2025 Total Maximum Daily Load Stormwater Implementation Plan Carroll County, Maryland

Prepared by
Carroll County Government Resource Management Division

Forward

This document summarizes completed, proposed, and potential restoration strategies to meet local and Chesapeake Bay Total Maximum Daily Load (TMDL) requirements associated with the urban wasteload allocation (WLA) for watersheds within Carroll County, Maryland. This document summarizes the ongoing, iterative process that will be updated as needed to track implementation of structural and nonstructural projects, alternative Best Management Practices (BMPs), and program enhancements that assist in meeting Environmental Protection Agency (EPA) approved TMDL stormwater WLAs. Updates will evaluate the success of Carroll County's watershed restoration efforts and document progress towards meeting approved stormwater WLAs. Some of the strategies presented in this document are considered "potential," and additional assessments will be required before any project is considered final or approved.

Table of Contents

Figures

Tables

Appendices

Page intentionally left blank

I. Introduction

The Carroll County Resource Management Division (RMD) has initiated watershed restoration planning to address the developed and approved watershed TMDL Wasteload Allocations (WLAs) within the County, as required by the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) permit. As co-permittees of the MS4 permit, the eight incorporated municipalities within the County also participate as stakeholders in this planning process. This includes the Towns of Manchester, Hampstead, New Windsor, Union Bridge, Mount Airy, and Sykesville, as well as the Cities of Westminster and Taneytown.

This document presents restoration strategies that are proposed to meet watershed-specific water quality standards through associated TMDL WLAs for developed source types for Carroll County. This TMDL Stormwater Restoration Plan establishes a reporting framework for project tracking, monitoring, and reporting, and was developed to meet the restoration plan requirement designated in the County's NPDES MS4 Permit (Section IV.E.). **Figure 1** below depicts the nine 8-digit watersheds within Carroll County.

A. Regulatory Setting and Requirements

Maryland water quality standards have been adopted to align with the Federal Clean Water Act's objective to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Individual standards are established to support the beneficial uses of water bodies such as fishing, aquatic life, drinking water supply, boating, and water contact recreation, as well as terrestrial wildlife that depend on water.

1. Use Class Designations and Water Quality Standards

All bodies of water, including streams within Maryland and all other states, are each assigned a designated use. Maryland's designated water uses are identified in the Code of Maryland Regulations (COMAR) 26.08.02.08. The designated use of a water body refers to its anticipated use and defines any protections necessary to sustain aquatic life there. Water quality standards refer to the criteria required to meet the designated use of a water body. A listing of Maryland's designated water uses are as follows:

- Use I: Water contact recreation, and protection of nontidal warm water aquatic life.
- Use II: Support of estuarine and marine aquatic life and shellfish harvesting (not all subcategories apply to each tidal water segment)
    - Shellfish harvesting subcategory
    - Seasonal migratory fish spawning and nursery subcategory (Chesapeake Bay only)
    - Seasonal shallow-water submerged aquatic vegetation subcategory (Chesapeake Bay only)
    - Open-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-water fish and shellfish subcategory (Chesapeake Bay only)
    - Seasonal deep-channel refuge use (Chesapeake Bay only)

- Use III: Nontidal cold water – usually considered natural trout waters
- Use IV: Recreational trout waters – waters are stocked with trout

If the letter "P" follows the use class listing, that particular stream has been designated as a public water supply. The designated use and applicable use classes can be found in **Table 1.** **Figure 2** below shows the locations of streams within the County and their various designated use classes, which include I, I-P, III, III-P, IV, and IV-P.

Table 1: Maryland Designated Uses

	Use Classes							
Designated Uses	I	I-P	II	II-P	III	III-P	IV	IV-P
Growth and Propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓	✓	✓	✓
Water Contact Sports	✓	✓	✓	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface water	✓	✓	✓	✓	✓	✓	✓	✓
Fishing	✓	✓	✓	✓	✓	✓	✓	✓
Agricultural Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Industrial Water Supply	✓	✓	✓	✓	✓	✓	✓	✓
Propagation and Harvesting of Shellfish			✓	✓				
Seasonal Migratory Fish Spawning and Nursery Use			✓	✓				
Seasonal Shallow-Water Submerged Aquatic Vegetation Use			✓	✓				
Open-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Water Fish and Shellfish Use			✓	✓				
Seasonal Deep-Channel Refuge Use			✓	✓				
Growth and Propagation of Trout					✓	✓		
Capable of Supporting Adult Trout for a Put and Take Fishery							✓	✓
Public Water Supply		✓		✓		✓		✓

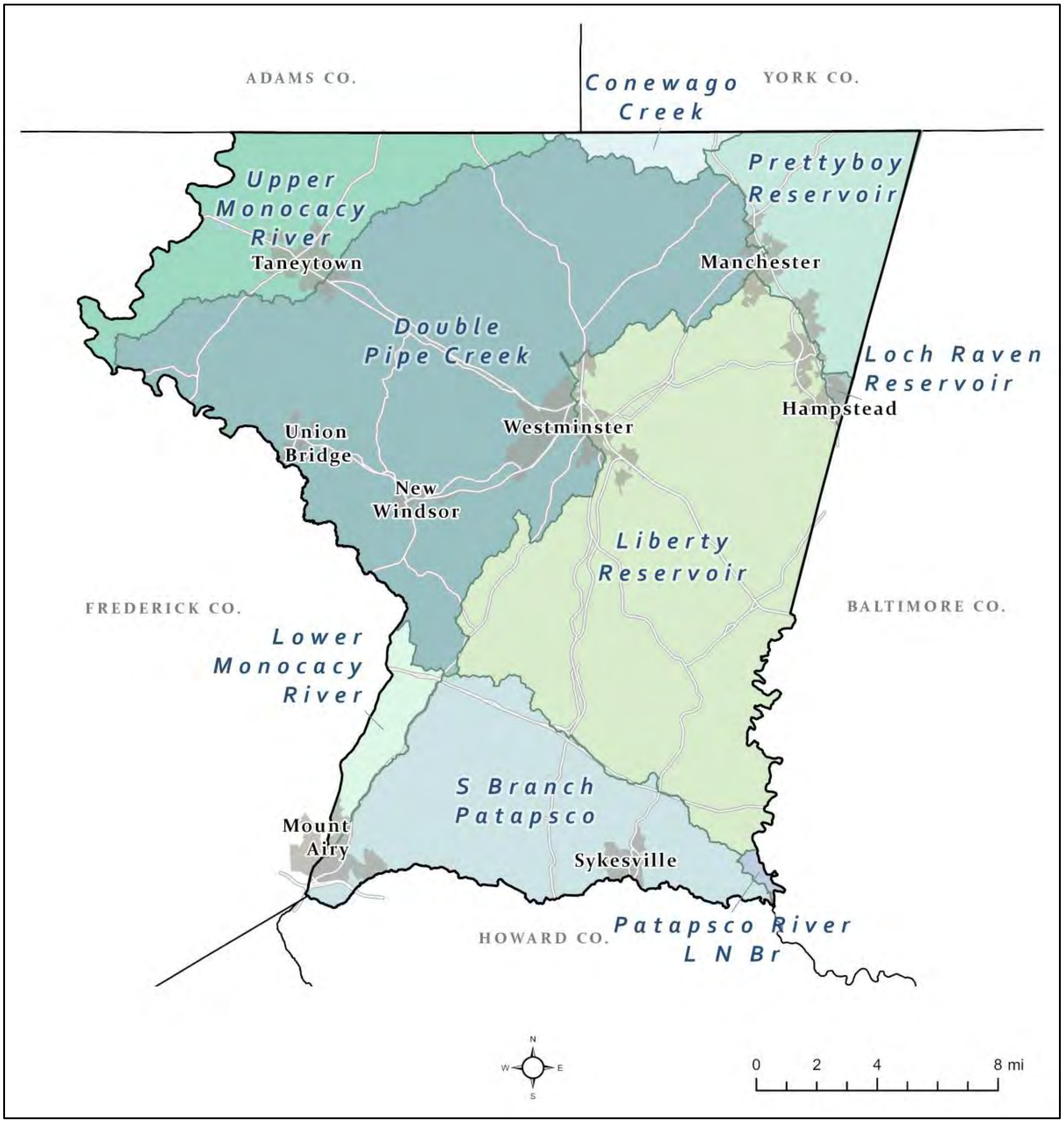


Figure 1: Carroll County 8-Digit Watersheds

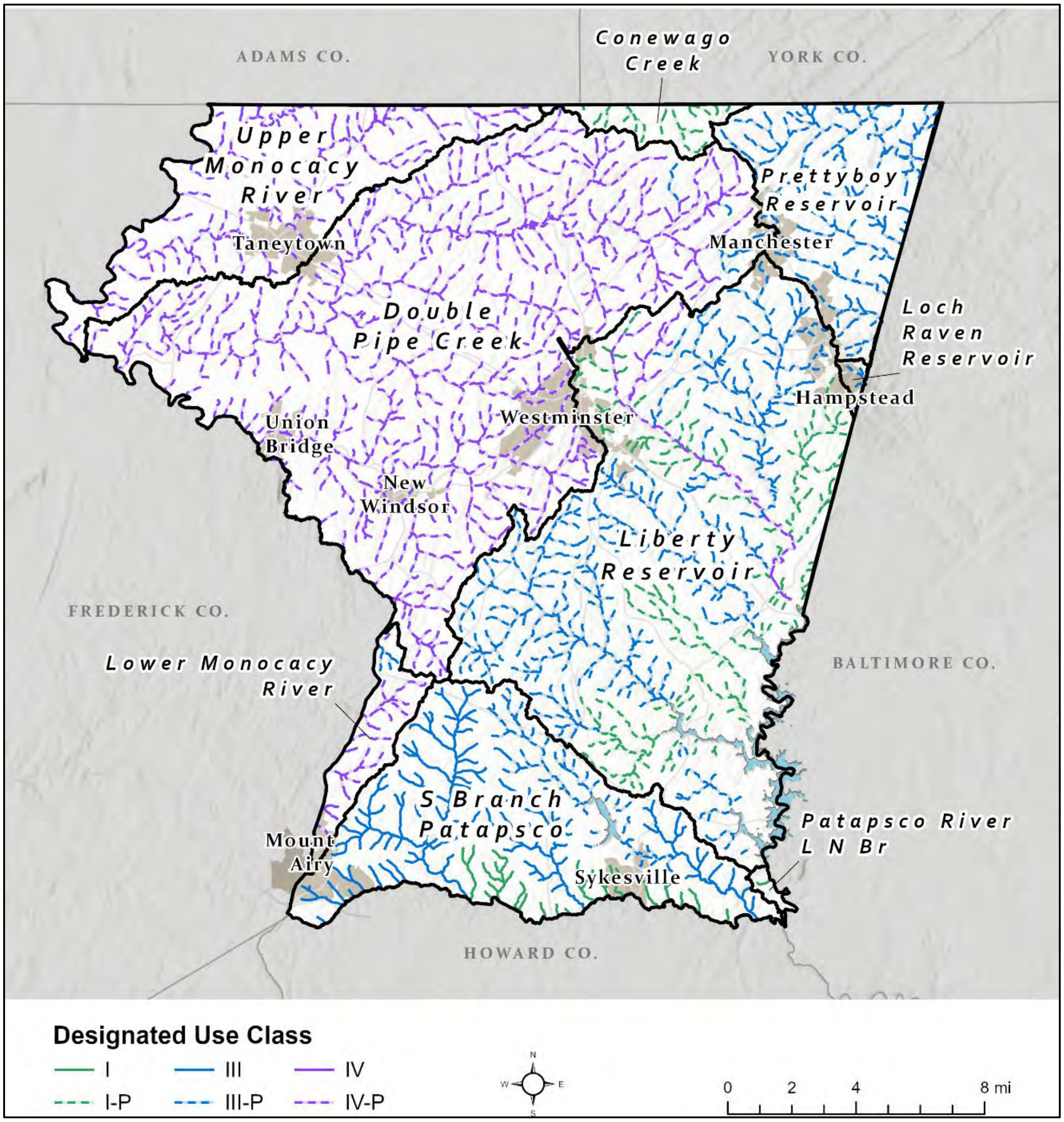


Figure 2: Designated Use Classes for Streams of Carroll County

2. Total Maximum Daily Loads

A TMDL establishes the maximum amount of an impairing substance or stressor that a waterbody can assimilate and still meet water quality standards (WQS). TMDLs are based on the relationship between pollution sources and in-stream water quality conditions. TMDLs calculate pollution contributions from the entire watershed and then allocate reduction requirements to the various contributing sources. Within the 8-digit watersheds, these allocations are divided among counties and municipalities and then further divided among sources, including agriculture, wastewater, and stormwater. As the County and each of the municipalities have joined as co-permittees on one

MS4 permit this restoration plan provides joint requirements, strategies, and progress for reducing TMDL loadings associated with the stormwater WLAs.

The County's NPDES MS4 permit requires that a restoration plan for each EPA-approved stormwater WLA be submitted to MDE for approval. Any subsequent TMDL WLA approved by the EPA is required to be addressed in a restoration plan within one year of EPA approval.

The objective of Maryland's nutrient and sediment TMDLs and their associated implementation plans is to ensure that watershed nutrient and sediment loads are at a level to support aquatic life. Currently in Maryland, there are no specific numeric criteria that quantify the impact of sediment or nutrients on the aquatic life of nontidal streams. MDE's Biological Stressor Identification (BSID) methodology is applied to determine and monitor whether aquatic life is impacted by elevated nutrient and sediment loads.

In addition to nutrient and sediment TMDLs, Attachment B of the County's MS4 permit includes TMDLs for mercury. Based on MDE's *Guidance for Developing a Stormwater Wasteload Allocation Implementation Plan for Mercury Total Maximum Daily Loads* (2014), atmospheric deposition is the major loading source to mercury-impaired waters in Maryland, primarily originating from power plants. While urban stormwater conveyance systems transport the atmospherically deposited mercury downstream, the impervious surfaces and conveyance systems are not the source. For this reason, the guidance document indicates that the majority of TMDL-required mercury load reductions are expected to occur at the state and federal level.

The list of EPA-approved TMDLs for Carroll County also includes bacteria. The bacteria TMDL is calculated and broken down into four main sources: human, domestic pet, livestock, and wildlife. While the County recognizes a need for bacteria reductions across all sources, the focus will be on the reduction of human-related sources associated with the stormwater (SW) WLA.

II. Restoration Plan Development

Of the nine 8-digit watersheds in Carroll County (**Figure 1**), seven watersheds have an associated TMDL WLA for developed source types. The seven watersheds with an approved TMDL are: Prettyboy Reservoir, Liberty Reservoir, Loch Raven Reservoir, Lower Monocacy River, Upper Monocacy River, Double Pipe Creek, and South Branch Patapsco River (Baltimore Harbor). The restoration planning process focuses on addressing these impairments through the implementation of water quality improvement projects.

A. Watershed Assessments

Watershed assessments were completed for each of the nine watersheds within Carroll County. Each assessment was done at the 8-digit level and further divided down to the 12-digit level for subwatershed analyses. Each watershed assessment consisted of a stream corridor assessment (SCA) and a characterization plan.

The County conducted SCAs in accordance with the Stream Corridor Assessment Survey Protocols, developed in 2001 by the Maryland DNR Watershed Restoration Division. Assessments were performed between January and March, in the years assessed, by County staff through cooperation with private landowners and municipalities. Landowner permission for access to stream corridors was obtained through a mailing detailing the purpose and timing of the assessment with a return response postcard. The County received permission to assess 786 of the 1,464 stream miles, or approximately 54% of all stream miles within the County (**Table 2**).

During each SCA, field teams collected information related to eroded streambanks, channel alterations, exposed utility pipes, drainage pipe outfalls, fish barriers, inadequate streamside buffers, trash dumps, and construction activities that were in or near the stream. Any unusual conditions were also noted. Each impairment was then ranked on a scale of one to five in relation to the impairment's severity, accessibility, and correctability. The goal of the numeric ranking was to identify and classify current impairments within the watershed to assist in prioritizing locations for restoration implementation.

In addition to the on-the-ground field assessments, County staff also conducted a desktop analysis of each of the nine 8-digit watersheds in a characterization plan. Each watershed's characterization plan described the unique background of the watershed, including the natural and anthropogenic characteristics of the watershed, and any water quality and living resource data that had been collected there.

Table 2: Stream Corridor Assessments (SCAs) by Watershed

8-Digit Watershed	Major Basin	Year Assessed	Miles Assessed	Total Miles	% Assessed
Prettyboy	Gunpowder	2011	80	97	82%
Liberty	Patapsco	2012	255	458	56%
South Branch Patapsco	Patapsco	2013	156	218	72%
Lower N. Branch	Patapsco	2014	6	6	100%
Lower Monocacy	Monocacy/Potomac	2014	10	23	43%
Conewago Creek	Susquehanna	2014	11	18	61%
Upper Monocacy	Monocacy/Potomac	2015	71	128	55%
Double Pipe	Monocacy/Potomac	2016	266	514	52%
Loch Raven	Gunpowder	2016	2	3	66%
		Total:	***786***	***1,464***	***54%***

B. Restoration Planning Timeline

Watershed restoration plans for the seven watersheds with approved TMDLs were first sent to MDE for review in August of 2016. In addition to the restoration plans, this submission also included watershed characterizations and SCA summaries for each watershed. The SCAs assisted in the restoration planning process, focusing on impacts and findings documented during the assessments.

In September 2017, the County received written comments from the Sediment, Stormwater, and Dam Safety Program and the Water and Science Administration at MDE, highlighting various points and deficiencies related to the submitted restoration plans. Following another review of the restoration plans by MDE's Integrated Water Planning Program (IWPP) in 2018, the County revised the seven watershed restoration plans and began releasing them for public comment in October of 2019.

C. Public Participation

As part of the watershed restoration efforts, Carroll County solicited input from the public regarding development of the County's TMDL restoration plans. Public involvement occurred following interim submissions of the restoration plans to MDE, which provided feedback and subsequent revisions to the plans. Interim submissions to MDE included Watershed Characterizations, Stream Corridor Assessment summaries, and Watershed Restoration Plans for the seven 8-digit watersheds in Carroll County with an approved TMDL WLA for developed source types.

Following two rounds of review by MDE, the County began releasing the restoration plans for public comment in the fall of 2019. Notice of this release was sent to the Carroll County Times on September 26, 2019, and posted on the Carroll County webpage. Hard copies of the plans were made available for review and comment at the RMD, and digital versions were posted on the RMD's webpage to allow for submission of electronic comments.

The Watershed Restoration Plans were released for 30-day public comment in a staggered method beginning on October 1, 2019. Upper and Lower Monocacy Watersheds were open for public comment from October 1 to October 30, Prettyboy and Loch Raven Watersheds were open for public comment from October 14 to November 14, and Double Pipe Creek and Liberty Watersheds were open for public comment from October 28 to November 28.

The County received extremely limited feedback from the public related to the seven restoration plans. Feedback from the public was incorporated into the restoration plans prior to the final submission to MDE in December of 2019, and a discussion of the feedback and its applicability to the restoration plans were provided in the County's 2019 MS4 Annual Report.

In May 2020, the County received correspondence from MDE that all watershed restoration plans were approved, as they met the required technical aspects and included all necessary watershed planning components.

III. Carroll County TMDL Watersheds

A. Liberty Reservoir

The Carroll County portion of the Liberty Reservoir Watershed is located along the eastern part of the County, and consists of seventeen 12-digit subwatersheds that cover a total land area of 87,249 acres. The watershed is within the Patapsco River Basin, part of the Piedmont physiographic province of Maryland. **Figure 3** depicts the location of the Liberty Reservoir Watershed and its streams, symbolized by use class.

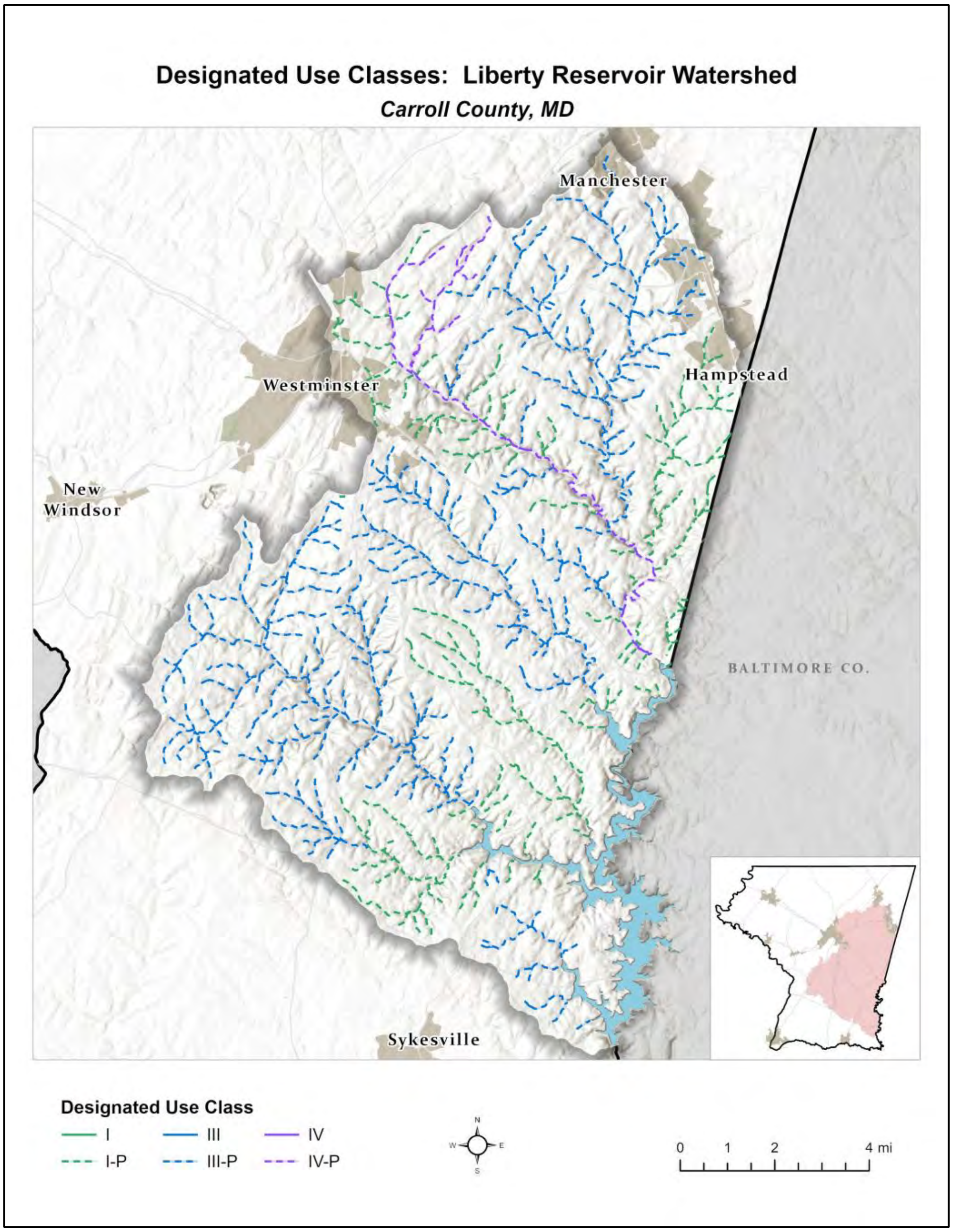


Figure 3: Liberty Reservoir 8-Digit Watershed Map

1. Liberty Watershed Water Quality Standards

The Liberty Reservoir Watershed within Carroll County consists of streams with a variety of designated uses, ranging from Use I (non-tidal warm water) to Use IV-P (recreational trout waters and public water supply). The Liberty Reservoir Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2002; a TMDL for bacteria was developed and approved in December of 2009. MDE identified Liberty Reservoir on the State's 2010 Integrated Report as impaired by sediments - sedimentation/siltation (1996) and nutrients - phosphorus (1996). A TMDL for phosphorus and sediment was developed and approved in May of 2014.

2. Liberty Watershed SW-WLA TMDLs

The current estimated stormwater baseline load for phosphorus within the Carroll County portion of the Liberty Reservoir Watershed was derived from the MDE TMDL Data Center. **Table 3** outlines the bacteria baseline, TMDL, and required percent reduction for jurisdictions within the Liberty Reservoir Watershed. The phosphorus baseline, TMDL, and required percent reduction are shown in **Table 4**. The sediment baseline, TMDL, and required percent reduction are listed in **Table 5.**

Table 3: Liberty Reservoir 8-digit Watershed Bacteria TMDL

Liberty Reservoir Watershed			Percent Reduction Required
Jurisdiction	Baseline (billion MPN/yr)	TMDL (billion MPN/yr)	
Carroll County	67,250	7,263	89.2%
Municipalities	19,102	2,063	89.2%
Total	*86,352*	*9,326*	*89.2%*

Table 4: Liberty Reservoir 8-digit Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	12,204	6,102	50%
Municipalities	1,685	893	47%
Total	*13,889*	*6,995*	*50%*

Table 5: Liberty Reservoir 8-digit Watershed Sediment TMDL

Jurisdiction	Baseline (tons/yr)	TMDL (tons/yr)	Percent Reduction Required
Carroll County	4,016	2,530	37%
Municipalities	614	350	43%
Total	*4,630*	*2,880*	*38%*

B. Prettyboy Reservoir

The Carroll County portion of the Prettyboy Reservoir Watershed is located in the northeast corner of the County, and consists of five 12-digit subwatersheds that cover a total land area of 21,025 acres. The watershed is within the Gunpowder River Basin, part of the Piedmont physiographic province of Maryland. **Figure 4** depicts the location of the Prettyboy Reservoir Watershed and its streams, symbolized by use class.

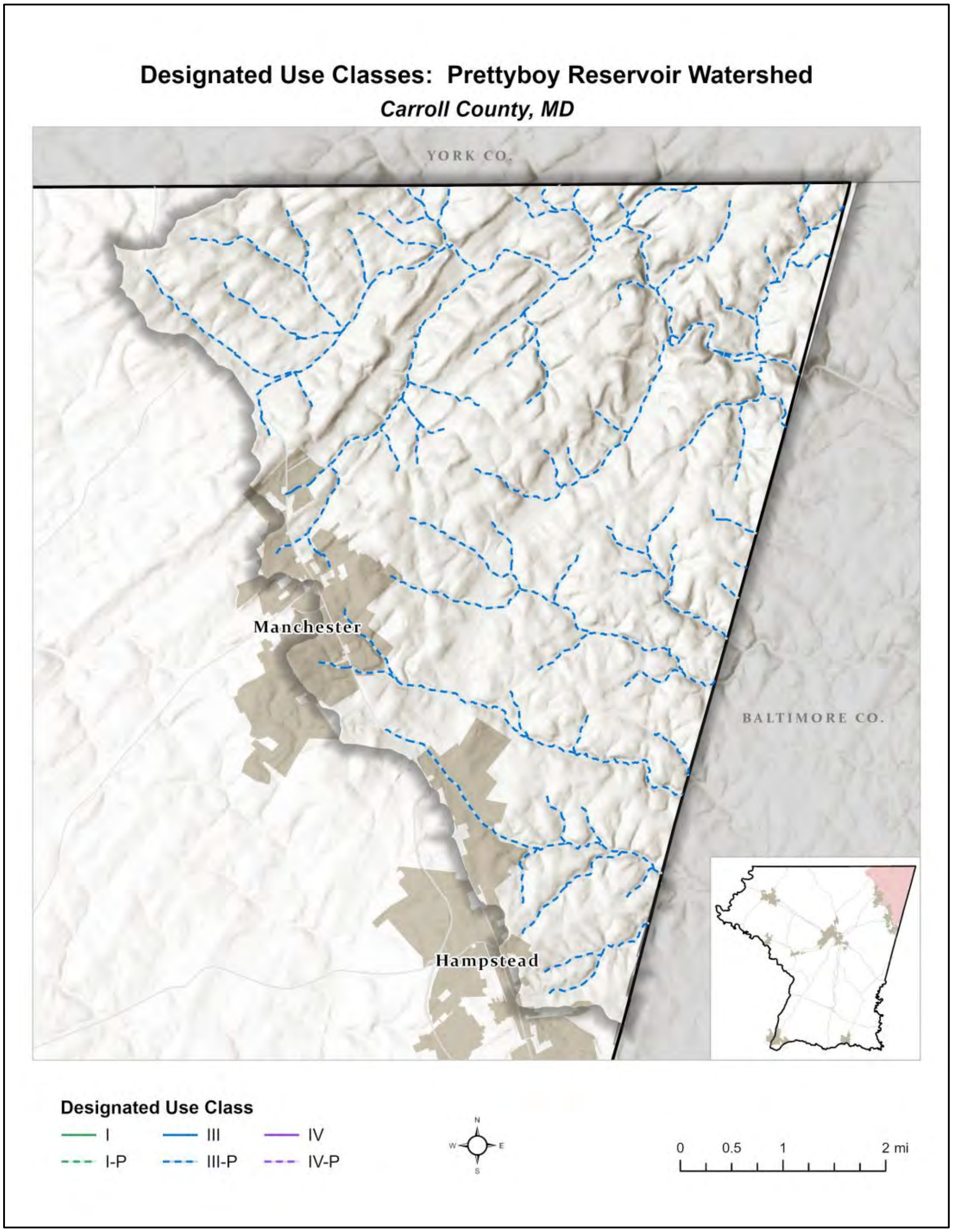


Figure 4: Prettyboy Reservoir Watershed 8-Digit Watershed Map

1. Prettyboy Watershed Water Quality Standards

The entire portion of the Prettyboy watershed within Carroll County is designated as Use III-P (Non-tidal Cold Water and Public Water Supply). The Prettyboy Reservoir Watershed was placed on Maryland's 303(d) list of impaired waters for nutrients in 1996 and for bacteria in 2002. A TMDL for phosphorus was developed and approved in March of 2007, and a subsequent TMDL for bacteria was developed and approved in October of 2009.

2. Prettyboy Watershed SW-WLA TMDLs

The estimated stormwater baseline loads in the Carroll County portion of the Prettyboy Reservoir Watershed were derived from the MDE TMDL Data Center. These stormwater WLAs are an aggregate of the municipal and industrial stormwater, including the loads from construction activity. **Table 6** lists the bacteria stormwater WLA baseline, TMDL, and required percent reduction for jurisdictions within the Prettyboy Reservoir Watershed. The phosphorus stormwater WLA baseline, TMDL, and required percent reduction for phosphorus within the Prettyboy Watershed is listed in **Table 7**.

Table 6: Prettyboy Reservoir 8-digit Watershed Bacteria TMDL

Prettyboy Reservoir Watershed			Percent Reduction Required
Jurisdiction	**Baseline (billion MPN/yr)**	**TMDL (billion MPN/yr)**	
Carroll County[1]	N/A	N/A	N/A
Muncipalities	37,268	5,650	84.8
Total	*37,268*	*5,650*	*84.8%*

[1] There is no stormwater WLA for the County, as the Prettyboy Reservoir watershed is essentially outside the reach of the County's stormwater system management plan. The predominate zoning and land use in the watershed is agriculture and, as such, it is not served by an organized storm sewer system. There is one area of urban development in the Prettyboy Watershed, represented by the incorporated Towns of Manchester and Hampstead (MDE, 2008).

Table 7: Prettyboy Reservoir 8-digit Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	1,843	1,572	15%
Total	*1,843*	*1,572*	*15%*

C. Loch Raven Reservoir

The Carroll County portion of the Loch Raven Reservoir Watershed is located in the northeast corner of the County, and covers a total land area of 592 acres. The watershed is within the Gunpowder River Basin, part of the Piedmont physiographic province of Maryland. **Figure 5** depicts the location of the Loch Raven Reservoir Watershed and its streams, symbolized by use class.

Figure 5: Loch Raven Reservoir 8-Digit Watershed Map

1. Loch Raven Watershed Water Quality Standards

The entire portion of the Loch Raven watershed within Carroll County is designated as Use III-P (Non-tidal Cold Water and Public Water Supply). The Loch Raven Reservoir Watershed was placed on Maryland's 303(d) list of impaired waters for nutrients and sediments in 1996. A TMDL for phosphorus and sediment was developed and approved in March of 2007.

2. Loch Raven SW-WLA TMDLs

The estimated stormwater baseline loads in the Carroll County portion of the Loch Raven Reservoir Watershed were derived from the MDE TMDL Data Center. **Table 8** outlines the bacteria baseline, TMDL, and required percent reductions for jurisdictions within the Loch Raven Watershed. The phosphorus stormwater baseline, TMDL, and required percent reduction within the Loch Raven Reservoir Watershed is listed in **Table 9.**

Table 8: Loch Raven Reservoir 8-digit Watershed Bacteria TMDL

Loch Raven Reservoir Watershed			Percent Reduction Required
Jurisdiction	Baseline (billion MPN/yr)	TMDL (billion MPN/yr)	
Carroll County	426	21	95%
Municipalities	4,714	104	98%
Total	*5,140*	*125*	*98%*

Table 9: Loch Raven Reservoir 8-digit Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	472	401	15%
Total	*472*	*401*	*15%*

D. Upper Monocacy River Watershed

The Monocacy River is a free-flowing stream that originates in Pennsylvania and flows 58 miles within Maryland, where it finally empties into the Potomac River. The Carroll County portion of the Upper Monocacy River Watershed is located in the northwest corner of the County, and consists of eight 12-digit subwatersheds that cover a total land area of 27,123 acres. The watershed is within the Potomac River Basin, part of the Piedmont physiographic province of Maryland. **Figure 6** depicts the location of the Upper Monocacy Watershed and its streams, symbolized by use class.

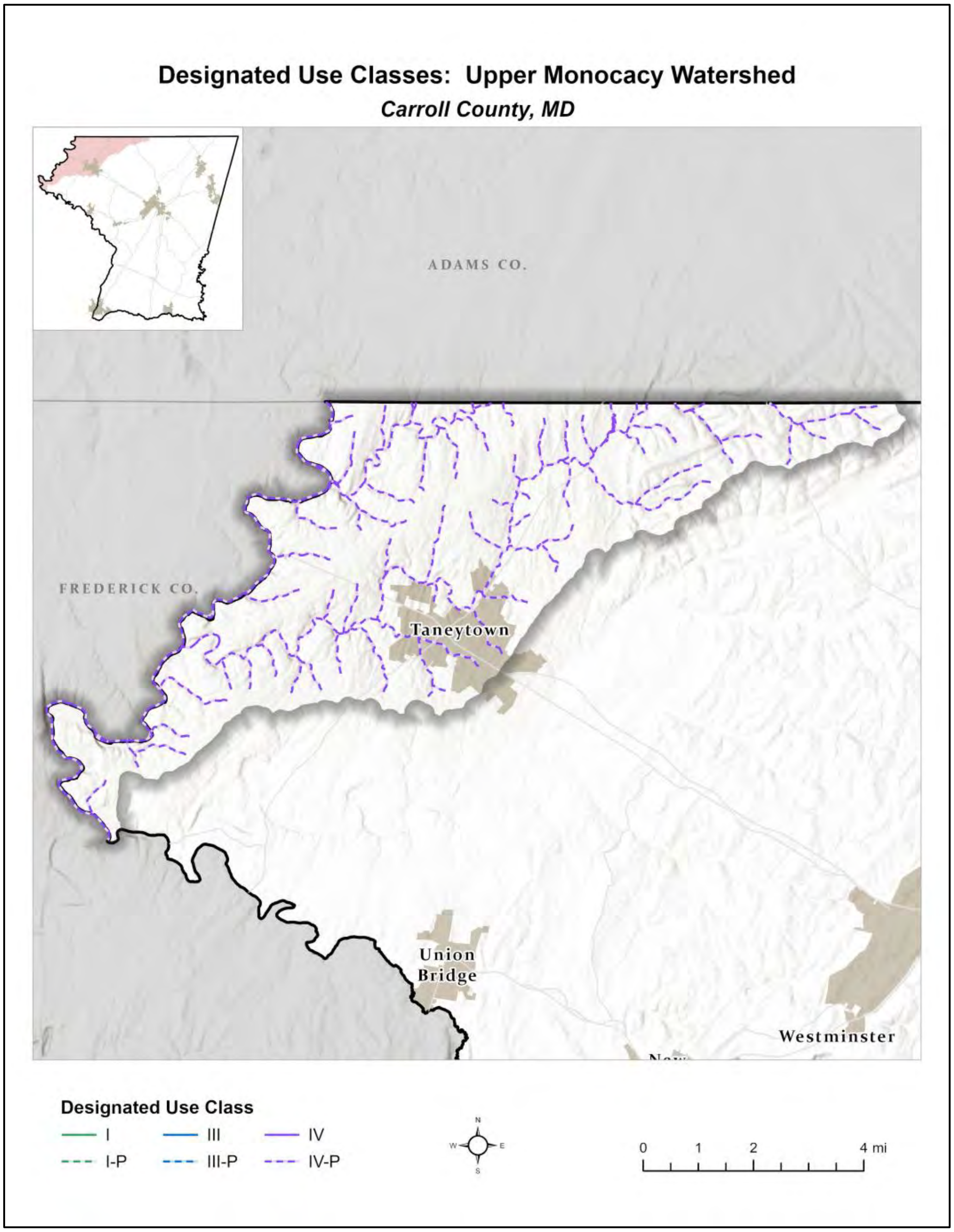


Figure 6: Upper Monocacy River 8-Digit Watershed Map

1. Upper Monocacy Watershed Water Quality Standards

The entire portion of the Upper Monocacy River watershed within Carroll County is designated as Use IV-P (Water Contact Recreation, Protection of Aquatic Life, Recreational Trout Waters, and Public Water Supply). The Upper Monocacy River watershed was placed on Maryland's 303(d) list of impaired waters for nutrients and sediments in 1996 and fecal bacteria in 2002. TMDLs for both Total Suspended Sediments (TSS) and bacteria were developed and approved in December of 2009. A TMDL for phosphorus was developed and approved in May of 2013.

2. Upper Monocacy SW-WLA TMDLs

The estimated stormwater baseline loads in the Carroll County portion of Upper Monocacy Watershed were derived from the MDE TMDL Data Center. **Table 10** outlines the bacteria baseline, TMDL, and required percent reduction for jurisdictions within the Upper Monocacy River watershed. The phosohorus baseline, TMDL, and required percent reduction are shown in **Table 11**, and the sediment baseline, TMDL, and required percent reduction are listed in **Table 12.**

Table 10: Upper Monocacy River 8-digit Watershed Bacteria TMDL

Upper Monocacy Watershed			Percent Reduction Required
Jurisdiction	**Baseline (billion MPN/yr)**	**TMDL (billion MPN/yr)**	
Carroll County	432,969	13,855	96.8%
Total	*432,969*	*13,855*	*96.8%*

Table 11: Upper Monocacy River 8-digit Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	1,427	1,353	5%
Total	*1,427*	*1,353*	*5%*

Table 12: Upper Monocacy River 8-digit Watershed Sediment TMDL

Jurisdiction	Baseline (tons/yr)	TMDL (tons/yr)	Percent Reduction Required
Carroll County	657.9	371.5	44%
Total	*657.9*	*371.5*	*44%*

E. Lower Monocacy River Watershed

The Monocacy River is a free-flowing stream that originates in Pennsylvania and flows 58 miles within Maryland, where it finally empties into the Potomac River. The Carroll County portion of the Lower Monocacy River Watershed is located in the southwest corner of the County, and consists of two 12-digit subwatersheds that cover a total land area of 5,463 acres. The watershed is within the Potomac River Basin, part of the Piedmont physiographic province of Maryland. **Figure 7** depicts the location of the Lower Monocacy Watershed and its streams, symbolized by use class.

Figure 7: Lower Monocacy River 8-Digit Watershed Map

1. Lower Monocacy Watershed Water Quality Standards

The entire portion of the Lower Monocacy River watershed within Carroll County is designated as Use IV-P (Water Contact Recreation, Protection of Aquatic Life, Recreational Trout Waters, and Public Water Supply). The Lower Monocacy River watershed was placed on Maryland's 303(d) list of impaired waters for nutrients in 1996 and fecal bacteria in 2002. A TMDL for bacteria was developed and approved in 2009 and for phosphorus in 2013.

2. Lower Monocacy SW-WLA TMDLs

The estimated stormwater baseline loads in the Carroll County portion of the Lower Monocacy Watershed were derived from the MDE TMDL Data Center. **Table 13** lists the bacteria stormwater WLA baseline, TMDL, and required percent reduction for jurisdictions within the Lower Monocacy River Watershed. The phosphorus stormwater WLA baseline, TMDL, and required percent reduction for jurisdictions within the Lower Monocacy River Watershed are listed in **Table 14**.

Table 13: Lower Monocacy River 8-digit Watershed Bacteria TMDL

Lower Monocacy Watershed			Percent Reduction Required
Jurisdiction	Baseline (billion MPN/yr)	TMDL (billion MPN/yr)	
Carroll County	116,000	1,856	98.4%
Total	*116,000*	*1,856*	*98.4%*

Table 14: Lower Monocacy River 8-digit Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	1,155	806	30%
Total	*1,155*	*806*	*30%*

F. Double Pipe Creek Watershed

The Carroll County portion of the Double Pipe Creek Watershed is located along the western portion of the County, and consists of twenty-one 12-digit subwatersheds that cover a total land area of 105,457 acres. The watershed is within the Potomac River Basin, part of the Piedmont physiographic province of Maryland. **Figure 8** depicts the location of the Double Pipe Creek Watershed and its streams, symbolized by use class.

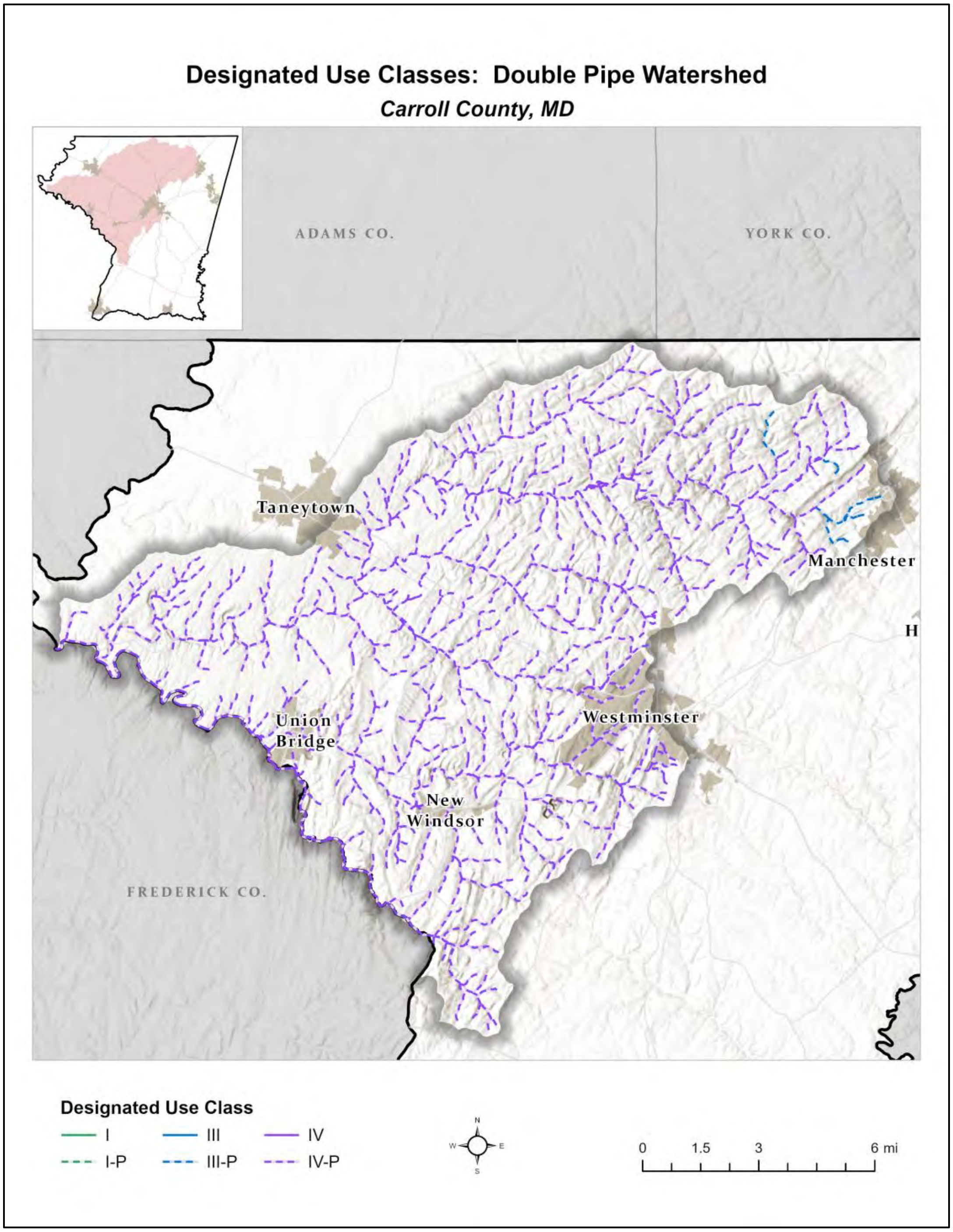


Figure 8: Double Pipe Creek 8-Digit Watershed Map

1. Double Pipe Creek Watershed Water Quality Standards

The entire portion of the Double Pipe Creek Watershed within Carroll County is designated as Use IV-P (Recreational Trout Waters). The Double Pipe Creek Watershed was placed on Maryland's 303(d) list of impaired waters for nutrients and sediment in 1996 and bacteria in 2002. A TMDL for sediment was developed and approved in September of 2008, for phosphorus in August of 2012, and for bacteria in December of 2009.

2. Double Pipe Creek SW-WLA TMDLs

The estimated stormwater baseline loads in the Carroll County portion of Double Pipe Creek Watershed were derived from the MDE TMDL Data Center. **Table 15** outlines the bacteria baseline, TMDL, and required percent reduction for jurisdictions within the Double Pipe Creek watershed. The phosohorus baseline, TMDL, and required percent reduction are shown in **Table 16**, and the sediment baseline, TMDL, and required percent reduction are listed in **Table 17**.

Table 15: Double Pipe Creek 8-digit Watershed Bacteria TMDL

Double Pipe Creek Watershed			Percent Reduction Required
Jurisdiction	Baseline (billion MPN/yr)	TMDL (billion MPN/yr)	
Carroll County	4,423,635	67,365	98.5%
Total	4,423,635	*67,365*	*98.5%*

Table 16: Double Pipe Creek 8-digit Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	9,316	2,329	75%
Municipalities	6,813	2,112	69%
Total	*16,129*	*4,441*	*72%*

Table 17: Double Pipe Creek 8-digit Watershed Sediment TMDL

Jurisdiction	Baseline	TMDL	Percent Reduction Required
Carroll County	4,759	3,149	34%
Total	*4,759*	*3,149*	*34%*

G. Baltimore Harbor (South Branch Patapsco)

The Carroll County portion of the Baltimore Harbor Watershed is located along the southern portion of the County and consists of eleven 12-digit subwatersheds that cover a total land area of 38,735 acres. The watershed is within the Patapsco River Basin, part of the Piedmont physiographic province of Maryland. **Figure 9** depicts the location of the Baltimore Harbor Watershed and its streams, symbolized by use class.

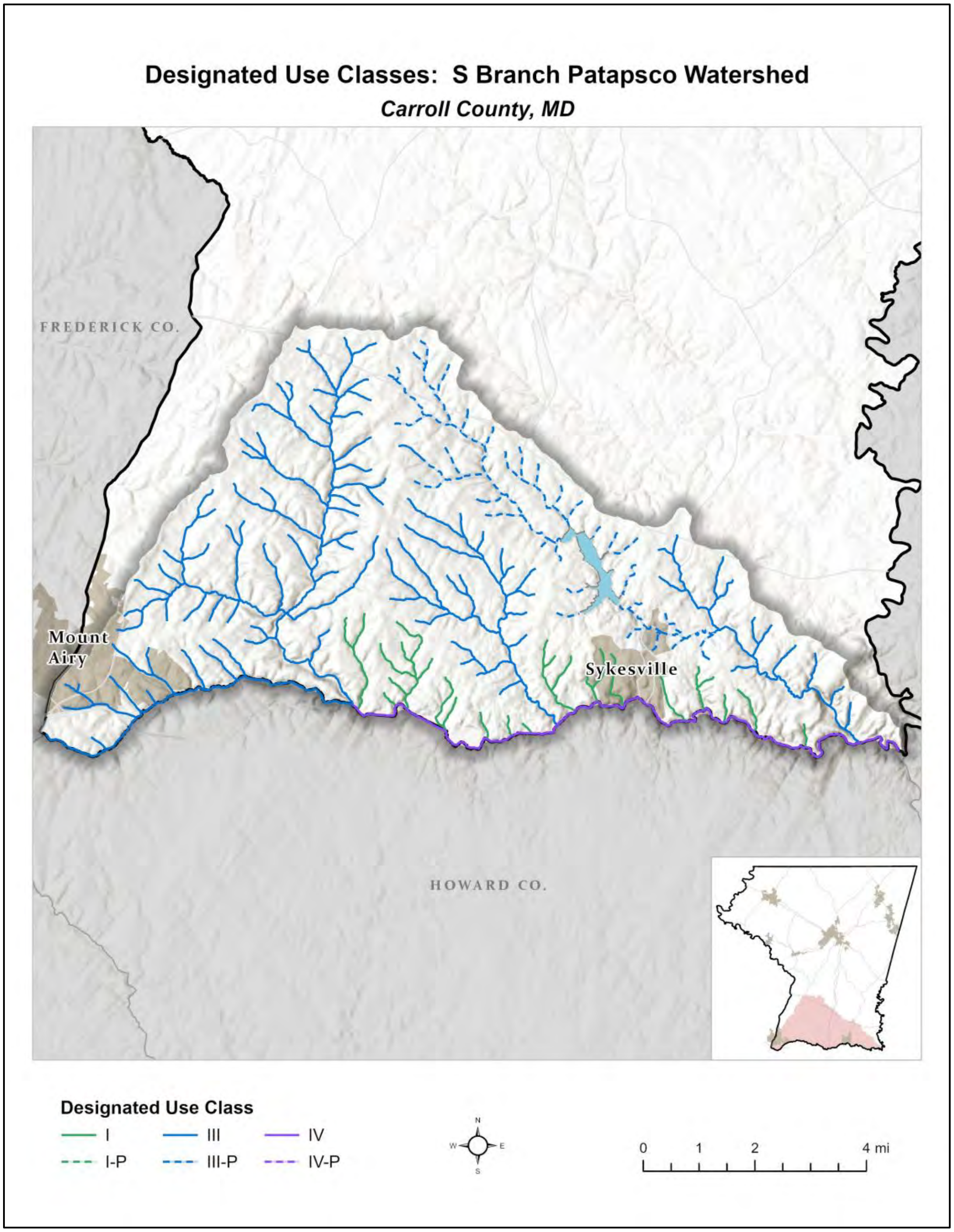


Figure 9: South Branch Patapsco River 8-Digit Watershed Map

1. Baltimore Harbor (S. Branch Patasco) Watershed Water Quality Standards

The South Branch Patapsco Watershed within Carroll County has surface waters with a variety of designated uses, ranging from Use I (non-tidal warm water) to Use IV-P (recreational trout waters and public water supply). The Baltimore Harbor was identified on the State's 1996 list of water quality limited segments (WQLSs) submitted to the U.S. EPA by MDE as impaired by nutrients. The Baltimore Harbor has also been identified on the 303(d) list as impaired by bacteria (fecal coliform) (1998), toxics (polychlorinated biphenyls, or PCBs) (1998), metals (chromium, zinc and lead) (1998), suspended sediments (1996), and impacts to biological communities (2004). As part of the Baltimore Harbor TMDL, Carroll County has an approved SW-WLA for phosphorus and sediment in the South Branch Patapsco watershed.

2. Baltimore Harbor (S. Branch Patasco) SW-WLA TMDLs

The estimated stormwater baseline loads in the Carroll County portion of the South Branch Patapsco watershed were derived from the MDE TMDL Data Center. **Table 18** lists the phosphorus stormwater WLA baseline, TMDL, and required percent reduction within the South Branch Patapsco (Baltimore Harbor) Watershed. The nitrogen stormwater WLA baseline, TMDL, and required percent reduction within the South Branch Patapsco Watershed are listed in **Table 19**.

Table 18: Baltimore Harbor Watershed Phosphorus TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	7,889	6,706	15%
Total	*7,889*	*6,706*	*15%*

Table 19: Baltimore Harbor Watershed Nitrogen TMDL

Jurisdiction	Baseline (lbs/yr)	TMDL (lbs/yr)	Percent Reduction Required
Carroll County	72,890	61,957	15%
Total	*72,890*	*61,957*	*15%*

IV. Programmatic Initiatives

A. Public Outreach and Education

An informed community is crucial to the success of any stormwater management program (US EPA, 2005). Throughout the year, County staff help inform the public of the importance of stormwater management and protecting water resources through a variety of outreach channels.

Across County and municipal websites, information is available to the general public on the MS4 program, stormwater management, and how to report pollution incidents. Various newsletters, such as the quarterly Resource Management Division newsletter, and the *Carroll Environment* Facebook page provide updates on restoration projects, monitoring efforts, and outreach events to the public.

The County and municipalities also provide outreach at local events, where an information booth is set up to provide materials and displays on homeowner stewardship, restoration efforts, volunteer opportunities, and other related topics. Staff engage with the public to answer questions and help connect them with their local watersheds and natural resources. Other hosted events, such as stream clean-ups or tree plantings, provide additional opportunities for involving the public in stewardship and restoration directly.

Carroll County also works with students to introduce concepts of stream health, watershed protection, restoration, and monitoring into their curriculum. These types of events range from in-classroom presentations to full field days with students and from pre-school through college-level groups.

The County's *MS4 Public Outreach Plan* is iteratively updated and provides a roadmap for public education and outreach development for each MS4 permit term. The County continues to expand its education and outreach efforts within all watersheds, regularly seeking additional opportunities to engage the public in water resource-related issues.

B. Stormwater Management

When runoff from precipitation flows over impervious surfaces, it can accumulate debris, chemicals, sediment, and other pollutants that may adversely affect the water quality of a stream. Additionally, the volume and velocity of the runoff can erode the stream banks, which results in habitat degradation and sediment mobilization. Together, these physical and chemical stressors create a high potential for stream degradation.

The State of Maryland began requiring stormwater management for new development in the mid-1980s to manage the quantity of runoff. In 2000, MDE released a new design manual for stormwater (MDE, 2000) that increased water quality and quantity control requirements and included stormwater management for subdivisions with lots greater than two acres. The manual was then revised in 2009 to reflect the use of environmental site design (ESD) practices.

Chapter 151 of the Carroll County Code was adopted pursuant to the Environmental Article, Title 4, Subtitle 2 of the Annotated Code of Maryland. Municipalities in Carroll County either implement Chapter 151 or have their own stormwater management code. The purpose of this chapter is to protect, maintain, and enhance public health, safety, and general welfare by establishing minimum requirements and procedures to control the adverse impacts of increased stormwater runoff. This code applies to all development and establishes minimum requirements to control the adverse impacts associated with stormwater runoff.

The goal of Chapter 151 is to manage stormwater by using environmental site design (ESD) to the maximum extent practicable (MEP) to: maintain after development, as nearly as possible, the predevelopment runoff characteristics; reduce stream channel erosion, pollution, and sedimentation; and use appropriate structural BMPs only when necessary. Implementation of Chapter 151 helps to restore, enhance, and maintain the physical, chemical, and biological integrity of streams, minimize damage to public and private property, and reduce the impacts of land development.

The current chapter was adopted in 2010 and was written to include the State of Maryland revisions to the design manual (MD Code, Environmental Article, Title 4, Subtitle 2), which mandated the use of non-structural ESD practices statewide to the MEP to mimic undeveloped hydrologic conditions.

C. Water Resource Protection Easements

As part of the development process, Carroll County protects waterways and floodplains with perpetual easements to minimize the potential for impacts to these sources during and after construction. The purpose of the Carroll County Water Resource Code (Chapter 154) is to protect and maintain ground and surface water resources of the County by establishing minimum requirements for their protection. The Carroll County Floodplain Code (Chapter 153) also provides a unified, comprehensive approach to floodplain management. Floodplains are important assets that provide vital natural functions such as temporary storage of floodwaters, moderation of peak flood flows, maintenance of water quality, and prevention of erosion.

These perpetually protected easements limit landowner use of environmentally sensitive areas and reduce the amount of nutrients and other pollutants entering the waterways. Easement locations associated with Carroll County's Chapters 153 and 154 are shown in **Figure 10**.

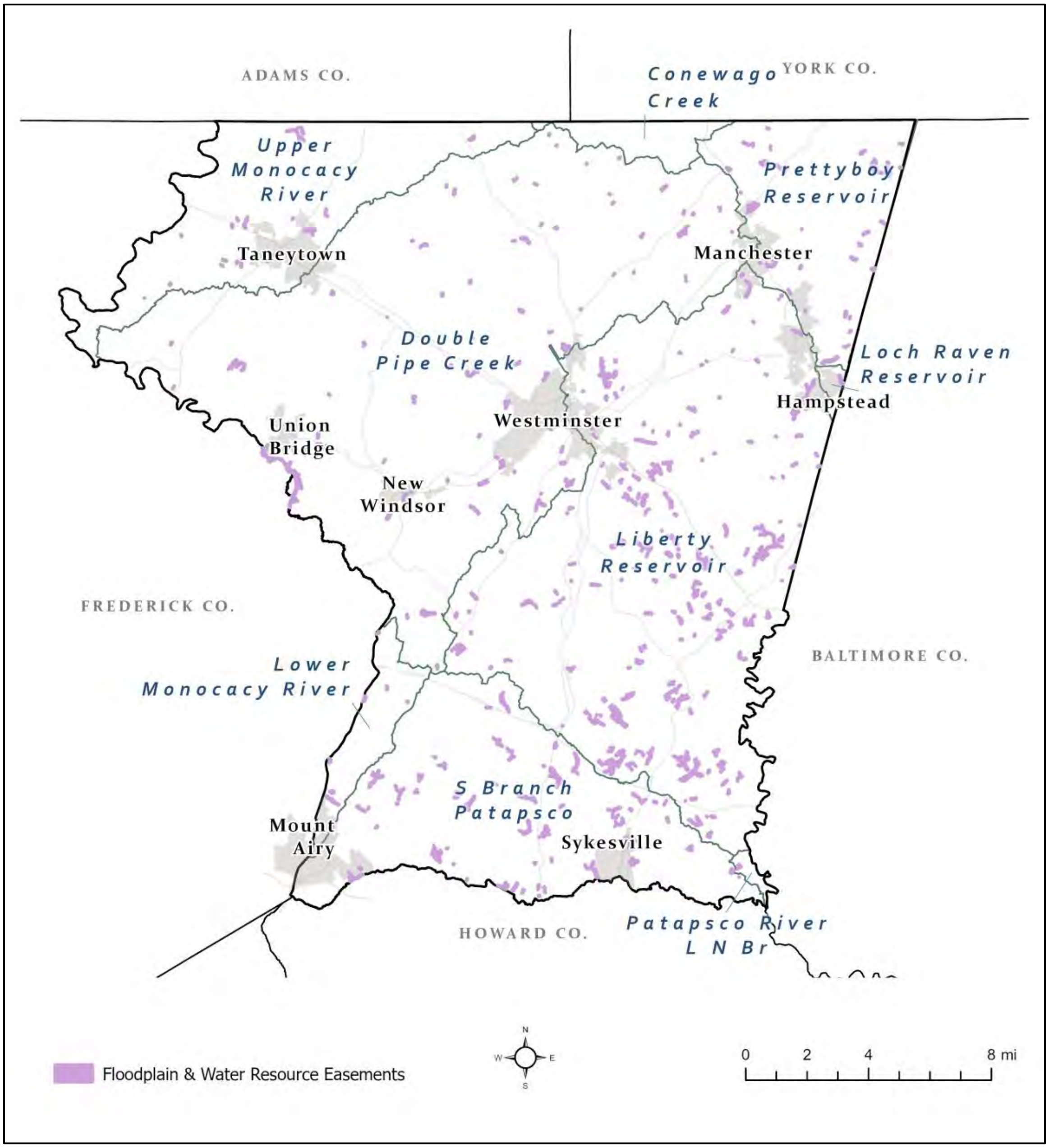


Figure 10: Carroll County Floodplain and Water Resource Protection Easements

D. Rural Legacy Areas

Maryland's Rural Legacy Program was created in 1997 to protect large, continuous tracts of land from sprawl development and to enhance natural resource, agricultural, forestry and environmental protection through cooperative efforts among state and local governments and land trusts (https://dnr.maryland.gov/land/pages/rurallegacy/home.aspx).

The goals of the Rural Legacy Program are to:

- Establish greenbelts of forests and farms around rural communities in order to preserve their cultural heritage and sense of place;
- Preserve critical habitat for native plant and wildlife species;
- Support natural resource economies such as farming, forestry, tourism, and outdoor recreation, and;
- Protect riparian forests, wetlands, and greenways to buffer the Chesapeake Bay and its tributaries from pollution run-off.

Carroll County includes the Little Pipe Creek Rural Legacy Area and part of the Upper Patapsco Rural Legacy Area. These areas within Carroll County account for 98,745 acres, which is nearly 40% of the land outside of the growth area boundaries. The extent of the Rural Legacy Areas within Carroll County can be found in **Figure 11.**

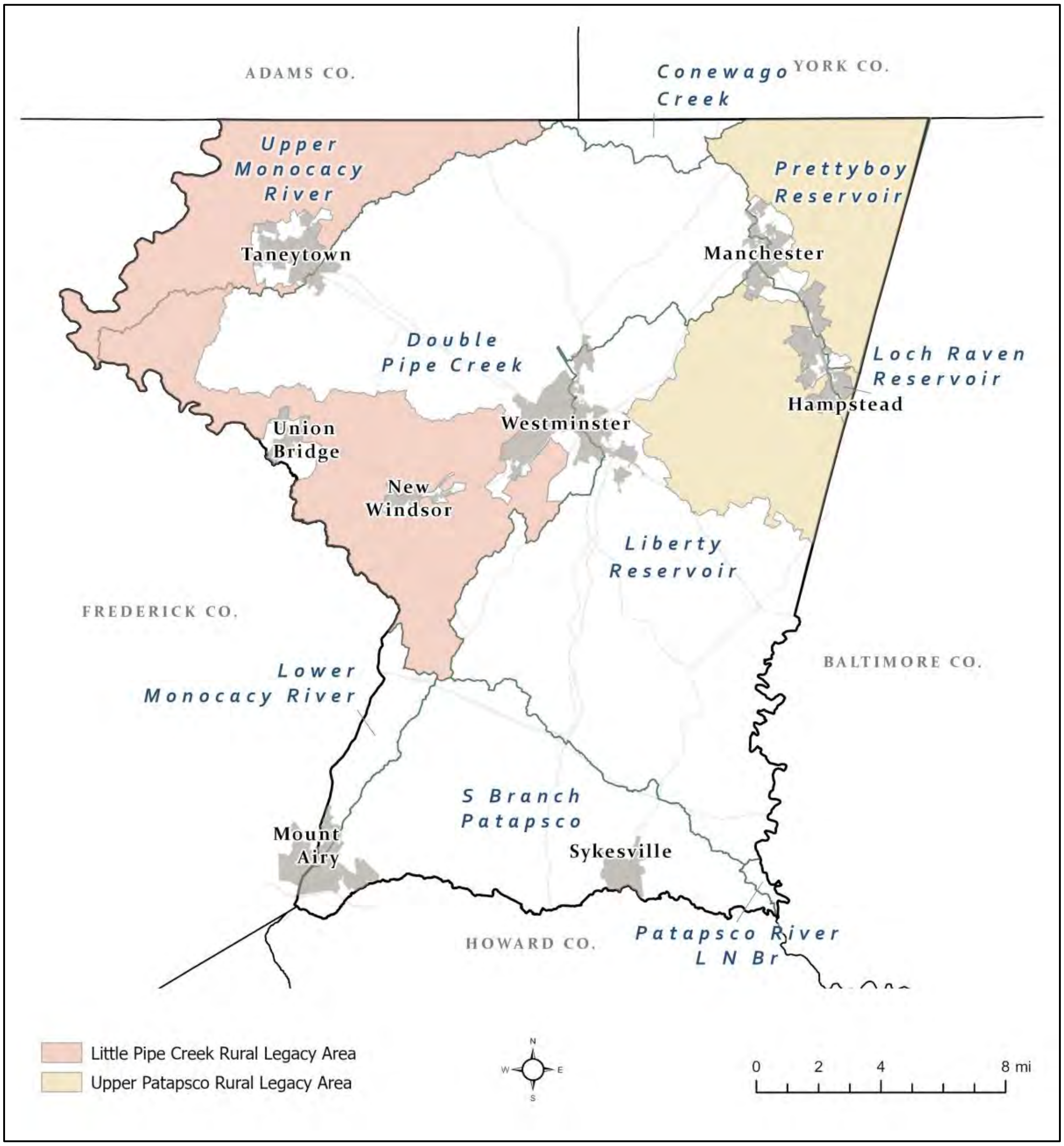


Figure 11: Carroll County Rural Legacy Areas

E. Water Resources Coordination Council

The Water Resources Coordination Council (WRCC) was formed by the Carroll County Commissioners, the eight municipalities, and the Carroll County Health Department in February of 2007 through a cooperative partnership and by formal joint resolution to discuss and address issues related to water resources. Monthly meetings, attended by representatives from the eight municipalities, the County, and the Carroll County Health Department, provide an excellent opportunity to discuss pertinent issues related to drinking water, wastewater, and stormwater management.

The WRCC led the effort to coordinate and develop the joint Water Resources Element (WRE), which was first adopted in 2010 and is currently being updated by the County and municipalities. The WRCC also serves as the local Watershed Implementation Plan (WIP) team for development and implementation of Maryland's Phase III WIP and continues to address WIP-related issues and tasks as they arise.

In FY2013 and FY2014, the WRCC collaborated to develop and sign a Memorandum of Agreement (MOA) to implement NPDES permit requirements, with specific provisions to cost-share the capital costs of meeting the municipalities' stormwater restoration requirements. The WRCC acts as the forum for setting project priorities, and the County will continue to provide administrative and operating support services for the restoration program. The MOA was subsequently updated and re-affirmed on October 7, 2021.

F. Carroll County NPDES MS4 Team

The NPDES team was formed following the issuance of the County's fourth-generation MS4 permit, which became effective on December 29, 2014. The team meets quarterly to discuss goals and progress related to MS4 permit compliance. The team consists of personnel from the Department of Planning and Land Management, including administration, water resources, stormwater, grading, engineering, and compliance.

G. Environmental Advisory Council (EAC)

The Environmental Advisory Council (EAC) is a Commissioner-appointed citizen board that provides an open forum on environmental issues and concerns. Monthly meetings are open to the public. The EAC functions at the direction of the Carroll County Board of Commissioners, works cooperatively with County environmental staff to research environmental policy issues, advises the Board of County Commissioners on environmental issues, fosters environmental education, and acts in the best interest of County residents by promoting effective environmental protection and management principles. The EAC is briefed regularly on NPDES permit specifics and implementation.

In its role to promote environmental awareness and outreach, the EAC accepts nominations for Environmental Awareness Awards every other year. Winners are recognized in a joint ceremony with the Board of County Commissioners, in the press, and on the EAC's website.

Since 2014, the EAC annually prepares a Carroll County Environmental Stewardship booklet, which is made available on the website and distributed at various other venues. The booklet describes efforts and initiatives undertaken by the County to demonstrate environmental stewardship and protection, including stormwater restoration, management projects, and progress.

H. Monocacy River Board

The Carroll County Monocacy River Board advocates for the Monocacy River, its watershed, and the varied resources contained within. The Board is charged with promoting best management practices, advocating for sustainable land uses, and encouraging the restoration and enhancement of the natural resources within the Monocacy River Watershed. This mission is accomplished through public education, volunteer opportunities, and encouraging multi-jurisdictional partnerships that will maintain and improve the river's water quality and ecological health, while respecting the property rights of landowners within the watershed.

V. Restoration Implementation

Carroll County continues to aggressively and consistently pursue measures to improve water quality and work towards meeting applicable stormwater WLAs. The County fully supports achieving pollutant load reductions through strong fiscal commitments, staff resources to implement the stormwater and water quality improvements program, and coordination between co-permittees. The County's fiscal expenditures and capital budgeting – historical, current, and planned – demonstrate the implementation of this commitment. The County completed the impervious restoration goals of both the third- and fourth-generation MS4 permits and has made significant effort toward the current fifth-generation permit restoration requirement as well. These achievements demonstrate the County's determined approach to meeting permit goals and improving water quality.

This document will be updated each year to track and summarize progress toward meeting all applicable TMDLs, as per section E.4 of the County's NPDES MS4 permit, for each 8-digit watershed with an approved SW-WLA TMDL.

The County tracks and documents pollution load reductions from all completed structural and nonstructural water quality improvement projects, enhanced stormwater management programs, and alternative stormwater control initiatives. Project information is maintained within a geodatabase to track implementation data over time, such as location, drainage area, impervious area, runoff depth treated, project type, project location, inspection, maintenance, and performance.

A. Stormwater Management Facilities

Stormwater management facilities provide controls on water quantity (e.g. downstream channel protection or flood management), water quality (e.g. nutrient and sediment removal), or a combination of both. Older stormwater facilities that were constructed to provide quantity management only can be modified to also provide water quality treatment. Other stormwater facilities that were constructed to provide only partial water quality treatment (i.e. less than 1") can also be modified to provide a higher level of treatment, thereby increasing the pollutant removal capacity of the facility. Additionally, in areas where no stormwater management currently exists, a new facility can be built to control and treat the stormwater runoff there. The retrofit process and the construction of new stormwater facilities offer significant opportunities to reduce pollutant loads in support of progress toward TMDL attainment.

In 2007, the Department of Public Works provided RMD with a list of County-owned SWM facilities that had existing maintenance issues (e.g. no available easements for accessing the property, slopes too steep to mow, trees too large to remove, etc.) After reviewing the list, RMD performed a GIS exercise to determine the drainage areas and impervious acres associated with these facilities. Field investigations were performed to determine the existing conditions of the facilities and whether or not additional drainage could be diverted into the facilities for treatment. A stormwater management facility retrofit program, which included a project schedule, was then established based on projected costs associated with the retrofits, outstanding compliance issues, and funding available in fiscal years 2008 through 2013. This process, the SCAs, and the continued identification of existing facilities as retrofit candidates have aided RMD in establishing projects for the restoration program.

B. Storm Drain Outfalls

During the County's SCAs that occurred from 2011-2016, in-stream and stormdrain outfall erosion sites were documented and rated for severity. The erosion sites were then analyzed in GIS to identify any associated existing stormwater management facilities and contributing storm drain networks. Storm drain outfalls lacking stormwater controls or where stormwater management was below current standards were identified as potential locations for stormwater BMP implementation. Providing stormwater management within these drainage networks reduces erosive flows and, consequently, allows for stabilization and natural regeneration of vegetation within the stream corridors.

C. Tree Planting and Reforestation

Riparian stream buffers and upland reforestation assist in reducing erosion, sedimentation, and overall stream temperatures. Following the completion of the first SCA in 2011 in the Prettyboy Watershed, the RMD began a tree planting program. This initiative focuses on reforesting open County, municipal, and private properties and is completely voluntary to landowners, with a goal of re-establishing forested upland and riparian corridors utilizing native tree stocks.

Plantings through this program are implemented at a stocking rate of 200-300 trees per acre, with successful plantings requiring a survival rate of 100 trees per acre. The tree planting initiative includes a three-year maintenance term, which consists of mowing, stake repair, and shelter maintenance, as well as a 75% survival requirement, guaranteed by the contractor awarded the project. Each planting is inspected annually for the first three years to ensure contractor compliance, and triennially thereafter to meet BMP inspection requirements. Additionally, private homeowners sign a Landowner Stewardship Agreement to ensure that the planting areas are maintained, protected, and able to be inspected by RMD staff.

D. Stream Restoration

Streams are dynamic systems that adjust to the tectonic, climatic, and environmental changes imposed upon them (Dollar, 2000). A stream system adapts in order to maintain a steady state, or dynamic equilibrium, between the driving mechanisms of flow and sediment transport and the resisting forces of bed and bank stability and resistance to flow (Soar et al., 2001).

Historic land use and urbanization have deteriorated the quality of streams within the Piedmont physiographic region. Booth and Henshaw (2001) documented the increase of sediment yield and channel erosion within urbanizing streams, and Langland and Cronin (2003) have shown that sediment yields in urban streams are more than an order of magnitude higher than in rural streams.

The County has implemented various stream restoration projects as a method to reduce nutrient and sediment loadings within the watersheds.

E. Streambank Regeneration

Stormwater runoff from inadequately managed impervious surfaces can cause accelerated streambank erosion in downstream channels. As pervious land is converted to impervious, the proportion of rainwater that infiltrates into the ground decreases. This, in turn, causes an increase in runoff and an increase in the volume and velocity of flow in downstream receiving channels. The increase in volume and velocity intensifies erosion and increases sediment loads within the stream corridor.

There are two approaches to reducing the destabilizing velocities in the receiving channel. The first is traditional stream restoration, which involves increasing the plan form and bank resistance. The second is upland stormwater management, which can include storing the total runoff volume and dissipating the acquired kinetic energy as turbulence in the water pool.

In the Piedmont region, where Carroll County is located, many areas that were developed prior to 1982 were constructed without stormwater management. Subsequently, developments were designed with peak flow controls that only matched existing conditions but did not return runoff characteristics to predevelopment conditions, as required now by COMAR 26.17.02.01. Meeting only the existing runoff conditions failed to address existing streambank instability, restore streams, and reduce nutrient and sediment export to the Bay.

A foremost goal of stormwater management is to maintain or return to pre-development hydrologic conditions. For over 10 years, Carroll County has been experimenting with the use of enlarged, enhanced sand filters as primary stormwater management practices. An analysis of the County's standard design determined that these practices reduce the two-year storm peak flow to below that of the equivalent forested watershed in good condition. The potential stormwater management, water quality, and stream restoration benefits resulting from this are substantial.

Because the two-year flow is thought to control bank geometry, the ability to achieve pre-development two-year hydrologic conditions using sand filters holds high potential for improving downstream bank conditions. The extent to which these effects stretch downstream is dependent on various additional factors, including soil type and land use in the unmanaged portion of the watershed below the sand filter.

In November 2002, RMD initiated fieldwork with the Center for Watershed Protection, who received funding from the Chesapeake Bay Trust's Restoration Research Program to continue evaluating the impact of hydraulic-controlling BMPs on the self-recovery of stream channel stability in urban watersheds. The original restoration research grant was awarded to Carroll County in May of 2016 to study the effect of stormwater retrofits on the hydrogeomorphology of downstream channels and associated nutrient and sediment load reductions. The grant concluded in December of 2020. During the four-year pre- and post-restoration paired watershed study, the retrofits performed as designed to reduce the magnitude, duration, and frequency of erosive flows, substantially decreasing the measured runoff curve numbers and simulating a hydrologic regime close to that of the "woods in good condition" performance standard. Therefore, it is likely that these channels will begin to stabilize, show less erosion potential, and reconnect to the floodplain over time.

Data collected during the original study indicate that the downstream channels are on a trajectory towards stabilization. Because bank stability and geomorphic response will take longer to develop than the duration of the original grant, the County has continued monitoring the study sites to provide documentation of a definitive stream channel response. During the next four-year study, a stage-discharge relationship will continue to be generated, but the primary focus will shift to the geomorphic component through annual cross-section surveys, pebble counts, and longitudinal profiles.

Although streambank regeneration is not currently an approved practice in the Wasteload Allocation Guidance Document (MDE, 2020), the guidance states that innovative practices can be used to provide jurisdictions additional options for watershed restoration activities. These include practices that are not listed in the Maryland Stormwater Design Manual (MDE, 2000) and without an assigned pollution removal efficiency from MDE or CBP, provided there is sufficient documentation and monitoring to verify pollutant removal efficiencies acceptable to MDE. The goal is that these long-term monitoring results will inform recommendations to credit upland stormwater practices as a hydrogeomorphic stream stabilization technique for sediment reductions.

F. Road Maintenance Projects

County and municipal road crews perform regular maintenance to infrastructure such as inlet cleaning, street sweeping, storm drain cleaning, and removal of impervious surfaces. Accounting for the number of inlets cleaned or the tons of debris removed provides an accurate measurement of how these particular practices reduce loadings within the watershed.

Street sweeping, using either mechanical or vacuum-assisted equipment, removes buildup of pollutants that have been deposited along the street or curb. Additionally, the removal of impervious surfaces improves water quality by improving the hydrologic conditions within the watershed.

G. Septic Systems

With the decline in water quality to the Chesapeake Bay, Senate Bill 320, Bay Restoration Fund, was signed into law in May of 2004. The purpose of the Bay Restoration Fund (BRF) was to address major contributors of nutrients to the Bay, such as effluent discharges, by creating a dedicated fund to upgrade Maryland's wastewater treatment plants with enhanced nutrient removal (ENR) technology to improve wastewater effluent quality. A portion of the BRF also collects fees from septic system users that will be utilized to upgrade on-site disposal systems (OSDS) to best available technology (BAT), as the drainage from failed septic systems may make its way through the drain field and eventually into local waters (Clary, et al. 2008). New septic systems, repairs, and replacements are tracked through the County Health Department.

Nutrient loads from failing septic systems are not part of the MS4 load reduction requirements for the County or Towns. However, upgrading septic systems or connecting houses to a sanitary sewer system will help the overall achievability of the TMDLs. BAT has been proven to be effective at nitrogen removal, but has not been shown to reduce Phosphorus. Any reductions to bacteria loading are also unknown at this time.

VI. Restoration Progress: FY2025

The restoration projects listed in this plan and any future progress towards meeting the stormwater WLAs will be documented through a combination of modeling and BMP reductions, calculated based on the 2020 MDE guidance document, *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated*, and all future guidance revisions. The current 2020 guidance document was an update of the August 2014 version, which was originally released as a draft document in June 2011.

A. TMDL Compliance

To address remaining TMDL requirements, the County will utilize a mix of techniques and practice types for locations identified in future Community Investment Program (CIP) budgets to progress towards fully attaining all approved SW-WLA TMDLs. It is not feasible, nor fiscally possible, to identify or specify the exact projects, locations, or costs beyond the current approved CIP.

B. Watershed Modeling

During the initial development of the County's SW-WLA TMDL implementation plans, which were originally submitted in June 2016 and ultimately approved following two rounds of reviews by MDE in May of 2020, the County, for modeling purposes, utilized Mapshed to document progress towards meeting the stormwater WLA. The MapShed tool (version 1.3.0; MapShed, 2015) was developed by Penn State University, and allowed for specific local data (streams, topology, and land use) to be used as the basis for TN, TP, and TSS reductions.

This modeling approach was approved by MDE as MapShed is a customized GIS interface that is used to create input data for the enhanced version of the Generalized Watershed Loading Function (GWLF-E) watershed model. The MapShed tool uses hydrology, land cover, soils, topography, weather, pollutant discharges, and other critical environmental data to develop an input file for the GWLF-E model. The basic process when using MapShed is: 1) select an area of interest, 2) create GWLF-E model input files, 3) run the GWLF-E simulation model, and 4) view the output. The MapShed geospatial evaluator and the GWLF-E models have been used for TMDL studies in Pennsylvania (Betz & Evans, 2015), New York (Cadmus, 2009), and New England (Penn State, 2016).

During the 2024 reporting year, the County began utilizing the TMDL Implementation Progress and Planning (TIPP) model, which is an Excel-based tool that was developed by MDE in 2022 to estimate load reductions associated with various restoration practices within the Cheseapeake Bay watershed. Loadings are based on the Chesapeake Bay Phase 6 CAST-2017d Watershed Model No Action (No BMP) scenario loading rates, aggregated at the 8-digit watershed (HUC-8) and Chesapeake Bay segment scale by county.

Inputs include baseline land use information, watershed characteristics, TMDL reduction requirements, and restoration activities. Land use comes from MDE's Phase 6 reclassified land use data for Carroll County; the same land use data is used for all watersheds and all baseline years. These activities can include both stormwater facilities and alternative reduction activities, including stream restoration, tree plantings, street sweeping, and inlet cleaning.

The outputs of the model include a summary of edge of stream (EOS) and edge of tide (EOT) nutrient and sediment loads for an individual watershed TMDL. There is also a summary of pollutant reduction progress at various points in time (e.g. baseline, the beginning of the current permit, current progress). Future planned restoration projects also generate an estimate of reductions into the future.

1. Liberty Reservoir Watershed Progress

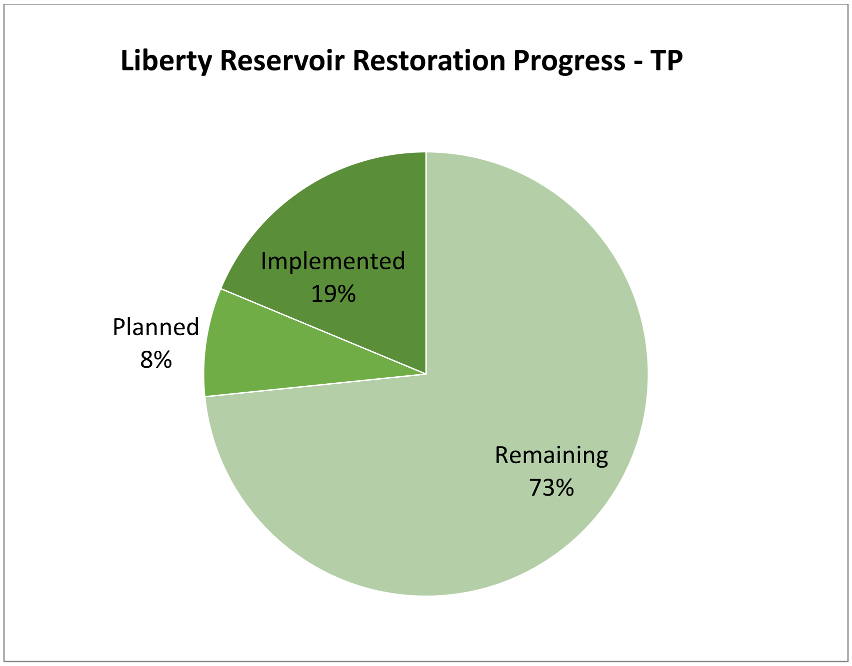
As described in Section III, phosphorus, sediment, and bacteria loads within the Liberty Reservoir Watershed must be reduced in order to meet water quality standards. The local TMDL includes an urban TP load reduction of 50% and TSS load reduction of 38% from the 2009 baseline year.

Load reductions for phosphorus and sediment associated with completed projects since the TMDL baseline year, as well as future projects planned through the County's current CIP, are shown in **Table 20**. The total percent TMDL reductions listed in the following tables include all completed and currently planned CIP projects.

Table 20: Total Phosphorus and Total Suspended Solids Load Reductions in the Liberty Reservoir Watershed

Total Phosphorus Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
24,828	50%	12,414	2,324	982	13.31%
Total Suspended Solids Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
86,400,137	38%	32,832,052	7,351,872	3,977,885	13.11%

The current progress of implemented and CIP-planned projects for the Liberty Reservoir Watershed since the TMDL baseline year is shown below in **Figures 12** and **13**.



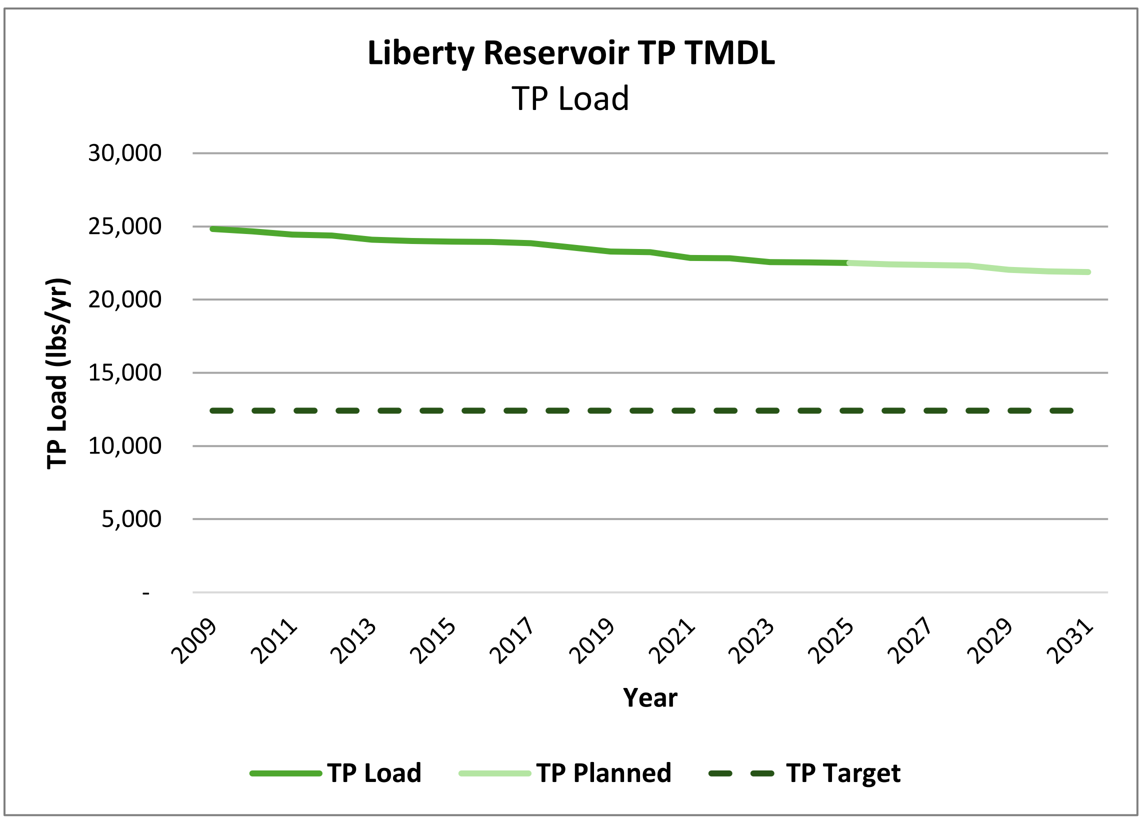
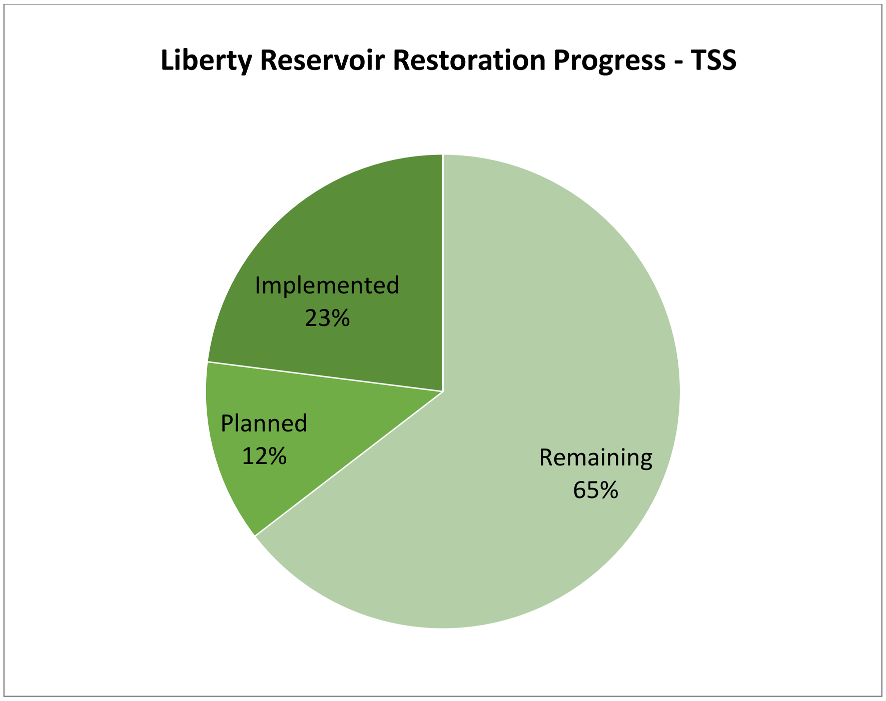


Figure 12: Liberty Watershed Restoration Progress for Total Phosphorus



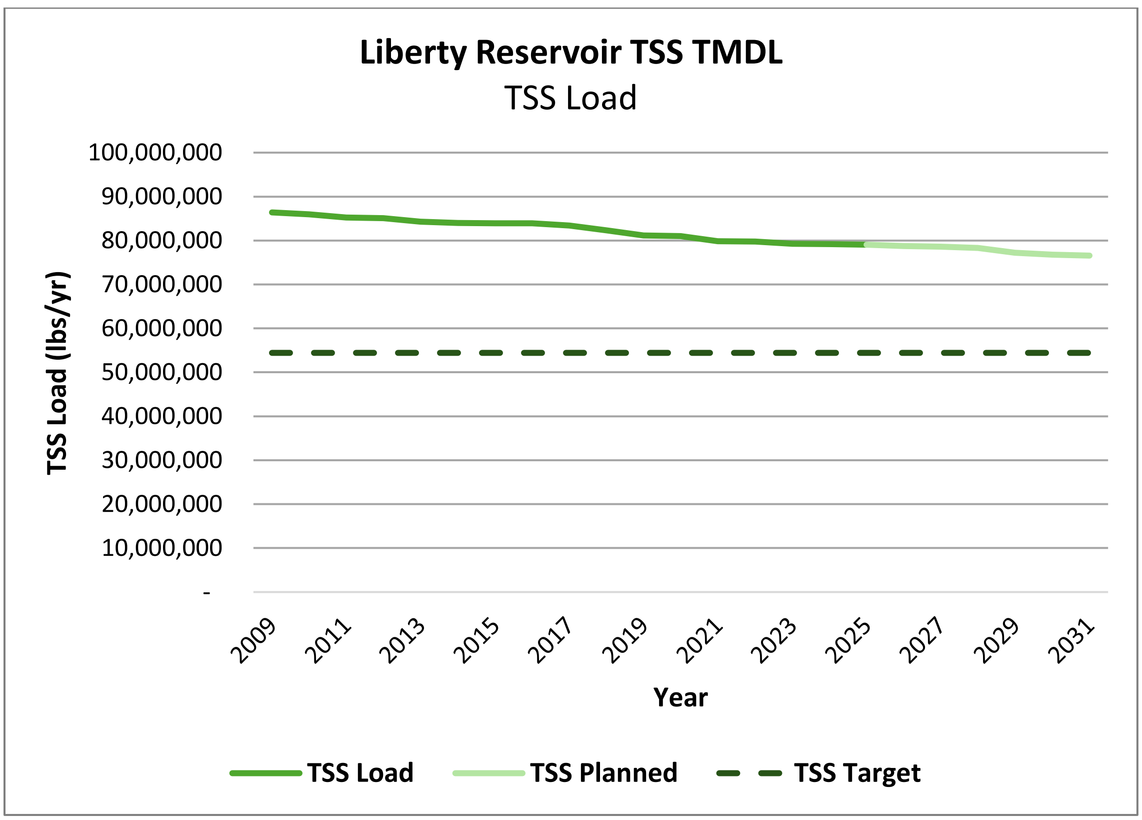


Figure 13: Liberty Watershed Restoration Progress for Total Suspended Solids

2. Prettyboy Reservoir Watershed Progress

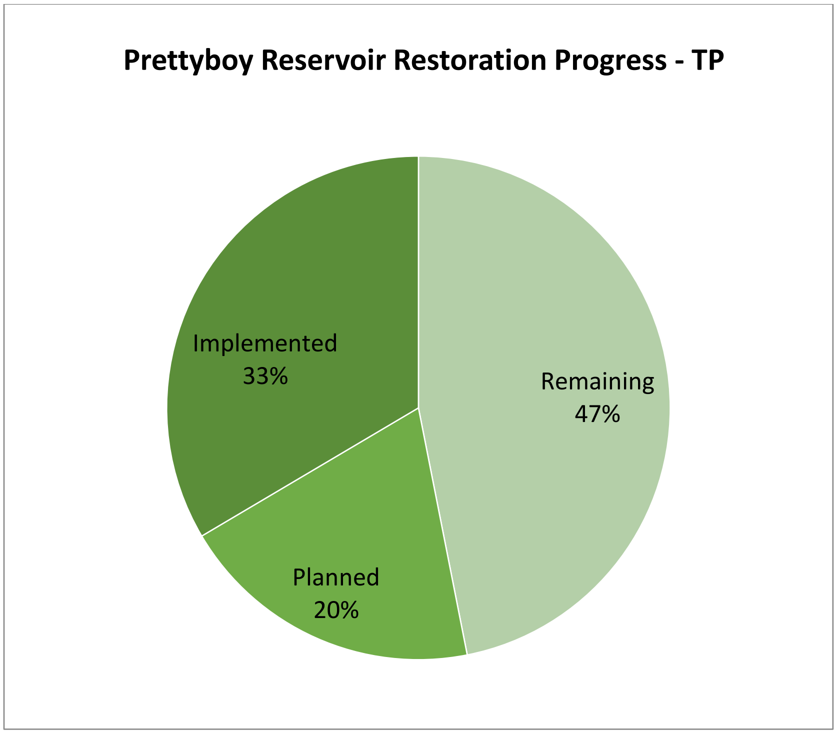
As described in Section III, phosphorus and bacteria loads within the Prettyboy Reservoir Watershed must be reduced in order to meet water quality standards. The local TMDL for TP includes an urban load reduction of 15% from the 1995 baseline year.

Load reductions for TP associated with completed projects since the TMDL baseline year, as well as projects planned through the County's current CIP, are shown in **Table 21**. The total percent TMDL reduction listed in the following table includes all completed and currently planned CIP projects.

Table 21: Total Phosphorus Load Reduction in the Prettyboy Reservoir Watershed

Modeled Baseline Load (lbs/yr)	% Required Reduction from TMDL	Required Load Reduction based on Modeled Baseline (lbs/yr)	Reduction from Current BMPs (lbs/yr)	Reduction from Restoration Plan Strategies (lbs/yr)	Total % Reduction (Achieved + Planned)
5739	15%	861	288	169	7.97%

The current progress of implemented and CIP-planned projects for the Prettyboy Reservoir Watershed since the TMDL baseline year is shown below in **Figure 14**.



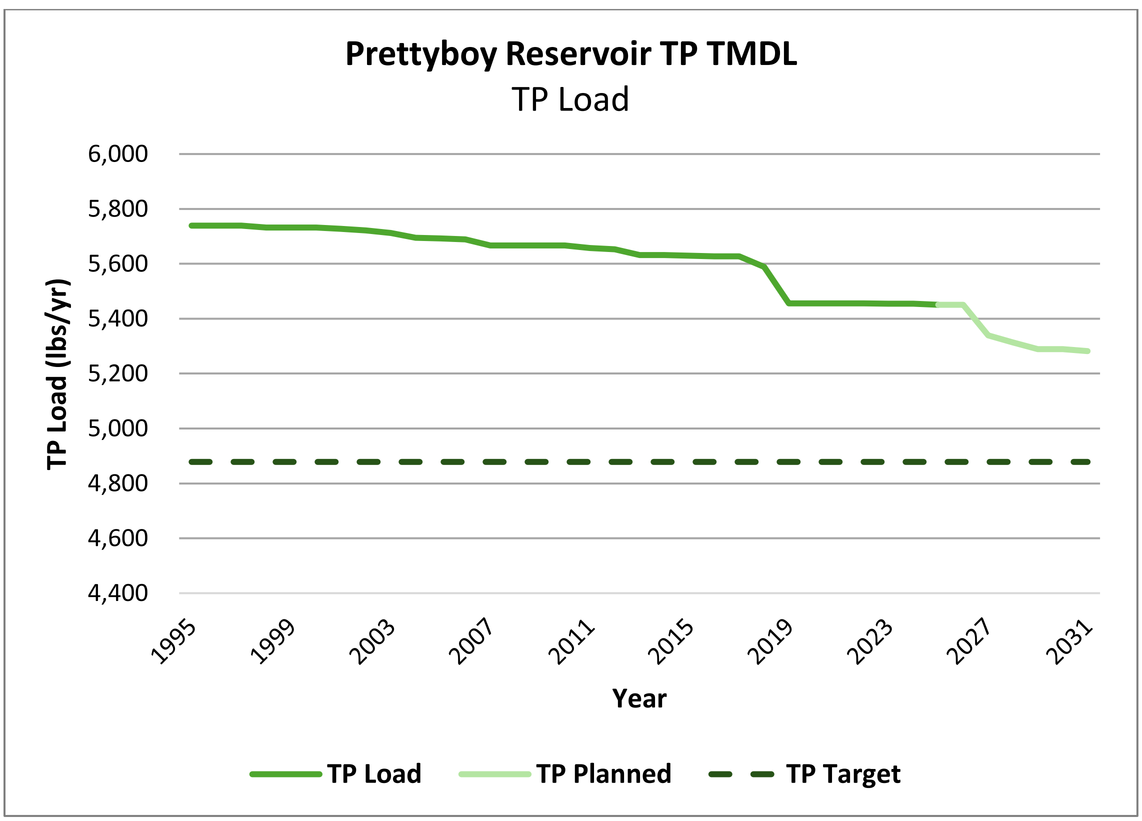


Figure 14: Prettyboy Reservoir Restoration Progress for TP

3. Loch Raven Reservoir Watershed

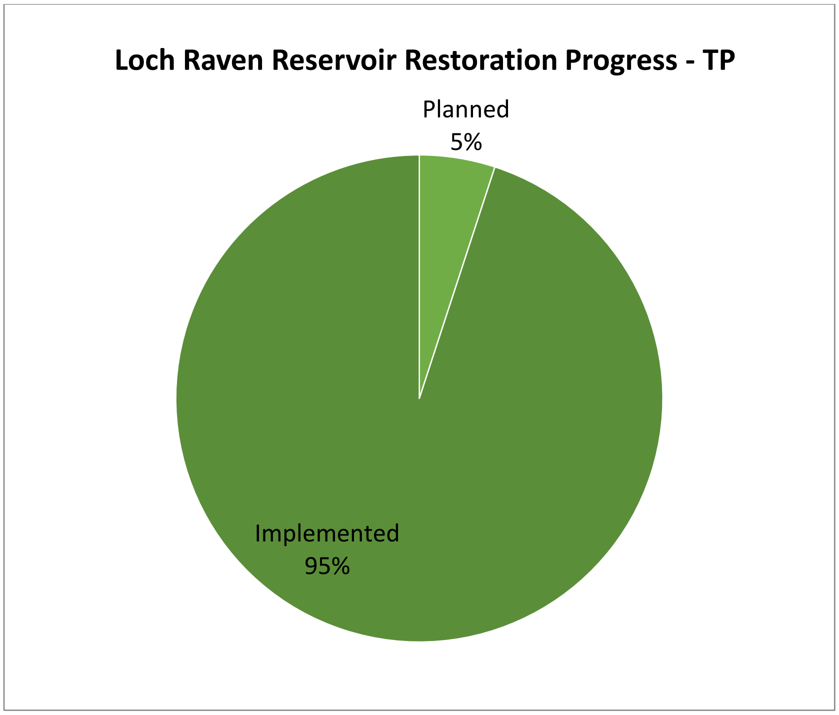
As described in Section III, phosphorus and bacteria loads within the Loch Raven Reservoir Watershed must be reduced in order to meet water quality standards. The local TMDL includes an urban TP load reduction of 15% from the 1995 baseline year.

Load reductions for TP associated with completed projects since the TMDL baseline year, as well as projects planned through the County's current CIP are shown in **Table 22**. The total percent TMDL reduction listed in the following table includes all completed and currently planned CIP projects.

Table 22: Total Phosphorus Load Reduction in the Loch Raven Reservoir Watershed

Modeled Baseline Load (lbs/yr)	% Required Reduction from TMDL	Required Load Reduction based on Modeled Baseline (lbs/yr)	Reduction from Current BMPs (lbs/yr)	Reduction from Restoration Plan Strategies (lbs/yr)	Total % Reduction (Achieved + Planned)
509	15%	76	72.63	253	63.86%

The current progress of implemented and CIP planned projects for the Loch Raven Reservoir Watershed since the TMDL baseline year is shown below in **Figure 15**.



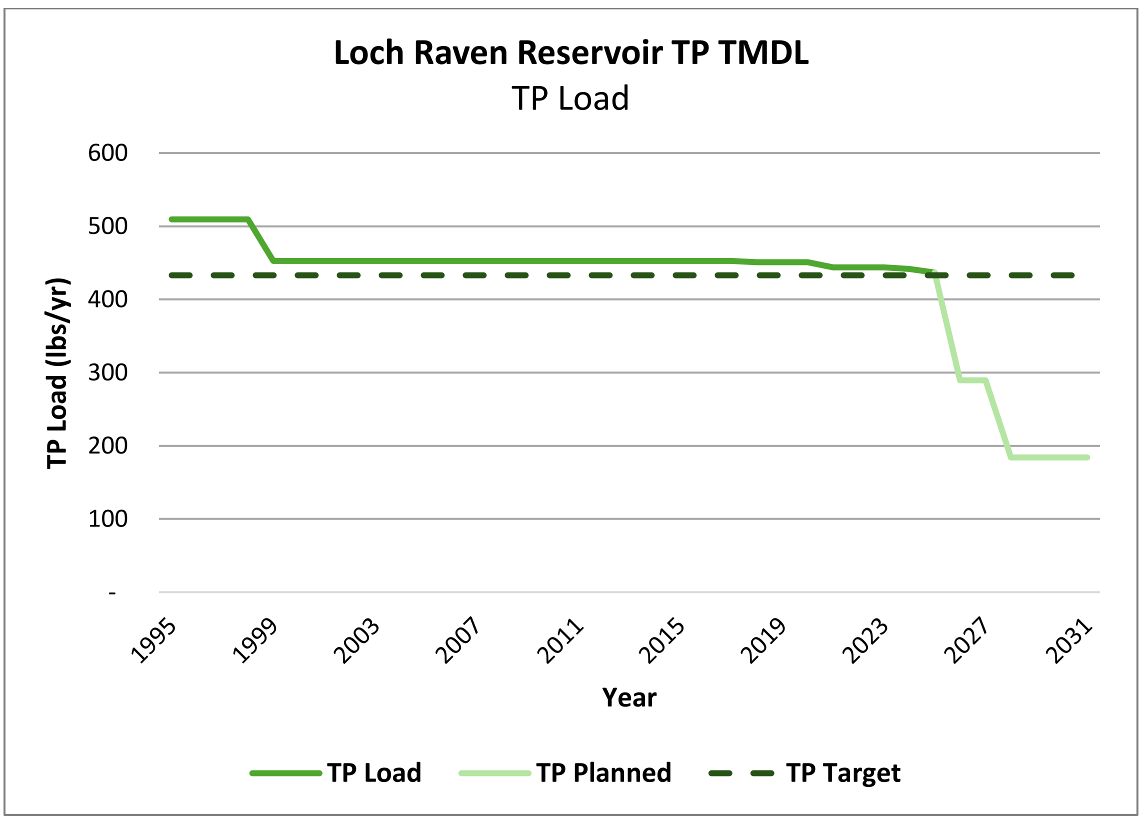


Figure 15: Loch Raven Reservoir Restoration Progress for TP

4. Upper Monocacy River Watershed

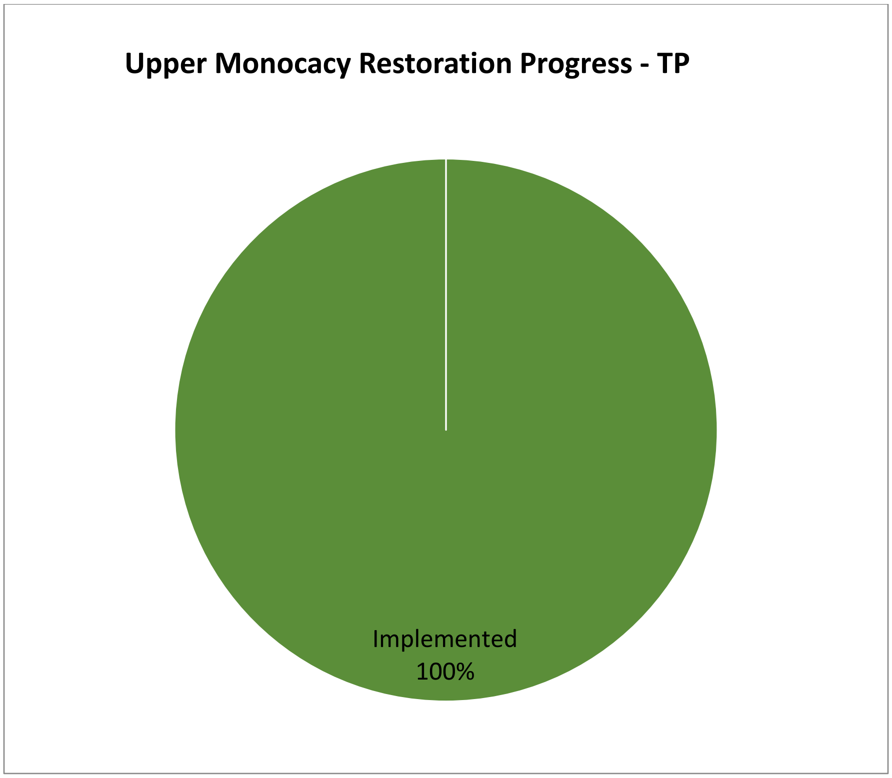
As described in Section III, phosphorus, sediment, and bacteria loads within the Upper Monocacy River Watershed must be reduced in order to meet water quality standards. The local TMDL includes an urban TP load reduction of 5% from the 2009 baseline year and a TSS load reduction of 44% from the 2000 baseline year.

Load reductions for TP and TSS associated with completed projects since the TMDL baseline year, as well as projects planned through the County's current CIP within the Upper Monocacy River Watershed are shown in **Table 23**. The total percent TMDL reduction listed in the following table includes all completed and currently planned CIP projects.

Table 23: Total Phosphorus and Total Suspended Solids Load Reductions in the Upper Monocacy Watershed

Total Phosphorus Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction Based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
5,267	5%	263	524	35	10.61%
Total Suspended Solids Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction Based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
10,329,691	43.50%	4,493,415	1,079,891	135,779	11.77%

The current progress of implemented and CIP-planned projects for the Upper Monocacy River Watershed since the TMDL baseline year is shown below in **Figures 16** and **17**.



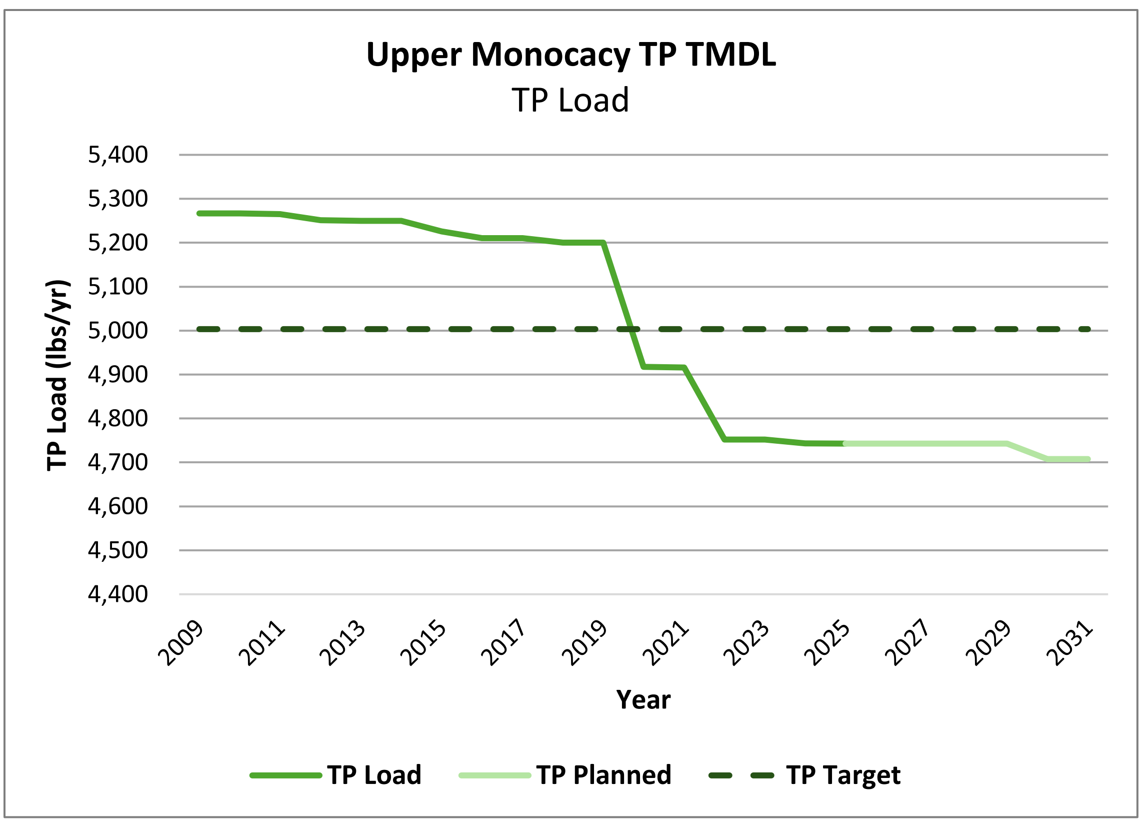
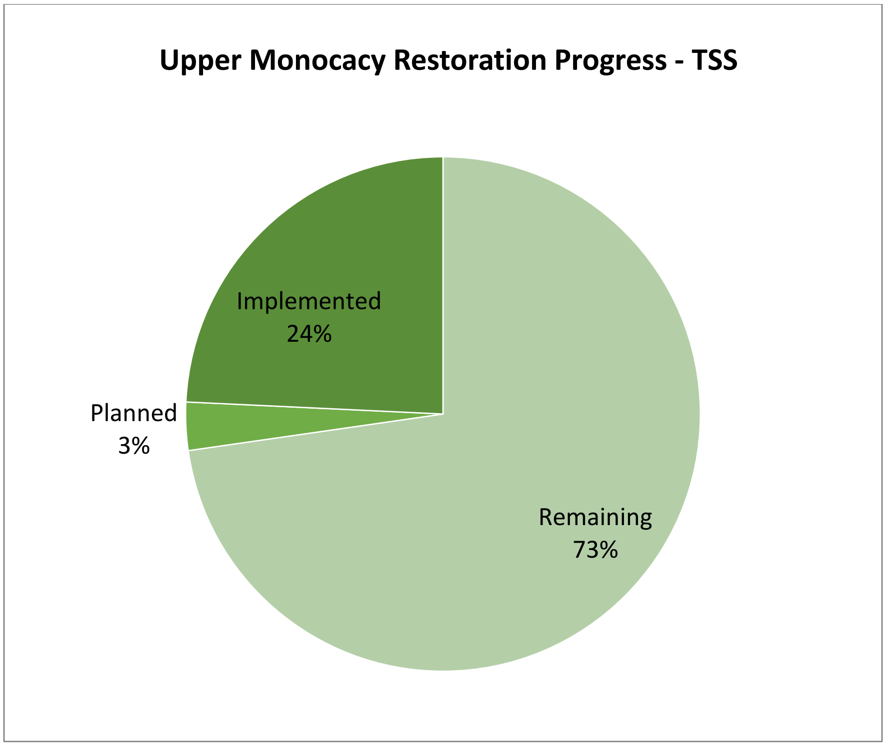


Figure 16: Upper Monocacy River Restoration Progress for TP



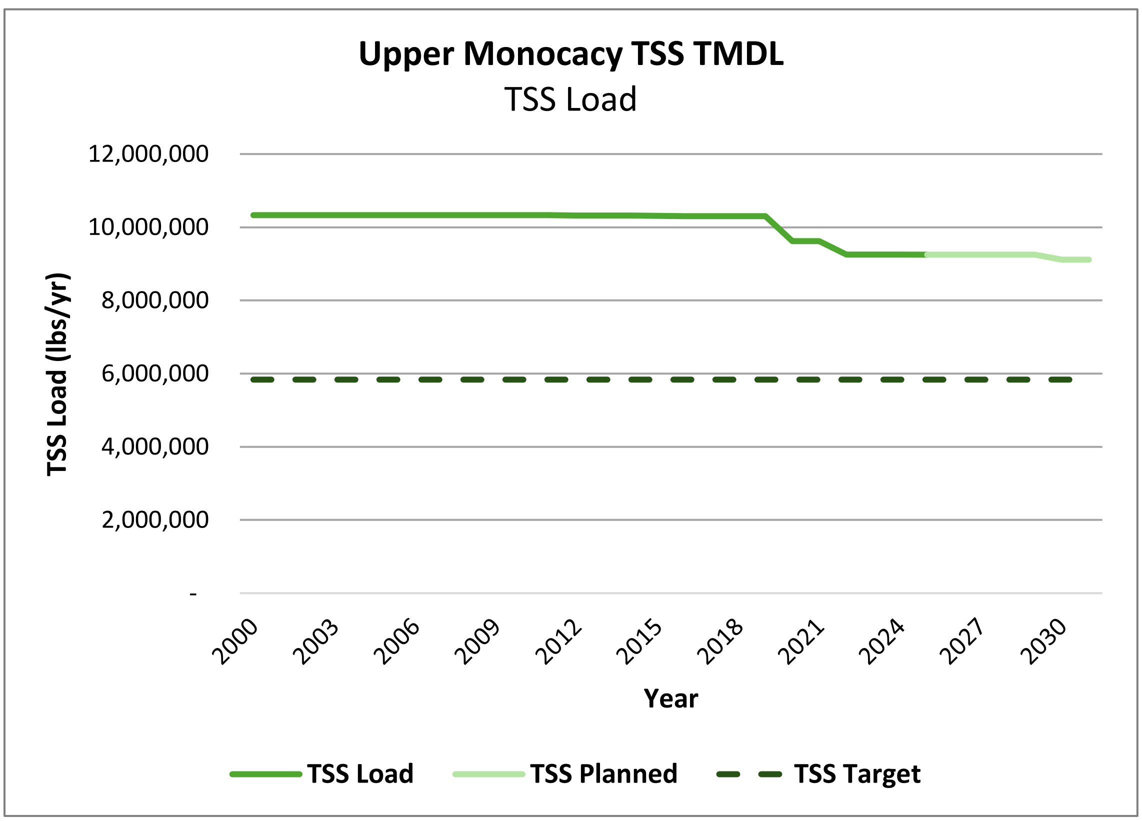


Figure 17: Upper Monocacy River Restoration Progress for TSS

5. Lower Monocacy River Watershed

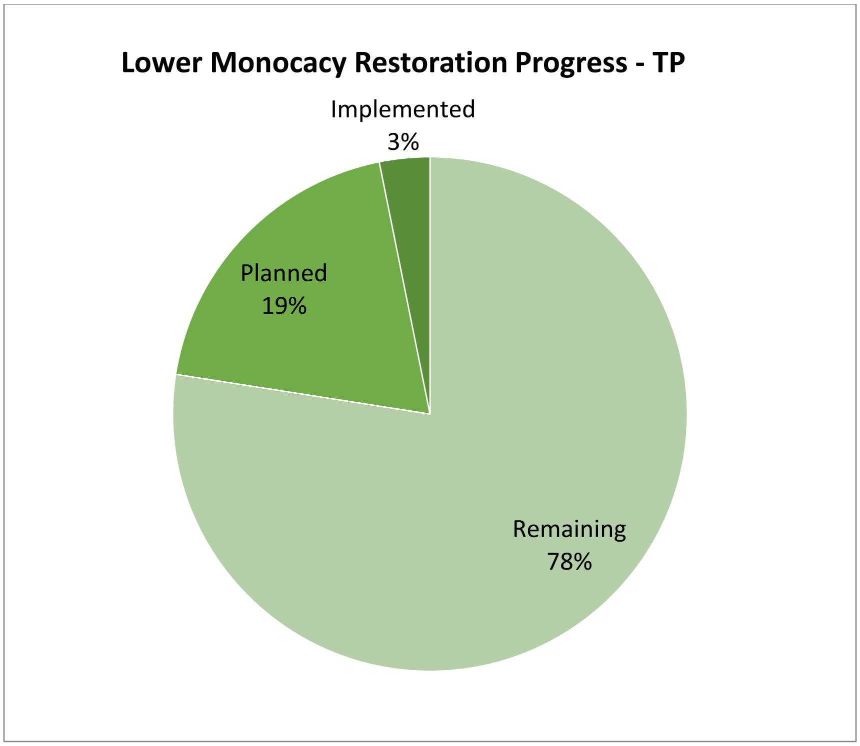
As described in Section III, phosphorus and bacteria loads within the Lower Monocacy River Watershed must be reduced in order to meet water quality standards. The local TMDL includes an urban TP load reduction of 30% from the 2009 baseline year.

Load reductions for TP associated with completed projects since the TMDL baseline year, as well as projects planned through the County's current CIP within the Lower Monocacy River Watershed are shown in **Table 24**. The total percent TMDL reduction achieved listed in the following table includes all completed and currently planned CIP projects.

Table 24: Total Phosphorus Load Reduction in the Lower Monocacy Watershed

Modeled Baseline Load (lbs/yr)	% Required Reduction from TMDL	Required Load Reduction based on Modeled Baseline (lbs/yr)	Reduction from Current BMPs (lbs/yr)	Reduction from Restoration Plan Strategies (lbs/yr)	Total % Reduction (Achieved + Planned)
1,069	30%	321	10	62	6.76%

The current progress of implemented and CIP planned projects for the Lower Monocacy River Watershed since the TMDL baseline year is shown below in **Figure 18**.



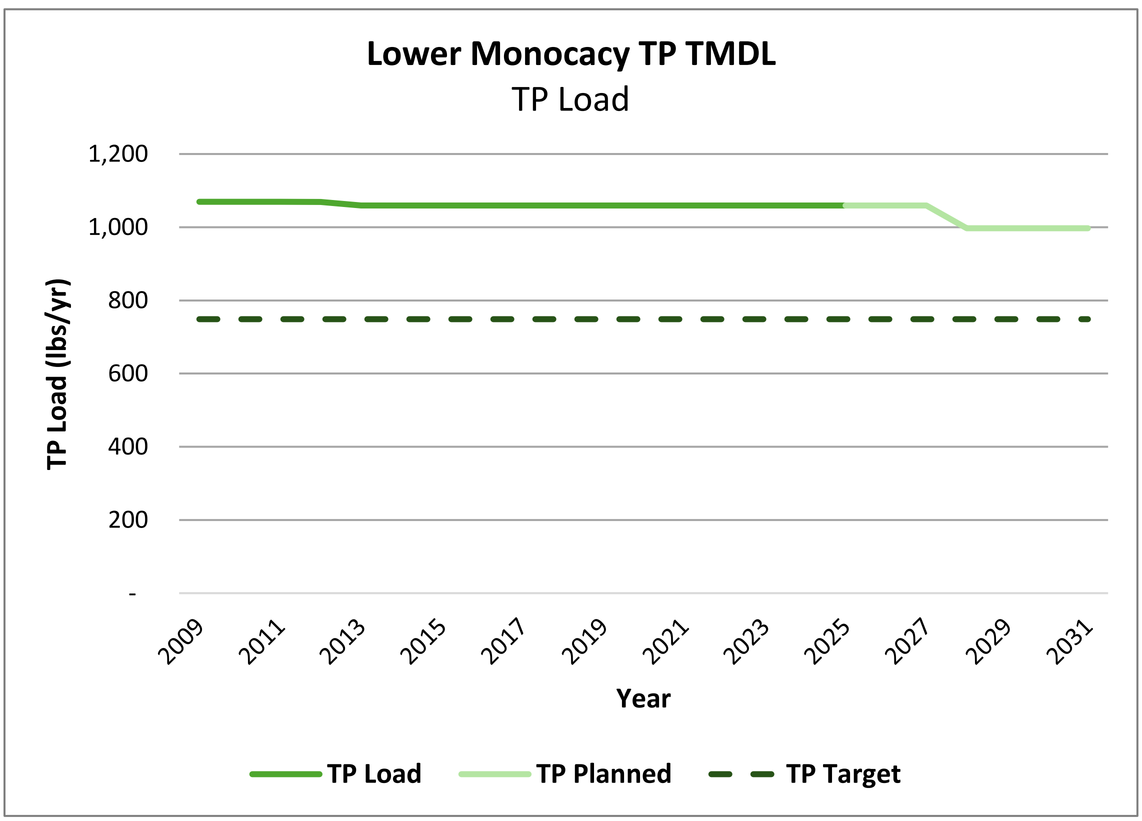


Figure 18: Lower Monocacy River Restoration Progress for TP

6. Double Pipe Creek Watershed

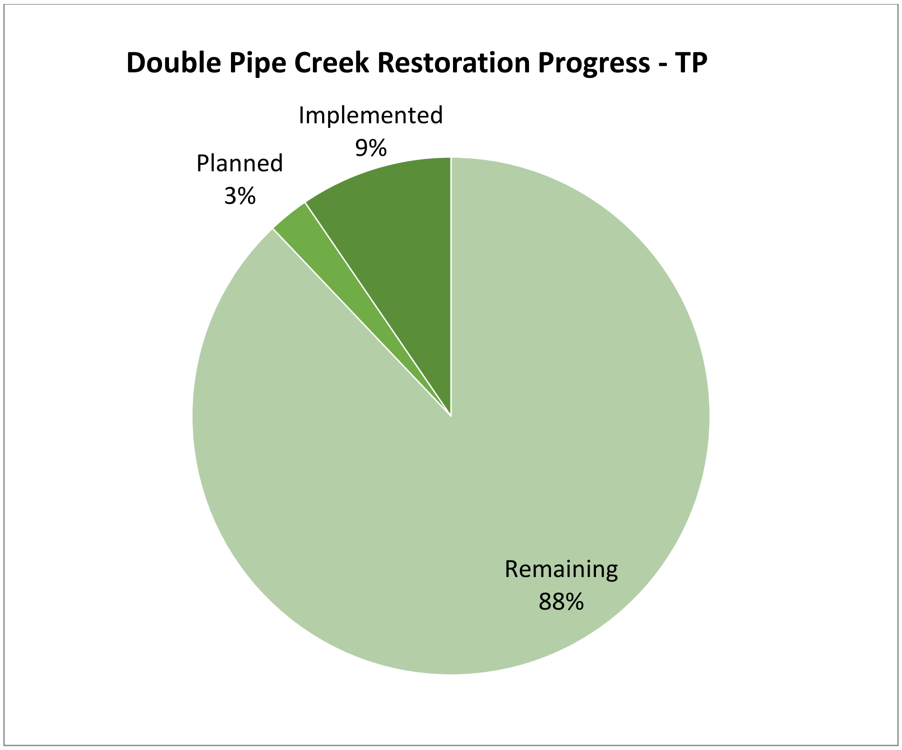
As described in Section III, phosphorus, sediment, and bacteria loads within the Double Pipe Creek Watershed must be reduced in order to meet water quality standards. The local TMDL includes an urban TP load reduction of 73% from the 2009 baseline year and a TSS load reduction of 34% from the 2000 baseline year.

Load reductions for TP and TSS associated with completed projects since the TMDL baseline year, as well as projects planned through the County's current CIP within the Double Pipe Creek Watershed are shown in **Table 25**. The total percent TMDL reductions listed in the following table include all completed and currently planned CIP projects.

Table 25: Total Phosphorus and Total Suspended Solids Load Reductions in the Double Pipe Creek Watershed

Total Phosphorus Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
20,193	72.5%	14,640	1,374	405	8.81%
Total Suspended Solids Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
48,380,761	33.80%	16,352,697	3,599,821	1,100,247	9.71%

The current progress of implemented and CIP-planned projects for the Double Pipe Creek Watershed since the TMDL baseline year is shown below in **Figures 19** and **20**.



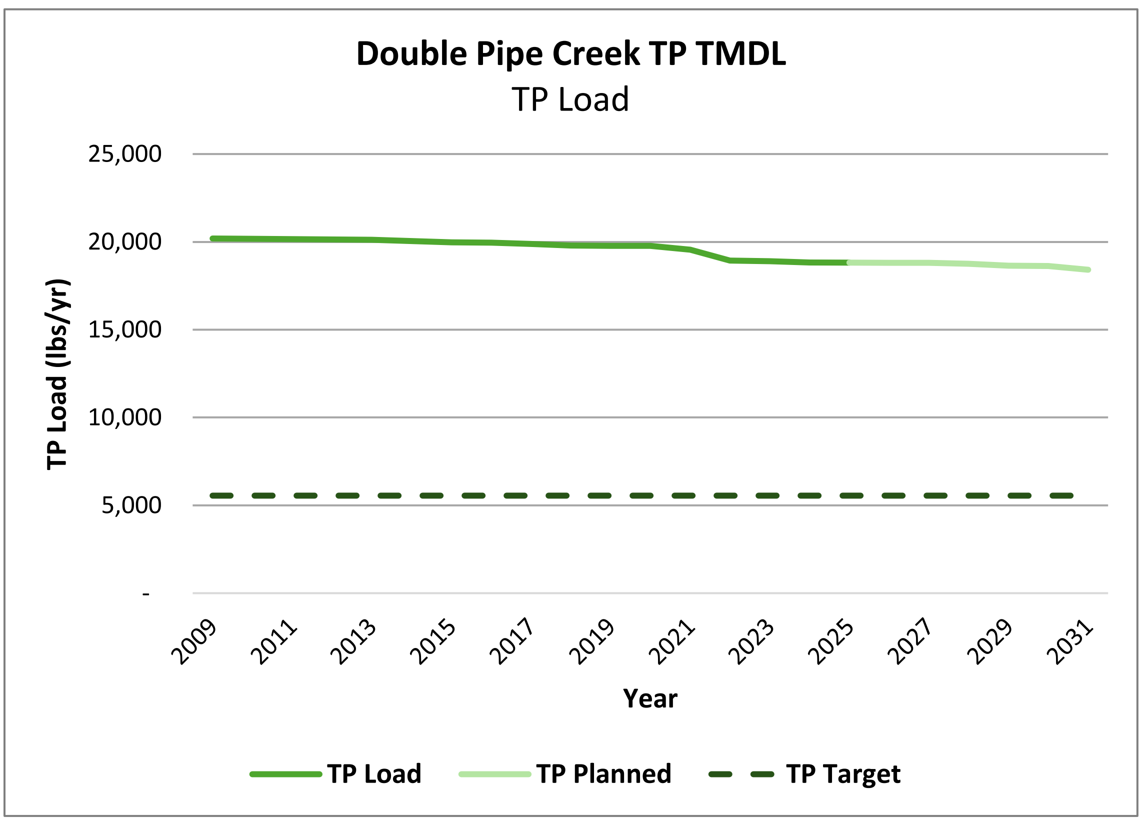
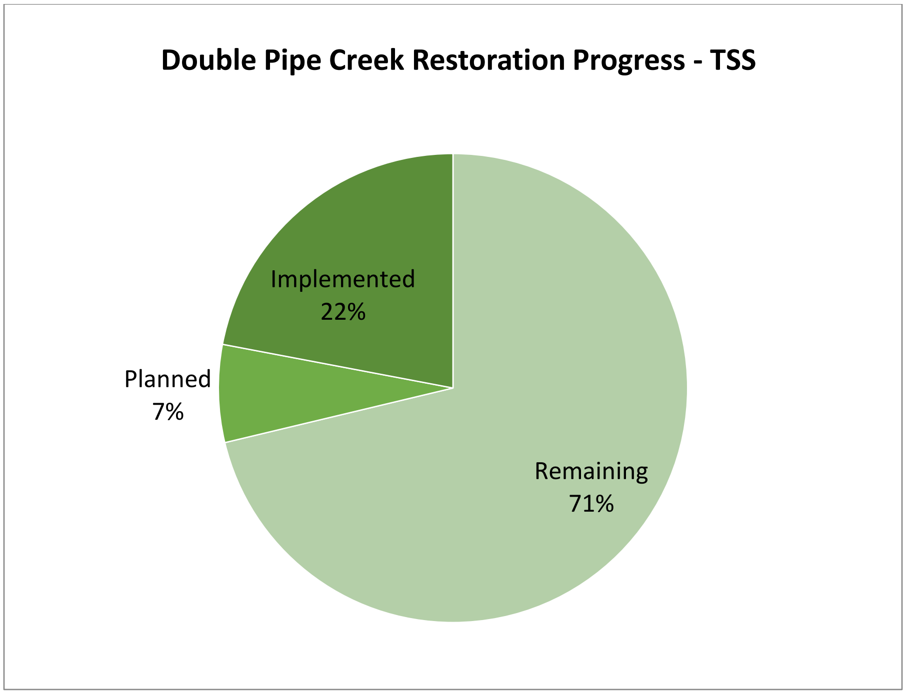


Figure 19: Double Pipe Creek Restoration Progress for TP



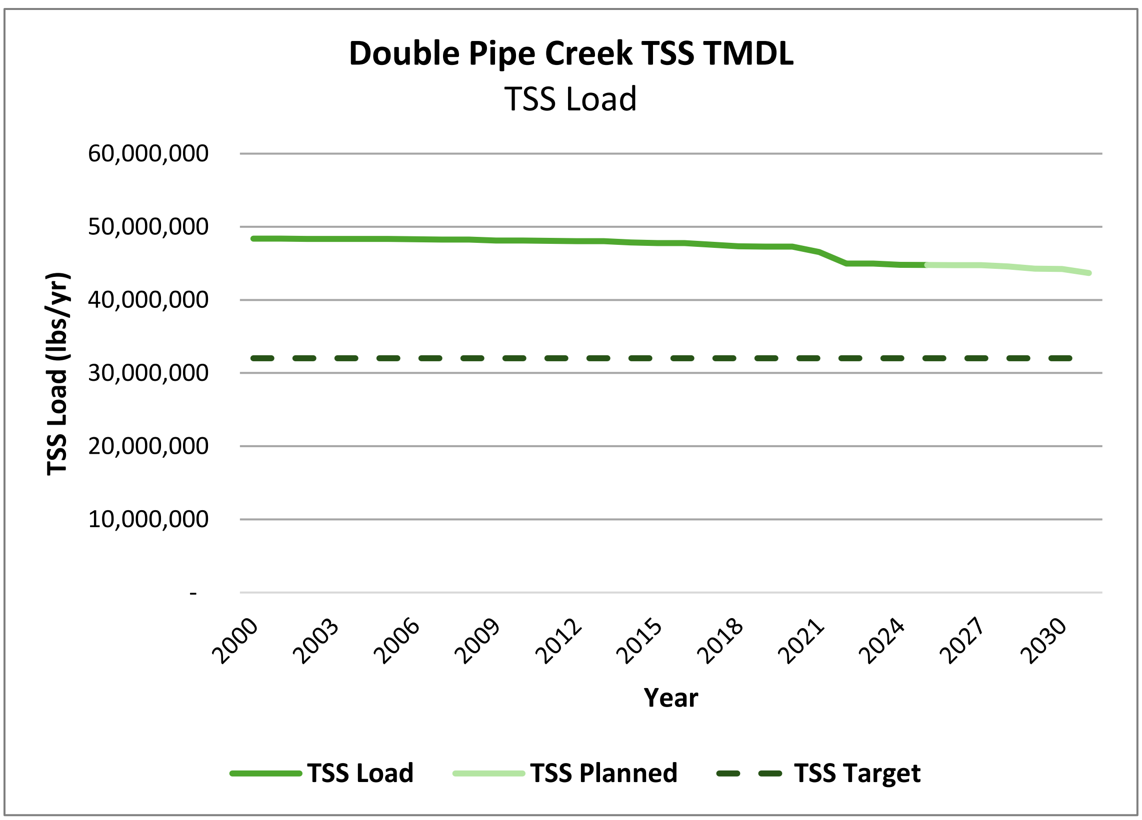


Figure 20: Double Pipe Creek Restoration Progress for TSS

7. Baltimore Harbor (South Branch Patapsco River) Watershed

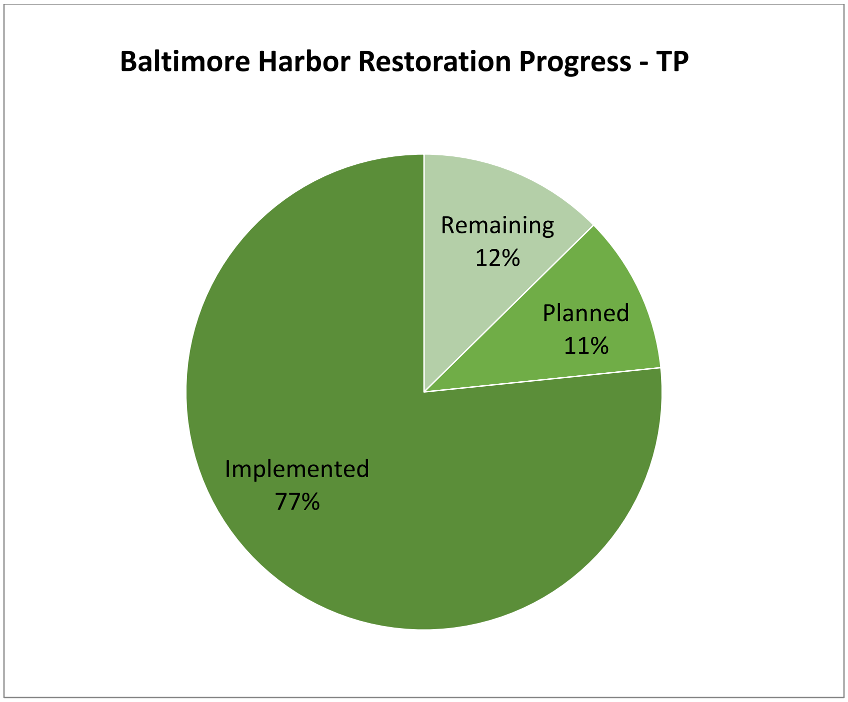
As described in Section III, phosphorus and nitrogen loads within the Baltimore Harbor (South Branch Patapsco River) Watershed must be reduced in order to meet water quality standards. The local TMDL includes urban TP and urban TN load reductions of 15% from the 1995 baseline year.

Load reductions for TP and TN associated with completed projects since the TMDL baseline year, as well as projects planned through the County's current CIP, within the South Branch Patapsco Watershed are shown in **Table 26**. The total percent TMDL reductions listed in the following table include all completed and currently planned CIP projects.

Table 26: Total Phosphorus and Total Nitrogen Load Reductions in the Baltimore Harbor (South Branch Patapsco River) Watershed

Total Phosphorus Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
17,814	15%	2,672	2,045	287	13.11%
Total Nitrogen Load Reduction					
Modeled Baseline Load (lbs/yr)	**% Required Reduction from TMDL**	**Required Load Reduction based on Modeled Baseline (lbs/yr)**	**Reduction from Current BMPs (lbs/yr)**	**Reduction from Planned Strategies (lbs/yr)**	**Total % Reduction (Achieved + Planned)**
154,556	15%	23183	13,899	2,631	10.71%

The current progress of implemented and CIP-planned projects for the Baltimore Harbor (South Branch Patapsco) Watershed since the TMDL baseline year is shown below in **Figures 21** and **22**.



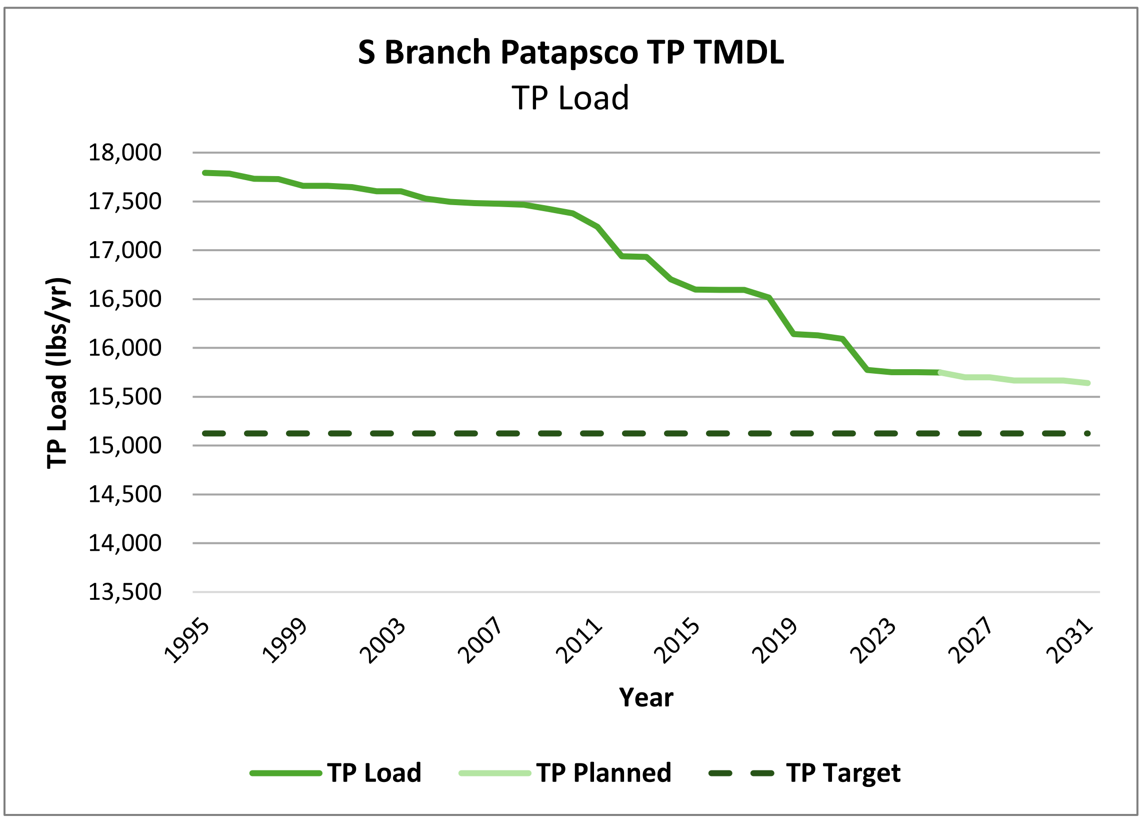
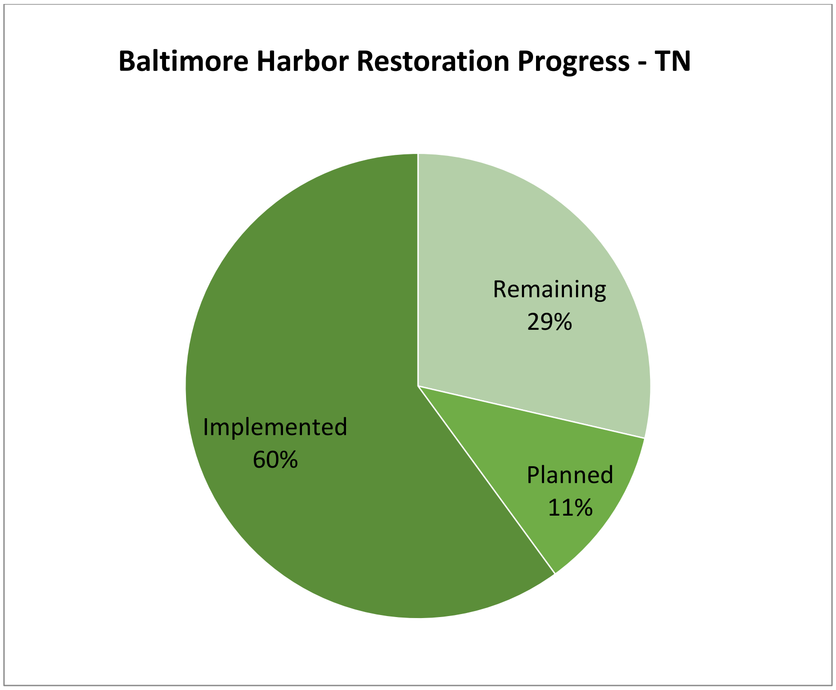


Figure 21: Baltimore Harbor (South Branch Patapsco River) Restoration Progress for Total Phosphorus



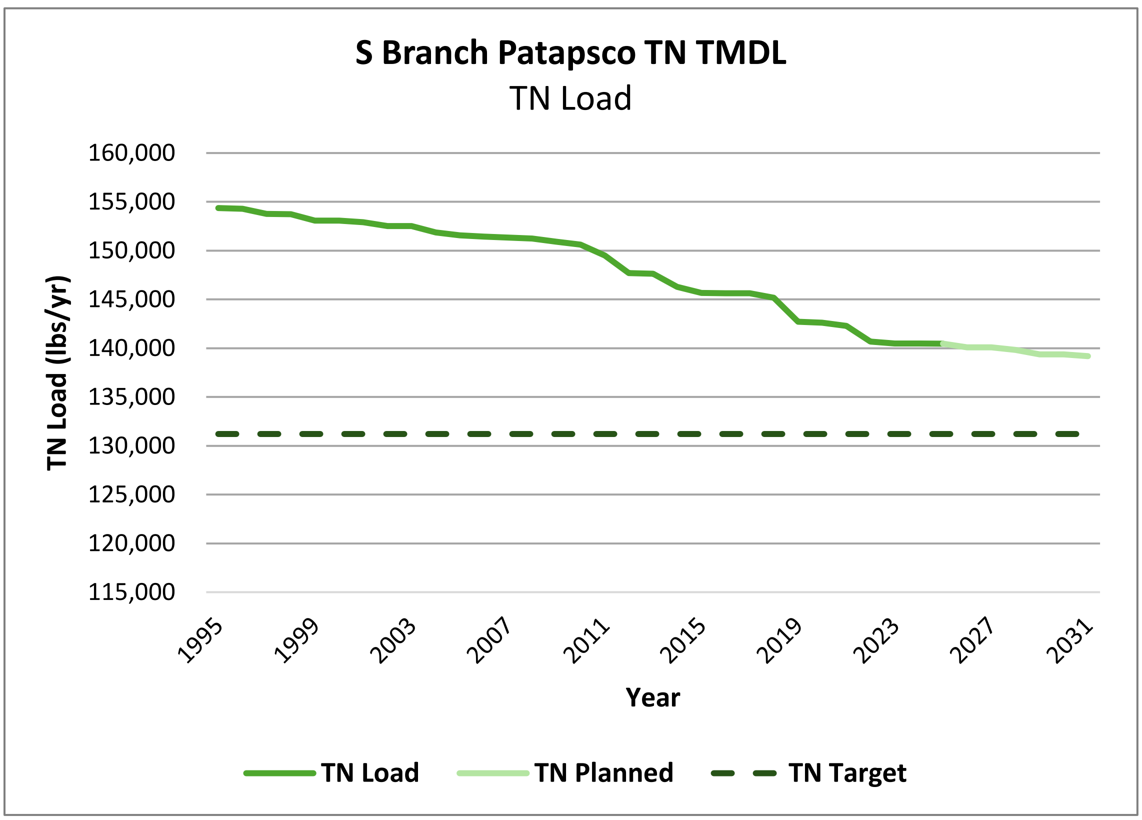


Figure 22: Baltimore Harbor (South Branch Patapsco River) Restoration Progress for Total Nitrogen

VII. Chesapeake Bay Restoration

This section describes progress towards achieving the County's TMDL requirements associated with the stormwater WLA for the Chesapeake Bay watershed. BMPs and restoration projects that have either been completed or proposed to address local TMDLs will ultimately reduce loadings to the Chesapeake Bay. The exception to this is the Liberty Reservoir Watershed, which has a delivered load factor of zero due to the reservoir's impoundment; reductions in this watershed have no effect on reducing loadings for the Chesapeake Bay TMDL.

A. Purpose and Scope

The purpose of the Chesapeake Bay TMDL is to establish specific pollutant loadings for all 92 river segments within the Bay watershed in order to meet the individual designated uses within the Chesapeake Bay. The Chesapeake Bay TMDL is the largest in the country, covering 64,000 square miles across seven jurisdictions: Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia.

Each designated use has established water quality standards or criteria for supporting those uses, which is established by individual states within the Chesapeake Bay watershed. The requirement for states to establish water quality criteria to meet specific designated uses came from section 303(c) of the 1972 Clean Water Act (CWA) that requires all waters of the U.S. to be "fishable" or "swimmable".

B. Background

Despite restoration efforts over the last several decades to restore the Chesapeake Bay and its tributaries, the EPA, in December of 2010, established the Chesapeake Bay TMDL. The Chesapeake Bay TMDL identified the reductions necessary, across all jurisdictions within the watershed, and set limits on nutrient loadings in order to meet the designated uses within the Bay and its tributaries.

The pollutants of concern for the Bay TMDL are sediment, nitrogen, and phosphorus. Excessive nitrogen and phosphorus in the Chesapeake Bay and its tidal tributaries promote a number of undesirable water quality conditions, such as excessive algal growth, low dissolved oxygen (DO), and reduced water clarity (Smith et al. 1992; Kemp et al. 2005).

The TMDL sets Bay watershed limits of 185.9 million pounds of nitrogen, 12.5 million pounds of phosphorus and 6.45 billion pounds of sediment per year. This reflects a 25% reduction in nitrogen, a 24% reduction in phosphorus, and a 20% reduction in sediment.

1. Water Quality Standards and Designated Uses

EPA's water quality standards (WQS) regulation defines designated uses as the "uses specified in WQS for each waterbody or segment, whether or not they are being attained" (40 CFR131.3). The 1987 Chesapeake Bay Agreement included a commitment to "develop and adopt guidelines for the protection of water quality and habitat conditions necessary to support the living resources found in the Chesapeake Bay system, and to use these guidelines in the implementation of water quality and habitat quality programs" (CEC 1987). Chesapeake Bay designated uses, protection, habitats, and locations are listed in **Table 27**, and the tidal water designated use zones are shown in **Figure 23**.

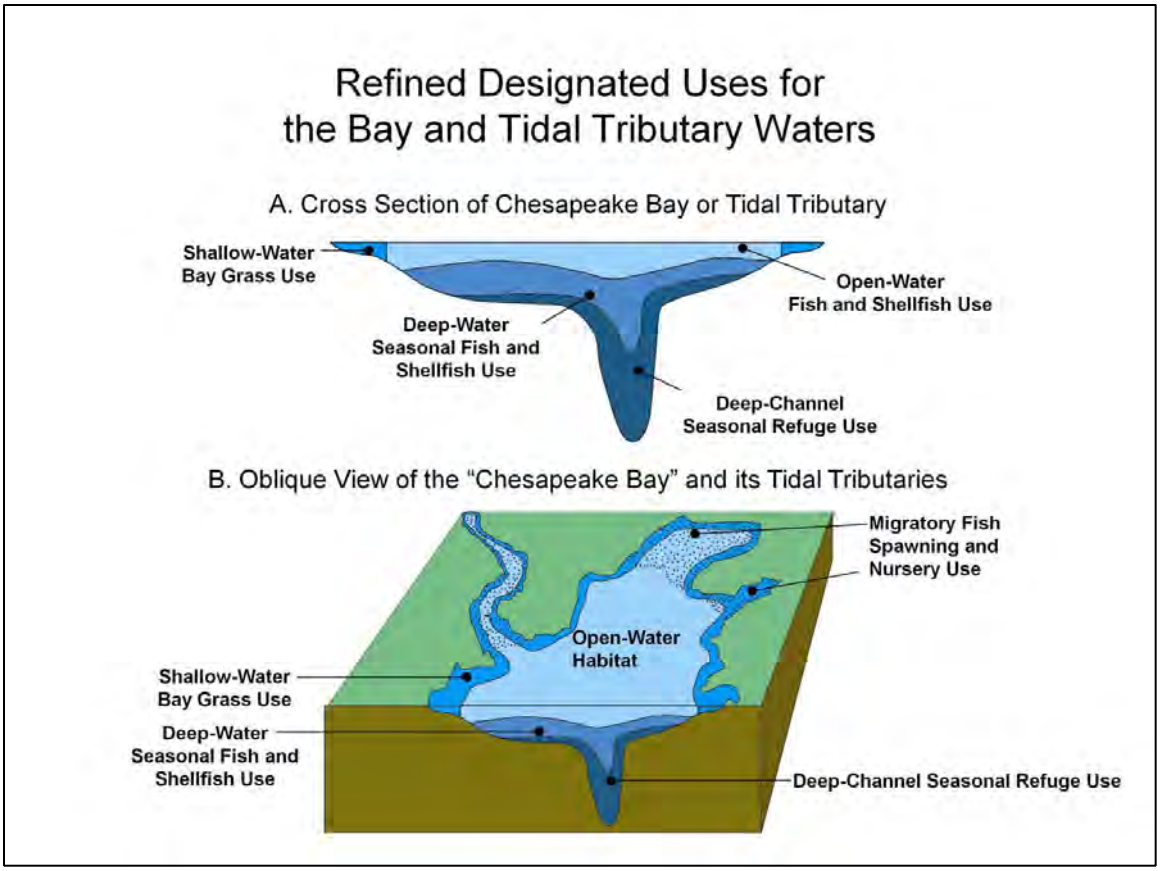


Figure 23: Chesapeake Bay Tidal Water Designated Use Zones (USEPA, 2003b)

The Chesapeake Bay designated use boundaries are based on a combination of natural factors, historical records, physical features, hydrology, and other scientific considerations (USEPA 2003b, 2004, 2010). The tidal water designated use zones for areas within Carroll County include: Use 1, migratory fish and spawning nursery; Use 2, shallow water; and Use 3, open water fish and shellfish. Criteria for the migratory fish spawning and nursery, shallow-water Bay grass, and open-water fish and shellfish designated uses were set at levels to prevent impairment of growth and to protect the reproduction and survival of all organisms living in the open water column habitats (USEPA 2003a).

Table 27: Chesapeake Bay Designated Uses

Designated Use	What is Protected	Habitats and Locations
1. Migratory Fish Spawning and Nursery	Migratory fish including striped bass, perch, shad, herring and sturgeon during the late winter/spring spawning and nursery season.	In tidal freshwater to low-salinity habitats. This habitat zone is primarily found in the upper reaches of many Bay tidal rivers and creeks and the upper mainstem Chesapeake Bay.
2. Shallow-Water	Underwater bay grasses and the many fish and crab species that depend on this shallow-water habitat.	Shallow waters provided by grass beds near the shoreline.
3. Open-Water Fish and Shellfish	Water quality in the surface water habitats to protect diverse populations of sportfish, including striped bass, bluefish, mackerel and seatrout, bait fish such as menhaden and silversides, as well as the shortnose sturgeon, and endangered species.	Species within tidal creeks, rivers, embayments and the mainstem Chesapeake Bay year-round.
4. Deep-Water Seasonal Fish and Shellfish	The many bottom-feeding fish, crabs and oysters, and other important species such as the bay anchovy.	Living resources inhabiting the deeper transitional water column and bottom habitats between the well-mixed surface waters and the very deep channels during the summer months. The deep-water designated use recognizes that low dissolved oxygen conditions prevail during the summer due to a water density gradient (pycnocline) formed by temperature and salinity that reduces re-oxygenation of waters below the upper portion of the gradient.
5. Deep-Channel Seasonal Refuge	Bottom sediment-dwelling worms and small clams that act as food for bottom-feeding fish and crabs in the very deep channel in summer.	Deep-channel designated use recognizes that low dissolved oxygen conditions prevail in the deepest portions of this habitat zone and will naturally have very low to no oxygen during the summer.

C. River Segment Locations

Carroll County is a headwater county, and as such it contains multiple Chesapeake Bay river segments. The eastern portion of the County drains into the upper part of the Bay via the Gunpowder and Patapsco River segments, while the western part drains into the southern Bay via the Potomac River segment.

1. Gunpowder River Segment

The Gunpowder River segment covers 283,263 acres across four counties within Pennsylvania and Maryland. Approximately 21,600 acres (7%) of the river segment is within Carroll County and includes both the Loch Raven Reservoir (592 acres) and Prettyboy Reservoir (21,025 acres) 8-digit watersheds.

2. Patapsco River Segment

The Patapsco River segment covers 374,186 acres across four counties within Maryland. Approximately 126,000 acres (34%) of this Chesapeake Bay River segment is within Carroll County and includes the Liberty Reservoir (87,249 acres) and South Branch Patapsco (38,735 acres) 8-digit watersheds.

3. Potomac River Segment

The Potomac River Basin is the second largest Chesapeake Bay River Segment, extending into Pennsylvania, Viginia and West Virginia. Within Maryland, the Potomac River segment covers 1,539,973 acres across eight counties. Approximately 138,000 acres (9%) of the Potomac River Basin located in Maryland is within Carroll County, and includes the 8-digit watersheds of Double Pipe Creek (105,457 acres), Upper Monocacy River (27,123 acres), and Lower Monocacy River (5,463 acres).

The Chesapeake Bay river segments and their extents within Carroll County are shown in **Figure 24**.

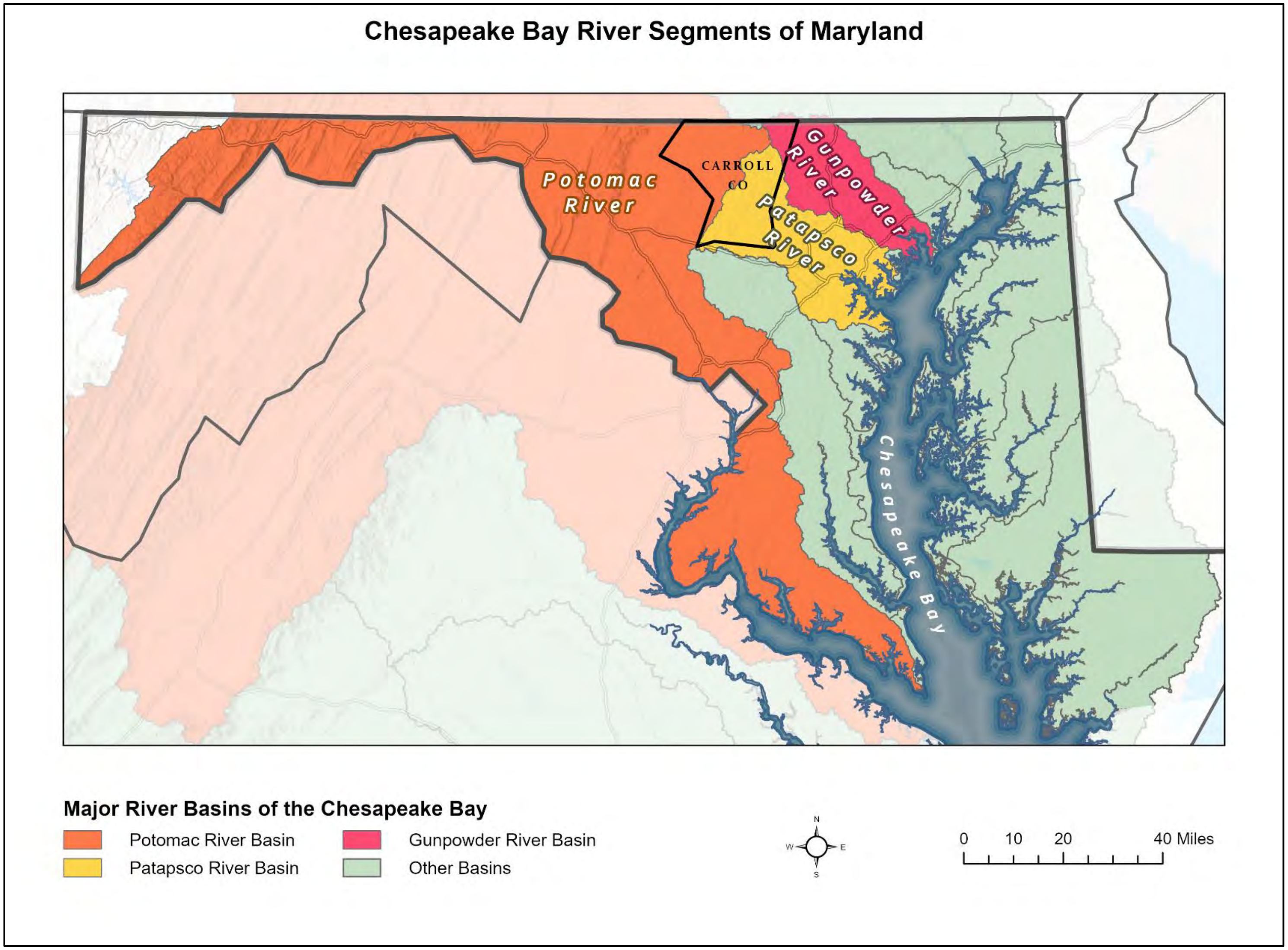


Figure 24: Chesapeake Bay River Segments of Maryland

D. Chesapeake Bay Restoration Progress

Chesapeake Bay TMDL baseline loads and required reductions for Carroll County were obtained from MDE and used in conjunction with the 2020 MDE Guidance document, *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated.* To evaluate Bay restoration progress, loading rates of TN, TP, and TSS for urban land were obtained from MDE (MDE, 2020) and used to calculate load reductions from BMPs. These loading rates from MDE were used instead of developing watershed-specific loading rates using MapShed because they correspond with the broader accounting procedure used by the Chesapeake Bay Watershed Model.

A delivered load is the amount of pollutant delivered to the tidal waters of the Chesapeake Bay or its tidal tributaries from an upstream point. Delivery factors differ by land-river segment and are based upon the estimated amount of attenuation that occurs in the tributaries before it reaches the mainstem of the Chesapeake Bay due to natural in-stream processes. **Table 28** lists the delivery factor of each land-river segment within Carroll County by HUC-8 watershed. Note that the Liberty Reservoir Watershed has a delivery factor of 0.00 for TN, TP, and TSS due to the reservoir impoundment.

Table 28: Chesapeake Bay Delivery Factors for Carroll County Land-River Segments by HUC-8 Watershed

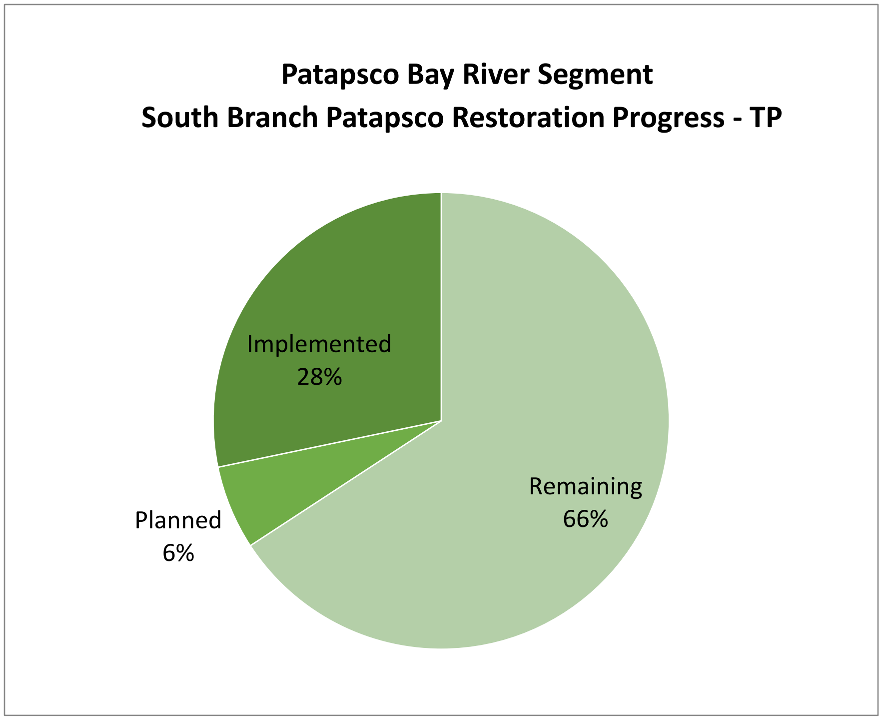
Cheseapeake Bay Land-River Segment	Carroll County HUC-8 Watershed	TN Delivery Factor	TP Delivery Factor
Patapsco River Segment	Liberty Reservoir Watershed	0.00	0.00
	South Branch Patapsco River Watershed	0.11	0.27
Potomac River Segment	Double Pipe Creek Watershed	0.25	0.47
	Upper Monocacy River Watershed	0.30	0.47
	Lower Monocacy River Watershed	0.37	0.47
Gunpowder River Segment	Prettyboy Reservoir Watershed	0.05	0.08
	Loch Raven Reservoir Watershed	0.16	0.36

Edge of Tide (EOT) loads and corresponding reductions were determined utilizing TIPP to model baseline load, required load reduction, reduction from current BMPs and reduction from planned BMPs. Chesapeake Bay TMDL progress is summarized by 8-digit watershed for each of the County's three land-river segment in **Tables 29** through **31** and shown in **Figures 25** through **36.** The tables provide the Chesapeake Bay TMDLs, progress achieved through implemented BMPs, expected reductions from future CIP-planned projects, and the total percent reduction achieved for each portion of the land-river segment watersheds within the County.

The baseline and reductions represent a combination of the County Phase I and Municipal Phase II values, based on the MOA between the County and each of the municipalities that combines the jurisdictions into one MS4 permit. The aggregated load allocations for municipalities within all land-river segment were added to the County load allocations obtained from the TMDL Data Center to determine the combined baseline loads and reductions.

Table 29: Carroll County Bay TMDL Restoration Progress for the Patapsco River Segment

Pollutant	8-Digit Watershed	Modeled Baseline Load (TIPP)	% Reduction Required*	Required Load Reduction Based on Modeled Baseline (lbs/yr)	Reduction from Current BMPs (lbs/yr)	Reduction from Planned Strategies (lbs/yr)	Total % Reduction (Achieved + Planned)	% TMDL Achieved
TP	S. Branch (Baltimore Harbor) (2130908)	6,400	35.26%	2,257	638	134	12.06%	34.21%
	Liberty Reservoir (2130907)	-	-	-	-	-	-	-
TN	S. Branch (Baltimore Harbor) (2130908)	69,341	13.79%	9,562	4,915	903	8.39%	60.85%
	Liberty Reservoir (2130907)	-	-	-	-	-	-	-



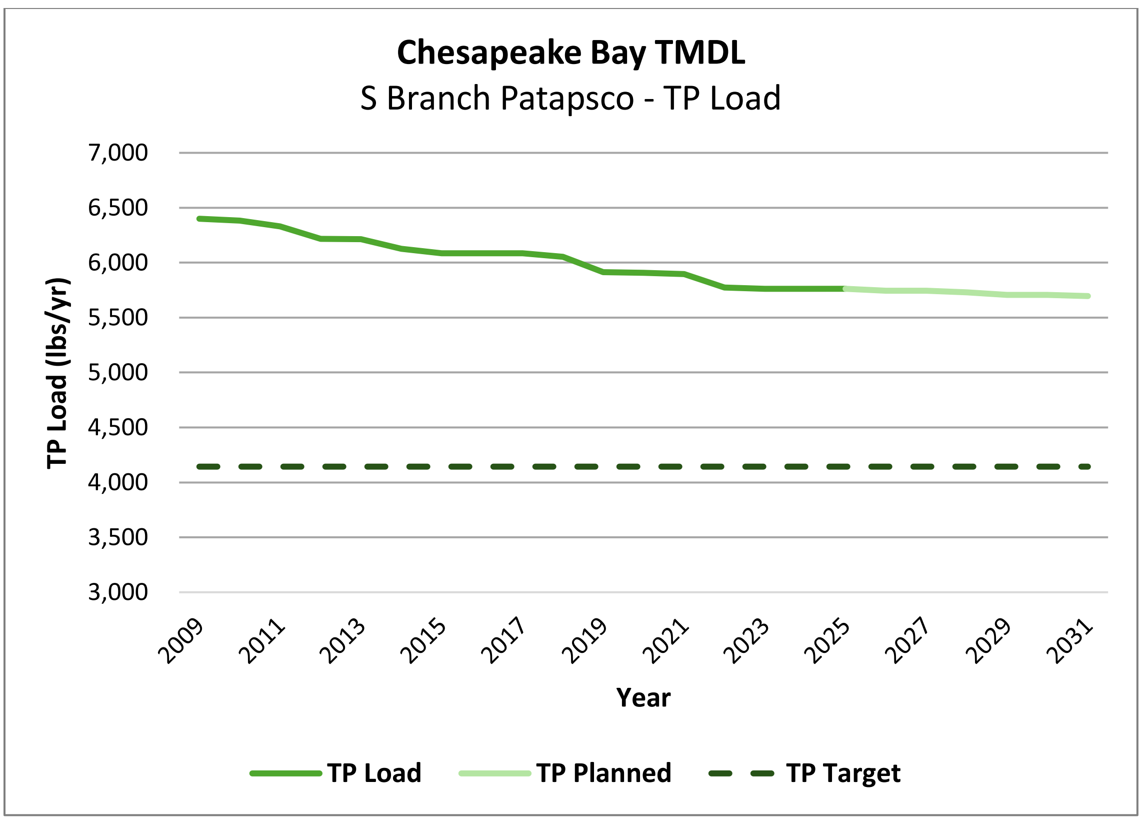
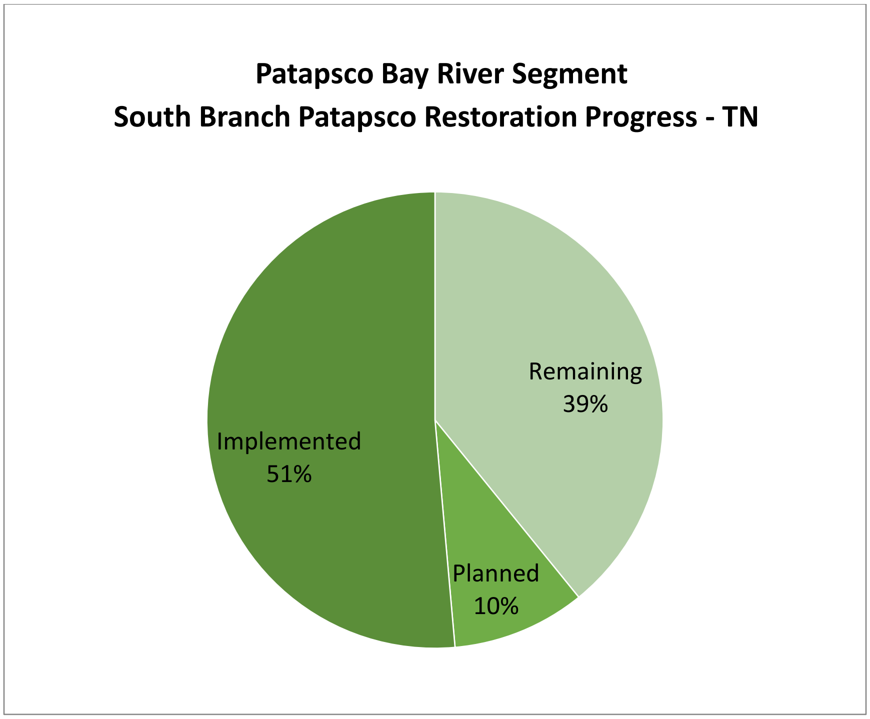


Figure 25: Patapsco River Segment – South Branch Patapsco Restoration Progress for Total Phosphorus



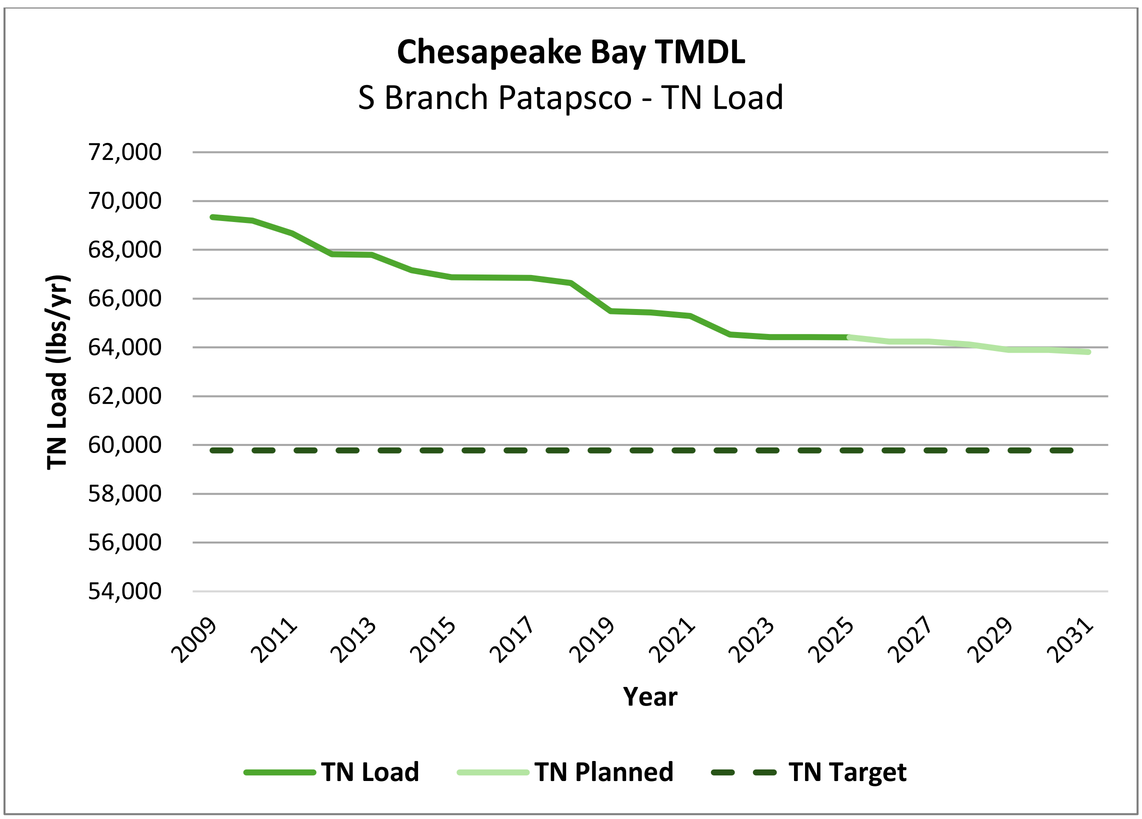
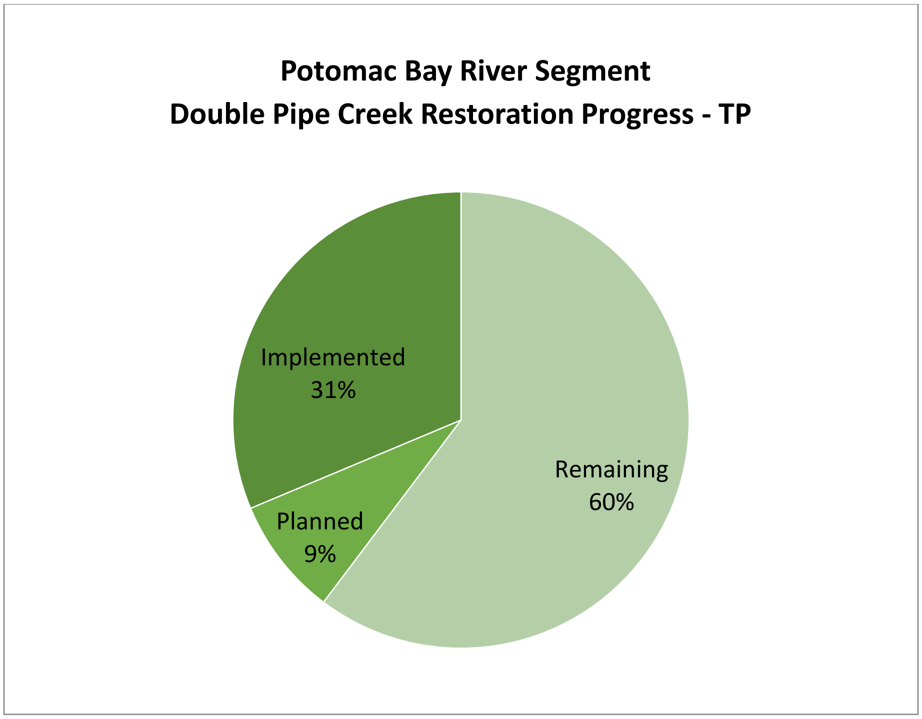


Figure 26: Patapsco River Segment – South Branch Patapsco Restoration Progress for Total Nitrogen

Table 30: Carroll County Bay TMDL Restoration Progress for the Potomac River Segment

Pollutant	8-Digit Watershed	Modeled Baseline Load (TIPP)	% Reduction Required	Required Load Reduction Based on Modeled Baseline (lbs/yr)	Reduction from Current BMPs (lbs/yr)	Reduction from Planned Strategies (lbs/yr)	Total % Reduction (Achieved + Planned)	% TMDL achieved
TP	Double Pipe Creek (2140304)	12,721	22.07%	2,808	866	255	8.81%	39.92%
	Upper Monocacy River (2140303)	3,160	22.07%	697	314	21	10.61%	48.09%
	Lower Monocacy River (2140302)	567	22.07%	125	5	33	6.76%	30.62%
TN	Double Pipe Creek (2140304)	176,130	9.25%	16,292	10,210	2,217	7.065	76.28%
	Upper Monocacy River (2140303)	30,250	9.25%	2,798	1,969	202	7.18%	77.59%
	Lower Monocacy River (2140302)	14,544	9.25%	1,345	119	495	4.23%	45.68%



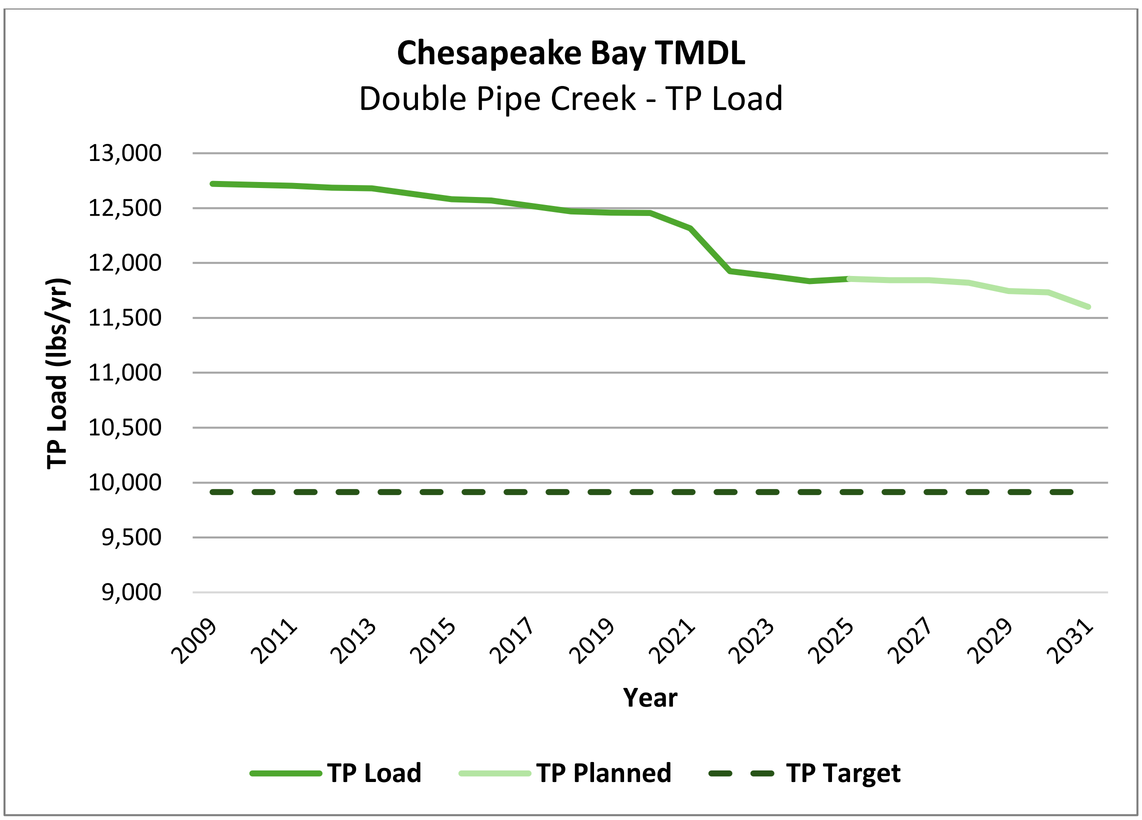
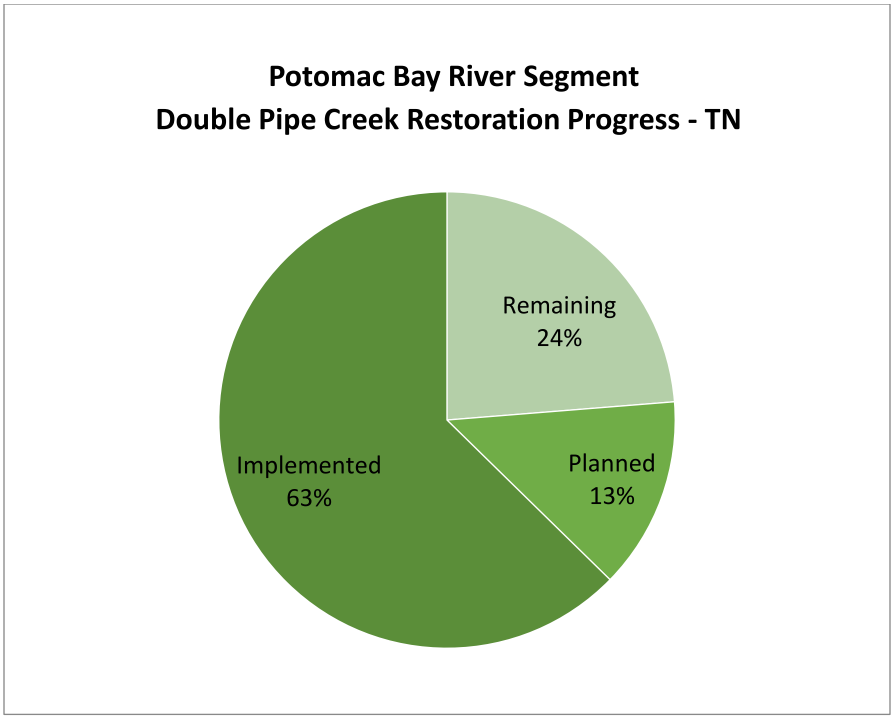


Figure 27: Potomac River Segment – Double Pipe Creek Restoration Progress for Total Phosphorus



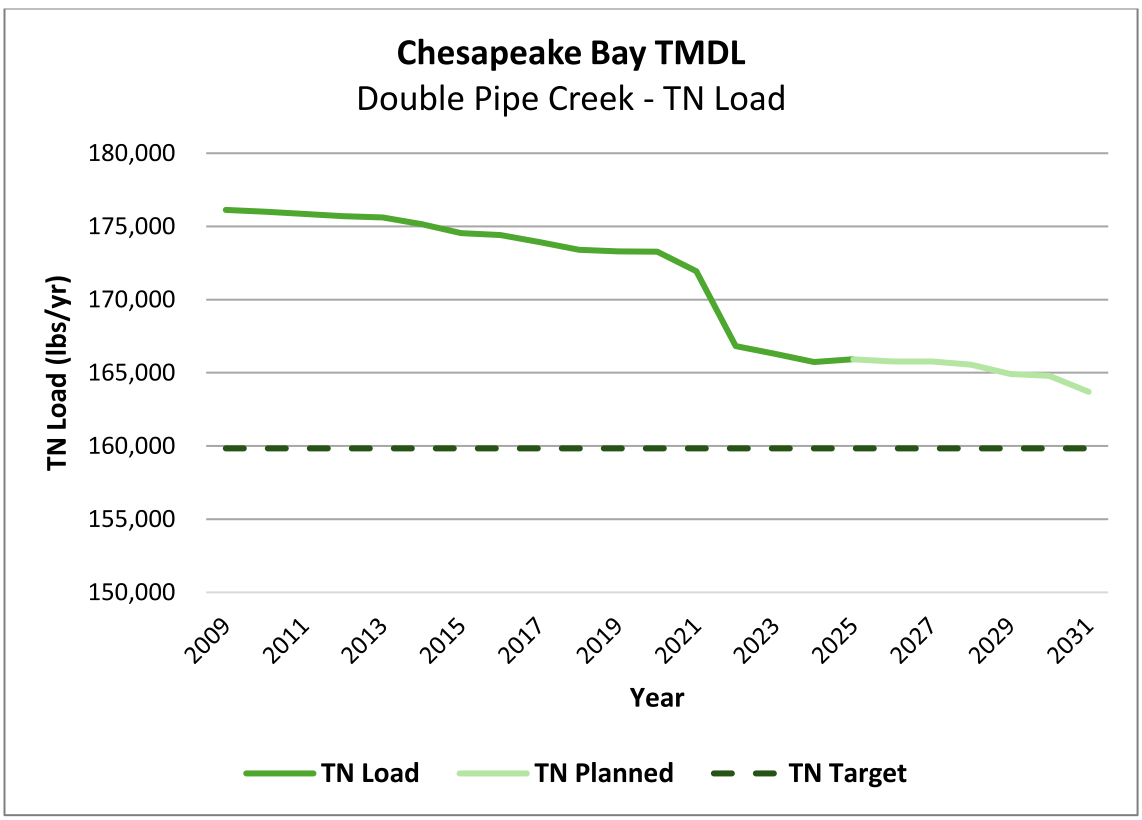
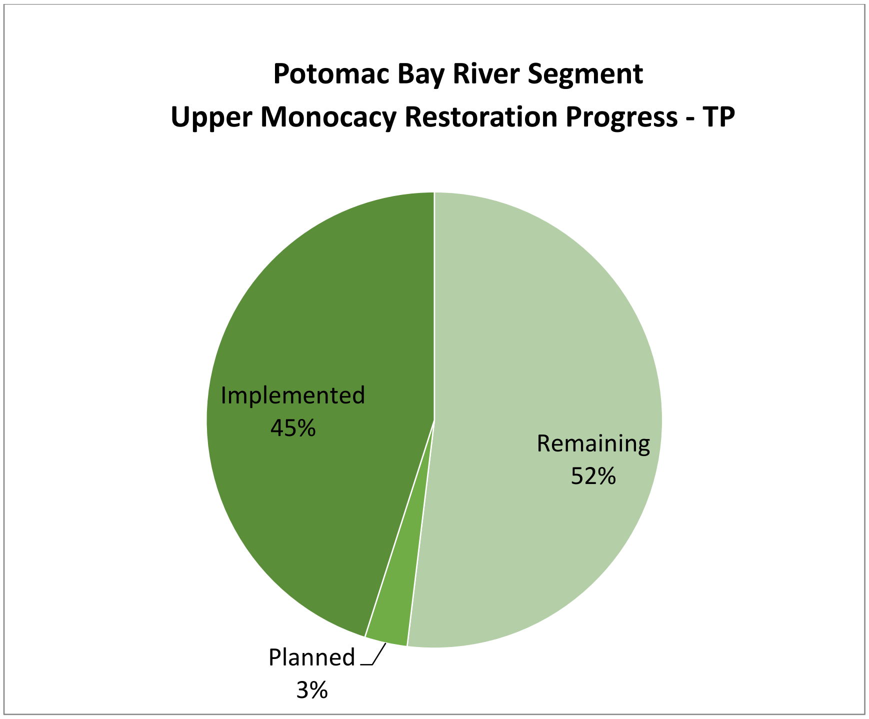


Figure 28: Potomac River Segment – Double Pipe Creek Restoration Progress for Total Nitrogen



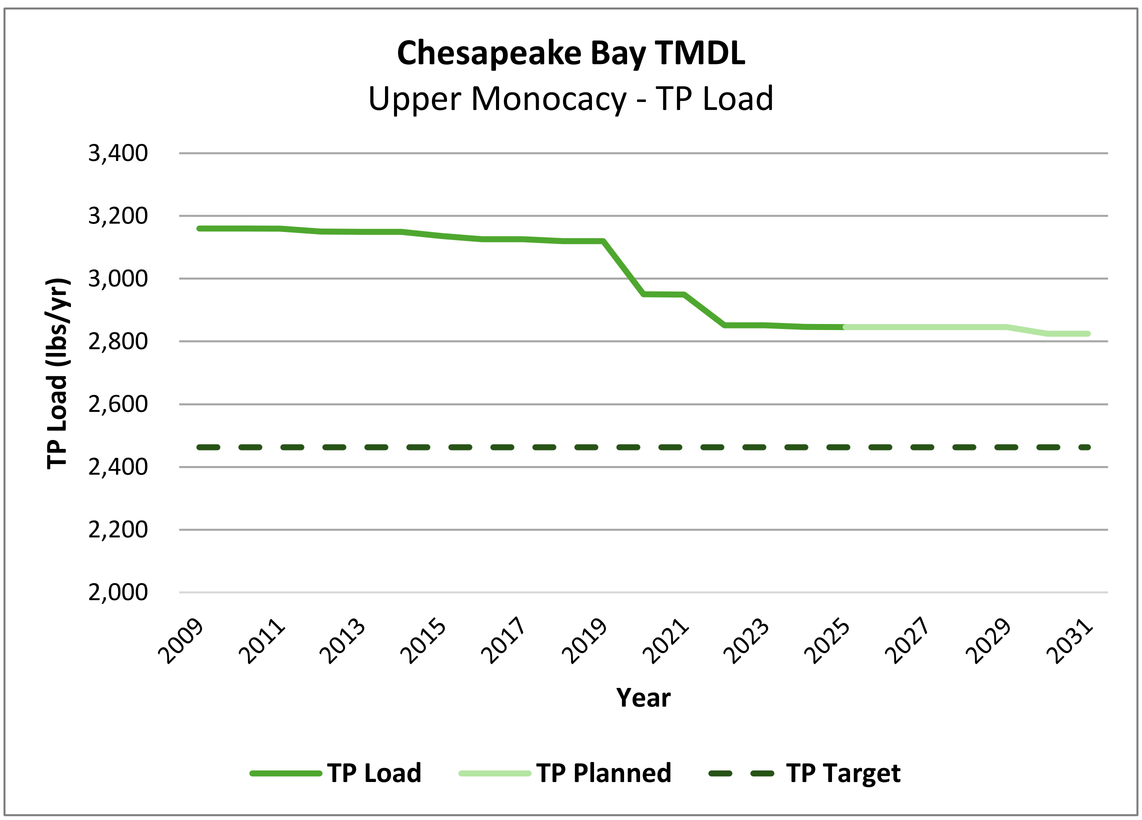
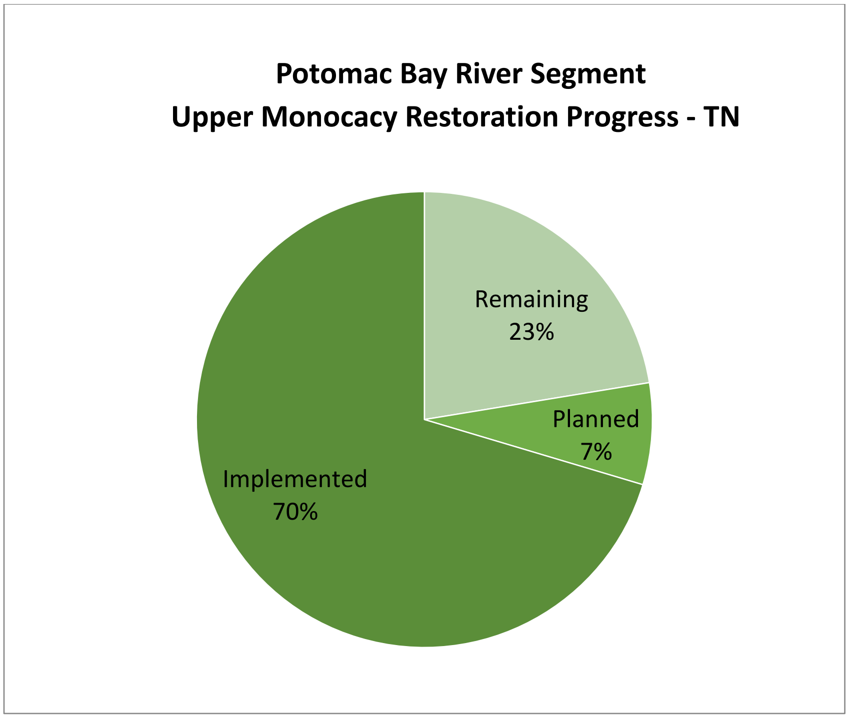


Figure 29: Potomac River Segment – Upper Monocacy River Restoration Progress for Total Phosphorus



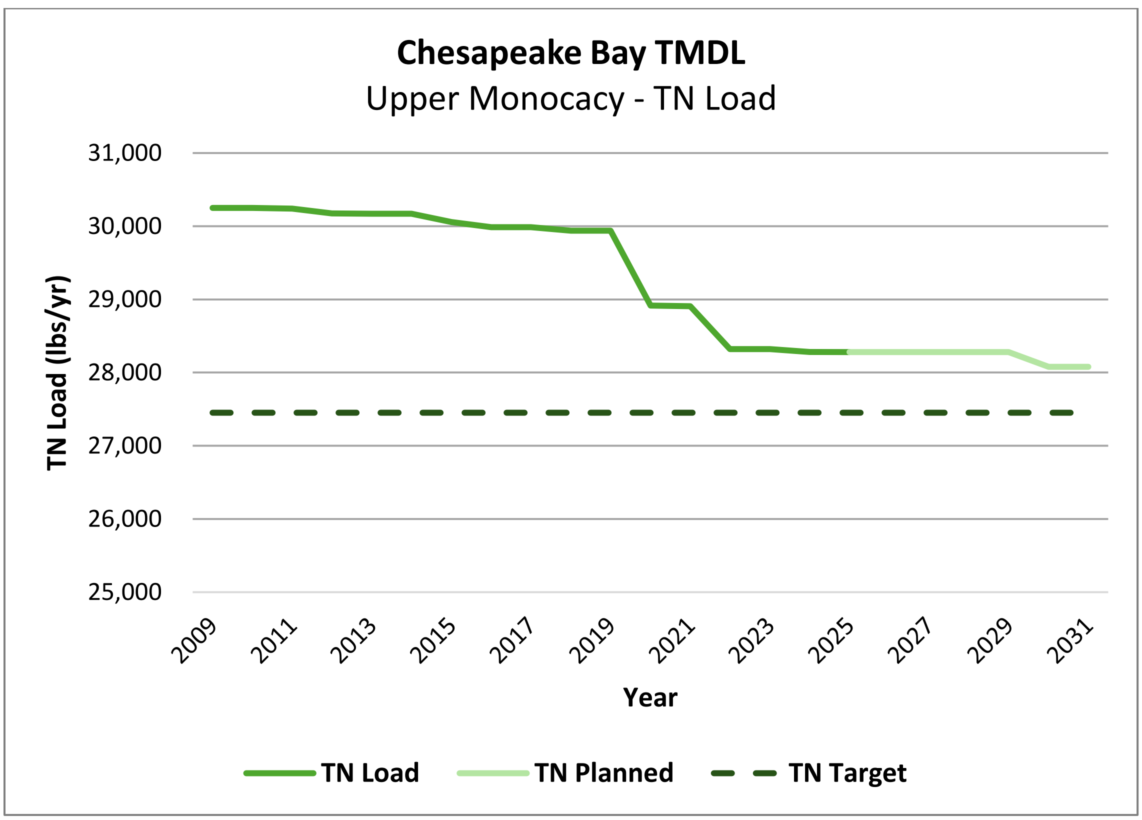
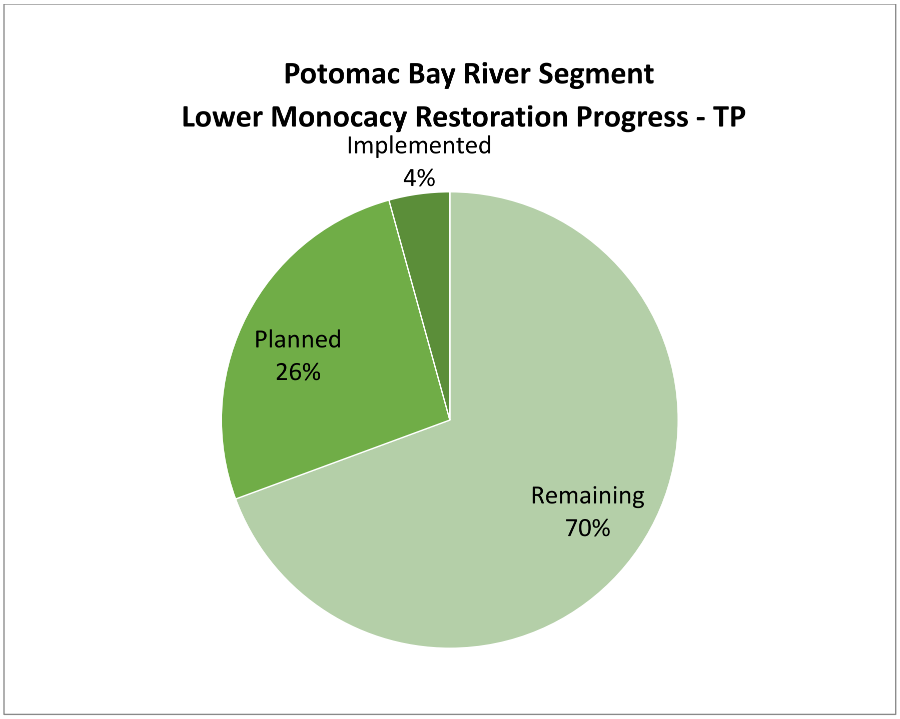


Figure 30: Potomac River Segment – Upper Monocacy River Restoration Progress for Total Nitrogen



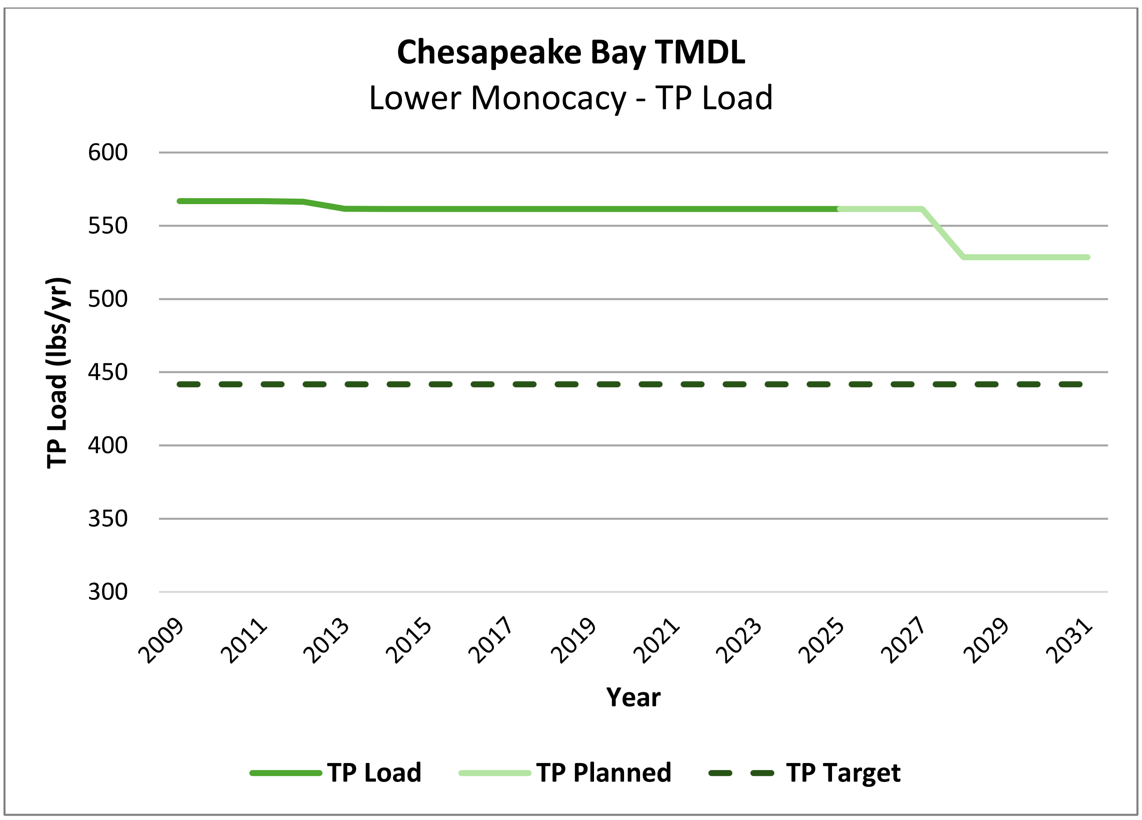
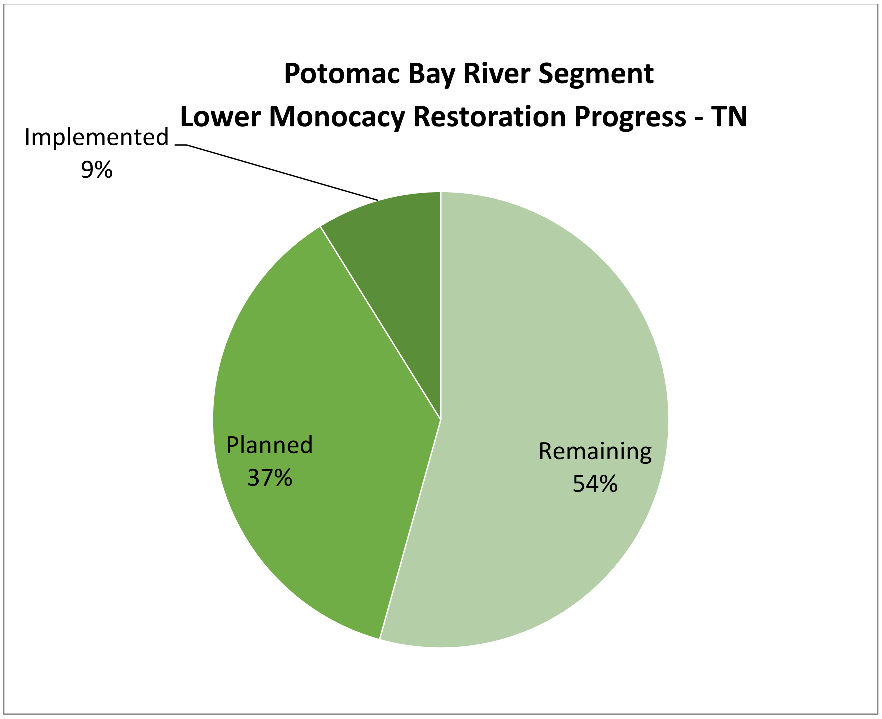


Figure 31: Potomac River Segment – Lower Monocacy River Restoration Progress for Total Phosphorus



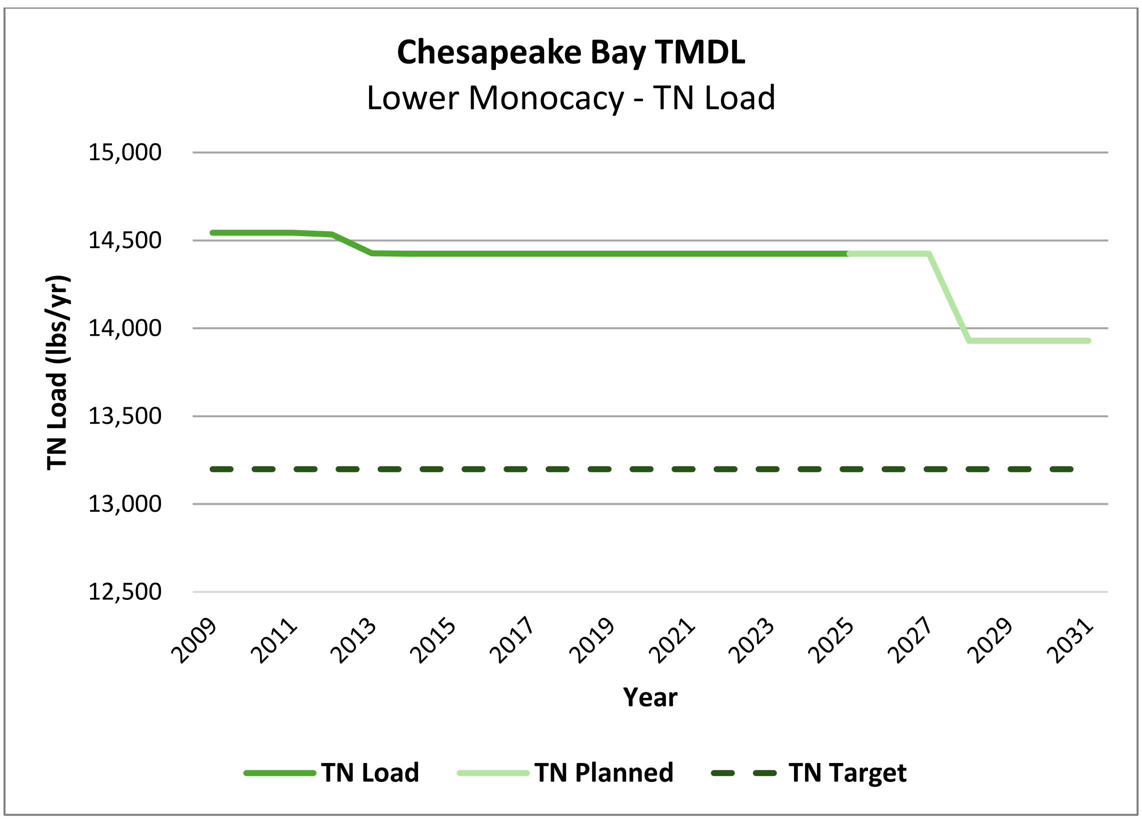
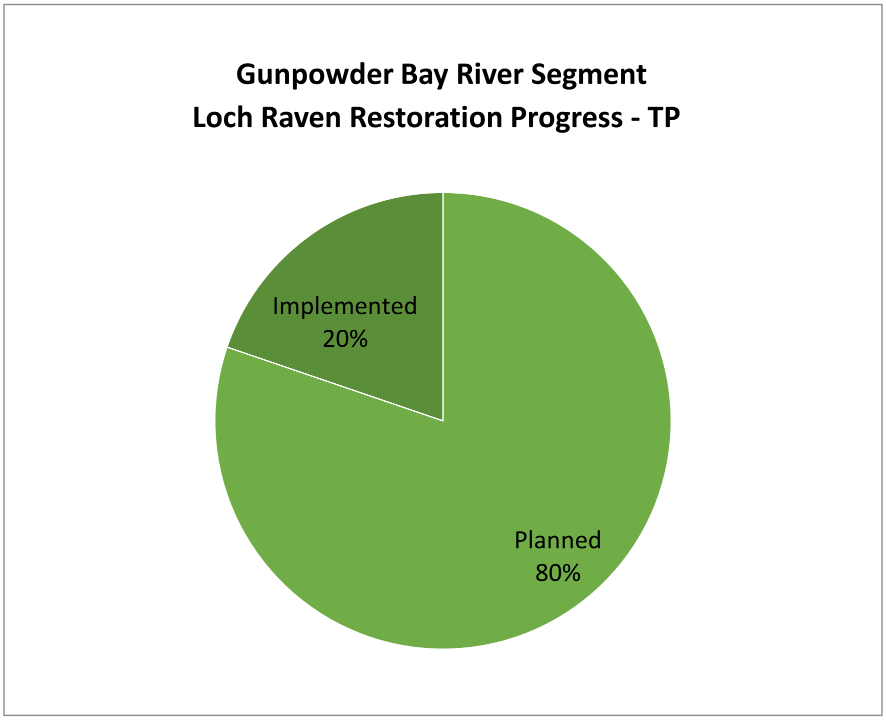


Figure 32: Potomac River Segment – Lower Monocacy River Restoration Progress for Total Nitrogen

Table 31: Carroll County Bay TMDL Restoration Progress for the Gunpowder River Segment

Pollutant	8-Digit Watershed	Modeled Baseline Load (TIPP)	% Reduction Required	Required Load Reduction Based on Modeled Baseline (lbs/yr)	Reduction from Current BMPs (lbs/yr)	Reduction from Planned Strategies (lbs/yr)	Total % Reduction (Achieved + Planned)	% TMDL achieved
TP	Loch Raven (2130805)	167	17.19%	29	6	93	59.31%	345.05%
	Prettyboy Reservoir (2130806)	887	17.19%	153	35	27	6.94%	40.36%
TN	Loch Raven (2130805)	1,342	9.59%	129	44	506	40.97%	427.18%
	Prettyboy Reservoir (2130806)	9,372	9.59%	899	325	248	6.11%	63.67%



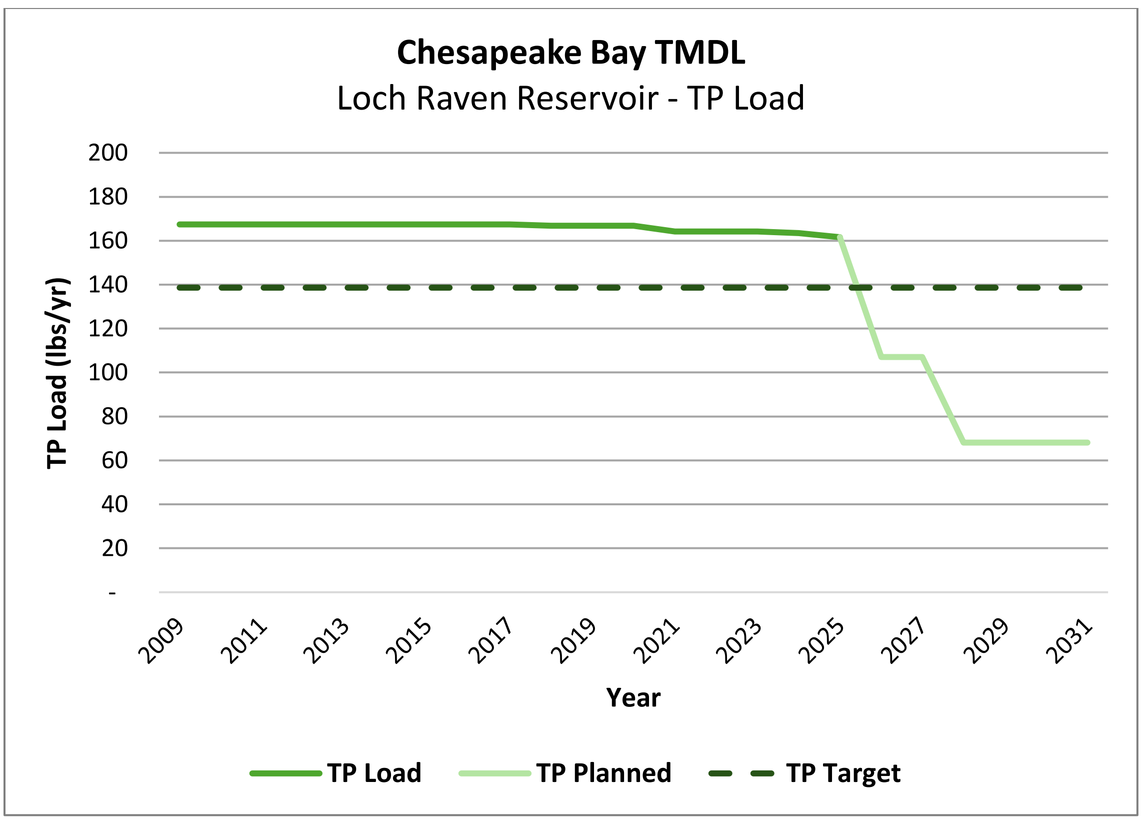
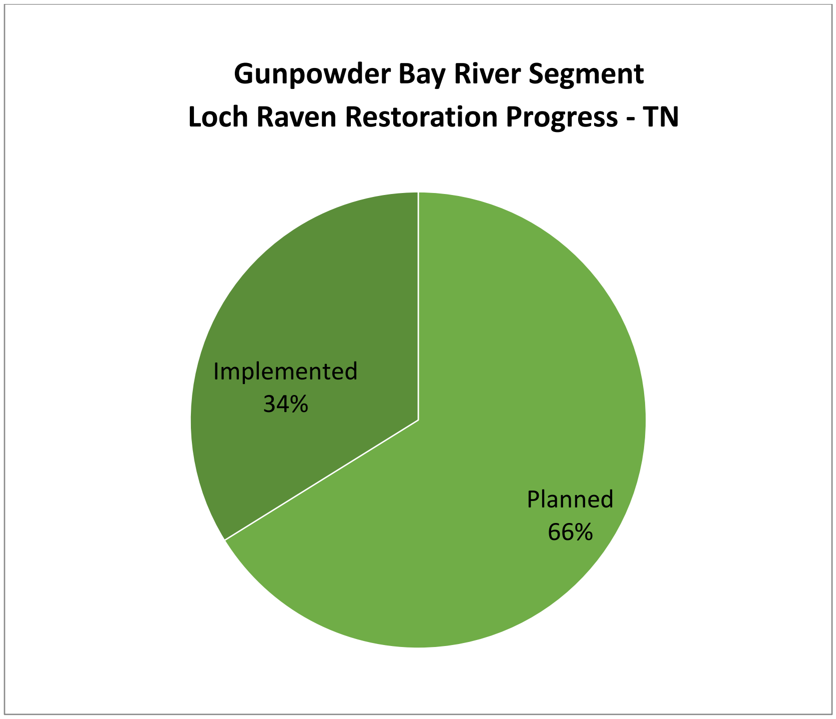


Figure 33: Gunpowder River Segment – Loch Raven Restoration Progress for Total Phosphorus



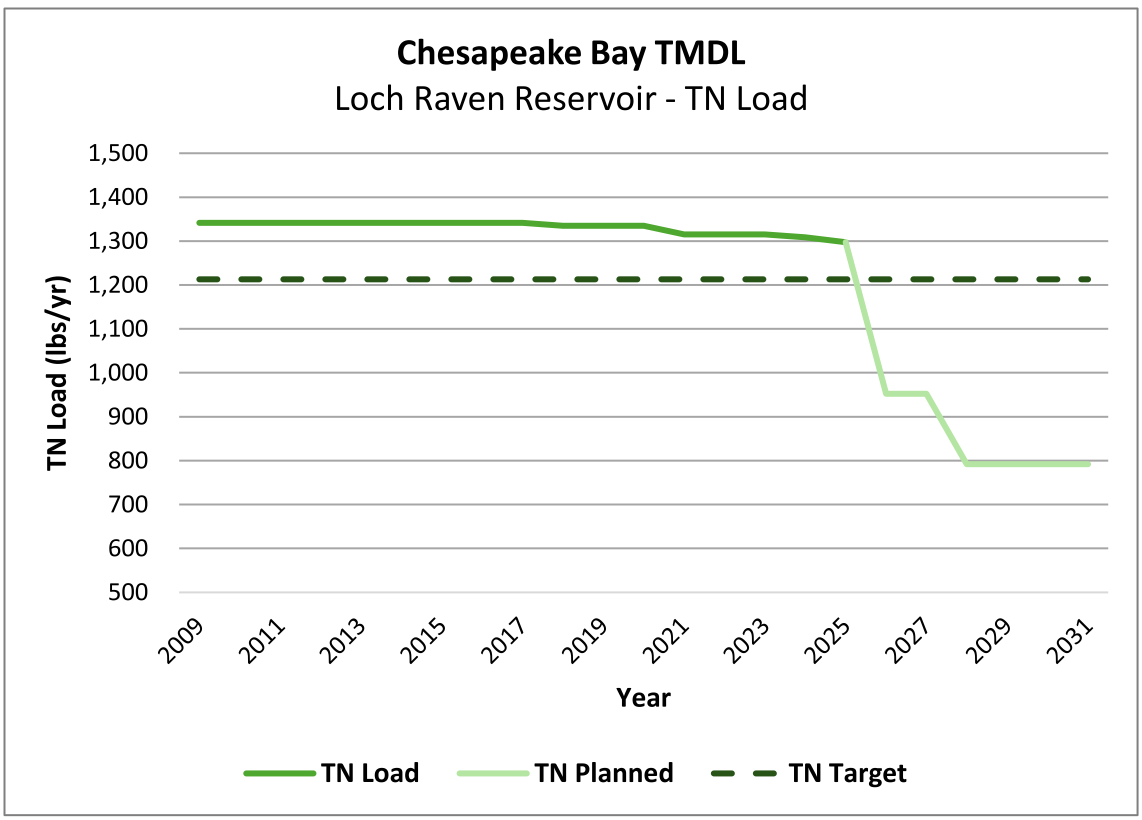
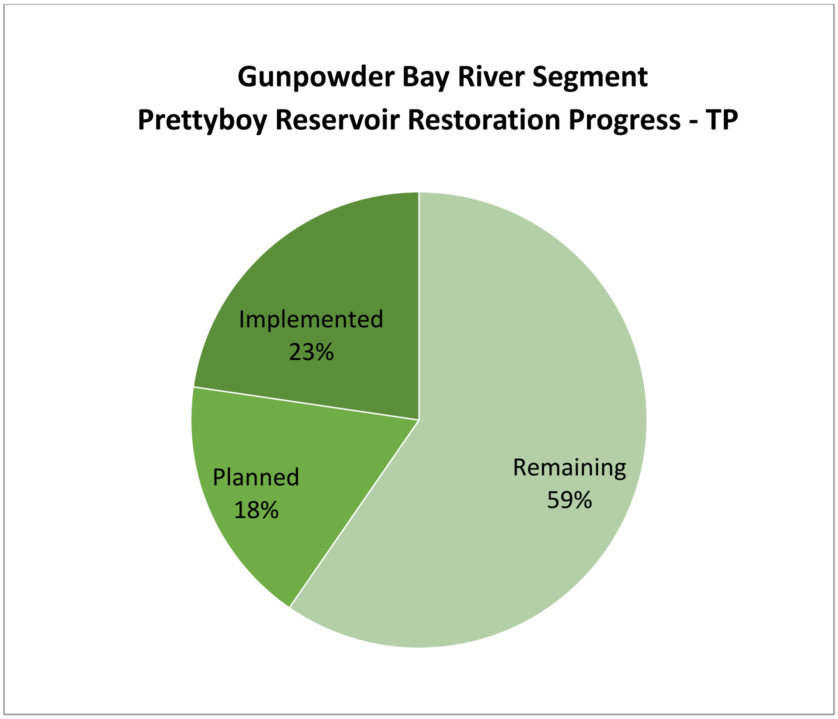


Figure 34: Gunpowder River Segment – Loch Raven Restoration Progress for Total Nitrogen



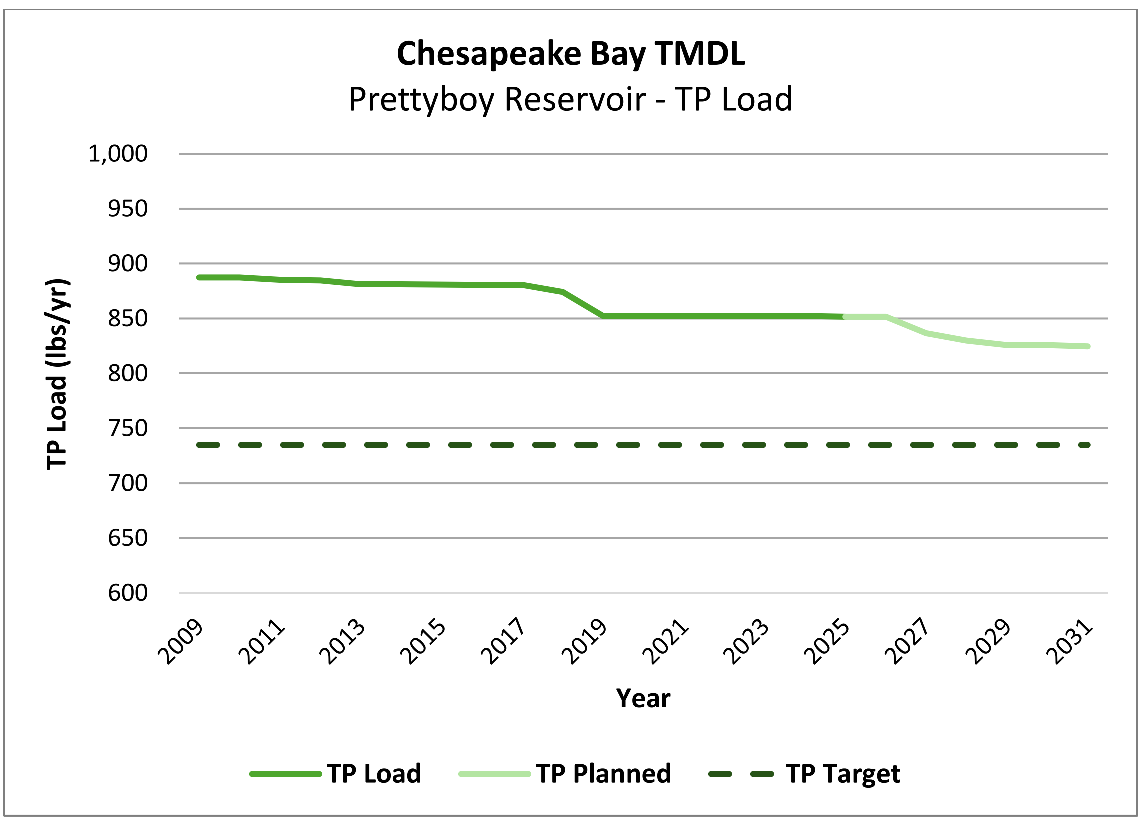
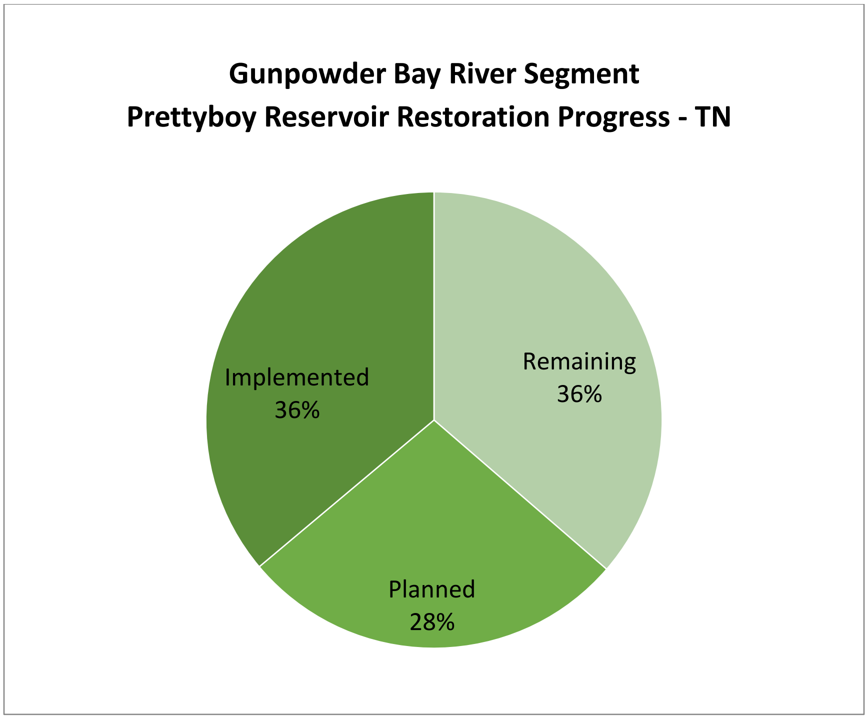


Figure 35: Gunpowder River Segment – Prettyboy Reservoir Restoration Progress for Total Phosphorus



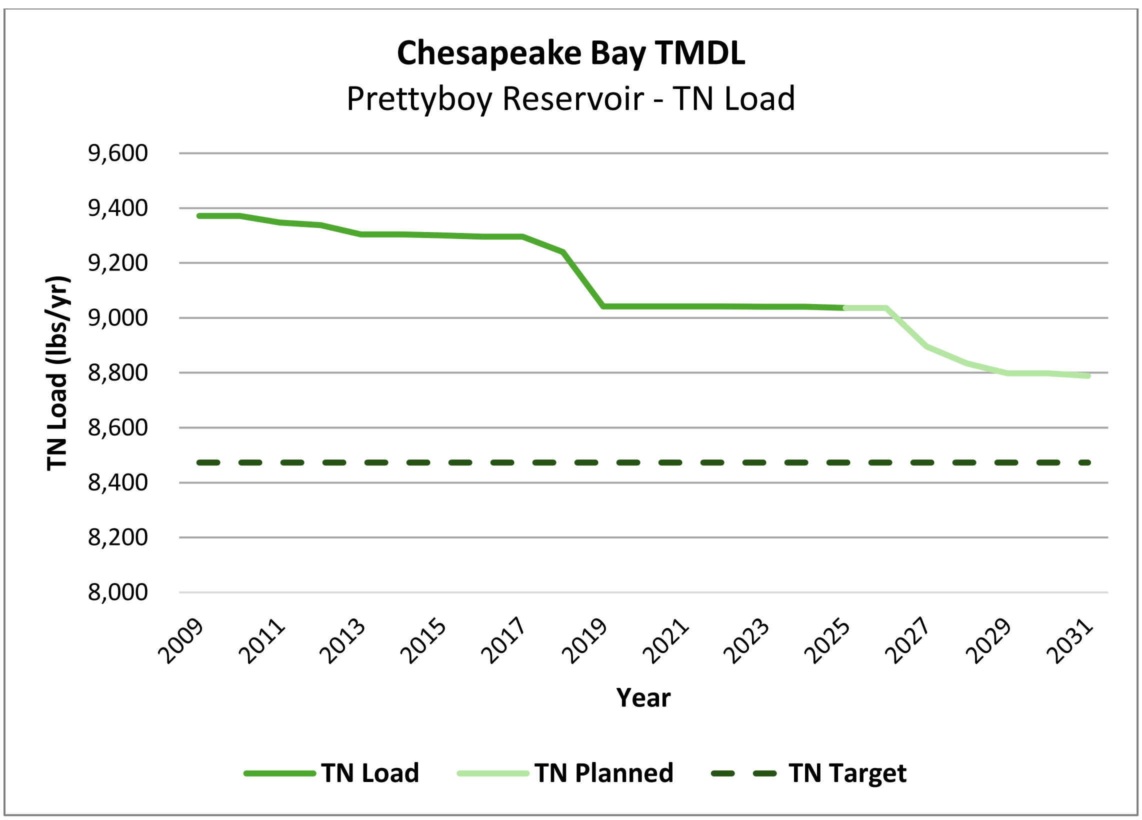


Figure 36: Gunpowder River Segment – Prettyboy Reservoir Restoration Progress for Total Nitrogen

VIII. TMDL Benchmarks

Through the continued implementation of stormwater management projects and alternative BMPs, Carroll County continues to make progress toward TMDL attainment at both the local and Bay levels. In order to develop a timeline for those attainments, benchmark tables have been created to provide current progress, CIP-approved planned progress, and the estimated year that TMDL attainment is projected to be reached (i.e. the year in which 100% of the required reductions will be met). To estimate the TMDL end date, the percent completed since the baseline year for each TMDL was determined with an assumption that progress will continue at that percent reduction per year. To achieve these goals, the County will continue to focus primarily on stormwater retrofits, streamside buffer plantings, street sweeping and inlet cleaning, and stream restoration opportunities.

Table 32 and **Table 33** lists the current progress through the 2025 permit year, the expected progress from CIP-approved projects through 2032, and the projected end date of full implementation for each TMDL within Carroll County.

Table 32: Local TMDL Benchmarks for Carroll County Watersheds

Watershed HUC-8	TMDL Pollutant	Current Progress (FY2025)	CIP-Planned Progress (FY2032)	Projected TMDL End Date
Liberty Reservoir*	Phosphorus	19%	27%	2068
	Sediment	23%	35%	2063
Prettyboy Reservoir*	Phosphorus	33%	53%	2054
Loch Raven Reservoir*	Phosphorus	95%	100%	2030
Upper Monocacy River*	Phosphorus	100%	100%	Complete
	Sediment	24%	27%	2067
Lower Monocacy River*	Phosphorus	3%	22%	2070
Double Pipe Creek*	Phosphorus	9%	12%	2075
	Sediment	22%	29%	2067
South Branch Patapsco River*	Phosphorus	77%	88%	2037
	Nitrogen	60%	71%	2045

*Assumes 2.00% reduction rate/year

Table 33: Cheseapeake Bay TMDL Benchmarks for Carroll County Watersheds

TMDL Shed ID's	6-Digit Watershed	8-Digit Watershed	Pollutant	Current Progress (FY2024)	CIP-Planned Progress (FY2031)	TMDL End Date
G1036	Patapsco River Segment	S. Branch (Baltimore Harbor) (2130908)	TP	28%	34%	2064
		Liberty Reservoir (2130907)	TP	-	-	-
		S. Branch (Baltimore Harbor) (2130908)	TN	51%	61%	2051
		Liberty Reservoir (2130907)	TN	-	-	-
G1050	Potomac River Segment	Double Pipe Creek (2140304)	TP	31%	40%	2061
		Upper Monocacy River (2140303)	TP	45%	48%	2057
		Lower Monocacy River (2140302)	TP	4%	30%	2066
		Double Pipe Creek (2140304)	TN	63%	76%	2043
		Upper Monocacy River (2140303)	TN	70%	77%	2042
		Lower Monocacy River (2140302)	TN	9%	46%	2058
G1024	Gunpowder River Segment	Loch Raven (2130805)	TP	20%	100%	2030
		Prettyboy Reservoir (2130806)	TP	23%	41%	2061
		Loch Raven (2130805)	TN	34%	100%	2030
		Prettyboy Reservoir (2130806)	TN	36%	64%	2049

IX. Bacteria Loads

Fecal bacteria (fecal coliform and fecal streptococci) are microscopic organisms found in the wastes of warm-blooded animals. The degree of their presence in water is used to assess the sanitary quality of water for body-contact recreation, consumption of shellfish, and drinking water.

Excessive amounts of fecal bacteria in surface water used for recreation are known to increase the risks of pathogen-induced illnesses to humans. Infections due to fecal-contaminated recreation waters may include gastrointestinal, respiratory, eye, ear, nose, throat, and skin diseases (US EPA 1986). TMDLs for fecal bacteria have been established to support attainment of the beneficial use designation of primary contact recreation.

A. Water Quality Criteria

Water quality criteria have been developed for each designated use and define the maximum pollutant concentrations allowable for supporting that designated use (EPA, 2012). For example, the human health criteria for bacteria are based on full body contact for a single sample or a steady state geometric mean of five samples. The freshwater criteria for bacteria are listed in **Table 34**. *E. coli* bacteria criteria are measured as most probable number per 100 millilitres (MPN/100 mL). The MPN is a statistical method used to estimate the viable number of bacteria in a sample.

Table 34: Freshwater Bacteria Criteria

Indicator	Steady State Geometric Mean Density (MPN/100 mL)	Maximum Allowable Density – Single Sample (MPN/100 mL)			
		Frequent Full Body Contact	Moderately Frequent Full Body Contact	Occasional Full Body Contact	Infrequent Full Body Contact
E. coli	126	235	298	410	576

Nutrient- and sediment-focused stormwater restoration projects can also provide ancillary reductions of bacteria contributions to surface waters. The County continues to focus on retrofitting older facilities through the use of enhanced infiltration and filtration designs, bringing facilities up to current standards or higher, and maintaining existing facilities that prevent wildlife sources of bacteria from entering the County's MS4 network. Addiitionally, the County implements alternative practices (e.g. street sweeping and inlet cleaning) that minimize potential bacteria loads.

MDE's Guidance for Developing Bacteria TMDL (Total Maximum Daily Load) Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plans (WIPs) does not provide a quantifiable methodology for tracking and measuring bacteria pollutant load reductions, however. In lieu of guidance on bacteria reduction efficiencies or loading rates by land use, a trend monitoring program for bacteria has been implemented by the County. Monitoring is performed at roughly the same date and time each month, and is recorded as either high or low flow based on amount of precipitation in the 72 hours prior to sampling.

B. Bacteria Source Reduction

1. Human Source Reduction

Elimination of human sources of bacteria within the watershed will occur through continued implementation of the County's Illicit Discharge Detection and Elimination (IDDE) and Public Outreach Programs. Additionally, waste collection-related repairs and measures by County and municipal public works departments provide additional reductions. This is achieved through infrastructure upgrades, reductions of sanitary sewer overflows (SSO), and providing septic connections within service areas. Through the Carroll County Health Department, upgrades of on-site septic systems to Best Available Technology (BAT) are also implemented where public sanitary sewer connections are not possible.

Replacing or repairing aging or failing infrastructure within public sanitary service areas reduces both the inflow and infiltration to the treatment plants and potential exfiltration of untreated wastewater to surface waters through the waste collection system. **Appendix A** lists all related measures and repairs that have been completed in each watershed since the baseline year for each bacterial TMDL, as well as any sanitary sewer overflows and the total number of gallons, if any, that occurred during this past reporting year.

a. Loch Raven Watershed

Within the Loch Raven Watershed, the wastewater service area is located throughout the developed headwaters region. The Hampstead Wastewater Treatment Plant (WWTP) is located along the Baltimore County border, with effluent flows split between the Piney Run and Deep Run subwatersheds within the Liberty Reservoir 8-digit Watershed. **Figure 37** shows the extent of the sanitary sewer infrastructure within the Loch Raven Watershed.

Additionally, there are approximately 39 OSDS within the watershed with none to date being upgraded to BAT. **Figure 38** shows the distribution of on-site disposal systems (OSDS) and BAT systems throughout the watershed.

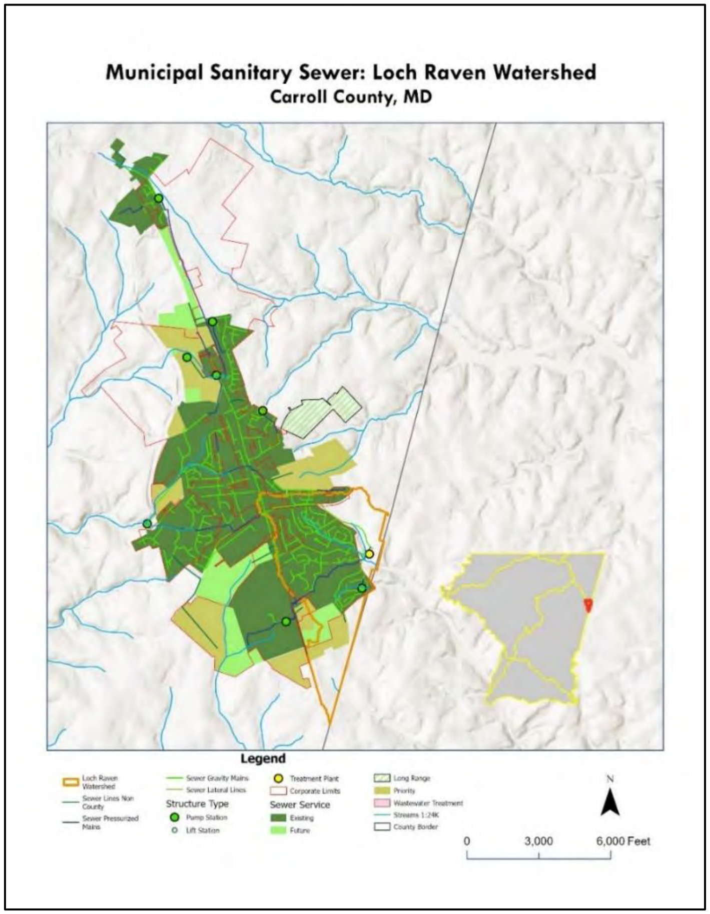


Figure 37: Loch Raven Municipal Sanitary Sewer

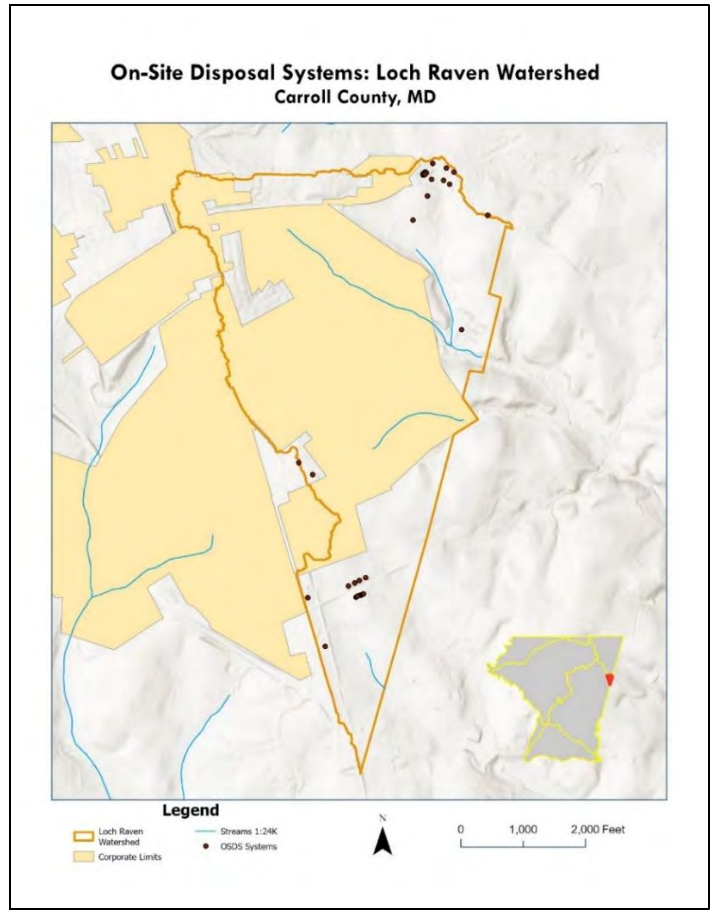


Figure 38: Loch Raven On-Site Disposal Systems

b. Prettyboy Watershed

Within the Prettyboy Watershed, wastewater service areas are located within the headwater regions of the George's and Murphy Run subwatersheds. The Hampstead WWTP is located within the Loch Raven 8-digit watershed, with effluent flows split between the Piney Run and Deep Run subwatersheds. The Town of Manchester WWTP is located within the George's Run subwatershed, and utilizes an effluent spray irrigation field during the growing season. **Figure 39** shows the extent of the sanitary sewer infrastructure within the Prettyboy Reservoir Watershed. Additionally, there are approximately ~3,700 OSDS systems within the watershed and 24 (0.6%) of them have been upgraded to BAT. **Figure 40** shows the OSDS and BAT systems and their distribution throughout the watershed.

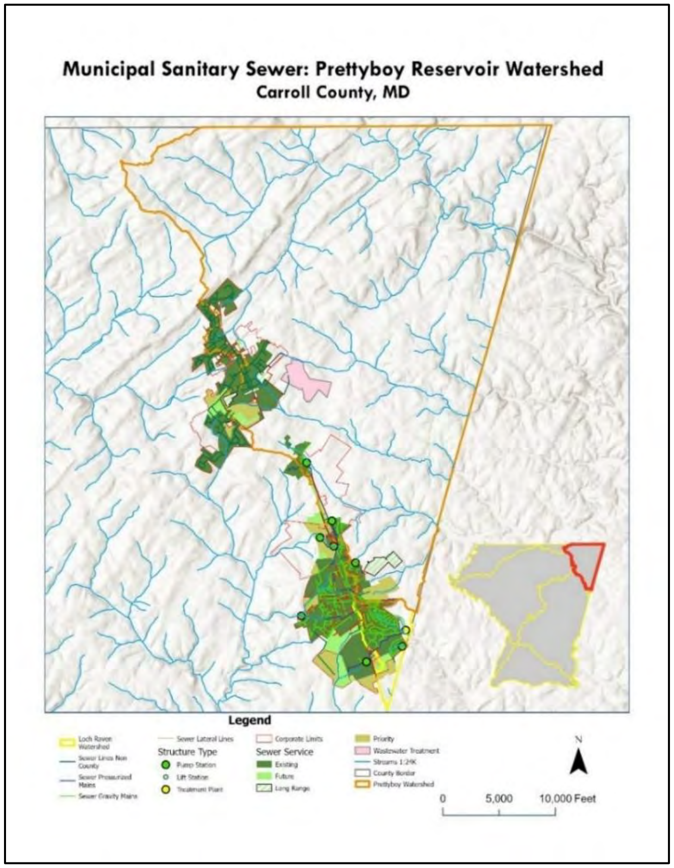


Figure 39: Prettyboy Municipal Sanitary Sewer

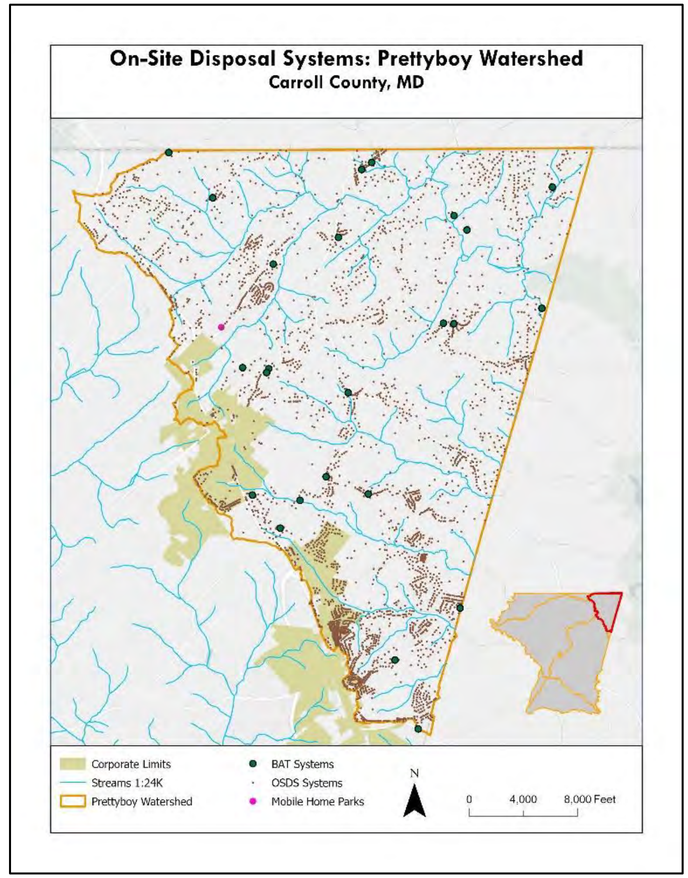


Figure 40: Prettyboy On-Site Disposal Systems

c. Upper Monocacy Watershed

Within the Upper Monocacy Watershed, the City of Taneytown's wastewater treatment plant is located along the mainstem of Piney Creek, and the wastewater service area is located throughout the developed headwater areas of the Piney Creek Watershed. **Figure 41** shows the extent of the sanitary sewer infrastructure within the Upper Monocacy Watershed.

Additionally, there are approximately ~1,400 OSDS systems within the watershed, and 23 (1.6%) of them have been upgraded to BAT. **Figure 42** shows the OSDS and BAT systems and their distribution within the watershed.

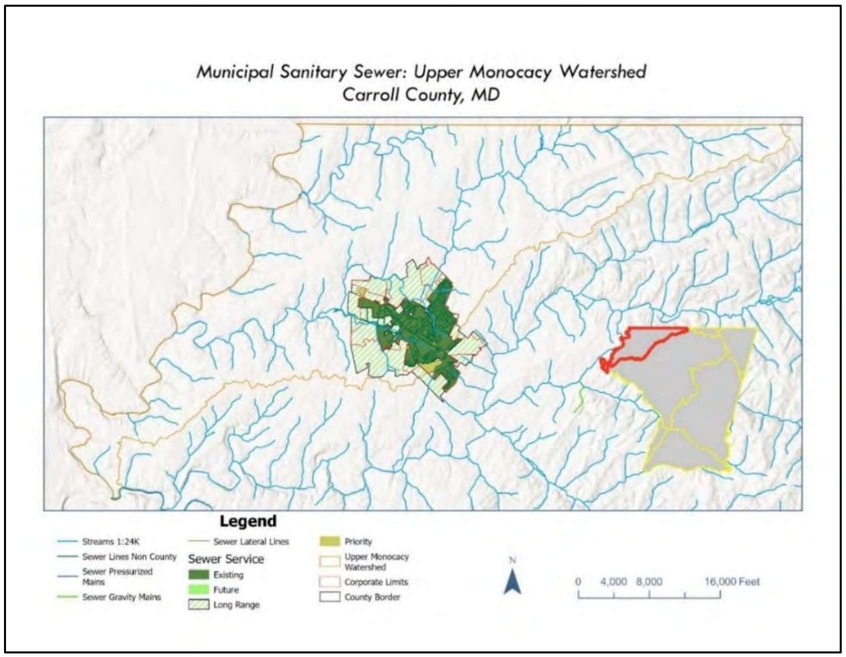


Figure 41: Upper Monocacy Municipal Sanitary Sewer

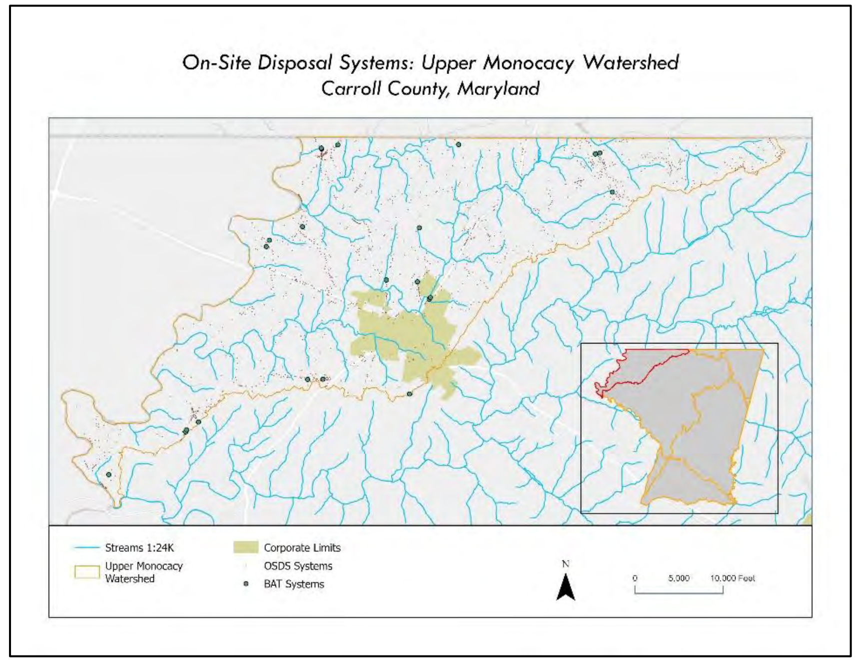


Figure 42: Upper Monocacy On-Site Disposal Systems

d. Lower Monocacy Watershed

Within the Lower Monocacy Watershed, the wastewater service area is located throughout the developed headwater areas of the South Fork subwatershed. The Town of Mount Airy WWTP is located within the South Branch Patapsco Watershed, and effluent is discharged into the South Branch Patapsco River. **Figure 43** shows the extent of the sanitary sewer infrastructure within the Lower Monocacy Watershed.

Additionally, there are approximately 1,100 OSDS systems within the watershed, with none to date being upgraded to BAT. **Figure 44** shows the OSDS and BAT systems and their distribution within the watershed.

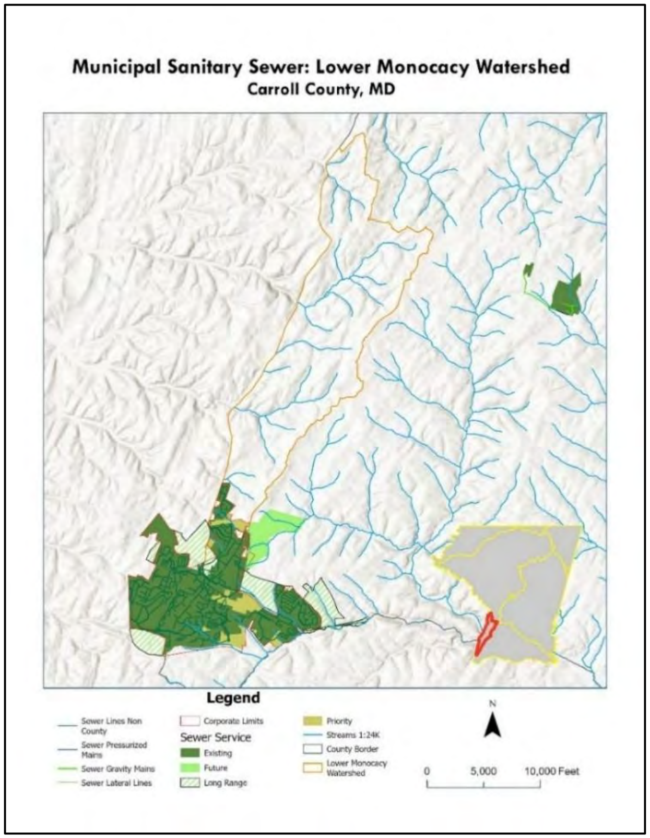


Figure 43: Lower Monocacy Municipal Sanitary Sewer

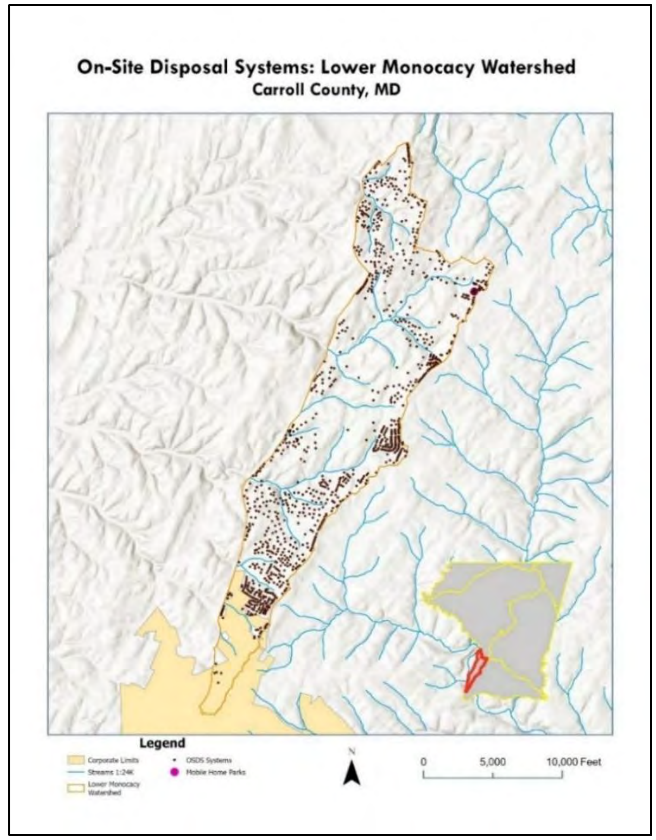


Figure 44: Lower Monocacy On-Site Disposal Systems

e. Liberty Reservoir Watershed

Within the Liberty Reservoir Watershed, wastewater service areas are located within the headwaters regions of Deep Run, East Branch Patapsco, Beaver Run and Little Morgan Run. Only the Freedom area and a portion of Hampstead’s effluent is discharged within the watershed. **Figure 45** shows the extent of the sanitary sewer infrastructure within the Liberty Reservoir Watershed.

Additionally, there are approximately 16,000 OSDS systems within the watershed, with 100 (0.6%) of them being updraded to BAT. **Figure 46** shows the OSDS and BAT systems and their distribution within the watershed.

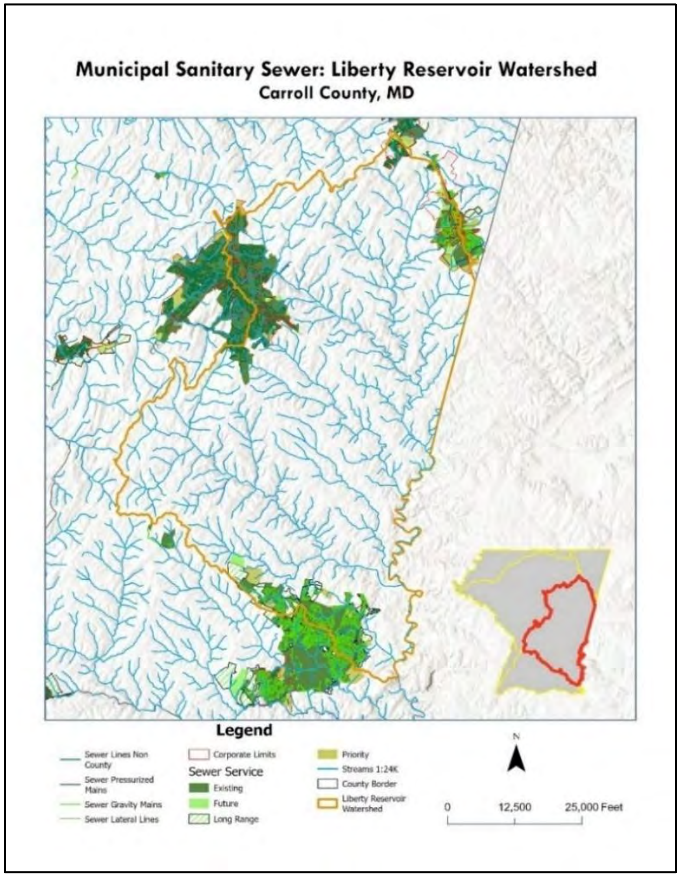


Figure 45: Liberty Reservoir Municipal Sanitary Sewer

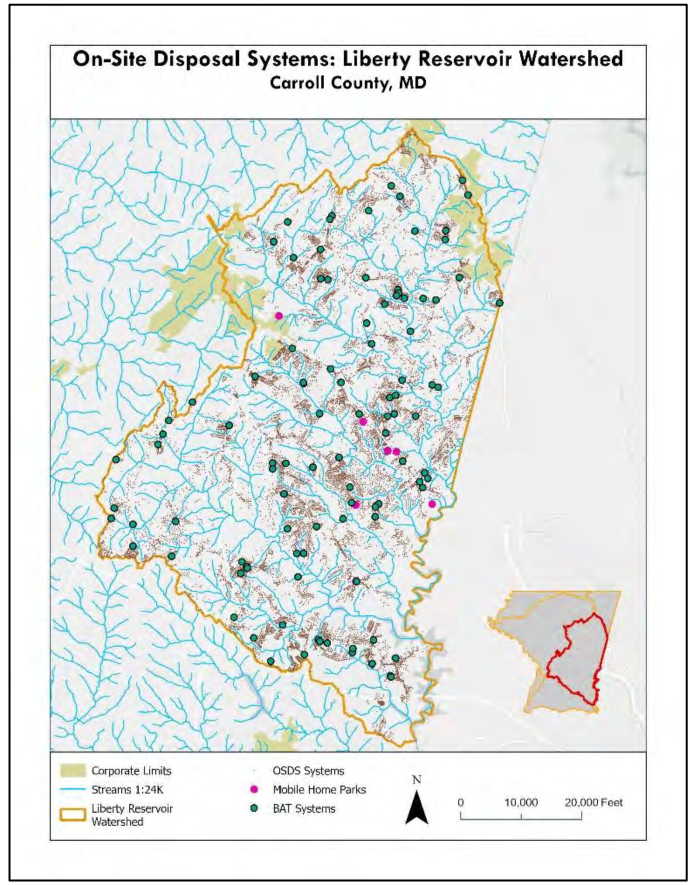


Figure 46: Liberty Reservoir On-Site Disposal Systems

f. Double Pipe Creek Watershed

Within the Double Pipe Creek Watershed, wastewater service areas are located throughout the Little Pipe Creek subwatershed, including the City of Westminster as well as the Town's of New Windsor and Union Bridge. Smaller service areas are present from the City of Taneytown and the Town of Manchester within a few headwater areas of Big Pipe Creek. **Figure 47** shows the extent of the sanitary sewer infrastructure within the Double Pipe Creek Watershed.

Additionally, there are approximately 8,400 OSDS systems within the watershed, with 89 (1.1%) of them being upgraded to BAT. **Figure 48** shows the OSDS and BAT systems and their distribution within the watershed.

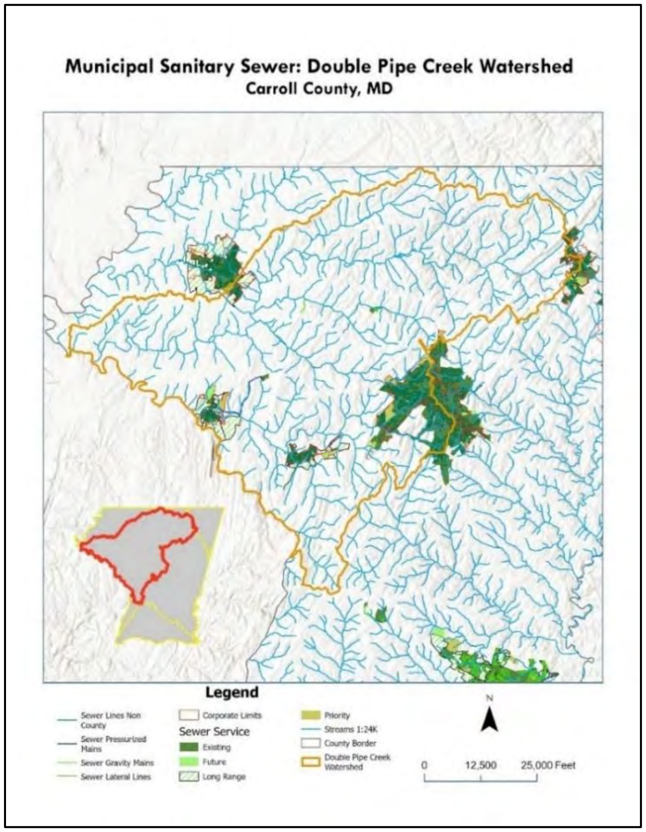


Figure 47: Double Pipe Creek Municipal Sanitary Sewer

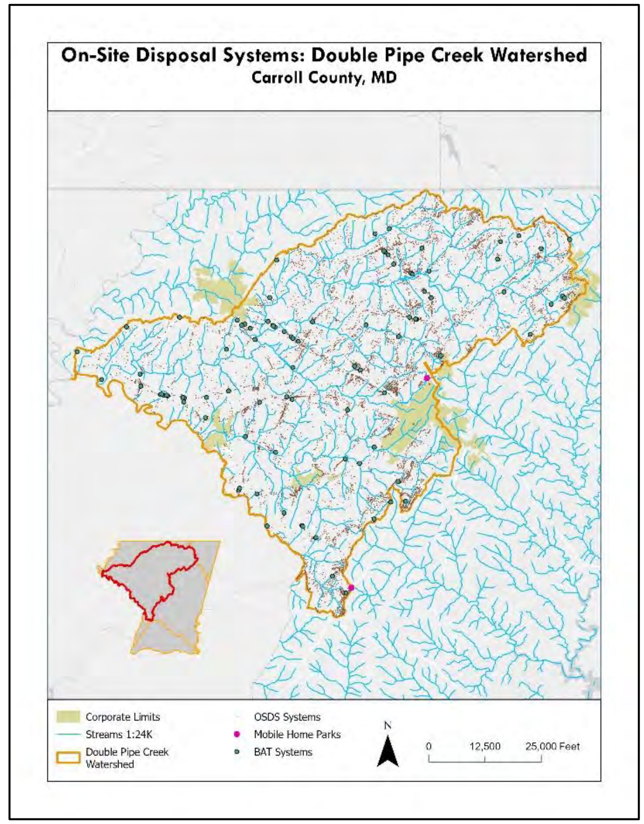


Figure 48: Double Pipe Creek On-Site Disposal Systems

2. Non-Human Source Reduction

The County's MS4 program is actively retrofitting older stormwater facilities, and in many cases, converting wet stormwater or detention ponds to dry facilities. The conversion of stormwater wet ponds to dry facilities through the County's MS4 permit will assist in reducing potential avian and other wildlife sources of bacteria.

Additionally, bacteria contributions from domestic pets can potentially have a significant impact on receiving water bodies from runoff carrying waste into nearby streams through the storm drain system. The County anticipates reductions from domestic pet sources to occur through education and outreach of the importance of eliminating this potential source.

3. Natural Resource Areas

Carroll County is located entirely within the Piedmont and does not include any designated public beaches or MDE designated shellfish areas.

C. Bacteria TMDL Watersheds – Carroll County

The County currently monitors 22 trend sites on a monthly basis across six 8-digit watersheds within the County that have an approved bacteria TMDL. Bacteria TMDL monitoring locations across the County are shown in **Figure 49.**

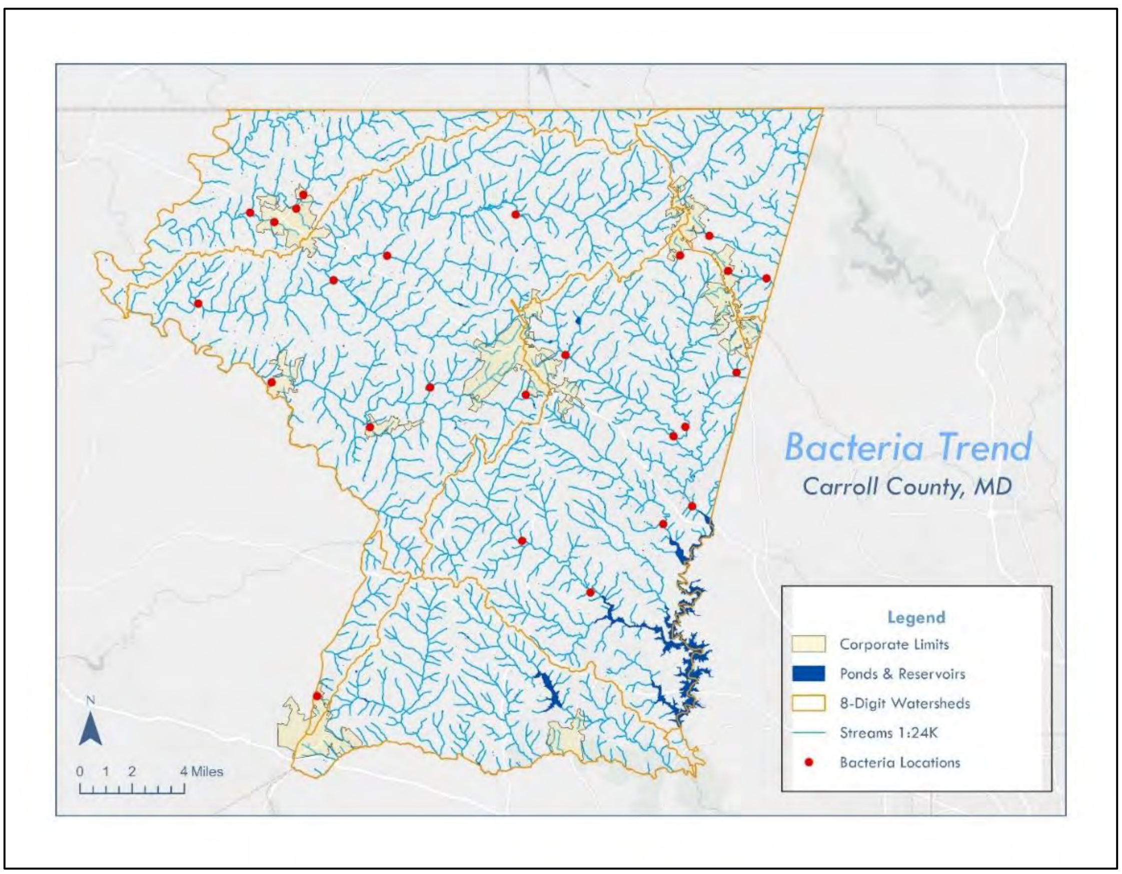


Figure 49: Carroll County Bacteria TMDL Monitoring Locations

X. Watershed Assessment and Trends Monitoring

Watershed Assessment monitoring requires permittees to conduct biological, bacteria, and conductivity monitoring throughout the jurisdiction. Results of monitoring will be used to evaluate the effects of BMP implementation, salt management practices, and bacteria control strategies to assess the overall health of biological communities in these watersheds. The overall goal is to evaluate the effects of BMP implementation and other management strategies on local water quality.

For bacteria sample results, FY2025 was the first year that incorporated 100x extended dilution for each sample collected during high flow conditions. This increased resolution may skew the overall trend results when compared to the previous sampling seasons, as the reporting limit increased from a maximum result of 2,420 MPN/100mL to 242,000 MPN/100mL.

A. Bacteria TMDL Trend Monitoring

1. Loch Raven Watershed

The Loch Raven Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2008. The 2008 bacteria listing was addressed with a TMDL that was developed and approved in December of 2009 (MDE 2009).

a. Loch Raven Trend Monitoring Locations

The Loch Raven Watershed within Carroll County is relatively small, consisting of a total drainage area of 332 acres. Currently, the County's long-term BMP effectiveness monitoring outfall and associated instream station are located within the watershed, and all associated bacteria monitoring data for this watershed is reported within the BMP effectiveness monoitoring section of the County's NPDES MS4 Annual Report.

2. Prettyboy Reservoir Watershed

The Prettyboy Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2002. The 2002 bacteria listing was addressed with a TMDL that was developed and approved in October of 2009 (MDE 2009).

a. Prettyboy Trend Monitoring Locations

The Prettyboy Watershed includes three bacteria trend monitoring locations. Two sites are located within the Murphy Run subwatershed, and the third is located within the George's Run Watershed.

i. GMR04

GMR04 is located off Gross Mill Road off of Upper Beckleysville Road, and has a total drainage area of 1,738 acres. The primary land cover within the drainage area is mixed low vegetation at 53%. Forest cover accounts for 36%, and impervious surfaces cover approximately 11% of the drainage area.

ii. GMR05

GMR05 is located off Greenmount Church Road near Gallery Court in the town of Hampstead, and has a total drainage area of 493 acres. The primary land cover within the drainage area is mixed low vegetation at 57%. Forest cover accounts for 27%, and impervious surfaces cover approximately 15% of the drainage area.

iii. GMR06

GMR06 is located off Maple Grove Road, and has a total drainage area of 740 acres. The primary land cover within the drainage area is mixed low vegetation at 57%. Forest cover accounts for 30%, and impervious surfaces cover approximately 13% of the drainage area.

The Prettyboy bacteria trend monitoring locations are shown in **Figure 50.**

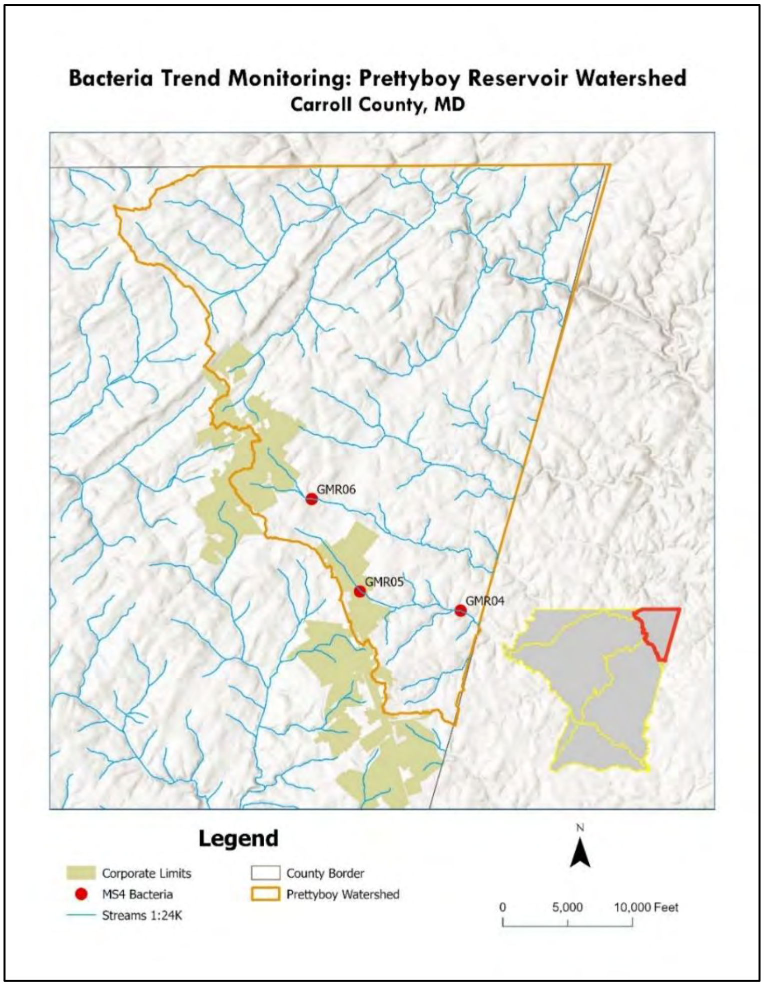


Figure 50: Prettyboy Bacteria Monitoring Locations

b. Prettyboy Trend Monitoring Results

Monitoring results for bacteria trend sampling within the Prettyboy Reservoir Watershed are shown below. For each site, **Table 35** lists the number of samples collected by flow type for the entire sampling year, and **Table 36** lists the number of samples collected by flow type for seasonal bacteria monitoring, May 1 – September 30.

Additionally, for each monitoring location, **Figures 51** through **56** show the annual and seasonal geometric means under low flow conditions, as well as all samples collected during the year under all flow conditions.

Table 35: Prettyboy Bacteria Monitoring Annual Data

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
GRM04	Low	11	150	10	220	8	150
	High	1	2420	3	100	5	275
	All	12	189	13	183	13	190
GMR05	Low	11	66	6	171	--	--
	High	1	1990	1	816	--	--
	All	12	88	7	213	--	--
GMR06	Low	--	--	--	--	3	332
	High	--	--	--	--	1	276
	All	--	--	--	--	4	317

Table 36: Prettyboy Bacteria Monitoring Seasonal Data (May 1 – September 30)

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
GRM04	Low	5	225	5	531	3	422
	High	0	--	0	--	2	318
	All	5	225	5	531	5	377
GMR05	Low	5	188	3	516	--	--
	High	0	--	0	--	--	--
	All	5	188	3	516	--	--
GMR06	Low	--	--	--	--	1	980
	High	--	--	--	--	1	276
	All	--	--	--	--	2	520

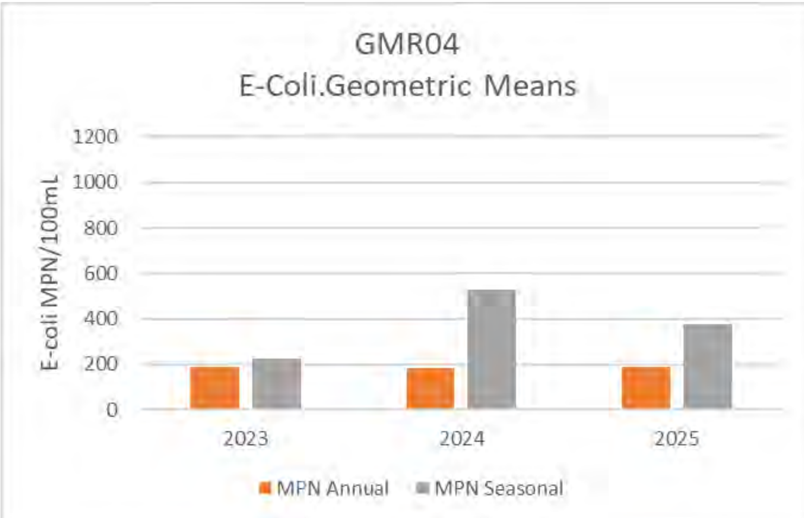


Figure 51: GMR04 Bacteria Monitoring Trends

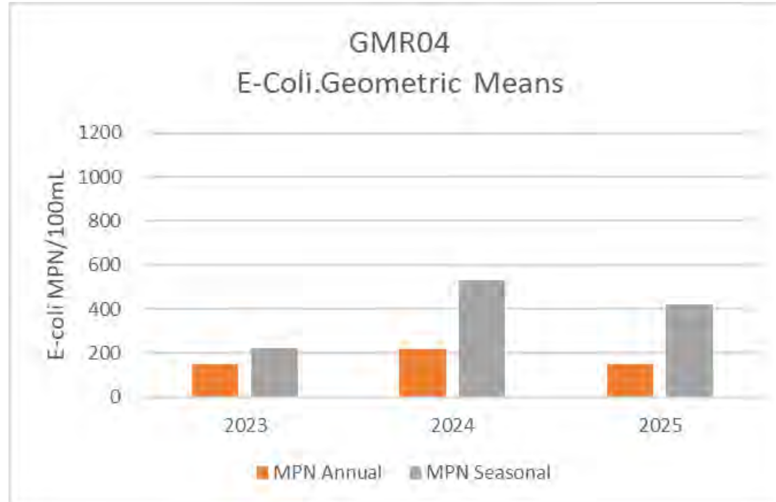


Figure 52: GMR04 Bacteria Monitoring Trends (Low Flow)

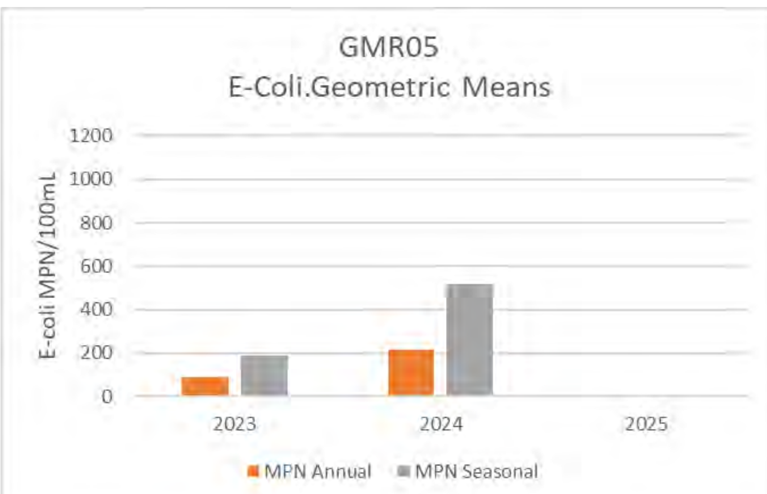


Figure 53: GMR05 Bacteria Monitoring Trends

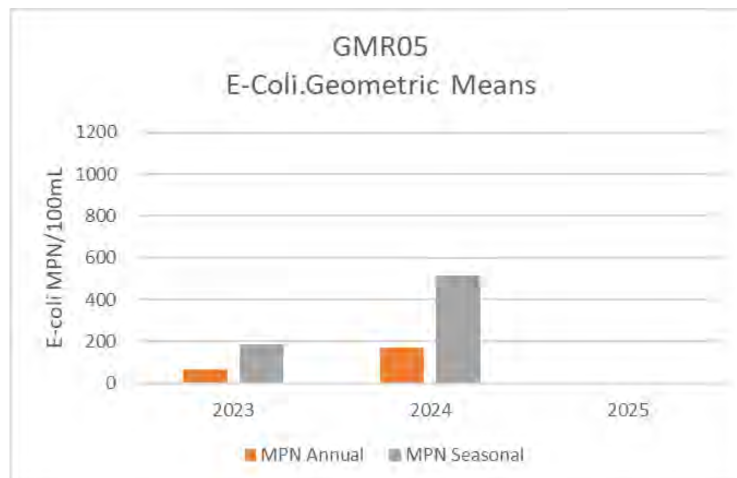


Figure 54: GMR05 Bacteria Monitoring Trends (Low Flow)

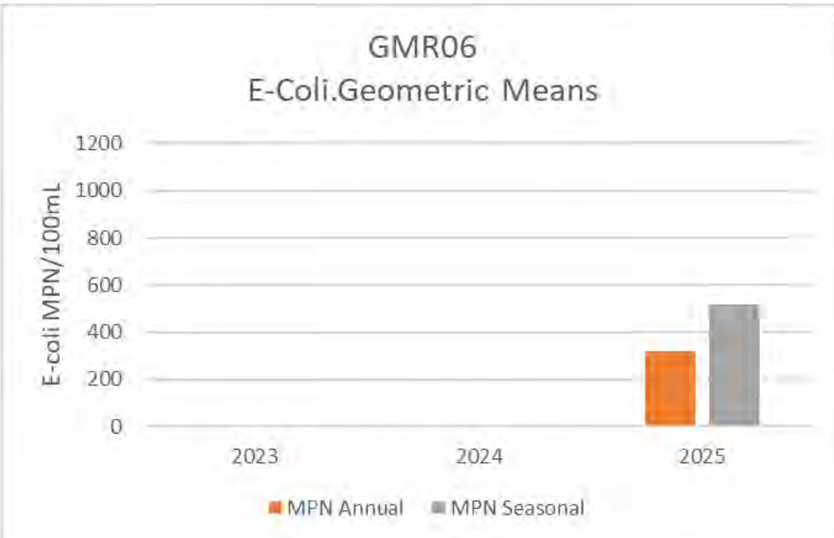


Figure 55: GMR06 Bacteria Monitoring Trends

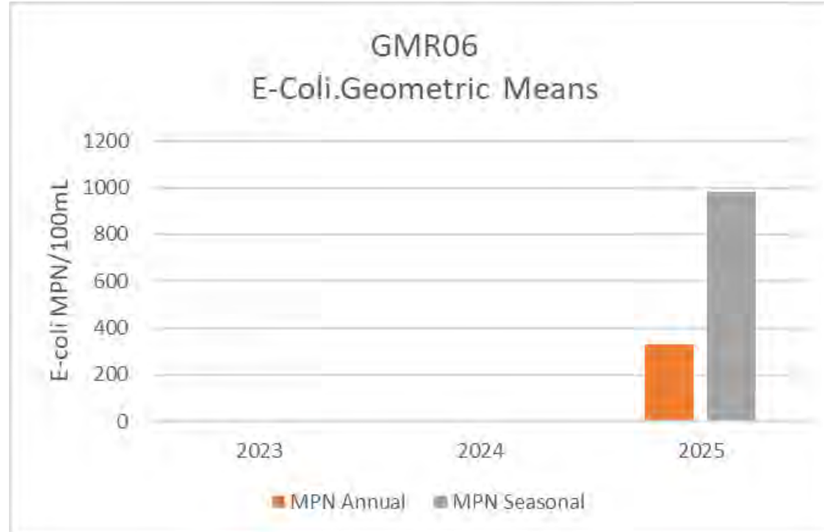


Figure 56: GMR06 Bacteria Monitoring Trends (Low Flow)

In addition to the annual and seasonal geometric mean calculations, each individual bacteria sample was compared to the single sample density exceedance criteria for human health, as presented in **Table 27**, which are based on full body contact in freshwater.

The single sample density of each sample collected over the previous sampling year are shown in **Figures 57 and 58**. Additionally, results from samples collected during high flow events are shown in red.

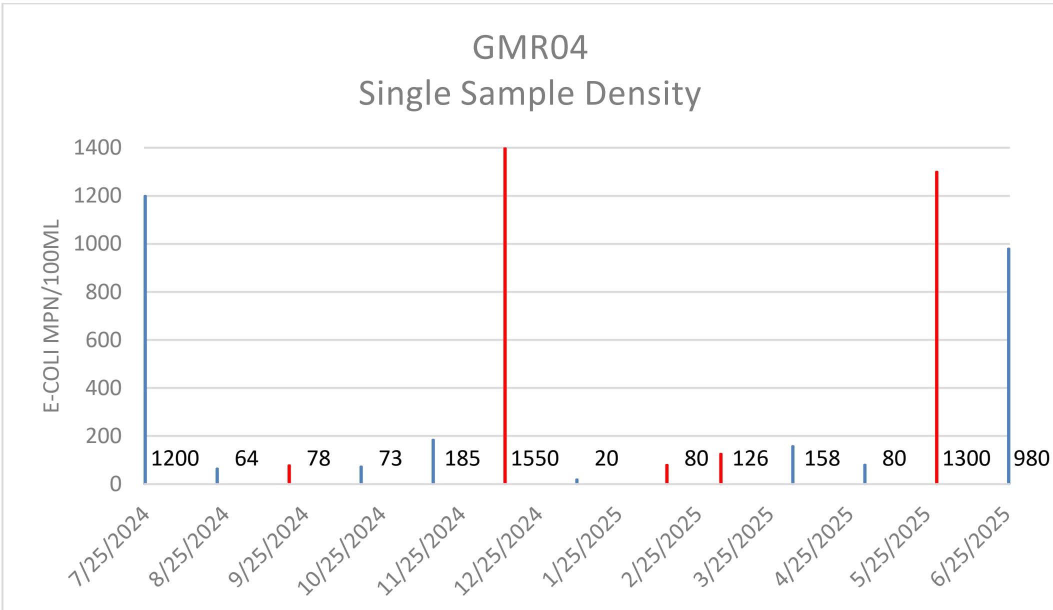


Figure 57: GMR04 Single Sample Density

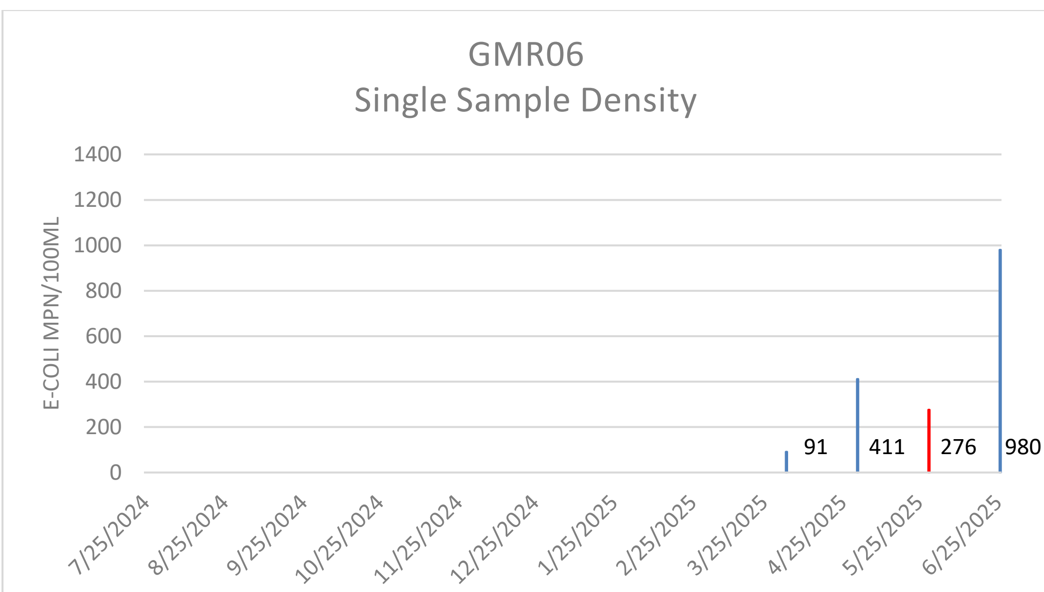


Figure 58: GMR06 Single Sample Density

3. Upper Monocacy Watershed

The Upper Monocacy Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2002. The 2002 bacteria listing was addressed with a TMDL that was developed and approved in December of 2009 (MDE 2009).

a. Upper Monocacy Trend Monitoring Locations

The Upper Monocacy Watershed includes four (4) bacteria trend monitoring locations. All four sites are located within the Piney Creek subwatershed. Two locations are on first order streams within corporate limits and the other two are located on the Piney Creek mainstem, one above, and one below the corporate limits of the City of Taneytown.

i. PIC01

PIC01 is located at the end of Obrien Avenue in the City of Taneytown, and has a total drainage area of 392 acres. The primary land cover within the drainage area is mixed low vegetation at 53%. Forest cover accounts for 21%, and impervious surfaces cover approximately 23% of the drainage area.

ii. PIC04

PIC04 is located off Frederick Street / Francis Scott Key Highway within the City of Taneytown behind the Taneytown Memorial Park in an open field adjacent to a small corporate center, and has a total drainage area of 493 acres. The primary land cover within the drainage area is mixed low vegetation at 51%. Forest cover accounts for 20%, and impervious land cover accounts for 28% of the drainage area.

iii. PIC07

PIC07 is located off Whippoorwill Drive, and has a total drainage area of 18,350 acres. This watershed originates in Pennsylvania, and 13,922 acres (76%) is within Carroll County. The primary land cover within the drainage area is mixed low vegetation at 68%. Forest cover accounts for 27%, and impervious land cover accounts for 4.7% of the drainage area within Carroll County.

iv. PIC09

PIC09 is located off Francis Scott Key Highway, and has a total drainage area of 13,631 acres. This watershed originates in Pennsylvania, and 9,203 acres (68%) is within Carroll County. The primary land cover within the drainage area is mixed low vegetation at 69%. Forest cover accounts for 28%, and impervious land cover accounts for 2.2% of the drainage area within Carroll County.

The bacteria trend monitoring locations within the Upper Monocacy Watershed are shown in **Figure 59.**

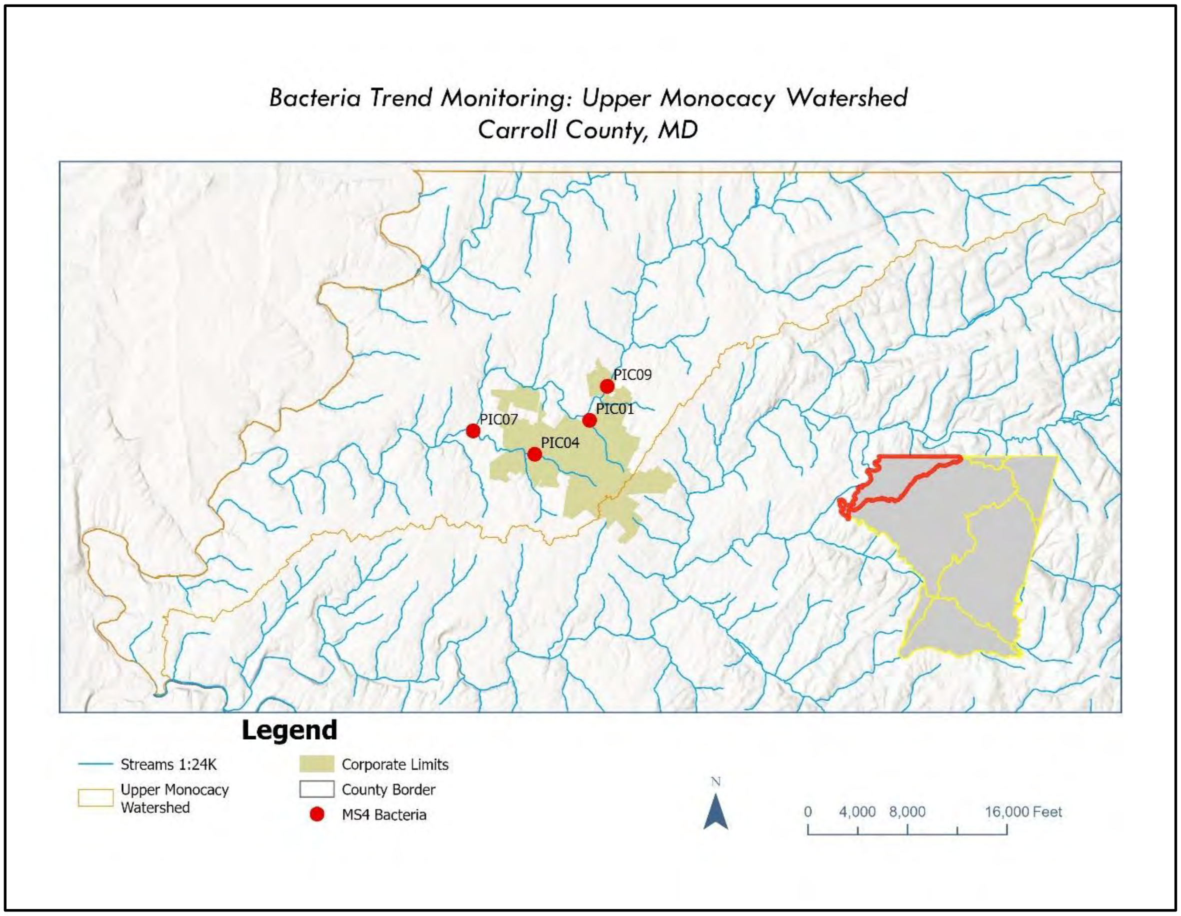


Figure 59: Upper Monocacy Bacteria Monitoring Locations

b. Upper Monocacy Trend Monitoring Results

Monitoring results for bacteria trend sampling within the Upper Monocacy Watershed are shown below. **Table 37** lists the number of samples collected by flow type for the entire sampling year for each site. **Table 38** lists the number of samples collected by flow type for seasonal bacteria monitoring, May 1 – September 30.

Additionally, for each monitoring location, **Figures 60** through **67** show the annual and seasonal geometric means under low flow conditions, as well as all samples collected during the year under all flow conditions.

Table 37: Upper Monocacy Bacteria Monitoring Annual Data

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
PIC01	Low	9	109	10	120	8	83
	High	3	408	1	1200	4	582
	All	12	152	11	148	12	158
PIC04	Low	10	288	9	128	9	106
	High	3	815	1	1990	4	1507
	All	13	366	10	168	13	241
PIC07	Low	10	196	10	166	9	239
	High	3	957	1	2420	4	1130
	All	13	282	11	212	13	385
PIC09	Low	--	--	5	286	9	267
	High	--	--	--	--	4	1616
	All	--	--	5	286	13	465

Table 38: Upper Monocacy Bacteria Monitoring Seasonal Data (May 1 – September 30)

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
PIC01	Low	3	707	3	507	3	282
	High	2	879	1	1200	2	1540
	All	5	840	4	629	5	556
PIC04	Low	4	832	3	322	3	953
	High	1	2420	1	1990	2	1540
	All	5	1030	4	508	5	1155
PIC07	Low	4	336	3	460	3	497
	High	1	2420	1	2420	2	2142
	All	5	499	4	696	5	892
PIC09	Low	--	--	1	2420	3	461
	High	--	--	--	--	2	3902
	All	--	--	1	2420	5	1084

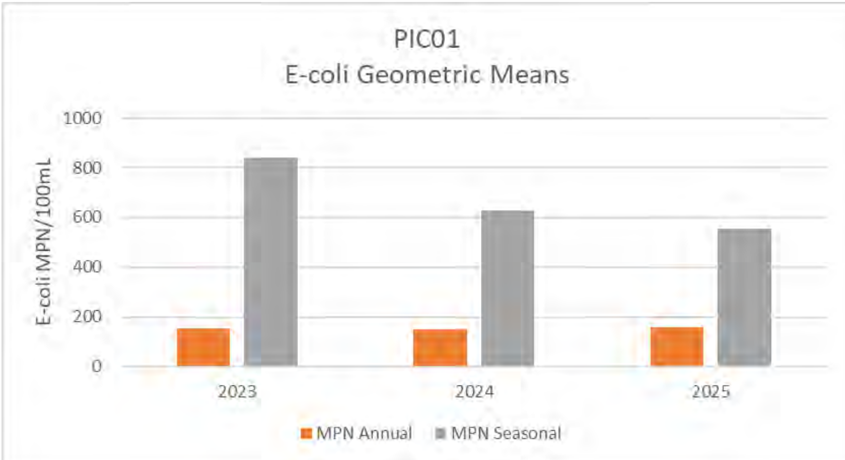


Figure 60: PIC01 Bacteria Monitoring Trends

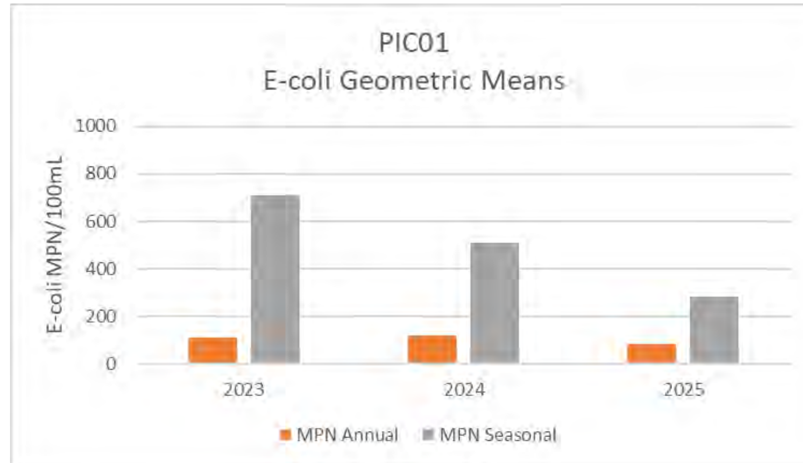


Figure 61: PIC01 Bacteria Monitoring Trends (Low Flow)

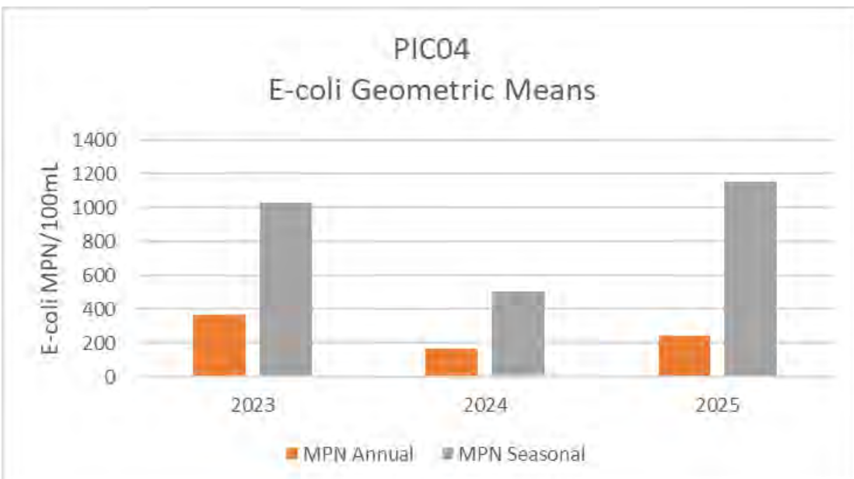


Figure 62: PIC04 Bacteria Monitoring Trends

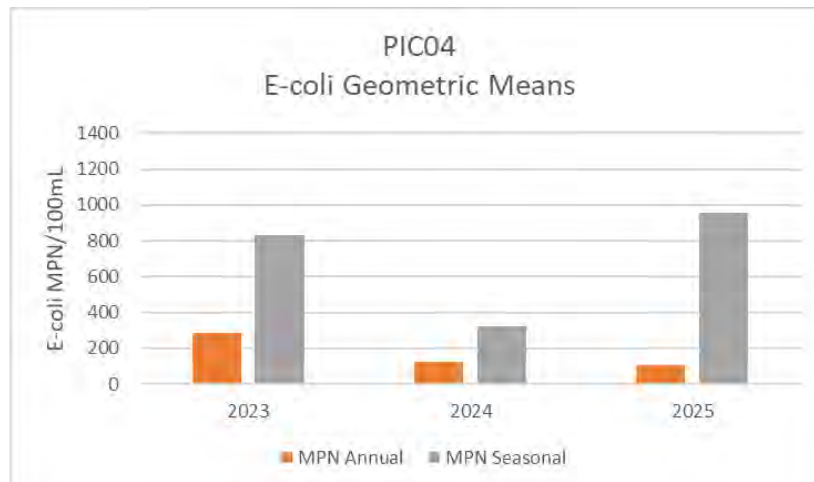


Figure 63: PIC04 Bacteria Monitoring Trends (Low Flow)

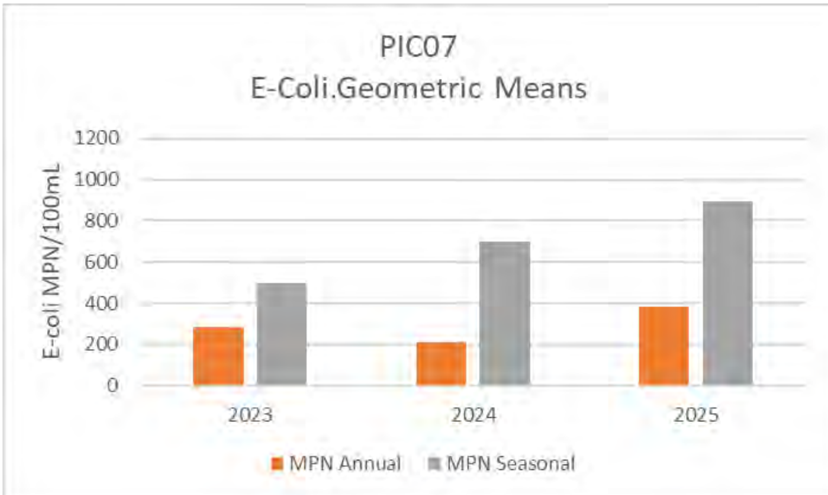


Figure 64: PIC07 Bacteria Monitoring Trends

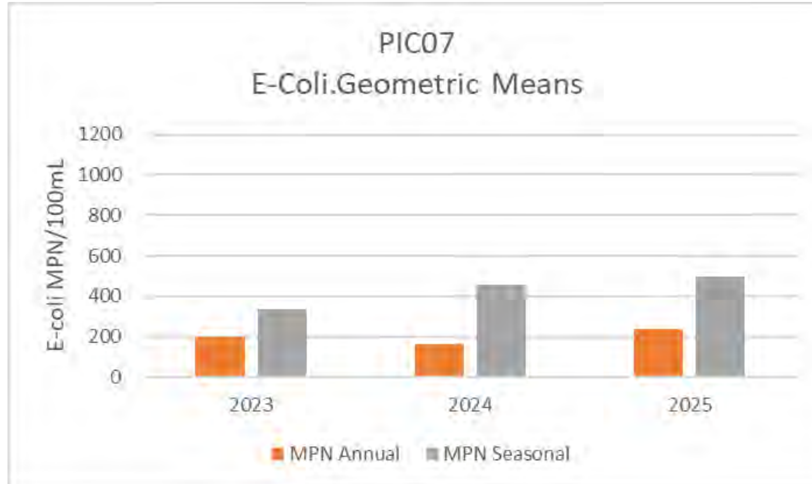


Figure 65: PIC07 Bacteria Monitoring Trends (Low Flow)

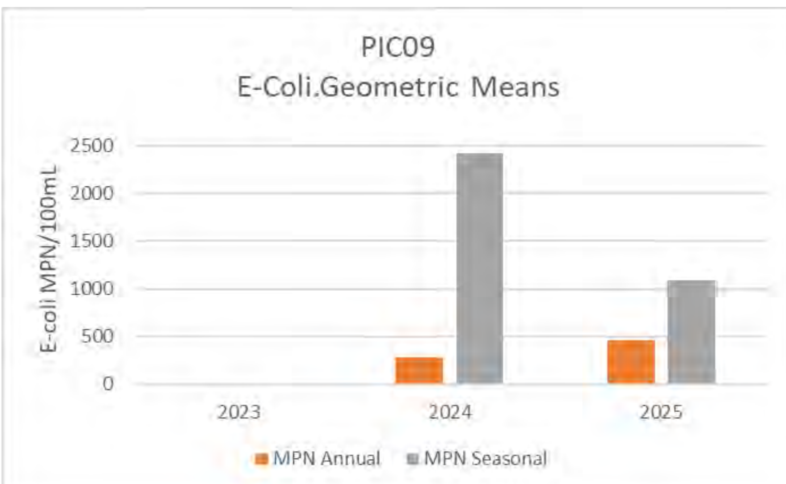


Figure 66: PIC09 Bacteria Monitoring Trends

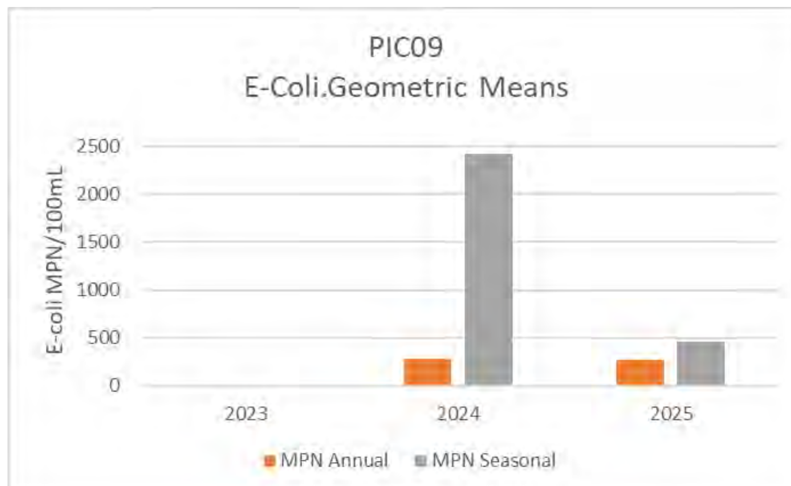


Figure 67: PIC09 Bacteria Monitoring Trends (Low Flow)

In addition to the annual and seasonal geometric mean calculations, each individual bacteria sample was compared to the single sample density exceedance criteria for human health, as presented in **Table 27**, which are based on full body contact in freshwater.

The single sample density of each sample collected over the previous sampling year is shown in **Figures 68** through **71**. Additionally, results from samples collected during high flow events are shown in red.

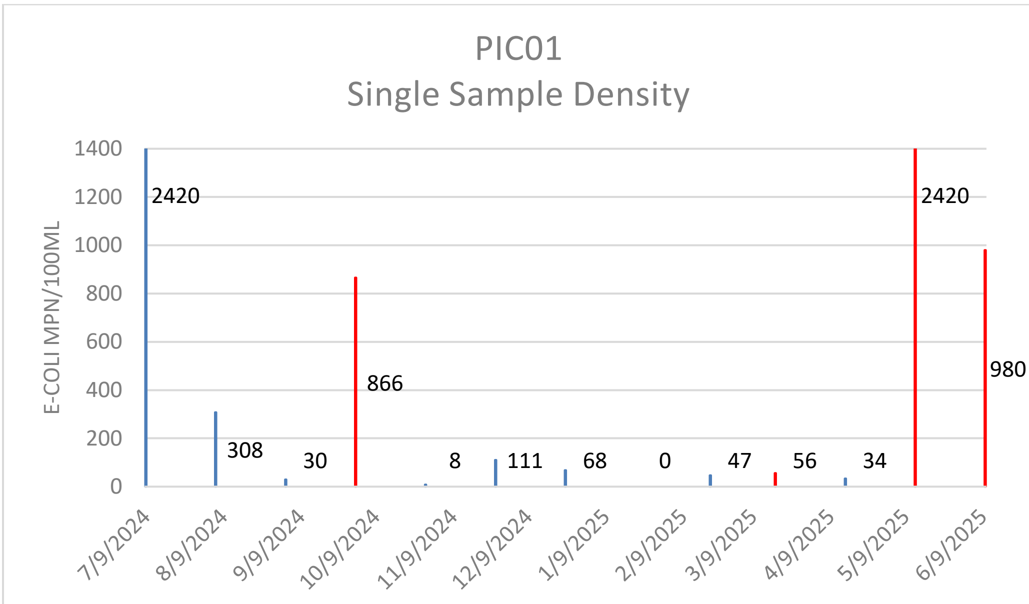


Figure 68: PIC01 Single Sample Density

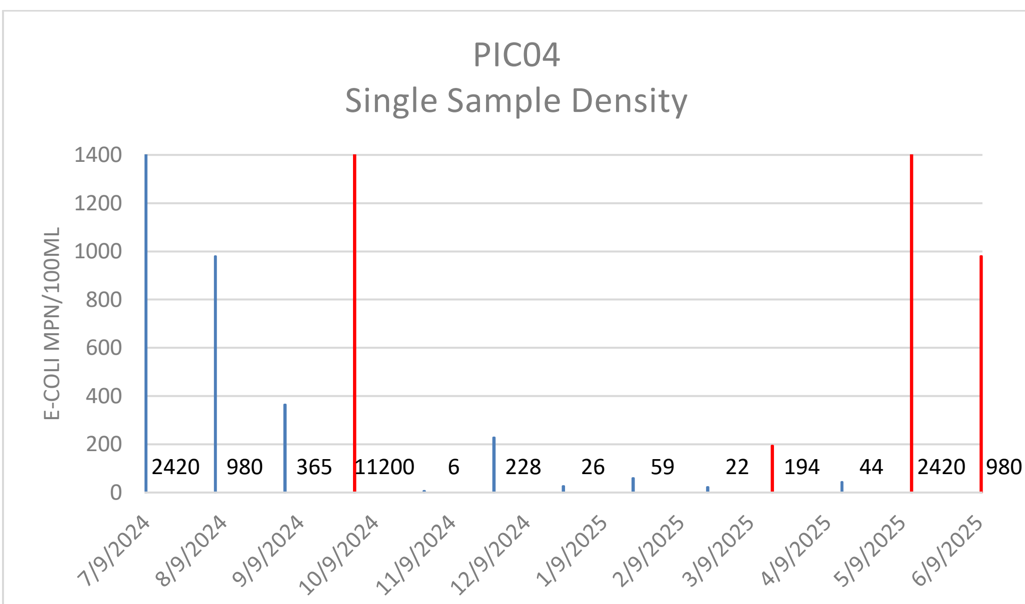


Figure 69: PIC04 Single Sample Density

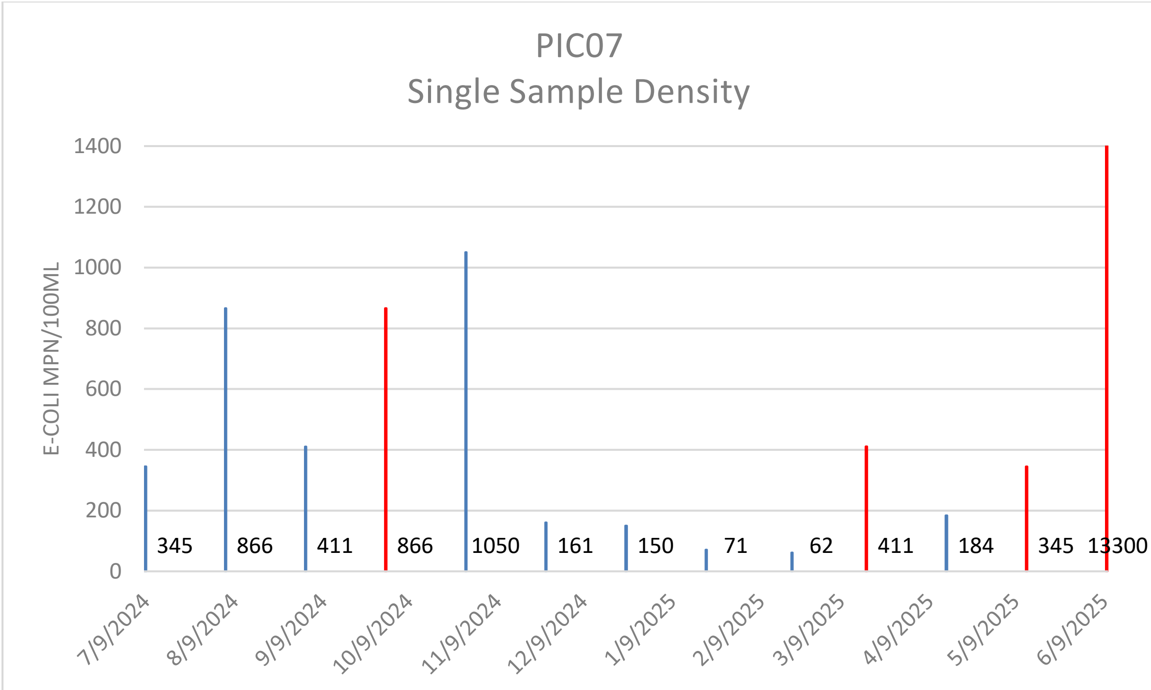


Figure 70: PIC07 Single Sample Density

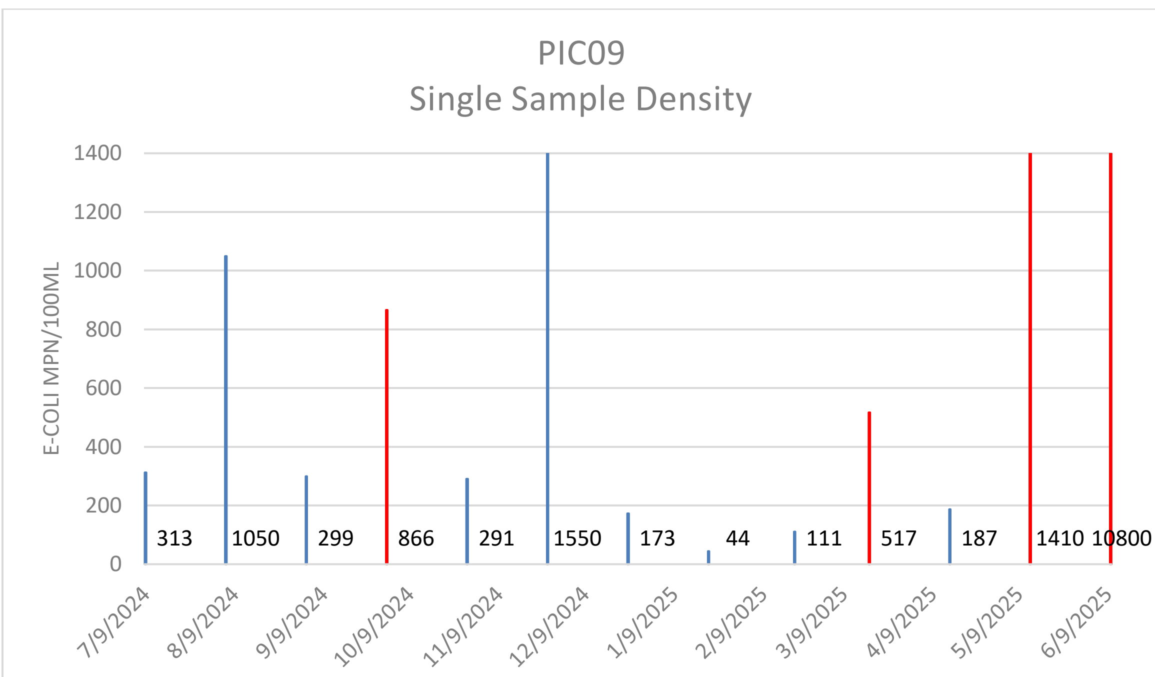


Figure 71: PIC09 Single Sample Density

4. Lower Monocacy Watershed

The Lower Monocacy Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2002. The 2002 bacteria listing was addressed with a TMDL that was developed and approved in December of 2009 (MDE 2009).

a. Lower Monocacy Trend Monitoring Locations

The Lower Monocacy Watershed includes one bacteria trend monitoring location. This location is on a first order stream within the Town of Mount Airy, and is located on the Carroll/Frederick County line.

i. SOF01

SOF01 has a total drainage area of 151 acres and is located at the end of Candice Drive across from Terra Oaks Court by Buffalo Road, within the Town of Mount Airy. The primary land cover within the drainage area is mixed low vegetation at 54%. Forest cover accounts for 26%, and impervious land cover accounts for 18.5% of the drainage area.

The bacteria trend monitoring location for the Lower Monocacy Watershed is shown in **Figure 72.**

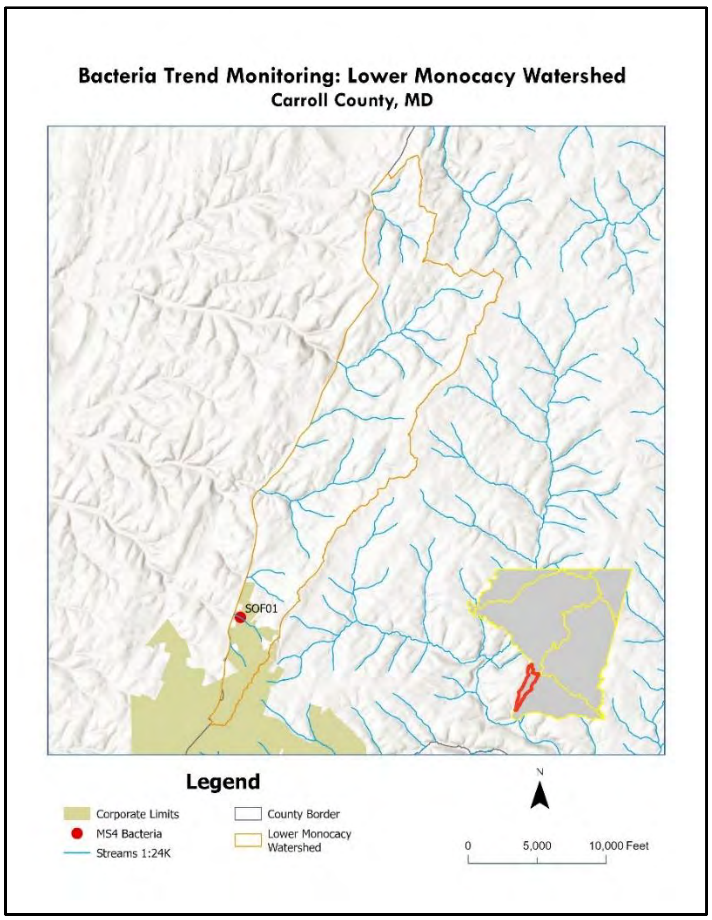


Figure 72: Lower Monocacy Bacteria Monitoring Location

b. Lower Monocacy Trend Monitoring Results

Monitoring results for bacteria trend sampling within the Lower Monocacy Watershed are shown in the following tables and figures. For each site, **Table 39** lists the number of samples collected by flow type for the entire sampling year, and **Table 40** lists the number of samples collected by flow type for seasonal bacteria monitoring, May 1 – September 30.

Additionally, for each monitoring location, **Figures 73 and 74** show the annual and seasonal geometric means under low flow conditions, as well as all samples collected during the year under all flow conditions.

Table 39: Lower Monocacy Bacteria Monitoring Annual Data

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
SOF01	Low	10	109	11	111	9	104
	High	3	445	1	93	4	539
	All	13	150	12	110	13	173

Table 40: Lower Monocacy Bacteria Monitoring Seasonal Data (May 1 – September 30)

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
SOF01	Low	4	157	4	116	3	210
	High	1	2420	1	93	2	851
	All	5	272	5	111	5	367

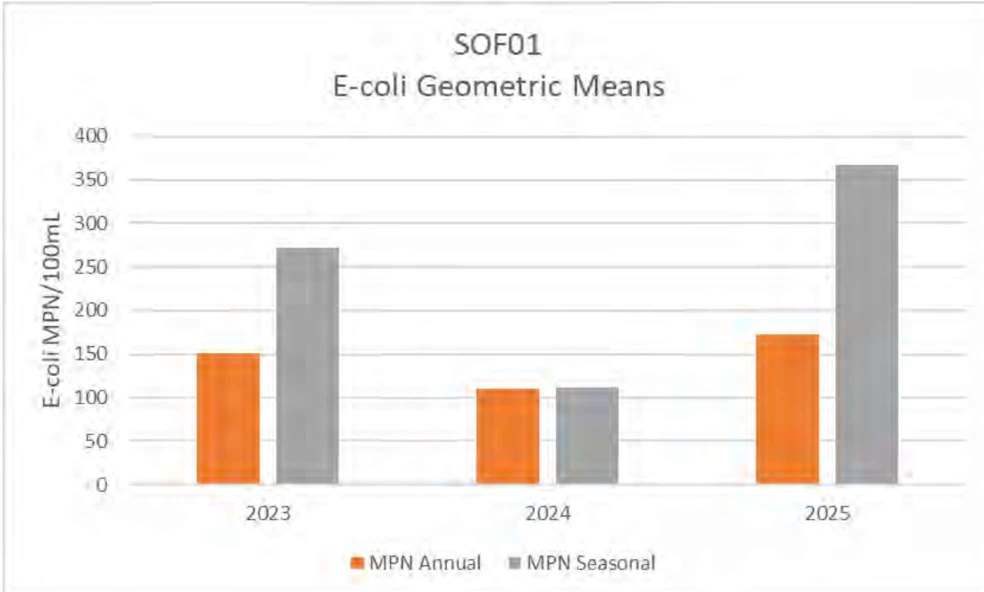


Figure 73: SOF01 Bacteria Monitoring Trends

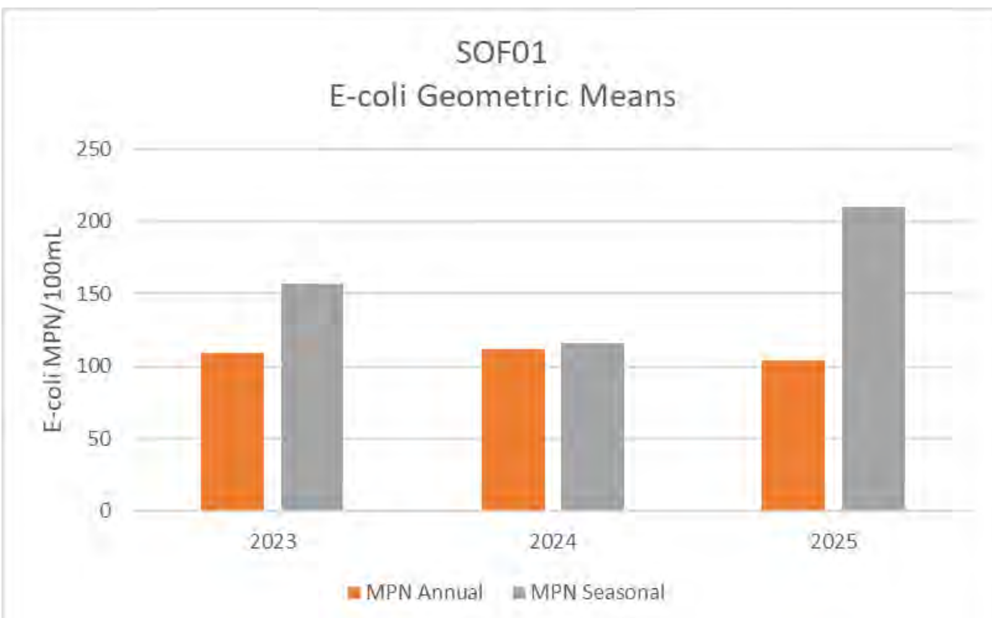


Figure 74: SOF01 Bacteria Monitoring Trends (Low Flow)

In addition to the annual and seasonal geometric mean calculations, each individual bacteria sample was compared to the single sample density exceedance criteria for human health, as presented in **Table 27**, which are based on full body contact in freshwater.

The single sample density of each sample collected over the previous sampling year is shown in **Figure 75**. Additionally, results from samples collected during high flow events are shown in red.

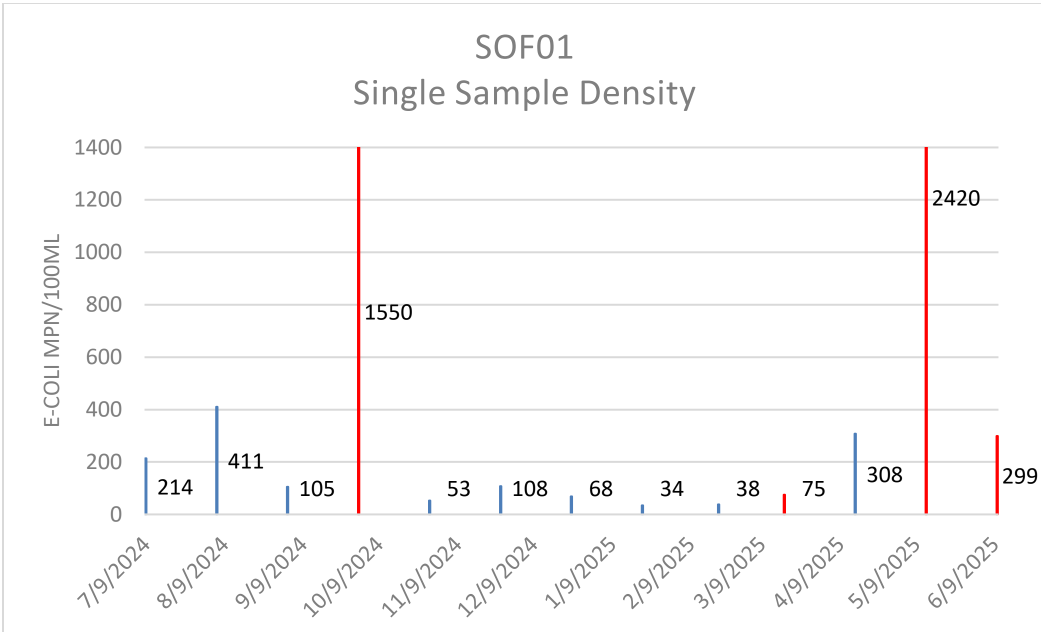


Figure 75: SOF01 Single Sample Density

5. Liberty Reservoir Watershed

The Liberty Reservoir Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2002. The 2002 bacteria listing was addressed with a TMDL that was developed and approved in December of 2009 (MDE 2009).

a. Liberty Reservior Trend Monitoring Locations

The Liberty Reservoir Watershed includes seven bacteria trend monitoring locations. Two locations are located within the Morgan Run subwatershed, one in the Beaver Run subwatershed, and the remaining four locations are within the Patapsco drainage, which include both the Eastern and Western Lower Patapsco subwatersheds.

i. BVR02

BVR02 is located off Hughes Road off of Gamber Road, and has a total drainage area of 8,999 acres. The primary land cover within the drainage area is mixed low vegetation at 49%. Forest cover accounts for 41%, and impervious land cover accounts for 9.3% of the drainage area.

ii. MGR01

MGR01 is located off London Bridge Road, and has a total dainage area of 17,988 acres. The primary land cover within the drainage area is mixed low vegetation at 51%. Forest cover accounts for 44%, and impervious land cover accounts for 4.6% of the drainage area.

iii. MGR02

MGR02 is located off Old Washington Road, and has a total drainage area of 10,013 acres. The primary land cover within the drainage area is mixed low vegetation at 59%. Forest cover accounts for 36%, and impervious land cover accounts for 4.4% of the drainage area.

iv. RR01

RR01is located at a dead end turn off Cedarhurst Road off of Emory Road, and has a total drainage area of 35,178 acres. The primary land cover within the drainage area is mixed low vegetation at 51%. Forest cover accounts for 39%, and impervious land cover accounts for 8.8% of the drainage area.

v. EPR04

EPR04 is located off Patapsco Road, and has a total drainage area of 13,171 acres. The primary land cover within the drainage area is mixed low vegetation at 54%. Forest cover accounts for 39%, and impervious land cover accounts for 6.4% of the drainage area.

vi. WPL05

WPL05 is located off Wesley Road, and has a total drainage area of 13,142 acres. The primary land cover within the drainage area is mixed low vegetation at 48%. Forest cover accounts for 39%, and impervious land cover accounts for 12.1% of the drainage area.

vii. WPL06

WPL06 is located off Lucabaugh Mill Road, and has a total drainage area of 3,921 acres. The primary land cover within the drainage area is mixed low vegetation at 53%. Forest cover accounts for 22%, and impervious land cover accounts for 23.9% of the drainage area.

The Liberty Reservoir bacteria trend monitoring locations are shown in **Figure 76.**

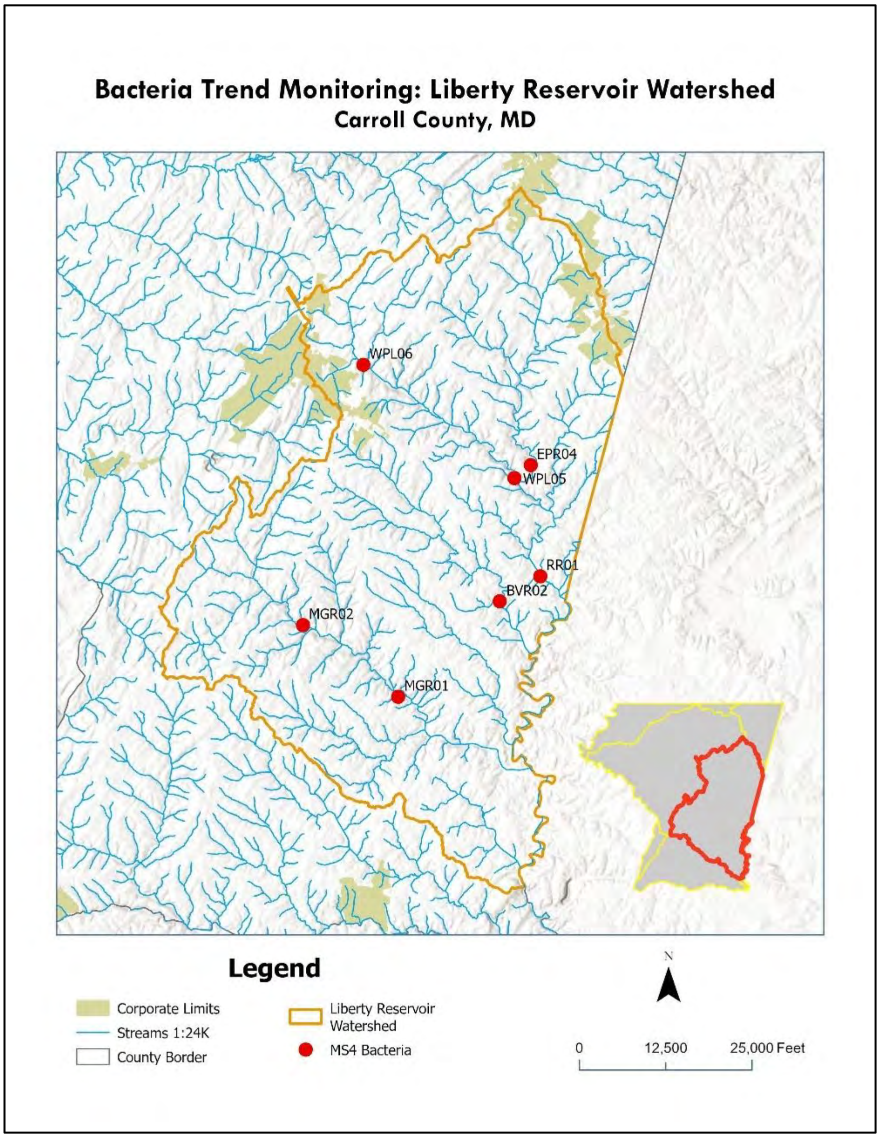


Figure 76: Liberty Reservoir Bacteria Monitoring Location

b. Liberty Reservoir Trend Monitoring Results

Monitoring results for bacteria trend sampling within the Liberty Reservoir Watershed are shown below. **Table 41** lists the number of samples collected by flow type for the entire sampling year for each site. **Table 42** lists the number of samples collected by flow type for seasonal bacteria monitoring, May 1 – September 30.

Additionally, for each monitoring location, **Figures 77** through **90** show the annual and seasonal geometric means under low flow conditions, as well as all samples collected during the year under all flow conditions.

Table 41: Liberty Bacteria Monitoring Annual Data

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
BVR02	Low	11	77	10	179	8	90
	High	1	111	3	194	5	750
	All	12	79	13	182	13	203
MGR01	Low	--	--	4	54	8	59
	High	--	--	2	116	5	343
	All	--	--	6	69	13	115
MGR02	Low	--	--	4	130	8	72
	High	--	--	2	109	5	287
	All	--	--	6	123	13	123
RR01	Low	11	115	10	125	8	165
	High	1	980	3	125	5	716
	All	12	137	13	125	13	290
EPR04	Low	--	--	3	179	8	111
	High	--	--	1	461	5	444
	All	--	--	4	227	13	189
WPL05	Low	--	--	4	138	8	127
	High	--	--	2	215	5	388
	All	--	--	6	160	13	195
WPL06	Low	--	--	4	132	8	116
	High	--	--	2	91	5	445
	All	--	--	6	117	13	195

Table 42: Liberty Bacteria Monitoring Seasonal Data (May 1 – September 30)

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
BVR02	Low	5	155	5	536	3	705
	High	0	--	0	--	2	547
	All	5	155	5	536	5	637
MGR01	Low	--	--	2	77	3	229
	High	--	--	0	--	2	293
	All	--	--	2	77	5	253
MGR02	Low	--	--	2	298	3	309
	High	--	--	0	--	2	335
	All	--	--	2	298	5	319
RR01	Low	5	186	5	197	3	805
	High	0	--	0	--	2	1386
	All	5	186	5	197	5	1001
EPR04	Low	--	--	2	301	3	320
	High	--	--	0	--	2	917
	All	--	--	2	301	5	487
WPL05	Low	--	--	2	239	3	384
	High	--	--	0	--	2	688
	All	--	--	2	239	5	485
WPL06	Low	--	--	2	290	3	512
	High	--	--	0	--	2	895
	All	--	--	2	290	5	640

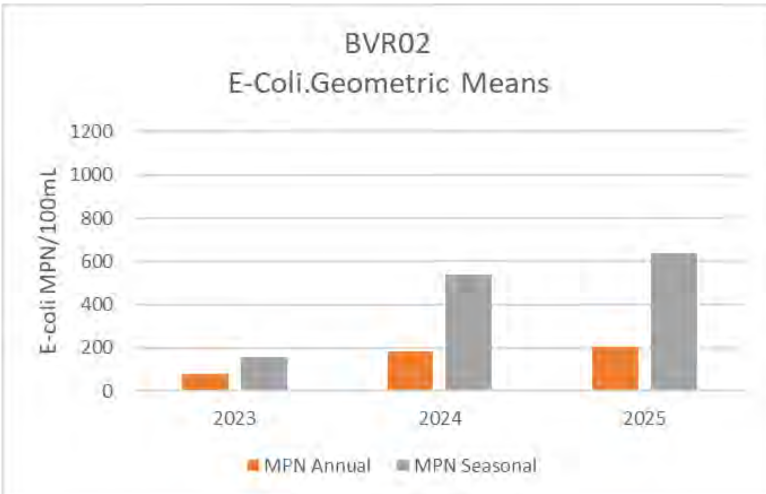


Figure 77: BVR02 Bacteria Monitoring Trends

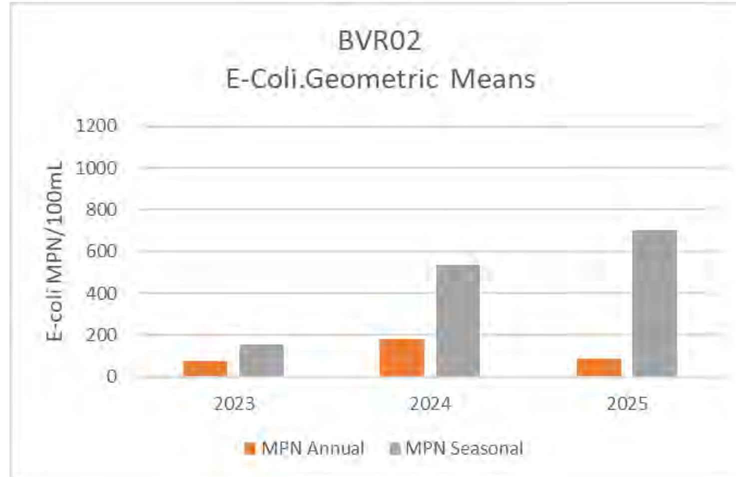


Figure 78: BVR02 Bacteria Monitoring Trends (Low Flow)

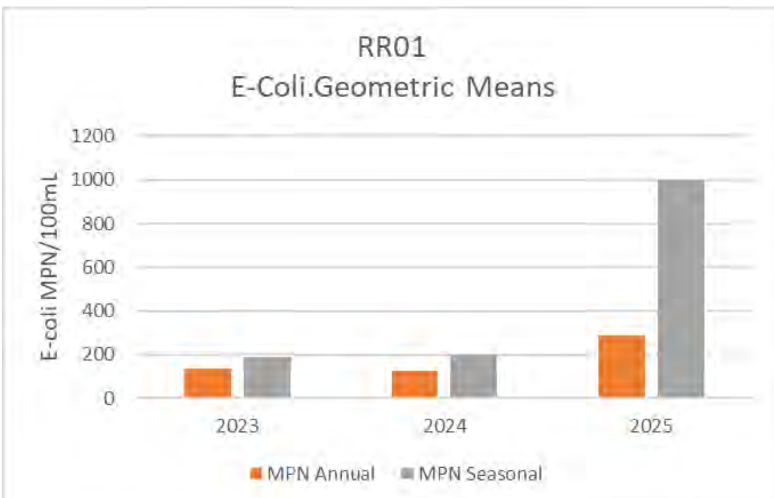


Figure 79: RR01 Bacteria Monitoring Trends

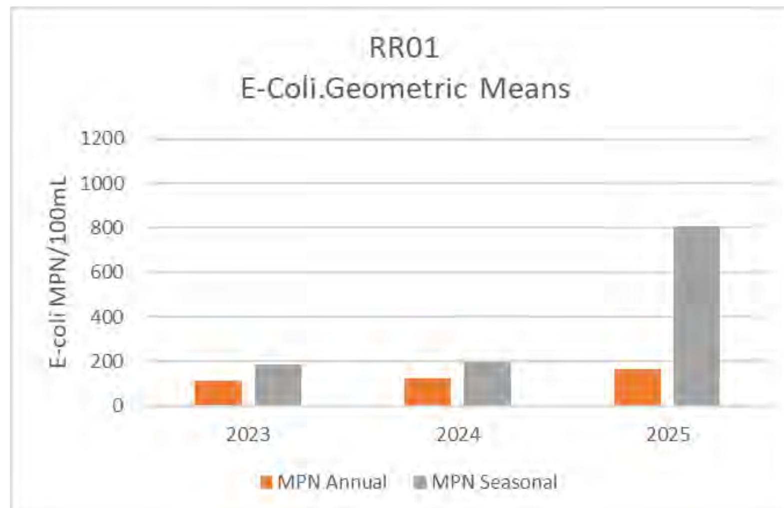


Figure 80: RR01 Bacteria Monitoring Trends (Low Flow)

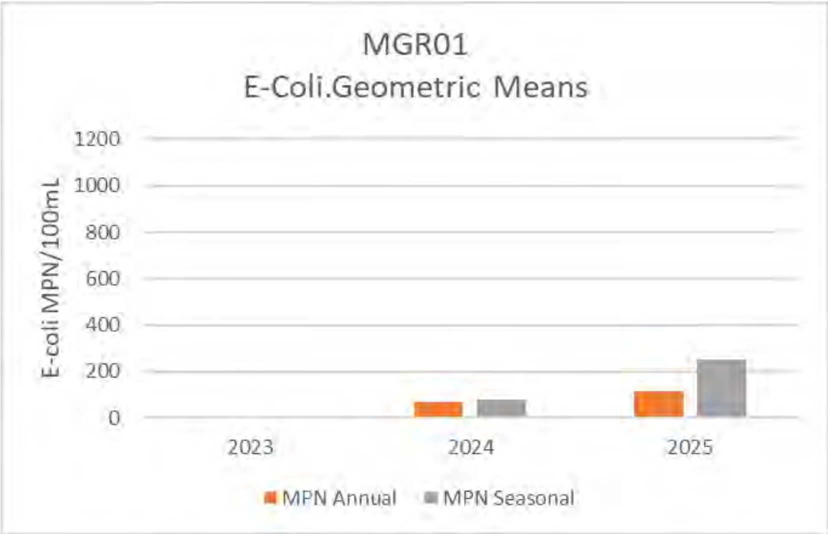


Figure 81: MGR01 Bacteria Monitoring Trends

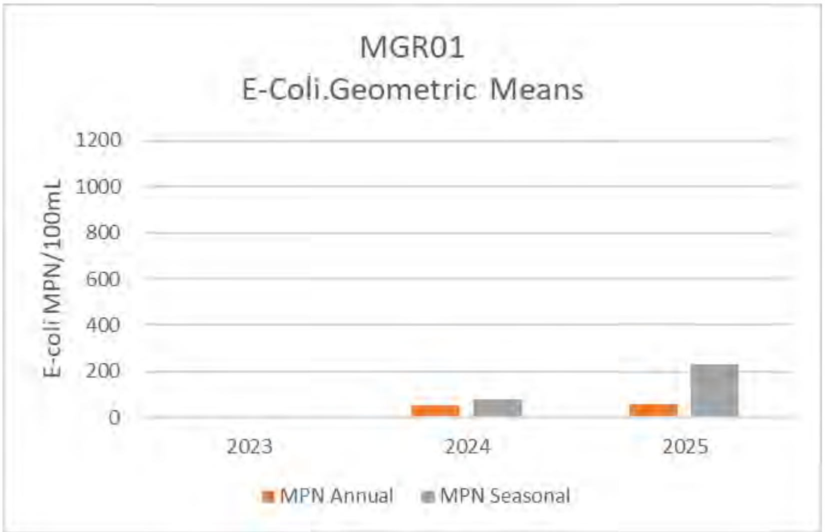


Figure 82: MGR01 Bacteria Monitoring Trends (Low Flow)

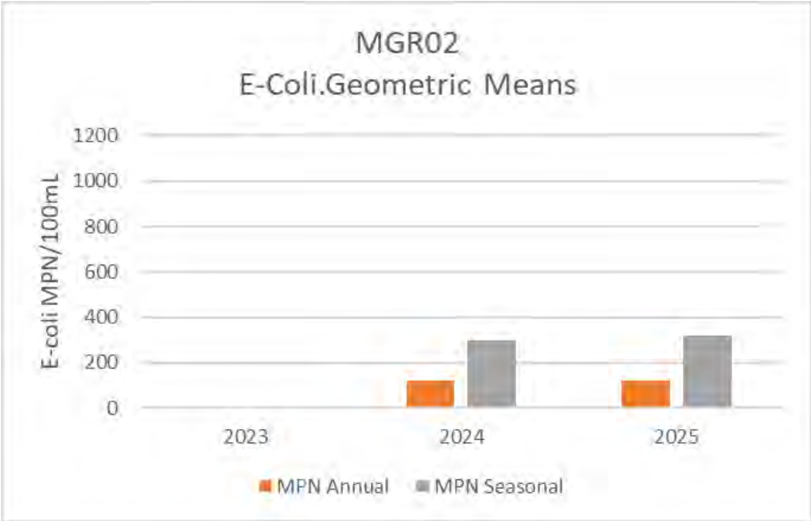


Figure 83: MGR02 Bacteria Monitoring Trends

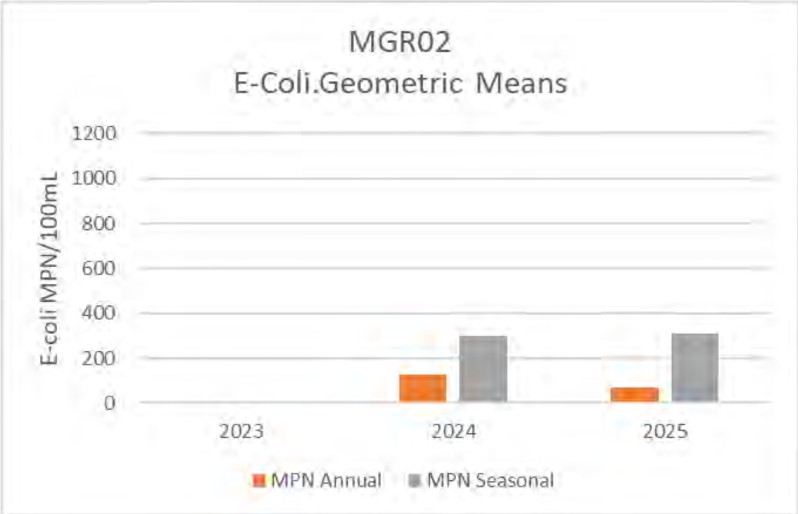


Figure 84: MGR02 Bacteria Monitoring Trends (Low Flow)

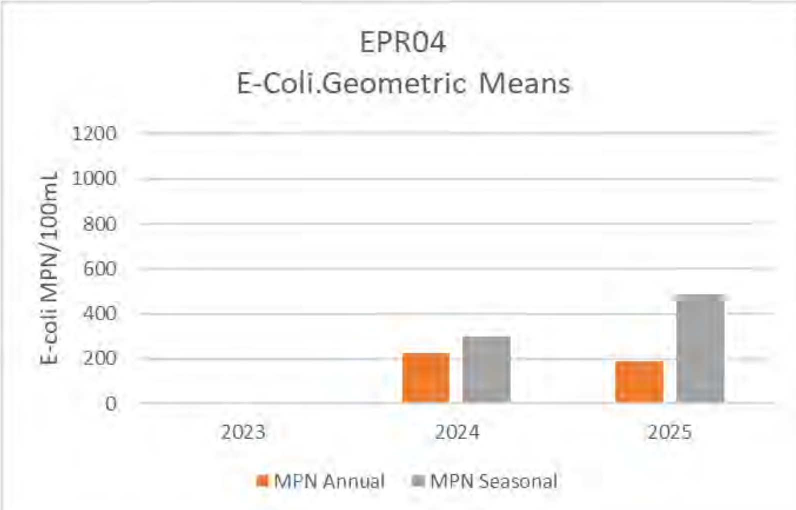


Figure 85: EPR04 Bacteria Monitoring Trends

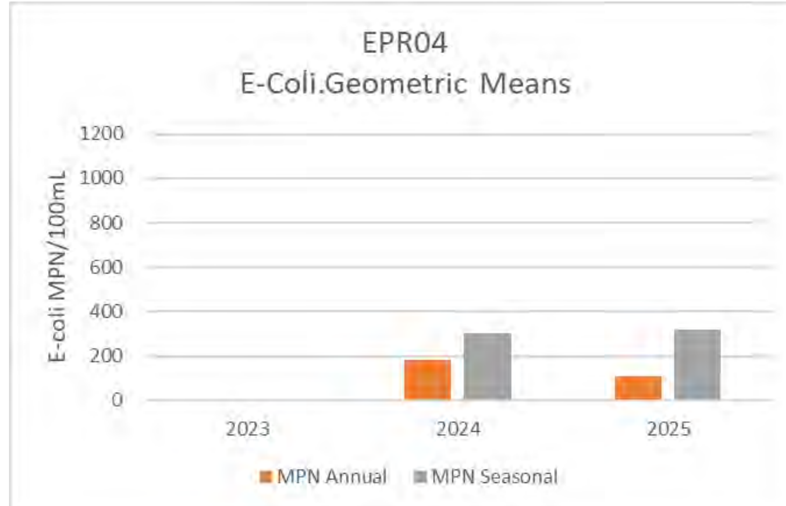


Figure 86: EPR04 Bacteria Monitoring Trends (Low Flow)

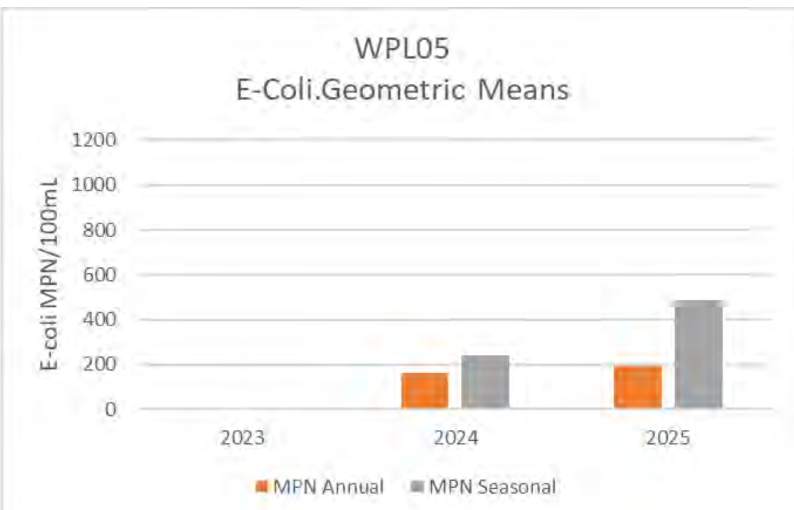


Figure 87: WPL05 Bacteria Monitoring Trends

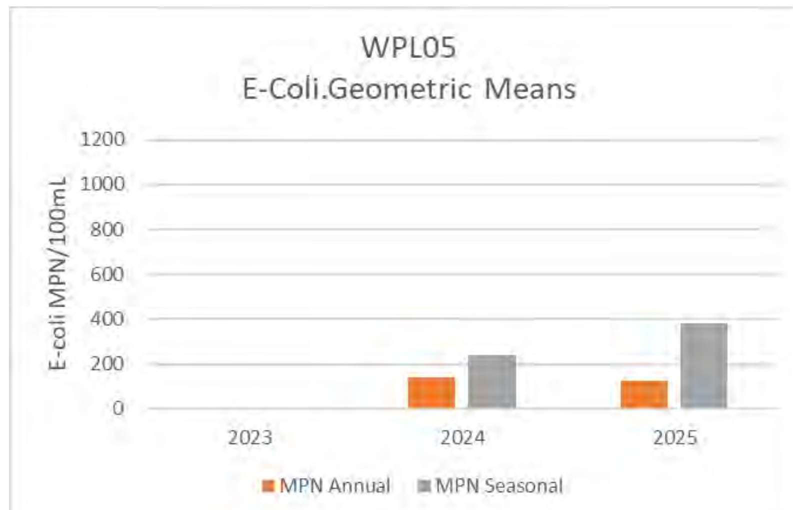


Figure 88: WPL05 Bacteria Monitoring Trends (Low Flow)

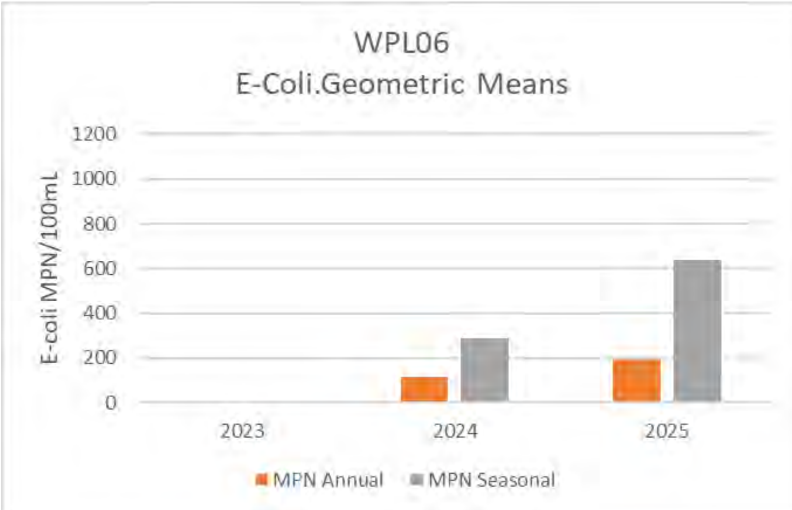


Figure 89: WPL06 Bacteria Monitoring Trends

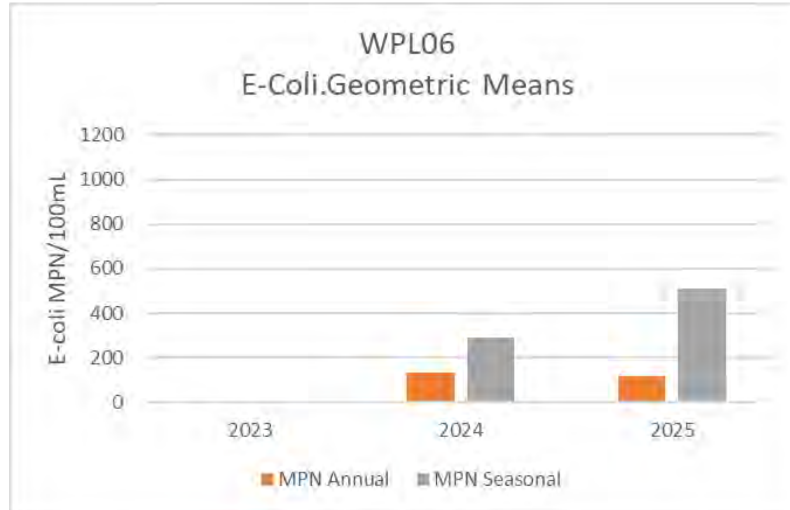


Figure 90: WPL06 Bacteria Monitoring Trends (Low Flow)

In addition to the annual and seasonal geometric mean calculations, each individual bacteria sample was compared to the single sample density exceedance criteria for human health, as presented in **Table 27**, which are based on full body contact in freshwater.

The single sample density of each sample collected over the previous sampling year for each location is shown in **Figures 91** through **97**. Additionally, results from samples collected during high flow events are shown in red.

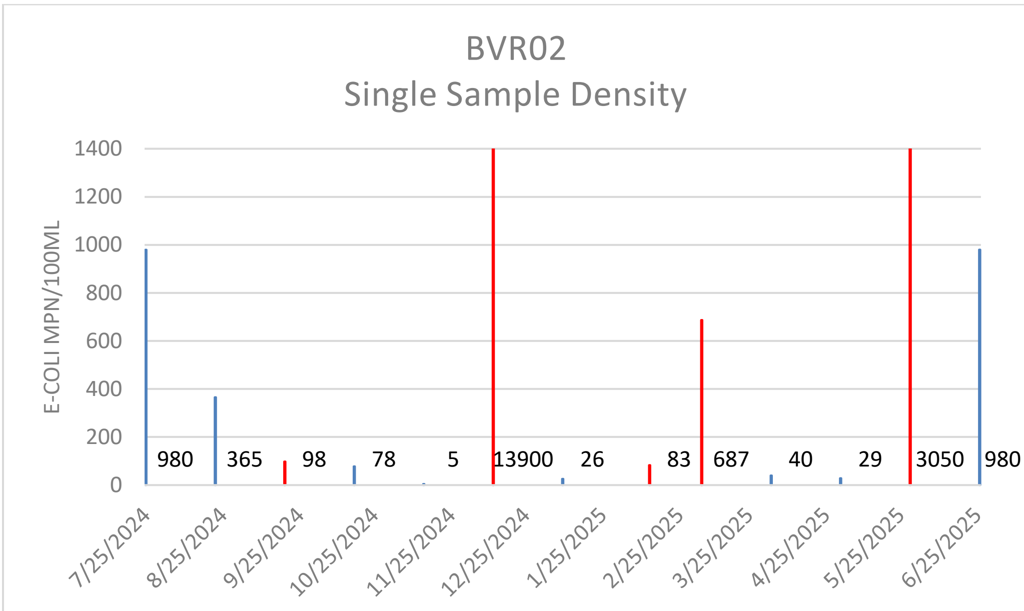


Figure 91: BVR02 Single Sample Density

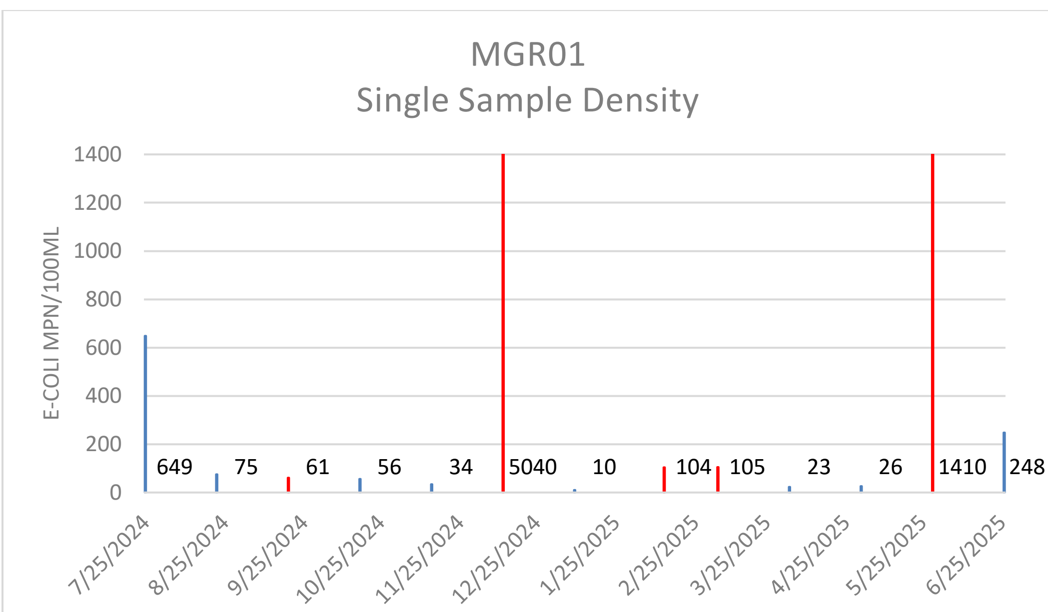


Figure 92: MGR01 Single Sample Density

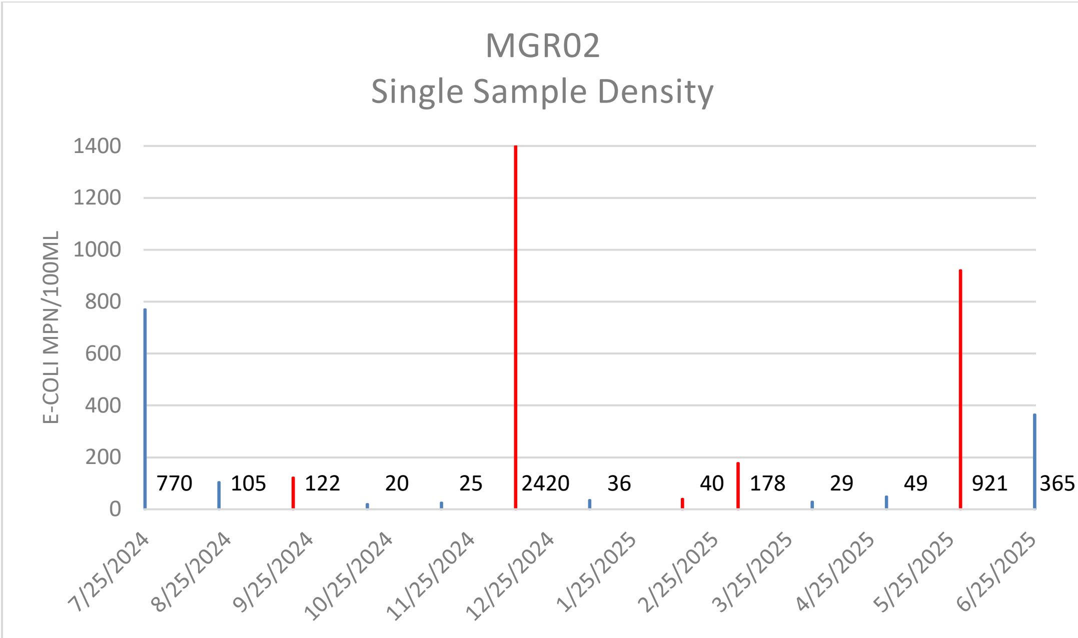


Figure 93: MGR02 Single Sample Density

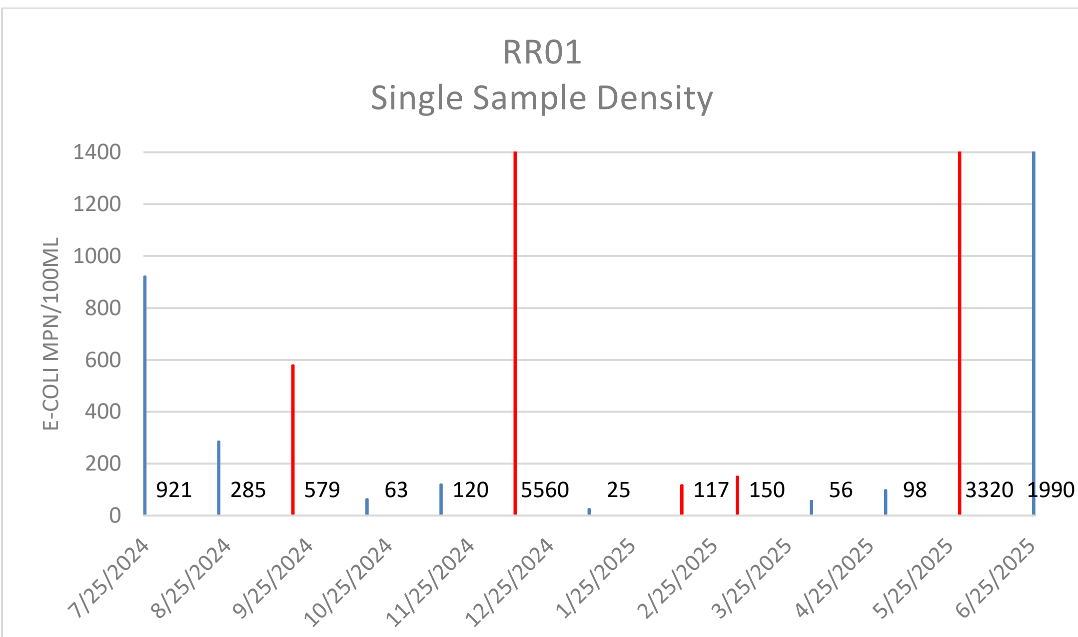


Figure 94: RR01 Single Sample Density

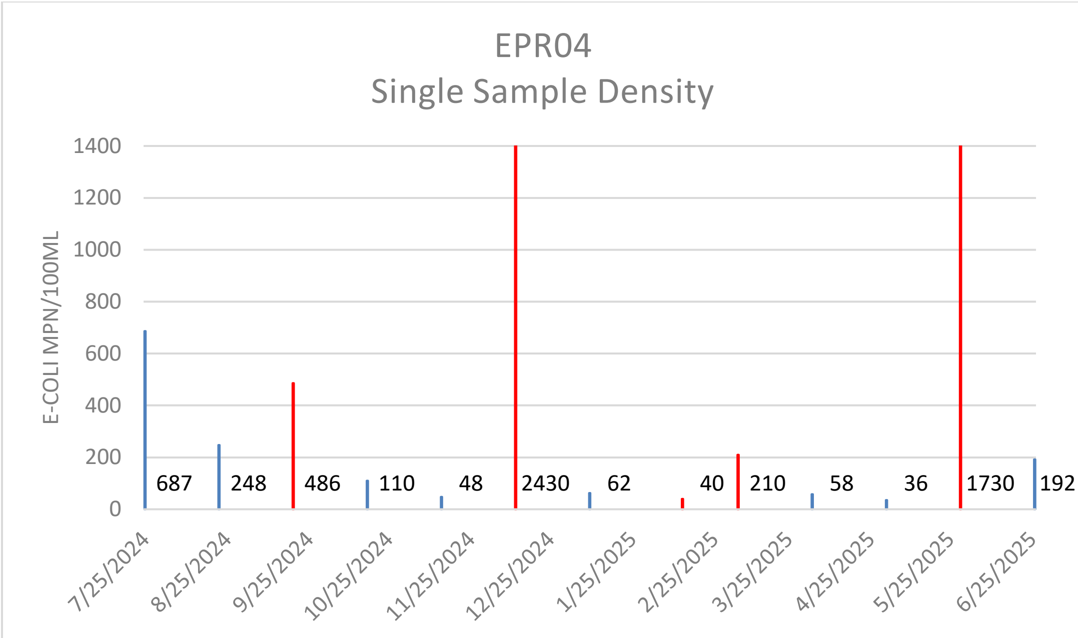


Figure 95: EPR04 Single Sample Density

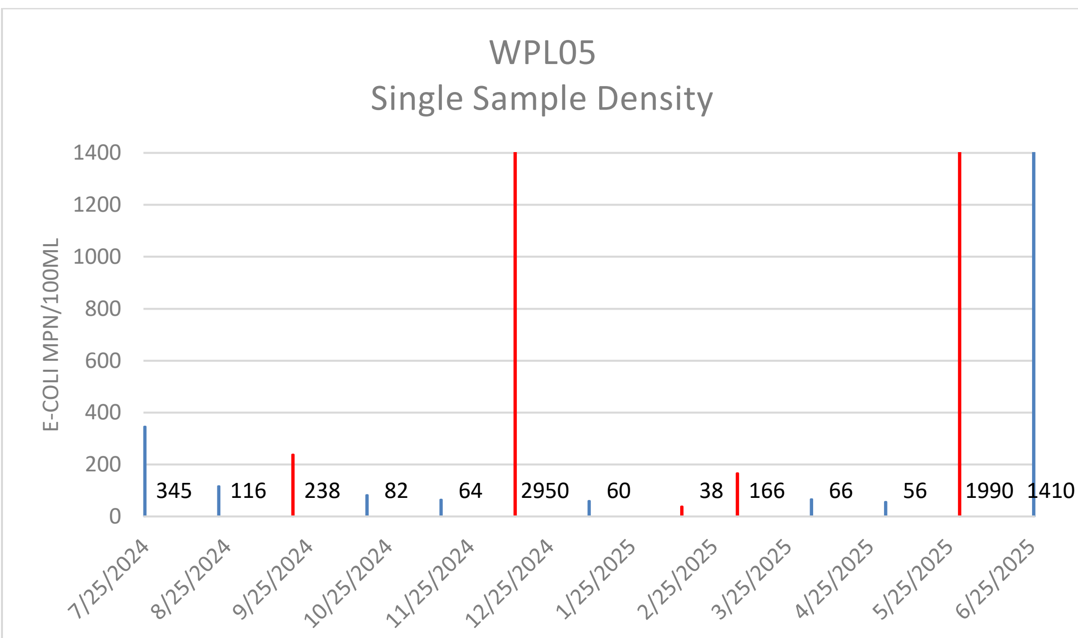


Figure 96: WPL05 Single Sample Density

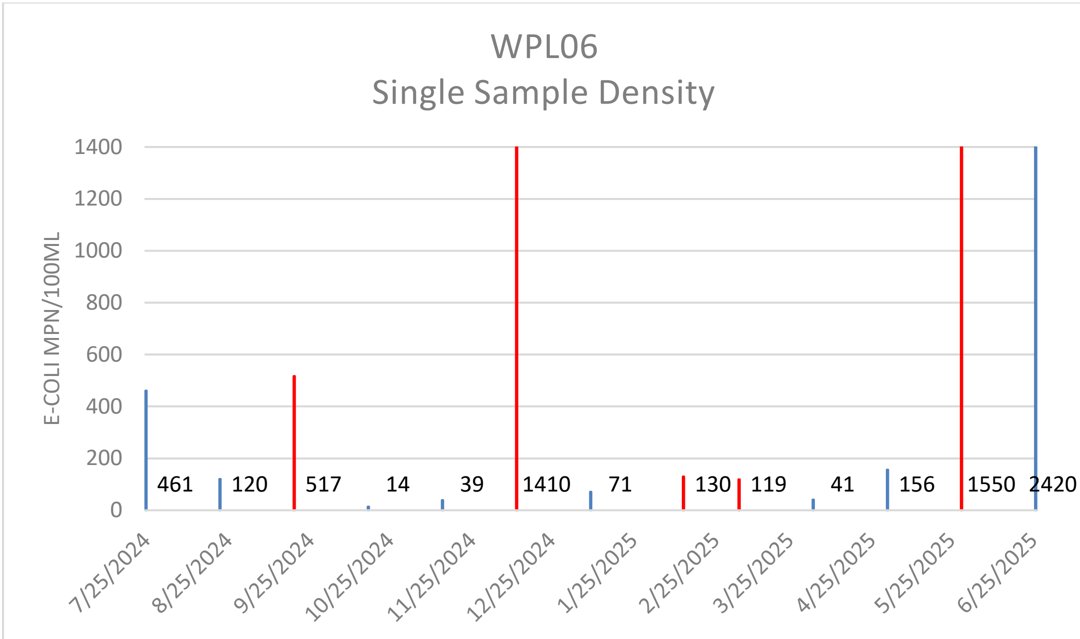


Figure 97: WPL06 Single Sample Density

6. Double Pipe Creek Watershed

The Double Pipe Creek Watershed was placed on Maryland's 303(d) list of impaired waters for bacteria in 2002. The 2002 bacteria listing was addressed with a TMDL that was developed and approved in December of 2009 (MDE 2009).

a. Double Pipe Creek Trend Monitoring Locations

The Double Pipe Creek Watershed includes eight bacteria trend monitoring locations. Four sites are located within the Big Pipe Creek subwatershed, and the other four locations are within the Little Pipe Creek subwatershed.

i. BPC01

BPC01 is located off of Saw Mill Road east of Littlestown Pike, and has a total drainage area of 15,850 acres. The primary land cover within the drainage area is mixed low vegetation at 51%. Forest cover accounts for 45%, and impervious land cover accounts for 3.3% of the drainage area.

ii. BPC11

BPC11 is located off of Rt. 194, and has a total drainage area of 65,804 acres. The primary land cover within the drainage area is mixed low vegetation at 58%. Forest cover accounts for 38%, and impervious land cover accounts for 3.6% of the drainage area.

iii. MDB03

MDB03 is located off of Trevanion Road, and has a total drainage area of 9,576 acres. The primary land cover within the drainage area is mixed low vegetation at 64%. Forest cover accounts for 30%, and impervious land cover accounts for 5.7% of the drainage area.

iv. BRB04

BRB04 is located off Mayberry Road northeast of Taneytown Pike, and has a total drainage area of 7,324 acres. The primary land cover within the drainage area is mixed low vegetation at 60%. Forest cover accounts for 36%, and impervious land cover accounts for 4.0% of the drainage area.

v. LPC06

LPC06 is located off Ridge Road just outside the City of Westminster, and has a total drainage area of 705 acres. The primary land cover within the drainage area is mixed low vegetation at 35%. Forest cover accounts for 34%, and impervious land cover accounts for 30.1% of the drainage area.

vi. LPC10

LPC10 is located off Jasontown Road, adjacent to Hyde's Quarry, and has a total drainage area of 6,662 acres. The primary land cover within the drainage area is mixed low vegetation at 51%. Forest cover accounts for 36%, and impervious land cover accounts for 12.6% of the drainage area.

vii. LPC11

LPC11 is located off of Atlee Ridge Road, within the Town of New Windsor's Atlee Ridge Park, and has a total drainage area of 3,989 acres. The primary land cover within the drainage area is mixed low vegetation at 66%. Forest cover accounts for 28%, and impervious land cover accounts for 5.0% of the drainage area.

viii. PBR01

PBR01 is located off Locust Street in the Town of Union Bridge, and has a drainage area of 25,944 acres. The primary land cover within the drainage area is mixed low vegetation at 65%. Forest cover accounts for 28%, and impervious land cover accounts for 6.4% of the drainage area.

The Double Pipe Creek bacteria trend monitoring locations are shown in **Figure 98.**

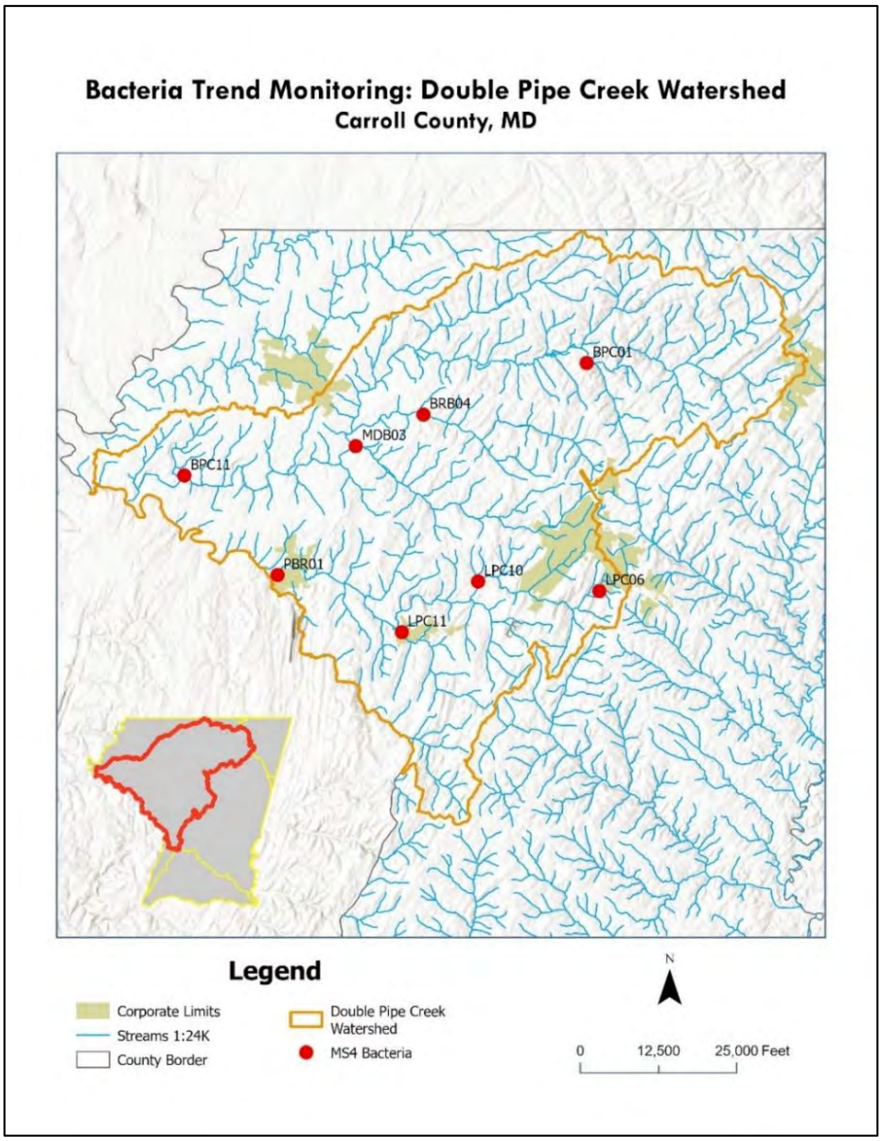


Figure 98: Double Pipe Creek Bacteria Monitoring Location

b. Double Pipe Creek Trend Monitoring Results

Monitoring results for bacteria trend sampling within the Double Pipe Creek Watershed are shown in the following tables and figures. **Table 43** lists the number of samples collected by flow type for the entire sampling year for each site, and **Table 44** lists the number of samples collected by flow type for seasonal bacteria monitoring, May 1 – September 30.

Additionally, for each monitoring location, **Figures 99** through **114** show the annual and seasonal geometric means under low flow conditions, as well as all samples collected during the year under all flow conditions.

Table 43: Double Pipe Creek Bacteria Monitoring Annual Data

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
BPC01	Low	7	252	9	164	9	180
	High	6	617	3	261	3	1838
	All	13	381	12	184	12	321
BPC11	Low	--	--	4	64	9	65
	High	--	--	1	167	3	1955
	All	--	--	5	77	12	153
MDB03	Low	--	--	3	416	9	238
	High	--	--	1	613	3	2383
	All	--	--	4	459	12	423
BRB04	Low	7	123	9	196	9	132
	High	6	478	3	487	3	1787
	All	13	230	12	246	12	253
LPC06	Low	7	94	9	246	9	73
	High	6	128	3	128	3	353
	All	13	109	12	209	12	108
LPC10	Low	--	--	4	163	9	137
	High	--	--	1	345	3	566
	All	--	--	5	189	12	195
LPC11	Low	--	--	4	86	9	92
	High	--	--	1	71	3	1295
	All	--	--	5	83	12	178
PBR01	Low	7	112	9	158	9	92
	High	6	224	3	246	3	2631
	All	13	154	12	176	12	212

Table 44: Double Pipe Creek Bacteria Monitoring Seasonal Data (May 1 – September 30) MPN/100mL

Location	Flow Type	2023		2024		2025	
		# Samples	MPN/ 100mL	# Samples	MPN/ 100mL	# Samples	MPN/ 100mL
BPC01	Low	2	1120	3	464	3	435
	High	3	744	2	294	2	3886
	All	5	876	5	387	5	1044
BPC11	Low	--	--	1	154	3	90
	High	--	--	1	167	2	6709
	All	--	--	2	160	5	506
MDB03	Low	--	--	1	228	3	470
	High	--	--	1	613	2	4968
	All	--	--	2	374	5	1206
BRB04	Low	2	158	3	625	3	549
	High	3	825	2	563	2	4066
	All	5	426	5	600	5	1223
LPC06	Low	2	272	3	767	3	302
	High	3	620	2	226	2	516
	All	5	446	5	470	5	374
LPC10	Low	--	--	1	365	3	304
	High	--	--	1	345	2	920
	All	--	--	2	355	5	473
LPC11	Low	--	--	1	579	3	322
	High	--	--	1	579	2	4383
	All	--	--	2	203	5	915
PBR01	Low	2	99	3	106	3	209
	High	3	229	2	376	2	6852
	All	5	164	5	176	5	844

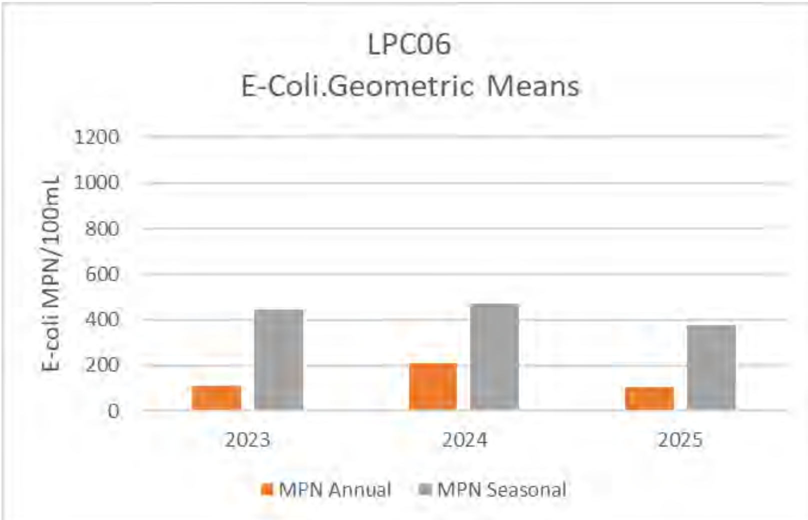


Figure 99: LPC06 Bacteria Monitoring Trends

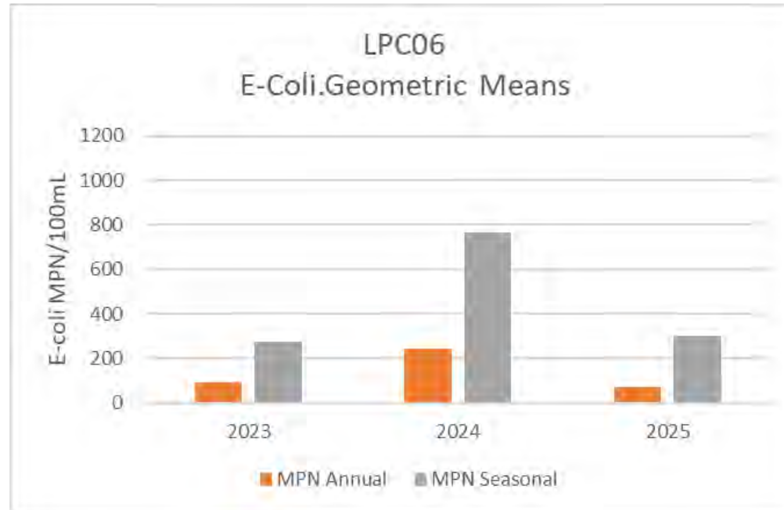


Figure 100: LPC06 Bacteria Monitoring Trends (Low Flow)

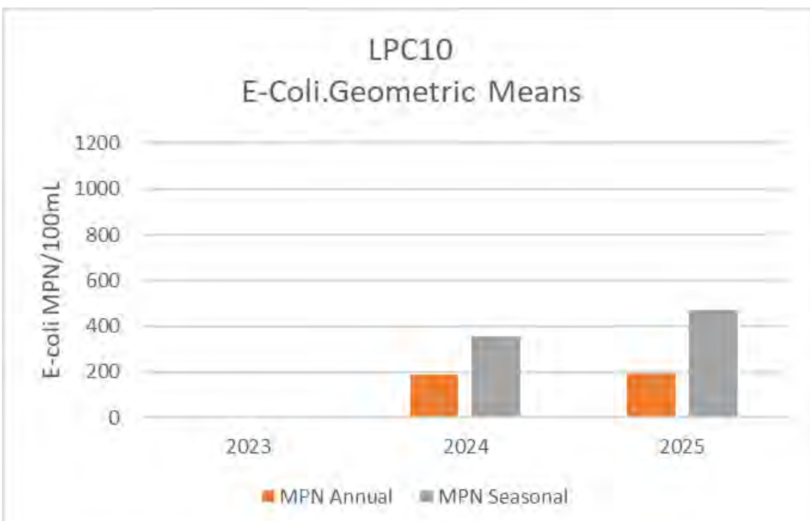


Figure 101: LPC10 Bacteria Monitoring Trends

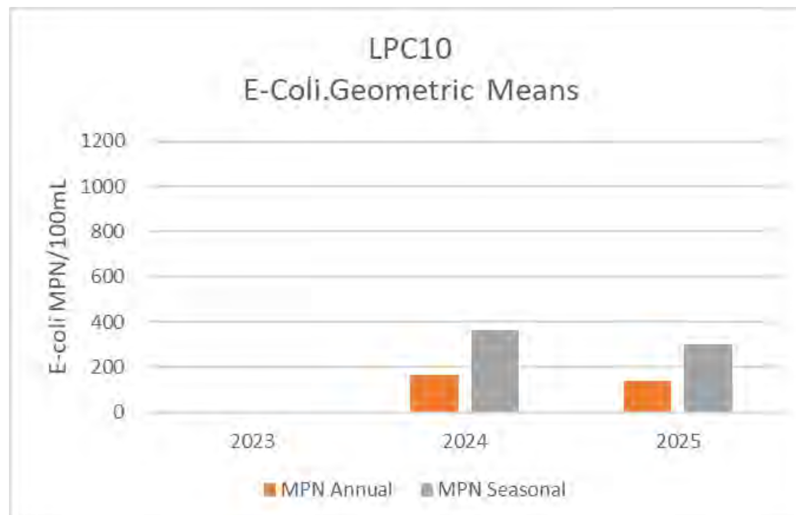


Figure 102: LPC10 Bacteria Monitoring Trends (Low Flow)

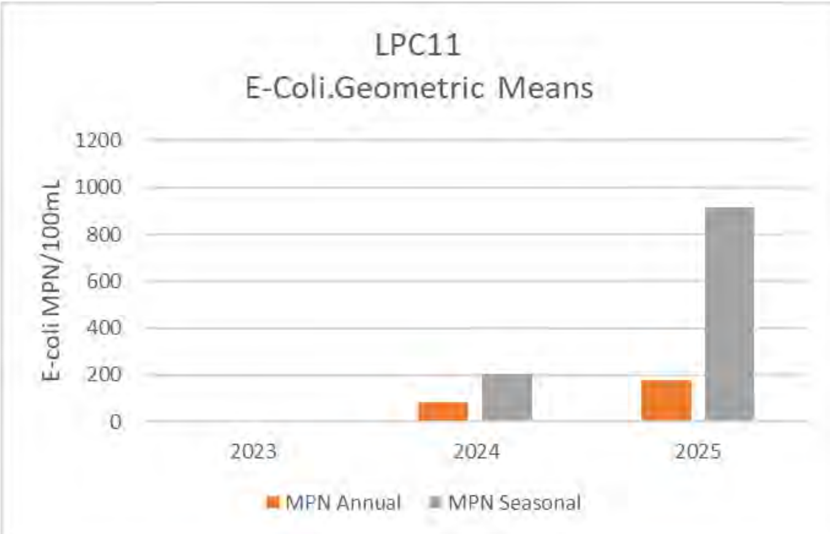


Figure 103: LPC11 Bacteria Monitoring Trends

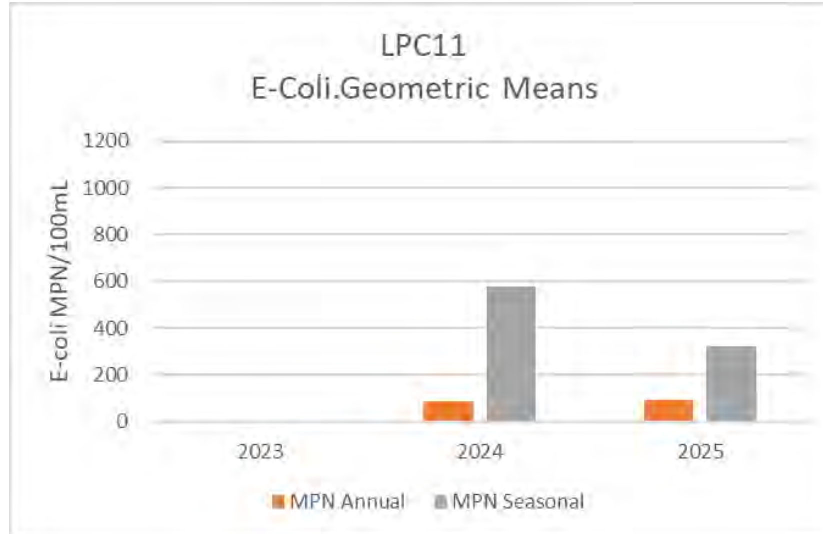


Figure 104: LPC11 Bacteria Monitoring Trends (Low Flow)

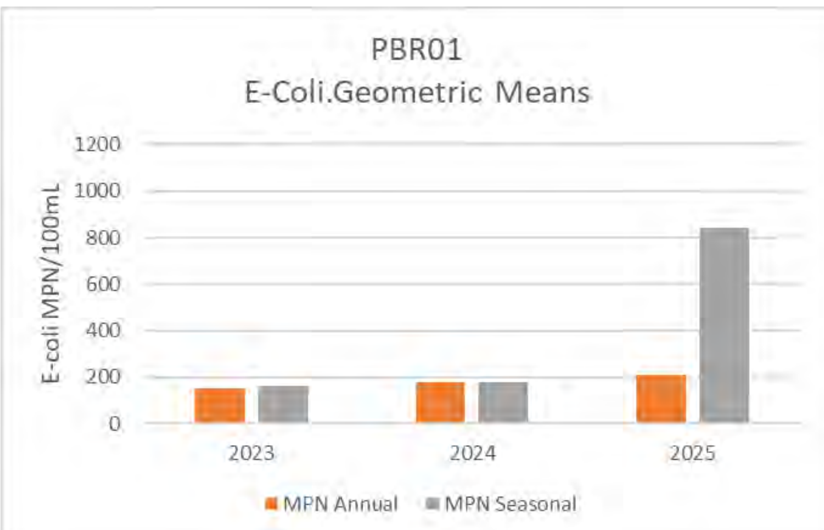


Figure 105: PBR01 Bacteria Monitoring Trends

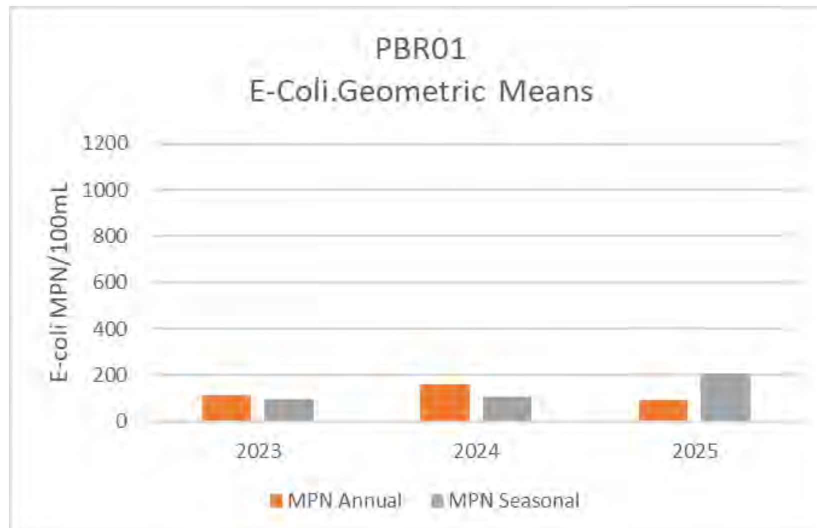


Figure 106: PBR01 Bacteria Monitoring Trends (Low Flow)

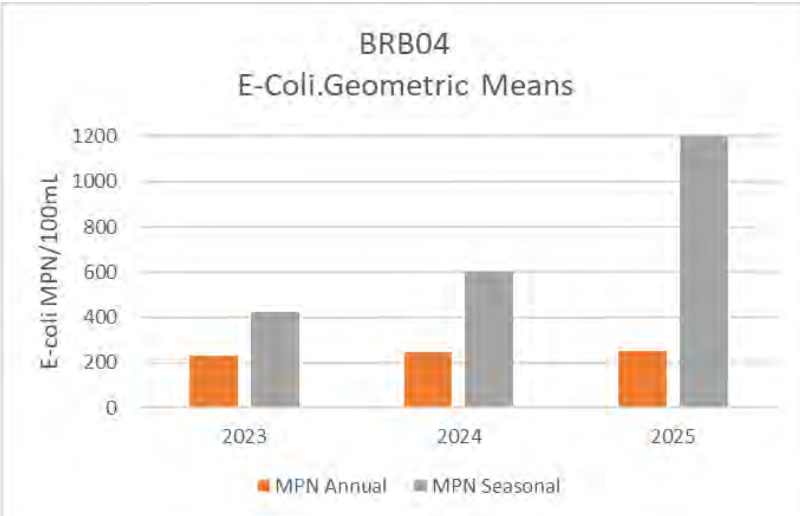


Figure 107: BRB04 Bacteria Monitoring Trends

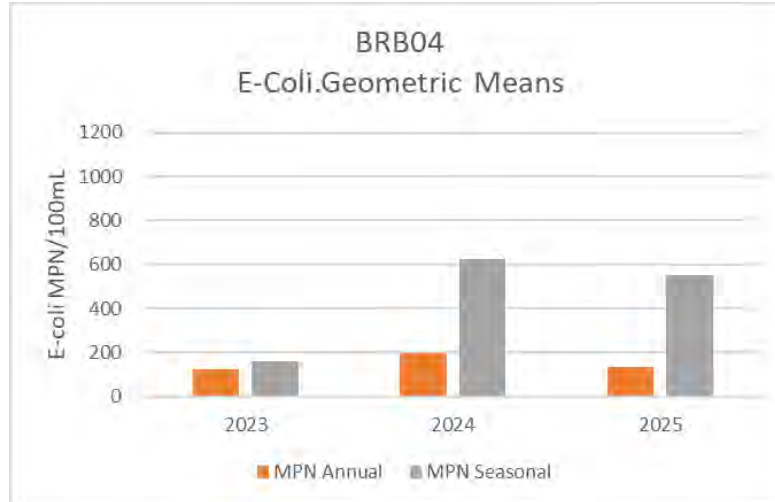


Figure 108: BRB04 Bacteria Monitoring Trends (Low Flow)

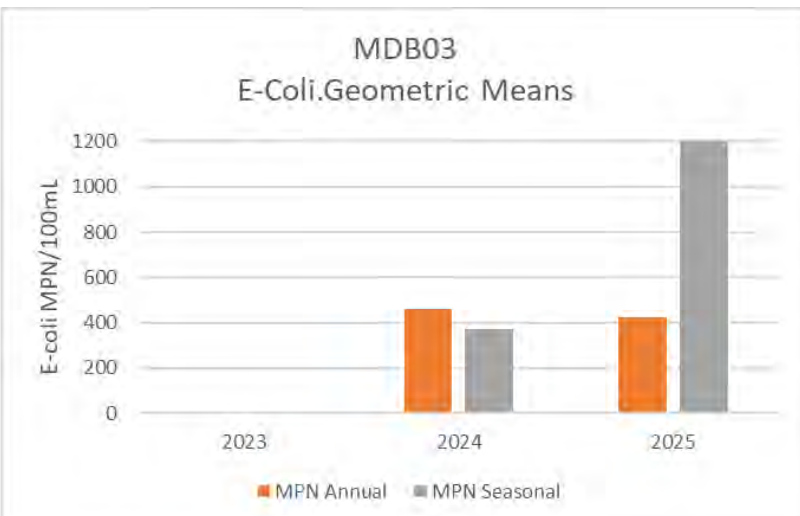


Figure 109: MDB03 Bacteria Monitoring Trends

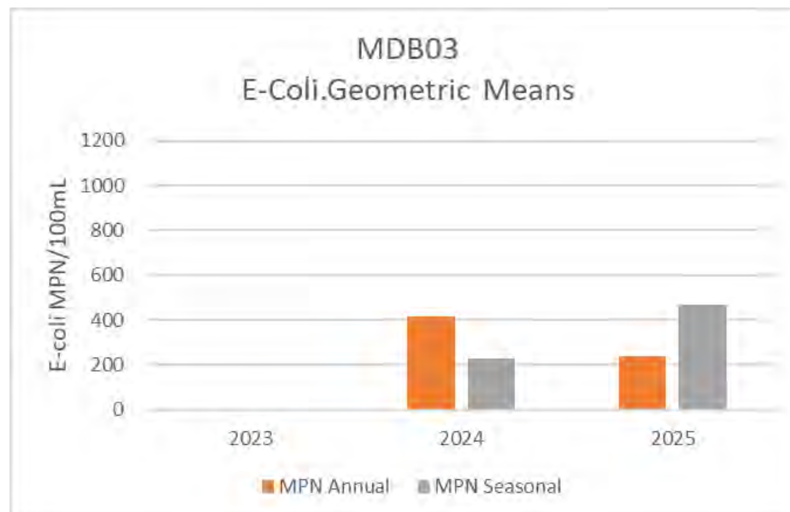


Figure 110: MDB03 Bacteria Monitoring Trends (Low Flow)

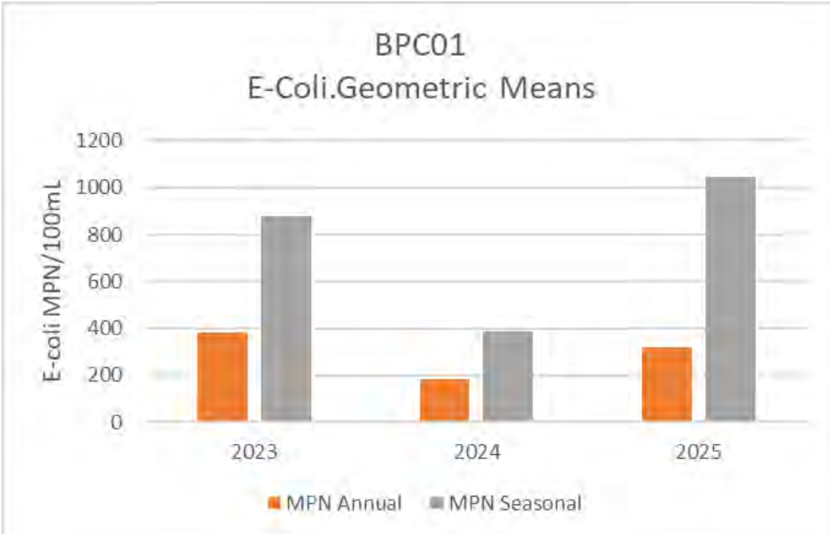


Figure 111: BPC01 Bacteria Monitoring Trends

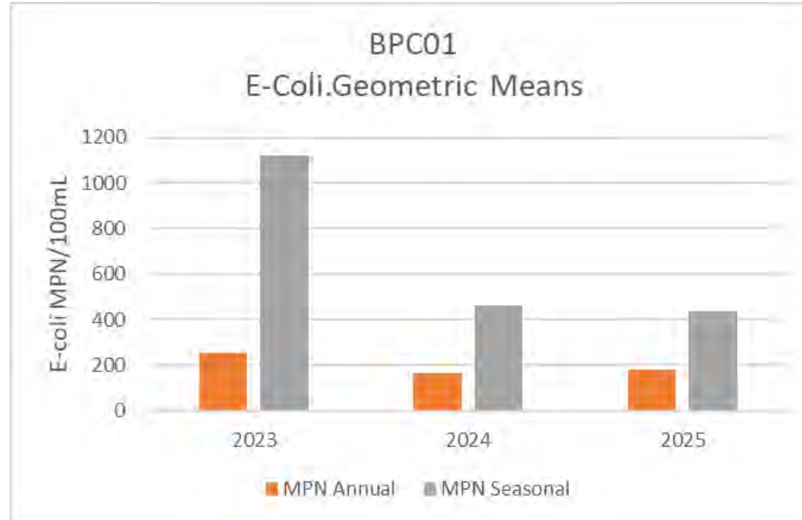


Figure 112: BPC01 Bacteria Monitoring Trends (Low Flow)

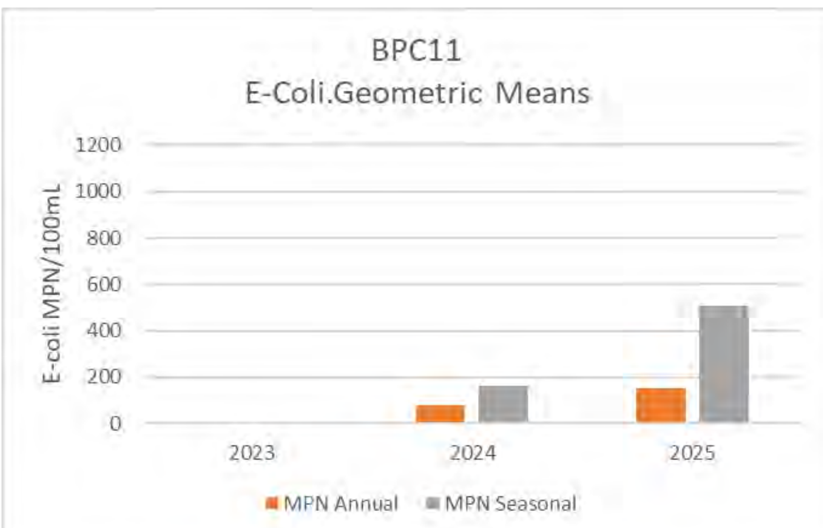


Figure 113: BPC11 Bacteria Monitoring Trends

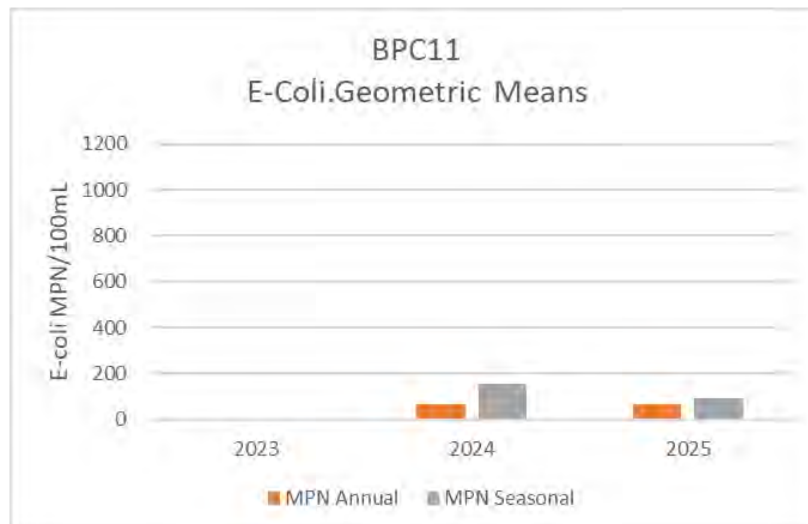


Figure 114: BPC11 Bacteria Monitoring Trends (Low Flow)

In addition to the annual and seasonal geometric mean calculations, each individual bacteria sample was compared to the single sample density exceedance criteria for human health, as presented in **Table 27**, which are based on full body contact in freshwater.

The single sample density of each sample collected over the previous sampling year is shown in **Figures 115** through **122**. Additionally, results from samples collected during high flow events are shown in red.

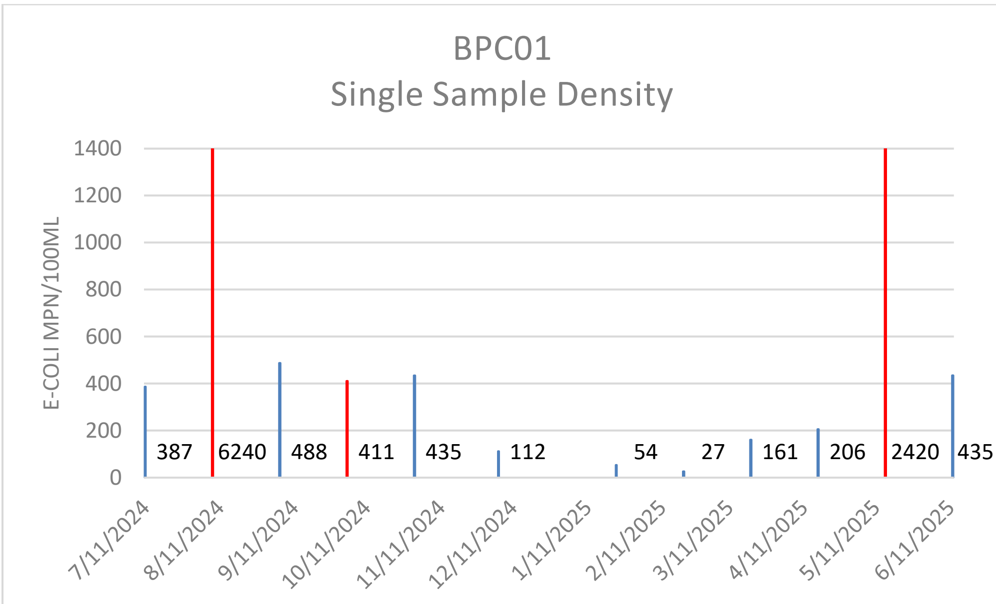


Figure 115: BPC01 Single Sample Density

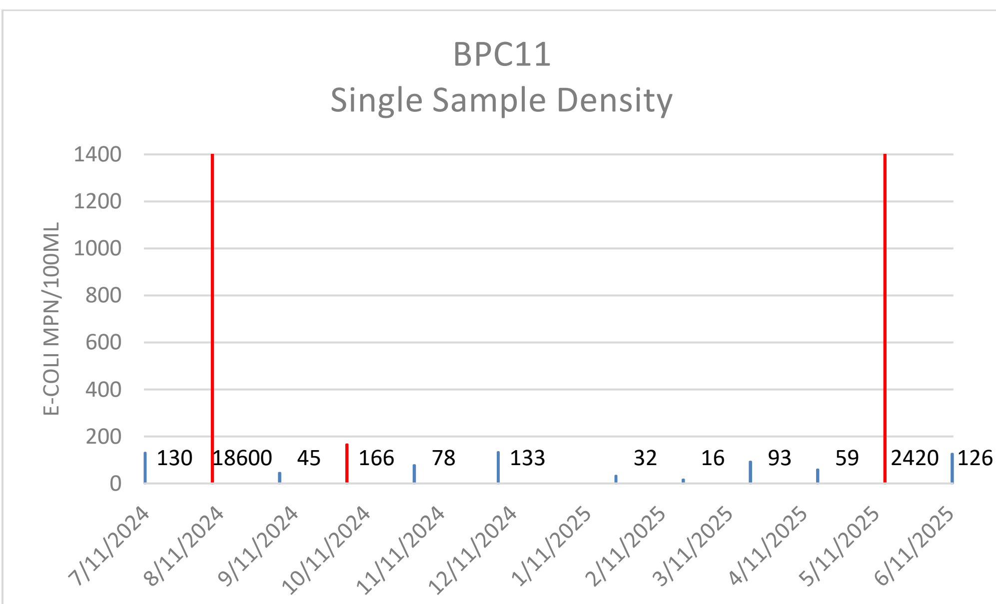


Figure 116: BPC11 Single Sample Density

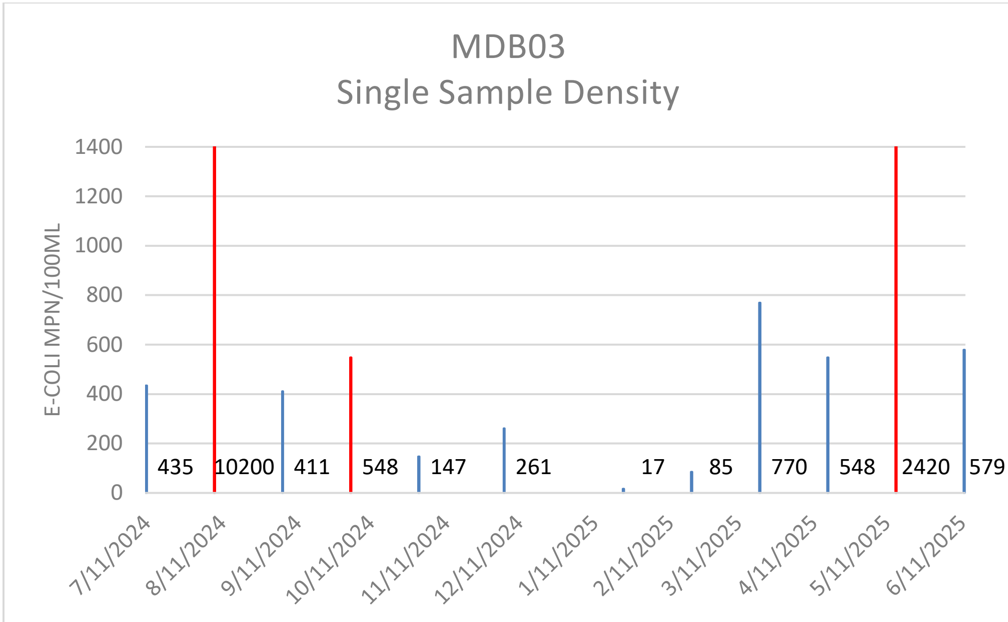


Figure 117: MDB03 Single Sample Density

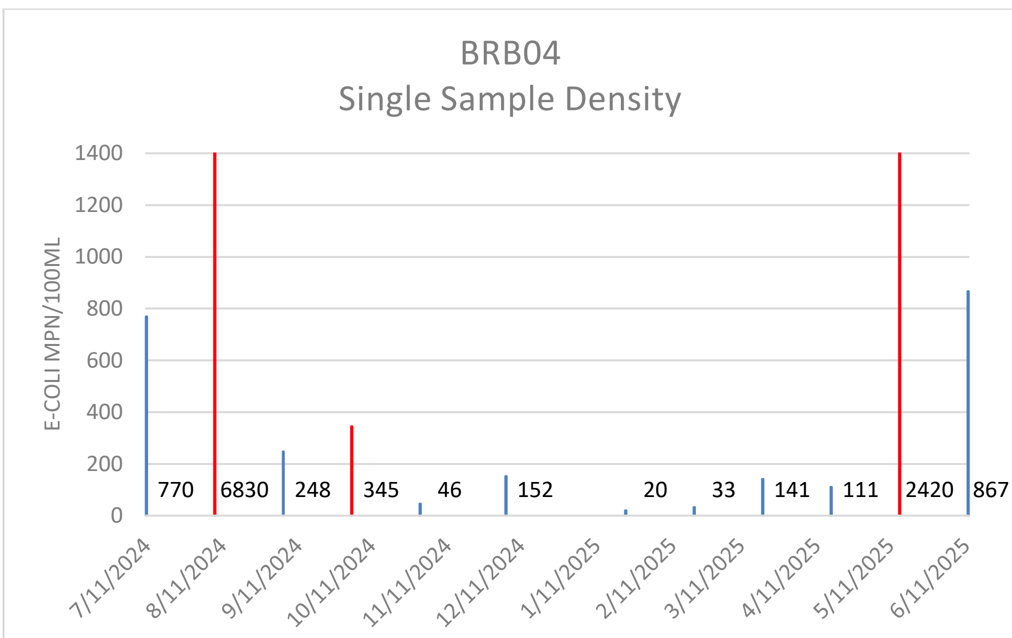


Figure 118: BRB04 Single Sample Density

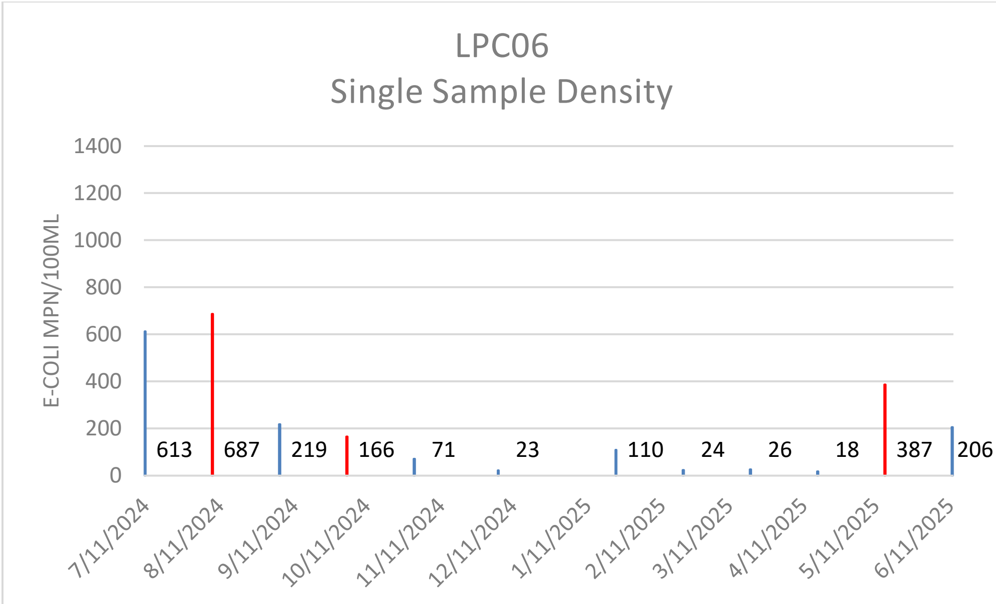


Figure 119: LPC06 Single Sample Density

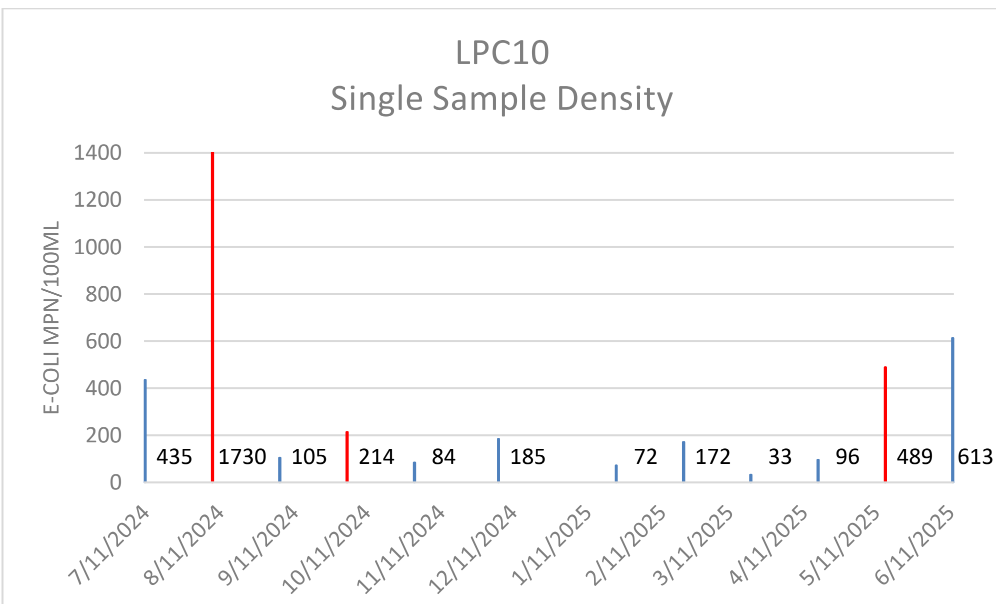


Figure 120: LPC10 Single Sample Density

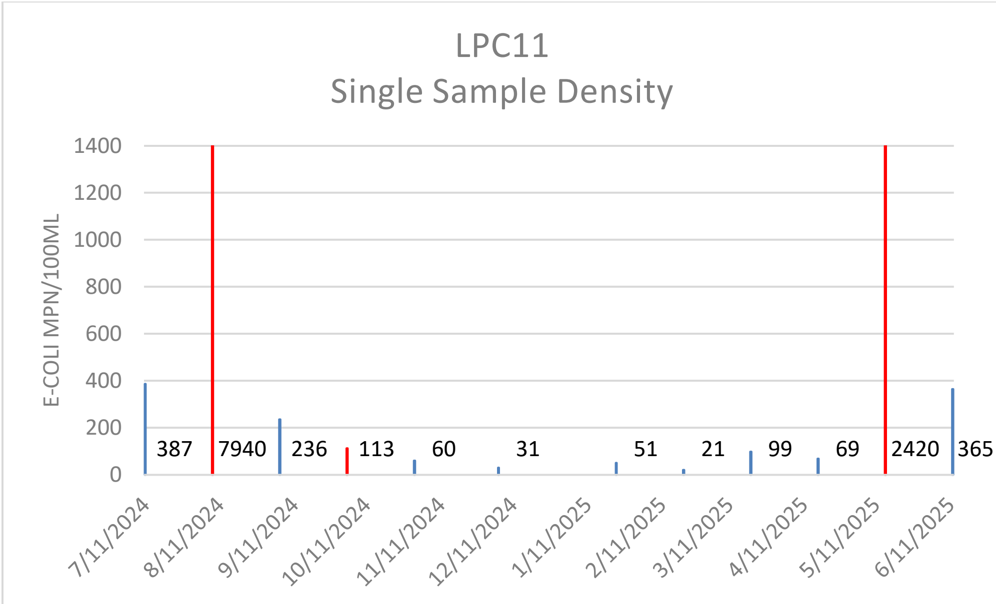


Figure 121: LPC11 Single Sample Density

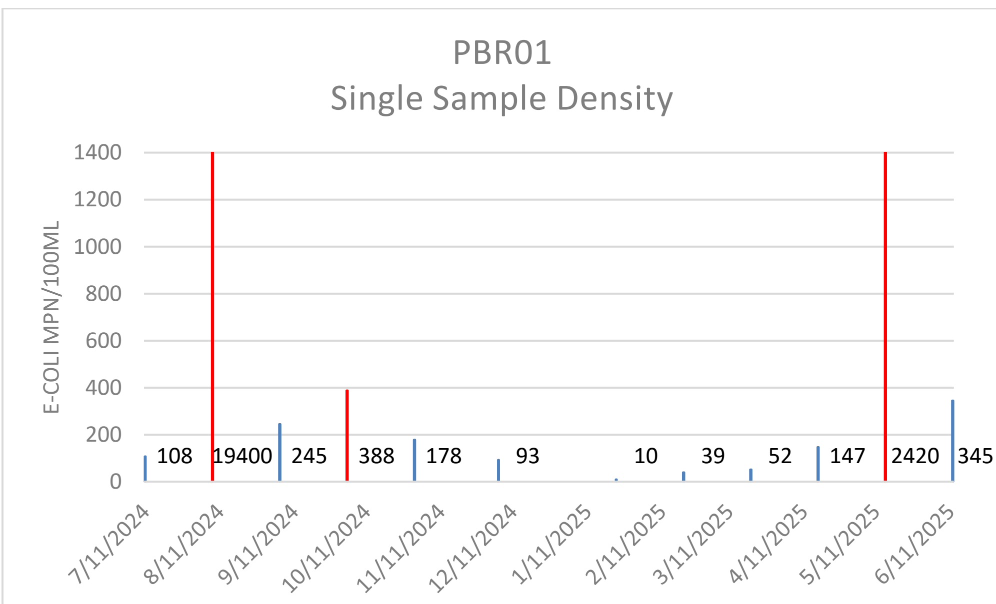


Figure 122: PBR01 Single Sample Density

B. Biological Trend Monitoring

To understand the population dynamics of key macroinvertebrates and their relationships with habitat conditions and water quality, a streamlined field survey is required as part of the Phase I MS4 permit monitoring requirements to assist in evaluating the effectiveness of BMP implementation. For this effort, Carroll County has adopted the MBSS methodology to assess the community of benthic macroinvertebrates and their habitats at the watershed level. Biological and habitat sampling follows MBSS methods (Harbold et al., 2024). Benthic taxa collection is conducted during the Spring Index Period (March 1 – April 30). Collection utilizes a D-frame net to disturb 20 square feet of the best available stream habitat, in one square foot increments, within a 75-m stream reach.

Biological sampling results are compiled with other MS4 monitoring data by the State to allow for comprehensive analyses and cross-jurisdictional comparisons. This effort helps to narrow data gaps, evaluate the overall water quality and aquatic life conditions of MS4 watersheds, facilitate delisting of impaired waterways, and inform regulation and management decisions.

To achieve 5% precision with a non-rotation sampling design for biological watershed monitoring, Carroll County is required to sample a minimum of 25 sites per year during the spring MBSS sampling period. To ensure data consistency and enable cross-jurisdiction analyses, a random sampling approach using MBSS protocols is utilized to select potential monitoring locations. For potential site selection, the County utilized the *Create spatially balanced points* feature tool within ArcGIS Pro. This tool generates a set of sample points based on inclusion probabilities, resulting in a spatially balanced sample design.

Samples to be collected each spring will be allocated proportionally to each 8-digit watershed with a currently approved TMDL based on sampleable stream miles within the 1:24K stream layer. **Table 45** breaks down the 1:24K stream miles within each TMDL watershed and includes the percent of miles as it relates to the total miles, the number of samples to be collected based on stream mile percent, and the number of samples to be collected within each TMDL watershed.

Table 45: Biological Stratification by Watershed

8-Digit Watershed	Stream Miles 1:24K	Percent (%) 1:24k Streams	# MBSS Samples (stream mile %)	Target Samples/ 8-digit	Oversampling Target/ 8-digit
Prettyboy Reservoir	71.48	7.13%	1.78	**2**	10
Loch Raven	1.5	0.15%	0.03	**0***	0
Liberty Reservoir	316.99	31.64%	7.91	**8**	40
South Branch Patapsco	151.44	15.11%	3.78	**4**	20
Lower Monocacy River	16.92	1.69%	0.42	**0**	0
Double Pipe Creek	366.24	36.55%	9.14	**9**	45
Upper Monocacy River	77.41	7.73%	1.9	**2**	10
Total (TMDL Watersheds)	**1,001.98**			**25**	**125**

*Single sample collected as part of BMP effectiveness study

1. Biological Sampling Locations

For 2025, 30 random biological locations were sampled following MBSS field sampling protocols during the spring index period. Thes locations are shown below in **Figure 123,** and are color coded based on the Index of Biotic Integrity (IBI) score. These locations were stratified across the Maryland 8-digit watersheds within Carroll County, utilizing a stream layer that is based on a 1:24,000 map scale, and randomly selected utilizing the *Create spatially balanced points* feature tool within ArcGIS Pro.

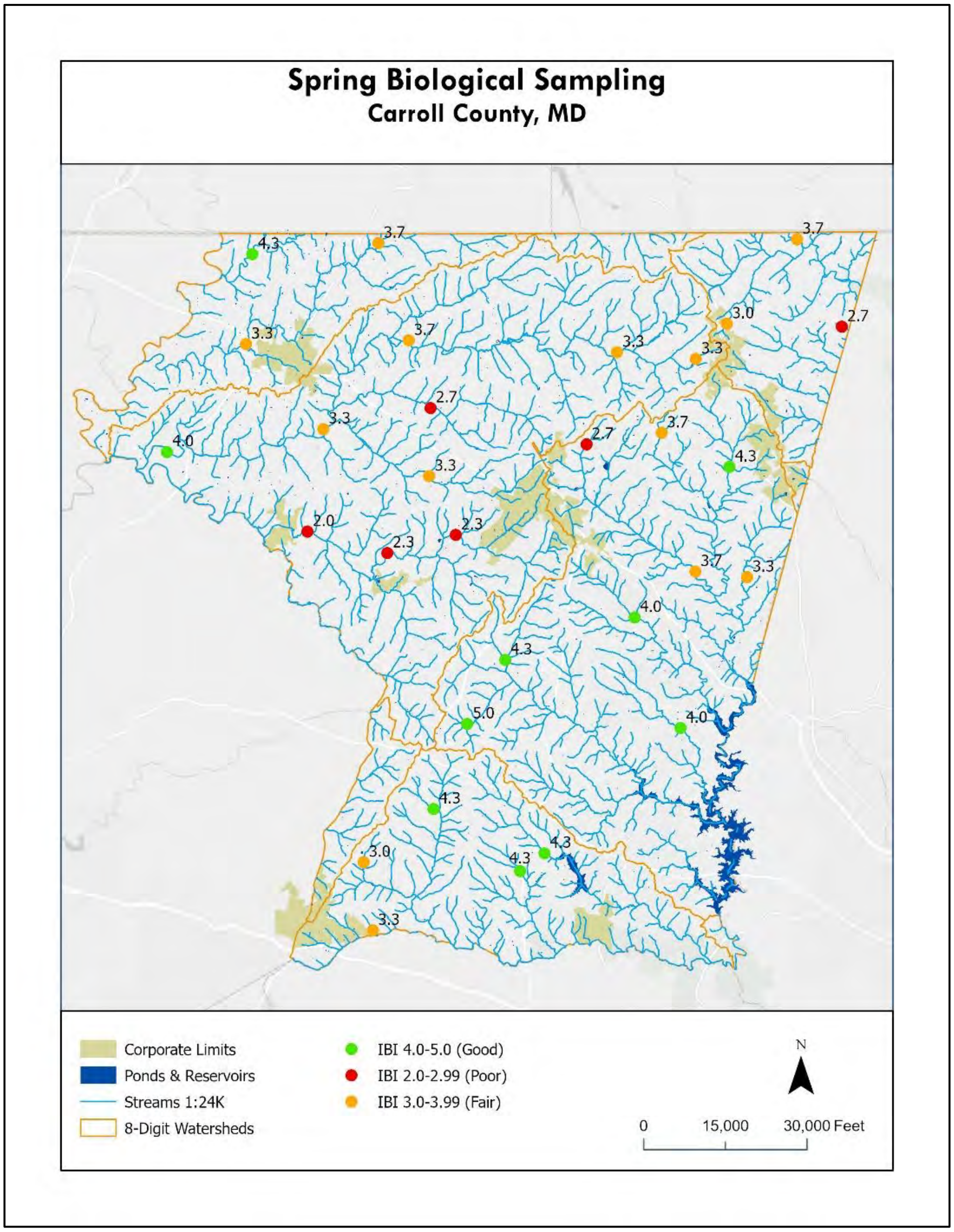


Figure 123: Carroll County FY2025 Biological Sampling Locations

2. Biological Sampling Results

In addition to the collection of benthic macroinvertebrates during the spring sample, in situ environmental data are also recorded, including dissolved oxygen, temperature, pH, turbidity, and conductivity. Data are collected using a YSI Pro DSS multiparameter probe. **Table 46** lists the monitoring site, watershed, associated BIBI score, and the physical data collected during spring sample collection.

A habitat assessment is also performed at each site for various parameters during the spring collection time, as well as in the summer. Spring habitat data includes documenting adjacent land use, dominant riparian vegetation, presence of buffer breaks, woody debris/rootwad counts, culvert information, streambank erosion, stream blockages, trash rating, distance to nearest road, and whether the site has evidence of stream channelization. Habitat data collected during the summer index period includes in situ water chemistry and an assessment of the summer habitat parameters: instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality/extent, riffle/run quality/extent, embeddedness, and shading. The associated habitat data for each location are listed in **Table 47**.

Table 46: 2025 Biological Monitoring Results

Site ID	Watershed	BIBI Score	Temperature (ºC)	pH	Dissolved Oxygen (mg/L)	Dissolved Oxygen (%)	Turbidity (NTU)	Conductivity (µS/cm)
LIBE-062-R-2025	Liberty Reservoir	2.7	43.5	7.51	12.27	99.6	2.81	249.7
PRET-316-R-2025	Prettyboy Reservoir	3.7	44.8	7.67	12.79	105.7	1.78	226.6
DOUB-276-R-2025	Double Pipe Creek	2.3	50	8.62	16.48	146.8	1.25	790
UMON-264-R-2025	Upper Monocacy	4.3	38.5	8.88	16.83	127.3	1.57	402
UMON-255-R-2025	Upper Monocacy	3.3	44.6	9.14	17.23	139.9	1.22	306.2
DOUB-280-R-2025	Double Pipe Creek	4.0	47.4	8.09	13.01	111.5	1.75	295.3
PRET-317-R-2025	Prettyboy Reservoir	3.0	47.3	7.73	12.36	105.8	1.13	395.9
DOUB-286-R-2025	Double Pipe Creek	3.3	50.9	7.61	11.44	102.7	5.47	411.3
DOUB-273-R-2025	Double Pipe Creek	2.0	50.7	8.32	13.94	124.8	3.87	607
DOUB-277-R-2025	Double Pipe Creek	3.3	48.5	7.92	12.81	111.6	3.95	375.7
DOUB-278-R-2025	Double Pipe Creek	3.3	45.9	8	12.76	107.1	3.91	311.9
DOUB-281-R-2025	Double Pipe Creek	2.7	47.1	7.82	12.95	110.5	4.22	257.4
LIBE-058-R-2025	Liberty Reservoir	3.3	46.2	7.5	12.38	104.2	1.93	353.9
LIBE-051-R-2025	Liberty Reservoir	3.7	48.9	7.78	12.9	112.9	1.17	427.9
LIBE-057-R-2025	Liberty Reservoir	4.0	51.3	7.74	13.07	117.9	2.48	344.2
DOUB-284-R-2025	Double Pipe Creek	3.3	38.8	7.61	14.16	107.5	2.43	257.3
SBPA-031-R-2025	S Branch Patapsco	4.3	48.5	7.26	12.38	107.7	4.19	225.9
SBPA-028-R-2025	S Branch Patapsco	3.3	45.2	7.39	12.36	102.7	3.36	173.5
SBPA-026-R-2025	S Branch Patapsco	4.3	50.4	7.3	13.49	120.1	.81	207.6
SBPA-029-R-2025	S Branch Patapsco	3.0	47.6	7.35	12.41	106.6	1.2	157
LIBE-060-R-2025	Liberty Reservoir	3.7	42.5	7.31	13.3	106.4	5.77	156.8
LIBE-054-R-2025	Liberty Reservoir	4.3	58.2	7.14	10.06	98.8	8.17	264.7

LIBE-056-R-2025	Liberty Reservoir	4.0	61.4	7.05	11.52	117.5	5.98	213.9
NPDES	Loch Raven	2.7	51.7	7.32	11.48	104.1	4.03	448.7
DOUB-283-R-2025	Double Pipe Creek	3.7	58.7	7.75	10.66	105.3	7.61	237.4
SBPA-023-R-2025	S Branch Patapsco	4.3	54.8	7.46	11.85	111.6	2.38	219.1
SBPA-023-R-2025-D	S Branch Patapsco	3.3	54.8	7.46	11.85	111.6	2.38	219.1
LIBE-053-R-2025	Liberty Reservoir	4.3	51.1	7.52	11.99	107.7	1.62	198.1
LIBE-053-R-2025-D	Liberty Reservoir	5.0	51.1	7.52	11.99	107.7	1.62	198.1
DOUB-272-R-2025	Double Pipe Creek	2.3	54.9	8.33	14.11	133.2	3.56	708
LIBE-059-R-2025	Liberty Reservoir	4.3	62.1	7.77	11.42	117.4	2.34	278.1
UMON-257-R-2025	Upper Monocacy	3.7	61.1	7.96	11.82	120.1	4.34	262.5
PRET-313-R-2025	Prettyboy Reservoir	2.7	61.3	6.77	10.56	107.6	3.65	120.9

Table 47: 2025 MBSS Physical Habitiat (Summer)

Site ID	Watershed	Instream Habitat	Epifaunal Substrate	Velocity/Depth Diversity	Pool/glide/eddy Quality	Riffle/Run Quality	Embeddedness (%)	Shading (%)
LIBE-062-R-2025	Liberty Reservoir	8	7	7	9	7	65	65
PRET-316-R-2025	Prettyboy Reservoir	10	11	12	11	13	45	40
DOUB-276-R-2025	Double Pipe Creek	17	15	17	16	15	0	40
UMON-264-R-2025	Upper Monocacy	14	9	10	8	16	0	20
UMON-255-R-2025	Upper Monocacy	13	13	10	14	8	40	65
DOUB-280-R-2025	Double Pipe Creek	14	17	16	14	20	0	30
PRET-317-R-2025	Prettyboy Reservoir	13	13	10	10	11	30	55
DOUB-286-R-2025	Double Pipe Creek	12	13	9	10	10	55	45
DOUB-273-R-2025	Double Pipe Creek	7	8	13	10	10	60	5
DOUB-277-R-2025	Double Pipe Creek	16	14	16	14	13	40	40

DOUB-278-R-2025	Double Pipe Creek	16	18	12	11	20	0	20
DOUB-281-R-2025	Double Pipe Creek	7	7	8	11	5	25	25
LIBE-058-R-2025	Liberty Reservoir	16	18	14	7	18	0	70
LIBE-051-R-2025	Liberty Reservoir	17	18	17	12	20	0	60
LIBE-057-R-2025	Liberty Reservoir	16	16	14	14	14	55	20
DOUB-284-R-2025	Double Pipe Creek	--	--	--	--	--	--	--
SBPA-031-R-2025	S Branch Patapsco	16	15	17	15	17	35	40
SBPA-028-R-2025	S Branch Patapsco	7	7	7	9	11	0	85
SBPA-026-R-2025	S Branch Patapsco	16	18	10	10	18	40	50
SBPA-029-R-2025	S Branch Patapsco	14	11	12	13	12	40	75
LIBE-060-R-2025	Liberty Reservoir	16	14	10	10	12	50	75
LIBE-054-R-2025	Liberty Reservoir	10	8	8	11	9	7	60
LIBE-056-R-2025	Liberty Reservoir	18	18	17	16	20	35	20
NPDES	Loch Raven	8	9	10	8	11	0	75
DOUB-283-R-2025	Double Pipe Creek	17	18	17	13	20	40	40
SBPA-023-R-2025	S Branch Patapsco	17	15	16	19	17	60	85
SBPA-023-R-2025-D	S Branch Patapsco	17	15	16	19	17	60	85
LIBE-053-R-2025	Liberty Reservoir	14	14	10	10	14	50	40
LIBE-053-R-2025-D	Liberty Reservoir	14	14	10	10	14	50	40
DOUB-272-R-2025	Double Pipe Creek	8	5	16	13	10	75	25
LIBE-059-R-2025	Liberty Reservoir	18	17	17	18	20	35	40
UMON-257-R-2025	Upper Monocacy	16	18	10	8	18	0	60
PRET-313-R-2025	Prettyboy Reservoir	--	--	--	--	--	--	--

C. Chloride Trend Monitoring

Elevated chloride concentrations are one of the most common chemical stressors to aquatic life in non-tidal streams in Maryland, according to the Biological Stressor Identification Analysis (BSID). Carroll County does not currently have any 8-digit watersheds with an approved TMDL for chloride. Liberty Reservoir Watershed is the only watershed within the County identified as impaired by chloride on Maryland's Integrated Report of Surface Water Quality, with the listing first being added in 2012. Currently, the priority for TMDL development for this listing is low and no listing category has been assigned for TMDL development.

However, Carroll County and other MS4 jurisdictions are required to manage salt application during winter storm events by improving the efficiency of winter weather management activities. To measure the effectiveness of these new requirements, Carroll County is required to monitor one location continuously in a first-order headwater stream.

The first-order stream segment being monitored has a drainage area of 299 acres, with 44 acres or about 15% being impervious, and is shown in **Figure 124.**

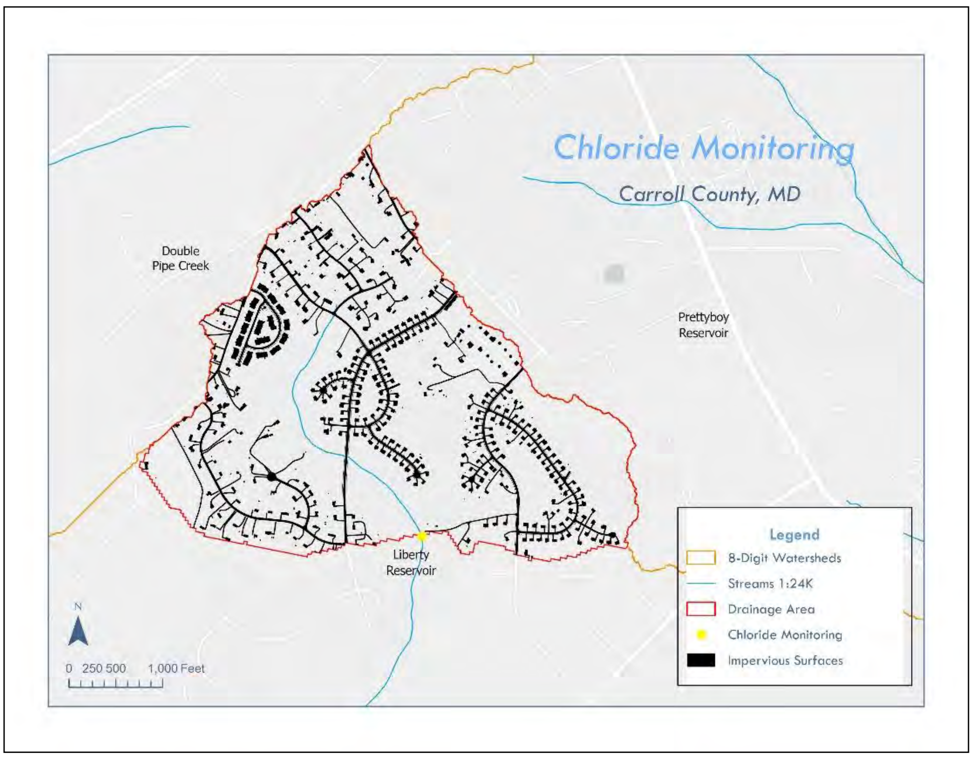


Figure 124: Carroll County Chloride Monitoring Location

1. Chloride Sampling Method

Chloride sampling is conducted using a HOBO U24-001 continuous conductivity data logger to collect 30-minute in-stream instantaneous data, measured as microsiemens per centimeter (µS/cm). In situ conductivity measurements are converted to specific conductance using the software HOBOware PRO.

2. Chloride Sampling Results

Continuous sampling data for the year is differentiated between wintertime (November 1 – March 31), and non-wintertime (April 1 – October 31). Actual conductivity, expressed in microsiemens per centimeter (µS/cm), is shown in **Table 48**, and includes the maximum seasonal conductivity, the mean, median, 75th-percentile, and 90th-percentile values during wintertime and non-wintertime. With the County's monitoring plan being approved during the early part of FY26, the County's continuous conductivity logger wasn't installed until late fall.

Table 48: Stream Conductivity

	Summer/Fall Conductivity (µS/cm) *July 1 - Oct 31*	**Winter Conductivity (µS/cm)** *Nov 1 - Mar 31*	**Spring Conductivity (µS/cm)** *April 1 - June 30*
Mean	n/a	190.22	232.72
Median	n/a	189.20	233.60
75th Percentile	n/a	210.10	252.20
90th Percentile	n/a	227.20	266.70
Maximum	n/a	300.90	289.80

The 30-minute instantaneous in-stream logger data, recorded over the entire monitoring year, are show below in **Figure 125**.

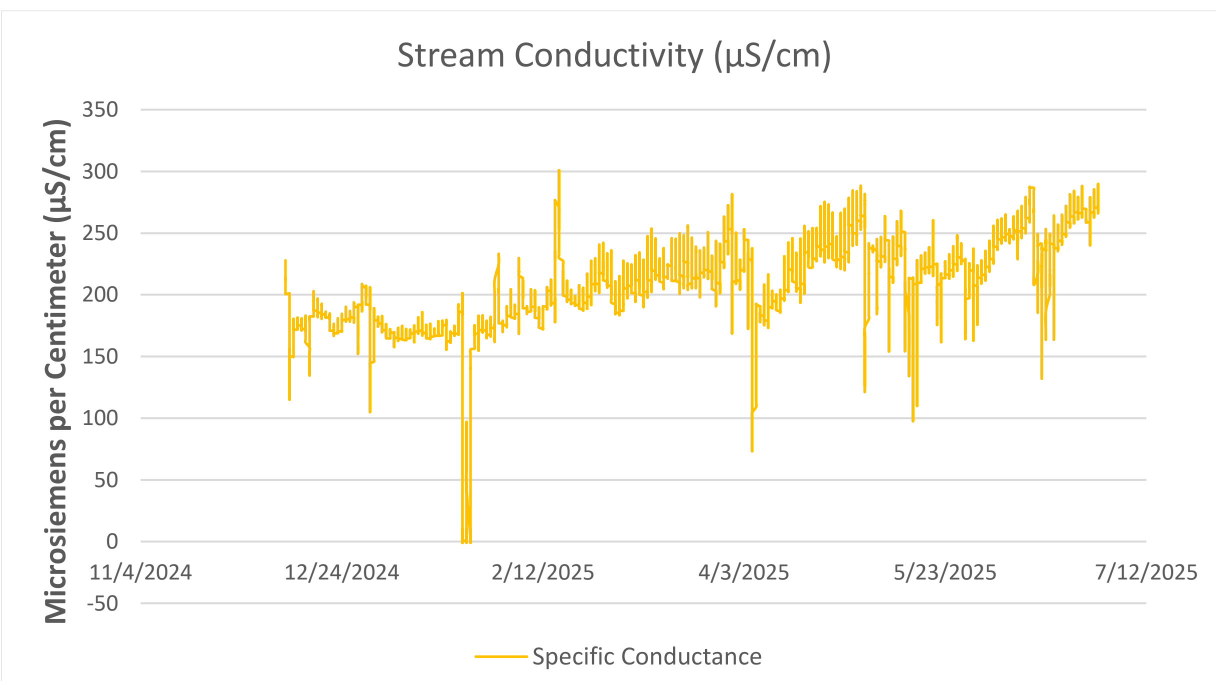


Figure 125: Stream Conductivity

3. Chloride Management Initiatives

Elevated chloride conditions within non-tidal streams are expected to decrease through the improved efficiency of winter weather management activities. The current Phase I MS4 Permit requires permittees to develop Salt Management Plans (SMPs) to help reduce the use of winter weather deicing and anti-icing materials, without compromising public safety. The plans have been developed by the County and and each municipal co-permittee. The SMPs are being submitted to the Department with this third-year annual report and will be implemented during the upcoming winter season.

This SMPs are based on the best road salt management practices described in the *Maryland Department of Transportation, State Highway Administration's Maryland Statewide Salt Management Plan,* which is developed and updated annually as required by the Maryland Code, Transportation Section 8-602.1. The SMPs provide details on each co-permittee's plan for utilizing best salt practices in their individual winter weather management programs, as well as details for continual program improvement.

With numerous staff and contractors involved in the application and management of salt for winter weather, training is a core component of the SMP effort. The County and each municipality have developed training materials customized to their operations that provide information on proper anti-icing and deicing management, which are provided annually to relevant staff and/or contractors. Public outreach is also provided by each co-permittee to help educate the public on best practices for salt management at their own homes or businesses.

Tracking of anti-icing and deicing materials applied for winter weather management is also a central element of the SMP program. All co-permittees have developed tracking documents to support both field and office staff in recording salt usage, so that the amount of material used per event can be calculated and used to help guide the winter weather program. Additionally, the tracking can be used to calculate the monthly and annual pounds used per line mile per inch of snow.

As data is collected through both the chloride monitoring and salt use tracking efforts, the County and municipal co-permittees can continue to adapt their winter management programs to enhance the reduction of chlorides in waterways.

In addition to SMP-related efforts, the County's Illicit Discharge Detection and Elimination (IDDE) Program addresses instances of improper salt storage, where salt is being managed in a way that potentially exposes it to stormwater. These incidents are typically reported from County or municipal staff observations or through the Stormwater Hotline. Staff work with the appropriate individuals, whether property management companies, contractors, or owners, to educate the responsible parties on best practices for managing salt to prevent stormwater pollution incidents. Best practices are then required to be put in place, and follow-up inspections and correspondence ensure that the appropriate changes have been made.

XI. References

Betz, D-E, B. Evans. 2015. Using MapShed Model for the Christina Basin TMDL Implementation and Water Quality Restoration. Villanova Urban Stormwater Partnership Symposium.

Booth, D. and P. Henshaw. 2001. Rates of channel erosion in small urban streams. *Water Science and Application*. 2:17-38.

CADMUS. 2009. Total Maximum Daily Load (TMDL) for Phosphorus in Summit Lake. The CADMUS Group, Inc., Waltham, MA. Retrieved from http://www.dec.ny.gov/docs/water_pdf/tmdlsummitlk09.pdf

CEC (Chesapeake Executive Council). 1987. *Chesapeake Bay Agreement*. Chesapeake Bay Program, Annapolis, MD.

Clary, J., Jones, J. E., Urbonas, B. R., Quigley, M. M., Stecker, E., & Wagner, T. 2008. Can Stormwater BMPs Remove Bacteria? New findings from the International Stormwater BMP Database. *Stormwater Magazine*. Retrieved from http://www.stormh2o.com/SW/Articles/Can_Stormwater_BMPs_Remove_Bacteria_203.aspx

Dollar, E.S.J. 2000. Fluvial geomorphology. *Progress in Physical Geography*. 24(3): 385-406.

Evans, B. M. and K. J. Corradini. 2015. MapShed Version 1.3 Users Guide. Penn State Institutes of Energy and the Environment. Retrieved from http://www.mapshed.psu.edu/Downloads/MapShedManual.pdf

Kemp, W.M., W.R. Boynton, J.E. Adolf, D.F. Boesch, W.C. Boicourt, G. Brush, J.C. Cornwell, T.R. Fisher, P.M. Glibert, J.D. Hagy, L.W. Harding, E.D. Houde, D.G. Kimmel, W.D. Miller, R.I.E. Newell, M.R. Roman, E.M. Smith, and J.C. Stevenson. 2005. Eutrophication of Chesapeake Bay: Historical trends and ecological interactions. *Marine Ecology Progress Series.* 303:1–29.

Harbold, W., J. Kilian, T. Ivasauskas, K. Hodgson, J. Sivalia, M. Genovese, S. Stranko, N. Hofmann, M. Ashton, G. Mathews, and S. Briggs. 2024. Maryland Biological Stream Survey: Field Sampling Manual. Maryland Department of Natural Resources. Publication # DNR 12-010524-1 https://dnr.maryland.gov/streams/Publications/MBSSFieldManual.pdf

Langland, M. and S. Cronin. 2003. A summary report of sediment processes in Chesapeake Bay and watershed. *U.S. Geological Survey Water Resources Investigation Report*. 03-4123

MapShed [Computer Software]. 2015. Retrieved from http://www.mapshed.psu.edu/download.htm.

Maryland Assessment and Scenario Tool (MAST). 2016. MAST Source Data. Retrieved from http://www.mastonline.org/Documentation.aspx.

Maryland Department of the Environment (MDE). 2000. Maryland Stormwater Design Manual, Volumes I and II.

Maryland Department of the Environment (MDE). 2008. Total Maximum Daily Loads of Fecal Bacteria for the Prettyboy Reservoir Basin in Baltimore and Carroll Counties, Maryland.

Maryland Department of the Environment (MDE). 2011. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated, Guidance for National Pollution Discharge Elimination System Stormwater Permits. Retrieved from: http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Documents/NPDES%20Draft%20Guidance%206_14.pdf.

Maryland Department of the Environment (MDE). 2014. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated. Retrieved from: http://www.mde.state.md.us/programs/Water/StormwaterManagementProgram/Documents/NPDES%20MS4%20Guidance%20August%2018%202014.pdf.

Maryland Department of the Environment (MDE). 2020. Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated. Retrieved from: https://mde.maryland.gov/programs/water/StormwaterManagementProgram/Documents/2020%20MS4%20Accounting%20Guidance.pdf

Penn State. 2016. Mapshed Overview. Retrieved from http://www.mapshed.psu.edu/overview.htm

Smith, D.E., M. Leffler, and G. Mackiernan, eds. 1992. *Oxygen Dynamics in the Chesapeake Bay: A Synthesis of Recent Research.* Maryland and Virginia Sea Grant College Program, College Park, MD.

Soar, P.J. and C.R. Thorne. 2001. Channel restoration design for meandering rivers. U.S. Army Corp of Engineers. Report ERDC/CHL.

USEPA (U.S. Environmental Protection Agency). 2003a. *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries*. EPA 903-R-03-002. U.S. Environmental Protection Agency, Region 3, Chesapeake Bay Program Office, Annapolis, MD.

USEPA (U.S. Environmental Protection Agency). 2003b. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability*. EPA 903-R-03-004. U.S. Environmental Protection Agency, Region 3, Chesapeake Bay Program Office, Annapolis, MD.

USEPA (U.S. Environmental Protection Agency). 2004. *Technical Support Document for Identification of Chesapeake Bay Designated Uses and Attainability–2004 Addendum.* EPA 903-R-04-006. U.S. Environmental Protection Agency, Region 3 Chesapeake Bay Program Office, Annapolis, MD.

USEPA (U.S. Environmental Protection Agency). 2005. *Fact Sheet for public education and outreach minimum control measure revised.* EPA 833-F00-005.

USEPA (U.S. Environmental Protection Agency). 2010. *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and Its Tidal Tributaries: 2010 Technical Support for Criteria Assessment Protocols Addendum*. May 2010. EPA 903-R-10-002. CBP/TRS 301-10. U.S. Environmental Protection Agency, Region 3 Chesapeake Bay Program Office, Annapolis, MD.

Appendix A: Waste Collection Infrastructure Upgrades

1. Loch Raven Reservoir Watershed

Hampstead – Carroll County Department of Public Works			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Sycamore Street	Lining	129	2014
Houcksville Road	Replacement	316	2016
Lower Beckleysville	Replacement	5,448	2017
Gaming square	Lining	422	2019
White Oak Ct.	Lining	190	2022
4401 Sycamore Drive	Lining	50	2023
697 Clearview Ave	Lining	10	2024
Loch Raven Watershed Total:		**6,565**	

2. Prettyboy Reservoir Watershed

Hampstead – Carroll County Department of Public Works			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Black Rock/Shiloh Road	Lining	1,877	2014
Total:		**1,877**	
Manchester			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Long Lane	Lining	20	
Christmas Tree Ln	Cured In Place Relining	1,110	2024
Total:		1,130	
Prettyboy Watershed Total:		**3,007**	

3. Upper Monocacy Watershed

Taneytown			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
E. Baltimore St. streetscape	6" lateral replacement	577	2009
E. Baltimore St. streetscape	8" main replacement	1,229	2009
E. Baltimore St. streetscape	15" main replacement	1,770	2009
E. Baltimore St. streetscape	6" main CIPP	148	2009
E. Baltimore St. streetscape	8" main CIPP	11,477	2009
Mill Ave sewer upgrade	10" main replacement	1,013	2012
Mill Ave sewer upgrade	10" main CIPP	653	2012
Commerce St. main replacement	8" main replacement	225	2017
Commerce St. main replacement	6" lateral repalcement	150	2017
York St. PS forcemain and gravity sewer replacement	12" main replacement	431	2013
O'Brien Ave Bridge/storm pond upgrade	12" main replacement	516	2020
Meadowbrook Interceptor (York St.) Cranemasters Property	Replacement	1150	2022
Meadowbrook Interceptor (York St.) Cranemasters Property near O'Brien Ave.	Lining	885	2023
Taneytown Elementary Property	Lining	237	2023
Fairground Ave.	Lining	2892	2023
Meadowbrook Interceptor (York St.) Cranemasters Property near O'Brien Ave.	Replacement	40	2023
Taneytown Elementary Property	Replacement	753	2023
Fairground Ave.	Replacement	712	2023
Roberts Mill Rd./Broad St. project	Replacement	1897	2023
Not reported	Lining	2,314	2025
	Upper Monocacy Watershed Total:	**29,069**	

4. Lower Monocacy Watershed

No Projects Reported

5. Liberty Reservoir Watershed

Hampstead – Carroll County Department of Public Works			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Ridge Rd. from 6636 Ridge to intersection with Marvin Ave.	Spiral Wound Lining	261	2009
Marvin Ave from 6625 Marvin to intersection with Ridge Rd.	Spiral Wound Lining	300	2009
Marvin Ave. from 6613 to 6621	Spiral Wound Lining	373	2009
Monroe Ave. from 6615 to 6623	Spiral Wound Lining	371	2009
Autumn View Rd. from 6821 to 6829	Spiral Wound Lining	399	2010
Harvest Farm Rd. from 2204 to intersection with Autumn View Rd.	Spiral Wound Lining	96	2010
Houcksville Rd. from 758 to 850 Houcksville & 906 to 912 Houcksville	Spiral Wound Lining	1,735	2014
West side of West Street north of Sullivan Drive	Spiral Wound Lining	250	2014
Marvin Ave. from 6621 to 6625	Spiral Wound Lining	305	2015
Marvin Ave. from 6608 to 6613	Spiral Wound Lining	309	2015
South of Dakota Rd & North of Gill Ave.	Cured In Place Lining	1,658	2016
Main St. from Upper Beckleysville Rd. to 230 ft. south of Hillcrest Ave.	VCP to PVC Replacement	1,582	2016
Carroll Highlands Rd. from 6520 to 6609	Cured In Place Lining	488	2016
Carroll Highlands Rd. from 6629 to 6703	Cured In Place Lining	212	2016
Carroll Highlands Rd. from 6706 to 6710	Cured In Place Lining	211	2016
South of Harvest Farm Rd.	Cured In Place Lining	1,705	2016
Liberty Rd. from 1818 to 1838	Cured In Place Lining	432	2016
Main running to the north of Shiloh Rd and west of Panther.	Cured In Place Lining	3,377	2017
Carroll St. from 1024 Carroll St. to Houcksville Rd.	Cured In Place Lining	571	2017

Sunset Drive from 3924 Sunset to Intersection with Riata Lane.	Cured In Place Lining	311	2017
West side of West Street south of Sullivan Drive.	Cured In Place Lining	434	2017
East of Snowdens Run	Cured In Place Lining	853	2017
Carroll Highlands Rd. from 6514 to 6520	Cured In Place Lining	320	2017
Panorama Dr. from 6506 to 6500	Cured In Place Lining	231	2017
Between Harvest Farm Rd and Carroll Highlands Rd.	Cured In Place Lining	715	2017
Between Carroll Highlands Rd. and Sunset Drive.	Cured In Place Lining	1,037	2017
Monroe Ave. from 6518 to intersection with Martin Pl.	Cured In Place Lining	250	2019
5531 Snowdens Run	Lining	85	2023
6424 Esquire Drive	Lining	35	2024
	Total:	**18,906**	
Manchester			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Forest Lane	Lining	250	2017/2018
Forest Lane	Lateral	15	2017/2018
	Total:	**265**	
Westminster			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Bennett Cerf, Baltimore Blvd.	Lining, replacement, grouting (Phase I)	10,165	2017/2018
Bennett Cerf, Manchester Rd, Rt 140	Lining, replacement, grouting (Phase II)	5,292	2019/2020
Magna Way	Lining	500	2025
	Total:	**15,957**	
	Liberty Reservoir Watershed Total:	**35,128**	

6. Double Pipe Creek Watershed

New Windsor			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
High St. & Main St.	Sewer Lining	3,650	2017
Not reported	Lateral Line Replacement	235	2025
Not reported	Sewer Lining	4,030	2025
	Total:	**7,915**	
Manchester			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Sheetz	Lateral	280	2017/2018
	Total:	**280**	
Westminster			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
Congressional Drive	Line replacement	30	2019
Gist Road/Route 27	Liner installation, spot repairs, manhole rehabilitation	5,296	2020/2021
	Total:	**5,326**	
Taneytown			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
4323 & 4325 Stumptown	Septic tank abandoned, Connected to sanitary	1	
4315 Stumptown Rd	Septic tank abandoned, Connected to sanitary	1	
Not reported	Septic tank abandoned, Connected to sanitary	1	
	Total:	3	
Union Bridge			
Project Location	**Project Type**	**Length (Linear feet)**	**Year(s)**
	Total:	0	
	Double Pipe Total:	**13,521**	

Appendix B: BAT Upgrades

1. Prettyboy Watershed

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
4923 SCHALK RD 1	MILLERS	21102	8/6/2009	Complete	2009
4420 HAYFIELD DR	MANCHESTER	21102	5/22/2009	Complete	2009
3610 WATER TANK RD	MANCHESTER	21102	6/11/2009	Complete	2009
5070 SHAFFER MILL RD	LINEBORO	21102	10/20/2009	Complete	2009
4530 BLACK ROCK RD	HAMPSTEAD	21074	6/4/2009	Complete	2009
4117 MAIN ST	LINEBORO	21102	4/1/2010	Complete	2010
4637 WATER TANK RD	MANCHESTER	21102	4/3/2013	Complete	2013
4801 ALESIA ROAD	MILLERS	21102	11/17/2016	Complete	2016
4947 SCHALK ROAD	WESTMINSTER	21157	3/1/2016	Complete	2016
4137 GRAVE RUN ROAD	MILLERS	21102	12/11/2017	Complete	2017
4426 UPPER BECKLEYSVILLE ROAD	HAMPSTEAD	21074	5/30/2018	Complete	2018
4217 MAIN ST	SYKESVILLE	21784	4/3/2018	Complete	2018
4900 UPPER BECKLEYSVILLE ROAD	HAMPSTEAD	21074	1/23/2019	Complete	2019
4220 MAPLE GROVE ROAD	HAMPSTEAD	21074	8/6/2018	Complete	2019
3646 WATER TANK ROAD	MANCHESTER	21102	5/16/2019	Complete	2019
2715 MOUNT VENTUS RD ONE	GLENVILLE	17329	8/10/2020	Complete	2021
3725 MAPLE GROVE RD	MANCHESTER	21102	1/3/2020	Complete	2020
3321 MAPLE GROVE RD	MANCHESTER	21102	6/22/2020	Complete	2020
2922 WAREHIME RD	MANCHESTER	21102	5/6/2020	Complete	2020
4901 ROLLER RD	MILLERS	21102	6/30/2020	Complete	2020
3500 Young Rd	Millers	21102	7/30/2020	Complete	2021
4958 Wentz Rd	Manchester	21102	8/20/2020	Complete	2021
3637 Water Tank Rd	Manchester	21102	9/8/2021	Complete	2022
3562 Basler Rd	Hampstead	21074	7/28/2022	Complete	2023

2. Upper Monocacy Watershed

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
3603 FRINGER RD	TANEYTOWN	21787	7/27/2009	Complete	2009
5201 TEETER RD	TANEYTOWN	21787	9/28/2011	Complete	2011
3920 BULLFROG RD	TANEYTOWN	21787	4/24/2013	Complete	2013
1919 S KEYSVILLE RD	KEYMAR	21757	7/17/2013	Complete	2013
8274 FOREST AND STREAM CLUB RD	DETOUR	21725	6/30/2013	Complete	2013
4726 BABYLON ROAD	TANEYTOWN	21787	7/28/2015	Complete	2015
5125 BABYLON RD	TANEYTOWN	21787	11/10/2015	Complete	2015
5132 BABYLON ROAD	TANEYTOWN	21787	6/28/2017	Complete	2017
4115 BAPTIST ROAD	TANEYTOWN	21787	9/9/2015	Complete	2015
5116 HARNEY ROAD	KEYMAR	21157	9/2/2015	Complete	2015
5118 HARNEY ROAD	KEYMAR	21157	9/2/2015	Complete	2015
5120 HARNEY ROAD	KEYMAR	21157	9/2/2015	Complete	2015
5822 KEYSVILLE ROAD	KEYMAR	21157	6/10/2019	Complete	2019
1931 S KEYSVILLE RD	KEYMAR	21757	5/28/2020	Complete	2020
4003 Bullfrog Rd	Taneytown	21787	7/31/2019	Complete	2020
4855 Stonesifer Rd	Taneytown	21787	10/1/2020	Complete	2021
3414 Francis Scott Key Hwy	Taneytown	21787	6/28/2021	Complete	2021
4227 N. Fringer Rd	Taneytown	21787	6/29/2021	Complete	2021
5801 Conover Rd	Taneytown	21787	6/30/2021	Complete	2021
5999 Keysville Rd	Keymar	21757	7/6/2021	Complete	2022
3631 Walnut Grove Rd	Taneytown	21787	11/29/2022	Complete	2023
3424 Francis Scott Key Highway	Taneytown	21787	9/12/2023	Complete	2024
2001 Keysville Bruceville Rd	Keymar	21757	12/18/2024	Complete	2025

3. Liberty Reservoir Watershed

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
4500 LONDON BRIDGE RD	SYKESVILLE	21784	4/23/2009	Complete	2009
5220 KLEES MILL RD	SYKESVILLE	21784	8/18/2009	Complete	2009
3537 SALEM BOTTOM RD	WESTMINSTER	21157	6/18/2009	Complete	2009
3110 ADAMS DR	HAMPSTEAD	21074	5/14/2009	Complete	2009
2500 PALOMINO CT	FINKSBURG	21048	5/12/2009	Complete	2009
2518 LAWNDALE RD	FINKSBURG	21048	5/18/2009	Complete	2009
722 RAINBOW DR	WESTMINSTER	21157	5/12/2009	Complete	2009
2104 SPENCER LANE	FINKSBURG	21048	8/11/2009	Complete	2009
4107 FRIAR TUCK WY	SYKESVILLE	21784	6/2/2012	Complete	2012
3517 OXWED CT	WESTMINSTER	21157	6/5/2009	Complete	2009
5220 STONE MILL CT	SYKESVILLE	21784	12/3/2009	Complete	2009
1860 CAIRNSMORE DR	FINKSBURG	21048	6/25/2009	Complete	2009
2021 WALSH DR	WESTMINSTER	21157	7/9/2009	Complete	2009
2708 LEPPO LANE	FINKSBURG	21048	7/16/2010	Complete	2010
2000 DENNINGS RD	NEW WINDSOR	21776	6/30/2013	Complete	2013
1732 PEACHWOOD CT	FINKSBURG	21048	7/24/2009	Complete	2009
90 FIG LEAF DR	HAMPSTEAD	21074	7/24/2009	Complete	2009
5824 MELVILLE RD	SYKESVILLE	21784	8/8/2009	Complete	2009
2102 ALFONSAS DR	WESTMINSTER	21157	9/3/2009	Complete	2009
2247 DEER PARK RD	FINKSBURG	21048	9/22/2009	Complete	2009
213 OPAL AVE	WESTMINSTER	21157	11/4/2009	Complete	2009
1811 ALBERT RILL RD	HAMPSTEAD	21074	11/4/2010	Complete	2010
1511 S SPRINGLAKE WY	SYKESVILLE	21784	6/30/2013	Complete	2013
2516 CORNSTALK DR	FINKSBURG	21048	3/5/2009	Complete	2009
203 OPAL AVE	WESTMINSTER	21157	1/21/2009	Complete	2009
194 OPAL AVE	WESTMINSTER	21157	9/3/2009	Complete	2009
5580 LINTON RD	SYKESVILLE	21784	12/6/2012	Complete	2012
1404 CHAZADALE WY	WESTMINSTER	21157	5/21/2013	Complete	2013
4600 Sykesville RD	SYKESVILLE	21784	7/13/2010	Complete	2010
1804 Hanover PKE	HAMPSTEAD	21074	3/14/2013	Complete	2013
2122 Coon Club RD	WESTMINSTER	21157	8/27/2013	Complete	2013
1519 Brehm Road	WESTMINSTER	21157	1/15/2014	Complete	2014
1940 Albert Rill RD	HAMPSTEAD	21074	12/23/2013	Complete	2013
1120 Arnold Road	WESTMINSTER	21157	10/16/2013	Complete	2013
2914 Dede Rd	FINKSBURG	21048	6/4/2014	Complete	2014
920 OLD WESTMINSTER PIKE	WESTMINSTER	21157	7/9/2015	Complete	2015
2013 Sandymount Rd	FINKSBURG	21048	5/15/2014	Complete	2014
3512 Westview Rd	WESTMINSTER	21157	8/14/2013	Complete	2013

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
3502 NINER ROAD	FINKSBURG	21048	5/6/2015	Complete	2015
4115 TEKLEN DR	WESTMINSTER	21157	1/13/2015	Complete	2015
2300 BEREN LANE	WESTMINSTER	21157	12/1/2015	Complete	2015
833 SHANDY BROOK DR	WESTMINSTER	21157	10/7/2015	Complete	2015
2658 BIRD VIEW ROAD	WESTMINSTER	21157	2/19/2015	Complete	2015
1631 EXETER ROAD	WESTMINSTER	21157	3/11/2015	Complete	2015
4004 BEE CT	WESTMINSTER	21157	2/19/2015	Complete	2015
1901 SULAINE CT	FINKSBURG	21048	1/13/2015	Complete	2015
2024 HANOVER PIKE	HAMPSTEAD	21074	1/22/2015	Complete	2015
4014 ROBIN HOOD WAY	SYKESVILLE	21784	9/8/2015	Complete	2015
600 LIBERTY ROAD	SYKESVILLE	21784	7/23/2015	Complete	2015
1193 GLENSIDE CT	HAMPSTEAD	21074	5/4/2015	Complete	2015
1545 OLD WESTMINSTER PIKE	WESTMINSTER	21157	5/20/2015	Complete	2015
3652 SYKESVILLE ROAD	SYKESVILLE	21784	4/21/2015	Complete	2015
1734 OLD WESTMINSTER PIKE	WESTMINSTER	21157	7/8/2015	Complete	2015
3101 BALTIMORE BLVD	FINKSBURG	21048	11/12/2015	Complete	2015
419 HOUCKSVILLE ROAD	HAMPSTEAD	21074	9/2/2015	Complete	2015
3410 OLD GAMBER ROAD	FINKSBURG	21048	9/8/2015	Complete	2015
1043 ARNOLD ROAD	WESTMINSTER	21157	9/24/2014	Complete	2014
3670 BAKER ROAD	WESTMINSTER	21157	6/29/2016	Complete	2016
2055 BANDY AVENUE	SYKESVILLE	21784	11/10/2015	Complete	2015
4436 BARTHOLOW ROAD	SYKESVILLE	21784	7/18/2016	Complete	2016
2225 CARROLLTON ROAD	WESTMINSTER	21157	10/11/2016	Complete	2016
2900 CARROLLTON ROAD	FINKSBURG	21048	7/1/2015	Complete	2015
2746 CEDARHURST ROAD	FINKSBURG	21048	7/25/2016	Complete	2016
2938 HAMPSTEAD MEXICO ROAD	HAMPSTEAD	21074	6/16/2017	Complete	2017
102 HANOVER PIKE	HAMPSTEAD	21074	9/17/2015	Complete	2015
3338 MARSTON ROAD	WESTMINSTER	21157	9/25/2015	Complete	2015
1206 MIDVALE COURT	HAMPSTEAD	21074	6/30/2016	Complete	2016
5519 MINERAL HILL	SYKESVILLE	21784	10/14/2016	Complete	2016
1405 OLD MANCHESTER ROAD	WESTMINSTER	21157	10/9/2015	Complete	2015
1862 OLD WESTMINSTER ROAD	WESTMINSTER	21157	6/13/2017	Complete	2017
3051 SHOOTING STAR WAY	FINKSBURG	21048	12/1/2015	Complete	2015
2304 SOUTHFIELD COURT	FINKSBURG	21048	7/6/2015	Complete	2015
4206 WASHINGTON WAY	SYKESVILLE	21784	6/29/2016	Complete	2016
5730 HODGES ROAD	SYKESVILLE	21784	7/10/2017	Complete	2017
3344 EMORY ROAD N	FINKSBURG	21048	9/19/2017	Complete	2017
1657 MANCHESTER ROAD	WESTMINSTER	21157	8/7/2017	Complete	2017
2702 SYKESVILLE ROAD	WESTMINSTER	21157	3/5/2018	Complete	2018
1629 OLD MANCHESTER ROAD	WESTMINSTER	21158	12/20/2018	Complete	2019

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
2534 ARUTHER AVENUE	SYKESVILLE	21784	7/16/2018	Complete	2019
2062 BANDY AVENUE	SYKESVILLE	21784	11/16/2018	Complete	2019
3139 SYKESVILLE ROAD	WETSMINTER	21158	8/13/2018	Complete	2019
1301 WESLEY AVENUE	FINKSBURG	21048	10/10/2018	Complete	2019
2535 ARTHUR AVENUE	SYKESVILLE	21784	1/25/2019	Complete	2019
67 WARFIELDSBURG ROAD	WESTMINSTER	21158	6/28/2019	Complete	2019
123 TAFT TERRACE	SYKESVILLE	21784	5/16/2019	Complete	2019
2600 JEFFREY LORI DR	FINKSBURG	21048	2/26/2020	Complete	2020
4305 JEFFERSON AVE	SYKESVILLE	21784	6/29/2020	Complete	2020
5908 FOREST CT	SYKESVILLE	21784	9/4/2020	Complete	2021
831 Sullivan Rd	Westminster	21157	9/23/2019	Complete	2020
2801 Armacost Ave	Finksburg	21048	10/1/2019	Complete	2020
2603 Sykesville Rd	Westminster	21157	8/14/2019	Complete	2020
2716 Coon Club Rd	Westminster	21157	10/28/2019	Complete	2020
2432 Neudecker Rd	Westminster	21157	12/3/2019	Complete	2020
1410 Bollinger Rd	Westminster	21157	9/2/2020	Complete	2021
5511 Strawbridge Terrace	Sykesville	21784	2/26/2021	Complete	2021
2919 Cedarhurst Rd	Finksburg	21048	5/28/2021	Complete	2021
2115 Ridge Rd	Westminister	21157	6/28/2021	Complete	2021
1326 Hillcrest DR	Sykesville	21784	3/21/2023	Complete	2023
511 Sullivan Rd	Westminster	21157	3/11/2024	Complete	2024
313 Barnes Ave	Westminster	21157	11/12/2024	Complete	2025

4. Double Pipe Creek Watershed

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
3524 MIDDLEBURG RD	UNION BRIDGE	21791	12/30/2008	Complete	2008
1257 BACHMANS VALLEY RD	WESTMINSTER	21158	6/18/2009	Complete	2009
2221 TREVANION RD	TANEYTOWN	21787	6/15/2009	Complete	2009
4117 BACK WOODS RD	MANCHESTER	21102	7/13/2009	Complete	2009
373 W DEEP RUN RD	WESTMINSTER	21158	7/13/2011	Complete	2011
7535 MIDDLEBURG RD	DETOUR	21725	8/19/2011	Complete	2011
1927 TREVANION RD	TANEYTOWN	21787	6/18/2012	Complete	2012
3455 Uniontown RD	WESTMINSTER	21157	6/30/2013	Complete	2013
4231 Wine Rd	WESTMINSTER	21158	6/5/2014	Complete	2014
6217 MIDDLEBURG ROAD	KEYMAR	21757	8/4/2015	Complete	2015
1660 E RICHARDSON ROAD	WESTMINSTER	21158	4/16/2015	Complete	2015
OLD HANOVER RD	WESTMINSTER	21158	12/11/2015	Complete	2015
2618 MANCHESTER ROAD	WESTMINSTER	21157	6/11/2015	Complete	2015
1480 MCKINSTRYS MILL ROAD	UNION BRIDGE	21791	7/20/2015	Complete	2015
1538 DENNINGS ROAD	NEW WINDSOR	21776	10/28/2015	Complete	2015
1729 OTTERDALE MILL ROAD	TANEYTOWN	21787	6/19/2015	Complete	2015
4106 HAWKS HILL ROAD	NEW WINDSOR	21776	6/30/2015	Complete	2015
743 OTTERDALE MILL ROAD	TANEYTOWN	21787	7/10/2015	Complete	2015
11 KALTEN ROAD	WESTMINSTER	21158	7/15/2015	Complete	2015
1850 OLD NEW WINDSOR PIKE	NEW WINDSOR	21776	10/8/2015	Complete	2015
2441 MARSTON ROAD	NEW WINDSOR	21776	11/4/2015	Complete	2015
5140 MAIN ROAD	UNION BRIDGE	21791	11/25/2015	Complete	2015
1138 GREEN MEADOW LANE	WESTMINSTER	21158	4/8/2015	Complete	2015
1600 ADAMS MILL ROAD	WESTMINSTER	21158	6/14/2016	Complete	2016
1330 BAUST CHURCH ROAD	UNION BRIDGE	21791	6/21/2016	Complete	2016
3730 DIEHL ROAD	TANEYTOWN	21787	6/28/2016	Complete	2016
2165 HAGERSTOWN LANE	KEYMAR	21757	4/19/2017	Complete	2017
2218 JOHN SELBY ROAD	NEW WINDSOR	21776	6/15/2016	Complete	2016
2902 LITTLESTOWN PIKE	WESTMINSTER	21158	10/5/2016	Complete	2016
3064 LITTLESTOWN PIKE	WESTMINSTER	21158	6/29/2017	Complete	2016
2518 MANCHESTER ROAD	WESTMINSTER	21158	2/1/2017	Complete	2017
1470 MCKINSTRYS MILL ROAD	UNION BRIDGE	21791	7/17/2015	Complete	2015
6051 MIDDLEBERG ROAD	KEYMAR	21157	9/21/2016	Complete	2016
6121 MIDDLEBERG ROAD	KEYMAR	21157	6/28/2016	Complete	2016
5207 MIDDLEBERG ROAD	UNION BRIDGE	21157	10/14/2016	Complete	2016
3405 OLD TANEYTOWN ROAD	WESTMINSTER	21158	7/11/2016	Complete	2016
1330 OLD TANEYTOWN ROAD	WESTMINSTER	21158	8/6/2015	Complete	2015
8051 SIXES BRIDGE ROAD	KEYMAR	21757	12/16/2015	Complete	2015

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
753 STONE ROAD	WESTMINSTER	21158	9/20/2016	Complete	2016
616 STONE ROAD	WESTMINSTER	21158	4/12/2017	Complete	2017
2241 TREVANION ROAD	TANEYTOWN	21787	9/16/2016	Complete	2016
2024 SANDAWAY DRIVE	WESTMINSTER	21157	10/8/2015	Complete	2015
3409 LITTLESTOWN PIKE	WESTMINSTER	21158	10/26/2017	Complete	2017
3854 LITTLESTOWN PIKE	WESTMINSTER	21158	10/18/2017	Complete	2017
1200 SILVER RUN VALLEY ROAD	WESTMINSTER	21158	10/12/2017	Complete	2017
1392 ALISON CT	WESTMINSTER	21158	3/15/2018	Complete	2018
1160 FRANCIS SCOTT KEY HWY	KEYMAR	21157	1/24/2019	Complete	2019
1010 PLEASANT VALLEY ROAD	WESTMINSTER	21158	7/14/2018	Complete	2019
1635 STONE CHAPEL ROAD	NEW WINDSOR	21776	8/8/2018	Complete	2019
3805 OLD TANEYTOWN ROAD	TANEYTOWN	21787	6/19/2019	Complete	2019
2193 TIMOTHY DRIVE	WESTMINSTER	21158	12/7/2018	Complete	2019
2121 BACHMAN VALLEY RD	MANCHESTER	21102	6/25/2020	Complete	2020
628 STONE RD	WESTMINSTER	21158	8/13/2020	Complete	2021
3530 Old Taneytown Rd	Taneytown	21787	7/26/2019	Complete	2020
3729 Old Taneytown Rd	Taneytown	21787	8/2/2019	Complete	2020
2209 Feeser Rd N	Taneytown	21787	12/11/2019	Complete	2020
4055 Bark Hill Rd	Union Bridge	21791	11/7/2019	Complete	2020
3928 Littlestown Pk	Westminster	21158	11/21/2019	Complete	2020
6200 Middleburg Rd	Middleburg	21757	7/31/2019	Complete	2020
4300 Green Valley Rd	Union Bridge	21791	7/12/2019	Complete	2020
3847 Sams Creek Rd	New Windsor	21776	7/24/2019	Complete	2020
3681 Senft Rd	Taneytown	21787	7/2/2019	Complete	2020
1025 Western Chapel Rd	Westminster	21157	7/9/2020	Complete	2021
6100 Middleburg Rd	Middleburg	21757	9/8/2020	Complete	2021
2357 Mayberry Rd	Westminster	21158	9/18/2020	Complete	2021
3749 Old Taneytown Rd	Taneytown	21787	9/25/2020	Complete	2021
3227 Old Taneytown Rd	Westminister	21787	1/18/2021	Complete	2021
1250 S. Pleasant Valley Rd	Westminister	21158	6/25/2021	Complete	2021
917 Francis Scott Key Hwy	Keymar	21757	8/17/2020	Complete	2021
3914 Old Taneytown Rd	Taneytown	21787	9/20/2021	Complete	2022
556 Bucher John Rd	Union Bridge	21791	10/8/2021	Complete	2022
2615 Manchester Rd	Westminster	21157	10/12/2021	Complete	2022
355 Springdale Rd	Westminster	21158	12/2/2021	Complete	2022
3371 Littlestown Pke	Westminster	21158	2/11/2022	Complete	2022
832 Regent St	Westminster	21157	3/2/2022	Complete	2022
5677 Middleburg Rd	Union Bridge	21791	5/2/2022	Complete	2022
1780 Greenwood Church Rd	New Windsor	21776	5/23/2022	Complete	2022
3152 Cardinal Dr	Westminster	21158	6/22/2022	Complete	2022

ADDRESS	CITY	ZIPCODE	INSTALL_DATE	IMPL_STATUS	IMPL_COMP_YR
5748 Middleburg Rd	Union Bridge	21791	6/29/2022	Complete	2022
2425 Francis Scott Key Highway	Keymar	21757	8/22/2022	Complete	2023
4204 Hanover Pike	Manchester	21102	10/10/2022	Complete	2023
3710 Watson Ln	Union Bridge	21791	12/30/2022	Complete	2023
4320 Littlestown Pike	Westminster	21157	1/5/2023	Complete	2023
3942 Littlestown Pike	Westminster	21158	7/21/2022	Complete	2023
3744 Back Woods Rd	Westminster	21058	7/8/2022	Complete	2023
2415 Trevanion Rd	Taneytown	21787	10/20/2023	Complete	2024
3319 Old Taneytown Road	Westminster	21158	10/17/2023	Complete	2024
2116 Marston Rd	New Windsor	21776	10/16/2024	Complete	2025
2130 Marston Rd	New Windsor	21776	10/16/2024	Complete	2025