4.0 TMDL Allocation

The allocation analysis for the bacteria impaired segment of the Upper York River, Lower Pamunkey River and Mattaponi River is the third stage in TMDL development. Its purpose is to develop a framework for reducing fecal coliform and enterococci loading under the existing watershed conditions so that water quality standards can be met. In this section, TMDL allocations will be presented for the shellfish impaired segment of the Upper York (cause group code: F26E-20-SF), recreational impaired segment within the Upper York (cause group code: F26E-05-BAC), recreational impairments for the Lower Pamunkey River (cause group code: F14E-03-BAC), and Lower Mattaponi River (cause group code: F25E-01-BAC).

The TMDL represents the maximum amount of pollutant that the stream can contain without exceeding the water quality standard. The load allocations for the selected scenarios were calculated using the following equation:

$$TMDL = \sum WLA + \sum LA + MOS$$

Where,

WLA = waste load allocation (point source contributions);

LA = load allocation (nonpoint source allocation); and

MOS = margin of safety.

Typically, several potential allocation strategies would achieve the TMDL endpoint and water quality standards. Available control options depend on the number, location, and character of pollutant sources.

4.1 Incorporation of Margin of Safety

The margin of safety (MOS) is a required component of the TMDL, which accounts for any lack of knowledge concerning the relationship between effluent limitations and water quality. According to EPA guidance (EPA, 1991), the MOS can be incorporated into the TMDL using two methods:

- Implicitly incorporating the MOS using conservative model assumptions to develop allocations; or
- Explicitly specifying a portion of the TMDL as the MOS and using the remainder for allocations.

The MOS will be implicitly incorporated into this TMDL. Implicitly incorporating the MOS requires that allocations meet the fecal coliform standard geometric mean of 14 MPN/100mL and the 90th Percentile Standard of 49 MPN/100mL and the entercocci standard geometric mean of 35 MPN/100mL and the Single Sample Maximum Standard of 104 counts/100mL at any time. Conservative assumptions such as using the worst case geometric mean, 90th percentile and highest instantaneous enterococci exceedances in load calculations are further examples of an implicit MOS.

4.2 Waste Load Allocation

Waste Loads are calculated based on the design flow of the facility at the standard of impaired use, when applicable.

Upper Tidal York River

Shellfish Bacteria Impairment

There are three permitted dischargers located in the Upper Tidal York watershed that discharge bacteria loads. Two are municipal permitted facilities, Parham Landing WWTP (VA0088331) and HRSD Town of West Point STP (VA0075434), and one is a domestic residential facility (VAG404212).

The Rock-Tenn West Point Mill outfall is located approximately two miles upstream of the shellfish impairment and is a wood-pulp processing facility. The Rock Tenn West Point facility will not receive waste load allocations (WLAs) for bacteria as the facility's process is not expected to contribute harmful bacteria to the waterway.

All facilities permitted for the discharge of bacteria were assigned WLAs for the shellfish impaired segment in the Upper York based on the VDH standard used to model shellfish prohibited zones below bacteria dischargers, which is 200 MPN (most probable number) / 100 mL for Fecal Coliform. The direct harvest of shellfish for human consumption is

prohibited below the HRSD Town of West Point Sewage Treatment Plant's (STP) discharge to the Mattaponi River, to approximately one and a half miles downstream of the confluence of the Pamunkey and Mattaponi Rivers.

The Parham Landing WWTP outfall is located approximately six and a half miles upstream of the Upper York River shellfish impairment; therefore, the WLA for this facility will be met through compliance with its existing enterococci permit limit.

Lower Mattaponi, Lower Pamunkey, and Upper York Rivers

Recreational Bacteria Impairments

The HRSD Town of West Point STP (Lower Mattaponi) and the Parham Landing WWTP (Lower Pamunkey) discharge directly to an impaired river segment. Their compliance with respective TMDL WLAs will be met with existing permit limits for enterococci.

The domestic residential facility discharges to a non-tidal, un-named tributary to Olssen's Pond, approximately two and a half miles upstream of the impaired Lower Pamunkey River segment. Therefore, the WLA for this facility will be met by compliance with the existing bacteria permit limit.

To be protective of the downstream recreational use, each bacteria discharger was also given WLAs in the Upper York River enterococci TMDL.

The future growth factors for the recreational impairments were computed between 0.74 and 0.76% of the respective TMDL values. The future growth factor of the shellfish impairment was computed as 1.58% of the TMDL value.

Although several additional point sources dischargers in the watershed, they were not permitted for bacteria discharge and, therefore, were excluded from TMDL allocations.

4.3 Load Allocation Development and Scenarios

The reduction of loadings from nonpoint sources, including livestock, pets, and wildlife direct deposition, was incorporated into the load allocation. Fecal coliform loadings (daily load capacity of the estuary) were calculated only in the estuaries of the Upper

York in order to obtain the current load and allowable load. Enterococci loading were calculated in the estuaries of the Upper York, the Lower Pamunkey River, and the Lower Mattaponi River. The current load for fecal colicorm is the maximum value of the geometric mean and 90th percentile and for enterococci the maximum instantaneous concentration based on measurements at monitoring stations inside the estuary. The allowable load is the maximum values of the bacteria standard based on VA DEQ standards for fecal coliform and enterococci. The required percent load reduction for the Upper York River and its tributaries watershed was estimated by subtracting the allowable load from the current load, dividing the remainder by the current load, and multiplying by 100. **Table 4-1** shows the computed model results of the current load, allowable load, and reduction for the 90th percentile for the Upper York River and **Table 4-2** the computed model results of the current load, allowable, reduction for the SSM (Single Sample Maximum) for the Upper York, Lower Pamunkey River and Lower Mattaponi River. The maximum values of the 90th percentile for fecal coliform and the maximum value for enterococci were used to calculate the load allocation and the TMDL in the watershed, since they represented the maximum current loads.

Table 4-1: Current Load, Allowable Load, and Required Reduction for the Shellfish Impaired Segment of Upper York

Waterbody	Station	Volume (m^3)	Max 90th Percentile (MPN/100mL)	90th Percentile Standard (MPN/100mL)	Current Load (MPN/day)	Allowable Load (MPN/day)	Required Reduction (%)
Upper York River	48-104B	56,969,506	468	49 (Fecal Coliform)	1.15E+15	1.14E+14	90%

Table 4-2: Current Load, Allowable Load, and Required Reduction for the Recreational Impaired Segments for the Upper York, Lower Pamunkey River and Lower Mattaponi River

Waterbody	Station	Volume (m^3)	Max Concentration (cfu/100mL)	Geometric Mean (cfu /100mL)	Current Load (cfu /day)	Allowable Load (cfu /day)	Required Reduction (%)
Upper York River	8-YRK031.39	56,969,506	2000	35 (Enterococci)	4.79E+15	2.42E+14	95%
Lower Pamunkey River	8-PMK006.36	39,068,362	2,000		3.14E+15	1.63E+14	95%
Mattaponi River	8-MPN004.39	22,468,802	1,500		1.33E+15	9.41E+13	93%

4.4 Allocation Plan and TMDL Summary

4.4.1 Waste Load Allocation

Waste load allocations are applied to two wastewater/sewage treatment plants (WWTPs/STPs) and a domestic facility. The allocated load for each discharger is generally calculated using the design flow and the permitted bacteria concentration. The allocated loads including the design flow and bacteria concentration are shown in **Tables 4-3**, **4-4, 4-5,** and **4-6**. To account for future growth, growth factors for the recreational impairments were computed between 0.74 and 0.76% of the respective TMDL values. The future growth factor of the shellfish impairment was computed as 1.58% of the TMDL value.

Table 4-3: Annual Waste Load Allocation for Fecal Coliform (*shellfish use*) in the Upper Tidal York River watershed

Point Source	Facility Name	Design Flow (gallons/day)	Fecal Coliform Concentration (MPN/100ml) [1]	Allocated Load (annual)	Percent Reduction
VAG404212	Residence[4]	1000	200	2.77E+09	0
VA0075434	HRSD Town of West Point Sewage Treatment Plant	600,000	200	1.66E+12	0
VA0088331	Parham Landing WWTP[4]	2,000,000	200	5.53E+12	0
			Future Growth[2]	6.58E+14	
			Current Allocated Waste Load	7.19E+12	
			Total Allocated Waste Load[3]	6.65E+14	

[1]The effluent fecal coliform concentration is based on the VDH standard used to model shellfish prohibited zones below bacteria dischargers. MPN = Most probable number.
[2]Future Growth is calculated as 1.58% of the TMDL
[3] Total Allocated Waste Load = Future Growth + Current Allocated Waste Load
[4]Permittees will meet compliance with the WLA through existing permit limitations for bacteria

Table 4-4: Annual Waste Load Allocation for Enterococci (*recreation use*) in the Upper Tidal York River watershed

Point Source	Facility Name	Design Flow (gallons/day)	Enterococci Concentration (cfu /100ml) [1]	Allocated Load (annual)	Percent Reduction
VAG404212	Residence[4]	1000	35	4.84E+08	0
VA0075434	HRSD Town of West Point Sewage Treatment Plant	600,000	35	2.90E+11	0
VA0088331	Parham Landing WWTP	2,000,000	35	9.68E+11	0
			Future Growth[2]	6.63E+14	
			Current Allocated Waste Load	1.26E+12	
			Total Allocated Waste Load[3]	6.64E+14	

[1]The effluent enterococci concentration is based on the geometric mean standard for enterococci. CFU = colony forming units.
[2]Future Growth is calculated as 0.75% of the TMDL.
[3]Total Allocated Waste Load = Future Growth + Current Allocated Waste Load
[4]Permittees will meet compliance with the WLA through existing permit limitations for bacteria

Table 4-5: Annual Waste Load Allocation for Enterococci (*recreation use*) in the Lower Pamunkey River watershed

Point Source	Facility Name	Design Flow (gallons/day)	Enterococci Concentration (cfu /100ml) [1]	Allocated Load (annual)	Percent Reduction
VA0088331	Parham Landing WWTP	2,000,000	35	9.68E+11	0
VAG404212	Residence[4]	1000	35	4.84E+08	0
			Future Growth[2]	4.41E+14	
			Current Allocated Waste Load	9.68E+11	
			Total Allocated Waste Load[3]	4.42E+14	

[1]The effluent enterococci concentration is based on the geometric mean standard for enterococci. CFU = colony forming units.
[2]Future Growth is calculated as 0.74% of the TMDL.
[3] Total Allocated Waste Load = Future Growth + Current Allocated Waste Load
[4]Permittees will meet compliance with the WLA through existing permit limitations for bacteria

Table 4-6 Annual Waste Load Allocation for Entercocci (*recreation use*) in the Lower Mattaponi River watershed

Point Source	Facility Name	Design Flow (gallons/day)	Enterococci Concentration (cfu /100ml) [1]	Allocated Load (annual)	Percent Reduction
VA0075434	HRSD Town of West Point Sewage Treatment Plant	600,000	35	2.90E+11	0
			Future Growth[2]	2.61E+14	
			Current Allocated Waste Load	2.90E+11	
			Total Allocated Waste Load[3]	2.62E+14	

[1] The effluent enterococci concentration is based on the geometric mean standard for enterococci. CFU = colony forming units.
[2]Future Growth is calculated as 0.76% of the TMDL.
[3] Total Allocated Waste Load = Future Growth + Current Allocated Waste Load
[4]Permittees will meet compliance with the WLA through existing permit limitations for bacteria

4.4.2 Load Allocation and TMDL

The load allocation for the Upper York impairments (shellfish and recreation, respectively) is based on Bacteria Source Tracking (BST) results for livestock, wildlife, human, and pets. The load allocation for Lower Pamunkey and Mattaponi River (Recreation) are based on Fecal Tool analyses for livestock, wildlife, human, and pets in the Lower Pamunkey River watershed and the Mattaponi River watershed. The BST results are based on a weighted average of samples collected by VDH-DSS over a twelve-month period from 2005-2006 at the VDH-DSS monitoring station 49-207. The enterococci results are based on the computed fecal coliform loads using the Fecal Tool spreadsheet analyses and the assumption that the distribution of enterococci loads will the same as the distribution of fecal coliform loads by source categories. A complete reduction of all human sources is required, since fecal coliform and enterococci from human sources are considered a serious concern in estuaries (VA DEQ, 2005). Reductions for wildlife are applied when the reduction of controllable loads (humans, livestock, and pets) does not achieve the water quality standard for the estuary (VA DEQ, 2005). However, the TMDL does not recommend reductions in wildlife populations. Allocations are developed using the proportion of these sources in the BST data. The fecal coliform TMDL allocations by BST source categories that would meet the 90th percentile fecal coliform standard of 49 MPN/100mL for the Upper Tidal York River

watersheds are provided in **Table 4-7**. The enterococci TMDL allocations by different source categories that would meet the Single Sample Maximum percentile enterococci standard of 104 count/100mL for the Upper York, Lower Pamunkey River and the Mattaponi River watersheds are provided in **Tables 4-8, 4-9** and **4-10**.

Summaries of the TMDL allocation plans for Upper York River (for shellfish and recreation, respectively), Lower Pamunkey River and Mattaponi River watersheds are presented in **Tables 4-11**, **4-12**, **4-13,** and **4-14,** respectively. Minor differences in current loads are due to rounding.

Table 4-3: Distribution of Fecal Coliform Under Existing Conditions, TMDL Allocation, and Reduction in the Upper Tidal York River watershed for Nonpoint Sources

Source	BST * Allocation (% of total load)	Current Load (MPN/day)	Allocated Load (MPN/day)	Required Reduction (%)
Livestock	22%	2.52E+14	0.00E+00	100%
Wildlife	55%	6.30E+14	1.12E+14	82%
Human	12%	1.37E+14	0.00E+00	100%
Pets	11%	1.26E+14	0.00E+00	100%
Total		1.15E+15	1.12E+14	90%

* Weighted average of samples taken between 2005 and 2006

Table 4-4: Distribution of Enterococci Under Existing Conditions, TMDL Allocation, and Reduction in the Upper Tidal York River watershed for Nonpoint Sources

Source	BST * Allocation (% of total load)	Current Load (count/day)	Allocated Load (count/day)	Required Reduction (%)
Livestock	22%	1.05E+15	0.00E+00	100%
Wildlife	55%	2.63E+15	2.40E+14	91%
Human	12%	5.75E+14	0.00E+00	100%
Pets	11%	5.27E+14	0.00E+00	100%
Total		4.78E+15	2.40E+14	95%

* Weighted average of samples taken between 2005 and 2006

Table 4-5: Distribution of Enterococci Under Existing Conditions, TMDL Allocation, and Reduction in the Lower Pamunkey Watershed for Nonpoint Sources				
Source	**Distribution of Allocation by Source* (% of total load)**	**Current Load (count/day)**	**Allocated Load (count/day)**	**Required Reduction (%)**
Livestock	75%	2.36E+15	0.00E+00	100%
Wildlife	8%	2.34E+14	1.62E+14	31%
Human	11%	3.54E+14	0.00E+00	100%
Pets	6%	1.94E+14	0.00E+00	100%
Total		3.14E+15	1.62E+14	95%
* Based on Fecal Tool analysis of bacteria loads				

Table 4-6: Distribution of Enterococci Under Existing Conditions, TMDL Allocation, and Reduction in the Mattaponi River Watershed for Nonpoint Sources				
Source	**BST * Allocation (% of total load)**	**Current Load (count/day)**	**Allocated Load (count/day)**	**Required Reduction (%)**
Livestock	78%	1.03E+15	2.22E+13	98%
Wildlife	5%	6.62E+13	6.62E+13	0%
Human	11%	1.47E+14	0.00E+00	100%
Pets	6%	8.36E+13	5.02E+12	94%
Total		1.33E+15	9.34E+13	93%
* Based on Fecal Tool analysis of bacteria loads				

Table 4-7: The Upper York River TMDL Allocation Plan for Fecal Coliform Loads (MPN/day)			
WLA (Point Sources)	**LA (Nonpoint sources)**	**MOS (Margin of safety)**	**TMDL**
1.82E+12	**1.12E+14**	**IMPLICIT**	**1.14E+14**

Table 4-12: The Upper York River TMDL Allocation Plan for Fecal Coliform Loads (MPN/year)			
WLA (Point Sources)	**LA (Nonpoint sources)**	**MOS (Margin of safety)**	**TMDL**
6.65E+14	**4.10E+16**	**IMPLICIT**	**4.16E+16**

Table 4-13: The Upper York River TMDL Allocation Plan for Enterococci Loads (cfu/day)			
WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
1.82E+12	2.40E+14	IMPLICIT	2.42E+14

Table 4-14: The Upper York River TMDL Allocation Plan for Enterococci Loads (cfu/year)			
WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
6.64E+14	8.77E+16	IMPLICIT	8.84E+16

Table 4-85: The Lower Pamunkey River TMDL Allocation Plan for Enterococci Loads (cfu/day)			
WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
1.21E+12	1.62E+14	IMPLICIT	1.63E+14

Table 4-16: The Lower Pamunkey River TMDL Allocation Plan for Enterococci Loads (cfu/year)			
WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
4.42E+14	5.91E+16	IMPLICIT	5.95E+16

Table 4-17: The Mattaponi River TMDL Allocation Plan for Enterococci Loads (cfu/day)			
WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
7.16E+11	9.34E+13	IMPLICIT	9.41E+13

Table 4-18: The Mattaponi River TMDL Allocation Plan for Enterococci Loads (cfu/year)			
WLA (Point Sources)	LA (Nonpoint sources)	MOS (Margin of safety)	TMDL
2.62E+14	3.41E+16	IMPLICIT	3.44E+16

4.5 Consideration of Seasonal Variability

The Clean Water Act requires that a TMDL be established with consideration of seasonable variations. This includes variations of the hydrologic flow regime and the water quality. The seasonable variation was accounted for by the incorporation of monthly sampling and long-term data record in estimating existing conditions.

4.6 Consideration of Critical Conditions

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. The Upper York bacteria TMDL reduction was developed using the maximum measured bacteria concentration within the impaired waterbody and stringent bacteria criteria (90th percentile for shellfish impaired waterbodies and the single sample maxium for recreational impaired waterbodies). These two elements; the use of the maximum measured bacteria concentration along with stringent bacteria criteria insure that the critical conditions are accounted for the Upper York Bacteria TMDL.