South River Sediment TMDL

Documentation of Attainment

September 2018
Anne Arundel County
Department of Public Works
Watershed Protection and Restoration Program
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1 Introduction

1.1 Background and Purpose

The Anne Arundel County Department of Public Works (DPW) Watershed Protection and Restoration Program (WPRP) is required to develop restoration plans to address local water quality impairments for which a Total Maximum Daily Load (TMDL) has been established by the Maryland Department of the Environment (MDE) and approved by the U.S. Environmental Protection Agency (EPA). A TMDL establishes a maximum load of a specific single pollutant or stressor that a waterbody can assimilate and still meet water quality standards for its designated use class.

Under the Federal Clean Water Act (CWA), the State of Maryland is required to assess and report on the quality of waters throughout the state. Where Maryland's water quality standards are not fully met, Section 303(d) requires the state to list these water bodies as impaired waters. States are the required to develop a TMDL for pollutants of concern for the listed impaired waters. The South River watershed has several impaired waters listings in Maryland's Integrated Report of Surface Water Quality [303(d) list and 305(b) Report] including nutrients, sediment, bacteria, PCBs, and chlorides. There are currently four final approved TMDLs within the South River watershed; the Chesapeake Bay TMDL for nutrients approved in 2010, a total suspended solids (TSS; sediment) approved in 2017, a polychlorinated biphenyls (PCB) TMDL approved in 2015 and a bacteria (fecal coliform) TMDL approved in 2005.

The South River watershed lies solely within the boundaries of Anne Arundel County. The responsibility for South River sediment reduction is therefore not shared by other Counties. The TMDL loading targets, or allocations are divided among pollution source categories, which in this case includes non-point sources (termed load allocation or LA) and point sources (termed waste load allocation or WLA). The WLA consists of loads attributable to regulated process water or wastewater treatment and regulated stormwater. For the purposes of the TMDL and consistent with implementation of the National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System Discharge Permit (MS4), stomwater runoff from MS4 areas is considered a point source contribution.

Anne Arundel County's current MS4 permit (11-DO-3316, MD0068306) issued in its final form by the MDE in February 2014 requires development of restoration plans for each stormwater WLA approved by EPA within one year of approval (Permit Section IV.E.2.b). Pursuant to MDE correspondence dated November 17, 2017 when it can be demonstrated through appropriate modeling protocols that the required WLA has been met, a formal restoration plan is not required. **This document presents modeling results that document the attainment of Anne Arundel County's sediment SW-WLA for the South River watershed and satisfies Section IV.E.2.b of the County's NPDES MS4 permit. Further, this document provides a discussion of monitoring approaches to demonstrate that habitat and sediment related stressors are addressed and will continue to be addressed in the South River watershed.**

1.2 TMDL Allocated Loads Summary

This document only addresses loads allocated to Anne Arundel County NPDES regulated stormwater point source sediment. Additional SW-WLAs for the South River watershed assigned to the Maryland State Highways Administration and other NDPES regulated stormwater are not the responsibility of Anne Arundel County and are not addressed in this document.

The South River Non-tidal watershed TMDL requires a 28% reduction of sediment loads from 2009 baseline levels to achieve the target SW-WLA for Anne Arundel County NDPES regulated stormwater.

The TMDL stormwater wasteload allocations for sediment in the Non-tidal South River watershed are presented in Table 1. These allocations are set forth in the technical document *South River Sediment TMDL, Point Source Technical Memorandum (Version: November 2016).* Loads were modeled using the Chesapeake Bay Program Watershed Model Phase 5.3.2 (CBP P5.3.2) watershed model 2009 Progress Scenario Edge of Stream (EOS) sediment loads.

Table 1: South River Sediment TMDL Allocations for NPDES Regulated Stormwater

NPDES Regulated Stormwater Sector	NPDES Permit #	Baseline Load (tons/yr)	WLA (tons/yr)	Reduction (%)
Anne Arundel Co. Phase I MS4	MD0068306	966	699	28
SHA Phase I MS4	MD0068276	88	64	27
"Other NPDES Regulated Stormwater"	N/A	390	288	26
Total		1,444	1,051	27

2 Watershed Characteristics

2.1 Watershed Delineation

The South River is one of 12 major watersheds in Anne Arundel County Maryland. It is situated in the central portion of the County. The watershed is comprised of approximately 36,514 acres and lies entirely within the County. It is bordered on the north by the Severn River watershed, on the west by the Patuxent River watershed and on the south by the Rhode River watershed. The South River drains directly to the Chesapeake Bay.

2.2 Land Cover/Land Cover

Land use distribution in the South River watershed consists primarily forest (56.6%) and urban land (36.5%). A summary of the watershed land use is presented in Table 2.

Table 2: 2017 General Land Use in the South River Watershed

Land Use	Acres	% of Total
Forest	20,681	56.7
Pasture	525	1.4
Crop	1,648	4.5
Regulated Urban	13,340	36.5
Water	306	0.8
Total	**36,514**	**100**

2.3 Impervious Surfaces

There are 4,659.6 acres of impervious cover in the watershed.

2.4. Water Quality

2.4.1 Designated Use

According to water quality standards established by MDE in the Code of Maryland Regulations (COMAR) 26.08.02.08 the Non-Tidal South River watershed is classified as Use I waters which are designated to support water contact recreation, and protection of non-tidal warm water aquatic life. Designated uses for the South River watershed are listed in Table 3.

Table 3: South River Watershed Designated Uses

Designated Uses	South River
Growth and propagation of fish, other aquatic life and wildlife	x
Water contact sports	x
Leisure activities involving direct contact with surface water	x
Fishing	X
Agriculture water supply	X
Industrial water supply	X
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-channel refuge use	
Growth and propagation of trout	
Capable of supporting adult trout for put and take fishery	
Public water supply	

2.4.2 303d Impairments

The South River watershed was originally listed on Maryland's 2002 Integrated Report (IR) as impaired for impacts to biological communities. The biological assessment was based on the combined results of Maryland's Biological Stream Survey (MBSS) Round 1 (1995-1997) and Round 2 (2000-2004) data. The results of the Biological Stressor Identification (BSID) analysis for the South River watershed are presented in a report entitled *Watershed Report for Biological Impairment of the Non-Tidal South River Watershed in Anne Arundel County, Maryland Biological Stressor Identification Analysis Results and Interpretation.* The report states that the degradation of biological communities in the South River watershed is strongly associated with anthropogenic impacts, poor epifaunal substrate, marginal to poor and poor instream habitat structure, no riparian buffer, high chlorides, and low pH. The BSID analysis determined that the biological impairment in the South River watershed is due in part to stressors within the sediment and instream habitat parameter groupings. Since sediment was identified as a stressor to the biological community in the South River watershed, the watershed was listed in Category 5 of the 2016 IR (approved by EPA in 2017) as impaired by sediment and requiring a TMDL. In addition to sediment the South River watershed was identified in Maryland's 2016 IR as having multiple

impairments. The 2016 IR classifies impairments by reporting categories which determine whether the development of a TMDL is required. A description of IR reporting categories are presented in Table 4.

Table 4: Maryland's 2016 Integrated Report Reporting Categories	
Integrated Report Category	**Description**
1	Waters attaining all water quality standards
2	Waters attaining the water quality standard for the single pollutant addressed
3	Insufficient information to determine if water quality standards are being attained
4a	Waters are impaired & have a completed TMDL
4b	Water are impaired but do not require a TMDL a technological solution has been initiated
4c	Waters are impaired but not for a conventional pollutant & do not require a TMDL
5	Waters are impaired and require development of a TMDL

South River watershed impairments identified in the 2016 IR are listed by category in Table 5. Subsequent to issuance of the 2016 IR, in 2017 a Sediment TMDL for the Non-tidal South River was approved. This TMDL, the subject of this Document of Attainment, is noted under Category 4a in Table 5.

Table 5: South River Watershed Impairments				
Category 2				
Assessment Unit	**Designated Use**	**Water Type**	**Impairment**	**Notes**
Broad Creek	Aquatic Life & Wildlife	Non-tidal	Zinc	
Annapolis Landing	Water Contact Sports	Public Beach	Enterococcus	
South River Mesohaline	Fishing	Chesapeake Bay Segment	Mercury in Fish	
Broad Creek	Aquatic Life & Wildlife	Non-tidal	pH	
Broad Creek	Aquatic Life & Wildlife	Non-tidal	Copper	
Broad creek	Aquatic Life & Wildlife	Non-tidal	Lead	
Category 4a				
Assessment Unit	**Designated Use**	**Water Type**	**Impairment**	**Notes**
South River Mesohaline	Fish & Shellfish	Chesapeake Bay Segment	Nitrogen	Ches. Bay TMDL approved 2012
South River Mesohaline	Seasonal SAV	Chesapeake Bay Segment	TSS	Ches. Bay TMDL approved 2012
South River Mesohaline	Fish & Shellfish	Chesapeake Bay Segment	Phosphorus	Ches. Bay TMDL approved 2012
South River Mesohaline	Shellfish Harvesting	Tidal Shellfish Area	Fecal Coliform	Bacteria TMDL approved 2006
Ramsey Lake	Shellfish Harvesting	Tidal Shellfish Area	Fecal Coliform	Bacteria TMDL approved 2006
Duvall Creek	Shellfish Harvesting	Tidal Shellfish Area	Fecal Coliform	Bacteria TMDL approved 2006

South River Mesohaline	Shellfish Harvesting	Tidal Shellfish Area	Fecal Coliform	Bacteria TMDL approved 2006
South River Mesohaline	Fish	Chesapeake Bay Segment	PCB in fish tissue	PCB TMDL approved 2016
Non-tidal South River	Aquatic Life & Wildlife	1st thru 4th Order Streams	TSS	Sediment TMDL approved 2017
Category 4c				
Assessment Unit	**Designated Use**	**Water Type**	**Impairment**	**Notes**
South River	Aquatic Life & Wildlife	1st thru 4th Order Streams	Lack of Riparian Buffer	
Category 5				
Assessment Unit	**Designated Use**	**Water Type**	**Impairment**	**Notes**
South River Mesohaline	Aquatic Life & Wildlife	Chesapeake Bay Segment	Cause Unknown	
South River	Aquatic Life &Wildlife	1st thru 4th Oder Streams	Chlorides	

2.4.3 TMDLs

The South River currently has six approved local TMDLs – four for Fecal Coliform Bacteria (approved 2006), one for PCBs in fish tissue (approved 2016) and one for sediment (approved 2017).

In addition to local TMDLs in the South River watershed, the County must also meet WLAs allocated from the Chesapeake Bay TMDL for Nitrogen, Phosphorus and Sediment (approved 2010). The local sediment TMDL for the South River watershed is more geographically specific that the Bay-wide allocated loads assigned in the Chesapeake Bay TMDL. All load reductions achieved from implementation efforts associated with the local South River sediment TMDL also support the County's Chesapeake Bay TMDL goals.

2.4.4 NPDES Permit

Section 402(p) of the Clean Water Act required the EPA to add Municipal Separate Storm Sewer System (MS4) discharges to the NPDES permit program. In 2002, EPA directed permit writers to include WSA requirements in NPDES permits. Ann Arundel County holds a Phase I MS4 permit (Permit #11-DP-3316, MD0068306) issued by MDE. The County's first permit was in 1993. The current fourth generation permit was issued in February, 2014. The Part IV.E.2.b. of the current permit states "Within one year of permit issuance, Anne Arundel County shall submit to MDE for approval a restoration plan for each stormwater WLA approved by EPA prior to the effective date of the permit. The County shall submit restoration plans for subsequent TMDL WLAs within one year of EPA approval." EPA approved a Sediment TMDL for the Non-tidal South River watershed on September 29, 2017.

3 Modeling Methodology

This section provides a summary of the County's methodology for calculating sediment loads and load reductions including the 2009 baseline, progress through the end of fiscal year 2018, and the required reductions from the 2009 baseline condition. Sediment loads and WLAs are presented as tons/year in the sediment TMDL, but are discussed as pounds/year in this document.

3.1 Loading Sources and Loading Rates

- **2009 Baseline Load:** Baseline levels (i.e., land use loads with baseline BMPs) from 2009 condition in the South River watershed were calculated using a spreadsheet model developed by the County using CAST loading areas, County MS4 jurisdictional land use acreages for loading sources, and CBP P5.3.2 loading rates for loading sources.
- **2018 Progress Loads and Reductions:** Progress loads and load reductions achieved from restoration BMP implementation through June 30, 2018. The 2018 Progress Loads were calculated form the 2009 Baseline Loads by the following calculation: 2009 Baseline – 2018 Progress Reduction.

To calculate the 2009 baseline loads and the 2018 progress loads, the County used a spreadsheet model developed by the County using County land use acreages for loading sources and Chesapeake Bay Watershed Model (CBWM) version 5.3.2 loading rates for loading sources.

Step 1. Determine the loading source areas in the watershed using CAST.

Step 2. Use the following data sources to determine the impervious acreage under the County's MS4 jurisdiction only:

- Public Parcels Layer (created in 2015)
- 2007 County Impervious Layer
- County Watershed Layer

The above analysis resulted in 4,150 acres of imperviousness within the County's MS4 jurisdictional area.

The MS4 Tree Canopy over Turf Grass and Turf Grass load sources combine all non-federal jurisdictions. The MS4 Tree Canopy over Turf Grass and MS4 Turf Grass land uses were summed to get the urban pervious amount. The loading rates listed in Table A.1 in MDE's August 2014 *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* guidance document were used for this analysis. The results of the analysis are summarized in Table 6.

Table 6: Loading Sources and Loads

Load Source	Sediment (lbs)	Loading Rate (lbs/acre)	Acres
Urban Impervious	3,652,000.0	880.0	4,150,0
Urban Pervious	821,850.5	140.0	5,870.4
Total	4,473,850.5		10,020.4

3.2 2009 Baseline Loads

The County's BMP database was used to calculate the sediment loads provided the following information was available for each BMP:

- Drainage Area
- Impervious Area
- BMP Type

After analyzing the BMP data for the South River watershed, some BMPs were excluded from the analysis for the following reasons: not ST or ESD/RR practice, IA>DA, missing IA, missing date. In some cases there was a very minor discrepancy where IA was larger than DA. In these cases, IA was adjusted to equal DA. Only BMPS built before 2009 were used to determine the baseline load. In the South River watershed, there are 1,334 BMPs built prior to 2009. The County's restoration projects built in 2009 through June 2018 were used for the 2018 progress analysis and consist of 20 BMPs and 11 stream restoration projects.

The sediment loads for each BMP type was determined by adding up the impervious loads and the non-impervious loads (assumed to be turf grass). The efficiencies of each BMP were determined from Table 2.E in MDE's guidance *document, Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated* (MDE, August 2014). If there was not enough information to determine the Runoff Depth Treated value (Q) it was assumed that each practice treated the 1" runoff depth and thus ESD/RR practices were given an efficiency of 70% reduction and ST practices were given an efficiency of 66% reduction. Extended detention dry ponds were given efficiencies of 60% and regular dry detention ponds were given efficiencies of 10%. An example of the calculations are shown in Table 7 (below). Loading rates can be found in Table 6.

Table 7: BMP Sediment Load Example for Wet Pond

Impervious Area (IA)	Drainage Area (DA)	Efficiency (E)	Turf Grass (TG) area (DA-IA)	Impervious Loading Rate (ILR)	Turf Grass Loading Rate (TLR)	Sediment Load from Turf TG*TLR*(1-E)	Sediment Load from Impervious IA*ILR*(1-E)
4.8 acres	26.0 acres	66%	21.2 acres	1,170.2 lbs/acre	399.4 lbs/acre	8,467.3 lbs	5,617.0 lbs

The total pounds of sediment was determined for the 2009 baseline by adding sediment loads from the following:

- BMPs prior to 2009
- Untreated Impervious
- Treated Pervious (from BMPs)
- Untreated Pervious

3.3 2018 Loads and Reductions

The total pounds of sediment for the 2018 comparison was calculated from the following sediment loads from:

- BMPs prior to 2009
- Restoration BMPs
- Untreated Impervious
- Treated Pervious (from BMPs)

- Untreated Pervious

The following BMPs were subtracted from the 2018 loads:

- Stream restoration project reductions
- Street sweeping reductions
- Inlet cleaning reductions

Streambank reduction uses 248 lbs/ft as found in Table 3 of the EPA CBP document *Recommendations of the Expert Panel to Define Removal Rates for Individual Stream Restoration Projects* (January 2014). The pounds of reduction (2,156,856 lbs) for the 11 stream restoration projects was subtracted from the total sediment load in the 2018 comparison. Street sweeping and inlet cleaning was subtracted for the 2018 comparison. Street sweeping was calculated by multiplying 0.44 x acreage swept then multiplying by 2,000 to convert tons to pounds. An efficiency rating of 11% was then applied. The sediment load rate of 0.44 per acre was taken from *Table A.1. CBP Annual Urban Runoff Loads Per Acre, Version 5.3.2* in the MDE guidance manual document. The 11% efficiency rating was taken from the document *Recommendations of the Expert Panel to Define Removal Rates for Street and Storm Drain Cleaning Practices* (May 19, 2016). Inlet cleaning was calculated by multiplying 420 x tons collected as shown in Table 3.E from MDE's guidance document. The 2017 data was used for both street sweeping and inlet cleaning. This data will need to be updated every year as it is an annual credit.

3.4 Accounting for Growth

Based on MDE guidance, growth in the stormwater load since the TMDL baseline year was not accounted for in the analysis conducted in the development of this document. Per guidance form MDE not to accountant for growth in local TMDL progress models with regard to restoration planning and progress tracking, the County modeled reductions in loads without accounting for growth. Local TMDLs are considered met, from a planning perspective, when the load reductions associated with restoration progress exceed the load reduction required.

3.5 Modeling Results

Sediment load reductions achieved between 2009 and FY 2018 are presented in Table 8.

Table 8: Sediment Load Modeling Results

Load	2009 Baseline Sediment Loads (lbs)	2018 Sediment Loads (lbs)
BMPs Prior to 2009	292,186.5	292,186.5
Restoration BMPs		19,724.3
Untreated Impervious	2,961,140.1	2,867,451.0
Treated Pervious	85,971.9	96,447.4
Untreated Pervious	625,352.7	569,627.8
Stream Restoration		-2,156,856.0
Street Sweeping		-4,447.2
Inlet Cleaning		-14,614.3
Total	**3,964,651.1**	**1,669,519.4**
% Reduction		**57.9**

3.6 Summary

The results from the County's analysis presented in Table 8 are summarized in Table 9 and show a 58% reduction in sediment from the 2009 baseline condition. This exceeds the required 28% reduction of sediment loads 2009 baseline levels to achieve the target SW-WLA for Anne Arundel County NPDES regulated stormwater.

Table 9: South River Sediment Loads and Load Reductions Summary	
	Sediment (lbs/year)
2009 Baseline Load	3,964,651
2018 Progress Load	1,669,519
% Reduction	**57.9**

In addition to restoration projects implemented by Anne Arundel County, the Maryland State Highway Administration (SHA) has implemented and is planning to implement several large restoration projects in the South River watershed. These projects are not accounted for in this document, however, they represent additional sediment reduction to the South River. Projects programmed through 2025 will further ensure that the Sediment TMDL stormwater WLA continues to be met into the future.

4 Planned Implementation

4.1 Programmed Restoration Projects

In addition to the sediment load reductions achieved through the implementation of restoration projects in the South River watershed between 2009 and the end of fiscal year (FY) 2018 the county will continue to implement sediment load reduction strategies in the South River watershed. There are 8 stream restoration projects and 10 restoration BMPs programmed for construction between FY 2019 and FY 2025. Table 10 identifies the restoration project type, number and anticipated associated sediment load reduction.

Table 10: Programmed Restoration Projects (2019 – 2025)		
BMP Type	# of Projects	Anticipated Sediment Reduction (lbs/yr)
Regenerative Step Pool Storm Conveyance (SPSC)	5	107,486.0
Bio-swale (MSWB)	2	5,852.7
Micro-bioretention (MMBR)	1	7,929.5
Sand Filter (FSND)	1	2,092.6
Bioretention (FBIO)	1	375.4
Stream Restoration (STRE)	7	6,823,968.0
Total	**17**	**6,947,704.2**

4.2 Projected Total Project Cost

A major source of funding for the implementation of restoration projects is the County's Watershed Protection and Restoration Fee (WPRF). Funding for the programmed restoration projects is through both the Capital Improvement Program (CIP) and through the County's WPRP Grant Program. In addition to funding provided through the WPRF Anne Arundel County actively pursues grant funding from Federal, State and non-governmental organizations (NGOs) to leverage funding for its restoration projects. Projected total project cost for projects identified in Table 10 are presented in Table 11.

Table 11: Project Cost

BMP Type	Total Projected Cost
Regenerative Step Pool Storm Conveyance (SPSC)	$1,137,052.06 (design only) + $4,156,987.33
Bioswale (MSWB)	$310,000.00
Micro-bioretention (MMBR)	$1,114,289.92
Sand Filter (FSND)	$206,030.16
Bioretention (FBIO)	$165,237.46
Stream Restoration (STRE)	$26,314,537.20
Total	**$33,404,134.10**

5 Tracking Implementation of Management Measures

Anne Arundel County manages a comprehensive system for tracking projects and accounting for new projects and programs. New BMPs constructed through new development and redevelopment projects are entered into the County's BMP database as they come on line. WPRP is responsible for implementing and tracking water quality improvement projects (i.e., restoration and retrofit projects). Additional internal County agencies including the Bureau of Highways Road Operation Division who are responsible for maintenance efforts (i.e. street sweeping and inlet cleaning) report to the WPRP. The County also tracks water quality projects installed by the Watershed Stewards Academy (WSA). Information on WSA projects is entered through the WPRP website (www.aarivers.org). Once this information is reviewed and validated by the County, they are incorporated into the County's master list of environmental projects.

5.1 Chesapeake Bay TMDL Two-Year Watershed Implementation Plan (WIP) Milestone Reporting

As part of the federal Chesapeake Bay Accountability Framework, Anne Arundel County is required to report two-year milestones representing near-term commitments and progress to MDE towards achieving load reductions goals for the Chesapeake Bay TMDL. These efforts support local TMDL planning and tracking at the County level.

Milestones are reported in two forms: Programmatic and BMP Implementation. Programmatic milestones identify the anticipated establishment or enhancement of the institutional means that support and enable implementation. Examples of Programmatic milestones include projected funding, enhancement of existing programs and resources, and the establishment of new programs and studies. The milestone reporting period for Programmatic milestones covers two calendar years. Submittal of the

County's next Programmatic milestone report is the *2018-2019 2-Year Milestone **Interim** Progress Report* due to MDE on January 31, 2019. This report will discuss progress achieved between January 1, 2018 and December 31, 2018. BMP Implementation milestones are a quantitative account of various types of restoration activities (e.g., structural BMPs , stream restoration, maintenance of efforts), which are geo-referenced. The period for BMP Implementation milestone reporting differs from the Programmatic milestone reporting in that it covers progress achieved during the fiscal year, not the calendar year. Submittal of the County's next Implementation milestone report is the *2018-2019 2-Year Milestone **Interim** Progress Report* also due to MDE on January 31, 2019. This report will discuss progress achieved from July 1, 2017 through June 30, 2018 (FY2018).

5.2 Annual NPDES MS4 Reporting

Part V.A.1. of the County's NPDES MS4 Permit requires the County to submit, on or before the anniversary date of the permit, a progress report demonstrating the implementation of the NPDES stormwater program based on the fiscal year. If the County's annual report does not demonstrate compliance with its permit and show progress toward meeting WLAs, the County must implement BMP and program modifications.

The annual report includes the following: (items in bold font directly relate to elements of the load reduction evaluation criteria)

a. The status of implementing the components of the stormwater management program that are established as permit conditions including:
    a. Source identification
    b. **Stormwater Management**
    c. Erosion and Sediment Control
    d. Illicit Discharge Detection and Elimination
    e. Litter and Floatables
    f. Property Management and Maintenance
    g. Public Education
    h. Watershed Assessment
    i. Restoration Plans
    j. TMDL Compliance
    k. Assessment of Controls
    l. Program Funding
b. **A narrative summary describing the results and analyses of data, including monitoring data that is accumulated throughout the reporting year.**
c. Expenditures for the reporting period and the proposed budget for the upcoming year.
d. A summary describing the number and nature of enforcement actions, inspections and public education programs.
e. **The identification of water quality improvements and documentation of attainment and/or progress toward attainment of benchmarks and applicable WLAs developed under EPA approved TMDLs; and,**

f. **The identification of any proposed changes to the County's program when WLAs are not being met.**
g. Attachment A – The County is required to complete a database containing the following information:
    a. Storm drain system mapping
    b. **Urban BMP locations**
    c. Impervious surfaces
    d. **Water quality improvement project locations**
    e. **Monitoring site locations**
    f. **Chemical monitoring results**
    g. **Pollutant load reductions**
    h. **Biological and habitat monitoring**
    i. Illicit discharge detention and elimination activities
    j. Erosion and sediment control, and **stormwater program information**
    k. Grading permit information
    l. Fiscal analyses – cost of NPDES related implementation

5.3 Financial Assurance Plan Reporting

The County Financial Assurance Plan (FAP) outlines the County's financial ability to meet its local and Chesapeake Bay TMDL obligations. The FAP demonstrates the County's ability to fund projects which will reduce pollutants of concern and make measureable progress towards improving water quality. Anne Arundel County's first FAP was submitted to MDE in July of 2016 and is required to be updated every two years.

6 Monitoring

While official monitoring for Integrated Report assessments and impairment status is the responsibility of the State, the County's WPRP has several on-going monitoring programs that target measures of water quality.

6.1 Countywide Biological Monitoring

In 2004, Anne Arundel County developed a countywide biological monitoring and assessment program to assess the biological condition of the County's streams at multiple scales (i.e., site-specific, primary sampling unit (PSU), and countywide. Under the Countywide Biological Monitoring and Assessment Program, biology (i.e., benthic macroinvertebrates) and stream habitat, as well as, geomorphological and water quality parameters, are assessed at approximately 240 sites throughout the entire County over a 5-year period using a probabilistic, rotating basin design. Round 1 of the County's Biological Monitoring and Assessment Program sampling occurred between 2004 and 2008, Round 2 took place between 2009 and 2013. Round 3 sampling began in 2017 and will be completed in 2021.

The biological monitoring program's stated goals are applicable at three scales: Countywide, Watershed-wide, and Stream-specific, and include the following components:

- Status: describe the overall stream condition
- Trends: how has the overall stream condition changed over time
- Problem Identification/prioritization: identify the impaired and most degraded streams
- Stressor-response relationships: identify anthropogenic stressors and their biological response
- Evaluation of environmental management activities: monitor the success of implemented programs and restoration/retrofit projects

The South River watershed is made up of two PSUs – the Upper North River and the Lower North River. Then sites were sampled in each of these PSUs in each round of sampling. Methodologies follow those used by MBSS for the biological sampling (benthic macroinvertebrates only) and habitat evaluations have included both MBSS's Physical Habitat Index (PHI) and EPA's Rapid Biological Assessment Protocol (RBP) metrics. *In situ* water quality measures are also collected at each site along with a geomorphic evaluation utilizing cross-sections, particle substrate analysis using pebble counts, and measures of channel slope.

6.2 Targeted Biological Monitoring of Restoration Projects

To evaluate management activities, the County uses assessment methods similar to the Countywide biological monitoring program to assess baseline and post-restoration conditions for select stream, wetland and stormwater restoration and retrofit sites. In addition, these techniques are utilized to meet several NPDES MS4 permit monitoring requirements, particularly related to Assessment of Controls and Watershed Restoration Assessment.

Following these procedures, the County is collecting several parameters related to water clarity and sediment deposition at each site.

- Water Quality Measures and Observations
    - Turbidity (measured), observations of general water clarity and color
- Biological Measures
    - Benthic macroinvertebrates (BIBI)
- Habitat Measures
    - General: bar formation, substrate, presence/absence of substrate type
    - PHI: epibenthic substrate, substrate, instream habitat
    - RBP: epifaunal substrate/available cover, pool substrate characterization, sediment deposition, channel alteration
- Geomorphic Measures
    - Particle size analysis using modified Wolman pebble counts at 10 transects proportioned by channel bed features

Results summarized at the PSU scale with mean BIB and habitat ratings (PHI and RBP) are presented in Table 11.

Table 11: Countywide Biological Monitoring Results for the South River

PSU Name	Round	PSU Code	Year Sampled	Drainage Area (acres)	BIBI Rating	PHI Rating	RBP Rating
Upper North River	1	11	2005	12,795	F	PD	PS
Upper North River	2	11	2011	12,795	P	PD	S
Lower North River	1	12	2005	23,981	P	D	PS
Lower North River	2	12	2009	23,981	P	PD	PS

BIBI Ratings: G = Good, F = Fair, P = Poor, VP = Very Poor
PHI Ratings: MD = Minimally Degraded, PD = Partially Degraded, D = Degraded, SD = Severely Degraded
RBP Ratings: C = Comparable, S = Supporting, PS = Partially Supporting, NS = Non Supporting

6.3 Watershed Assessments

In 2001, Ann Arundel County initiated a series of systematic and comprehensive watershed assessments and management plans for restoration and protection across the County. The plans were developed within the regulatory context that includes NPDES MS4 requirements, local TMDLs and Watershed Implementation Plans for the Chesapeake Bay TMDL, Maryland Stormwater Regulations and the Water Resources Element of the County's General Development Plan.

Biological monitoring is a component of the characterization and prioritization process within the management plans. The biological monitoring data is primarily utilized in the County's Watershed Management Tool (WMT), which was developed and is maintained by the WPRP. Within this program, sampling sites were selected using a targeted approach with the goal of having at least one, and sometimes two sites located within each subwateshed planning unit in order to examine the relationships between land use and ecological conditions downstream. Monitoring components include benthic macroinvertebrate community sampling, *in situ* water chemistry measurements, and instream and riparian physical habitat condition assessments. Waters quality grab sampling and detailed geomorphic assessment have been included for some watershed studies, but not as routine monitoring components.

The goals of the Watershed Assessment Program include:

- Characterize subwatersheds
- Prioritize subwatersheds for preservation and restoration; and
- Inform stressor-response relationships for planning and modeling.

The County continues to reevaluate its monitoring programs as the state of the science progresses, as the understanding of water quality and ecological interactions are improved, and as regulatory programs are added or modified.