Bacteria Stormwater Wasteload Allocation (SW-WLA) Watershed Implementation Plan (WIP) for Prince George's County

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Abbreviations and Acronyms

AFO	animal feeding operation
ANFS	anthropogenic and non-human fecal sources
ARA	antibiotic resistance analysis
AMD	[Prince George's County Department of the Environment] Animal Management Division
BIBI	Benthic Index of Biotic Integrity
BMP	best management practice
BSID	biological stressor identification
BST	bacterial source tracking
CAFO	concentrated animal feeding operation
CFU/100 mL	colony forming units per 100 milliliters
CIP	Capital Improvement Program
CWA	Clean Water Act
CWMA	Cooperative Wildlife Management Area
CWP	Clean Water Partnership
DEP	[Florida] Department of Environmental Protection
DoE	[Prince George's County] Department of the Environment
DPIE	[Prince George's County] Department of Permitting, Inspection, and Enforcement
DPW&T	[Prince George's County] Department of Public Works and Transportation
E. coli	*Escherichia coli*
EPA	[U.S.] Environmental Protection Agency
ESD	environmental site design
°F	degrees Fahrenheit
FAP	Financial Assurance Plan
FIB	Fecal Indicator Bacteria
FIBI	Fish Index Biotic Integrity
FY	fiscal year
GM	geometric mean
HFS	human fecal source
HOA	homeowner association
HSG	hydrologic soil group
IBI	Index of Biotic Integrity
JBA	Joint Base Andrews
IDDE	illicit discharge detection and elimination
LA	load allocation
lb	pound
MBSS	Maryland Biological Stream Survey
MD DNR	Maryland Department of Natural Resources
MDE	Maryland Department of the Environment
MEP	maximum extent practicable
mg/L	milligrams per liter

M-NCPPC	Maryland-National Capital Park and Planning Commission
MOS	margin of safety
MPN/100 mL	most probable number per 100 milliliters
MPR	maximum practicable reduction
MST	microbial source tracking
MS4	municipal separate storm sewer system
NHD	National Hydrography Dataset
NPDES	National Pollutant Discharge Elimination System
OSDS	onsite sewage disposal system
PCC	People for Change Coalition
PCB	polychlorinated biphenyls
ppm	parts per million
qPCR	quantitative polymerase chain reaction
ROW	right-of-way
RR	runoff reduction
RV	recreational vehicle
SCA	stream corridor assessment
SR3	Sewer Repair, Replacement and Rehabilitation
SSO	sanitary sewer overflow
ST	stormwater treatment
STV	statistical threshold value
SWM	stormwater management
SWMM	Stormwater Management Model
TMDL	total maximum daily load
TSS	total suspended solids
UMCES	University of Maryland Center for Environmental Science
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WIP	Watershed Implementation Plan
WLA	wasteload allocation
WPRPP	[MDE] Watershed Protection Restoration and Planning Program
WTM	Watershed Treatment Model

1. Introduction

On December 2, 2022, the Maryland Department of the Environment (MDE) issued Prince George's County (the County) a fifth generation permit (MDE 2022a) for its National Pollutant Discharge Elimination System (NPDES) municipal separate storm sewer system (MS4), which is a series of stormwater sewers owned by a municipal entity (e.g., the County) that discharges the conveyed stormwater runoff into a water body (e.g., Anacostia River).

The MS4 permit (MDE 2022a) requires that the County develop local restoration plans—henceforth referred to as watershed implementation plan(s) (WIPs)—to address each U.S. Environmental Protection Agency (EPA)-approved total maximum daily load (TMDL) with stormwater wasteload allocations (WLAs).

A TMDL can be seen as a *pollution diet* in that the load is the maximum amount of a pollutant that a water body can assimilate and still meet water quality standards and designated uses. The WLA is the portion of the TMDL that is allocated to permitted dischargers such as wastewater treatment plants or MS4s.

The MS4 permit stipulates that the County must develop additional restoration plans within 1 year of the EPA approval of a new TMDL. As of January 1, 2023, there are three EPA-approved bacteria TMDLs in the County: Anacostia River, Piscataway Creek, and portions of the Upper Patuxent River watersheds (Figure 1-1). Local TMDL restoration plans for bacteria were previously developed in 2014 for the County portions of the watersheds associated with the Anacostia River, Piscataway Creek, and portions of the Upper Patuxent River watersheds.

MDE's 2022 *Guidance for Developing Bacteria Total Maximum Daily Load Stormwater Wasteload Allocation Watershed Implementation Plans* (MDE 2022b) primarily focuses on the spatial identification of potential sources on the landscape, water quality monitoring to identify sources, elimination of fecal bacteria sources, and estimating trends; the MDE 2022 guidance focus is less on meeting WLAs because of the inaccuracies associated with quantifying land-use loading rates and traditional BMP performance. There are no final achievement dates for bacteria load reduction.

Bacteria reduction is contingent on a source identification and elimination approach. This document presents the overall bacteria-targeted strategy and is meant as a living document for meeting bacteria water quality standards.

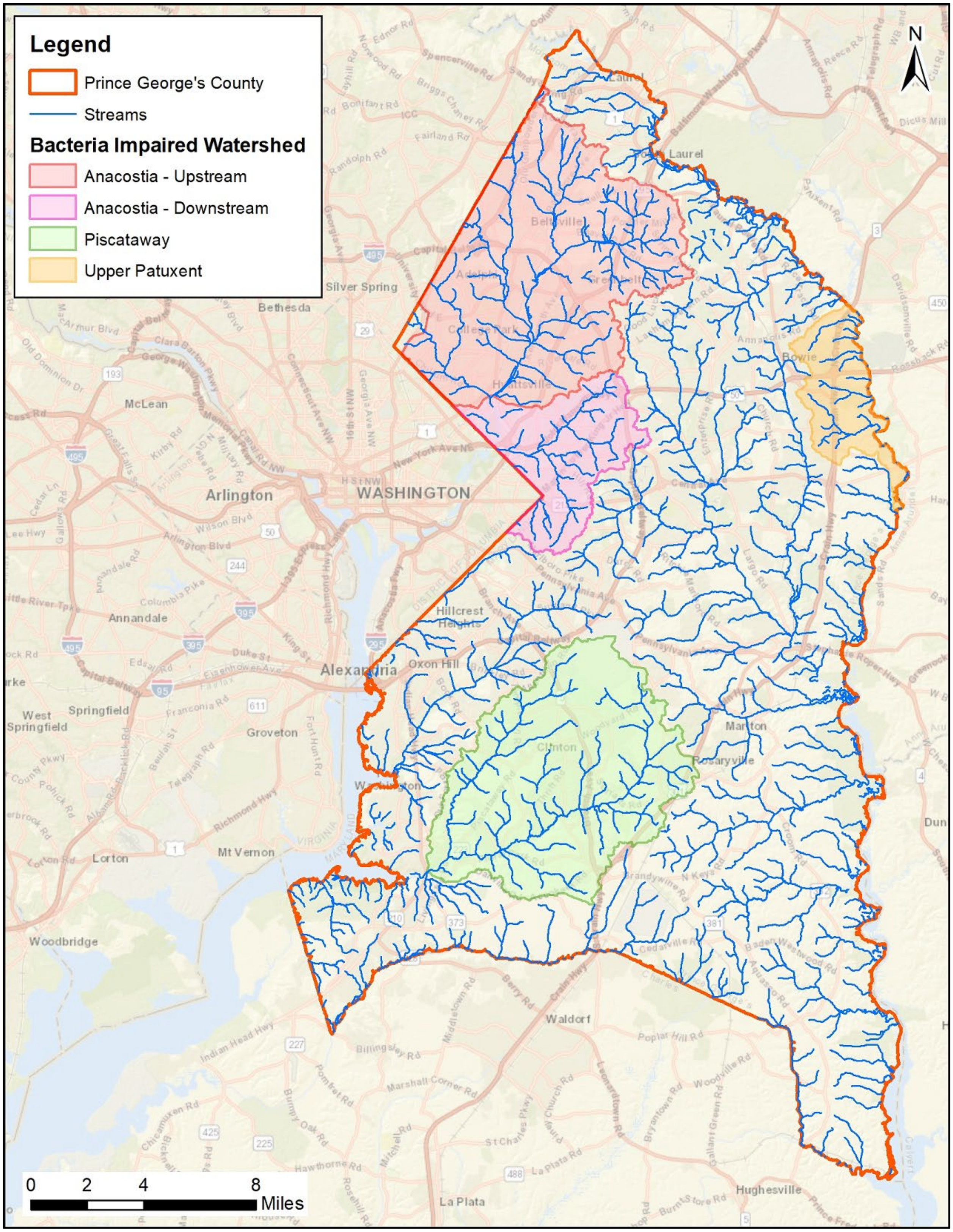

Figure 1-1. Bacteria-impaired and listed watersheds in Prince George's County, MD.

This strategy document is organized in the following sections:

- Section 1: Introduction
  - Includes discussion of implementation plans, water quality impairments, water quality standards, designated uses, bacteria TMDLs in the County, and existing water quality data.
- Section 2: Bacteria WIP Guidance and Requirements
  - Reviews MDE WIP guidelines for bacteria, including required and recommended data for bacteria source track-down studies.
- Section 3: Sources of Bacteria and Associated Data Sources
  - Reviews potential sources of elevated bacteria levels and associated data (e.g., sanitary sewer overflows [SSOs] and the MDE online database of SSOs).
- Section 4: County Monitoring Approach
  - Discusses MS4-permit required monitoring and optional monitoring approaches.
- Section 5: Source Tracking and Subwatershed Prioritization
  - Explains how the County will use water quality data and data sources (from Section 3) to track and identify potential bacteria sources.
- Section 6: County Programmatic Source Control Management Actions
  - Summarizes existing County programs that will address bacteria impairments; the Section also includes potential enhancements.
- Section 7: Adaptive Approach and Reporting
  - Describes the County's adaptive management, progress tracking, and reporting approach.
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- Appendix A: Regional Field Screening Methods
  - Reviews monitoring programs from other jurisdictions.
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- Appendix B: Public Involvement to Support Implementation Activities

1.1. Purpose of Report and Watershed Implementation Plans

1.1.1. What is a TMDL?

Section (§) 303(d) of the Clean Water Act (CWA) and EPA's Water Quality Planning and Management Regulations (codified at Title 40 of the Code of Federal Regulations Part 130) require states to develop TMDLs for impaired water bodies. TMDLs provide the scientific basis for a state to establish water quality-based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of the state's water resources (USEPA 1991).

A TMDL is a pollution diet that establishes the amount of a pollutant a water body can assimilate without exceeding its water quality standard for that pollutant. A TMDL is represented as a mass per unit of time (e.g., pounds per day). The mass per unit time is called the load. For instance, a

TMDL could stipulate that a maximum load of 1,000 pounds of sediment per day could be discharged into an entire stream before the stream experiences any detrimental effects. The pollution diet for a given pollutant and water body is composed of the sum of individual WLAs for point sources and LAs (load allocations), which are nonpoint sources and natural background levels of that same pollutant. In addition, the TMDL must include an implicit or explicit margin of safety (MOS) to account for uncertainty in the relationship between pollutant loads and the quality of the receiving water body. The following equation illustrates TMDL components, where Σ means the sum:

$$\text{TMDL} = \Sigma \text{ WLAs} + \Sigma \text{ LAs} + \text{MOS}$$

A WLA is the portion of the overall pollution diet assigned to permitted dischargers, such as the County's MS4. The County's MS4 permit requires that the County develop local restoration plans or WIPs to address each EPA-approved TMDL with a stormwater waste load allocation (WLA).

1.1.2. What is a Watershed Implementation Plan?

A WIP is a strategy for managing the natural resources within a geographically defined watershed. For the County's Department of the Environment (DoE), this largely means managing urban stormwater (i.e., runoff originating from rainstorms or snowmelt) to protect and / or restore the County's waterbodies for their designated uses. Stormwater management is most effective when viewed in the watershed context—watersheds are land areas and their network of streams that convey stormwater runoff to a common body of water. Figure 1-1 shows the bacteria-impaired watersheds of the County. Successful stormwater management consists of both structural pollution control practices (e.g., vegetated roadway swales) and behavior change via public outreach (e.g., pet waste campaigns and education) at both the public and private levels.

The WIP development process addresses changes that are needed to the County's priorities to comply with water quality regulations, to improve the health of the streams in the County to meet designated uses, and to create value for neighborhoods in the County's watersheds.

The overall goals of the WIP are to:

- Protect, restore, and enhance habitat in the watershed.
- Restore watershed functions, including hydrology, water quality, and habitat, using a balanced approach that minimizes negative impacts.
- Support compliance with regional, state, and federal regulatory requirements.
- Increase awareness and stewardship within the watershed, including encouraging policymakers to develop policies that support a healthy watershed.
- Provide to stakeholders the understanding that these implementation plans will carry over several years and be based on adaptive management.

This document represents the first stage in achieving these goals. This plan is not meant to constitute site-level planning but, rather, focuses on watershed-based planning more broadly.

In summary, the WIP process seeks to:

- Identify causes and sources of pollution.
- Describe management options and identify critical areas.
- Estimate technical and financial assistance needed.
- Develop an education component.
- Describe interim, measurable milestones.
- Identify indicators to measure progress.
- Develop a monitoring component.

1.1.3. What are Fecal Coliform Bacteria?

Fecal bacteria (e.g., the organism *Escherichia coli [E. coli]* and two classes of fecal microbes, streptococci and enterococci) are single-celled pathogens found in the waste of warm-blooded animals, including humans. Fecal bacteria known to cause disease or sickness in humans when ingested in activities like swimming and wading or during consumption of shellfish. Pathogenic fecal bacteria (disease-causing organisms) are impractical to monitor directly; therefore, fecal indicator bacteria (FIB) are often used as a surrogate measure to indicate risk of gastrointestinal illness in place of direct measurement of pathogens (UDFCDC & County of Denver 2016).

Fecal bacteria can enter surface waters through multiple paths such as leaking sewage pipes and septic systems, stormwater runoff carrying pet waste, and waste from wild local animal populations. *E. coli* and the enterococci are the most monitored forms of fecal bacteria because they indicate the presence of untreated sewage (human), which often carries human pathogens. Excessive amounts of fecal bacteria in surface waters indicate an increased risk of pathogen-induced illness to humans. These illnesses include gastrointestinal, respiratory, and skin diseases, as well as infections in the eye, ear, and throat. (USEPA 1986). Pathogen-induced diseases are easily transmitted to humans through contact with contaminated surface waters, often through recreational contact or ingestion.

1.2. Prince George's County Water Quality Impairments

This section summarizes the bacteria-related water quality problems identified in the County's watersheds.

1.2.1. Designated Uses

MDE classifies waterbodies in the state based on the waterbody's existing conditions and the designated uses for the water body. Additional information on designated uses are found in the *Code of Maryland Regulations* (COMAR) Sections 26.08.02.02 *Designated Uses* and 26.08.02.04-1 *Anti-Degradation Policy*.

The County has the following designated uses (*Code of Maryland Regulations* [COMAR] 26.08.02.02), summarized in Table 1-1:

- Use Class I: Water Contact Recreation, Fishing, and Protection of Nontidal Warmwater Aquatic Life including fish (other than trout), agricultural and industrial water supply
- Use Class I-P: Water Contact Recreation, Protection of Aquatic Life, and Public Water Supply

- Use Class II: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting (tidal reaches only)
- Use Class III: Nontidal Cold Water
- Use Class IV: Recreational Trout Waters

Table 1-1. Designated water uses in the County based on MDE use-class groupings in COMAR.

Designated Uses	Use Classes				
	I	II	III	IV	I-P
Growth and propagation of fish (not trout), other aquatic life and wildlife	✓	✓	✓	✓	✓
Water contact sports	✓	✓	✓	✓	✓
Leisure activities involving direct contact with surface waters	✓	✓	✓	✓	✓
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					✓

Source: MDE 2022d.

Of the five designated use classes in the County, the impaired watersheds have all use classes but class I-P, which covers Rocky Gorge Reservoir and its tributaries. Figure 1-2 shows the County's three watersheds (Anacostia River, Piscataway Creek, and the Upper Patuxent River) and the designated uses in each.

The Anacostia River watershed contains primarily Class I use streams; The NWB is Class IV and the upper reaches of Paint Branch are Class III. The Anacostia River watershed also has some Class II waters at the County's border with Washington, D.C. The Piscataway Creek watershed has mainly Class I, except for a tidal stream, which is Class II. The Upper Patuxent River watershed is all Class I use.

Maryland also has designated Tier II high quality waters, which are waterbodies with existing water quality that is significantly better than water quality standards. Per federal regulations (Title 40 of the *Code of Federal Regulations* Section 131.12 [40CFR131.12]), these waters must be maintained at their high-quality level.

Figure 1-2 also shows these Tier II waters in the County. Beaverdam Creek is a Tier II water stream segment that flows into the Northeast Branch of the Anacostia River. Piscataway Creek has two short segments of Tier II stream segments and has a large portion with no assimilative capacity. MDE's assimilative capacity analysis is a measure of how much Tier II stream water quality can decline before that water quality is considered degraded. For additional information on Maryland's Tier II waters and assimilative capacity, please see MDE's webpage on anti-degradation.[1] The Upper Patuxent River watershed does not have Tier II stream segments.

1.2.1. Water Quality Standards

Maryland's General Water Quality Criteria states that

> . . . the waters of this State may not be polluted by…any material, including floating debris, oil, grease, scum, sludge and other floating materials attributable to sewage, industrial waste, or other waste in amounts sufficient to be unsightly; produce taste or odor; change the existing color to produce objectionable color for aesthetic purposes; create a nuisance; or interfere directly or indirectly with designated uses. . . [COMAR 26.08.02.03-3B(2)].

In addition to the General Water Quality Criteria, Maryland's water quality standards include numeric criteria for *E. coli* and *Enterococci* in freshwater. Table 1-2 shows the water quality criteria for two types of Class 1 waters—freshwater and marine/estuarine.

Table 1-2. Maryland bacteria water quality criteria for Class I waters (COMAR 26.08.02.03-3).

Indicator	Steady-State Geometric Mean Indicator Density[a]	Statistical Threshold Value[b]	Waterbody Type
E. coli	126 MPN/100 mL	410	freshwater
Enterococci	35 MPN/100 mL	130	freshwater, marine/estuarine

Notes:
MPN=most probable number; mL=milliliters.
[a] The geometric mean of samples taken over a 90-day period shall not exceed the steady-state geometric mean values for the given indicator.
[b] 10% of samples taken over a 90-day period shall not exceed the statistical threshold value.

Maryland also has narrative criteria stating that when a sanitary survey and an epidemiological study approved by the Department disclose no significant health hazard, the criteria in Table 1-2 do not apply (MDE 2023b).

According to EPA (USEPA 2014), waters contaminated by non-human fecal material can also pose a risk to swimmers because some pathogens are zoonotic, meaning they infect animals and can also cause illness in humans. Typically, human beings can become infected through contact with an animal infected with a zoonotic pathogen or animal waste. The EPA also summarizes key waterborne zoonotic pathogens and their potential survivability in the environment.

[1] https://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/Antidegradation_Policy.aspx

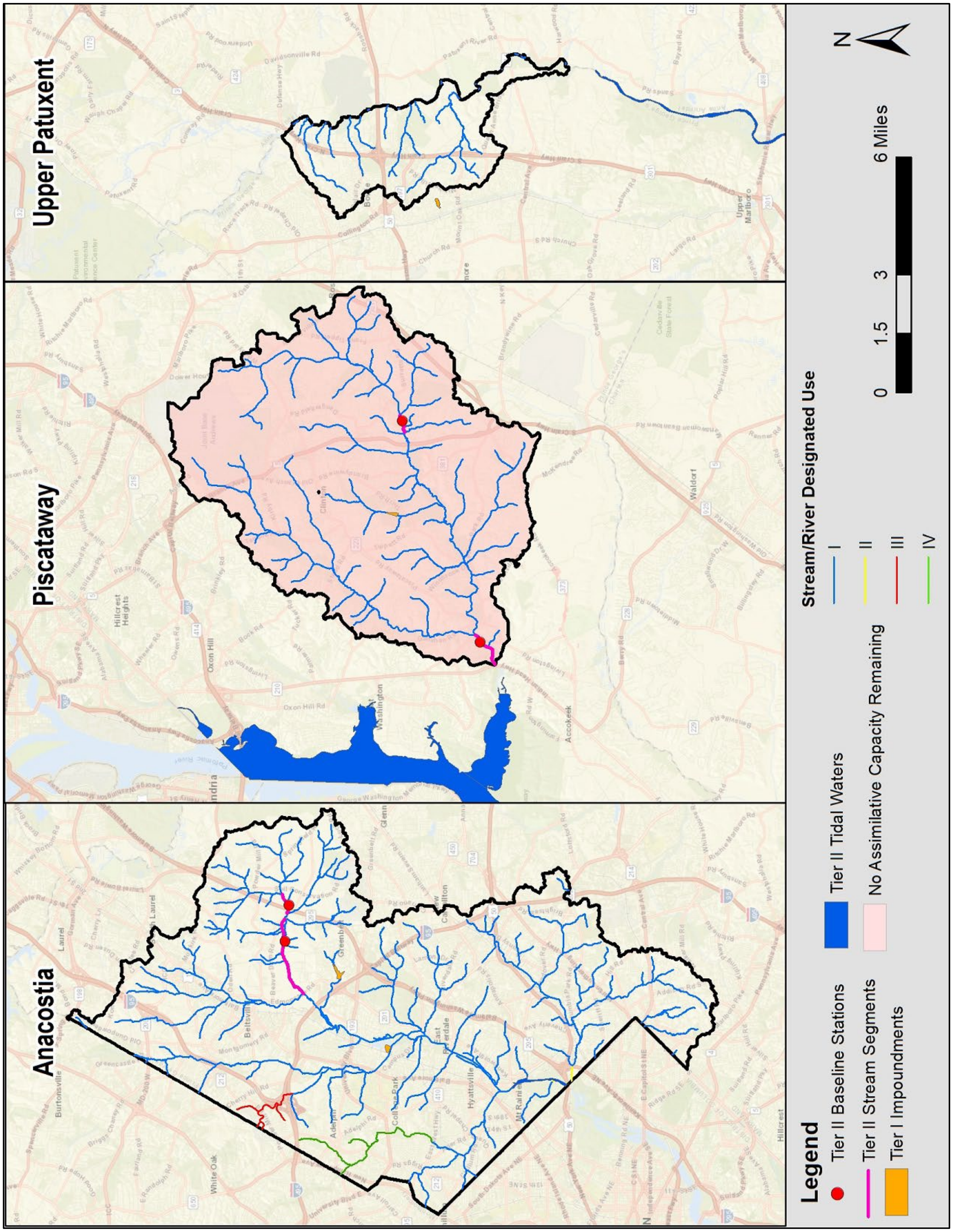

Figure 1-2. Designated uses and Tier II stream segments in bacteria-impaired and listed watersheds in Prince Georges' County, MD.

1.2.1. 303(d) Listing Methodology

Assessments for the water contact recreation use are conducted using data from the most recent 5-year data window for the current Clean Water Act §303(d)/305(b) Integrated Report cycle (MDE 2023b). For this reason, 303(d) listings can change during each Integrated Reporting cycle based on new data. Only data with a quality rating of Tier III[2] is used for decision-making with respect to designated use support status. Maryland uses both the geometric mean (GM) criteria and the statistical threshold values (STVs) from the numeric criteria for bacteria to evaluate water quality standards attainment and support 303(d) listings.

Data are assessed in 90-day periods as either attaining or not attaining the recreational criteria shown in Table 1-2. The default minimum sample size for a 90-day period is 10 sampling events, which typically equates to weekly sampling over a 90-day period (see exception described below). For characterizing the impairment status of the water contact recreation use of a waterbody, MDE places greater priority on samples collected during steady-state, dry weather conditions within the beach season (Memorial Day through Labor Day) to be representative of the critical condition (highest-use conditions) (MDE 2009).

In a given 90-day period, if both the GM and associated STV meet the numeric criteria, then the waterbody is in attainment for that 90-day period. For the Integrated Report, a waterbody is listed in Category 2 (waters attaining some standards) if all 90-day windows with assessable data are attaining water quality criteria.

For 303(d) listing, the evaluation typically relies upon the attainment of the GM criteria because they are more reflective of longer-term water quality issues. If a GM exceeds a GM criterion in one or more 90-day periods, the waterbody is listed in Category 5 (impaired waters for which a TMDL is required). When GM criterion exceedances do not occur, yet more than 10% of data values exceed the STV for any 90-day period, MDE evaluates the magnitude and timing of the STV exceedances to determine if they constitute impairment.

MDE uses best professional judgment to evaluate the data with overwhelming evidence of impairment or attainment but fewer than 10 sampling events. If data indicate consistently low bacteria levels within sparsely populated watersheds, MDE will consider attainment of the criteria if no likely sources of bacteria are present in the watershed. Conversely, for incomplete data sets that consistently demonstrate high bacteria counts (e.g., exceeding an STV value), MDE may list the waterbody in Category 5. Tier III data with fewer than 10 sampling events may also be placed in Category 3 (waters with insufficient information) and prioritized for follow-up monitoring to determine attainment status.

[2] For Maryland's Integrated Report, MDE evaluates submitted data according to data quality tiers. The tiers are based on both the level of data quality and the authorized uses of the provided data, where Tier I has the lowest and Tier III has the highest data quality requirements. Tier III datasets are legally defensible data and, therefore, acceptable for regulatory decision-making. The data must be accompanied by a Quality Assurance Project Plan and documentation of field sampling and/or laboratory testing protocols.

1.2.2. Impairment Listings

Maryland's *Final Combined 2020–2022 Integrated Report of Surface Water Quality* (MDE 2022c) lists the following as bacteria impairments in Prince George's County, which are depicted in Figure 1-2 and summarized in Table 1-3.

Table 1-3. Bacteria impairments and TMDLs by water body and suspected causes in Prince George's County, MD.

Water Body	Impairment	Suspected Cause(s)	EPA approval date
Anacostia River	Enterococcus	Pet waste	TMDL approved 2008
Anacostia River tidal fresh estuary	Enterococcus	Pet waste	TMDL approved 2008
Middle Patuxent River	Fecal coliform	Source unknown	TMDL needed
Piscataway Creek	*E. coli*	Sanitary sewer overflows, domestic pets, livestock, wildlife	TMDL approved 2008
Upper Patuxent River	*E. coli*	Livestock grazing or feeding operations	TMDL approved 2011

1.2.3. Summary of Bacteria TMDLs in Prince George's County

Anacostia River TMDL—2007

The Anacostia River has been listed as impaired for fecal coliform bacteria since 2002 in non-tidal segments and since 2004 in tidal segments. Two drainage areas define the Anacostia River watershed (Table 1-1):

- Nontidal area upstream of the confluence of NWB and NEB, and
- Area between the confluence of the NWB/ NEB and the Maryland/Washington, DC border, which includes tidal and non-tidal reaches.

The District of Columbia (DC) developed a fecal coliform TMDL for the Anacostia River in 2003, which was approved by EPA. DC's TMDL assigned an allocation to Maryland's portion of the Anacostia River, including both tidal and non-tidal segments of the Anacostia River drainage in Maryland.

The 2003 TMDL analysis used fecal coliform bacteria as the pathogen indicator organism, whereas Maryland used enterococci as an indicator for its bacteria TMDL (MDE 2008). Although MDE used a different pathogen indicator, its TMDL used the allocation from DC's TMDL. Therefore, this indicator definition and allocation standard is protective of both Maryland and DC designated uses (MDE 2008). Maryland's TMDL was approved by EPA in 2007.

Upstream of Confluence

MDE's searchable Integrated Report Database lists bacteria impairments with TMDLs for the 8-digit basin 02140205 upstream of the NWB / NEB (of the Anacostia) confluence for enterococcus (MDE 2022c) (Figure 1-1 depicts the NWB / NEB location.) Probable sources were determined using bacteria source tracking (BST) at the six sampling stations upstream of the confluence. The results varied by location. Overall, BST results were pets (24–45%), human (9–23%), livestock (7–28%), and wildlife (32–44%).

According to MDE's maximum practicable reduction (MPR) analysis, water quality standards cannot be achieved in all six of the County's non-tidal subwatersheds (MDE 2008). Reasons for this unattainability can include subwatersheds where wildlife was identified as a significant component. An additional barrier to water quality is that some subwatersheds require notably high load reductions to meet water quality standards (MDE 2008). In other words, some watersheds are deeply impaired as a baseline of water quality.

These MPR targets were defined using best management practice (BMP) effectiveness and assuming no reduction for wildlife sources. Because bacteria reduction by structural BMPs (e.g., wet ponds) is highly variable, MDE created a human health risk model: a subjective estimation of overall risk using bacteria disease risk to humans. This model accounted for bacteria sources and possible reduction of those sources. For example, MDE described pet waste education as a potentially effective practice for urban sources, as well as onsite sewage disposal system upgrades. MDE also noted use of BMPs for agricultural livestock.

Downstream of NWB / NEB Confluence to MD / DC border

The TMDL detailed a BST study by Washington, DC, which estimated potential fecal bacteria sources. The bacteria source proportions are 56.5% wildlife, 22.2% human, 21.1% pet, and 0.3% livestock. There are no wastewater treatment plants (WWTPs) in this area of the Anacostia River watershed.

Non-Tidal Piscataway Creek Basin TMDL—2007 (Revised 2018)

The non-tidal portions of Piscataway Creek (8-digit watershed 02140203) are listed as impaired for *E. coli* (
Figure 1-1). An antibiotic resistance analysis (ARA) shows probable sources of bacteria to this part of the watershed as 46% from humans, 18% from wildlife, 17% from livestock, 16% from pets, and 3% from unknown origins.

In their TMDL document, MDE indicates that the TMDL is not attainable because reduction of fecal bacteria loads from all sources—including wildlife—are beyond the MPR targets (MDE 2018). More specifically, reduction of the wildlife component is beyond practicable reduction. The source of specific wildlife was not determined in the TMDL.

Upper Patuxent Fecal Bacteria TMDL—2010

A portion of the Upper Patuxent watershed (8-digit basin 02131101) is listed for *E. coli.* This portion includes the Upper Patuxent River from Queen Anne Bridge Road to the confluence with the Little Patuxent River for *E. coli* (

Figure 1-1). MDE used multiple ARA source tracking methods to determine the relative proportion of domestic, human, livestock, and wildlife source categories. The largest category of potential sources in the watershed was wildlife (35%), followed by livestock (28%), human (19%), and pet (18%) (MDE 2010).

In this 2010 TMDL document, MDE indicates that water quality standards can be achieved in the MPR in the Patuxent River Upper subwatersheds included in the TMDL (MDE 2010).

1.3. Existing Water Quality Data

1.3.1. Bacteria Monitoring Data

Water quality data has been collected at various locations throughout the County as part of multiple studies. This body of water quality data provides insight into the health of the County's waterways and reflects progress toward reducing sources of impairment. The County currently measures water quality for concentrations of *E. coli* as part of complying with its MS4 permit.

Data used for restoration planning were obtained from the U.S. *Water Quality Portal* (www.waterqualitydata.us). This source is sponsored by EPA, the U.S. Geological Survey (USGS), and the National Water Quality Monitoring Council. It collects data from more than 400 federal, state, local, and tribal agencies. EPA's STORET (STOrage and RETrieval) Data Warehouse (https://www3.epa.gov/storet/dbtop_online.html) was also searched for additional information.

Figure 1-3 presents the available water quality monitoring stations for the three County watersheds related to the bacteria TMDLs. Table 1-4 summarizes E. *coli* monitoring data for these three impaired waterbodies. Similarly, Table 1-5 summarizes for enterococcus, while Table 1-6 summarizes fecal coliform bacteria data.

Bacteria data in the County tend to be dated. Enterococcus data are only available for the Anacostia River from 2002 to 2005, while the most recent fecal coliform bacteria data are from 2012. Only two stations have *E. coli* data for the past five years: ANA30 and USGS-1649500.

Measurement methodology for bacteria data vary. More recent data are reported in most probable number (MPN) of bacteria per 100 milliliters (mL). The MPN measurement is a statistical estimation of bacteria in a liquid. Older data are reported in colony forming units (CFU) per 100 mL. The CFU measurement is an estimated count of colonies in a solid substrate (i.e., auger).

Table 1-4. *E. coli* water quality monitoring stations and concentrations, TMDL watersheds, Prince George's County, MD.

Impairment Watershed	Station ID	Start Date	End Date	Unit	Result - Minimum	Result - Average	Result - Maximum	Count of Results
Anacostia - Downstream	BA(1)	06/22/04	08/17/04	CFU/100 mL	320	1,812	12,000	13
	ANA0079	08/19/04	08/19/04	MPN/100 mL	1,220	1,220	1,220	1
	ANA0082	08/18/04	08/18/04	MPN/100 mL	660	660	660	1
	ANA30	01/15/08	11/09/21	MPN/100 mL	14	653	2,987	119
	BA(1)	06/07/05	10/25/07	MPN/100 mL	22	2,798	39,000	66
	WA(2)	06/20/06	10/31/06	MPN/100 mL	37	990	4,500	14
Anacostia - Upstream	SC1	06/24/04	08/12/04	CFU/100 mL	480	1,243	2,000	7
	SC2	06/24/04	08/12/04	CFU/100 mL	360	1,316	2,400	7
	USGS-1649500	12/11/03	09/29/04	CFU/100 mL	67	3,690	27,000	12
	USGS-1651000	10/29/03	09/29/04	CFU/100 mL	3	2,530	14,000	11
	USGS-1649500	06/23/04	04/07/22	MPN/100 ml	21	11,226	120,000	439
	USGS-1651000	05/26/04	05/10/10	MPN/100 ml	33	14,776	290,000	90

Impairment Watershed	Station ID	Start Date	End Date	Unit	Result - Minimum	Result - Average	Result - Maximum	Count of Results
	NEB0002	08/18/04	10/14/04	MPN/100 mL	280	1,237	3,650	6
	NEB0016	08/18/04	10/14/04	MPN/100 mL	240	933	2,610	6
	NWA0002	08/18/04	10/14/04	MPN/100 mL	460	1,270	2,380	6
	NWA0016	08/18/04	10/14/04	MPN/100 mL	660	2,308	8,660	6
	PA(1)	06/20/06	10/31/06	MPN/100 mL	36	1,168	9,700	16
Piscataway	PIS0045	10/23/02	10/20/03	MPN/100 mL	10	253	1,350	25
	TIN0006	10/23/02	10/20/03	MPN/100 mL	10	253	2,010	25
Upper Patuxent	PXT0613	11/04/03	10/22/09	MPN/100 mL	10	1,482	17,330	49
	PXT0630	10/23/08	10/22/09	MPN/100 mL	10	1,227	19,860	25

Notes:
CFU = colony-forming unit; MPN = most probable number

Table 1-5. Enterococcus water quality monitoring stations and concentrations in TMDL watersheds, Prince George's County, MD.

Impairment Watershed	Station ID	Start Date	End Date	Unit	Result - Minimum	Result - Average	Result - Maximum	Count of Results
Anacostia - Downstream	ANA0079	08/19/04	08/19/04	MPN/100 mL	230	230	230	1
	ANA0082	08/18/04	08/18/04	MPN/100 mL	550	550	550	1
	BA(1)	06/22/04	08/17/04	CFU/100 mL	320	1,812	12,000	13
	BA(1)	08/24/05	10/25/07	MPN/100 mL	14	862	10,000	30
Anacostia - Upstream	BED0001	10/07/02	10/20/03	MPN/100 mL	20	896	8,660	26
	INC0030	10/07/02	10/20/03	MPN/100 mL	10	763	7,700	25
	NEB0002	10/07/02	08/09/05	MPN/100 mL	9	575	8,160	42
	NEB0016	08/18/04	08/09/05	MPN/100 mL	10	1,724	24,190	16
	NWA0002	10/07/02	08/09/05	MPN/100 mL	2	676	9,800	42
	NWA0016	08/18/04	08/09/05	MPN/100 mL	1	1,454	19,500	16
	PNT0001	10/07/02	10/20/03	MPN/100 mL	10	327	4,350	25
	SC1	06/24/04	08/12/04	CFU/100 mL	480	1,243	2,000	7
	SC2	06/24/04	08/12/04	CFU/100 mL	360	1,316	2,400	7
	USGS-1649500	12/11/03	09/29/04	CFU/100 mL	22	8,346	60,800	12
	USGS-1649500	06/23/04	11/16/05	MPN/100 ml	20	15,167	240,000	16
	USGS-1651000	10/29/03	09/29/04	CFU/100 mL	8	11,421	40,000	11
	USGS-1651000	05/26/04	11/16/05	MPN/100 ml	10	55,792	920,000	17

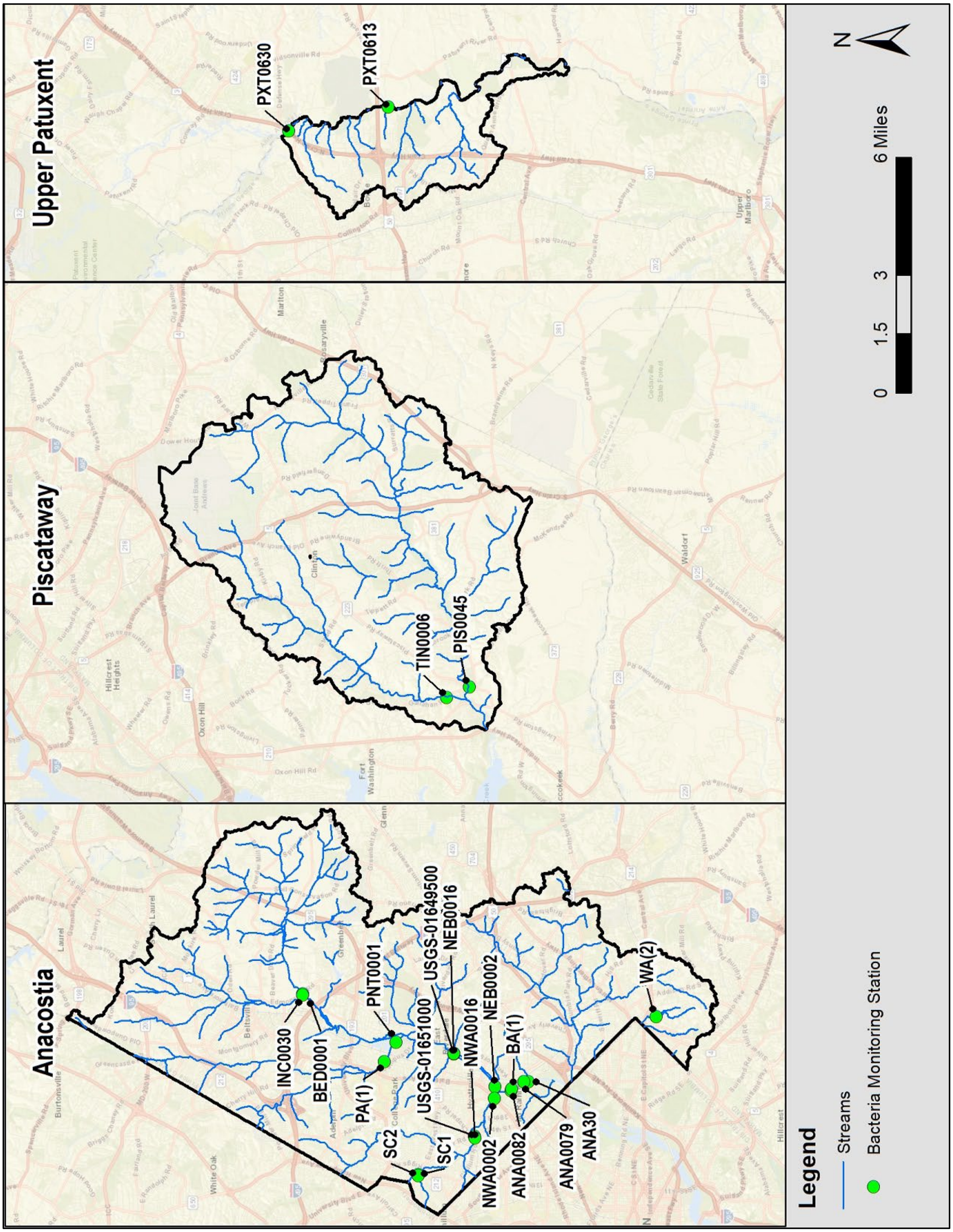

Figure 1-3. Bacteria water quality monitoring locations in TMDL watersheds, Prince George’s County.

Table 1-6. Fecal coliform water quality monitoring stations and concentrations in TMDL watersheds, Prince George's County, MD.

Impairment Watershed	Station ID	Start Date	End Date	Unit	Result - Minimum	Result - Average	Result - Maximum	Count of Results
Anacostia - Downstream	ANA0082	01/07/86	04/01/98	MPN/100 mL	23	8,747	240,000	139
	ANA30	10/07/91	04/14/92	CFU/100 mL	140	9,468	34,000	5
	ANA30	05/12/92	12/11/12	MPN/100 mL	0	3,239	160,000	258
	BA(1)	06/07/05	10/25/07	CFU/100 mL	75	10,431	220,000	70
	BA(1)	06/10/02	10/05/04	MPN/100 mL	33	4,668	160,000	119
Anacostia - Downstream	GREE_NPS_1	06/15/81	12/15/83	CFU/100 mL	0	203	2,400	49
	GREE_NPS_2	06/15/81	04/02/84	CFU/100 mL	0	295	3,800	55
	GREE_NPS_3	06/15/81	03/05/84	CFU/100 mL	0	540	5,700	50
	GREE_NPS_4	06/15/81	03/05/84	CFU/100 mL	1	696	6,000	49
	GREE_NPS_5	06/15/81	02/07/84	CFU/100 mL	0	555	4,800	50
	GREE_NPS_6	06/15/81	03/05/84	CFU/100 mL	0	507	5,000	52
	GREE_NPS_7	06/15/81	03/05/84	CFU/100 mL	0	557	5,500	51
	GREE_NPS_8	10/19/81	01/09/84	CFU/100 mL	0	129	1,100	24
	GREE_NPS_9	02/16/82	04/02/84	CFU/100 mL	0	127	650	40
	PA(1)	06/13/06	10/31/06	CFU/100 mL	100	2,211	11,000	17
	SC1	06/24/04	09/02/04	MPN/100 mL	480	2,388	6,100	11
	SC2	06/24/04	09/02/04	MPN/100 mL	130	4,483	29,000	10
	USGS-1649500	07/16/69	01/21/74	CFU/100 mL	18	2,152	13,000	49
	USGS-1651000	07/16/69	06/02/92	CFU/100 mL	27	7,231	170,000	48
	WA(2)	06/06/06	10/31/06	CFU/100 mL	20	1,062	3,900	16
Piscataway	PIS0033	01/06/86	04/06/98	MPN/100 mL	13	6,450	93,000	133
	USGS-1653650	07/21/72	01/21/74	CFU/100 mL	46	1,096	6,600	16
	XFB1986	01/06/86	04/06/98	MPN/100 mL	2	879	43,000	132
Upper Patuxent	TF1.0	01/06/86	04/13/98	MPN/100 mL	22	4,214	240,000	142

1.3.2. Trend Analysis

The bacteria monitoring data were analyzed to identify any clear trends in water quality using a simple linear regression. For Anacostia River TMDL segments (downstream and upstream of the NWB / NEB confluence), the two stations with the most bacteria data were plotted to determine if trends were present. The Piscataway Creek and Upper Patuxent River watersheds only had two stations each; therefore, both were plotted.

Water quality in waterways is constantly in flux, as reflected in the scattering of observed concentrations. The high variance in the data (i.e., data scatter) demonstrates the complexity of the processes that can affect water quality at a monitoring point. As water flows downstream, its physical, chemical, and biological composition changes because of many inputs that vary in space and time. For example, precipitation events can affect the concentrations. Even when flows are stable, those concentrations can vary along different reaches of the stream and at different stream depths. The rate, volume, and quality of runoff also varies with land use and land cover. Impervious surface runoff increases water volume and alters the concentration levels of water quality parameters. All the interactions between the waterway, terrain, built environment, and climate contribute to the scatter of the data points. However, patterns are observable.

- Enterococcus in the Anacostia River watershed remained relatively constant from 2004 to 2007 (Figure 1-4).
- Fecal coliform bacteria at the ANA30 station shows a decreasing trend in the Anacostia River watershed from 1992 to 2012 (Figure 1-5).
- *E. coli* in the Anacostia River watershed (both Upper and Lower) show slight decreasing and inconclusive trends (Figure 1-6, Figure 1-7).
- *E. coli* in the Piscataway Creek watershed had slightly increasing trends from 2002 to 2003 (Figure 1-8).
- *E. coli* in the Upper Patuxent River watershed shows one station as slightly increasing and the other station slightly decreasing (Figure 1-9).

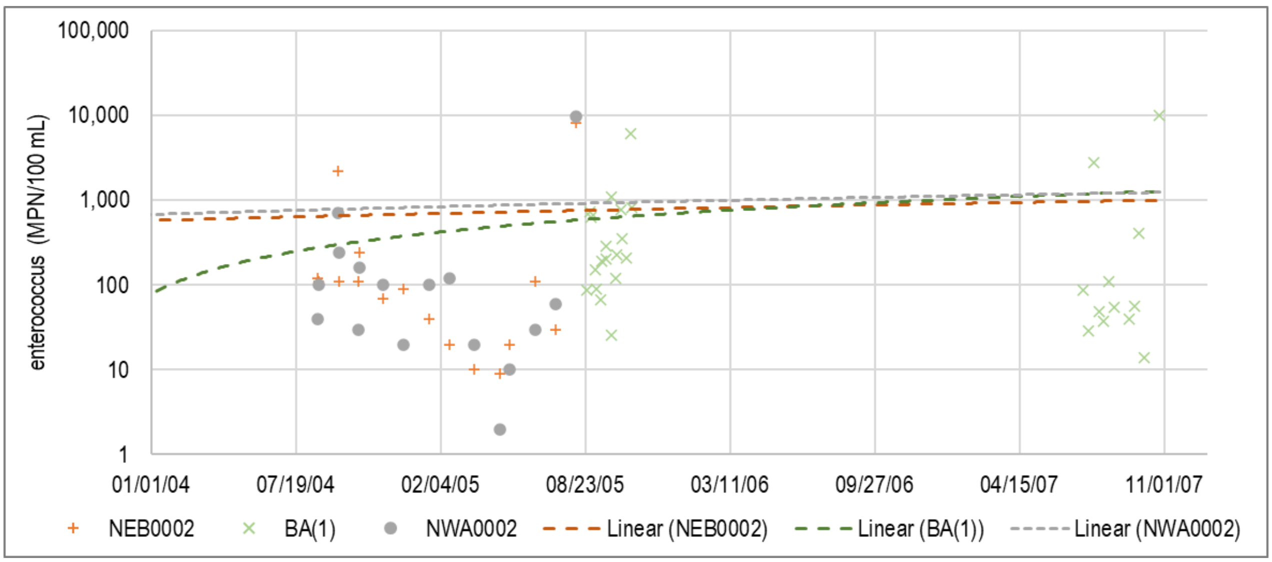

Figure 1-4. Enterococcus concentrations at select stations in the Anacostia River watershed, 2004 to 2007.

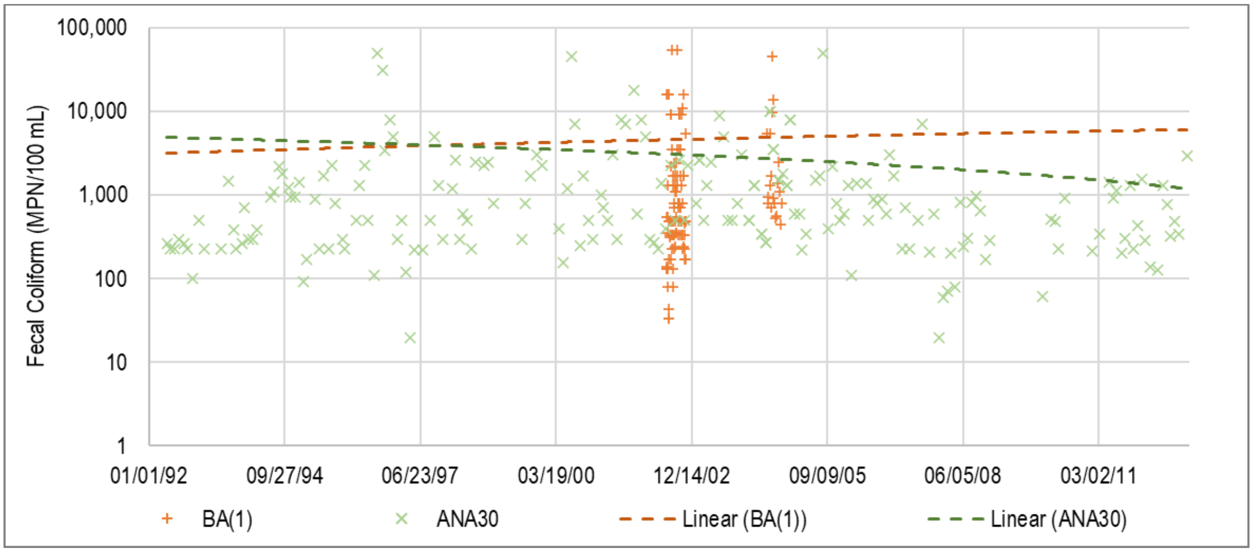

Figure 1-5. Fecal coliform concentrations at select stations in the Anacostia River watershed, 1992 to 2011.

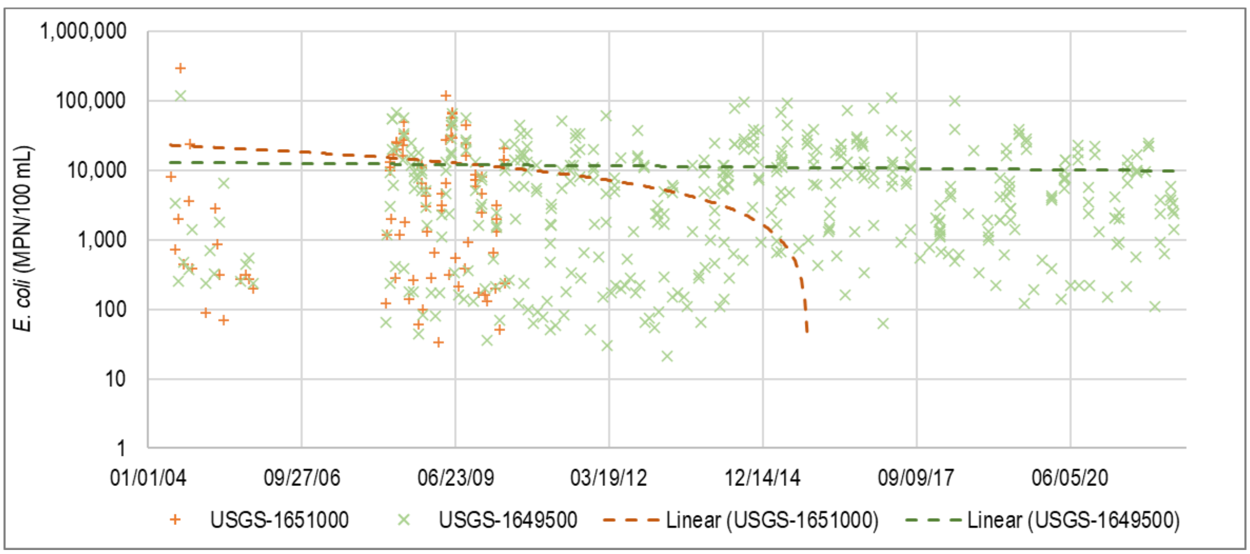

Figure 1-6. *E. coli* concentrations at select stations in the Upstream Anacostia River watershed, 2004-2020.

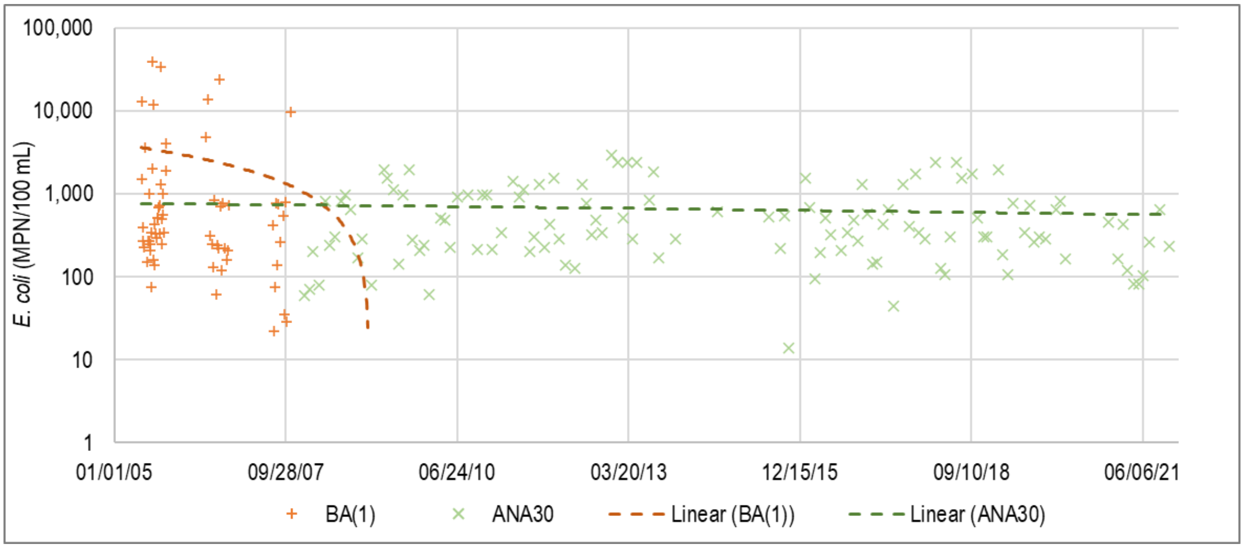

Figure 1-7. *E. coli* concentrations at select stations in the Downstream Anacostia River watershed, 2005 to 2021.

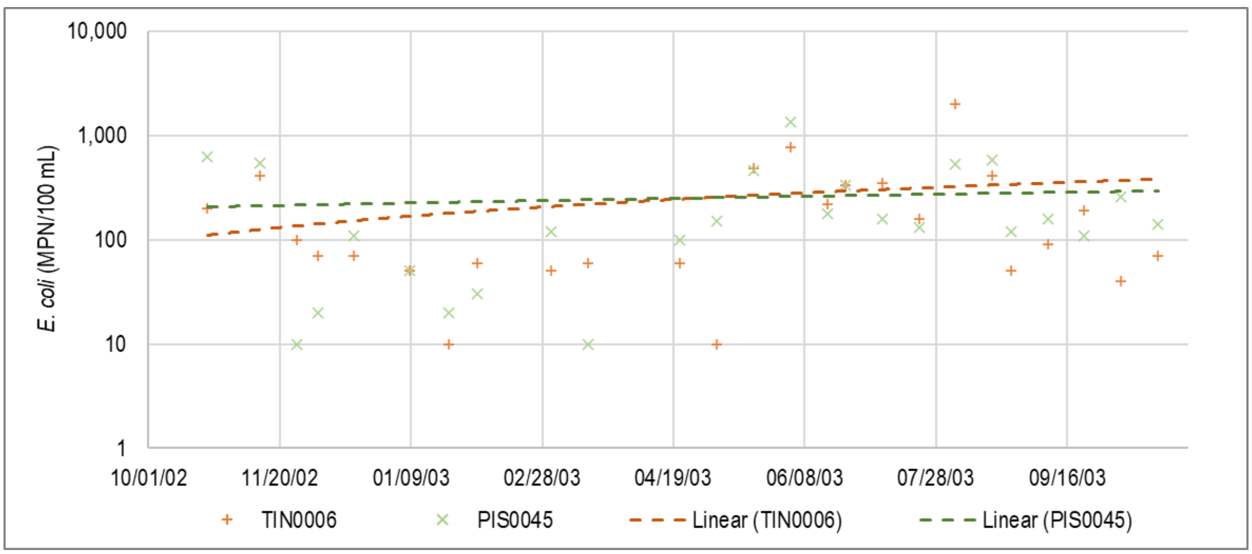

Figure 1-8. *E. coli* concentrations at select stations in the Piscataway Creek watershed, 2002 to 2003.

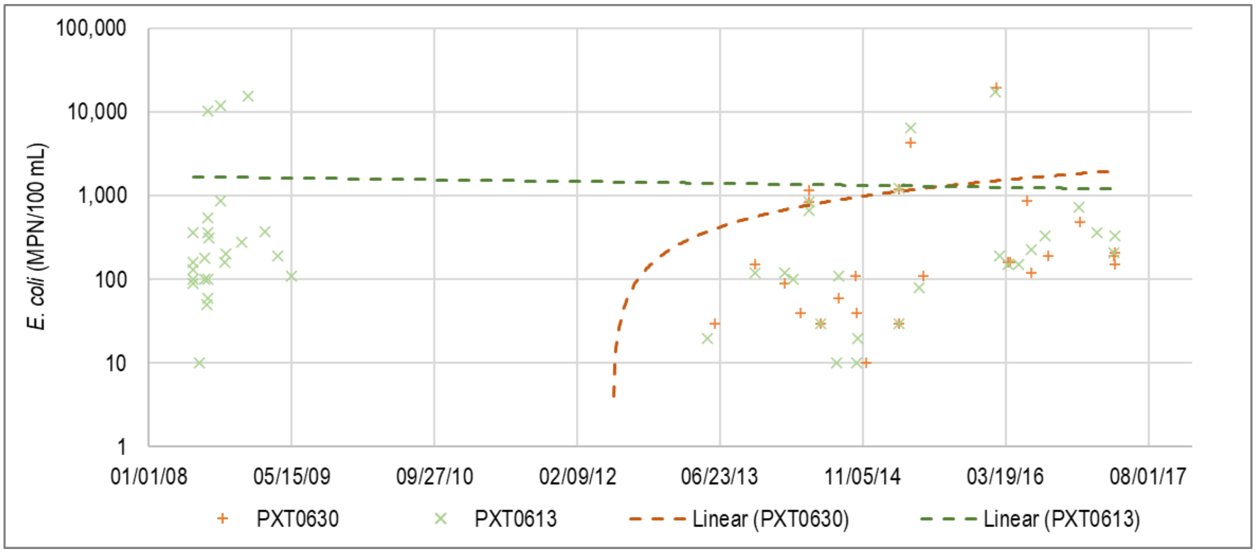

Figure 1-9. *E. coli* concentrations at select stations in the Upper Patuxent River watershed. 2008 to 2017.

1.3.3. Biological (Benthic Macroinvertebrate) Monitoring Data

MDE guidance for developing bacteria WIPs recommends reviewing data on benthic macroinvertebrate (stream bottom aquatic insects) monitoring (MDE 2022b). Analyzing the species of benthic organisms collected along a stream reach can provide a good indication of the health of that reach because various order-level taxa are known to tolerant or intolerant to pollution and therefore good indicators of stream health (Rosenberg and Resh 1993). For example, there is a negative relationship between the presence of bacteria and macroinvertebrate biodiversity (Jerves-Cobo et. al 2018).

DoE began implementing its countywide, watershed-scale biological monitoring and assessment program in 1996 and is in its fifth round of sampling. The primary measure of stream health in this monitoring effort is the Benthic Index of Biological Integrity (BIBI) (Southerland et al. 2007).

Figure 1-10 presents the locations and results of biological monitoring in three TMDL watersheds. The Anacostia River watershed has mainly *Very Poor*, *Poor*, and *Fair* ratings. A few *Good* ratings exist, with some good conditions found in the upper NEB in Round 4 (2019–2021). Piscataway Creek watershed has a mix of all ratings, with the Tinkers Creek subwatershed having *Very Poor*, *Poor*, and *Fair* ratings, while the lower mainstem of Piscataway Creek having many *Good* ratings. The Upper Patuxent River watershed showed *Very Poor*, *Poor*, and *Fair* ratings.

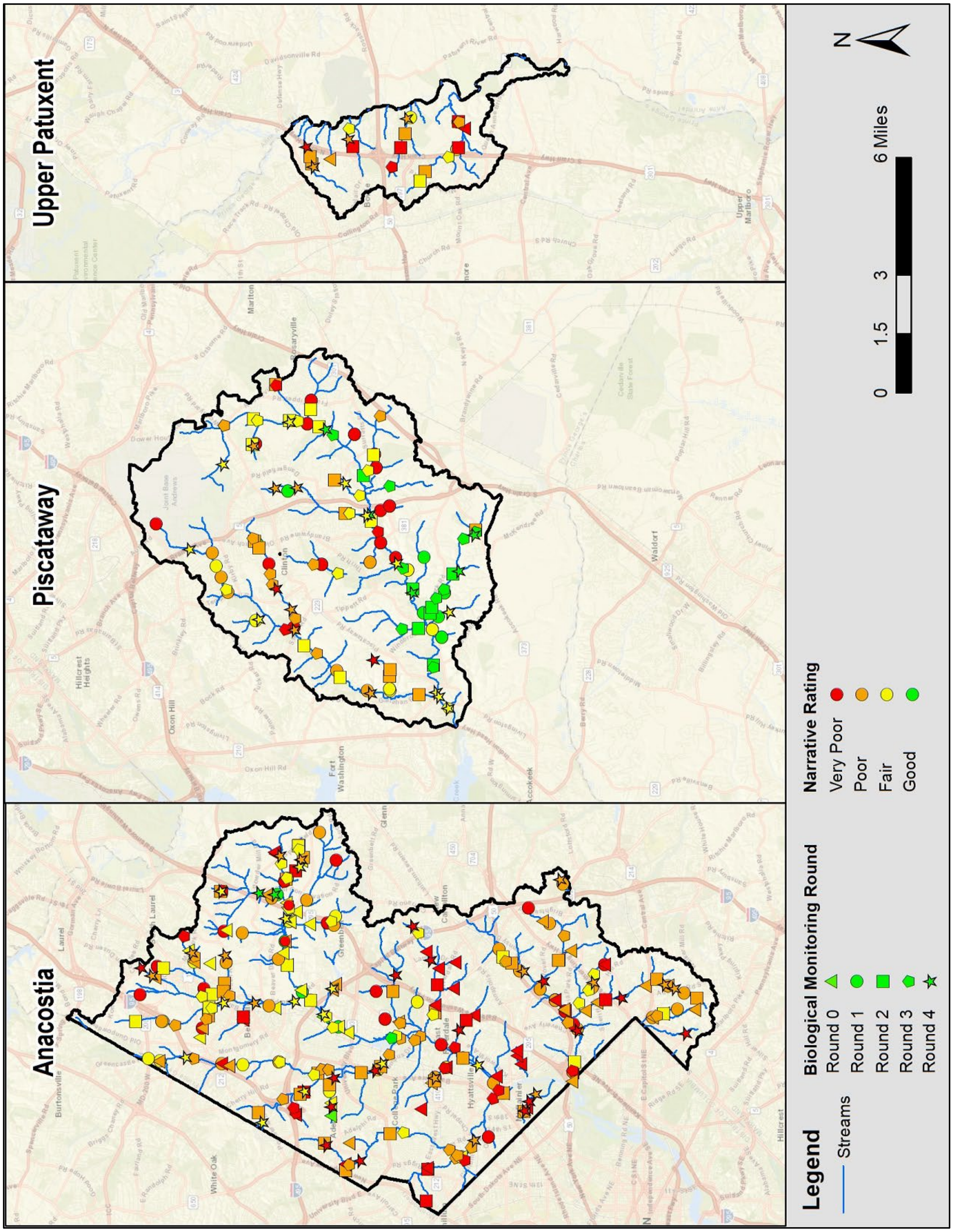

Figure 1-10. Biological monitoring locations in TMDL watersheds in Prince George's County, MD.

2. Bacteria WIP Guidance and Requirements

This section reviews and summarizes the 2014 MDE guidance on developing bacteria restoration plans (MDE 2014) that was updated and replaced with the 2022 guidance (MDE 2022b).

2.1. 2014 Guidance

MDE's 2014 *Guidance for Developing a Stormwater Wasteload Allocation Implementation Plan for Bacteria Total Maximum Daily Loads*, (MDE 2014) provides MS4 jurisdictions with management action recommendations on specific management strategies and actions to include in stormwater wasteload allocation (SW-WLA) WIPs for bacteria TMDLs. The guidance did not list all available practices. Its intent was to provide a starting point for MS4 jurisdictions to develop watershed plans in response to bacteria TMDLs.

The guidance offered options for source identification, including:

- Bacteria source tracking (BST),
- Watershed Treatment Model (WTM) or other defensible models,
- Local monitoring data, and
- Hotspot identification using GIS/field analysis looking for illicit connections.

MDE suggested that load reduction projects be implemented in areas where baseline data exists and categorizes projects into four categories:

- Practices to reduce human sources (e.g., broken sewer lines, illicit plumbing connections, and homeless populations),
- Practices to reduce domestic pet sources,
- Practices to reduce wildlife sources (e.g., rats, racoons, geese, deer) from poor trash management and poorly-maintained stormwater ponds, and
- Stormwater management BMPs to treat bacteria from stormwater when bacteria reductions are scientifically defensible.

2.2. 2022 Guidance

MDE's 2022 *Guidance for Developing Bacteria Total Maximum Daily Load Stormwater Wasteload Allocation Watershed Implementation Plans* (MDE 2022b) provides recommendations on specific management strategies and actions to include in WIPs for bacteria TMDLs. The guidance indicates that the nutrient and sediment accounting frameworks used in other TMDLs is not appropriate for creating local bacteria implementation plans. Two key differences are (1) bacteria modeling is not required for implementation planning, and (2) there are no final achievement dates for bacteria load reductions.

The 2022 MDE guidance, therefore, presents an implementation strategy that focuses on these actions:

- Spatial identification of potential bacteria sources on the landscape,
- Water quality monitoring to identify bacteria sources,
- Elimination of fecal bacteria sources, and

- Estimating bacteria trends.

For bacteria TMDLs, MDE focuses on source track down and elimination to meet WLAs because of the inaccuracies associated with quantifying land use loading rates and the lack of data on traditional BMP performance on the control of bacteria.

The following subsections summarize the main points of the 2022 MDE guidance and are organized by their guidance document sections.

Introduction and Overview of MDE's Methodology

The objective of 2022 MDE guidance is to specify requirements and recommendations for permitted Phase I MS4 stormwater jurisdictions in the development of bacteria WIPs and subsequent progress reporting. It specifies required and recommended datasets for performing source tracking, as well as water quality monitoring strategies to better track down sources of bacteria, to meet TMDLs.

Section 1: TMDL Modeling Methodologies

Maryland's TMDL methodology for fecal bacteria uses observed bacteria concentrations and flows to estimate watershed loading inputs. The guidance briefly covers the water quality models used to simulate bacteria concentrations in the water column of receiving waters for the purposes of developing TMDLs.

Bacteria TMDLs do not pinpoint specific sources of fecal bacteria across the landscape; yet, the 2022 guidance requires permittees to identify possible and probable sources. Most of Maryland's bacteria TMDL wasteload allocations and load allocations are informed by BST data. Jurisdictions are encouraged to collect new BST data to assess changes in microbial community sources especially if there has been significant land use change in an area since the BST data was last gathered.

Section 2: Overview of Regulatory Requirements Informing WIP Development

This section of the guidance provides a summary of the regulatory framework, MS4 and otherwise, for the development of permit-required bacteria TMDL watershed implementation plans. The guidance describes how a jurisdiction can implement a future monitoring plan that is consistent with State approved assessment methodologies for water body delisting purposes.

TMDL SW-WLA Implementation Plans

The focus of a bacteria WIP is on making progress toward the applicable water quality criteria. The guidance document provides recommendations for addressing five basic elements of a WIP, which are outlined in Part IV Standard Conditions of the County's MS4 permit, along with annual reporting, adaptive management, and program reviews (Part V.A.3 and Part V.B). WIPs must be adaptive, updated once in a permit term, and incorporate new information that allows for a more accurate assessment of program efforts.

Assessment of Controls - BMP Effectiveness Monitoring

The guidance reiterates permit monitoring requirements that permittees should be considering in their bacteria implementation plans:

- baseflow sampling,

- storm event sampling, and
- continuous monitoring.

Assessment of Controls – Watershed Assessments

The new permit requires the County to collect monthly samples at one station in all bacteria TMDL watersheds. The guidance encourages optional microbial source tracking (MST) using qPCR (quantitative polymerase chain reaction) methodologies for stations with high concentrations and no identified sources upstream.

Section 3: Required and Recommended Datasets for Planning Spatially-Based Implementation

The guidance describes the spatial datasets jurisdictions are required to include in their source trackdown activities or, alternately, what jurisdictions should consider in planning efforts to reduce sources of fecal bacteria to impaired waterbodies. MDE recommends that potential sources be investigated via source tracking monitoring, inspections, or other means. MDE cites a 2018 paper by Florida Department of Environmental Protection (DEP) (see Appendix A for additional information) on assessment of microbial source tracking markers and tracers.

This 2022 MDE guidance requires three major categories of data for WIP development. These are discussed in Section 3 of this document in more detail. The following is an overview by data category:

Category 1:

- General datasets like
  - land use/land cover,
  - MS4 infrastructure, and
  - MDE shoreline surveys with specific subsets of information needed and available.
- Predominantly human source datasets, prioritized because of human health risks, like
  - sanitary sewer data,
  - septic systems (on-site systems), and
  - and other potential sources (e.g., landfills, homeless encampments).

Category 2:

- Predominantly non-human source datasets, with lower priority human health risk, like
  - domestic pets,
  - urban non-stormwater discharges,
  - wildlife, and
  - agricultural sources.

Category 3:

- Natural bacteria source datasets, including
  - MDE-designated shellfish harvesting areas for potential sources of bacteria to shellfish, and
  - beach locations (both designated and non-recognized) and the data from county health departments.

Section 4: Bacteria Monitoring - Source Identification, Tracking Progress, and Estimating Trends

The next phase of fecal bacteria source identification and remediation relies on field investigations and water quality monitoring. The County's 2022 MS4 permit has a watershed assessment monitoring requirement (Part IV.G.2) as part of assessment of controls that requires bacteria monitoring following MDE's 2021 Monitoring Guidelines (MDE 2021a). The sampling requirements specified in MDE's MS4 permit monitoring guidelines align with MDE's Integrated Report (MDE 2022b) assessment methodologies for bacteria in terms of procedures and lab methodologies, except for temporal resolution. The 2021 Monitoring Guidelines (MDE 2021a) require monthly sampling instead of weekly sampling from the Integrated Report. MS4 weekly sampling is not required unless concentrations are approaching numeric water quality criteria thresholds. More information on the County's monitoring is in Section 4 of this document.

The 2022 MDE bacteria guidance outlines required and recommended datasets for WIP creation. These datasets are required to identify potential sources, track progress, and establish trends. The datasets include data from the following sources:

- Required datasets
  - IDDE (illicit discharge detection and elimination) monitoring,
  - MDE's monitoring of shellfish harvesting areas, and
  - Beach monitoring performed by local Health Departments.
- Recommended datasets
  - National Primary Drinking Water Regulations and Monitoring Data,
  - Food Safety Modernization Act (FSMA) Produce Safety Rule (PSR) for bacteria in irrigation water, and
  - Benthic macroinvertebrates (biological monitoring).

Only IDDE and biological monitoring are part of the County's MS4 permit monitoring requirements.

Section 5: Management Actions

The guidance provides a series of general management action options in response to the anticipated bacteria sources (i.e., human, domestic pets, and wildlife). Practices include sanitary sewer repairs, septic upgrades, and pet waste management. Management actions are discussed in section 6 of this document.

Section 6: Reporting

The new guidance covers basic reporting requirements (plans and data) for years 1, 3, and 4 of the MS4 permit, as well for annual reports. Reporting is discussed in Section 7 of this document.

Section 7: Current Research Applications and Future Research Needs

This section of MDE guidance discusses current and needed research. An area emphasized by MDE is correlating human-source fecal bacteria presence and concentration to specific tracers that are easily analyzed and less expensive. For example, these tracer substances include paraxanthine (a caffeine metabolite), artificial sweeteners like sucralose and acesulfame potassium, and acetaminophen, which do not readily break down in the natural environment and all indicate human sources of sewage. Other human tracers include chemicals in stormwater runoff from MRI and x-ray contrast chemicals, which could indicate hospital wastewater and potentially leaking sanitary pipes. Chemical tracers help with detecting nutrient species can track the discharge of waste streams. Other emerging tracers of interest include per- and polyfluorinated compounds in drinking water and diverse surfactants remaining in treated water effluent.

Section 8: Microbial Source Tracking

MDE guidance recommends Baltimore City’s MST methodology (see Appendix A of this document), while also indicating that standard local methods have yet to be developed. Even with standard methods, MST is not fully accurate for calculating the percent breakdown of bacteria sources and, therefore, has limitations. A sound way to view this microbial methodology is that MST information complements the fecal indicator bacteria concentration data but cannot replace it.

3. Sources of Bacteria and Associated Data Sources

This section describes potential sources of bacteria and potential datasets that could be used for hot spot and source identification. Potential sources are categorized as human-sourced bacteria, nonhuman-sourced bacteria, and other sources that do not fit neatly into either category. There are some overlaps between the categories and sources. If there is an overlap, the source is included in its most likely source category. "Other" also includes bacteria sources not directly or necessarily associated with stormwater conveyance systems or with human-sourced bacteria, but that can still impair a waterway. Many of the potential sources fall outside the DoE's regulatory jurisdiction (e.g., sanitary sewers owned by Washington Suburban Sanitary Commission [WSSC], landfills regulated by the State, open air markets overseen by the State Health Department).

3.1. Category 1: Human-Sourced Bacteria

Predominantly human-sourced bacteria are the highest priority category for source elimination because of their ability to cause disease in humans during water body recreation or shellfish consumption. These human-sourced bacteria can enter streams through the stormwater system or direct discharge into streams. This includes discharge from sanitary sewers, failing septic systems, chemical toilet spills, and other human-derived fecal bacteria sources. ***Data on these three sources are required by MDE.*** This required data focuses on the municipal sanitary sewer as the source of untreated sewage, including known location of failures.

3.1.1. Sanitary Sewer Overflows, Exfiltration, and Cross-Connections

Untreated sewage from sanitary sewers is one of the highest-risk sources of bacteria for humans. There are multiple potential sources, such as SSOs, exfiltration, and cross-connections.

- ***SSOs*** occur when sanitary sewers unintentionally discharge raw sewage to surface waters. These events contribute nutrients, bacteria, and solids into local waterways. SSOs can be caused by sewer blockages, broken pipes, pipe defects, and power failures to lift stations. They often occur during and after major storm events because of infiltration and inflow of groundwater into sanitary sewer pipes through cracks and breaks in the pipes. The same cracks allow sewage to percolate into the ground, some of which can seep into streams or adjacent stormwater collection pipes. MDE tracks SSOs and other bypasses in their *Reported Sewer Overflow Database* (https://opendata.maryland.gov/Energy-and-Environment/Reported-Sewer-Overflows/3rgd-zjxx/data).
- ***Exfiltration*** occurs when sanitary wastewater leaks from sanitary sewers through cracks in sewer lines or manholes. This leakage can contribute bacteria to both surface and ground water. WSSC is under a 2005 consent decree with the EPA to overhaul its sewer lines to reduce SSOs under their Sewer Repair, Replacement and Rehabilitation (SR3) Program. This will also reduce exfiltration. Information on the program could be used to determine where WSSC has made upgrades and what areas are planned for future upgrades. WSSC manages most sanitary wastewater the County. Additional information on this program is included in Section 6.2.2 of this report.
- ***Cross-connections*** occur where sanitary sewer systems are accidently connected to the storm sewer instead of the sanitary sewer. This problem introduces raw sewage directly into the County's MS4 and waterways without treatment. These connections can be discovered through the County's IDDE Program, which is a required program in the

County's MS4 permit. Additional information on this program is included in Section 6.2.1 of this report. Monitoring for this program is included in Section 4.3 of this report.

To summarize, data and potential data sources of untreated sewage discharge from sanitary sewers include the following (as noted above ***data on these sources are required by MDE)***:

- SSOs documented in
  - MDE's SSO event database.
- Exfiltration vulnerability documented by
  - Sewer lines geospatial data (WSSC),
  - Locations of retrofits/repairs (WSSC),
  - Sewer Repair, Replacement and Rehabilitation (SR3) Program data. and
  - Locations of lift stations (WSSC), and
- Cross-connection locations noted in
  - IDDE information in DoE's annual MS4 report and geodatabase.

3.1.2. On-site Sewage Disposal Treatment Systems

Septic systems or on-site disposal systems (ODSDs) are used when dwellings cannot be connected to the sanitary sewer system, mainly due to site location. Typical systems are not a major source of bacteria, if operating properly. However, ODSDs are a potential source of fecal bacteria when not regularly maintained and located near waterbodies. Failing on-site systems can increase nitrogen, phosphorus, and bacteria levels.

The prevention of human exposure to sewage is administered by the County Health Department in accordance with their ODSD regulations. Their ODSD program and support is described in Section 6.2.3 of this report.

OSDSs are a required dataset for WIPs. The data in this section are required for bacteria WIP development. Data and potential data sources of untreated sewage discharge from sanitary sewers include the following:

- Sanitary sewer envelope (WSSC) linked to residential parcels (Maryland-National Capital Park and Planning Commission M-MCPPC]).
- County BMP database, especially concerning
  - Retrofit/upgraded or connection to municipal sanitary sewer,
  - Septic system best available technology (BAT) upgrade locations and locations of sewer connections.
  - Age of subdivision (to gauge infrastructure integrity), and
  - Parcel size (older development with small lots likely to have small treatment zones).
- Health Department ODSD databases, including
  - BAT systems.
- Parcel data, indicating mobile home parks and campgrounds (M-NCPPC), and
- Recreational vehicle (RV) wastewater disposal sites (Internet search).

3.1.3. Other Predominantly Human-Sourced Bacteria Sources

There are potential sources of fecal bacteria from human sources that are not related to wastewater treatment. Homeless encampments, due to their lack of proper sanitation, could be sources of fecal bacteria when they are near the MS4 or stream. Chemical toilets, especially near water, used for events and construction sites are also potential sources of fecal bacteria due to factors such as lack of cleaning, tipping over, or damage. Lastly, *grey water* (untreated rainwater, reused for urban irrigation) could be a source of fecal bacteria under some circumstances because this water source is typically not chlorinated. ***The data in this section are optional for bacteria WIP development***.

Data and potential data sources of human-sourced bacteria include the following:

- Homeless encampments (Source of data unknown),
- Chemical toilet deployment (Source of data unknown),
- Reclaimed water/grey water use (Source of data unknown),
- Bars/stairwells near bars/washdown areas (Source of data unknown),
- Pools / hot tubs (MDE data, M-NCPPC, Internet search), and
- Open air markets (Maryland's GIS Data Catalog—Maryland Farmers Market Directory).

3.2. Category 2: Predominantly Non-Human-Sourced Bacteria

The next category of bacteria data sources includes mainly non-human bacteria sources. These are lower priority as non-human derived bacteria pose a lower risk to human health. These sources can be correlated with land use categories and storm sewer system discharge points, in relation to pets and wildlife.

3.2.1. Land Use / Land Cover and Zoning / Parcel Data

While land use, land cover, and zoning information is not *per se* a bacteria source, this information can be used to help determined potential bacteria hotspots. Fecal bacteria impairments are strongly associated with urban land use. Land use data can be used to identify medium- and high-density residential areas, where there are potentially more pets. Zoning and parcel data will help identify businesses that might produce bacteria loads from pet waste, such as dog day-care and grooming locales as well as veterinarians. Zoning and parcel data can identify businesses that might attract vermin (e.g., rats, racoons, pigeons), such as restaurants. Information that can be obtained in zoning and parcel data is included in multiple bacteria sources subsections in this document***. Land use data is a required data source for WIP development.***

Data and potential data sources of land use, parcel, and zoning data include the following:

- Maryland Department of Planning land use and land cover,
- Chesapeake Conservancy land-cover (MDE 2021b), and
- M-NCPPC property parcels and zoning data.

3.2.2. Municipal Stormwater Infrastructure

The stormwater conveyance infrastructure represents potential sources or hotspots (discharge points) because these structures can convey bacteria from pet waste and other sources.

Stormwater management facilities, like wet ponds or failed dry ponds, often attract waterfowl that defecate in and around the pond, creating sources of bacteria that eventually drain into the MS4 or directly to waterways (EPA 2001). During the bacteria source trackdown of stormwater systems, it will be important to know what the contributing drainage area to develop a location-based monitoring strategy. This knowledge includes what stormwater is conveyed to that location.

Stormwater conveyance poses other potential bacteria sources. A 2014 report (ASCE 2014) lists secondary sources of fecal bacteria including biofilms (i.e., a slime layer) in stormwater conveyance infrastructure flushed out during storm events, particularly in areas not exposed to sunlight. Biofilms are a concern because they can host a variety of pathogens (e.g., *E. coli*, *Salmonella enterica*, *Campylobacter jejuni*) and protect unwanted resident organisms from environmental stresses, including biocides (Costerton et al. 1995, Costerton et al. 1987, Hall-Stoodley et al. 2004, Parsek and Singh 2003, Skinner et al. 2010, Burkhart 2012). Skinner et al. (2010) and Burkhart (2013) also found that biofilms inside stormwater conveyance infrastructure could allow for growth of fecal bacteria communities.

Another potential secondary source is fecal bacteria in the sediment found in storm sewers, BMPs, or waterbodies. This sediment can be resuspended by wind, heavy flows, or agitation. Sediments, especially those in pipes not exposed to solar ultraviolet radiation, provide a suitable, moist environment for the growth of deposited microorganisms (Burkhart 2013, Clark et al. 2010, Weston Solutions 2010).

The locations of these stormwater outlets and impoundments for stormwater aid in tracking down sources and are a required for WIP development.

Data and potential data sources of stormwater infrastructure include the following:

- Stormwater management facilities (DoE),
- Stormwater conveyance including pipes, inlets, and outlets (DoE), and
- Canals / ditches / swales (National Hydrology Dataset [NHD] from USGS).

3.2.3. Domestic Pets

Domestic pets are large potential source of bacteria. These sources are likely in residential areas, parks, and around businesses providing animal-related services when and where pet owners do not pick up after their pets. Hotspots include dog parks and the garbage bins provided at dog parks.

This “pet” category also includes feral communities of cats and stray dogs. These animal communities do not have pet owners to pick up their waste. The bacteria in such animal feces—and from housed pets—often end up in stormwater and, thereby, into water bodies. The County’s pet waste program and support is described in Section 6.1 of this report.

MDE requires information on pets to be included in WIPs. Data and potential data sources of information on pets and stray pets include the following:

- Dog license information (Animal Services Division [ASD]),

- Stray (dog and cat) intake information (ASD),
- Dog parks (Internet search, M-NCPPC website), and
- Businesses providing animal-related services, including
  - Dog breeders (Source of data unknown),
  - Kennels (Source of data unknown),
  - Pet stores (Source of data unknown),
  - Veterinarian offices (Maryland's GIS Data Catalog—Maryland Licensed Animal Plant Facilities - Veterinary Hospitals), and
  - Dog groomers (Source of data unknown).

3.2.4. Garbage / Refuse

Landfills could be a source of fecal bacteria (e.g., from pet waste) if the landfill is leaking or during trash transfers from leaking garbage trucks. Illegal dump sites pose a similar risk. Landfills and illegally dumped materials and litter can attract wildlife (e.g., rats, racoons, gulls) resulting in increased fecal bacteria risk to water from these animals. ***Information on these types of bacteria sources is recommended, but not required for WIP development.***

Dumpsters can be a source of nutrients, oxygen-demanding substances, and bacteria. Commercial dumpsters can contain food waste and rodent droppings, while residential receptacles can contain food waste, diapers, or pet waste, and likewise attract vermin.

Improperly covered dumpsters and waste containers collect rainwater that can discharge with elevated levels of bacteria from rotting food and animal waste through leaks and holes in the bottom of the receptacles and then enter the stormwater conveyance system. Leaks can also occur when the waste receptacles are emptied or when the receptacles are washed.

Waste disposal trucks can include spills and other leak events. Accidental spills are significant sources of illicit discharges (CWP & Pitt 2004), but specific bacteria loadings are hard to determine. Accidental spills could be from leachate by trash trucks when they are not properly sealed, allowing liquid garbage to leak, leaving a stain of garbage leachate on roadways. This type of leakage to impervious surfaces can be a source of bacteria to water. The Denver Urban Drainage and Flood Control District (now the Mile High Flood Control District) lists garbage truck leachate as a potential source of *E. coli* (UDFCD 2018) based on work by Armand Ruby Consulting in 2011. More recently, Ruby and Bilginsoy (2017) cite truck leachate as a prioritized source of bacteria in Santa Cruz County, CA.

Information on the County's litter and illegal dumping programs and support is described in Section 6.3.3 of this report.

Data and potential data sources of information on garbage and refuse (***recommended, but not required for WIP development)*** include the following:

- Illegal dump sites (Source of data unknown),
- Landfills of two categories
  - Operational (M-NCPPC), and
  - Historic (MDE 2009 Historic Landfill Initiatives Report),
- Trash transfer stations (Resource Recovery Division [RRD]),
- Garbage truck routes (M-NCPPC impervious data and MDP land use), and
- Restaurant dumpsters and grease bins (Parcel data from M-NCPPC).

3.2.5. Wash Water

Washing facilities (e.g., vehicles, equipment, dumpster concrete pads) can contribute nutrients, oxygen-demanding substances, and bacteria to streams. Wash water from industrial and commercial activities often contain considerable amounts of fecal bacteria. A study in San Diego, CA (Weston 2009, cited in UWRRC 2014) showed that washdown water contained a median of 2,000 MPN/100 mL enterococci (20–200,000 MPN/100mL), while median concentrations from dumpster and grease trap leaks were ranged from 2,000–200,000 MPN/100mL enterococci. ***Information on these types of bacteria sources is recommended, but not required for WIP development.***

Data and potential data sources of information on wash water include the following:

- Areas of excessive irrigation (e.g., lawns) (Source of data unknown),
- Power washing operations (Source of data unknown), and
- Car washing locations (Source of data unknown).

3.2.6. Wildlife

While wildlife populations are often outside the control of MS4 permittees, this category comprises the highest fecal bacteria baseline loads in the TMDL for the Upper Patuxent River TMDL. Many wildlife species thrive in urban and suburban areas. Urban wildlife includes deer, rats, raccoons, geese, ducks, pigeons, and other smaller mammals and birds. Wildlife travel through urban greenspace, as well as fields and forests to water sources by *animal corridors*. These corridors can be sources of bacteria. For example, Canada geese are plentiful, and their waste has very high fecal coliform loads, with most of this waste deposited adjacent to streams and stormwater management ponds (Swallow et al. 2010). Additionally, there are open areas where birds flock (e.g., landfills, shopping centers). In residential areas, rats and other opportunistic feeders also present potential health issues for County residents in the form of bacteria.

The bacteria loads from these types of wild animal sources are not highly controllable and not directly related to the County's bacteria reductions, but do contribute to the overall problem. ***Information on these types of bacteria sources is recommended, but not required for WIP development.***

Data and potential data sources of information on wildlife include the following:

- Records on deceased animals on roads and parks (ASD),
- Maryland Department of Natural Resources (MD DNR) wildlife population surveys,
- Wildlife corridors (Source of data unknown),
- Rat infestation complaints (Source of data unknown), and
- Parcel information as described above for restaurants, dumpsters, and landfills (M-NCPPC).

3.2.7. Agriculture / Livestock

The 2022 MDE bacteria guidance lists agriculture and livestock as a predominant source statewide of non-human sourced bacteria. Locally, livestock are listed as a major contributor of bacteria in the Upper Patuxent and Piscataway watershed (MDE 2006, 2010). Livestock sources include farms with concentrated animal feeding operations (CAFOs), hobby farms or ranchettes (small, rural farms that are not necessarily businesses), slaughterhouses, and agricultural land where impoundments or reclaimed grey water is used for irrigation.

Only countywide information (not by watershed or other smaller category) is available to the public from the 2017 USDA Agriculture 2017 Census. However, this source reports more than 3,000 cattle, 355 hogs, 390 sheep, and 12,000 chickens in the County. (USDA 2019). The Census also shows 367 farming operations and 795 acres of irrigated farmland (USDA 2019). A search of the MDE's *AFO [Animal Feeding Operation] Public Participation Process* website[3], returned no registered AFOs in Prince George's County.

Information on these types of bacteria sources is recommended, but not required for WIP development.

Data and potential data sources of information on agriculture include the following:

- Maryland Department of Planning (land use information),
- Chesapeake Conservancy land-cover (MDE 2021b),
- M-NCPPC property parcels and zoning data,
- Concentrated animal feeding operations (CAFOs) (MDE ArcGIS Services request),
- Countywide USDA Agriculture 2017 Census Data,
- Horse stables, riding trails & centers (M-NCPPC, horse recreation websites),
- Suburban hobby farms / ranchettes (Maryland's GIS Data Catalog: Maryland_Licensed_Animal_Plant_Facilities_-_Licensed_Horse_Stables),
- Grey water reuse for farm irrigation in proximity to MS4 or rivers (Source of data unknown).
- Manure spreading operations (Source of data unknown), and
- Slaughterhouses (Source of data unknown).

[3] https://mdedataviewer.mde.state.md.us/Public/Land/CAFO/Public%20Search%20Tool. Accessed March 2023.

3.2.8. Other Predominantly Non-Human-Sourced Bacteria

The locations or activities listed below are potential sources of non-human-sourced bacteria due to food products discarded on ground or washing activities commonly associated with those activities or locations. Some categories can overlap with earlier information, such as discarded food waste attracting wildlife pests. ***Information on these types of bacteria sources is recommended, but not required for WIP development.***

Data and potential data sources of information on non-human-sourced bacteria include the following:

- Outdoor dining locations (Picnic and parks data from M-NCPPC),
- Food processing facilities (Source of data unknown,)
- Piers/docks (M-NCPPC),
- Bait shops (Source of data unknown), and
- Areas of excessive irrigation (Source of data unknown).

3.3. Category 3: Other Sources

3.3.1. Soils/Sediments Adjacent to Waterbodies

Soils adjacent to waterbodies have been found to be a source of enterococci. Additionally, *E. coli* can be found in interstitial waters (water found between the grains of sand or sediment) in shorelines and beach sand adjacent to water bodies. These land-based bacteria can be mixed into the water column, making them mobile with water bodies. Human exposure in these shore and beach environments is largely due to wading and other shallow water recreational activities (Kolb and Roberts 2009). Naturalized *E. coli* strains distinct from fecal isolates have even been found in Ontario Canada, meaning that a fecal bacteria source load might not be required for *E. coli* to exceed water quality standards (Lyautey et al. 2010). *This is a natural source of bacteria that cannot be controlled.*

3.4. Natural Resource Areas

MDE guidance also requires information on locations of special concern for bacteria impairments. ***This information is required for WIP development.*** These include MDE-designated shellfish harvesting areas and beaches. These areas are of special concern due to risk of ingesting fecal coliform bacteria via contaminated shellfish or through primary contact recreation (e.g., swimming).

Prince George's County does not have any designated state bathing beaches characterized by the Maryland Beaches Program (MDE 2023a). There are no known local or non-designated beaches. There may be secondary contact recreation, through wading, in the County but there are no known locations of primary contact recreation.

The Maryland Shoreline Survey Program conducts shoreline inspection for each shellfish harvesting area at least once every five to seven years, as mandated by the National Shellfish Sanitation Program under the auspices of the U.S. Food and Drug Administration. Prince George's County does not have designated shellfish areas. The southern portion of the Patuxent River is classified as a *Restricted Area*, which means that oysters are not allowed to be directly harvested at any time. Direct harvesting of oysters or clams is prohibited in these types of areas.

Data and potential data sources of information on natural resource areas include the following:

- Maryland Shoreline Survey Program (Health Department),
- Designated beaches (MDE ArcGIS Services request),
- Local beaches (Source of data unknown), and
- Non designated beaches (Source of data unknown).

4. County Monitoring Approach

The purpose of monitoring conditions in County watersheds is to measure the water quality progress resulting from WIP implementation. Monitoring can also aid in identifying or confirming potential bacteria sources or hotspots that were identified by a geospatial data analysis. DoE recognizes that effective environmental monitoring requires a long-term commitment to routine and consistent sampling, measurement, analysis, and reporting. Although some of the monitoring requirements for assessing progress toward meeting TMDLs originate with MDE, other requirements reflect the County's interest in providing additional meaningful information to policymakers and the public. Appendix A summarizes monitoring approaches identified in the MDE 2021 bacteria guidance, including those approaches used by Anne Arundel County and the City of Baltimore.

4.1. MS4 Permit Monitoring for Assessments of Control

Under the terms of the new MS4 permit and as outlined in MDE's 2021 MS4 Monitoring Guidelines, the County is required to develop bacteria monitoring programs to identify sources, track progress, and establish trends. These monitoring programs fall under two types of programs: BMP effectiveness monitoring and watershed assessment monitoring. Each monitoring program type will have its own monitoring plan with specifics on locations, timing of events, and quality protocols. This section gives a brief overview of the MS4 permit monitoring.

4.1.1. BMP Effectiveness (Required)

The MS4 permit BMP effectiveness monitoring component requires evaluating the cumulative effects of urban stormwater retrofits and alternative urban BMPs through water quality monitoring for storm and baseflow at a subwatershed scale in the County or by entering the Chesapeake Bay Program's Pooled Watershed Program for BMP Effectiveness. The County entered the Pooled Monitoring Program in July 2024.

4.1.2. Watershed Assessment (Required)

The MS4 permit also requires that the County will conduct watershed assessment and trend monitoring, including stream biology, habitat, bacteria (*E. coli*, Enterococcus), and chlorides, all based on MDE's *2021 MS4 Monitoring Guidelines: BMP Effectiveness and Watershed Assessment*.

The monitoring guidelines for bacteria require that the County establish a monitoring station in each watershed impaired for bacteria and monitor monthly. The County has selected at least one monitoring station in each of the three watersheds that have bacteria TMDLs: Anacostia, Piscataway, and Upper Patuxent (Figure 4-1). The County will collect a monthly bacteria grab sample per monitoring station at the same day and time (e.g., last Friday of every month), regardless of weather conditions, except for hazardous conditions (e.g., thunderstorms, winter weather events) where sampling will be delayed until the hazardous conditions abate. Additional information is included in the County's watershed assessment sampling plan (DoE 2024b). Results from the monitoring will be provided to MDE in the County's annual MS4 submittal package in the MDE spreadsheet format.

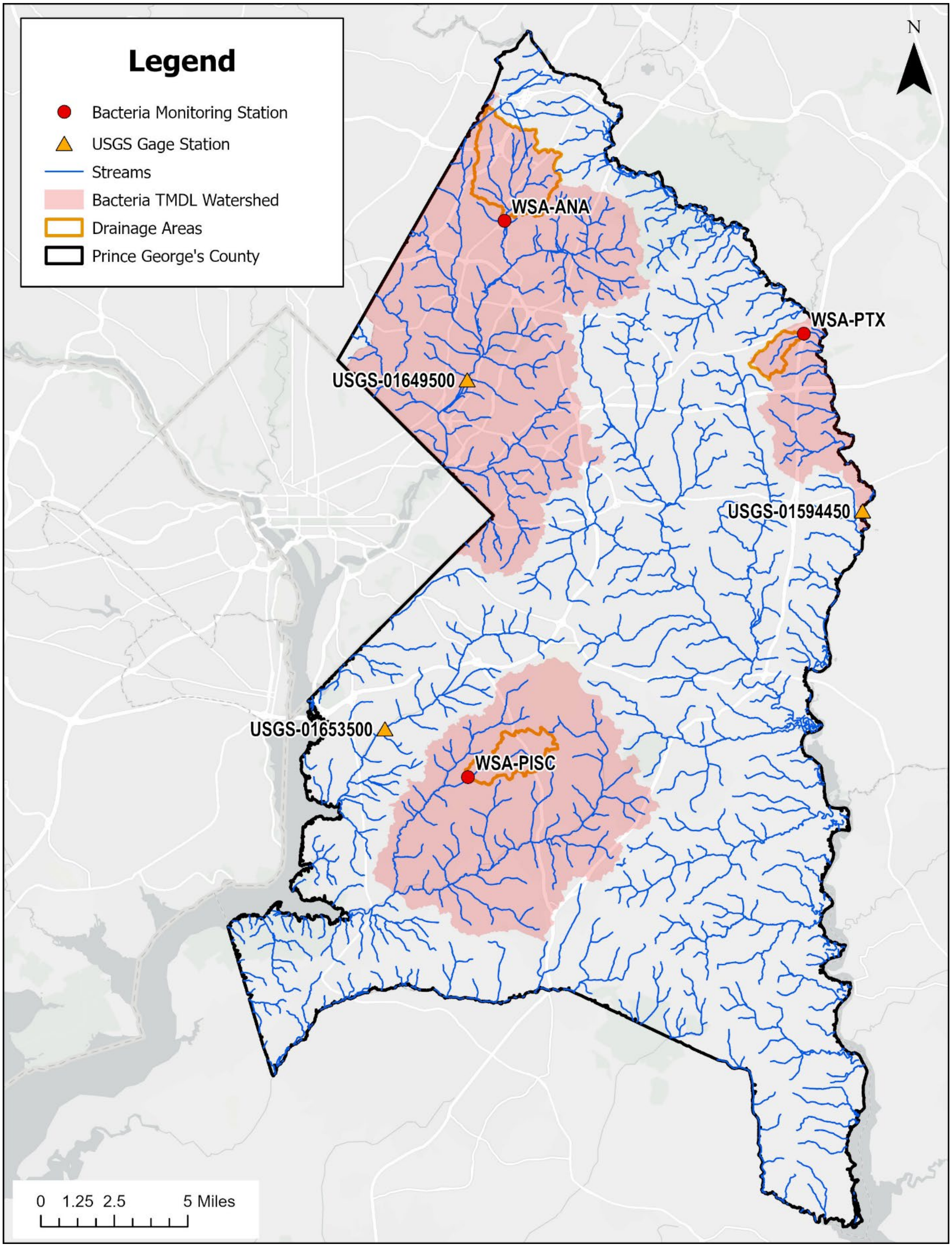

Figure 4-1. Watershed assessment bacteria monitoring locations in Prince George's County, MD.

4.1.3. Bacteria / Microbial Source Tracking (Optional)

MDE encourages MST, also known as BST, in its 2022 bacteria guidance; additionally, the MS4 monitoring guidelines call for using qPCR (quantitative polymerase chain reaction) methodologies. Jurisdictions are encouraged to conduct BST analysis for locations with high bacteria concentrations and no known or identified sources upstream. MDE also encourages jurisdictions to collect new BST data at TMDL assessment points to assess changes in microbial community sources, especially if there has been significant land-use change in an area since the BST data was last gathered for TMDL development. The County will explore BST on a case-by-case basis and conduct BST analysis as determined necessary.

4.2. Potential Additional Bacteria Monitoring

The County collected bacteria samples in the three TMDL watersheds as part of its countywide biological monitoring. This monitoring provides both randomized bacteria results throughout the County and valuable information for source tracking. Only a single data point is collected at each location. High bacteria results indicate a potential source of bacteria upstream that should be investigated. This randomized monitoring could detect high bacteria levels that otherwise would not be found through traditional approaches. If deemed useful, the County will continue collecting samples during biological monitoring and have them analyzed using Standard Method 9223B (Colilert Quad-Tray). An alternative is the use of fecal indicator bacteria tests, such as Coliscan EasyGel, which are less expensive and readily available. However, this test should be considered only as a screening tool and should not be used for official reporting. Monitoring data are provided annually in the annual countywide WIP.

4.3. Illicit Discharge Detection and Elimination Monitoring

IDDE activities are required in the County's MS4 permit. They are a source of data suggested by MDE for WIP development and as a tool for tracking progress and establishing trends. The County conducts an IDDE program, through which inspectors examine major stormwater outfalls and test the water for unusual levels of pollutants. Major outfalls are defined stormwater pipes that discharge runoff from commercial and industrial land into a body of water. The County targets up to 150 storm drain outfalls per year for dry-weather sampling to detect illicit discharges. If a dry-weather flow is present, the discharge is sampled using Hach chemical test kits and probes to evaluate parameters known to be associated with wastewater intrusion into storm drains, including temperature, pH, ammonia, dissolved oxygen, turbidity, detergents, chlorine, phenols, and fluoride. The County applies threshold concentrations to four of these parameters as indicators of an illicit discharge. These thresholds are 0.17 parts per million (ppm) for phenol, 0.4 ppm for chlorine, 0.5 ppm for detergents, and 1.0 ppm for ammonia (KCI Technologies 2015).

If the discharge from the outfall has a concentration above the threshold limit for detergents, phenols, chlorine, or ammonia, verification sampling is completed between 4 and 24 hours after the initial sampling. If both sampling events indicate that an illicit discharge is occurring, then a grab sample is collected at the outfall and taken to a laboratory for formal analysis. When lab analyses confirm that an illicit discharge is likely, the County follows the stormwater conveyance system upstream and continues sampling to identify the source of the pollutant. When a source is identified, the County takes actions to eliminate the illicit discharge.

5. Source Tracking and Subwatershed Prioritization Methodology

Litten (2007) recommends two strategies for designing trackdown field sampling: (1) top-down sampling that begins with a known source that is being confirmed or (2) bottom-up sampling that begins with little knowledge and engages in a systematic hunt. Trackdown studies often look for something unusual, such as unusually high bacteria concentrations above background levels. These trackdown studies will be applied to priority watersheds; then, the method will be followed for lower priority watersheds. Trackdown studies will not be conducted for watersheds that are not listed as impaired.

For the source trackdown and subwatershed prioritization, the County will review potential bacteria sources that can indicate where contamination might occur. After collecting information on all potential sources of contamination within each subwatershed, the County will rank subwatersheds based on the number of potential sources and likely severity of contamination to prioritize subsequent targeted water quality sampling studies.

5.1. Bacteria Source Data Modifications

The County made multiple attempts to obtain data for the bacteria trackdown study. There are several data sets that could not be collected. In some cases, alternative data sources were found. The list below only discusses missing required information. Optional information is discussed if alternate sources were found.

- Natural Resource Areas
  - Beach locations: No designated beach locations were found in state or local datasets.
  - MDE Designated Shellfish Harvesting areas: No shellfish harvesting areas were found in state or local datasets.
- Predominantly Human Sources
  - Municipal Sanitary Sewer Infrastructure exfiltration points
    - Lift stations: County did not receive requested information.
    - Pump stations public & private: County did not receive requested information.
    - Retrofit/repair locations/status: County did not receive requested information.
    - Sanitary conveyance system: County had access to older data, which is incomplete but was used to provide an estimate.
  - On-site Disposal Systems
    - All systems: The County does not have a list of ODSDs. The County does maintain a list of BAT system upgrades and a list of residences with former ODSDs that are now connected to the sanitary conveyance systems. The County used parcel data and the sewered area geospatial data to identify likely residential properties with ODSDs. This information was then compared to sewer connection data.
    - WPRPP Chesapeake Bay Phase III WIP septics project – Age of subdivision: Project information is not available.

    - WPRPP Chesapeake Bay Phase III WIP septics project – Parcel size-explanatory variable: Project information is not available.
    - WPRPP Chesapeake Bay Phase III WIP septics project – Leaking systems: Project information is not available.

- Predominantly Non-Human Sources
  - Domestic pets
    - Medium to high density residential areas: Instead of inferring pet density using land use data, the County used actual pet license information as to the location of pets.
    - Businesses providing animal related services – Commercial production and treatment: Data was not readily available.
    - Businesses providing animal related services - Pet storage and treatment: Data was not readily available.
  - Urban non-stormwater discharges
    - Garbage truck routes (Optional): This information is not available in a geospatial format. The County assumed that all residential roads will be part of garbage truck routes.
  - Dumpsters and transfer stations: Information is not available.
  - Wildlife
    - Rodents/fecal vectors (Optional): Rodents and other vectors are assumed to be linked to food-related businesses, such as restaurants.

5.2. Initial Source Rankings for Source Tracking

As shown in Section 3, there are multiple potential sources of elevated bacteria concentrations in the County. However, not all are major sources or concerns. In this subsection, the potential sources are separated into two classes: human fecal sources (HFSs), and anthropogenic and non-human fecal sources (ANFSs). In each class, the potential sources are ranked in order of importance.

The rationale for this ranking scheme is that all sources that are mandated by MDE guidance to be included in a WIP should be accounted for. Subsequently, those sources will be prioritized that have the most significant health risks, which is a combination of the risk of contamination and the risk of exposure. Finally, those sources that can be effectively measured and realistically mitigated will be prioritized.

These evaluations require significant professional judgement. In general, the health risk is based on how likely contamination and human exposure are. The overall impact includes not only the human health risk but also the ease of implementation and potential effectiveness of any mitigation measures in reducing contamination.

The ranking of sources, for both HFS and ANFSs risk category types, was done by scoring each source from highest to lowest by summing over qualitative scores assigned to these four elements: contamination risk, exposure risk, mitigation potential, and mitigation cost. These scores range from 1 to 4, with 4 indicating the highest contamination and exposure risks, as well as highest mitigation potential; also scored is the mitigation cost.

Table 5-1 and Table 5-2 provide a general ranking of HFSs and ANFSs. The rationale and ranking methodology are additionally elaborated below the tables.

Table 5-1. Relative ranking of human fecal sources, for use in Prince George's County bacteria WIP.

Source	Health Risk		Data Source(s)	Data Collected?	Potential Mitigation Strategies	Required for WIP	Weight
	Contamination Risk	Exposure Risk					
Exfiltration (Leaking sewers)	Leak is present	Untreated sewage	WSSC	No	Sewerage repairs	Yes	10
Illicit discharges	Illicit discharge occurs	Untreated sewage	PGC DoE	Yes	Regulate discharges	Yes	10
SSOs	Overflow occurs	Untreated sewage	MDE records	Yes	Treatment capacity increase	Yes	10
Cross-connections	Cross-connection is present	Untreated sewage	WSSC	No	Sewerage repairs	Yes	10
Campgrounds	Possibility of poor septage disposal / lack of restrooms	Untreated sewage	Parcel GIS data, M-NCPPC website	Yes	Fix septic systems	Yes	10
RV wastewater disposal sites	Possibility of improper disposal/spillage	Untreated sewage	RV websites	Yes	Regulate sites	Yes	10
Septic systems	Possibility of septic failure	Untreated sewage	Parcel GIS data, WSSC non-sewered areas	Yes	Mandate septic retrofits	Yes	5
Mobile home parks	Possibility of septic failure	Untreated sewage	Parcel GIS data	Yes	Mandate septic retrofits	Yes	5
Bars/stairwells washdown areas	Untreated washoff	Human waste washoff	Unknown	No	Levy fines / improve awareness	No	5
Chemical toilets	Possibility of improper disposal	Partial chemical treatment likely	Unknown	No	Mandate safe disposal	No	5
BAT systems	Possibility of septic failure	Untreated sewage	PGC DoE records	Yes	Mandate BAT retrofits	Yes	5
Homeless encampments	Lack of restrooms	Human waste washoff	No sources	No	Provide shelter access.	No	5

Source	Health Risk		Data Source(s)	Data Collected?	Potential Mitigation Strategies	Required for WIP	Weight
	Contamination Risk	Exposure Risk					
Pools/hot tubs	Grey water	Grey water	MDE GIS data; M-NCPPC; Internet search	Yes	Improve awareness	No	5
Open air markets	Lack of restrooms, Vermin/pest (rodent/birds) waste.	Untreated sewage, diseases vectors	MDE GIS data; M-NCPPC	Yes	Improve awareness	No	1
Reclaimed irrigation water	Possibility of improper application	Grey water	Unknown	No	Sponsor BMP programs	No	1

Table 5-2. Relative ranking of anthropogenic non-human fecal matter sources for Prince George's County bacteria WIP.

Source	Health Risk		Data Source(s)	Data Collected?	Potential Mitigation Strategies	Required for WIP	Weight
	Contamination Risk	Exposure Risk					
Pet storage, treatment, and groomers	Failure to cleanup	Pet waste	No sources	No	Levy fines / improve awareness	Yes	5
Pet waste	Failure to cleanup	Pet waste	ASD pet licenses	Yes	Levy fines / improve awareness	Yes	5
Veterinary hospitals	Sanitary disposal	Limited pet waste	MDE GIS	Yes	Levy fines / improve awareness	Yes	5
Pet commercial production, and pet shops	Failure to cleanup	Pet waste	No sources	No	Levy fines / improve awareness	Yes	5
Dog parks and walking trails	Failure to cleanup	Pet waste, disease vectors	Parcel GIS data (parks), web search, MNCPPC website	Yes	Levy fines / improve awareness	Yes	5
Feral cat and stray dog populations	Animal waste	Disease vectors	ASD records	Yes	Animal control / Improve awareness	No	5
Horse venues	Animal waste	Disease vectors	MDE datasets, web search	Yes	Improve awareness	No	5

Source	Health Risk: Contamination Risk	Health Risk: Exposure Risk	Data Source(s)	Data Collected?	Potential Mitigation Strategies	Required for WIP	Weight
Horse trails	Animal waste, failure to cleanup	Disease vectors	MNCPPC, web search	Yes	Levy fines / improve awareness	No	5
Restaurants, outdoor dining, and restaurant dumpsters grease bins	Untreated washoff, Vermin/pest (rodent/birds) waste	Disease vectors	Parcel GIS data (restaurant)	Yes	Levy fines / improve awareness	No	2.5
Geese/ waterfowl	Animal waste	Fecal matter	Parcel GIS data (parks)	No	Exclusion zones	No	2.5
Garbage truck routes	Leaking trucks, spilled garbage	Untreated municipal solid waste	PGC GIS (residential roads)	Yes	Levy fines / improve awareness	No	2.5
Trash transfer stations	Leaking trucks, spilled garbage, and untreated washoff	Untreated municipal solid waste	RRD	No	Levy fines, Change site drainage	No	0.5
Piers/docks, and bait shops	Untreated washoff. Vermin/pest (rodent/birds) waste.	Grey water. Disease vectors	M-NCPPC website, Parcel GIS data	Yes	Levy fines / improve awareness	No	0.5
Food processing facilities	Possibility of improper disposal. Vermin/pest (rodent/birds) waste	Disease vectors	No sources	No	Levy fines / improve awareness	No	0.5
Illegal dump sites	Vermin/pest (rodent/birds) waste, human/pet waste	Disease vectors	No sources	No	Levy fines	No	0.5
Services of grease and biological waste	Vermin/pest (rodent/birds) waste, Possibility of improper disposal.	Disease vectors	No sources	No	Levy fines / improve awareness	No	0.5
Car washing, and power washing	Untreated washoff of bird waste	Disease vectors	No sources	No	Levy fines / improve awareness	No	0.5
Landfills	Vermin/pest (rodent/birds) waste. Minimal human/pet waste leaks	Disease vectors	MDE/ PGC GIS data	Yes	Animal control	No	0.5

Source	Health Risk		Data Source(s)	Data Collected?	Potential Mitigation Strategies	Required for WIP	Weight
	Contamination Risk	Exposure Risk					
Mammals (Nonvermin/ pests: e.g., deer)	Animal waste	Fecal matter	Linked to park trails, picnic areas, and restaurants	Yes	Exclusion zones	No	0.5

HFSs with an overall score of 15 or higher are assigned a weight, W_i, of 10, with an overall score of 11 to 15 are assigned a weight of 5, and with an overall score of less than 11 are assigned a weight of 1. ANFSs are generally considered a lower health hazard to humans (Domingo and Ashbolt 2019) and get half the weight of the HFSs. Similarly, ANFSs with an overall score of 15 or higher are assigned a weight of 5, with an overall score of 11 to 15 are assigned a weight of 2.5, and with an overall score of less than 11 are assigned a weight of 0.5.

Several judgement considerations define the HFS and ANFS rankings in Table 5-1 and Table 5-2 above:

- Sources with known sewer failures, such as leaky, or cross-connected sewers and SSOs have a 100% contamination risk. Such sources will drain directly into receiving waters, and therefore contribute to high exposure risk. For sources such as campground sewage and pet defecation, where incomplete information might be available, the contamination risk is assumed to be high, but not 100%. The exposure risk in these cases is assessed primarily as a human health hazard, and therefore the possibility of carrying disease vectors is ranked higher than exposure to animal fecal matter or grey water posing less significant human health risks.
- Mitigation potential in these tables refers to whether it would be possible to implement effective mitigation strategies and includes the feasibility of those strategies in achieving bacteria reduction. For example, sewer conveyance repairs are a straightforward mitigation strategy and rank high, whereas regulating illicit discharges is difficult and ranks low. Programs that require improving public awareness or enforcement by levying fines or permits might be difficult to achieve, as the effectiveness of such programs cannot be easily measured and rely on behavior change. Finally, the cost of mitigation is an important factor to consider, with more expensive activities ranked lower than less expensive ones.

5.3. Bacteria Source Tracking Subwatershed Prioritization Process

The County will conduct bacteria source tracking using a geospatial analysis. This analysis will be completed for each watershed individually. The countywide analysis will support subwatershed prioritization for additional monitoring. The subwatershed analysis will follow the approach outlined below and illustrated in Figure 5-1.

1. Determine the standardized (normalized) score for each source in a subwatershed.
    a. Calculate the subwatershed points, P, for a given source, i (See Table 5-3 for a list of sources and how to determine points);

   b. Divide by the total points for that source, $P_{tot,i}$, across all subwatersheds in the watershed of interest;
   c. Subwatershed source score for that source, $S_i = P_i / P_{tot,i}$. ; and
   d. This process will create a standardized method of comparison for disparate types of sources.
2. Sum the weighted subwatershed source scores, S_S.
   a. Multiply W_{si} (weight for the source from Table 5-3) by source score; and
   b. Sum weighted scores for all sources in the subwatershed, $S_S = \Sigma W_{si} S_{i.}$; Now,
3. Calculate the overall subwatershed score, $S_O = (10 \times S_{WQ}) + S_S$.
4. Rank the subwatersheds from highest to lowest S_O.
5. Prioritize the subwatersheds as follows:
   a. Bottom 20% as priority rank 5,
   b. Second 20% from bottom as priority rank 4,
   c. Middle 20% as priority rank 3,
   d. Second 20% from top as priority rank 2, and
   e. Top 20% as priority rank 1.

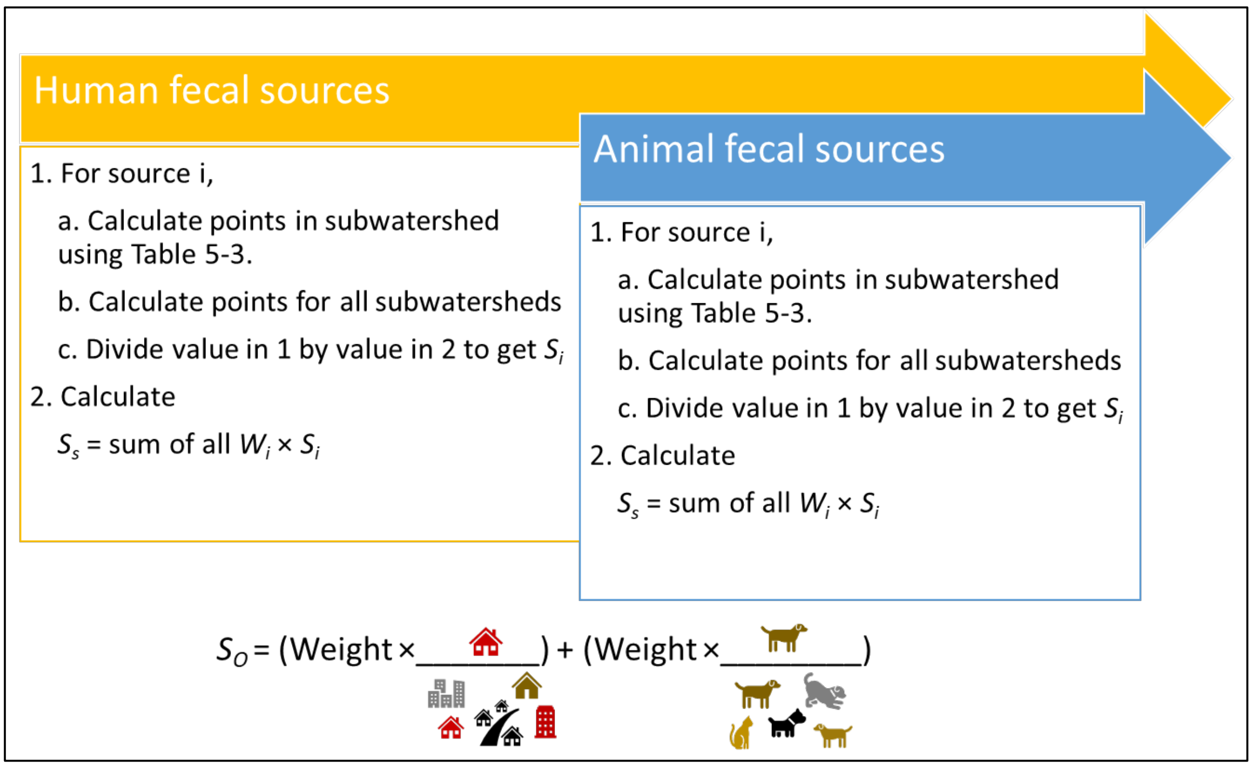

Figure 5-1. Subwatershed prioritization workflow for bacteria WIP.

Table 5-3. Subwatershed prioritization scoring.

Source	Type	Weight	Variable (if data available)	Assumption for analysis
Exfiltration (Leaking sewers)	HFS	10	Area not repaired (data not available – Used total known sanitary sewers for assessment)	Compare sewered area to the areas that have had sewer repairs within 10 years. Assume that areas without recent repairs have potential to leak.
Illicit discharges	HFS	10	Number of occurrences	Use past data on illicit discharge locations.
SSOs	HFS	10	Count of overflows + % of total volume × 100[a]	Assume overflows with historic E. *coli* concentrations will have bacterial contamination
Cross-connections	HFS	10	Number of residential parcels with connections to MS4 lines (data not available)	Assume some fraction of homes with cross connections from previous studies in municipalities if data are not available
Campgrounds	HFS	10	Number of campsites	Assume all campsites will have fecal contamination
RV wastewater disposal sites	HFS	10	Number of sites	Assume all RV wastewater disposal sites will have fecal contamination
Septic systems	HFS	5	Number of residential parcels not in sewered area minus number of BAT systems	If residential parcel is in the unsewered area, then must have septic system. BAT systems included below; parcel size and age-based assumptions will not be used to determine if parcel has a BAT system
Mobile home parks	HFS	5	Number of mobile home parks	Assume all mobile home parks will have fecal contamination
BAT systems	HFS	5	Number of systems	Parcel size and age-based assumptions will not be used to determine if parcel has a BAT system
Pools/hot tubs	HFS	1	Number of pools	Assume all pools will have fecal contamination
Open air markets	HFS	1	Number of markets	Assume all open air markets will have fecal contamination
Pet storage, treatment, and groomers	ANFS	5	Number of establishments (data not available)	Assume all establishments will have fecal contamination
Pet waste	ANFS	5	Number of dog licenses	Assume pet owners not properly clean up after pets
Veterinary hospitals & SPCA	ANFS	5	Number of veterinarian clinics	Assume all facilities will have fecal contamination
Feral cat and stray dog populations	ANFS	5	Number of stray animals (dogs and cats)	Distribution of animals by watershed
Dog parks	ANFS	5	Number of parks	All dog parks will be sources of contamination
Dog walks	ANFS	5	Miles of trails	Assume that owners walk dogs along trails and not properly clean up after pets

Source	Type	Weight	Variable (if data available)	Assumption for analysis
Pet commercial production, and pet shops	ANFS	5	Number of establishments (data not available)	Assume all facilities will have fecal contamination
Horse venues / ranchettes	ANFS	5	Number of venues	Assume that owners are not taking proper precautions or cleaning up after horses
Horse trails	ANFS	5	Number of trails	Assume that owners are not taking proper precautions or cleaning up after horses
Restaurants	ANFS	2.5	Number of establishments	Assume all facilities will have fecal contamination due to rodents and birds near dumpsters and dumpster leakage.
Garbage truck routes	ANFS	2.5	Miles of residential roads.	All residential roads are trash routes.
Trash transfer stations	ANFS	0.5	Number of facilities (data not available)	Assume all facilities will have fecal contamination
Piers/docks, and bait shops	ANFS	0.5	Number of establishments	Assume all facilities will have fecal contamination
Landfills	ANFS	0.5	Area of landfills	Bacteria source is flocking birds
Mammals (Nonvermin/pests: e.g., deer)	ANFS	0.5	Repeated information. Did not use to prevent double-counting. Parks and trails factored in for dogs. Picnic areas factored for outdoor dining.	Distribution of animals by watershed will be used if available, otherwise an average value will be assigned to watersheds with no data

Note:
[a] Potential outliers were removed during analysis.

The subwatershed prioritization for BST combines both human and anthropogenic bacteria sources. Subwatershed prioritization is the first step in investigating bacteria hotspots for source identification and implementation. Once the subwatersheds have been prioritized by ranking them according to the number of sources posing a significant human health risk, the County will conduct monitoring in the highest priority subwatersheds to determine spatial and temporal patterns in bacteria contamination. By conducting monitoring in the highest priority subwatersheds, the County hopes to identify and eliminate potential sources more quickly and efficiently.

5.4. Targeted Water Quality Monitoring for Source Tracking

Water quality data will be an important factor in the source trackdown studies. The County will review existing water quality data (Section 1.3) to look for temporal and geographic trends in the data, including the presence of outliers and water quality criterion exceedances.

As part of this targeted strategy, the County identified high-priority subwatersheds within each TMDL watershed based on the prioritization process discussed in Section 5.3. The County began preliminary sampling of high-priority watersheds in 2024 and will continue in 2025 (Figure 5-2). Each high-priority subwatershed is further divided into catchments to facilitate source identification. Within each catchment, a bacteria sampling site is located near the catchment outlet, with additional sites located upstream of each stream confluence in a catchment. Catchments will be further prioritized for follow-up monitoring and source identification using the results of iterative, spatially targeted sampling. The County will rely on the following action levels to determine if additional monitoring and source identification are needed in a given catchment.

- Less than five samples: Continue sampling
- At least five samples, with no values over 126 MPN/100 mL: Stop sampling
- At least five samples, one or more values exceed 126 MPN/100mL: Conduct additional sampling based on the locations where the sample values exceed 126 MPN/100mL, with higher priority given to catchments and subcatchments with one or more sample values exceeding 410 MPN/100mL

The County sometimes collects additional bacteria samples to aid in source trackdown. For two years, bacteria screening samples were collected during countywide biological monitoring. Only a single data point is collected at each location. High bacteria level results indicate a potential source of bacteria upstream that should be investigated further. This randomized monitoring could detect high bacteria levels that otherwise would not be found through traditional approaches. Additional information on the countywide biological sampling is included in the County's watershed assessment sampling plan (DoE 2024b). Bacteria monitoring data are provided in the annual countywide WIP and annual MS4 report, using MDE reporting formats.

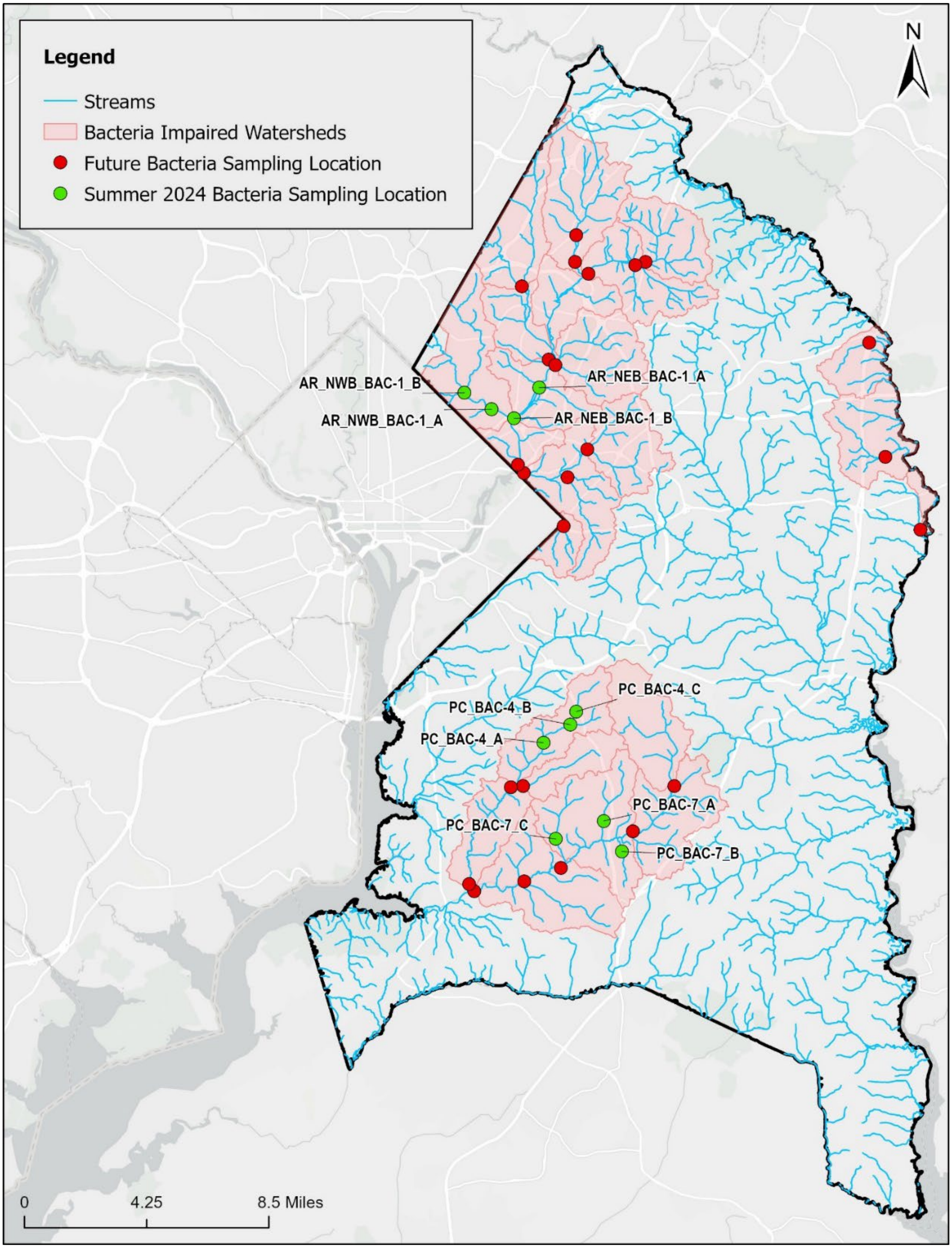

Figure 5-2. Bacteria source trackdown monitoring locations in Prince George's County, MD.

6. County Programmatic Source Control Management Actions

The County and other agencies have initiated a wide range of programmatic stormwater management initiatives over the years to address existing water quality concerns. These initiatives are grouped into the following three categories:

- public education programs,
- wastewater programs, and
- stormwater-specific programs.

Each category (and its respective individual initiatives) is further described in this section, including the contributions that these programs make to water quality protection and improvement.

Many of the County's stormwater-related programmatic initiatives target more than one topic area. For example, in addition to promoting adoption of on-the-ground BMPs, the Alternative Compliance Program promotes stormwater education via environmentally-focused sermons at places of worship. Listed below are programs administered by various departments within the County government or its partners that either directly or indirectly support water quality improvements relating to bacteria.

6.1. Pet Waste Management

The County recognizes that an informed public is essential to the restoration process. DoE has initiated a wide range of initiatives to inform County residents about the impacts their daily activities have on the health of their watershed and local water bodies. During FY 2024, the County hosted 500 environmental education and outreach events that promoted environmental awareness, green initiatives, and community involvement in reducing pollutants in its waterways through printed materials, such as brochures or newsletters; electronic materials, such as website pages; mass media, such as newspaper articles or public service announcements (radio or television); and conducting targeted workshops on stormwater management for the public (DoE 2024a). In addition to events, DoE's outreach and educational programs also encourage volunteerism and environmental stewardship among community organizations, businesses, and citizens.

This section identifies outreach opportunities to educate and engage residents and businesses in the County about pet waste. Besides being unsightly and smelly, pet waste contributes nutrients (nitrogen and phosphorus), bacteria, and other pollutants to local water bodies if not disposed of properly. A targeted pet waste strategy can raise residents' awareness and concern about pet waste disposal enough to spur behavior change that will reduce bacteria in the watershed. The main public outreach effort to combat pet-based bacteria will be educating pet owners on the proper disposal of pet waste and the harmful effects pet waste can have on local water bodies.

The most effective program for reducing bacteria and nutrient loads from dogs is an aggressive waste-pickup program. This County program also involves installing dog waste bag dispensers in high-activity areas. Behavior change is facilitated by public education and supported technically in that the County provides dog waste disposal facilities and baggies in many residential areas and in parks where pets congregate.

The pet waste program consists primarily of education and outreach to encourage pet owners to pick up waste, which is required by County code with penalties for violators. A County ordinance requires pet owners to immediately remove pet waste from public and private property (Prince George's County Municipal Code §3-139). Violations of the ordinance are primarily identified through a public complaint process. A civil fine in the amount of $50 is levied for the first violation of the ordinance; a second offense receives a fine of $100, and any subsequent violation receives a fine of $250 (Prince George's County Municipal Code §3-116).

The public education portion links pet waste pickup messages to the idea of being a responsible pet owner. Such messages can help to build a community of responsible pet owners who care for their pets and, more importantly for water quality, clean up after them. Most dog owners consider their pets to be members of their family and want to make the right choices to protect the health of their pets and their family. Messages and actions focusing on proper pet waste pickup as a routine behavior of responsible pet owners will help residents who already see themselves as responsible but might not be consistently picking up after their dogs, more likely to adopt the behavior as permanent. Further, such messages help pet owners see the connection between proper pet waste practices as directly influencing safe local watersheds. Many pet owners can understand that clean local water is better for pet health, if their pets drink or wander into water bodies.

The County has initiated numerous countywide education and outreach initiatives to inform the public about the impacts of pet waste. The County will continue their current outreach programs involving pet waste and also look for partner opportunities with trusted community messengers to educate and engage the community about pet waste. For example, partners can attend existing community meetings, events, and school functions in locations with the highest concentrations of dog licenses and strays. Outreach efforts can also include social media postings, community message boards, or email distribution services.

6.1.1. Pet Waste Disposal Education

Department of the Environment Sustainability Division Activities

"Scoop your poop" campaigns (https://www.princegeorgescountymd.gov/3689/Scoop-That-Poop) are often motivated by the important role of poor waste recovery practices by pet owners on stream water quality. The County Sustainability Division (SD) manages and administers the pet waste disposal program to raise residents' awareness and concern about pet waste disposal enough to spur behavior change. The overall message is "Be a responsible pet owner by picking up your dog's waste." The overall slogan is "Do Your Doody! Scoop That POOP! Scoop it, bag it, trash it."

SD has been implementing its Pet Waste Campaign since 2017 and has worked with 35 municipalities and homeowners' associations (HOAs). SD continues to provide "scoop the poop" signs to HOAs and civic associations. The signs are a great option for communities that want to initiate a pet waste campaign but lack funds for maintaining a pet waste station. In FY 2024, DoE continued distributing the pet waste video, brochures, posters, and game to communities seeking to educate residents about the problems caused by pet waste and to encourage them to pick up after their pets.

SD will continue to use a multi-pronged approach to support pet waste pickup and disposal activities in the County:

- Building and maintaining partnerships, such as working with the cities of Greenbelt and Bowie to assist in their pet waste campaigns.
- Partnering with the Environmental Finance Center (EFC) at the University of Maryland and the Prince George's County People for Change Coalition to increase awareness about pet waste pollution and encourage residents to pick up their pets' poop (see more details below).

Figure 6-1. Playing "Scoop that Poop" game with a Mount Rainier resident.

- Conducting numerous Pet Waste Expos and Pet Waste Management Summits
- Participating in community and municipal festival and events to provide materials and engage with the public to increase the public's awareness about pet waste pollution (Figure 6-1).
- Developing and distributing pet waste materials:
  - "Scoop the Poop" pledge card asks County residents to commit to picking up after their pets.
  - "Why Scoop that Poop" brochure in English and Spanish.
  - "What Happens When You Don't Scoop that Poop?" brochure in English and Spanish.
  - "Do Your Doody Scoop That Poop" 3 x 4 foot poster.
  - "Target Locations" 3×4 foot poster.
  - "Promoting Pet Waste Pick-up" 3×4 foot poster.
  - Pet waste giveaways (with County's campaign slogan): bag dispensers with baggies for dog owners and poop emoji squeezable toys for children who play the poop game.
  - Community signage for high-use areas (for children and adults):
    - "Why Scoop that Poop" dog park sign (Figure 6-2), and
    - Installation of pet waste disposal stations.

Interactive Displays and Speakers for Community Meetings

County staff support multiple outreach events to provide presentations /displays / handouts, answer questions, and promote environmental stewardship. At these events, County staff also provide information on the importance of trees and tree planting, stormwater pollution prevention, lawn care, Bayscaping (replacing turf with plants native to the Chesapeake Bay region), and both trash prevention and cleanup.

Figure 6-2. "Why Scoop That Poop" dog park sign, Prince George's County.

Pet Waste Outreach Conducted by Trusted Partners

There are several organizations or trusted partners in the County that have conducted pet waste education and outreach. For example, the University of Maryland and Sustainable Maryland received a $135,000 grant (2017) to develop and implement a pet waste education campaign for the College Park, Riverdale Park, Capitol Heights, Edmonston, Brentwood, and Greenbelt communities in the County. In addition, the University received another $100,000 grant (2018) to conduct pet waste education for the communities of Capitol Heights, Colmar Manor, Seat Pleasant, Berwyn Heights, Forest Heights, Glenarden, and Hyattsville.

Before 2017, the University of Maryland and Sustainable Maryland supported the County in hosting three Pet Waste Management Summits between 2016 and 2019. The summits were attended by County elected officials, municipal staff, and residents to learn more about pet waste management and how they can incorporate pet waste best management practices into their overall sustainability initiatives. Attendees also learned about the County's Pet Waste Campaign and resources available to start their own local pet waste management program.

The People for Change Coalition (PCC) was awarded grants in 2017 to install pet waste disposal stations and promote awareness of the problems that pet waste can cause in Kettering, Glendale/Lanham, and Largo Town Homes homeowner associations. These grants were funded through the County's Stormwater Stewardship Grant by the Chesapeake Bay Trust (CBT). The Stormwater Stewardship Grant provides funds for on-the-ground restoration activities that improve neighborhoods, improve water quality, and engage County residents in the restoration and protection of the local rivers and streams.

PCC also hosted a "Scoop da Poop" Town Hall for residents at the Kentland Community Center in June 2017. The event was attended by homeowner associations, businesses, community leaders, nonprofits, and residents who learned why pet waste is a concern, current pet waste laws, and how they can get pet waste stations installed in their communities. PCC could partner again with the County to conduct similar events at a local schools or community centers.

Pet Waste Disposal Stations and Dog Parks

The County has installed more than 200 pet waste disposal stations and numerous dog leash dispensers have been handed out (Figure 6-3). EFC, along with funding from the CBT, assisted these communities to implement local pet waste awareness programs and install the pet waste disposal stations: Bladensburg, Brentwood, Cottage City, District Heights, Edmonston, and Landover Hills. EFC has engaged 30 unique communities in these municipalities through events geared toward identifying goals related to pet waste and stormwater management. They have also adapted the County's English outreach education material into Spanish.

Figure 6-3. Pet waste disposal station encourages residents to pick-up and dispose of pet waste.

6.1.2. Additional Outreach to Support Implementation Activities

The County's outreach efforts continue to specifically target TMDL pollutants and pollutant-generating behaviors. Over the past several years, SD has sponsored the following activities and projects:

- ***Inventory of Environmental Outreach Programs in and around Prince George's County.*** SD inventoried existing local programs (e.g., nonprofits and educational) working toward shared goals of environmental stewardship or stormwater pollution reduction and that already have ongoing or planned outreach efforts in and around the County. This inventory identifies potential outside partners and overlapping programs/efforts. SD researched which types of programs and materials have been successful and are available to share and cross-market to target audiences.
- ***Audience Research Analysis.*** The County is made up of a diverse population in terms of age, race, culture, language, education, and income. As a result, SD analyzed U.S. Census data and secondary research to gain an understanding of the potential target audiences and their specific characteristics as well as possible barriers to environmental messages (e.g., lack of homeownership, native language, age, and household economics). This analysis helped determine the best way to reach diverse groups and identify different messaging and methods that would resonate with target audiences.
- ***Prince George's County Stormwater Outreach and Engagement Strategies.*** SD developed seven individual campaign strategies: pet waste disposal, increasing the tree canopy, stormwater management and implementation, anti-littering, lawn stewardship,

household hazardous waste, and residential car care. Each campaign included goals, target audiences, priority locations, key messages, delivery techniques (e.g., events, materials, trainings, social media, and developing / promoting programs), metrics, potential partnerships, and priority neighborhoods. The campaigns also included slogans and messages on what citizens should be doing (e.g., using fertilizer only if soil tests dictate a need) and not be doing (e.g., spilling fertilizer on driveways). SD is using these outreach and engagement strategies to plan and implement programs, events, and other efforts to encourage residents to adopt pollutant-reducing behaviors.

- ***Enhancing and Growing Partnerships.*** The County's numerous partnerships with groups such as USDA Extension Master Gardeners, CBT, and the University of Maryland EFC continue to be fostered and supported so that outreach efforts piggybacking on the efforts undertaken by those groups can continue to grow. In addition, new partnerships with groups such as landscapers, nursery suppliers, HOAs, and local Scout troops help broaden stormwater outreach and reach citizens who have not been reached in the past.

Although results of outreach and involvement efforts are difficult to quantify in terms of pollutant reductions, these activities make a difference by slowly changing the mindsets and behaviors of County residents over time.

6.1.3. Animal Services Division Programs

DoE's Animal Services Division (ASD) administers programs for animal control, animal licensing, vaccination, spaying and neutering, public education, cruelty prevention, euthanasia, and other programs (Figure 6-4). They will continue with its current programs, including adoption events, spay and neuter clinics, and public education events. Spaying and neutering as well as pet adoptions can keep animals from becoming strays, thus reducing the amount of animal waste that is not properly disposed of. The division keeps detailed records on the number and types of licensed animals in the County, as well as statistics related to the stray animal population. This information can help determine if the overall stray population is decreasing. ASD is also responsible for removing deceased animals from roadways. This prevents bacteria from the decomposing animals from entering the stormwater network and additional waste from animals attracted to the deceased animals.

Figure 6-4. Example social media post from the Anmal Services Division.

6.2. Sanitary Wastewater Related Activities

6.2.1. Illicit Connection

DoE's Stormwater Management Division's Inspection and Compliance Section receives illicit discharge/water quality complaint referrals through several avenues:

- County's Customer Call Center 311 system,

- E-mails from State and local government agencies,
- Correspondences from the director's office, and
- Direct phone calls or e-mails from County residents.

To expedite a County response to those complaints, DoE staff immediately refers the investigation and corrective action to WSSC if sanitary wastewater is suspected of being the source of the illicit discharge.

6.2.2. Sewer Repair and Rehabilitation

One source of the nutrients and bacteria found in stormwater is aging sewer systems. Many sewer pipes in the region were constructed in the 1940s and 1950s. The County is also experiencing SSOs. WSSC is under a 2005 consent decree with the EPA to overhaul its sewer lines to reduce SSOs under their SR3 Program to upgrade the sewer systems. The largest factor in SSOs in sewer pipe blockages (e.g., debris, grease, roots). The single most effective measure to reduce SSOs is to repair and rehabilitate existing sewer lines. The SR3 Program includes sewer pipe lining or replacement, manhole replacement, and protecting exposed pipes and manholes. Additional methods to reduce potential sewage from entering in County waterways include eliminating cross-connections and both pump station repairs and upgrades.

WSSC coordinates with the County on all sewer repairs and rehabilitation. WSSC

- Provides the County daily sewer and water line breaks and estimates of the discharge flows from broken systems.
- Coordinates with the County major sewer line repairs or replacements.
- Coordinates with the County on wastewater plant upgrades.

WSSC is working with the Restaurant Association of Maryland and other agencies on educating food service establishments for the best ways for disposing of fats, oils, and grease to help reduce SSOs due to blockages. As part of this disposal guidance, WSSC conducts inspections for food service establishments (e.g., restaurants/kitchens serving the public, cafeterias, hotel, grocery stores).

The improvements to leaky sewer lines could dramatically reduce human bacteria loads. An aggressive program to also discover and eliminate cross-connections could also substantially reduce human bacteria loads. The County has a program to detect illicit discharges into the County's stormwater system, including discovery and elimination of cross-connections.

6.2.3. Onsite Sewage Disposal System Repair and Replacement

The Prince George's County Health Department responds to complaints about sanitary sewer overflows, failing and malfunctioning OSDSs that may impact the waters of the State. Bacteria loads from failing OSDSs are not part of the County's stormwater MS4 responsibilities; however, upgrading septic systems or connecting houses to a sanitary sewer system could lower the number of bacteria entering County streams. Typical solutions are connecting to sanitary sewers, maintaining septic systems to ensure proper operation, or replacing failing septic systems with BAT system.

The County's stormwater BMP database contains more than 800 records of septic connections and 75 advanced denitrification systems as of June 30, 2022.

Using Chesapeake Bay Restoration Fund grants, the Health Department plans to continue replacing failing septic systems in critical areas (within 1,000 feet of tidal waters) based on available funding and eligibility. Failing systems inside critical areas are prioritized.

The Health Department provides the following septic system activities for County residents:

- Percolation tests to determine soil suitability for individual sewage disposal systems.
- Review of septic system plans, issue septic system permits for
  - replacement of failing septic systems, and
  - conventional septic systems in new construction.
- Inspection of well and septic system construction in existing homes.
- Disbursement of funds from the State's Chesapeake Bay Restoration Fund for the installation of BAT nitrogen-reducing septic tanks or connection to the public sewer.
- Site evaluations for the potential installation of innovative and alternative septic systems where conventional septic systems will not work.
- Inspection and licensing of septage haulers to operate in the County.
- Evaluation of septic systems and wells for the operation of new foster care homes, adult and childcare facilities, camps, schools, and other institutional facilities.
- Sanitary water and sewer surveys in problem areas in conjunction with WSSC.

6.3. MS4 Program Activities

6.3.1. Illicit Discharge Detection and Elimination

The County uses the full enforcement authority authorized by the County Code to investigate and eliminate illicit discharges. The County Code assigns the authority and responsibility for responding to and eliminating illicit discharges by type, activity, or location. For instance, enforcement actions associated with violations involving the improper storage of materials and/or dumping on private property are governed under the zoning ordinance, and both housing and property codes.

DoE's Stormwater Management Division's Inspection and Compliance Section receives illicit discharge/water quality complaint referrals through the County's Customer Call Center 311 system, through e-mails from State and local government agencies, through correspondences from the director's office, and through direct phone calls or e-mails from County residents. DoE also maintains close communications with environmental organizations throughout the County. Site investigations are performed on all incoming complaints except for complaints that clearly fall within the purview of another agency. To expedite a County response to those complaints, DoE staff immediately refers the investigation and corrective action, if warranted, to the responsible agency.

6.3.2. Street Sweeping and Storm Drain Maintenance

The County conducts street sweeping operations on select arterial, collector, and industrial roadways. Residential subdivisions are swept on a request-only basis. Street sweeping captures debris, including sediment and associated bacteria that reaches waterways. Street sweeping falls under MDE's identified programmatic practices for pollution reduction that can provide water quality benefits. Areas of high impervious cover have also been positively correlated with higher bacteria concentrations by Luckenbach et al, 2008, Mallin et al., 2001, Paule-Mercado et al., 2016, and Selvakumar & Borst, 2006. Bacteria could breed in street gutters and storm drains due to moist conditions and organic material (MPCA 2022).

Storm drain maintenance is typically targeted in two focus areas: the 21 communities annually served by the Comprehensive Community Cleanup Program and in response to citizen complaints for clogged and malfunctioning systems.

6.3.3. Litter Control and Illegal Dumping

Urban litter is noted by EPA 2001 and Armand Ruby Consulting 2011 as a source of pathogens. The County conducted several countywide trash reductions, litter reduction, and recycling programs. Specifically, the County continued several measures, including continuing its Adopt-A-Stream program, using the PGCLitterTRAK mobile app tracking tool, involving communities and municipalities in the Clean Sweep Initiative in the Anacostia watershed, and continuing the County's trash trap projects (Figure 6-5).

The County maintains an aggressive litter control and collection program along County maintained roadways. The litter service schedule is based on historical collection data; therefore, the most highly littered roadways are serviced as often as 24 times per year. In general, major collector and arterial urban roadways are serviced weekly with rural roadsides served at least once per month. In FY2024, the Growing Green with Pride activities resulted in the removal of an estimated 24.5 tons of litter and illegal dumping from communities across Prince George's County in FY 2024. Roadside Litter Removal contractors removed 392,850 pounds of trash and 772 discarded tires (DoE 2024a).

The County receives requests for removal of litter and illegal dumping through the County's 311 system. Illegal dumping in the right-of-way is removed within five working days of notification. Illegal dumping on public property is the responsibility of the Department of Public Works and Transportation (DPW&T). Enforcement actions associated with violations involving the improper storage of materials and/or dumping on private property are the responsibility of the Department of Permitting, Inspections, and Enforcement (DPIE) as authorized under the Zoning Ordinance, Housing and Property Codes.

Figure 6-5. Example social media post for litter control.

6.4. Other Activities

6.4.1. Household and Commercial Waste Disposal Measures

Additional potential sources of bacteria include leakages from trash cans, dumpsters, and garbage trucks containing diapers (as well as pet waste); boat and recreational vehicle discharges; and secondary sources such as pool and hot tub discharges. Measures to eliminate these sources include these recommendations:

- Covering dumpsters at location to prevent rain from entering containers and trash from blowing out due to wind.
- Implementing programs or measures to eliminate leaks from garbage trucks (see Section 3.2.4).
- Conducting public education regarding covering private trash cans to prevent leaks and to prevent nuisance wildlife from using the trash as a food source.
- Enforcing programs for waste management on boats and RVs.

6.4.2. Urban Wildlife Waste

Urban wildlife includes deer, rats, raccoons, geese, ducks, pigeons, and other smaller mammals and birds. The bacteria and nutrient loads from those sources are not highly controllable and not directly related to the County's stormwater MS4 implementation goals for bacteria but some practices can help reduce wildlife loadings to a small extent.

Rats and other opportunistic feeders present potential health issues for County residents in the form of bacteria, parasites, and other health issues (e.g., fleas, ticks). Reducing the amount of litter will help control these potential bacteria sources. Over time, the number of nuisance wildlife should decline and not only reduce bacteria and nutrient loading, but also potentially improve community health.

M-NCPPC, in partnership with the MD DNR, allows for regulated public deer hunting at five parks in the County to help control the population. These parks are Aquasco Farm Cooperative Wildlife Management Area (CWMA), Gardner Road Park CWMA, Patuxent River Park - Billingsley CWMA, Queen Anne Bridge Road CWMA, and Marlboro Natural Area CWMA.

6.5. Summary of County Source Control Management Actions

Table 6-1 presents the County's overall bacteria implementation strategies.

Table 6-1. County source control management actions.

Source / Responsible Entity	Strategy	How	Measure	Timeline
Pet waste / DoE SD	Prevent pet waste from reaching waterways	Conduct public education and outreach through events and social media	Number of events. Number of posts.	Ongoing
Pet waste / DoE SD	Prevent pet waste from reaching waterways	Erect signage and provide dog waste stations in common areas and parks	Number of stations installed	Ongoing

Source / Responsible Entity	Strategy	How	Measure	Timeline
Pet waste / DoE SD	Prevent pet waste from reaching waterways	Develop pet waste guidebook for residents	Finalized document	Ongoing
Pet waste / DoE ASD	Prevent pet waste from reaching waterways	Spay and neuter clinics	Number of events	Ongoing
Sanitary sewer repair / WSSC	Reduce sanitary wastewater from entering MS4 or waterbodies	Respond to reports of sewer breaks and illicit connections. Perform sanitary sewer repairs. Eliminate of SSOs.	Number of linear feet of sewer repair. Number of other features (e.g., pump stations) repairs or replaced. (If received from WSSC)	Ongoing
Failing septic systems / Department of Health	Ensure repair of failing systems	Respond to reports of failing systems & work with homeowner to set a timeline for repair	Number of reports and upgraded septic tanks.	Ongoing
Illicit discharges / DoE SMD	Reduce/ eliminate illicit discharges	Respond to reports of potential illicit discharges. Work with property owners, businesses, utilities, or agencies responsible for discharge to eliminate.	Number of events investigated and outcomes	Ongoing
Street sweeping / DPW&T	Remove bacteria hosts prior to entrance to MS4 and waterbodies	Perform routine street sweeping on County roads	Number of miles swept and pounds removed	Ongoing
Litter control / DoE SD	Reduce litter as potential source of bacteria	Conduct public education and outreach through events and social media	Number of events. Number of posts.	Ongoing
Litter collection / DPW&T	Reduce litter as potential source of bacteria	Routine litter collection along County-maintained roads.	Pounds of litter.	Ongoing
Illegal dumping / DPW&T, DPIE	Remove illegal dumping materials as potential bacteria source and attractant of vermin	Respond to resident reports via the County 311 system	Number of illegal dumping sites cleaned up	Ongoing
Bacteria source track down / DoE SMD	ID potential sources to eliminate	GIS analysis of TMDL watersheds	Completed studies	June 2024
Bacteria source track down / DoE SMD	Determine if priority watersheds have elevated bacteria levels	Sample priority watersheds	Number of subwatersheds monitored	Ongoing

Source / Responsible Entity	Strategy	How	Measure	Timeline
Bacteria assessment monitoring / DoE SMD	Monitor watershed with TMDLs	Sample randomized locations in TMDL watersheds at biological sampling locations	Number of samples collected	Ongoing
Bacteria permit monitoring / DoE SMD	Monitor watershed with TMDLs	Perform monthly monitoring at fixed locations in TMDL watersheds	Number of samples collected	Ongoing

Source: Adopted from Appendix D in Oregon DEQ 2007.
Notes: Column header definitions:

- **Source:** Bacteria sources and responsible entity?
- **Strategy:** Source control management strategy to reduce and/or control bacteria from source.
- **How:** Steps to conduct source control management strategy.
- **Measure:** How will you quantitatively or qualitatively demonstrate successful implementation or completion of this strategy?
- **Timeline:** Expected completion timeline.

7. Adaptive Approach and Reporting

To control stormwater discharges and reduce associated pollutant loadings to the maximum extent practicable (MEP), the County is required by its MS4 permit to:

> …to promote a comprehensive adaptive approach toward solving stormwater discharge water quality problems (MDE 2022a).

It will be important for the County, MDE, and watershed partners to work together to ensure successful ongoing implementation. This document was developed using the best information available at the time the plan was developed. As implementation progresses, an adaptive management approach allows for adjustments to restoration activities as new information becomes available from the state or different stakeholders. Additionally, an adaptive management approach can help leverage opportunities to increase effectiveness and often reduce costs. The County will use new information as it becomes available to assess the effectiveness of its restoration program and adjust as needed.

Close coordination is especially valuable for adaptive solutions because of the possibility of unanticipated circumstances arising during bacteria trackdown and reduction activities. For example, pet waste education campaigns depend on changing public behavior; human behavior change takes time, often resulting in slower progress towards meeting water quality criteria. The adaptive process will need to acknowledge the causes of lag—human behavior across time, for example—in implementation. Further, adaptive management allows for ongoing addressing of those causes or otherwise proposing additional water quality remediation activities to compensate for the lag.

The County will evaluate the progress during its next permit cycle following this adaptive approach. The evaluation will take advantage of experience with new programmatic initiatives and more recent water quality data. The evaluation could provide the County with the opportunity to remove practices from consideration that are expensive and show no water quality improvement. For this WIP, adaptation will involve ongoing monitoring, evaluating applied strategies, assessing progress, and incorporating any useful new knowledge into further restoration activities.

Several aspects of this strategy support the use of adaptive approach:

- The County will use adaptive approach to evaluate the most appropriate restoration practices at the best locations. This means that the County will look across land uses to determine where programmatic efforts will be most cost-effective in achieving pollutant load reductions. The County reserves the right to use alternative management activities if the opportunity arises and if the alternative practices will produce benefit at a lower cost.
- Using water quality monitoring results, DoE can adjust implementation priorities and target areas of high bacteria concentrations. A lack of positive response will be taken as evidence that additional or more intensive source reduction is necessary to achieve a meaningful bacteria load reduction.

At the end of each 5-year NPDES permit term, the County will assess the effectiveness of the strategies and the impact they have on the TMDL goals and recommend adjustments to the plan for MDE review. This could include changing implementation strategies that may not be yielding results and redirecting funding to strategies that are demonstrated to be more effective.

Overall success of the strategy will depend on the concerted effort of the County and many regional agencies, municipalities, community leaders, and local landowners. Each partner (e.g., federal, state, or local government; nonprofit; business owner; or private landowner) has an important role to play in the restoration process. The proposed management actions will require significant time and resources from all those entities. Technical assistance and other in-kind support from the watershed partners and the public will be important in implementing the plan. That support will be especially important in addressing impediments to implementing the plan that include permitting challenges, technological limitations to monitoring and attribution, and a lack of BMPs that can control bacteria loading.

7.1. Strategy Review and Annual Reporting

The County, required by its MS4 permit for all TMDLs and WLA,

> … shall annually document, in one Countywide Stormwater TMDL Implementation Plan, updated progress toward meeting these TMDL WLAs. (Part IV.F.3);

And as per Part V.A of the permit, the County shall submit

> Annual progress reports, required under 40 CFR §122.42(c), will facilitate the long-term assessment of Prince George's County's NPDES stormwater program.

As specified in the County's permit, this annual progress report includes information about the countywide stormwater TMDL implementation plan, IDDE, trash and litter control measures, public outreach and education initiatives, and watershed assessments, among others. The MS4 permit is the chief vehicle for tracking and reporting on programmatic initiatives.

This County MS4 permit also is the chief vehicle for tracking and reporting WIP implementation. The completed annual progress reports and appendices are and will be posted on DoE's stormwater management website.[4]

The County's MS4 permit sets implementation goals for the permit period in terms of impervious acres treated over the 5-year permit term. To assess compliance with its permit, the County has a process to track and report IDDE activities as well as public outreach and education events and activities. The County also conducts BMP effectiveness monitoring and watershed assessment monitoring.

7.2. Reporting Schedule

The MDE 2022 bacteria WIP guidance does not require timeframes and milestones such as those for nutrient and sediment TMDLs. However, the guidelines do require a progress reporting schedule, focused on staged source tracking and planning. The County will follow the reporting schedule identified in the 2022 bacteria guidance, which is summarized in this section:

[4] https://www.princegeorgescountymd.gov/293/NPDES-MS4-Permit. Accessed June 2022.

7.2.1. Source Tracking and Planning

Year 1 (by December 1, 2023)

- WIP (this document) including the following:
  - Source tracking / using water quality datasets to identify potential sources.
  - Developing general and specific strategies for eliminating or remediating these sources.
  - Using monitoring / analysis strategies for identifying new sources, confirming existing sources, assessing trends, and evaluating impairment status.
  - Keeping a matrix/table summarizing (such as Table 7-1) various sources of fecal bacteria and remediation strategies for these sources.

Year 3 (by December 1, 2025)

- Implementing a geospatial data package including information and accompanied by data referenced in Section 3 of this document.

Year 4 (by December 1, 2026)

- Updating the data package from Year 3 submission.
- Using one advanced spatial analysis using the spatial data submission from Year 3 submission.

Year 5 (by December 1, 2027)

- Updating the data package from Year 3 submission.

7.2.2. Annual Progress MS4 Report

- Providing, starting in Year 2 of the permit, updates on bacteria WIP activities in a reporting matrix (Table 7-1). Activities will also be reported spatially in the annual MS4 geodatabase submission, described above.
- Summarizing of monitoring data.
- Reporting monitoring data reported in the annual MS4 report submission in specified spreadsheet format.

Table 7-1. Example reporting TMDL implementation matrix.

Source / Responsible Entity	Strategy	How	Measure	Timeline	Status
Pet waste / DoE SD	Prevent pet waste from reaching waterways	Conduct public education and outreach through events and social media	Number of events. Number of posts.	Ongoing	
Pet waste / DoE SD	Prevent pet waste from reaching waterways	Erect signage and provide dog waste stations in common areas and parks	Number of stations installed	Ongoing	
Pet waste / DoE SD	Prevent pet waste from reaching waterways	Develop pet waste guidebook for residents	Finalized document	Ongoing	

Source / Responsible Entity	Strategy	How	Measure	Timeline	Status
Pet waste / DoE ASD	Prevent pet waste from reaching waterways	Spay and neuter clinics	Number of events	Ongoing	
Sanitary sewer repair / WSSC	Reduce sanitary wastewater from entering MS4 or waterbodies	Respond to reports of sewer breaks and illicit connections. Perform sanitary sewer repairs. Eliminate of SSOs.	Number of linear feet of sewer repair. Number of other features (e.g., pump stations) repairs or replaced.	Ongoing	
Failing septic systems / Department of Health	Ensure repair of failing systems	Respond to reports of failing systems & work with homeowner to set a timeline for repair	Number of reports and upgraded septic tanks.	Ongoing	
Illicit discharges / DoE SMD	Reduce/ eliminate illicit discharges	Respond to reports of potential illicit discharges. Work with property owners, businesses, utilities, or agencies responsible for discharge to eliminate.	Number of events investigated and outcomes	Ongoing	
Street sweeping / DPW&T	Remove bacteria hosts prior to entrance to MS4 and waterbodies	Perform routine street sweeping on County roads	Number of miles swept and pounds removed.	Ongoing	
Litter control / DoE SD	Reduce litter as potential source of bacteria	Conduct public education and outreach through events and social media	Number of events. Number of posts.	Ongoing	
Litter collection / DPW&T	Reduce litter as potential source of bacteria	Routine litter collection along County-maintained roads.	Pounds of litter.	Ongoing	
Illegal dumping / DPW&T, DPIE	Remove illegal dumping materials as potential bacteria source and attractant of vermin	Respond to resident reports via the County 311 system	Number of illegal dumping sites cleaned up	Ongoing	
Bacteria source track down / DoE SMD	ID potential sources to eliminate	GIS analysis of TMDL watersheds	Completed studies	June 2024	Complete. Revised February 2025 after MDE comment.

Source / Responsible Entity	Strategy	How	Measure	Timeline	Status
Bacteria source track down / DoE SMD	Determine if priority watersheds have elevated bacteria levels	Sample priority watersheds	Number of subwatersheds monitored	Ongoing	
Bacteria assessment monitoring / DoE SMD	Monitor watershed with TMDLs	Sample randomized locations in TMDL watersheds at biological sampling locations	Number of samples collected	Ongoing	
Bacteria permit monitoring / DoE SMD	Monitor watershed with TMDLs	Perform monthly monitoring at fixed locations in TMDL watersheds	Number of samples collected	Ongoing	

Source: Adopted from Appendix D in Oregon DEQ 2007
Notes: Column header definitions:

- **Source:** Bacteria sources and responsible entity?
- **Strategy:** Source control management strategy to reduce and/or control bacteria from source.
- **How:** Steps to conduct source control management strategy.
- **Measure:** How will you quantitatively or qualitatively demonstrate successful implementation or completion of this strategy?
- **Timeline:** Expected completion timeline.
- **Status:** Current status of the strategy.

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Appendix A: Regional Field Screening Methods

MDE's 2022 guidance includes several bacteria plans as appendices, which are summarized in this appendix. They include:

- City of Baltimore's 2020 guidance document for source identification,
- ShoreRivers 2020 bacterial monitoring program,
- Anne Arundel County's 2020 watershed and site selection guide,
- University of Maryland Center for Environmental Science's (UMCES's) Tracer Outline provided by Dr. Michael Gonsior, and
- Florida Department of the Environment (DEP) 2018 document, "Restoring Bacteria-Impaired Waters. A Toolkit to Help Local Stakeholders Identify and Eliminate Potential Pathogen Problems," Version 3.

City of Baltimore's Field Screening Methods for Illicit Discharges of Bacteria

The City of Baltimore briefly describes its program for illicit discharge detection using ammonia as a screening parameter at outfalls and streams. Ammonia is used to track human based sources such as sewage cross-connections (municipal wastewater) and sewage infiltration. When high ammonia concentrations—usually greater or equal to 0.3 mg/L—cannot be traced to a sewage source, a sample is analyzed and if enterococcus are detected at or above 1,500 MPN/100 mL, then sewage is considered the cause. This screening level is specific to the City and not based on Maryland water quality standards or permit requirements.

If ammonia and bacteria concentrations indicate sewage but source tracking (e.g., dye testing, field reconnaissance, historic maps, CCTV of pipes) was unsuccessful in pinpointing the source, bacteria DNA analysis from outfall or in-stream samples was then used to look for human and canine indicators and a percent sewage equivalent, against reference sites with no sewage discharges.

ShoreRivers Swimmable Bacteria Monitoring Program

This document provides a brief explanation of this organization's use of the EPA protocol for water quality testing for enterococcus at popular swimming locations. The document then describes their methodology for site selection, which is based on swimmer/public safety, as opposed to WIP development.

Anne Arundel County Bacteria Monitoring - Watershed And Site Selection

This one-page document summarizes the county's bacteria TMDLs and its approach to identifying monitoring locations. The six locations per watershed are based on (1) cost, (2) ability of field crew to collect samples and transfer samples to lab within holding time, and (3) ability to potentially identify distinct geographic locations contributing to bacteria loads (also known as *hotspots*).

In each watershed, the most downstream monitoring site would be the MDE monitoring site used to establish the TMDL. A simple desktop analysis of each watershed is then used to determine the other five sites in each watershed, which were designed to allow for potential identification of source hotspots and/or potential identification of land use differences in bacteria contribution.

UMCES Bacteria Tracer Outline

This informal document was created for MDE by Dr. Michael Gonsior, professor at the University of Maryland Center for Environmental Science (UMCES) and trained as an analytical biogeochemist. This document lists domestic wastewater tracers, concerns about common tracers, and options for using alternate tracers to identify human sewage. These substitute traces include sweeteners (e.g., sucralose), Acesulfame-K, and both prescription medical drugs (e.g., the antibiotic sulfamethoxazole, the anticonvulsant carbamazepine) and over-the-counter drugs (e.g., ibuprofen, acetaminophen, diclofenac, caffein and its metabolite paraxanthine).

Gonsior suggests that high *E. coli* without the presence of sucralose would be a good indicator for non-human animal waste, and where tracers are not providing a clear source, genetic microbial source tracking could be used albeit at a higher cost.

Florida DEP Restoring Bacteria-Impaired Waters

This document (Florida DEP 2018) was created to help local stakeholders identify and eliminate pathogen sources in surface waters, specifically fecal bacteria, to protect public health. The DEP guidance is intended for MS4 Phase I coordinators and other local leaders working on developing and implementing restoration plans.

Florida DEP outlined an eight-step approach that includes questioning existing data, using qPCR microbial source tracking to make sure control efforts are focused on untreated human waste, and the addition of the chemical tracers (i.e., acetaminophen, naproxen, and ibuprofen) because they indicate untreated waste when present in waterbodies and stormwater. They encouraged monthly monitoring to get a sense for local low and high concentrations and local trends and how to determine if intensive source-specific monitoring is required.

The guidance explains how to prioritize waterbodies or stream segments by calculating median exceedances and an exceedance frequency score. In addition to current prioritization, the document also emphasizes using historical data to guide future sampling strategies, identify hot spots, and look for correlations to rainfall and seasonality, including seasonal differences in how the waterbody is used.

The document covers how to select bacteria sampling locations at the watershed with such care as parcel scale in how to avoid disturbing biofilms, which may inflate results. The technical guidance discusses how to interpret qPCR results, as well as water analysis details like persistence in the environment, resuspension ability and dissolvability of tracers.

DEP then cover different types of discharge detection and differentiation techniques including MST, dye testing, smoke testing, CCTV, thermal imaging cameras, optical brighteners, the use of beach surveys, wildlife surveys, and even using sewage sniffing dogs.

DEP recommends evaluating new bacteria data as soon as possible and having your lab provide preliminary results if results appear to range in the hundreds of thousands to trigger immediate follow-up actions and source tracking. More generally, the approach strongly encourages that all disparate stakeholders (public works, utility, inspectors, and other field staff) use maps to point out potential hotpots and then do a field walk as a group.

The third chapter of this DEP guidance covers the possible management actions from structural such as wet ponds, swales, and improved septic systems to non-structural such as improved inspection and maintenance of sewage lift stations, septic systems, regularly scheduled IDDE, social marketing, stronger local ordinances to achieve FIB reductions such as pet waste and septic ordinances and more frequent communication across agency-stakeholders among others.

Appendix B: Public Involvement to Support Implementation Activities

The County recognizes the importance to the success of its stormwater management efforts of involving the public in planning and implementing the restoration process. This recognition means that the County welcomes any ideas citizens have to improve the process. People who live and work in the watersheds are most familiar with these natural features. They can act as the eyes and ears of the County on a day-to-day basis to identify water quality issues, pollutant spills, or potential BMP opportunities. Residents can stay informed on the County's progress through the annual MS4 report to MDE, which is posted on the County's website and contains information on BMP implementation, public outreach events, and other County programs that can help meet TMDL goals. In addition, the County welcomes public input on restoration activities and potential BMP types or locations.

Besides staying informed, homeowners, nonprofit organizations, and business associations can play a more active role in the restoration process. Residents can take a pledge to clean up after their pets and practice environmentally friendly lawn care. In addition, the public can participate in the Rain Check Rebate and Tree ReLEAF Grant Programs. Local nonprofits can participate in the Alternative Compliance Program. Private landowners and nonprofit organizations can aid in restoring the watersheds by installing BMPs (e.g., rain barrels, rain gardens, and permeable pavement) on their properties to help minimize their impact on the overall pollution loading to the County's water bodies. One motivation for installing BMPs on private property reduces the owner's CWA Fee. Although those practices might seem insignificant, the overall load reductions can be significant if enough private landowners get involved. Organizations such as HOAs, neighborhood associations, and business organizations can also help by promoting the programmatic initiatives outlined in this restoration plan.

Community organizations and citizens groups can participate in restoration activities by getting involved in local nonprofit groups with which the County is currently partnering. This section lists ways County residents and organizations can stay informed and help promote pollutant-reducing behaviors. These activities will also reduce the demand on the County's resources and staff's limited time.

- **Learn about County programs that promote tree plantings, cleanup events, and community awareness**. DoE SD manages numerous programs in which citizens can get involved and promote pollutant-reducing behaviors. Residents can either organize or participate in volunteer efforts by working with their civic associations or schools, or one-on-one with property owners. The public can visit the Community Outreach web page at https://www.princegeorgescountymd.gov/351/Community-Outreach for more information on DoE SD programs and how to contact the County. Other volunteer programs included the following:
  - **Volunteer Neighborhood Cleanup Program** provides interested communities with technical assistance and materials such as trash bags, gloves, and roll-off containers (depending on availability). The public can visit the website at

https://www.princegeorgescountymd.gov/464/Volunteer-Neighborhood-Cleanup-Program.

  - **Volunteer Storm Drain Stenciling Program** helps spread the word to prevent water pollution by stenciling/inlet marking the storm drains in neighborhoods with "Don't Dump - Chesapeake Bay Drainage." Stenciling serves as a visual reminder to neighbors that anything dumped in the storm drain contaminates the Chesapeake Bay. DoE SD provides the supplies and helps design a storm drain stenciling/inlet marking project that can be accomplished with any size team or age group at https://www.princegeorgescountymd.gov/465/Volunteer-Storm-Drain-Stenciling-Program.

- **Apply for CBT grants to implement projects**. The public can find more information about the CBT grants at https://cbtrust.org/grants/.
  - **Prince George's County Rain Check Rebate:** Rebate incentives to install practices that will improve stormwater runoff quality.
  - **Prince George's County Stormwater Stewardship:** Funds restoration activities that engage community members in improving water quality.
- **Litter Reduction and Citizen Engagement Mini Grants** support efforts that engage and educate residents, students, and businesses on ways to make their communities cleaner and greener. Up to $2,500 can be awarded to HOAs and nonprofits to develop and implement projects such as community cleanups, "Adopt-a-Stream" projects to remove litter from a local stream, and storm drain stenciling.
- **Stay informed** on local watershed news. The County provides numerous ways for residents to stay informed about community events, trainings, emergencies, and County news:
  - **Monitor the County's social media accounts** to become aware of trainings and community events that promote environmental education and include opportunities to provide feedback to the County. See the County's accounts at Facebook (PGC Department of the Environment), Twitter (PGC Environment @PGCsprout), and Instagram (pgcsprout).
  - **Monitor the County's website** to view information about upcoming events, meetings, recent news, and details about the County's programs at https://www.princegeorgescountymd.gov/.
  - **Sign up to receive "Alert Prince George's"** to receive emergency alerts, notifications, and updates to registered devices. Example notifications include traffic conditions, government closures, public safety incidents, and severe weather. More information is available at http://www.princegeorgescountymd.gov/794/Alert-Prince-Georges.
  - **View the Clean Water Map,** an interactive tool to help the community stay informed about the health of County waters and know where restoration efforts are taking place. Residents can view BMPs, BMP drainage areas, and locations of activities such as Rain Check Rebates and Stormwater Stewardship Grants at https://princegeorges.maps.arcgis.com/apps/webappviewer/index.html?id=dc168a43d3554905b4e4d6e61799025f.

- **Provide feedback**. The County heard through numerous outreach and engagement events that several citizens and watershed groups want to work with the County on clean water protection. This partnership would allow residents to provide information and feedback about on-the-ground support for BMP implementation projects, programmatic initiatives, and other outreach efforts to support implementation. Ways to provide this feedback include the following:
  - **Attend a public involvement meeting.** The County holds public outreach and involvement meetings as part of restoration planning efforts and other programs. The County also welcomes suggestions on potential BMP types or locations so that the County can help communities identify and install the best BMPs for specific areas.
  - **Use County Click 3-1-1**, a call center (available weekdays 7 a.m. to 7 p.m.) and a website application (download CountyClick311Mobile) that allows County residents to request services or report problems. This tool could be used to report on visual inspections of installed BMPs and is available at www.countyclick311.com.
- **Help foster partnerships.** Residents and both civic and environmental groups can work directly with an organization or commercial business that has a significant amount of untreated impervious surface such as large parking lots or a large building footprint. Group members can offer technical assistance and volunteer labor hours to support installation and/or maintenance. Groups can also work with established organizations such as the Alice Ferguson Foundation https://fergusonfoundation.org/ to participate in cleanup events or provide volunteer hours.
- **Become educated through partner trainings and events**. Numerous organizations in Prince George's County are always in need of volunteers. They also provide meaningful education programs in which participants learn about the issues through hands-on educational experiences. Those organizations include the following:
  - **Watershed Stewards Academy** equips and supports community leaders to recognize and address local pollution problems in their nearby streams and rivers. They provide community leaders with the tools and resources they need to bring solutions to those problems, restoring their local waterways and the communities they affect. More information is available at http://extension.umd.edu/watershed/watershed-stewards-academy.
  - **Alice Ferguson Foundation** has training and outreach events to unite students, educators, park rangers, communities, regional organizations, and government agencies throughout the Washington, DC, metropolitan area to promote the environmental sustainability of the Potomac River watershed. More information is available at https://fergusonfoundation.org/.
  - **Anacostia Watershed Society** has numerous educational programs, river restoration programs, and community events. More information is available at https://www.anacostiaws.org/.

Appendix C: Results of Subwatershed Prioritization