30 established sites classified as Marinas, Other Places Where Boats Are Moored, and Under Surveillance. Activities on the water and around the shoreline are monitored during regular seawater collection runs. Investigated were nine sites that involved animal wastes, nine industrial wastes sites and two solid waste sites.

There is one Sewage Treatment Plant that discharges effluent into the Great Wicomico River via Crabbe Mill Stream. Although this treatment plant is located outside of the survey boundary, it is included as part of this report as a Sewage pollution source. The treatment plant is located at Northumberland High School in Heathsville, Virginia and is Facility No. VA0020877. It is a small Municipal treatment plant which serves ≥ 500 students and faculty. According to Lee Bowles, who manages this treatment plant, the system was upgraded two years ago. A copy of the latest inspection by DEQ is attached to this report.

There are three campgrounds located on the Great Wicomico River, The Great Wicomico Campground, Glebe Point Campground and Camp Kittamaquad Girl Scout Campground.

The current restrictions on shellfish harvesting are numbers 013-220 and 013-089 both effective as of 4 March 2005. Copies of those restrictions are attached to this report.

Copies of Hydrographic and Bacteriological data are not required, but are attached. The data covers the period of 04/13/04 to 06/01/05.

This report lists only those properties that have a sanitary deficiency or have other environmental significance. ***"DIRECT"*** indicates that the significant activity or deficiency has a direct impact on shellfish waters. Individual field forms with full information on properties listed in this report are on file in the Richmond office of the Division of Shellfish Sanitation and are available for reference until superseded by a subsequent survey of the area. Data in the report is also made available to local health departments and other agencies to address items that may be out of compliance with their regulatory programs.

SECTION B: SEWAGE POLLUTION SOURCES

SEWAGE TREATMENT FACILITIES

95. ***DIRECT*** - [redacted] VPDES Permit # VA0020877. Design flow is .008MGD. Treatment consists of a grease trap, stabilization pond, chlorination, and dechlorination. Final effluent discharges to Crabbe Mill Stream. The most recent OWP/DEQ inspection report is attached.

ON-SITE DEFICIENCIES

3. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) – Location: [redacted] Dwelling – white vinyl siding with metal roof 2 story. No Contact. A 2-inch black pipe drains onto ground surface at the rear of the house off of the kitchen. No recent activity. Sanitary Notice issued 3/30/05 to field # DB-43. Tax Map # 38-A (1) - 10.

5. CONTRIBUTES POLLUTION, ***DIRECT***- Location: 1[redacted]. Dwelling - beige vinyl siding 2 story. No Contact. Clean out cap is missing. Distance to Whays Creek is ≤ 250'. Sanitary Notice issued 3/31/05 to field # DB-87. Tax Map # 37-(6)-1-D.

6. CONTRIBUTES POLLUTION – Location: [redacted]. Dwelling - white asbestos shingles 1 story with gray roof. 3 persons. Effluent erupting onto ground surface. Sanitary Notice issued 4/1/05 to field # DB-124. Tax Map # 37-1-114B.

11. CONTRIBUTES POLLUTION, ***DIRECT***- Location: [redacted]. Dwelling - townhouse units. No Contact. Effluent erupting onto ground surface. Distance to marsh < 150 ft. at approximately 25' in elevation. Sanitary Notice issued to field #DB-206. Tax Map # 37-B (1) - 36-A,B,C,D,E,F,G,H.

13. CONTRIBUTES POLLUTION, ***DIRECT***-Location: 7[redacted] Dwelling - cream colored siding 2 story with brown trim and metal roof. No Contact. Septic tank lid is missing with part of the well curbing broken. Area is covered with a wood platform. Distance to Warehouse creek is approximately 200' .Sanitary Notice issued 4/7/05 to field #DB- 236. Tax Map # 37-(1)-27.

24. CONTRIBUTES POLLUTION – Location: [redacted] Dwelling - white shingle siding 1 ½ story with brown roof shingles. No Contact. Septic Tank lid is open exposing waste water, etc. Sanitary Notice issued 4/27/05 to field # DB-478. Tax Map # 36-A (1) - 38-C.

29. CONTRIBUTES POLLUTION, ***DIRECT***- Location: 1[redacted] Dwelling - white siding 2 story with brown shingles. Contact made with neighbors. On 4/29/05 it was observed that effluent had been pooling onto the ground over the drainfield. The effluent was flowing slightly down slope onto the adjacent property. A Sanitary Notice was issued on 4/29/05 to field # DB528. Tax Map #36-A (1) - 36. A call was received on 6/8/05 from the adjacent property owner that the effluent was pooling onto the ground surface. A second visit was made on that date and found was a defective drain line which was allowing the effluent to bubble out of the ground onto the ground surface. A heavy rainfall had preceded this event and had caused the effluent to run down slope and pool around the drilled well on the adjacent property as well as enter a storm drain that emptied into the Great Wicomico River at approximately 500' away at a slope of 45`. As this was a direct hit into Shellfish Waters, a second Sanitary Notice was issued 6/8/05 to field # DB-528.

30. CONTRIBUTES POLLUTION – Location: [redacted] Dwelling - gray vinyl siding double-wide with red shutters and black shingles. No Contact. Effluent pooling onto ground surface. Sanitary Notice issued 4/29/05 to field #DB-536. Tax Map # 36-A (1) - 30-A.

41. CONTRIBUTES POLLUTION – Location: [redacted] Dwelling - gray siding (wood) 1 ½ story with gray shingles. No Contact. Cracked lid on septic tank. In rear of house a 4-inch black drain hose found. Unknown origin. Sanitary Notice issued 5/12/05 to field # DB-746. Tax Map # 26-A (1)3 - 45.

46. NO FACILITIES-Location: [redacted] Property Owners pool. A Port-A-John was available for use. There was no lavatory for use to wash hands, etc. There were no solid waste containers present. The pool is located a good distance from the homes in this subdivision and is ≤ 350 feet from the Great Wicomico River. A sanitary notice was issued 5/16/05 to field #DB-777 requesting information on the Port-A-John. As of 6/17/05, a copy of the Portable Toilet Service agreement has not been received.

47. CONTRIBUTES POLLUTION, ***DIRECT***- Location: [redacted] Dwelling - brick 2 story with white trim. No Contact. Septic tank lid cracked and a white pipe of unknown origin on south side of house, both approximately 300' from the Great Wicomico River. Sanitary Notice issued 5/17/05 to field# DB-789.

49. NO FACILITIES, ***DIRECT-*** Location: [redacted] Dwelling - pink and white mobile home. 5 persons; and

CONTRIBUTES POLLUTION, *DIRECT*- Privy needs repair or replacement. Containers full of wastes etc. are inside the privy. Contents are overflowing onto ground surface. Yard is full of junk and debris. Distance to ravine which empties into the Great Wicomico is ≤ 75'. Sanitary Notice issued 5/17/05 to field #DB-801. Tax Map # 26-(1) - 63-B.

50. CONTRIBUTES POLLUTION, ***DIRECT-*** Location: [redacted] Dwelling - white siding with green trim. 6 persons. Effluent is pooling onto ground surface. Owner is using a black pipe to drain effluent off of ground surface into a ravine that feeds into the Great Wicomico River ≤ 75' away. Sanitary Notice issued 5/17/05 to field # DB-802. Tax Map #26-(1)—63-B.

51. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) – Location: [redacted] Dwelling - white 2 ½ story with gray shingles. 6 persons. Grease trap overflowing onto ground surface. Local Health officials were at this location this A.M. preparing application for repair/replacement of the system. Sanitary Notice issued 5/18/05 to field # DB-815. Tax Map # 26-(1) - 32-B.

63. NO FACILITIES – Owner: [redacted] Occupant: [redacted] Dwelling – gray trailer serving as field office. Portable toilet located adjacent to field office. Sanitary Notice issued 3-25-05 to field #C-5.

68. NO FACILITIES, ***DIRECT*** – Owner: [redacted] Occupant: [redacted] Dwelling – wood frame T-111 gray garage. Portable toilet located on premises approximately 100' from a ravine leading to Ball's Creek at 50' elevation. Sanitary Notice issued 4-22-05 to field #C-221.

69. NO FACILITIES – Location: [redacted] Dwelling – beige house trailer with green shutters. No contact. Portable toilet located behind trailer. Sanitary Notice issued 5-13-05 to field #C-233.

70. NO FACILITIES, ***DIRECT*** – Location: [redacted] access Portable Toilet approximately 3' from a ravine which leads down slope to the Great Wicomico River at 25' elevation. Sanitary Notice Issued 5/18/05 to field # C-322.

75. CONTRIBUTES POLLUTION, ***DIRECT***- Location: [redacted] Dwelling – Brick 2 story with brown siding. 1 person. Effluent is pooling onto ground surface. Sanitary Notice issued 6/6/05 to field # DB958.

77. CONTRIBUTES POLLUTION (Kitchen or Laundry Wastes) – Location: [redacted]. Dwelling – white siding 2 story with green roof. 4 persons. A port-a-john is provided at this property by Essential Systems for Human sewage disposal, however, the owner states she discards her kitchen waste water onto the ground surface. There is no running water to the house. The owner uses a bucket suspended inside a dug well to gather water for the house. Sanitary Notice issued 6/8/05 to field #DB977.

91. CONTRIBUTES POLLUTION, ***DIRECT***- Location: [redacted]. Dwelling – Gray block and unpainted T-1-11 wood siding 2 story. No contact. 4 inch PVC sewer pipe delivers effluent from house to tidal pond which directly connects the Great Wicomico River. Sanitary Notice issued 5/27/05 to field #D-91.

POTENTIAL POLLUTION

1. Location: [redacted] Dwelling – white siding 1 ½ story with green shutters. 3 persons. Yard is full of junk and debris. Two travel trailers are stationed on the property, one showing the possibility of occupancy.

2. Location: [redacted] Dwelling – dark brown log cabin 1 ½ story. No Contact. Yard is full of junk and debris. Owner is discarding old materials such as batteries, old engines etc. overboard.

4. Location: [redacted]. Dwelling – cream colored siding 1 story with gray shutters and brown shingles. Vacant at time of survey, but contact was made with property owner. Septic tank has recently been pumped. Previous occupants encountered problems flushing toilets, etc.

7. Location: [redacted] Dwelling – gray wood siding 2 story with red door and double car garage. No Contact. Grass is tall and dark over drainfield. No signs of effluent. Yard is fenced in.

9. Location: [redacted] Dwelling – wood siding (unpainted) with wood shingles and unattached garage. Septic tank appears recently been pumped out, dirt is freshly dug around the tank. No signs of malfunction.

12. Location: [redacted] Dwelling – cream vinyl siding 1 ½ story with green shutters and brown shingles. No Contact. In rear of house, an open 3-inch PVC pipe was found. Unsure of its origin. NOTE – The clean out for the septic is located in front of the house. Sanitary Notice issued 4/7/05 to field # DB232. Tax Map #37-1-54C.

18. Location: [redacted] Dwelling – brown wood siding with gray trim and metal roof. Barn with living quarters in one end and open garage area. 2-inch PVC pipe (found on 1998 survey as CPKL/NF) still intact. No evidence of effluent activity.

19. Location: [redacted] Dwelling – gray wood siding, 1 story and gray shingles. 2-inch PVC pipe (found on 1998 survey as CPKL/NF) still intact. No evidence of effluent. NOTE: Spoke with property owner who has built a home on the property. She states these buildings are used for storage at this time. I requested that she remove the pipes and she stated she would.

28. Location: [redacted] Dwelling – white siding 1 ½ story with gray shingles. Vacant. No Contact. On SW side of house a pipe of unknown origin runs out onto ground. In rear of house, old drain lines, concrete, standing water and old electric wires are exposed. Sanitary Notice issued 4/29/05 to field # DB524. Tax Map # 36-A (1) - 40. This property is under renovation.

31. Location: [redacted] Dwelling – cream colored mobile home with aqua trim. Vacant. This property is uninhabitable and according to a neighbor, the dwelling has been condemned by the local health department. Septic area has been disturbed, possibly it has recently been pumped out) but no effluent or odor was present.

32. Location: [redacted] Dwelling – white siding 1 story with brick frame on front of house and brown shutters. 3 persons. Resident stated that sometime ago the septic system filled with water and the effluent ran onto the ground surface. The local health department was notified at that time. There was no evidence that this had happened recently.

36. Location: [redacted] Dwelling – white siding 1 story with brown shingles. 2 persons. In wet weather, toilets are slow to flush, but owner has never experienced any problems with pooling effluent.

37. Location: [redacted]. New construction. No Contact. Portable toilet is located ≤ 300 ft. from the Great Wicomico. Owner, who lives out of town, is the contractor. To obtain a copy of his portable toilet agreement, a sanitary notice was issued 5/11/05 to field# DB-713. Tax Map #36-(8) - 5.

38. Location: [redacted] Dwelling –olive green siding with black shingles and white trim. No Contact. Grass is dark over drain field lines. No evidence of effluent or odor.

41. Location: [redacted] Dwelling – wood siding 2 story with screened porch at the rear of the house. No Contact. PVC pipe of unknown origin, under kitchen window ≤ 20ft. from ravine leading into the Great Wicomico River. Sanitary Notice issued 5/12/05 to field # DB-752. Tax Map # 26-A (1)3 - 26.

44. Location: [redacted] Dwelling - gray siding 2 story with white trim and gray shingles. No Contact. For Sale Sign posted on property. PVC pipe of unknown origin extends under deck. No signs of discharge. Sanitary Notice issued 5/16/05 to field # DB-771. Tax Map #26-A (1)2 - 24.

45. Location: [redacted] Dwelling – white siding 2 story with metal roof. No Contact. PVC pipe (2-inch) of unknown origin. No signs of discharge. Sanitary Notice issued 5/16/05 to field # DB-773. Tax Map # 26-A (1)2 - 28.

48. Location: [redacted] New construction. No Contact. Potable Toilet is located ≤ 300 feet from The Great Wicomico River. To obtain a Copy of his Portable Toilet Agreement a Sanitary Notice was issued on 5/17/05 to Field #DB-792. Tax Map #35-(3) - 7.

53. Location: [redacted] Dwelling - apartment complex, (4units) 1 story white siding with brown shingles. No Contact. Grass over drain field is tall and dark. No effluent or odor present.

54. Location: [redacted] Dwelling - tan vinyl siding 2 story with white trim and metal roof. No Contact. Grass over drain field is tall and dark. No effluent or odor present.

55. Location: [redacted] Dwelling – light blue double-wide with gray shingles and white trim. No Contact. Grass over drain field is dark. No effluent or odor present.

56. Location: [redacted] (911# not posted) New Construction. Port-a-John is located within 500 feet of the Great Wicomico. A building permit was not posted on the property. Contractors at the site were not aware of who was responsible for the portable toilet. To obtain information on the portable toilet, a Sanitary Notice was issued 5/19/05 to field #DB-848. Tax Map #25-A (1) - 21.

73. Location: [redacted] 911# not posted) Dwelling – white siding 1 ½ story with blue shutters. No Contact. New system has been installed. Due to recent rains, water is pooling over the area. No evidence of malfunction.

76. Location: [redacted] Dwelling – white siding 1 ½ story with metal roof. 3 persons. A travel trailer, with electric, is parked in yard. Occupant in the house states that folks occasionally stay in the travel trailer when they come down on weekends. No evidence of effluent on ground surface.

78. Location: [redacted]. Dwelling – brown mobile home with dark brown shutters and tar roof. 3 persons. Grass over drain field is tall and dark. No evidence of effluent or malfunction of system.

79. Location: [redacted] Dwelling – yellow siding 2 story with brown trim. No Contact. Junk, debris and tall grass cover yard. No evidence of malfunction.

80. Location: [redacted] Dwelling – small 1 story with asbestos shingles and tar papered roof. Privy in good condition is on premises. Old ringer type washing machine was found in rear of house. No wash water found on ground surface.

84. Location: [redacted] Dwelling – White with orange stripe "Prowler" camping trailer. No contact. 3 inch waste line exits trailer with end duct taped over. Trailer is at 6' elevation and 40' from Cranes Creek. No evidence of effluent on ground surface.

SECTION C: NON-SEWAGE WASTE SITES

INDUSTRIAL WASTES

14. ***DIRECT*** – Location: [redacted] 1 x 1000 gallon Unleaded gasoline tank, 1 x 1000 gallon Diesel fuel tank, both without berms. ≤ 200' from Great Wicomico River.

15. Location: [redacted] Fuel distributor. 3 persons. 2 x 20,000 gallon #2 Unleaded Gasoline, 3 x 10,000 gallon #2 Fuel Oil, 1 x 500 gallon Diesel Fuel, 1 x 500 gallon Unleaded Gasoline, 2 x 10,000 gallon (empty), all without berms.

21. Location: [redacted] 3 persons, 2 x 250 gallon Kerosene tank, 2 x 55 gallon used oil tanks, both without berms, 1 x 4000 gallon Diesel Fuel, 1 x 4000 gallon Gasoline, both underground.

22. Location: [redacted] Boat sales and repair shop. 1 x 250 gallon Diesel fuel tank, 1 x 250 Gasoline Fuel tank, both without berms. Storage of boats and engines on property.

34. Location: [redacted] 3 x 10,000 gallon, 2 x 8,000 gallon, 1 x 12,000 gallon of liquid nitrogen, all without berm.

68. ***DIRECT*** – Location: [redacted] 2 persons. Observed on site was 1 x 500 gallon diesel fuel tank, 1 500 gallon unleaded fuel tank, and 1 x 100 gallon used oil tank all without berms approximately 100' from a ravine leading to Ball's Creek at 50' elevation.

SOLID WASTE DUMPSITES

16. Location: [redacted] 22432. Burgess auto repair/fuel station. 2 persons. Old cars, tires, and scrap iron metal scattered on property.

52. Location: [redacted]. No Contact. Old vehicles, boats, refrigerators, metal, and other debris scattered on property.

SECTION D: BOATING ACTIVITY

MARINAS

17. [redacted]. Commercial Marina. 30 seasonal Slips, 10 transient slips, 16 dry storage spaces, Present during survey were 2 pleasure boats under 26', 2 pleasure boats over 26'.Services available are: Fuel, water, electricity, ramp, restroom facilities, solid waste containers, and dump station. Facility No. 762.

23. [redacted]. Present at time of survey were 25 pleasure boats < 26' and 4 pleasure boats > 26' in dry storage. Approximately 50 dry storage spaces are available as is 18 seasonal slips. Services provided are dump station, ramp, electricity, water, and restroom facilities. Owner is exempt from sewage holding tank pump-out services. Facility No.761.

26. [redacted] Boat repair/Marine Parts facility. 10 – 15 persons. Present at time of survey were 6 pleasure boats < 26' and 9 pleasure boats > 26'. There are 21 seasonal slips available for wet storage, 0 slips for dry storage. Other services included repair work, fuel, electricity, water, restroom facilities, and solid waste containers. Dump station and sewage holding tank pump-out services are also available. Facility No. 1518.

43. [redacted] Present at time of survey were 6 pleasure boats < 26' (1 wet storage, 5 dry storage), 2 pleasure boats >26' (wet storage). Other services available include electricity, water, a ramp, solid waste containers, restroom facilities and a dump station. Sewage holding tank pump-out service is not available. Facility No. 809.

64. [redacted] Community pier and ramp. [redacted] was present at time of survey. 16 slips/moorings available. Present at time of survey were 3 boats under 26' in wet storage. Boating services provided are water, electricity, and an in-out ramp. Containers are available for solid waste collection. Sanitary facilities provided are 1 commode, 1 urinal, and 2 lavatories for men; and 2

commodes and 2 lavatories for women. Sewage disposal is to a septic tank with drainfield, which appeared to be in satisfactory condition at time of inspection. There are no boat holding tank pump-out facilities or portable dump station facilities provided at this location.

81. [redacted] Community pier. Available at this location are 7 seasonal slips. Present at time survey were 2 pleasure boats < 26', 2 pleasure boats > 26', 1 PWC, and 2 rafts. Services provided are electricity and water. No other services available. Facility No. 781.

92. [redacted] Mooring facility and unloading point for workboats. No contact. 6 slips/moorings available. Present at the time of survey were 3 workboats <26' and 2 workboats >26'. The only boating service provided is fuel. Containers are available for solid waste collection. Sanitary facilities provided are 1 privy for men and 1 privy for women. The privies serve as dump stations for portable toilets. Owner has an exemption to the requirement to provide boat holding tank pump-out facilities at this location.

93. [redacted] Seafood sales and crab shedding facility. 1 employee. 10 slips/moorings available. Present at the time of survey were 2 workboats >26'. Boat services provided are water and electricity. Containers are available for solid waste collection. Owner has an exemption to the requirement to provide onshore sanitary facilities, boat holding tank pump-out facilities and portable toilet dump station facilities at this location.

OTHER PLACES WHERE BOATS ARE MOORED

11. [redacted] This facility serves property owners of the Inland Harbour Townhouse units located at this site. Services provided are electricity and water. Owner has an exemption to the requirement to provide onshore sanitary facilities, boat holding tank pump-out facilities, and portable toilet dump station facilities at this location. Facility No. 734.

25. [redacted] Private dock. 6 Seasonal slips available. Present at time of survey were 1 pleasure boat < 26', I work boat >26', and 1 pleasure Boat > 26' in wet storage. Services available are ramp, electricity, water, dump station, and restroom facilities. Owner has an exemption to the requirement to provide boat holding tank pump-out facilities at this location. Facility No. 755.

27. [redacted] Services provided are dump station, repair, electricity, and water. There are 14 seasonal slips available. Present at time of survey were 4 work boats, 4 pleasure boats (all < 26'), 1 work boat, and 2 pleasure boats (all > 26') in wet storage, plus 4 work boats, 4 pleasures boats (all < 26') in dry storage. Facility No. 1158.

57. [redacted] No contact. Present at time of survey was one work boat under 26'. The only boating service provided is an in-out ramp. Containers are available for solid waste collection. There are no sanitary facilities, boat holding tank pump-out facilities or portable toilet dump station facilities provided at this location.

59. [redacted] Community boat ramp and pier. No contact. 2 slips available. No boats present at time of survey. The only boating service available is an in-out ramp. There are no containers available for solid waste collection, sanitary facilities, boat holding tank pump out facilities or dump station facilities provided at this location.

60. [redacted]. Dry storage area for 12 pleasure boats under 26'. No contact. There are no boating services, sanitary facilities, or boat pump-out facilities available.

61. [redacted] Community boat ramp and pier. No contact. 7 slips. No boats present at time of survey. Boating service provided is an in-out ramp. There are no containers available for solid waste collection. Sanitary facilities are 2 commodes and lavatories for men and women, and a boat dump station pump out facility.

85. [redacted] Boat repair facility. 5 employees. 11 slips/moorings available. Present at the time of survey were10 workboats <26' and 1 pleasure boat >26'. Boating services provided are water, electricity and repair. Containers are available for solid waste collection. A portable toilet dump station is available. Sanitary facilities provided are a portable john and the restrooms in owner's house in which disposal is to a septic tank with drainfield, which appeared to be in satisfactory condition at time of inspection. There are no boat holding tank pump-out facilities provided at this location.

86. [redacted] Private dock. No contact. 9 slips/moorings available. No boats present at the time of survey. Boating services provided are electricity and water. There are no sanitary facilities, boat holding tank pump-out facilities or portable dump station facilities.

87. [redacted] Private dock. No contact. 6 slips/moorings and 3 dry storage spaces available. Present at time of survey were 3 pleasure boats <26'. Boating services provided are electricity and water. Containers are available for solid waste collection. Sanitary facilities provided are 1 commode, 1 lavatory and 1 shower for men and women. Sewage disposal is to septic tank with drainfield, which appeared to be in satisfactory condition at time of inspection. There are no boat holding tank pump-out facilities or portable toilet dump station facilities provided at this location.

90. [redacted] Private dock. No contact. 8 slips/moorings available. Present at time of survey were 1 workboat <26' and 1 workboat >26'. Boating services provided are fuel and electricity. Containers are available for solid waste collection. There are no sanitary facilities, boat holding tank pump-out facilities or portable toilet dump station facilities available at this location.

UNDER SURVEILLANCE

8. [redacted] No Contact. Services provided include a boat ramp and 1 transient slip. No boats present at time of survey.

65. [redacted] right as you enter. Community pier and ramp. No contact. 6 slips/moorings available. No boats present at time of survey. Boat service provided is an in-out ramp. There are no containers provided for solid

waste. There are no sanitary facilities, boat holding tank pump-out facilities, or portable dump station facilities provided at this location.

66. [redacted] No contact. 4 slips/moorings available. No boats present at time of survey. Boat service provided is an in-out ramp. There are no containers provided for solid waste. There are no sanitary facilities, boat holding tank pump-out facilities, or portable dump station facilities provided at this location.

67. [redacted] No contact. 2 slips/moorings available. No boats present at time of survey. Boat service provided is an in-out ramp. There are no containers provided for solid waste. There are no sanitary facilities, boat holding tank pump-out facilities, or portable dump station facilities provided at this location.

71. [redacted] No Contact. Services provided are a dock with an in-out ramp. No boats present at time of survey.

72. [redacted] Services provided are a dock with an in-out ramp. No boats present at time of survey. Facility No. 815.

74. [redacted] Private dock. No Contact. 9 seasonal slips and an in-out ramp are available for use. No other services are available. Owner has an exemption to the requirement to provide dump station and boat holding tank pump-out services at this location.

82. [redacted] Community pier. No contact. 6 slips/moorings available. No boats present at the time of survey. The only boating service provided is electricity. There are no containers for solid waste collection. Owners have an exemption to the requirement to provide onshore sanitary facilities and portable toilet dump station facilities.

83. [redacted] Boat repair facility. No contact. 4 slips/moorings available. No boats present at the time of survey. Boating services provided are fuel, electricity, water and repair. There are no containers for solid waste collection, sanitary facilities, boat holding tank pump-out facilities or portable toilet dump station facilities available at this location.

88. [redacted]. Private dock. No contact. 3 slips/moorings available. Present at the time of survey was 1 workboat <26' and 1 workboat >26'. Boating services provided are electricity and water. Containers are available for solid waste collection. There are no sanitary facilities, boat holding tank pump-out facilities or portable toilet dump station facilities available at this location.

89. [redacted] Public boat ramp. No contact. No boats present at the time of survey. The only boating service is an in-out ramp. There are no containers for solid waste collection. There are no sanitary facilities, boat holding tank pump-out facilities or portable toilet dump station facilities available at this location.

SECTION E: CONTRIBUTES ANIMAL POLLUTION

10. ***DIRECT*** - Location: [redacted]. Dwelling - Brick 1 ½ story with brown shingles and olive trim. No Contact. Present at time of survey were 3 dogs and 2 goats. The goats were Inside of a fenced area which was <50 ft from the marsh waters of the Great Wicomico River. Manure was left on ground surface, upslope of the river.

20. Location: [redacted]. Dwelling – gray wood siding (paint peeling) 1 ½ story with light blue trim. No Contact. Present at time of survey were100 -150 chickens. Manure was left on ground surface.

33. Location: [redacted]. Dwelling - white siding 1 story with green trim and gray shingles. 2 persons. Present at Time of survey were 25 -30 chickens. Manure is left on ground surface.

35. Location: [redacted] No Contact. Present at time of survey were approximately 40 hunting dogs. Very little waste on ground surface. Tools were present that help clean up waste. Waste disposal unknown.

39. Location: [redacted] Dwelling - White siding 1 ½ story with green shutters. No Contact. Present at time of Survey were 4 horses, 1 dog and several cats. Manure is left on ground surface < 200' from a first order stream.

40. Location: [redacted] Dwelling – white siding 2 ½ story with black tin roof. Present at time of survey were 13 cattle, 7 horses, and 1 miniature mule. Manure left on ground surface.

58. [redacted] welling- white aluminum siding & brick 1 – story with green shutters 2 persons. Present at time of survey were 30 hunting dogs in pens in back yard. Manure is left on ground after removed from dog pens.

62. [redacted] Dwelling- grey vinyl 1-story with white trim and new siding and porch. 4 persons. Present at time of survey were 8 goats in fenced pasture and 50 penned fowl approximately 100' from a tributary of the Great Wicomico River. Manure is left on ground.

93. ***DIRECT*** –Location: [redacted] Dwelling – white wood siding 2 story. Business – horse boarding and riding lessons. 1 person. Present at the time of survey were 22 horses in stables and in pasture at 20' elevation and 150' from the Great Wicomico River. Manure is both trucked away and left on the ground surface.

SUMMARY

AREA 13
GREAT WICOMICO RIVER
July 18, 2005

SECTION B: SEWAGE POLLUTION SOURCES

1. SEWAGE TREATMENT FACILITIES

1 - DIRECT - #95
0 - INDIRECT - None
1 – B.1. TOTAL

2. ON-SITE SEWAGE DEFICIENCIES

Correction of deficiencies in this section is the responsibility of the local health department.

9 - CONTRIBUTES POLLUTION, DIRECT - #5, 11, 13, 29, 47, 49, 50, 75, 91
4 - CONTRIBUTES POLLUTION, INDIRECT - #6, 24, 30, 41,
0 - CP – (Kitchen or Laundry Wastes), DIRECT –None
3 - CP - (Kitchen or Laundry Wastes), INDIRECT - #3, 51, 77
3 - NO FACILITIES, DIRECT – #46, 49, 70,
3 - NO FACILITIES, INDIRECT - #63, 68, 69
22 - B.2. TOTAL

3. POTENTIAL POLLUTION

Periodic surveillance of these properties will be maintained to determine any status change.

28 - POTENTIAL POLLUTION - #1, 2, 4, 7, 9, 12, 18, 19, 28, 31, 32, 36, 37, 38, 42, 44, 45, 48, 53, 54, 55, 56, 73, 76, 78, 79, 80, 84

SECTION C: NON-SEWAGE WASTE SITES

1. INDUSTRIAL WASTE SITES

1 - DIRECT – #14,
5 – INDIRECT - #15, 21, 22, 34, 68
6 - C.1. TOTAL

2. SOLID WASTE SITES

0 - DIRECT – None
2 - INDIRECT - #16, 52
2 - C.2. TOTAL

SECTION D: BOATING ACTIVITY

8 - MARINAS - #17, 23, 26, 43, 64, 81, 92, 93
11 - OTHER PLACES WHERE BOATS ARE MOORED - #11, 25, 27, 57, 59, 60, 61, 85, 86, 87, 90,
11- UNDER SURVEILLANCE - #8, 65, 66, 67, 71, 72, 74, 82, 83, 88, 89
30 - D. TOTAL

SECTION E: CONTRIBUTES ANIMAL POLLUTION

3 - DIRECT- #10, 62, 94
6 -INDIRECT- #20, 33, 35, 39, 40, 58
9 -E. TOTAL

2) Condemnation Notice(s): Condemnation Notice 89: Great Wicomico River

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COMMONWEALTH of VIRGINIA

Department of Health
P O BOX 2448
RICHMOND, VA 23218

TTY 7-1-1 OR
1-800-828-1120

NOTICE AND DESCRIPTION OF SHELLFISH AREA CONDEMNATION NUMBER 89, GREAT WICOMICO RIVER

EFFECTIVE 3 APRIL 2002

Pursuant to Title 28.2, Chapter 8, §§28.2-803 through 28.2-808, §32.1-20, and §9-6.14:4.1, B.16 of the *Code of Virginia:*

1. The "Notice and Description of Shellfish Area Condemnation Number 89, Great Wicomico River," effective 15 March 2001, is cancelled effective 3 April 2002.

2. Condemned Shellfish Area Number 89, Great Wicomico River, is established, effective 3 April 2002. It shall be unlawful for any person, firm, or corporation to take shellfish from area #89 for any purpose, except by permit granted by the Marine Resources Commission, as provided in Section 28.2-810 of the *Code of Virginia.* The boundaries of the area are shown on map titled "Great Wicomico River, Condemned Shellfish Number 89, 3 April 2002" which is part of this notice.

3. The Department of Health will receive, consider and respond to petitions by any interested person at any time with respect to reconsideration or revision of this order.

BOUNDARIES OF CONDEMNED AREA NUMBER 89

A. The condemned area shall include all of that portion of the Great Wicomico River and its tributaries lying upstream of a line drawn between Marine Resources Commission survey markers "Cedar Pt. VFC" and "Richardson VFC."

B. The condemned area shall include all of that portion of Balls Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Clay" due south to the opposite shore.

C. The condemned area shall include all of that portion of Tipers Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Northern 98" due west to the opposite shore.

D. The condemned area shall include all of that portion of Whays Creek and its tributaries lying upstream of a line drawn due west to the opposite shore from the point of land located 320 feet (straight line distance) along the shore upstream of Marine Resources Commission survey marker "TRAV 1."

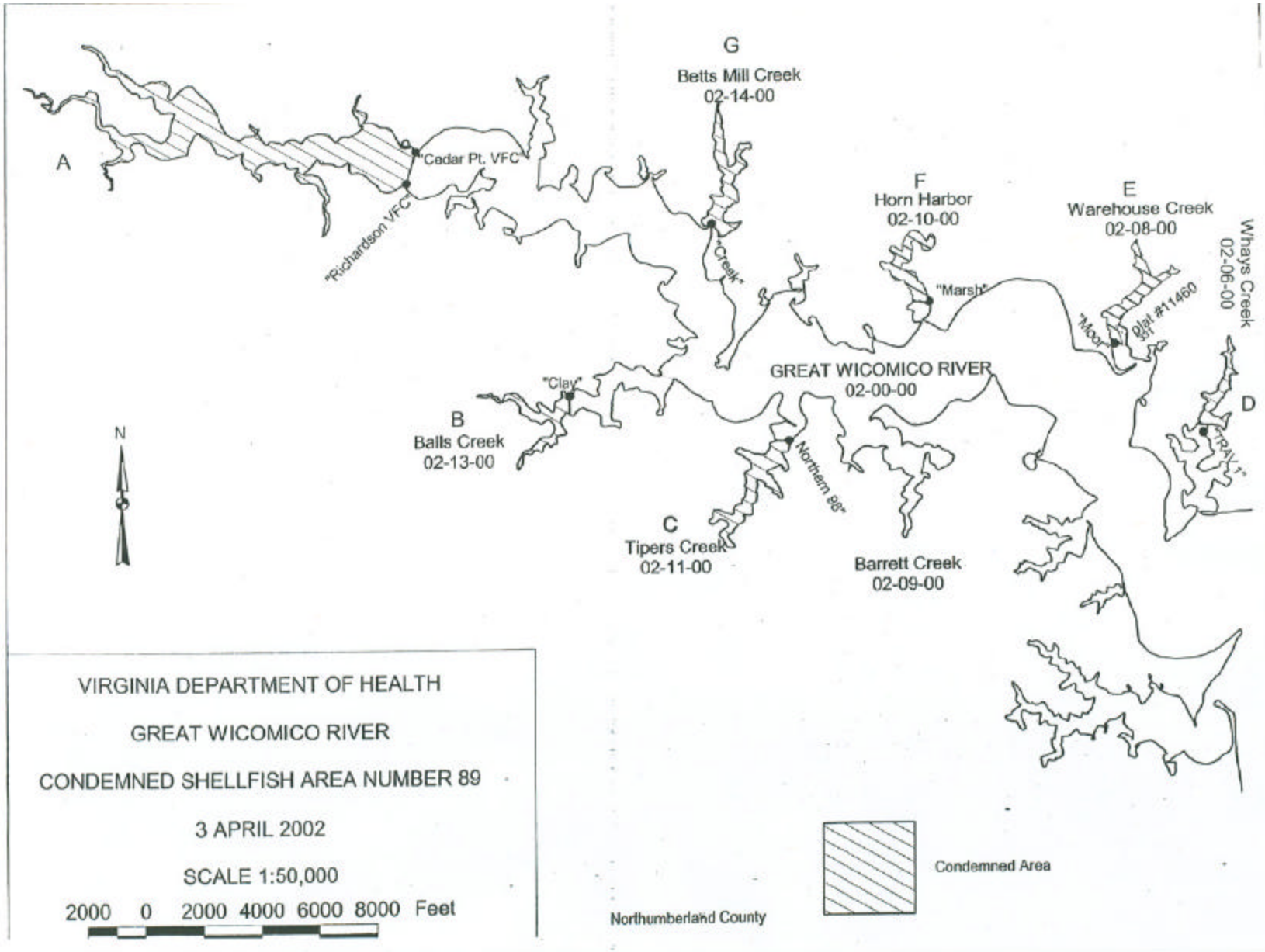
E. The condemned area shall include all of that portion of Warehouse Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Moor" southeasterly through corner 331 of plat 11460 to the opposite shore.

F. The condemned area shall include all of Horn Harbor and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Marsh" due west to the opposite shore.

G. The condemned area shall include all of that portion of Betts Mill Creek and its tributaries lying upstream of a line drawn from Marine Resources Commission survey marker "Creek" southwesterly to the prominent point of land on the opposite shore.

Recommended by: _____
Director, Division of Shellfish Sanitation

Ordered by: _____ 3/11/22
Acting State Health Commissioner Date


A
"Cedar Pt. VFC"
"Richardson VFC"
G
Betts Mill Creek
02-14-00
"Creek"
F
Horn Harbor
02-10-00
"Marsh"
E
Warehouse Creek
02-08-00
Whays Creek
02-06-00
"Moor"
Plat #11460
GREAT WICOMICO RIVER
02-00-00
"Clay"
B
Balls Creek
02-13-00
Northern 98"
C
Tipers Creek
02-11-00
Barrett Creek
02-09-00
D
"RAY"
N
VIRGINIA DEPARTMENT OF HEALTH
GREAT WICOMICO RIVER
CONDEMNED SHELLFISH AREA NUMBER 89
3 APRIL 2002
SCALE 1:50,000
2000 0 2000 4000 6000 8000 Feet
Northumberland County
Condemned Area

Appendix B: Supporting Documentation and Watershed Assessment

1. **Fecal Production Literature Review**
2. **Steady State Tidal Prism Model**
3. **Geographic Information System Data: Sources and Process**
4. **Watershed Source Assessment**

1. Fecal Production Literature Review

	Concentration in feces		Fecal coliform production rate		Comments
	FC/g	Ref.	FC/day (seasonal)	Ref.	
Cat	7.9E+06	1	5.0E+09	4	
Dog	2.3E+07	1	5.0E+09	4	
Chicken	1.3E+06	1	1.9E+08	4	
Chicken			2.4E+08	9	
Cow	2.3E+05	1	1.1E+11	4	average of dairy and beef
Beef cattle			5.4E+09	9	
Deer	1.0E+02	6	2.5E+04	6	assume 250 g/day
Deer	?		5.0E+08	9	best prof. judgement
Duck			4.5E+09	4	average of 3 sources
Duck	3.3E+07	1	1.1E+10	9	
Canada Geese			4.9E+10	4	
Canada Geese	3.6E+04	3	9.0E+06	3	
Canada Geese	1.5E+04	8	3.8E+06	8	assume 250 g/day (3)
Horse			4.2E+08	4	
Pig	3.3E+06	1	5.5E+09	4	
Pig			8.9E+09	9	
Sea Gull	3.7E+08	8	3.7E+09	8	assume 10 g/day
Sea gull			1.9E+09	5	mean of four species
Rabbit	2.0E+01	2	?		
Raccoon	1.0E+09	6	1.0E+11	6	assume 100 g/day
Sheep	1.6E+07	1	1.5E+10	4	
Sheep			1.8E+10	9	
Turkey	2.9E+05	1	1.1E+08	4	
Turkey			1.3E+08	9	
Rodent	1.6E+05	1	?		
Muskrat	3.4E+05	6	3.4E+07	6	
Human	1.3E+07	1	2.0E+09	4	
Septage	4.0E+05	7	1.0E+09	7	assume 70/gal/day/person

1. Geldreich, E. and E. A. Kenner. 1969. Concepts of fecal streptococci in stream pollution. J. Wat. Pollut. Control Fed. 41:R336-R352.
2. Geldreich, E., E. C. Best, B. A. Kenner, and D. J. Van Donsel. 1968. The bacteriological aspects of stormwater pollution. J. Wat. Pollut. Control Fed. 40:1861-1872.
3. Hussong, D., J. M. Damare, R. J. Limpert, W. J. L. Sladen, R. M. Weiner, and R. R. Colwell. 1979. Microbial impact of Canada geese (Branta canadensis) and whistling swans.
4. U.S. Environmental Protection Agency. 2001. Protocol for Developing Pathogen TMDLs. EPA 841-R-00-002. Office of Water (4503F), United States Environmental Protection Agency, Washington, DC. 132 pp.
5. Gould, D. J. and M. R. Fletcher. 1978. Gull droppings and their effects on water quality. Wat. Res. 12:665-672.
6. Kator, H. and M. W. Rhodes. 1996. Identification of pollutant sources contributing to degraded sanitary water quality in Taskinas Creek National Estuarine Research Reserve, Virginia. Special Report in Applied Marine Science and Ocean Engineering No. 336, The College of William and Mary, VIMS/School of Marine Science.
7. Kator, H., and M. W. Rhodes. 1991. Evaluation of Bacteroides fragilis bacteriophage, a candidate human-specific indicator of fecal contamination for shellfish-growing waters. A final report prepared under NOAA Cooperative Agreement NA90AA-H-FD234. Prepared and submitted to NOAA, Southeast Fisheries Science Center, Charleston Laboratory, Charleston, SC. 98 pp.
8. Alderisio, K. A. and N. DeLuca. 1999. Seasonal enumeration of fecal coliform bacteria from the feces of ring-billed gulls (Larus delawarensis) and Canada geese (Branta canadensis). Appl. Environ. Microbiol. 65:5628-5630.
9. TMDL report attributed to Metcalf and Eddy 1991 (Potomac Headwaters of West VA).

2. Steady State Tidal Prism Model

A detailed description of the tidal prism model is presented in this section. It is assumed that a single volume can represent a water body, and that the pollutant is well mixed in the water body system, as shown in Figure A-1.

The mass balance of water can be written as follows (Guo and Lordi, 2000):

$$\frac{dV}{dT} = (Q_0 - Q_b + Q_f) \tag{1}$$

where Q_0 is the quantity of water that enters the embayment on the flood tide through the ocean boundary (m^3T^{-1}); Q_b is the quantity of mixed water that leaves the bay on the ebb tide that did not enter the bay on the previous flood tide (m^3 per tidal cycle); Q_f is total freshwater input over the tidal cycle (m^3); V is the volume of the bay (m^3); T is the dominant tidal period (hours).

It is further assumed that Q_0 is the pure ocean water that did not flow out of the embayment on the previous ebb tide, and that Q_b is the embayment water that did not enter into the system on the previous flood tide. The mass balance for the fecal coliform can then be written as follows:

$$\frac{dVC}{dT} = Q_0C_0 - Q_bC + L_f + L_l - kVC \tag{2}$$

where L_f is the loading from upstream; L_l is the additional loading from the local area within the tidal cycle, k is the fecal coliform removal rate (or a damped parameter for the net loss of fecal coliform), C is fecal coliform concentration in the embayment, and C_0 is the fecal coliform concentration from outside the embayment.

In a steady-state condition, the mass balance equations for the water and the fecal coliform concentration can be written as follows:

$$Q_b = Q_0 + Q_f \tag{3}$$

$$Q_bC + kVC = Q_0C_0 + L_f + L_l \tag{4}$$

The fecal coliform concentration in the embayment can be calculated as follows:

$$C = \frac{Q_0C_0 + L_f + L_l}{Q_b + kV} \tag{5}$$

From Equation (4), assuming $L_f + L_l = Load_t$ and letting C_c be the criterion of fecal coliform in the embayment, the loading capacity can be estimated as:

$$Load_T = C_c(Q_b + kV) - Q_0 C_0 \quad (6)$$

If we assume the concentration outside of the embayment is negligible, and there no freshwater discharge, equation 6 may be simplified as:

$$Load_r = (r+k)*C_c*V \quad (7)$$

Where r is flushing rate.

The daily load can be estimated based on the dominant tidal period in the area. For the Chesapeake Bay the dominant tide is lunar semi-diurnal (M_2) tide with a tidal period of 12.42 hours. If fecal coliform concentration is in MPN/100ml, the daily load (counts day^{-1}) can be estimated as:

$$Load = Load_T \times \frac{24}{12.42} \times 10000 \quad (8)$$

In practice, one may not know Q_0 *a priori*. Instead, one is given the tidal range of the tidal embayment. From that, Q_T, the total ocean water entering the bay on the flood tide, can be calculated. From this, Q_0, the volume of new ocean water entering the embayment on the flood tide can be determined by the use of the ocean tidal exchange ratio β as:

$$Q_0 = bQ_T \quad (9)$$

where β is the exchange ratio and Q_T is the total ocean water entering the bay on the flood tide. The exchange ratio can be estimated from salinity data (Fischer et al., 1979):

$$b = \frac{S_f - S_e}{S_0 - S_e} \quad (10)$$

where S_f is the average salinity of ocean water entering the bay on the flood tide, S_e is the average salinity of the bay water leaving the bay, and S_0 is the salinity at the ocean side. The numerical value of β is usually smaller than 1, and it represents the fraction of new ocean water entering the embayment. Once Q_0 is known, then Q_b can be calculated from equation (3).

The residence time, T_L, is an estimate of time required to replace the existing pollutant concentration in a system; it can be calculated as follows:

$$T_L = \frac{V_b}{Q_b} \quad (11)$$

where V_b is mean volume of the embayment. From the definition, the denominator can either be Q_T or Q_b . However, using Q_T assumes that the ocean water enters into the embayment during the flood tide is 100% new, whereas using Q_b takes into consideration that a portion of water is not entirely new. It can be shown that the latter is more realistic. If Q_b is used in the residence time calculation, it will result in a longer time scale than if Q_T is used (Ketchum, 1951; Guo and Lordi, 2000).

Table B-5 lists the errors associated with estimated load corresponding to the model parameter selection. It can be seen that introducing a 20% error in model parameters results in a 0.5% to 19% error in load estimation.

Table B-1: Sensitivity of Model Parameter Selection

Units	**Return Ratio**	**Boundary Condition MPN/100ml**	**Decay Rate per day**	**Freshwater Input cfs**	**Tidal Range M**
Model Parameter	0.5	52.0	2	4	0.5
Change of model Parameter	0.1	10.4	0.4	4	0.1
Error introduced in model parameter	20%	20%	20%	100%	20%
Error introduced in load estimation	1.90%	2.00%	18.30%	0.52%	4.7%
Change of reduction due to change of parameters	0.81%	0.82%	0.81%	0.05%	0.06%

Fischer, H.B., List, E.J., Koh, R.C.Y., Imberger, J., and N.H. Brooks (1979): Mixing in inland and coastal water, Academic, San Diego.

Guo, Q. and G. P. Lordi (2000). “Method for quantifying freshwater input and flushing time in an estuary.” J. of Environmental Engineering, vol. 126, No. 7, ASCE, 675-683.

Ketchum, B. H. (1951). “The exchanges of fresh and salt water in tidal estuaries.” J. of Marine Research, 10(1): 18-38.

B-3 Geographic Information System Data: Sources and Process

A geographic information system is a powerful computer software package that can store large amounts of spatially referenced data and associated tabular information. The data layers produced by a GIS can be used for many different tasks, such as generating maps, analyzing results, and modeling processes. Below is a table that lists the data layers that were developed for the watershed and hydrodynamic models.

Table B-2 GIS Data Elements and Sources

Data Element	Source	Date
Watershed boundary	Division of Shellfish Sanitation, VA Department of Health	Various dates
Subwatershed boundary	Center for Coastal Resources Management	2003
Land use	National Land Cover Data set (NLCD), US Geological Survey	1999
Elevation	Digital Elevation Models and Digital Raster Graphs, US Geological Survey	Various dates
Soils	SSURGO and STATSGO, National Resource Conservation Service	Various dates
Stream network	National Hydrography Dataset	1999
Precipitation, temperature, solar radiation, and evapotranspiration	Chesapeake Bay Program, Phase V	2002
Stream flow data	Gauging stations, US Geological Survey	Various dates
Shoreline Sanitary Survey deficiencies	Division of Shellfish Sanitation, VA Department of Health	Various dates
Wastewater treatment plants	VA Department of Environmental Quality	Various dates
Sewers	Division of Shellfish Sanitation, VA Department of Health	Various dates
Dog population	US Census Bureau American Veterinary Association	2000 2002
Domestic livestock	National Agricultural Statistics Service, USDA	1997/2001
Wildlife	Virginia Department of Game and Inland Fisheries, US Fish and Wildlife Service	2004 2004
Septic tanks (from human population)	Division of Shellfish Sanitation, VA Department of Health US Census Bureau	Various dates 2000
Water quality monitoring stations	Division of Shellfish Sanitation, VA Department of Health	Various dates
Water quality segments	Center for Coastal Resources Management	2003
Tidal prism segments	Department of Physical Sciences, VIMS	2003
Water body volumes	Bathymetry from Hydrographic Surveys, National Ocean Service, NOAA	Various dates
Condemnation zones	Division of Shellfish Sanitation, VA Department of Health	Various dates
Tidal data	NOAA tide tables	2004

A. GIS Data Description and Process

Watershed boundary determined by VDH, DSS. There are 105 watersheds in Virginia.

Subwatershed boundaries were delineated based on elevation, using digital 7.5 minute USGS topographic maps. There are 1836 subwatersheds.

The original land use has 15 categories that were combined into 3 categories:
urban (high and low density residential and commercial);
undeveloped (forest and wetlands); and
agriculture (pasture and crops).

Descriptions of Shoreline Sanitary Survey deficiencies are found in each report. Contact DSS for more information. Digital data layer generated by CCRM from hardcopy reports.

Wastewater treatment plant locations were obtained from DEQ and digital data layer was generated by CCRM. Design flow, measured flow, and fecal coliform discharges were obtained from DEQ.

Sewers data layer was digitized from Shoreline Sanitary Surveys by CCRM.

Dog numbers were obtained using the American Vet Associations equation of #households * 0.58. See website for additional information—
http://www.avma.org/membshp/marketstats/formulas.asp#households1.
Database was generated by CCRM.

Domestic livestock includes cows, pigs, sheep, chickens, turkeys, and horses. Database was generated by CCRM.

Wildlife includes ducks and geese, deer, and raccoons. Animals were chosen based on availability of fecal coliform production rates and population estimates. Database was generated by CCRM.
Ducks and geese–US FWS, DGIF
Deer–DGIF
Raccoons–DGIF

Human input was based on DSS sanitary survey deficiencies and US Census Bureau population data (number of households).

Water quality monitoring data are collected, on average, once per month. Digital data layer of locations was generated by DSS. Water quality data was mathematically processed and input into a database for model use.

Water bodies were divided into segments based on the location of the monitoring stations (midway between stations). If a segment contained >1 station, the FC values were averaged. If a segment contained 0 stations, the value from the closest station(s) was assigned to it. Digital data layer of segments was generated by CCRM. FC loadings in the water were obtained by multiplying FC concentrations by segment volume.

Bathymetry data were used to generate a depth grid that was used to estimate volumes for each water quality segment and tidal prism segment.

The 1998 303d report was used to set the list of condemnation zones that require TMDLs. The digital data layer was generated by CCRM from hardcopy closure reports supplied by DSS.

B. Population Numbers

The process used to generate population numbers used for the nonpoint source contribution analysis part of the watershed model for the four source categories: human, livestock, pets and wildlife is described for each below.

Human:

The number of people contributing fecal coliform from failing septic tanks were developed in two ways and then compared to determine a final value.

1) Deficiencies (septic failures) from the DSS shoreline surveys were counted for each watershed and multiplied by 3 (average number of people per household).
2) Numbers of households in each watershed were determined from US Census Bureau data. The numbers of households were multiplied by 3 (average number of people per household) to get the total number of people and then multiplied by a septic failure rate* to get number of people contributing fecal coliform from failing septic tanks.

*The septic failure rate was estimated by dividing the number of deficiencies in the watershed by the total households in the watershed. The average septic failure rate was 12% and this was used as the default unless the DSS data indicated that septic failure was higher.

Livestock:

US Census Bureau data was used to calculate the livestock values. The numbers for each type of livestock (cattle, pigs, sheep, chickens (big and small), and horses) were reported by county. Each type of livestock was assigned to the land use(s) it lives on, or contributes to by the application of manure, as follows:

Cattle	cropland and pastureland
Pigs	cropland
Sheep	pastureland
Chickens	cropland
Horses	pastureland

GIS was used to overlay data layers for several steps:

1) The county boundaries and the land uses to get the area of each land use in each county. The number of animals was divided by the area of each land use for the county to get an animal density for each county.
2) The subwatershed boundaries and the land uses to get the area of each land use in each subwatershed.
3) The county boundaries and the subwatershed boundaries to get the area of each county in each subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was used to determine the number of animals in the subwatershed.

Using MS Access, for each type of livestock, the animal density by county was multiplied by the area of each land use by county in each subwatershed to get the number of animals in each subwatershed. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of animals in the subwatershed. The number of animals in each subwatershed was summed to get the total number of animals in each watershed.

Pets:

The dog population was calculated using a formula for estimating the number of pets using national percentages, reported by the American Veterinary Association:

dogs = # of households * 0.58.

US Census Bureau data provided the number of households by county. The number of dogs per county was divided by the area of the county to get a dog density per county. GIS was used to overlay the subwatershed boundaries with the county boundaries to get the area of each county in a subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was calculated. Using MS Access, the area of each county in the subwatershed was multiplied by the dog density per county to get the number of dogs per subwatershed. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of dogs in the subwatershed. The number of dogs in each subwatershed was summed to get the total number of dogs in each watershed.

Wildlife:

Deer—

The number of deer were calculated using information supplied by DGIF, consisting of an average deer index by county and the formula:

#deer/mi^2 of deer habitat = (-0.64 + (7.74 * average deer index)).

Deer habitat consists of forests, wetlands, and agricultural lands (crop and pasture). GIS was used to overlay data layers for the following steps:

1) The county boundaries and the subwatershed boundaries to get the area of each county in each subwatershed. If a subwatershed straddled more than one county, the areal proportion of each county in the subwatershed was calculated.
2) The subwatershed boundaries and the deer habitat to get the area of deer habitat in each subwatershed.

Using MS Access, number of deer in each subwatershed were calculated by multiplying the #deer/mi^2 of deer habitat times the area of deer habitat. If more than one county was present in a subwatershed, the previous step was done for each county in the subwatershed, then summed for a total number of deer in the subwatershed. The number of deer in each subwatershed was summed to get the total number of deer in each watershed.

Ducks and Geese—

The data for ducks and geese were divided into summer (April through September) and winter (October through March).

Summer

The summer numbers were obtained from the Breeding Bird Population Survey (US Fish and Wildlife Service) and consisted of bird densities (ducks and geese) for 3 regions: the southside of the James River, the rest of the tidal areas, and the salt marshes in both areas. The number of ducks and geese in the salt marshes were distributed into the other 2 regions based on the areal proportion of salt marshes in them using the National Wetland Inventory data and GIS.

Winter

The winter numbers were obtained from the Mid-Winter Waterfowl Survey (US Fish and Wildlife Service) and consisted of population numbers for ducks and geese in several different areas in the tidal region of Virginia. MS Access was used to calculate the total number of ducks and geese in each area and then these numbers were grouped to match the 2 final regions (Southside and the rest of tidal Virginia) for the summer waterfowl populations. Winter populations were an order of magnitude larger than summer populations.

Data from DGIF showed the spatial distribution of ducks and geese for 1993 and 1994. Using this information and GIS a 250m buffer on each side of the shoreline was generated and contained 80% of the birds. Wider buffers did not incorporate significantly more birds, since they were located too far inland. GIS was used to overlay the buffer and the watershed boundaries to calculate the area of buffer in each watershed. To distribute this information into each subwatershed, GIS was used to calculate the length of shoreline in each subwatershed and the total length of shoreline in the watershed. Dividing the length of shoreline in each subwatershed by the total length of shoreline gives a ratio that was multiplied by the area of the watershed to get an estimate of the area of buffer in each subwatershed. MS Excel was used to multiply the area of buffer in each subwatershed times the total numbers of ducks and geese to get the numbers of ducks and geese in each subwatershed. These numbers were summed to get the total number of ducks and geese in each watershed. To get annual populations, the totals then were divided by 2, since they represent only 6 months of habitation (this reduction underestimates the total annual input from ducks and geese, but is the easiest conservative method to use since the model does not have a way to incorporate the seasonal differences).

Raccoons—

Estimates for raccoon densities were supplied by DGIF for 3 habitats—wetlands (including freshwater and saltwater, forested and herbaceous), along streams, and upland forests. GIS was used to generate a 600ft buffer around the wetlands and streams, and then to overlay this buffer layer with the subwatershed boundaries to get the area of the buffer in each subwatershed. GIS was used to overlay the forest layer with the subwatershed boundaries to get the area of forest in each subwatershed. MS Access was used to multiply the raccoon densities for each habitat times the area of each habitat in each subwatershed to get the number of raccoons in each habitat in each subwatershed. The number of raccoons in each subwatershed was summed to get the total number of raccoons in each watershed.

B-4. Watershed Source Assessment

The watershed assessment calculates fecal coliform loads by source based on geographic information system data. A geographic information system is a powerful computer software package that can store large amounts of spatially referenced data and associated tabular information. The data layers produced by a GIS can be used for many different tasks, such as generating maps, analyzing results, and modeling processes. The watershed model requires a quantitative assessment of human sewage sources (i. e., malfunctioning septic systems) and animal (livestock, pets and wildlife) fecal sources distributed within each watershed.

The fecal coliform contribution from livestock is through the manure spreading processes and direct deposition during grazing. This contribution was initially estimated based on land use data and the livestock census data. In the model, manure was applied to both cropland and pasture land depending on the grazing period. Figure B-1 shows a diagram of the procedure for estimating the total number of livestock in the watershed and fecal coliform production. A description of the process used to determine the source population values for wildlife, pets and human used in the calculation of percent loading is found in Appendix B.

FIGURE B-1 Diagram to Illustrate Procedure Used to Estimate Fecal Coliform Production from Estimated Livestock Population

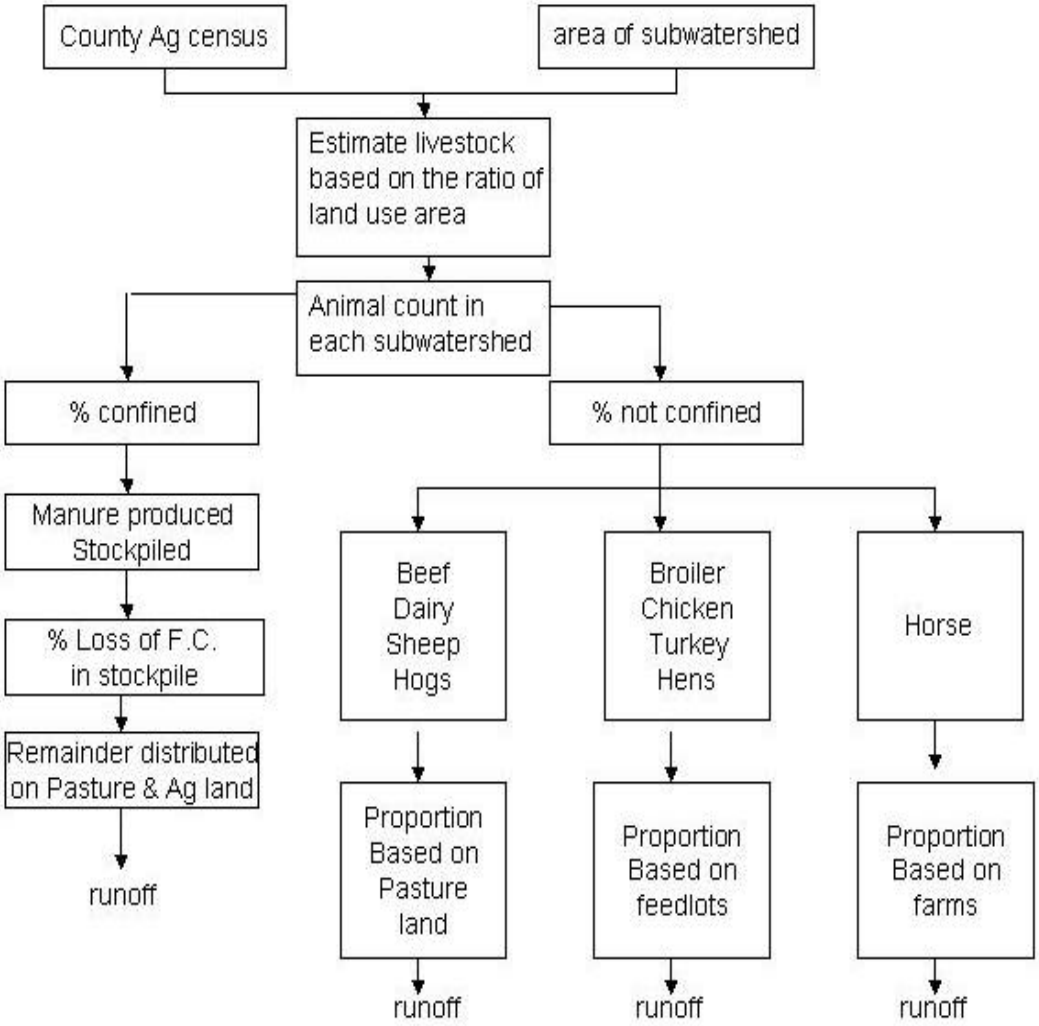


Table B-3 Nonpoint Source Load Distribution by Condemned Area Using Watershed Model: Growing Area 13 Great Wicomico River

Condemnation Area	Livestock	Wildlife	Pet	Human
89A Great Wicomico River	68%	19%	12%	1%
89B Balls Creek	58%	29%	12%	1%
89C Tipers Creek	42%	44%	12%	2%
89E Warehouse Creek	67%	27%	6%	0%
89F Whays Creek	55%	41%	4%	0%

Appendix C: Water Quality Data Summary

Table 4-3. Observed Geometric Mean and 90th Percentile By Condemned Area

Condemned Area	Mean of Geometric Means	SD Geometric Means	Mean of the 90th Means	SD 90th Means	Last 30 Sample Geo mean	Last 30 Sample 90th
89A Great Wicomico River	16.2	4.5	105.1	41.4	12.8	80.7
89B Balls Creek	21.2	6.3	151.6	67.9	32.9	284.6
89C Tipers Creek	14.3	4.8	77.7	27.0	19.3	115.8
89E Warehouse Creek	13.9	5.0	75.3	32.4	11.9	69.2
89F Whays Creek	12.5	3.5	76.7	30.5	10.6	69.6

Appendix D

1) Code of Virginia §62.1-194.1 Obstructing or contaminating state waters.
2) Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999 Revised as of July 1, 2000

D1: Code of Virginia §62.1-194.1

§62.1-194.1. Obstructing or contaminating state waters.

Except as otherwise permitted by law, it shall be unlawful for any person to dump, place or put, or cause to be dumped, placed or put into, upon the banks of or into the channels of any state waters any object or substance, noxious or otherwise, which may reasonably be expected to endanger, obstruct, impede, contaminate or substantially impair the lawful use or enjoyment of such waters and their environs by others. Any person who violates any provision of this law shall be guilty of a misdemeanor and upon conviction be punished by a fine of not less than $100 nor more than $500 or by confinement in jail not more than twelve months or both such fine and imprisonment. Each day that any of said materials or substances so dumped, placed or put, or caused to be dumped, placed or put into, upon the banks of or into the channels of, said streams shall constitute a separate offense and be punished as such. In addition to the foregoing penalties for violation of this law, the judge of the circuit court of the county or corporation court of the city wherein any such violation occurs, whether there be a criminal conviction therefor or not shall, upon a bill in equity, filed by the attorney for the Commonwealth of such county or by any person whose property is damaged or whose property is threatened with damage from any such violation, award an injunction enjoining any violation of this law by any person found by the court in such suit to have violated this law or causing the same to be violated, when made a party defendant to such suit. (1968, c. 659.)

D2: Code of Federal Regulations. Title 33, Volume 2, Parts 120 to 1999 Revised as of July 1, 2000 From the U.S. Government Printing Office via GPO Access [CITE: 33CFR159]

NAVIGABLE WATERS

CHAPTER I--COAST GUARD, DEPARTMENT OF TRANSPORTATION (CONTINUED)

PART 159--MARINE SANITATION DEVICES

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159.201 Recognition of facilities.

Authority: Sec. 312(b)(1), 86 Stat. 871 (33 U.S.C. 1322(b)(1)); 49 CFR 1.45(b) and 1.46(l) and (m).

Source: CGD 73-83, 40 FR 4624, Jan. 30, 1975, unless otherwise noted.

Subpart A--General

Sec. 159.1 Purpose.

This part prescribes regulations governing the design and construction of marine sanitation devices and procedures for certifying that marine sanitation devices meet the regulations and the standards of the Environmental Protection Agency promulgated under section 312 of the Federal Water Pollution

Control Act (33 U.S.C. 1322), to eliminate the discharge of untreated sewage from vessels into the waters of the United States, including the territorial seas. Subpart A of this part contains regulations governing the manufacture and operation of vessels equipped with marine sanitation devices.

Sec. 159.3 Definitions.

In this part:
Coast Guard means the Commandant or his authorized representative.
Discharge includes, but is not limited to, any spilling, leaking, pouring, pumping, emitting, emptying, or dumping.
Existing vessel includes any vessel, the construction of which was initiated before January 30, 1975.
Fecal coliform bacteria are those organisms associated with the intestine of warm-blooded animals that are commonly used to indicate the presence of fecal material and the potential presence of organisms capable of causing human disease.
Inspected vessel means any vessel that is required to be inspected under 46 CFR Ch. I.
Length means a straight line measurement of the overall length from the foremost part of the vessel to the aftermost part of the vessel, measured parallel to the centerline. Bow sprits, bumpkins, rudders, outboard motor brackets, and similar fittings or attachments are not to be included in the measurement.
Manufacturer means any person engaged in manufacturing, assembling, or importing of marine sanitation devices or of vessels subject to the standards and regulations promulgated under section 312 of the Federal Water Pollution Control Act.
Marine sanitation device and device includes any equipment for installation on board a vessel which is designed to receive, retain, treat, or discharge sewage, and any process to treat such sewage.
New vessel includes any vessel, the construction of which is initiated on or after January 30, 1975.
Person means an individual, partnership, firm, corporation, or association, but does not include an individual on board a public vessel.
Public vessel means a vessel owned or bare-boat chartered and operated by the United States, by a State or political subdivision thereof, or by a foreign nation, except when such vessel is engaged in commerce.
Recognized facility means any laboratory or facility listed by the Coast Guard as a recognized facility under this part.
Sewage means human body wastes and the wastes from toilets and other receptacles intended to receive or retain body waste.
Territorial seas means the belt of the seas measured from the line of ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of 3 miles.
Type I marine sanitation device means a device that, under the test conditions described in Secs. 159.123 and 159.125, produces an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids.
Type II marine sanitation device means a device that, under the test conditions described in Secs. 159.126 and 159.126a, produces an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter.
Type III marine sanitation device means a device that is designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage.
Uninspected vessel means any vessel that is not required to be inspected under 46 CFR Chapter I.

United States includes the States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Canal Zone, and the Trust Territory of the Pacific Islands.
Vessel includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on the waters of the United States.

[CGD 96-026, 61 FR 33668, June 28, 1996, as amended by CGD 95-028, 62 FR 51194, Sept. 30, 1997]

Sec. 159.4 Incorporation by reference.

(a) Certain material is incorporated by reference into this part with the approval of the Director of the Federal Register under 5 U.S.C. 552(a) and 1 CFR part 51. To enforce any edition other than that specified in paragraph (b) of this section, the Coast Guard must publish notice of change in the Federal Register; and the material must be available to the public.
All approved material is available for inspection at the Office of the Federal Register, 800 North Capitol Street, NW., suite 700, Washington, DC, and at the U.S. Coast Guard Office of Design and Engineering Standards (G-MSE), 2100 Second Street SW., Washington, DC 20593-0001, and is available from the sources indicated in paragraph (b) of this section.
(b) The material approved for incorporation by reference in this part, and the sections affected, are as follows:

American Society for Testing and Materials (ASTM)
100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 11-95, Standard Specification for Wire Cloth and Sieves for Testing Purposes--159.125

[USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

Sec. 159.5 Requirements for vessel manufacturers.

No manufacturer may manufacture for sale, sell, offer for sale, or distribute for sale or resale any vessel equipped with installed toilet facilities unless it is equipped with:
(a) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or
(b) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

[CGD 95-028, 62 FR 51194, Sept. 30, 1997]

Sec. 159.7 Requirements for vessel operators.

(a) No person may operate any vessel equipped with installed toilet facilities unless it is equipped with:
(1) An operable Type II or III device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12 or Sec. 159.12a; or

(2) An operable Type I device that has a label on it under Sec. 159.16 or that is certified under Sec. 159.12, if the vessel is 19.7 meters (65 feet) or less in length.

(b) When operating a vessel on a body of water where the discharge of treated or untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3 or 140.4, the operator must secure each Type I or Type II device in a manner which prevents discharge of treated or untreated sewage. Acceptable methods of securing the device include--

(1) Closing the seacock and removing the handle;

(2) Padlocking the seacock in the closed position;

(3) Using a non-releasable wire-tie to hold the seacock in the closed position; or

(4) Locking the door to the space enclosing the toilets with a padlock or door handle key lock.

(c) When operating a vessel on a body of water where the discharge of untreated sewage is prohibited by the Environmental Protection Agency under 40 CFR 140.3, the operator must secure each Type III device in a
manner which prevents discharge of sewage. Acceptable methods of securing the device include--

(1) Closing each valve leading to an overboard discharge and removing the handle;

(2) Padlocking each valve leading to an overboard discharge in the closed position; or

(3) Using a non-releasable wire-tie to hold each valve leading to an overboard discharge in the closed position.

[CGH 95-028, 62 FR 51194, Sept. 30, 1997]

Subpart B--Certification Procedures

Sec. 159.11 Purpose.

This subpart prescribes procedures for certification of marine sanitation devices and authorization for labels on certified devices.

Sec. 159.12 Regulations for certification of existing devices.

(a) The purpose of this section is to provide regulations for certification of existing devices until manufacturers can design and manufacture devices that comply with this part and recognized facilities are prepared to perform the testing required by this part.

(b) Any Type III device that was installed on an existing vessel before January 30, 1975, is considered certified.

(c) Any person may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 for certification of a marine sanitation device manufactured before January 30, 1976. The Coast Guard will issue a letter certifying the device if the applicant shows that the device meets Sec. 159.53 by:

(1) Evidence that the device meets State standards at least equal to the standards in Sec. 159.53, or

(2) Test conducted under this part by a recognized laboratory, or

(3) Evidence that the device is substantially equivalent to a device certified under this section, or

(4) A Coast Guard field test if considered necessary by the Coast Guard.

(d) The Coast Guard will maintain and make available a list that identifies each device certified under this section.

(e) Devices certified under this section in compliance with Sec. 159.53 need not meet the other regulations in this part and may not be labeled under Sec. 159.16.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.12a Certification of certain Type III devices.

(a) The purpose of this section is to provide regulations for certification of certain Type III devices.

(b) Any Type III device is considered certified under this section if:

(1) It is used solely for the storage of sewage and flushwater at ambient air pressure and temperature; and

(2) It is in compliance with Sec. 159.53(c).

(c) Any device certified under this section need not comply with the other regulations in this part except as required in paragraphs (b)(2)and (d) of this section and may not be labeled under Sec. 159.16.

d) Each device certified under this section which is installed aboard an inspected vessel must comply with Sec. 159.97.

[CGD 76-145, 42 FR 11, Jan. 3, 1977]

Sec. 159.14 Application for certification.

(a) Any manufacturer may apply to any recognized facility for certification of a marine sanitation device. The application for certification must indicate whether the device will be used aboard all vessels or only aboard uninspected vessels and to which standard in Sec. 159.53 the manufacturer requests the device to be tested.

(b) An application may be in any format but must be in writing and must be signed by an authorized representative of the manufacturer and include or be accompanied by:

(1) A complete description of the manufacturer's production quality control and inspection methods, record keeping systems pertaining to the manufacture of marine sanitation devices, and testing procedures;

(2) The design for the device, including drawings, specifications and other information that describes the materials, construction and operation of the device;

(3) The installation, operation, and maintenance instructions for the device; and

(4) The name and address of the applicant and the manufacturing facility.

(c) The manufacturer must furnish the recognized facility one device of each model for which certification is requested and samples of each material from which the device is constructed, that must be tested destructively under Sec. 159.117. The device furnished is for the testing required by this part except that, for devices that are not suited for unit testing, the manufacturer may submit the design so that the recognized facility may determine the components of the device and materials to be submitted for testing and the tests to be performed at a place other than the facility. The

Coast Guard must review and accept all such determinations before testing is begun.

(d) At the time of submittal of an application to a recognized facility the manufacturer must notify the Coast Guard of the type and model of the device, the name of the recognized facility to which application is being made, and the name and address of the manufacturer, and submit a signed statement of the times when the manufacturer will permit designated officers and employees of the Coast Guard to have access to the manufacturer's facilities and all records required by this part.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.15 Certification.

(a) The recognized facility must evaluate the information that is submitted by the manufacturer in accordance with Sec. 159.14(b) (1), (2), and (3), evaluate the device for compliance with Secs. 159.53 through 159.95, test the device in accordance with Sec. 159.101 and submit to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C.
20593-0001 the following:

(1) The information that is required under Sec. 159.14(b);

(2) A report on compliance evaluation;

(3) A description of each test;

(4) Test results; and

(5) A statement, that is signed by the person in charge of testing, that the test results are accurate and complete.

(b) The Coast Guard certifies a test device, on the design of the device, if it determines, after consideration of the information that is required under paragraph (a) of this section, that the device meets the requirements in Subpart C of this part.

(c) The Coast Guard notifies the manufacturer and recognized facility of its determination under paragraph (b) of this section. If the device is certified, the Coast Guard includes a certification number for the device. If certification is denied, the Coast Guard notifies the manufacturer and recognized facility of the requirements of this part that are not met. The manufacturer may appeal a denial to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

(d) If upon re-examination of the test device, the Coast Guard determines that the device does not in fact comply with the requirements of Subpart C of this part, it may terminate the certification.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.16 Authorization to label devices.

(a) When a test device is certified under Sec. 159.15(b), the Coast Guard will issue a letter that authorizes the manufacturer to label each device that he manufactures with the manufacturer's certification that the device is in all material respects substantially the same as a test device certified by the U.S. Coast Guard pursuant to section 312 of the Federal Water Pollution Control Act Amendments of 1972.

(b) Certification placed on a device by its manufacturer under this section is the certification required by section 312(h)(4) of the Federal Water Pollution Control Act Amendments of 1972, which makes it unlawful for a vessel that is subject to the standards and regulations promulgated under the Act to operate on the navigable waters of the United States, if such vessel is not equipped with an operable marine sanitation device certified pursuant to section 312 of the Act.

(c) Letters of authorization issued under this section are valid for 5 years, unless sooner suspended, withdrawn, or terminated and may be reissued upon written request of the manufacturer to whom the letter was issued.

(d) The Coast Guard, in accordance with the procedure in 46 CFR 2.75, may suspend, withdraw, or terminate any letter of authorization issued under this section if the Coast Guard finds that the manufacturer is engaged in the manufacture of devices labeled under this part that are not in all material respects substantially the same as a test device certified pursuant to this part.

Sec. 159.17 Changes to certified devices.

(a) The manufacturer of a device that is certified under this part shall notify the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001 in writing of any change in the design of the device.

(b) A manufacturer shall include with a notice under paragraph (a) of this section a description of the change, its advantages, and the recommendation of the recognized facility as to whether the device remains in all material respects substantially the same as the original test device.

(c) After notice under paragraph (a) of this section, the Coast Guard notifies the manufacturer and the recognized facility in writing of any tests that must be made for certification of the device or for any change in the letter of authorization. The manufacturer may appeal this determination to the Commandant (G-MSE), U.S. Coast Guard, Washington, D.C. 20593-0001.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Sec. 159.19 Testing equivalency.

(a) If a test required by this part may not be practicable or necessary, a manufacturer may apply to the Commandant (G-MSE), U.S. Coast Guard, Washington, DC 20593-0001 for deletion or approval of an alternative test as equivalent to the test requirements in this part. The application must include the manufacturer's justification for deletion or the alternative test and any alternative test data.

(b) The Coast Guard notifies the manufacturer of its determination under paragraph (a) of this section and that determination is final.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 82-063a, 48 FR 4776, Feb. 3, 1983; CGD 88-052, 53 FR 25122, July 1, 1988; CGD 96-026, 61 FR 33668, June 28, 1996]

Subpart C--Design, Construction, and Testing

Sec. 159.51 Purpose and scope.

(a) This subpart prescribes regulations governing the design and construction of marine sanitation devices.

(b) Unless otherwise authorized by the Coast Guard each device for which certification under this part is requested must meet the requirements of this subpart.

Sec. 159.53 General requirements.

A device must:

(a) Under the test conditions described in Secs. 159.123 and 159.125, produce an effluent having a fecal coliform bacteria count not greater than 1,000 per 100 milliliters and no visible floating solids (Type I),

(b) Under the test conditions described in Secs. 159.126 and 159.126a, produce an effluent having a fecal coliform bacteria count not greater than 200 per 100 milliliters and suspended solids not greater than 150 milligrams per liter (Type II), or

(c) Be designed to prevent the overboard discharge of treated or untreated sewage or any waste derived from sewage (Type III).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.55 Identification.

(a) Each production device must be legibly marked in accordance with paragraph (b) of this section with the following information:

(1) The name of the manufacturer.

(2) The name and model number of the device.

(3) The month and year of completion of manufacture.

(4) Serial number.

(5) Whether the device is certified for use on an inspected or an uninspected vessel.

(6) Whether the device is Type I, II, or III.

(b) The information required by paragraph (a) of this section must appear on a nameplate attached to the device or in lettering on the device. The nameplate or lettering stamped on the device must be capable of withstanding without loss of legibility the combined effects of normal wear and tear and exposure to water, salt spray, direct sunlight, heat, cold, and any substance listed in Sec. 159.117(b) and (c). The nameplate and lettering must be designed to resist efforts to remove them from the device or efforts to alter the information stamped on the nameplate or the device without leaving some obvious evidence of the attempted removal or alteration.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.57 Installation, operation, and maintenance instructions.

(a) The instructions supplied by the manufacturer must contain directions for each of the following:

(1) Installation of the device in a manner that will permit ready access to all parts of the device requiring routine service and that will provide any flue clearance necessary for fire safety.

(2) Safe operation and servicing of the device so that any discharge meets the applicable requirements of Sec. 159.53.

(3) Cleaning, winter layup, and ash or sludge removal.

(4) Installation of a vent or flue pipe.

(5) The type and quantity of chemicals that are required to operate the device, including instructions on the proper handling, storage and use of these chemicals.

(6) Recommended methods of making required plumbing and electrical connections including fuel connections and supply circuit overcurrent protection.

(b) The instructions supplied by the manufacturer must include the following information:

(1) The name of the manufacturer.

(2) The name and model number of the device.

(3) Whether the device is certified for use on an inspected, or uninspected vessel.

(4) A complete parts list.

(5) A schematic diagram showing the relative location of each part.

(6) A wiring diagram.

(7) A description of the service that may be performed by the user without coming into contact with sewage or chemicals.

(8) Average and peak capacity of the device for the flow rate, volume, or number of persons that the device is capable of serving and the period of time the device is rated to operate at peak capacity.

(9) The power requirements, including voltage and current.

(10) The type and quantity of fuel required.

(11) The duration of the operating cycle for unitized incinerating devices.

(12) The maximum angles of pitch and roll at which the device operates in accordance with the applicable requirements of Sec. 159.53.

(13) Whether the device is designed to operate in salt, fresh, or brackish water.

(14) The maximum hydrostatic pressure at which a pressurized sewage retention tank meets the requirements of Sec. 159.111.

(15) The maximum operating level of liquid retention components.

(16) Whether the device is Type I, II, or III.

(17) A statement as follows:

Note: The EPA standards state that in freshwater lakes, freshwater reservoirs or other freshwater impoundments whose inlets or outlets are such as to prevent the ingress or egress by vessel traffic subject to this regulation, or in rivers not capable of navigation by interstate vessel traffic subject to this regulation, marine sanitation devices certified by the U.S. Coast Guard installed on all vessels shall be designed and operated to prevent the overboard discharge of sewage,
treated or untreated, or of any waste derived from sewage. The EPA standards further state that this shall not be construed to prohibit the carriage of Coast Guard-certified flow-through treatment devices which have been secured so as to prevent such discharges. They also state that waters where a Coast Guard-certified marine sanitation device permitting discharge is allowed include coastal waters and estuaries, the Great Lakes and interconnected waterways, freshwater lakes and impoundments accessible through locks, and other flowing waters that are navigable interstate by vessels subject to this regulation (40 CFR 140.3).

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15325, Apr. 12, 1976]

Sec. 159.59 Placard.

Each device must have a placard suitable for posting on which is printed the operating instructions, safety precautions, and warnings pertinent to the device. The size of the letters printed on the placard must be one-eighth of an inch or larger.

Sec. 159.61 Vents.

Vents must be designed and constructed to minimize clogging by either the contents of the tank or climatic conditions such as snow or ice.

Sec. 159.63 Access to parts.

Each part of the device that is required by the manufacturer's instructions to be serviced routinely must be readily accessible in the installed position of the device recommended by the manufacturer.

Sec. 159.65 Chemical level indicator.

The device must be equipped with one of the following:

(a) A means of indicating the amount in the device of any chemical that is necessary for its effective operation.

(b) A means of indicating when chemicals must be added for the proper continued operation of the device.

Sec. 159.67 Electrical component ratings.

Electrical components must have current and voltage ratings equal to or greater than the maximum load they may carry.

Sec. 159.69 Motor ratings.

Motors must be rated to operate at 50 deg.C ambient temperature.

Sec. 159.71 Electrical controls and conductors.

Electrical controls and conductors must be installed in accordance with good marine practice. Wire must be copper and must be stranded. Electrical controls and conductors must be protected from exposure to chemicals and sewage.

Sec. 159.73 Conductors.

Current carrying conductors must be electrically insulated from non-current carrying metal parts.

Sec. 159.75 Overcurrent protection.

Overcurrent protection must be provided within the unit to protect subcomponents of the device if the manufacturer's recommended supply circuit overcurrent protection is not adequate for these subcomponents.

Sec. 159.79 Terminals.

Terminals must be solderless lugs with ring type or captive spade ends, must have provisions for being locked against movement from vibration, and must be marked for identification on the wiring diagram required in Sec. 159.57. Terminal blocks must be nonabsorbent and securely mounted. Terminal blocks must be provided with barrier insulation that prevents contact between adjacent terminals or metal surfaces.

Sec. 159.81 Baffles.

Baffles in sewage retention tanks, if any, must have openings to allow liquid and vapor to flow freely across the top and bottom of the tank.

Sec. 159.83 Level indicator.

Each sewage retention device must have a means of indicating when the device is more than \3/4\ full by volume.

Sec. 159.85 Sewage removal.

The device must be designed for efficient removal of nearly all of the liquid and solids in the sewage retention tank.

Sec. 159.87 Removal fittings.

If sewage removal fittings or adapters are provided with the device, they must be of either 1\1/2\" or 4" nominal pipe size.

Sec. 159.89 Power interruption: Type I and II devices.

A discharge device must be designed so that a momentary loss of power during operation of the device does not allow a discharge that does not meet the requirements in Sec. 159.53.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.93 Independent supporting.

The device must have provisions for supporting that are independent from connecting pipes.

Sec. 159.95 Safety.

(a) Each device must--

(1) Be free of design defects such as rough or sharp edges that may cause bodily injuries or that would allow toxic substances to escape to the interior of the vessel;

(2) Be vented or provided with a means to prevent an explosion or over pressurization as a result of an accumulation of gases; and

(3) Meet all other safety requirements of the regulations applicable to the type of vessel for which it is certified.

(b) A chemical that is specified or provided by the manufacturer for use in the operation of a device and is defined as a hazardous material in 46 CFR Part 146 must be certified by the procedures in 46 CFR Part 147.

(c) Current carrying components must be protected from accidental contact by personnel operating or routinely servicing the device. All current carrying components must as a minimum be of drip-proof construction or be enclosed within a drip-proof compartment.

Sec. 159.97 Safety: inspected vessels.

The Commandant approves the design and construction of devices to be certified for installation and operation on board inspected vessels on the basis of tests and reports of inspection under the applicable marine engineering requirements in Subchapter F of Title 46, Code of Federal Regulations, and under the applicable electrical engineering requirements in Subchapter J of Title 46 Code of Federal Regulations.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.101 Testing: general.

Unless otherwise authorized by the Coast Guard, a recognized facility must perform each test described in Secs. 159.103 through 159.131. The same device must be used for each test and tested in the order in which the tests are described. There must be no cracking, softening, deterioration, displacement, breakage, leakage or damage of components or materials that affects the operation or safety of the device after each test described in Secs. 159.103 through 159.117 and Sec. 159.121, and the device must remain operable after the test described in Sec. 159.119. The device must be set up in a manner simulating installation on a vessel in accordance with the manufacturer's instructions with respect to mounting, water supply, and discharge fittings.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.103 Vibration test.

The device, with liquid retention components, if any, filled with water to one-half of their volume, must be subjected to a sinusoidal vibration for a period of 12 hours, 4 hours in each of the x, y, and z planes, at the resonant frequency of the device (or at 55 cycles per second if there is no resonant frequency between 10 to 60 hertz) and with a peak amplitude of 0.019 to 0.021 inches.

Sec. 159.105 Shock test.

The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 1,000 vertical shocks that are ten times the force of gravity (10g) and have a duration of 20-25 milliseconds measured at the base of the half-sine shock envelope.

Sec. 159.107 Rolling test.

(a) The device, with liquid retention components, if any, filled with water to half of their volume, must be subjected to 100 cycles with the axis of rotation 4 feet from the centerline of the device, no more than 6 inches below the plane of the bottom of the device, and parallel to any tank baffles. The device must then be rotated 90 degrees on its vertical axis and subjected to another 100 cycles. This testing must be repeated with the liquid retention components filled to the maximum operating level as specified by the manufacturer in Sec. 159.57.

(b) Eighty percent of the rolling action must be approximately 15 degrees on either side of the vertical and at a cyclic rate of 3 to 4 seconds. Twenty percent motions must be approximately 30 degrees, or the maximum angle specified by the manufacturer under Sec. 159.57, whichever is greater, on either side of the vertical at a cyclic rate of 6 to 8 seconds.

Sec. 159.109 Pressure test.

Any sewage retention tank that is designed to operate under pressure must be pressurized hydrostatically at a pressure head of 7 feet or to 150 percent of the maximum pressure specified by the manufacturer for operation of the tank, whichever is greater. The tank must hold the water at this pressure for 1 hour with no evidence of leaking.

Sec. 159.111 Pressure and vacuum pulse test.

Liquid retention components of the device with manufacturer specified venting installed must be subjected to 50 fillings of water at a pressure head of 7 feet or the maximum pressure specified by the manufacturer for operation of the device, whichever is greater, and then emptied with a 45 gallon per minute or larger positive displacement pump that remains in operation 30 seconds after emptying the tank at the end of each cycle.

Sec. 159.115 Temperature range test.

(a) The device must be held at a temperature of 60 deg.C or higher for a period of 16 hours.

(b) The device must be held at a temperature of -40 deg.C or less for a period of 16 hours following winterization in accordance with manufacturers' instructions.

Sec. 159.117 Chemical resistance test.

(a) In each case where the recognized facility doubts the ability of a material to withstand exposure to the substances listed in paragraphs (b) and (c) of this section a sample of the material must be tested.

(b) A sample referred to in paragraph (a) of this section must be partially submerged in each of the following substances for 100 hours at an ambient temperature of 22 deg.C.

(1) Sewage.

(2) Any disinfectant that is required in the operation of the device.

(3) Any chemical compound in solid, liquid or gaseous form, used, emitted or produced in the operation of the device.

(4) Fresh or salt (3.5 percent Sodium Chloride) flush water.

(5) Toilet bowl cleaners.

(6) Engine Oil (SAE/30).

(7) Ethylene Glycol.

(8) Detergents (household and bilge cleaning type).

(c) A sample of the material must be doused 20 times, with a 1 hour drying period between dousings, in each of the following substances:

(1) Gasoline.

(2) Diesel fuel.

(3) Mineral spirits.

(4) Turpentine.

(5) Methyl alcohol.

Sec. 159.119 Operability test; temperature range.

The device must operate in an ambient temperature of 5 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C and in an ambient temperature of 50 deg.C with inlet operating fluid temperature varying from 2 deg.C to 32 deg.C.

Sec. 159.121 Sewage processing test.

(a) The device must process human sewage in the manner for which it is designed when tested in accordance with this section. There must be no sewage or sewage-treating chemicals remaining on surfaces or in crevices that could come in contact with a person using the device or servicing the device in accordance with the instructions supplied under Sec. 159.57(b)(7).

(b) During the test the device must be operated and maintained in accordance with the manufacturer's instructions. Any initial start-up time specified by the manufacturer must be allowed before test periods begin. For 1 hour of each 8-hour test period, the device must be tilted to the maximum angles specified by the manufacturer under Secs. 159.55 and 159.57.

(c) Except for devices described in paragraph (d) of this section, the devices must process and discharge or store human sewage over at least an 8-consecutive hour period on at least 10 days within a 20-day period. The device must receive human sewage consisting of fecal matter, urine, and toilet paper in a ratio of four urinations to one defecation with at least one defecation per person per day. Devices must be tested at their average rate of capacity as specified in Sec. 159.57. In addition, during three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity.

(d) A device that processes and discharges continuously between individual use periods or a large device, as determined by the Coast Guard, must process and discharge sewage over at least 10-consecutive days at the average daily capacity specified by the manufacturer. During three periods of each day the system must process sewage at the peak capacity for the period of time it is rated at peak capacity. The sewage for this test must be fresh, domestic sewage to which primary sludge has been added, as necessary, to create a test sewage with a minimum of 500 miligrams of suspended solids per liter.

Sec. 159.123 Coliform test: Type I devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent discharged from a Type I device during the test described in Sec. 159.121 must be less than 1000 per 100 milliliters when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10-test days, one sample must be taken at the beginning, middle, and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.125 Visible floating solids: Type I devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples of approximately 1 liter each shall be taken from a Type I device at the same time as samples taken in Sec. 159.123 and passed expeditiously through a U.S. Sieve No. 12 as specified in ASTM E 11 (incorporated by reference, see Sec. 159.4). The weight of the material retained on the screen after it has been dried to a constant weight in an oven at 103 deg.C. must be divided by the volume of the sample and expressed as milligrams per liter. This value must be 10 percent or less of the total suspended solids as determined in accordance with 40 CFR Part 136 or at least 38 of the 40 samples.

Note: 33 U.S.C. 1321(b)(3) prohibits discharge of harmful quantities of oil into or upon the navigable waters of the United States or adjoining shorelines or into or upon the waters of the contiguous zone. Under 40 CFR 110.3 and 110.4 such discharges of oil include discharges which:

(a) Violate applicable water quality standards, or

(b) Cause a film or sheen upon or discoloration of the surface of the water or adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. If a sample contains a quantity of oil determined to be harmful, the Coast Guard will not certify the device.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976; USCG-1999-5151, 64 FR 67176, Dec. 1, 1999]

Sec. 159.126 Coliform test: Type II devices.

(a) The arithmetic mean of the fecal coliform bacteria in 38 of 40 samples of effluent from a Type II device during the test described in Sec. 159.121 must be 200 per 100 milliliters or less when tested in accordance with 40 CFR Part 136.

(b) The 40 samples must be taken from the device as follows: During each of the 10 test days, one sample must be taken at the beginning, middle and end of an 8-consecutive hour period with one additional sample taken immediately following the peak capacity processing period.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.126a Suspended solids test: Type II devices.

During the sewage processing test (Sec. 159.121) 40 effluent samples must be taken at the same time as samples are taken for Sec. 159.126 and they must be analyzed for total suspended solids in accordance with 40 CFR Part 136. The arithmetic mean of the total suspended solids in 38 of 40 of these samples must be less than or equal to 150 milligrams per liter.

[CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.127 Safety coliform count: Recirculating devices.

Thirty-eight of forty samples of flush fluid from a re-circulating device must have less than 240 fecal coliform bacteria per 100 milliliters. These samples must be collected in accordance with Sec. 159.123(b) and tested in accordance with 40 CFR Part 136.

[CGD 73-83, 40 FR 4624, Jan. 30, 1975, as amended by CGD 75-213, 41 FR 15326, Apr. 12, 1976]

Sec. 159.129 Safety: Ignition prevention test.

(a) Components of a device that are a potential ignition source in an explosive atmosphere must pass the test in paragraph (b) or (c) of this section or meet the requirements of paragraph (d) or have a specific warning in the instruction manual required by Sec. 159.57 that the device should not be installed in an explosive atmosphere.

(b) Components protected by vapor exclusion must be placed in a chamber filled with a rich mixture of gasoline or propane in air with the pressure being varied from 0 to 2 psig once an hour for 8 hours. Vapor readings must be taken in the void being protected and must indicate a leakage less than 20 percent of the lower explosive limit of the mixture in the chamber.

(c) Components providing ignition protection by means other than vapor exclusion must be fitted with an ignition source, such as a spark plug, and a means of injecting an explosive mixture of gasoline or propane and air into the void that protects the component. Connections must be made so as to minimize any additional volume added to the protected void by the apparatus delivering the explosive mixture. The component must be placed in a chamber filled with an explosive mixture and there must be no ignition of the explosive mixture surrounding the component when the following tests are conducted:

(1) Using any overload protection that is part of the device, the potential ignition source must be operated for one half hour at 110 percent of its rated voltage, one half hour at 50 percent of its rated voltage and one half hour at 100 percent of its rated voltage with the motor or armature locked, if the potential ignition source is a motor or part of a motor's electrical circuit.

(2) With the explosive mixture in the protected void, the test installed ignition source must be activated 50 times.

(3) The tests paragraphs (c) (1) and (2) of this section must be repeated with any plugs removed.

(d) Components that are certified as being intrinsically safe in accordance with the Instrument Society of America (RP 12.2) or explosion proof in accordance with the Underwriters Laboratories STD 698 in Class I, Group D hazardous locations (46 CFR 111.80-5(a)) need not be subjected to this testing.

Sec. 159.131 Safety: Incinerating device.

An incinerating device must not incinerate unless the combustion chamber is closed, must purge the combustion chamber of combustible fuel vapors before and after incineration must secure automatically if the burner does not ignite, must not allow an accumulation of fuel, and must neither produce a temperature on surfaces adjacent to the incineration chamber higher than 67 deg.C nor produce a temperature on surfaces in normal body contact higher than 41 deg.C when operating in an ambient temperature of 25 deg.C. Unitized incineration devices must completely burn to a dry, inert ash, a simultaneous defecation and urination and must not discharge fly ash, malodors, or toxic substances.

Subpart D--Recognition of Facilities

Sec. 159.201 Recognition of facilities.

A recognized facility is an independent laboratory accepted by the Coast Guard under 46 CFR 159.010 to perform the tests and inspections required under this part. A list of accepted laboratories is available from the Commandant (G-MSE-3).

[CGD 95-028, 62 FR 51194, Sept. 30, 1997, as amended by USCG-1999-5832, 64 FR 34715, June 29, 1999]

Appendix F Public Comments