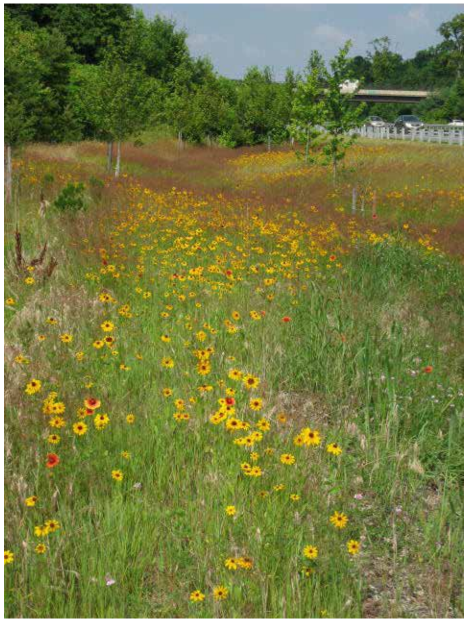
MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

South River Watershed Sediment TMDL Implementation Plan

PUBLIC REVIEW DRAFT August 24, 2018



MDOT MARYLAND DEPARTMENT OF TRANSPORTATION
STATE HIGHWAY ADMINISTRATION

OPPORTUNITY FOR PUBLIC REVIEW AND COMMENT

DRAFT IMPLEMENTATION PLAN FOR THE
TOTAL MAXIMUM DAILY LOAD (TMDL) OF SEDIMENT IN THE
NON-TIDAL SOUTH RIVER WATERSHED, ANNE ARUNDEL COUNTY, MARYLAND

The Maryland Department of Transportation State Highway Administration (MDOT SHA) was issued a National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System (MS4) Permit, (Permit No. 11-DP-3313), by the Maryland Department of the Environment (MDE) on October 9, 2015. This permit covers stormwater discharges from the storm drain system owned or operated by MDOT SHA within Anne Arundel, Baltimore, Carroll, Cecil, Charles, Frederick, Harford, Howard, Montgomery, Prince George's, and Washington Counties. The permit requires MDOT SHA to submit an implementation plan to MDE that addresses Environmental Protection Agency (EPA)-approved stormwater waste load allocations (WLAs) within one year of EPA approval.

EPA approved the ***Total Maximum Daily Load of Sediment in the Non-tidal South River Watershed, Anne Arundel County, Maryland*** on September 28, 2017. The MDOT SHA Office of Environmental Design (OED) is soliciting comments on its draft Implementation Plan to meet this WLA as required under the MS4 Permit. A 30-day public comment period will take place from August 24, 2018 to September 24, 2018. The draft Implementation Plan is available on MDOT SHA's website at http://www.roads.maryland.gov/Index.aspx?PageId=362.

Comments should be submitted to MDOT SHA **on or before September 24, 2018** by emailing to wpd@sha.state.md.us, faxing to (410) 209-5003, or mailing to:

Maryland Department of Transportation
State Highway Administration
Office of Environmental Design, C-303
707 N. Calvert Street
Baltimore, MD 21202

Please note that comments should include the name and address of the person submitting the comments. Responses to comments will not be provided directly, but material comments received during the comment period will be considered and the draft Implementation Plan will be revised as appropriate prior to submittal to MDE. A summary of comments received will be included in the MDOT SHA MS4 annual report submitted to MDE annually on October 9 and posted to this website: http://www.roads.maryland.gov/Index.aspx?pageid=336.

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SOUTH RIVER WATERSHED SEDIMENT TMDL IMPLEMENTATION PLAN

A. WATER QUALITY STANDARDS AND DESIGNATED USES

TMDLs focus on offsetting the impacts of pollutants to waterway designated uses. The Federal Clean Water Act (CWA) established requirements for each state to develop programs to address water pollution including:

- Establishment of water quality standards (WQSs);
- Implementation of water quality monitoring programs;
- Identification and reporting of impaired waters; and
- Development of maximum allowable pollutant loads that when met and not exceeded will restore WQSs to impaired waters, called TMDL documents.

WQSs are based on the concept of designating and maintaining specifically defined uses for each waterbody. **Table 1** lists the designated uses for waterways in the State of Maryland. TMDLs are based on these uses.

One means for the EPA to enforce these standards is through the NPDES program, which regulates discharges from point sources. MDE is the delegated authority to issue NPDES discharge permits within Maryland and to develop WQSs for Maryland including the water quality criteria that define the parameters to ensure designated uses are met.

Table 1: Designated Uses in Maryland

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

Source: http://www.mde.maryland.gov/programs/water/TMDL/WaterQualityStandards/Pages/wqs_designated_uses.aspx

MS4 Permit Requirements

The MDOT SHA MS4 Permit requires coordination with county MS4 jurisdictions concerning watershed assessments and development of a coordinated TMDL implementation plan for each watershed that MDOT SHA has a WLA. Requirements from the MDOT SHA MS4 Permit specific to watershed assessments and coordinated TMDL implementation plans include *Part IV.E.1.* and *Part IV.E.2.b.*, copied below.

Watershed Assessments (Permit Part IV.E.1.)

SHA shall coordinate watershed assessments with surrounding jurisdictions, which shall include, but not be limited to the evaluation of available State and county watershed assessments, SHA data, visual watershed inspections targeting SHA rights-of-way and facilities, and approved stormwater WLAs to:

- *Determine current water quality conditions;*
- *Include the results of visual inspections targeting SHA rights-of-way and facilities conducted in areas identified as priority for restoration;*
- *Identify and rank water quality problems for restoration associated with SHA rights-of-way and facilities;*
- *Using the watershed assessments established under section a. above to achieve water quality goals by identifying all structural and nonstructural water quality improvement projects to be implemented; and*
- *Specify pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater WLAs.*

Coordinated TMDL Implementation Plans (Permit Part IV.E.2.b.)

Within one year of permit issuance, a coordinated TMDL implementation plan shall be submitted to MDE for approval that addresses all EPA approved stormwater WLAs (prior to the effective date of the permit) and requirements of Part VI.A., Chesapeake Bay Restoration by 2025 for SHA's storm sewer system. Both specific WLAs and aggregate WLAs which SHA is a part of shall be addressed in the TMDL implementation plans. Any subsequent stormwater WLAs for SHA's storm sewer system shall be addressed by the coordinated TMDL implementation plan within one year of EPA approval. Upon approval by MDE, this implementation plan will be enforceable under this permit. As part of the coordinated TMDL implementation plan, SHA shall:

- *Include the final date for meeting applicable WLAs and a detailed schedule for implementing all structural and nonstructural water quality improvement projects, enhanced stormwater management programs, and alternative stormwater control initiatives necessary for meeting applicable WLAs;*
- *Provide detailed cost estimates for individual projects, programs, controls, and plan implementation;*
- *Evaluate and track the implementation of the coordinated implementation plan through monitoring or modeling to document the progress toward meeting established benchmarks, deadlines, and stormwater WLAs; and*
- *Develop an ongoing, iterative process that continuously implements structural and nonstructural restoration projects, program enhancements, new and additional programs, and alternative BMPs where EPA approved TMDL stormwater WLAs are not being met according to the benchmarks and*

deadlines established as part of the SHA's watershed assessments.

B. WATERSHED ASSESSMENT COORDINATION

According to the USGS (2016):

> *A watershed is an area of land that drains all the streams and rainfall to a common outlet such as the outflow of a reservoir, mouth of a bay, or any point along a stream channel. The word watershed is sometimes used interchangeably with drainage basin or catchment. The watershed consists of surface water--lakes, streams, reservoirs, and wetlands--and all the underlying ground water. Larger watersheds contain many smaller watersheds. Watersheds are important because the streamflow and the water quality of a river are affected by things, human-induced or not, happening in the land area "above" the river-outflow point.*

The 8-digit scale is the most common management scale for watersheds across the State, and therefore is the scale at which most of Maryland's local TMDLs are developed. See **Figure 1** for an illustration of the 8-digit watersheds in Maryland.

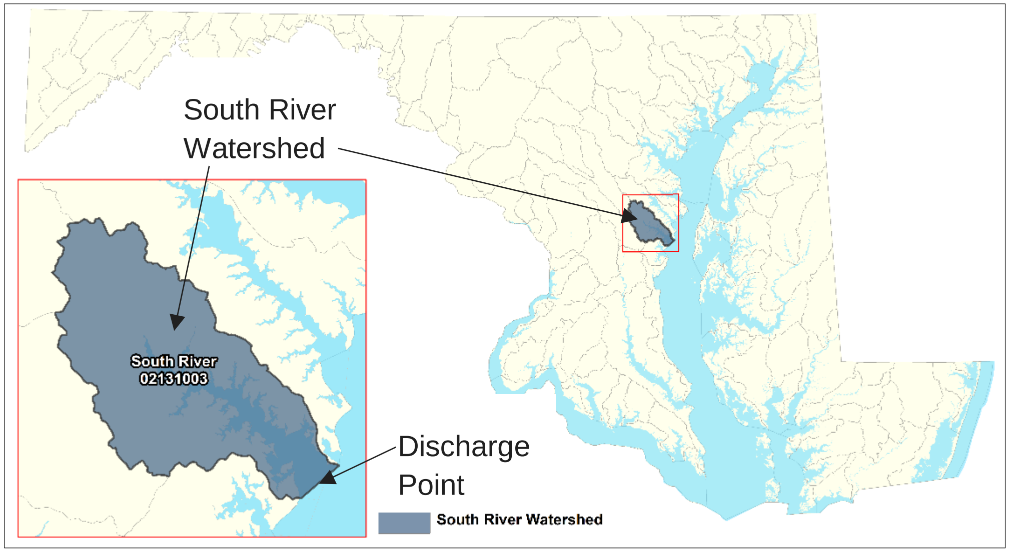


Figure 1: Maryland 8-digit Watershed Example

County Watershed Assessments

Each MS4 county performs detailed assessments of local watersheds as a part of its MS4 permit requirements. These assessments determine current water quality conditions and include visual inspections; the identification and ranking of water quality problems for restoration; the prioritization and ranking of structural and non-structural improvement projects; and the setting of pollutant reduction benchmarks and deadlines that demonstrate progress toward meeting applicable WQSs. MDOT SHA relies on assessments performed by other jurisdictions in fulfilling its MS4 assessment requirement.

Watershed assessment evaluations conducted by MDOT SHA focus on issues that MDOT SHA can improve through practices targeting MDOT SHA right-of-way (ROW) or infrastructure. This information is used to determine priority areas for BMP implementation and to identify potential project sites or partnership project opportunities.

Summaries of these evaluations are included under **Section F**. MDOT SHA watershed assessment evaluations focus on the following:

- Impacts to MDOT SHA infrastructure such as failing outfalls and downstream channels;
- Older developed areas with little SWM and available opportunities to install retrofits;
- Degraded streams;
- Priority watershed issues such as improvements within a drinking water reservoir, special protection areas, or Tier II catchments;
- Identification of areas most in need of restoration;
- Description of preferred structural and non-structural BMPs to use within the watershed;
- Potential project sites for BMPs; and
- In watersheds with PCB TMDLs, identifying locations of any known PCB sources.

In addition to using information from the county watershed assessments, MDOT SHA also undertakes other activities to identify potential project sites and prioritize BMP implementation including:

- Coordination meetings with each of the MS4 counties to discuss potential partnerships with the mutual goal of improving water quality;
- Visual watershed inspections as described below; and
- Maximizing existing impervious treatment within new roadway projects (practical design initiative).

C. VISUAL INSPECTIONS TARGETING MDOT SHA ROW

MDOT SHA methodically reviews each watershed for potential restoration projects within MDOT SHA ROW to meet the load reductions for current pollutant WLAs. Each watershed is assessed using a grid system in conjunction with detailed corridor assessments. The watershed review process includes two phases to visually inspect each watershed and identify all structural and non-structural water quality improvement projects to be implemented.

Desktop Evaluation

Phase one is a desktop evaluation of the watershed using available county watershed assessments and MDOT SHA data. MDOT SHA has created a grid system of 1.5-mile square cells to track the progress of the visual ROW inspections, allowing prioritized areas to be targeted first. With this grid system, many spatial data sets are reviewed to determine the most effective use of each potential restoration site. The sites are documented geographically and stored in GIS. Viable sites are prioritized based on cost-effectiveness and those located within watersheds with the most pollutant reduction needs move forward to the second phase, which is to perform field investigations. Data reviewed includes:

- Aerial imagery;
- Street view mapping;
- Environmental features delineations such as critical area boundary, wetlands buffers, floodplain limits;
- County data such as utilities, storm drain systems, contour and topographic mapping;
- MDOT SHA ROW boundaries;

- Current MDOT SHA stormwater control and restoration practice locations; and
- Drainage area boundaries.

Figure 6, located in **Section F**, illustrates the 1.5 mile grid system for the South River watershed.

Field Investigations

Phase two is a field investigation of each viable site resulting from the watershed desktop evaluation. MDOT SHA inspects and assesses each site in the field to identify and document existing site conditions, water quality opportunities, and constraints. This information is used to determine potential restoration BMP types as well as estimated restoration credit quantities.

MDOT SHA will continue to prioritize visual inspections in the highest need watersheds. **Figure 2** is an example field investigation summary map that documents observations. A standardized field inspection form is used.

D. BENCHMARKS AND DETAILED COSTS

Benchmarks and deadlines demonstrating progress toward meeting all applicable stormwater WLAs are provided in **Section F**. It contains generalized cost information that includes an overall estimated cost to implement the proposed practices. Detailed costs for specific construction projects are available on MDOT SHA's website (www.roads.maryland.gov) under the Contractors Information Center.

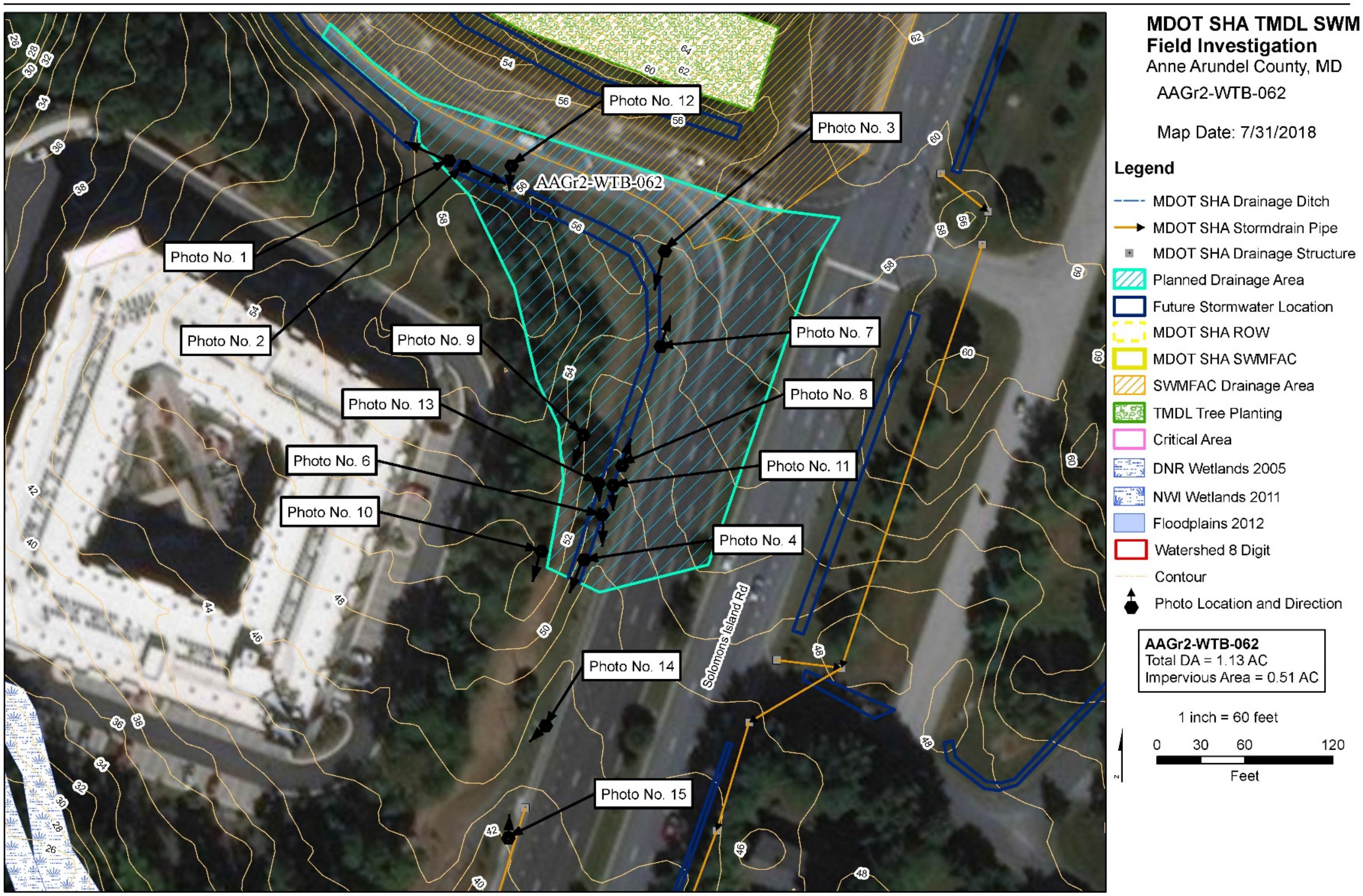


Figure 2: Example Field Investigation Summary Map

E. POLLUTION REDUCTION STRATEGIES

E.1. MDOT SHA TMDL Responsibilities

TMDLs define the maximum pollutant loading that can be discharged to a waterbody and still meet water quality criteria for maintaining designated uses. **Figure 3** illustrates the concept of maximum loading. The green area on the bar depicts the maximum load that maintains a healthy water environment for the pollutant under consideration. When this load is exceeded, the waterway is considered impaired as illustrated by the red portion of the bar. The example waterway needs restoration through implementation of practices to reduce the pollutant loading to or below the TMDL.

Generally, the formula for a TMDL is:

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

Where:

TMDL = total maximum daily load
WLA = wasteload allocation for point sources;
LA = load allocation for non-point sources; and
MOS = margin of safety.

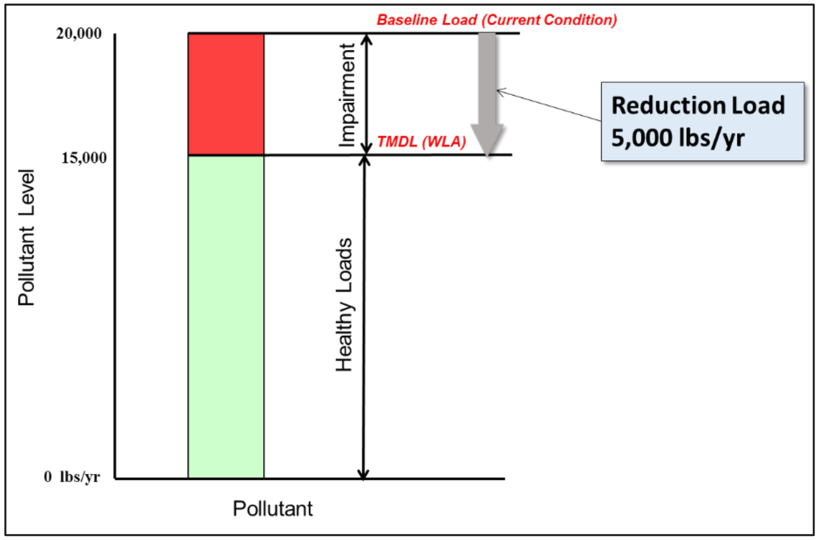


Figure 3: Example TMDL and Reduction Requirement

Modeling Parameters

MDE requires that pollutant modeling follow the guidance in the MDE (2014a) document and if other methods are employed, they must be approved by MDE. MDOT SHA developed a restoration modeling protocol that describes the methods used for modeling pollutant load reductions for local TMDLs with MDOT SHA responsibility. This protocol was submitted to MDE as an appendix with the MDOT SHA MS4 2016 Annual Report. The protocol has been updated from the initial version of the Automated Modeling Tool (AMT) originally submitted to MDE on June 30, 2016 to take into account changes in the modeling approach resulting from MDE comments on MDOT SHA's 2016 Annual Report, along with other modifications to improve accuracy. This protocol can be found under the "Related Documents" section on the MDOT SHA website, https://www.roads.maryland.gov/Index.aspx?pageid=336.

Different modeling methods are used depending upon the pollutants and current reduction practices in use. Brief descriptions of modeling methods are included in the following section, but the MDOT SHA restoration modeling protocol should be consulted for a more detailed explanation.

Aggregated Loads

WLAs may be assigned to each MS4 jurisdiction separately or as an aggregated WLA for all urban stormwater MS4 permittees that combines them into one required allocation and reduction target. The modeling approach developed by MDOT SHA uses MDOT SHA data (both impervious and pervious land as well as BMPs built before the TMDL baseline year, also known as baseline BMPs) to calculate baseline loads and calibrated reduction targets. Following this approach, disaggregation is done for each TMDL.

Available Reduction Practices

MDOT SHA reserves the right to implement new BMPs, activities, and other practices that are not currently available to achieve local TMDL load reduction requirements. In the future, expert panels may be convened to study the effectiveness of new or modified BMPs on pollutants. MDOT SHA will modify reduction strategies as necessary based on new, approved treatment guidance, and will include revised strategies in updates to this implementation plan.

E.2. Sediment Pollution Reduction Strategy

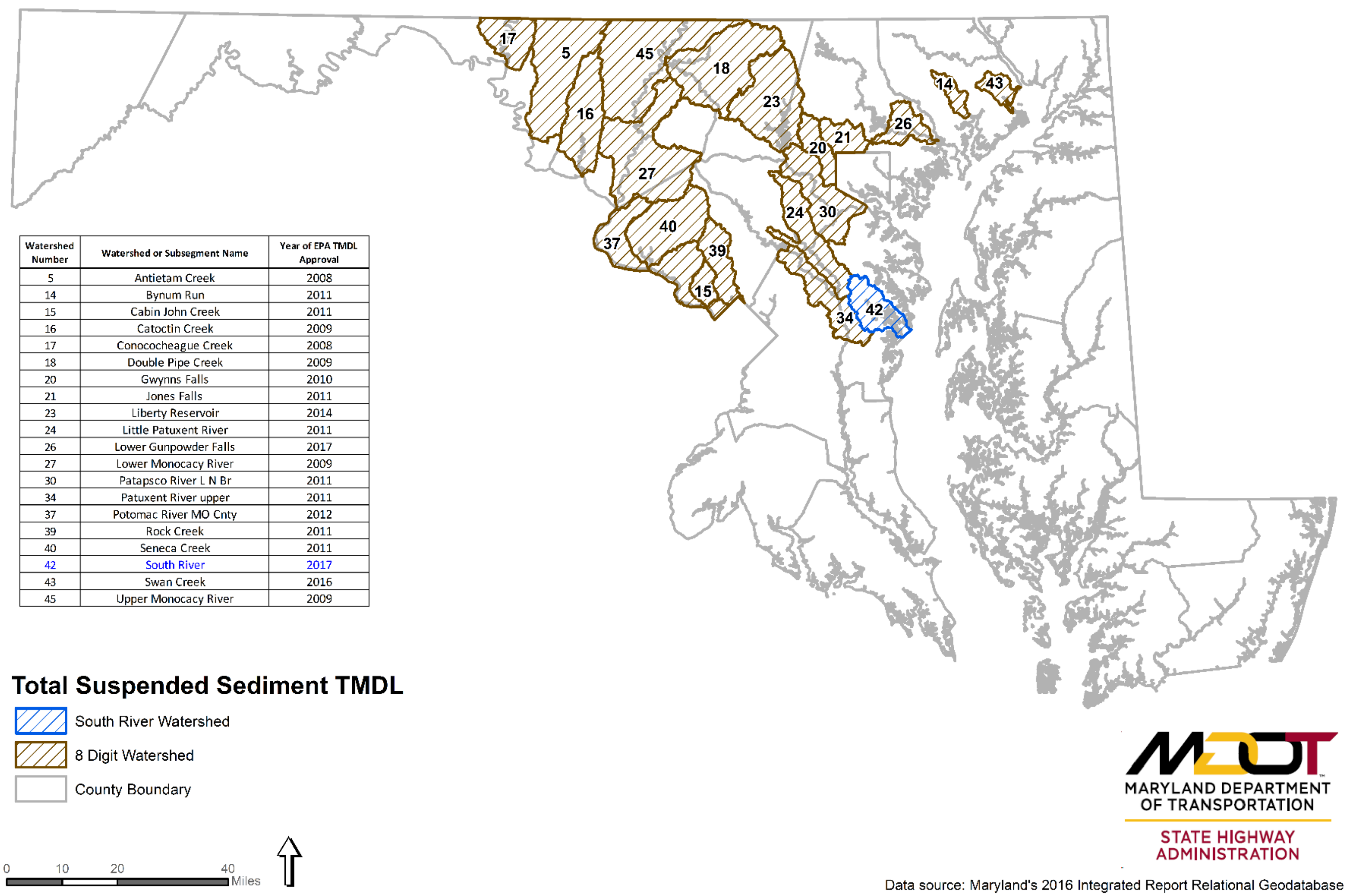
E.2.a. Sediment TMDLs Affecting MDOT SHA

There are many EPA-approved sediment TMDLs within Maryland and **Figure 4** is a map showing MDOT SHA sediment TMDL responsibilities by watershed. The following is a list of TMDL documents for sediment with MDOT SHA responsibility that are addressed in this plan:

- *Total Maximum Daily Load of Sediment in the Non-tidal South River Watershed, Anne Arundel County, Maryland, approved by EPA on September 28, 2017.*

In **Table 2,** the MDOT SHA reduction target for the South River sediment TMDL is 28 percent, or 66,125 lbs/yr. The watershed can safely receive 170,035 pounds of sediment by MDOT SHA on a yearly basis without being considered impaired. MDOT SHA's reduction target is found by multiplying the MDOT SHA baseline load by the MDOT SHA reduction target percent. The MDOT SHA WLA is found by subtracting the MDOT SHA baseline load by the MDOT SHA target load. The projected reduction achieved is found by modeling the sediment load reduction that will be experienced by the construction of current and future BMPs in the South River watershed. These BMPs are either currently under construction or are planned to be constructed in the future. It is estimated that these BMPs will reduce sediment loading by 394,589 pounds to the watershed.

Three dates are shown in **Table 2**: the EPA approval date, the baseline year set by MDE, and the Target Year. The baseline year published on the MDE Data Center will be used for MDOT SHA's implementation planning. This usually correlates to the time-period when monitoring data was collected for MDE's TMDL analysis. The Target Year is the year MDOT SHA proposes to meet the WLA.



Watershed Number	Watershed or Subsegment Name	Year of EPA TMDL Approval
5	Antietam Creek	2008
14	Bynum Run	2011
15	Cabin John Creek	2011
16	Catoctin Creek	2009
17	Conococheague Creek	2008
18	Double Pipe Creek	2009
20	Gwynns Falls	2010
21	Jones Falls	2011
23	Liberty Reservoir	2014
24	Little Patuxent River	2011
26	Lower Gunpowder Falls	2017
27	Lower Monocacy River	2009
30	Patapsco River L N Br	2011
34	Patuxent River upper	2011
37	Potomac River MO Cnty	2012
39	Rock Creek	2011
40	Seneca Creek	2011
42	South River	2017
43	Swan Creek	2016
45	Upper Monocacy River	2009

Figure 4: MDOT SHA Sediment TMDL Responsibilities in Local Watersheds

Table 2: MDOT SHA South River Watershed Sediment Modeling Results

Watershed Name	Watershed Number	County	Pollutant	EPA Approval Date	WLA Type	Baseline Year	Unit	MDOT SHA Baseline Load	MDOT SHA % Reduction Target	MDOT SHA Reduction Target	MDOT SHA WLA	Projected Reduction to be Achieved	Target Year
South River	02131003	AA	Sediment	09/28/2017	Individual	2009	Lbs./yr.	236,160	28.0%	66,125	170,035	394,589	2025

E.2.b. Sediment Sources

Discussions in the TMDL concerning sediment sources focus on types of land use with information derived from the Chesapeake Bay Watershed Model (CBWM). Cropland and regulated urban lands tend to be the most significant sources, followed by other agricultural uses and wastewater sources. Specific sources of each pollutant that could be useful for targeting controls are not included in the TMDL, but MDOT SHA researched a number of other references and determined sources beyond land uses that are summarized in **Table 3**. Sources of sediment include surface erosion from construction sites and cropland as well as stream erosion from high flows during storm events.

Table 3: Nutrient and Sediment Sources from Various References

Land Use	Nutrient Sources	Sediment Sources
Agriculture	Chemical Fertilizer Manure	Soil Erosion
Urban	Pet Waste Lawn Fertilizer Parking Lot, Roof, and Street Runoff	Construction Erosion Parking Lot, Roof, and Street Runoff
Wastewater	Municipal Industrial Failed Septic Systems CSO/ SSO Leaking Sewers	
Natural	Atmospheric Deposition	Stream Erosion Shoreline Erosion

References used to develop this table are MDE, 2014b; EPA, 2010b; Hoos et al., 2000; and Schueler, 2011.

MDOT SHA Loading Sources

MDOT SHA-owned land is a small portion of each of the TMDL watersheds and it consists of relatively uniform land uses including roadways and roadside vegetation. In urbanized areas, the MDOT SHA ROW may extend to include sidewalks and portions of driveways. There are also parking areas associated with MDOT SHA land such as park and ride facilities, office complexes, and maintenance facilities.

Of the land uses in **Table 3**, MDOT SHA is a contributor of sediments mostly through urban and natural sources. MDOT SHA has no responsibility for agriculture sources.

E.2.c. Sediment Reduction Strategies

To date, MDOT SHA has used a variety of structural, non-structural, and alternative BMPs in an effort to reduce sediment in the watersheds that have a corresponding TMDLs. However, we can see that load reduction activities cannot be limited to just BMP implementation as opportunities to build new BMPs are limited. The use of nutrient credit trading will also be explored as a tool in reaching load reduction targets. When MDOT SHA partners on projects with other MS4 jurisdictions, load splitting can be used as a means to achieve WLA reductions.

BMP Implementation

As a requirement under the MS4 Permit, MDOT SHA must complete the implementation of restoration efforts for 20 percent of its impervious surface area. MDOT SHA has an extensive program to plan, design, and construct BMPs that offset untreated impervious surfaces in MDOT SHA ROW.

MDOT SHA intends to build these BMPs used for impervious restoration in watersheds that have a TMDL where possible. One of the major challenges with using a strategy of building BMPs to meet WLAs is that there can be a lack of feasible ROW for BMP placement opportunities. There are instances where MDOT SHA roadway encompasses a majority of the area in the ROW leaving very little land to construct BMPs. The visual watershed inspection process has indicated areas where BMP placement is possible and where it is not feasible due to utility relocation, land purchases, site access problems, and a host of other issues. Therefore, MDOT SHA is continually seeking new opportunities and partnerships to install BMPs.

Nutrient Credit Trading

In an effort to meet the MDOT SHA WLA in watersheds with limited BMP placement opportunities, MDOT SHA is exploring the possibility of nutrient credit trading. It is expected that MS4 jurisdictions will have the ability to purchase pounds of phosphorus, nitrogen, and sediment in a quantity that will allow them to reach their intended WLA. Once the trading program, regulations, and guidance are finalized and approved by EPA, MDOT SHA intends to utilize this program as another practice to meet TMDL requirements.

TMDL End Date

Currently, MDOT SHA models BMP implementation for restoration practices that can be placed in the watershed based on the visual watershed inspection process. To date, the load reductions from identified practices exceed the load reduction requirement for the South River; however, MDOT SHA has set a reduction target date of 2025 to allow for the possibility of changes in programmed or planned sites. For example, MDOT SHA currently has two planned stream restoration projects in the South River watershed accounting for a total of 21,056 linear feet with projected load reductions of 315,840 lbs/yr. Changes to either of these projects would affect whether MDOT SHA meets the TMDL reduction requirement.

F. MDOT SHA SOUTH RIVER WATERSHED SEDIMENT TMDL IMPLEMENTATION PLAN

F.1. Watershed Description

Located entirely within central Anne Arundel County, the South River watershed (Maryland 8-digit Basin Code: 02131003) drains to the South River, which discharges to the Chesapeake Bay. The South River watershed is approximately 56.6 square miles (36,200 acres), not including water/wetlands; approximately 300 acres of the watershed is covered by water. There are no "high quality," or Tier II, stream segments within the South River watershed. The entire South River watershed is within the Coastal plain geologic province of Maryland. The total population in the South River watershed is approximately 75,800 (MDE, 2017c).

The designated use of the non-tidal portion of the South River is Use Class I – Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life (MDE, 2017c).

Waters within the South River watershed are subject to the following impairments as noted on MDE's 303(d) List:

- Fecal Coliform;
- PCBs in Fish Tissue;
- Nitrogen (Total);
- TSS;
- Phosphorus (Total); and
- Chlorides.

MDOT SHA is included in the sediment TMDL (MDE, 2017c), with a reduction requirement of 28 percent, as shown in **Table 2**. This TMDL only applies to the non-tidal portion of the South River watershed. There are no other pollutants with TMDLs and MDOT SHA WLAs for the non-tidal portion of this watershed. There is a PCB TMDL for the mesohaline portion of the South River watershed.

There are 76 centerline miles of MDOT SHA roadway located within the South River watershed. The associated ROW encompasses 1,291 acres, of which 433 acres are impervious. MDOT SHA facilities located within the watershed consist of one (1) highway office and/or lab, two (2) park and rides, and one (1) salt storage facility.

See **Figure 5** for a map of MDOT SHA facilities within the South River watershed.

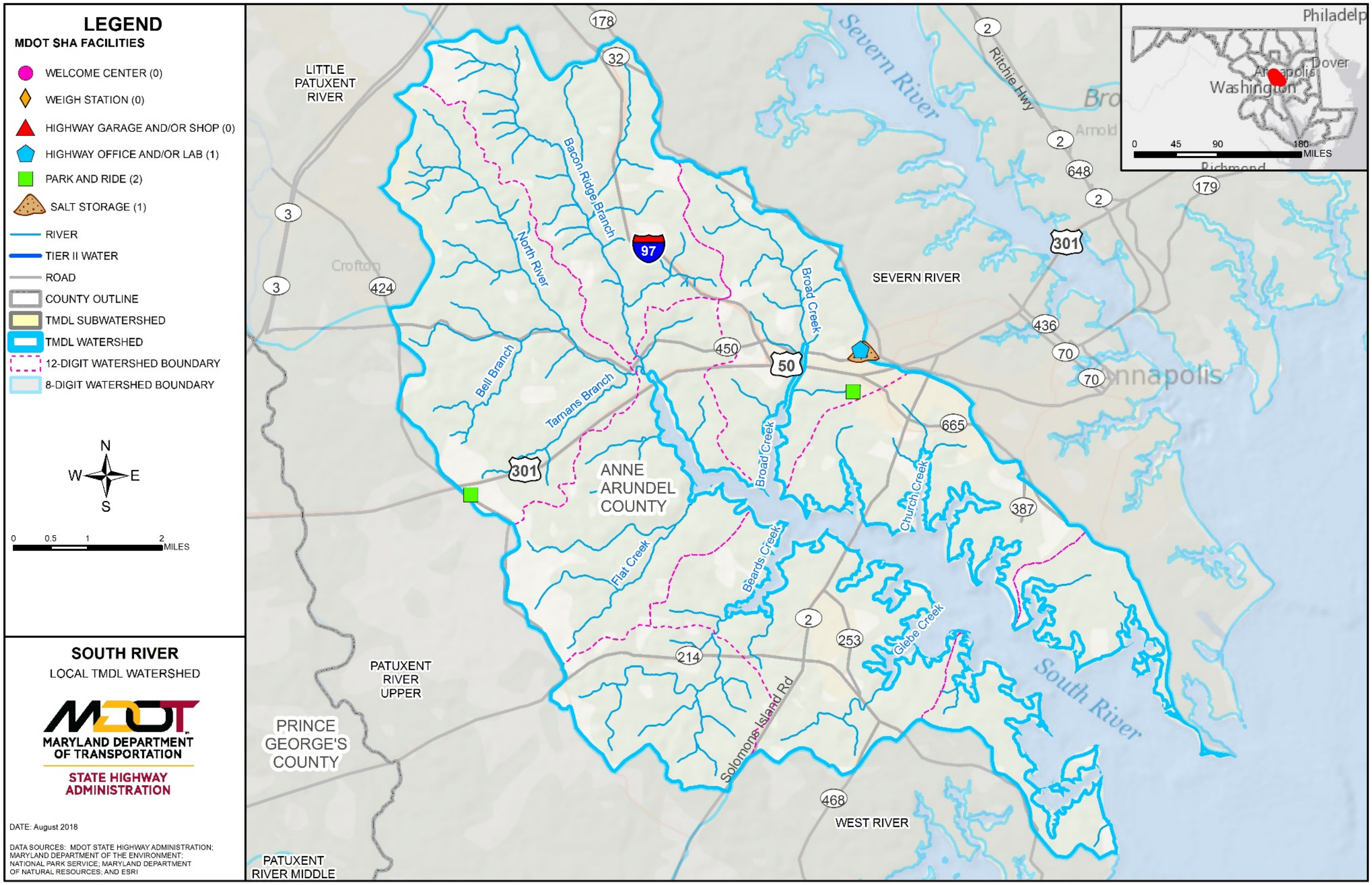


Figure 5: South River Watershed

F.2. Summary of County Assessment Review

On behalf of the Anne Arundel County Department of Public Works, CH2MHILL and KCI Technologies completed the *South River Watershed Study Summary Report* in November of 2008 (CH2MHILL and KCI, 2008) (hereinafter referred to as the "Watershed Study"). The Watershed Study elaborated on the findings from the 2006 Anne Arundel County-sponsored stream assessment of the South River watershed, which was completed as part of the County's Watershed Management Master Plan for the South River. Approximately 246 miles of streams were studied in the 2006 stream assessment; data collected from the assessment provided the County with information on the current conditions (or baseline condition) of the South River watershed (CH2MHILL and KCI, 2008).

In order to provide greater detail and specificity in the analysis and reporting, the South River watershed was divided into 59 subwatersheds in the Watershed Study. For ease of presentation, however, the 59 subwatersheds were grouped into three clusters: Headwaters, North Shore, South Shore.

The Headwaters cluster of subwatersheds lies almost entirely above U.S. Route 301 (US 301) and includes 151.4 miles of streams with three major streams: North River, Bacon Ridge Branch, and Tarnans Branch. The Headwaters cluster area also includes the majority of the watershed surrounding Broad Creek to the north of US 301. The cluster is approximately 16,200 acres, of which 9 percent is impervious. Residential and transportation areas make up most of the impervious surface in the Headwaters cluster; approximately half of the impervious area is residential, and a quarter is transportation, which is due to the cluster being bisected by several major road corridors such as Interstate 97 and MD Route 450. The Headwaters cluster area is less populated than either the North Shore or South Shore clusters. While the Headwaters cluster has several residential and agricultural areas, "most notably in this cluster are the large tracts of contiguous forested land" (CH2MHILL and KCI, 2008, Appendix A, p.1).

The North Shore cluster of subwatersheds lies below US 301 to the north of South River and includes a portion of the city of Annapolis. Major streams include Broad Creek and Church Creek. The North Shore cluster is approximately 6,900 acres, of which 27 percent is impervious. It includes 21.3 miles of streams, with at least half of the subwatersheds containing streams that are completely influenced by tides. The North Shore cluster area is highly populated and is dominated by residential and commercial development. While this cluster also has a large percentage of forested land, it is much more fragmented than in the Headwaters cluster (CH2MHILL and KCI, 2008).

The South Shore cluster lies below US 301 to the south of South River. Major streams include Flat Creek and Beards Creek. The South Shore cluster is approximately 13,000 acres, of which 15 percent is impervious. It includes 69.8 miles of streams. Like the North Shore cluster, the South Shore cluster is also highly populated. The South Shore cluster includes a number of small parks and a small regional airport. There is a high residential concentration in the South Shore cluster subwatersheds that are directly adjacent to the South River. Several of the subwatersheds in this cluster are bisected by a significant utility corridor. The rest of the South Shore cluster area contains a significant amount of contiguous forested land (CH2MHILL and KCI, 2008).

Pollutant loading from the South River watershed was modeled for total nitrogen, total phosphorous, TSS, and fecal coliform. Specifically, for sediment (i.e., the pollutant of the subject TMDL [MDE, 2017c]), existing conditions showed that the areas with the highest TSS load from runoff (tons/yr) were in the North Shore cluster in the subwatersheds immediately surrounding Broad Creek and Church Creek as well as in the South Shore cluster in the subwatersheds immediately surrounding Glebe Creek (CH2MHILL and KCI, 2008).

Currently, Anne Arundel County is managing its stormwater runoff in the South River watershed through both urban stormwater management facilities and agricultural BMPs. In regard to the agricultural BMPs, the Watershed Study states that the significant acreage of agricultural land in the South River watershed prompted the County to carefully consider how to evaluate runoff quality and BMP effectiveness in these areas of the watershed. Therefore, the County collected and organized data on agricultural practices/BMPs (e.g., conservation tillage, cover crop, nutrient management; manure storage, etc.) in the watershed as an input to the County's watershed management process.

In addition to the stream assessment, information on land use, stormwater BMPs, and pollutant-loading models were compiled in a prioritization model that ranked and prioritized the watershed. This prioritization effort included prioritization within all three clusters for stream reach restoration; subwatershed restoration; and subwatershed preservation. The Watershed Study provides numerous color-coded maps that show the specific results (exact locations and ratings) of all prioritizations within each cluster. Broad-based conclusions can be drawn from these maps as well. For example, the preservation maps in particular show that the Headwaters cluster overwhelming contains the most subwatersheds ranked as high priority for preservation, which can be attributed to the fact that the Headwaters cluster has a limited amount of development along with large contiguous tracts of forest cover (CH2MHILL and KCI, 2008).

The modeling results for the South River watershed showed that the following four types of practices will provide the biggest impact towards reducing pollutant loadings from urban sources in the future: 1) implementation of enhanced stormwater retrofits, 2) expansion of stream buffers by 300 feet in unsewered areas, 3) preservation of greenways, and 4) implementation of regenerative conveyance BMPs (Watershed Study provides a figure that shows potential locations for regenerative conveyance). While the modeling results show the biggest impact if these BMP types are implemented fully across the watershed, the Watershed Study noted that other types of BMPs might be more appropriate for or have a bigger impact on the loading of an individual subwatershed. Other factors such as the results of cost benefit analyses will impact the County's final decision on which scenario to implement in an individual subwatershed (CH2MHILL and KCI, 2008).

F.3. MDOT SHA Visual Inventory of ROW

The MS4 Permit requires MDOT SHA to perform visual assessments. **Section C** describes the MDOT SHA visual assessment process. For each BMP type, implementation teams have performed preliminary evaluations for each grid and/or major state route corridor within the watershed as part of desktop and field evaluations. The grid-system used for the South River watershed is shown in **Figure 6** which illustrates that 47 grid cells have been reviewed, encompassing portions of 14 state route corridors. Results of the visual inventory categorized by BMP type follow.

Structural SW Controls

Preliminary evaluation identified 164 locations as potential new structural SW control locations. Further analysis of these locations resulted in:

- 19 new structural SW controls constructed or under contract.
- 118 additional sites deemed potentially viable for new structural SW controls and pending further analysis, may be candidates for future restoration opportunities.
- 27 sites deemed not viable for structural SW controls and have been removed from consideration.

Tree Planting

Preliminary evaluation identified 47 locations as potential tree planting locations. Further analysis of these locations resulted in:

- 27 sites constructed or under contract.
- 20 sites deemed not viable for tree planting and have been removed from consideration.

Stream Restoration

Preliminary evaluation identified 12 sites as potential stream restoration locations. Further analysis of these locations resulted in:

- 3 sites constructed or under contract.

Grass Swale Rehabilitation

No grass swale rehabilitation sites were identified in this watershed for restoration.

Outfall Stabilization

Preliminary evaluation identified 91 outfalls along 2 State roadway corridors as potential for stabilization. Further analysis of these sites resulted in:

- 13 outfall sites deemed potentially viable for outfall stabilization efforts and pending further analysis, may be candidates for future restoration opportunities.
- 78 outfall sites deemed not viable for outfall stabilization and have been removed from consideration.

Retrofit of Existing Structural SW Controls

Preliminary evaluation identified 20 existing structural SW controls as potential retrofits. Further analysis of these locations resulted in:

- Retrofit of 7 existing structural SW controls constructed or under contract.
- 3 retrofit sites deemed potentially viable for retrofit and pending further analysis may be candidates for future restoration opportunities.
- 10 retrofit sites deemed not viable for retrofit and have been removed from consideration.

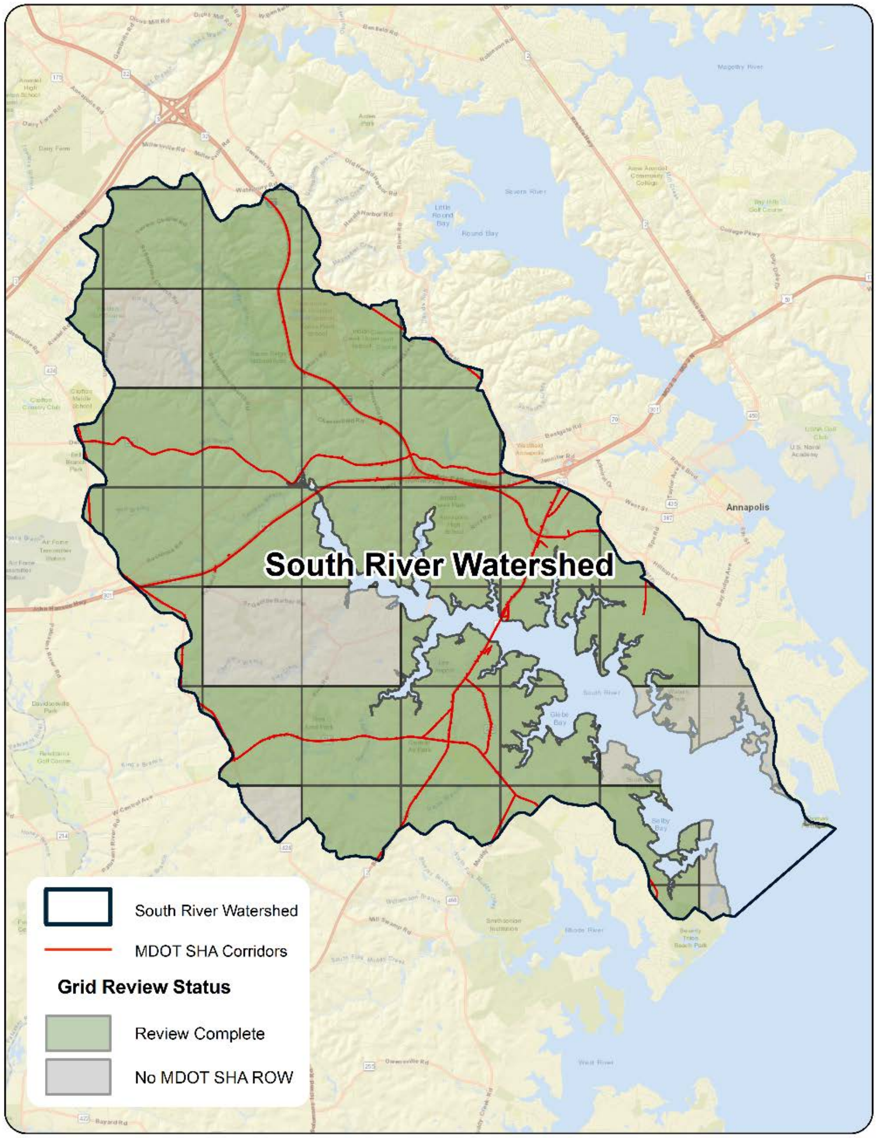


Figure 6: South River Watershed Site Search Grids

F.4. MDOT SHA Pollutant Reduction Strategies

Proposed practices that are currently programmed for implementation to meet the sediment reductions in the South River watershed are shown in **Table 4**. Projected sediment reductions using these practices are 394,589 lbs which is 597% of the required reduction. Three timeframes are included in the table below:

- BMPs built before the TMDL baseline. In this case, the baseline is 2009;
- BMPs built after the baseline through fiscal year 2018; and
- BMPs built after fiscal year 2018 through 2025 the projected target date.

The currently programmed BMPs will exceed the reduction requirement shown in **Table 2**. It is important to note that MDOT SHA is reducing loads outside of the ROW that we are not modeling in the baseline loads, and as a result, the load reduction is higher than the baseline. The majority of future load reductions are from two planned stream restoration projects accounting for a total of 21,056 linear feet with projected load reductions of 315,840 lbs/yr; exceeding modeled baseline loads from MDOT SHA ROW.

Estimated Capital Budget costs to design and construct the programmed practices within the South River watershed total $59,277,000. These projected costs are based on an average cost per impervious acre treated that is derived from cost history for a group of completed projects for each BMP category.

Figure 7 is a map of MDOT SHA's restoration practices in the watershed and include those that are under design or construction. Inlet cleaning is not reflected on this map.

Table 4: South River TSS BMP Implementation					
BMP	**Unit**	**Baseline (Before 2009)**	**Restoration BMPs**		**Restoration Cost**
			Progress (2010 – FY18)	**Future (After FY18)**	
New Structural SW Controls	drainage area acres	257.7	27.1	40.2	$34,484,000
Retrofit	drainage area acres		61.4	54.7	$8,581,000
Tree Planting	acres of tree planting	0.6	3.7	8.3	$385,000
Stream Restoration	linear feet		2,300	21,056	$15,597,000
Inlet Cleaning[1]	dry tons		39.8		$227,000
Street Sweeping	acres swept		30.6		$3,000
Load Reductions	**TSS EOS lbs/yr**	32,423	66,616	327,973	

[1] *Inlet cleaning and street sweeping are annual practices.*

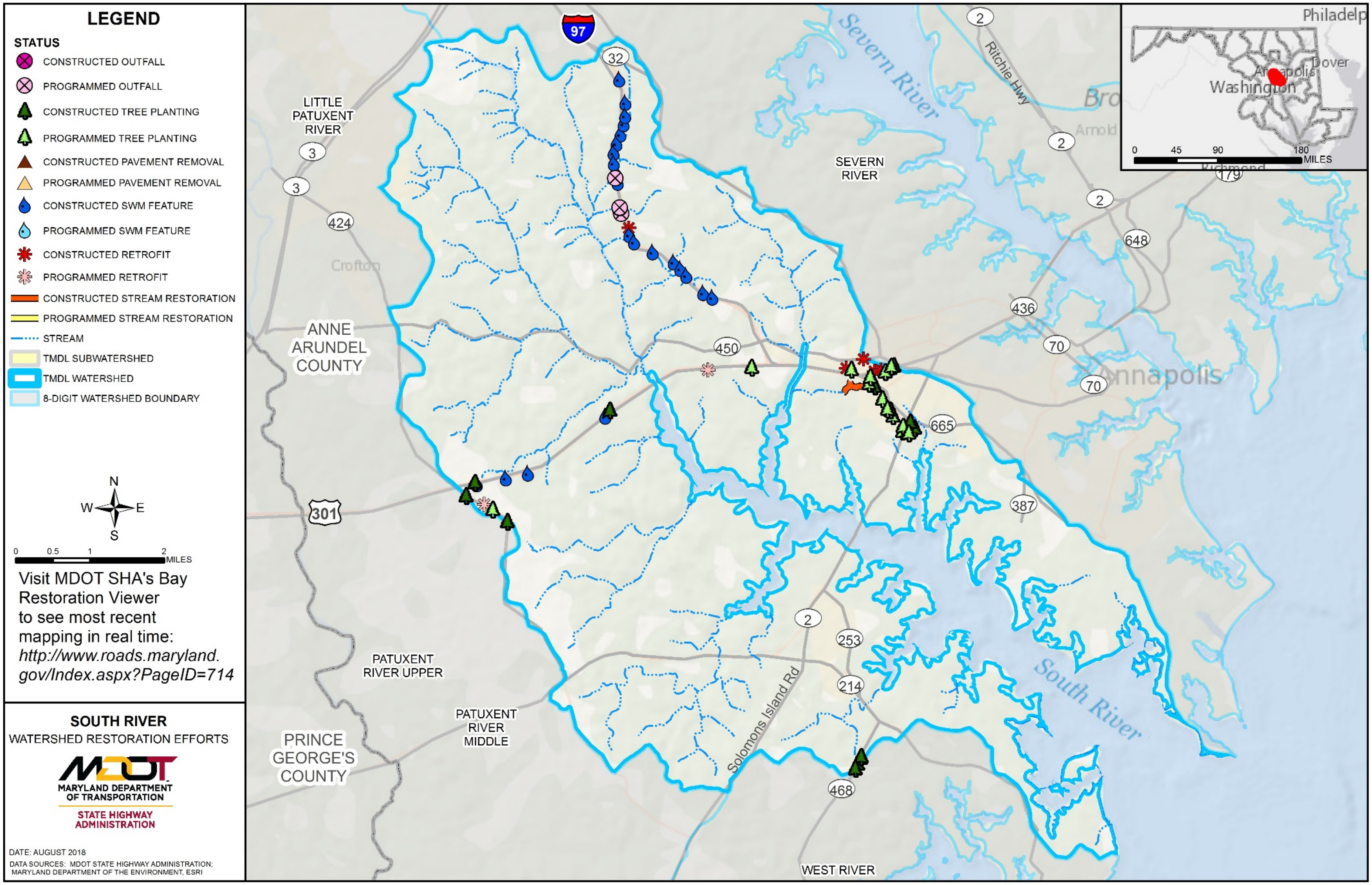


Figure 7: MDOT SHA Programmed Restoration Strategies within the South River Watershed

ABBREVIATIONS

Note: This list of abbreviations was developed for the MDOT SHA 2016 Impervious Restoration and Coordinated TMDL Implementation plan (available at www.roads.maryland.gov). Many of the abbreviations may not apply to this document.

AA	Anne Arundel (County)
AA-DPW	Anne Arundel County, Department of Public Works
AAH	Adopt-A-Highway
AASHTO	American Association of State Highway and Transportation Officials
ac	Acre
AFB	Air Force Base
Alt	Alternative
AMT	Automated Modeling Tool
AMT, Inc.	A. Morton Thomas and Associates, Inc.
ATV	All-terrain vehicle
BA	Baltimore (County)
BARC	Beltsville Agriculture Research Center
Bay	Chesapeake Bay
BBO	Beaverdam Run, Baisman Run, and Oregon Branch Subwatersheds of the Loch Raven Reservoir Watershed
BC-DEPRM	Baltimore County, Department of Environmental Protection and Resource Management
BC-DEPS	Baltimore County, Department of Environmental Protection and Sustainability
BIBI	Benthic Index of Biotic Integrity
BMP	Best Management Practice
BOD	Biochemical Oxygen Demand
BSID	Biological Stressor Identification
BST	Bacterial Source Tracking
CAFO	Concentrated Animal Feeding Operation
CBP	Chesapeake Bay Program
CBWM	Chesapeake Bay Watershed Model
CC	Charles (County)
CC-BRM	Carroll County, Bureau of Resource Management
CC-DPGM	Charles County, Department of Planning & Growth
CCMS	Customer Care Management System
CFR	Code of Federal Regulations
CIP	Capital Improvement Project
CL	Carroll (County)
CRP	Community Reforestation Program
CSN	Chesapeake Stormwater Network
CSO	Combined Sewer Overflow
CTP	Consolidated Transportation Program
CWA	Clean Water Act
CWAPTW	Clean Water Action Plan Technical Workgroup
CWP	Center for Watershed Protection
DC	District of Columbia
DO	Dissolved Oxygen
DEL	Delivered Loads
DMCF	Dredged Material Containment Facilities
DNR	Maryland Department of Natural Resources
DRMO	Defense Reutilization and Marketing Office
ECD	Environmental Compliance Division (MDOT SHA)

E. coli	*Escherichia coli*
ED	Extended Detention
EMC	Event Mean Concentration
EMS	Environmental Management System
EOS	Edge of Stream
EPA	United States Environmental Protection Agency
EPD	Environmental Programs Division
ESC	Erosion and Sediment Control
ESD	Environmental Site Design
FC	Fecal Coliform
FC-DPW	Frederick County, Division of Public Works
FEMA	Federal Emergency Management Administration
FIB	Fecal Indicator Bacteria
FIBI	Fish Index of Biotic Integrity
FMD	Facility Maintenance Division (MDOT SHA)
FR	Frederick (County)
FY	Fiscal Year
GIS	Geographic Information System
HA	Harford (County)
HC-DPW	Harford County, Department of Public Works
HO	Howard (County)
HUC	Hydrologic Unit Code
HWG	Horsley Witten Group, Inc.
ICPRB	Interstate Commission on the Potomac River Basin
IDDE	Illicit Discharge Detection and Elimination
ISWBMPDB	International Stormwater BMP Database
LA	Load Allocations
lbs	Pounds (weight)
LF	Linear Feet
LN	Lower North
LNB	Lower North Branch
LRE	Loch Raven East subwatershed
LJF	Lower Jones Falls (Watershed)
LU	Land Use
MAA	Maryland Aviation Administration
MAST	Maryland Assessment Scenario Tool
MC-DEP	Montgomery County, Department of Environmental Protection
MD	Maryland
MDA	Maryland Department of Agriculture
MDE	Maryland Department of the Environment
MDOT	Maryland Department of Transportation
MDP	Maryland Department of Planning
MEP	Maximum Extent Practicable
MEPA	Maryland Environmental Policy Act
MGF	Middle Gwynns Falls (Watershed)
MO	Montgomery (County)
MOS	Margin of Safety
MPR	Maximum Practicable Reduction
MS4	Municipal Separate Storm Sewer System
NBOD	Nitrogenous Biochemical Oxygen Demand
NEPA	National Environmental Policy Act
NFHL	National Flood Hazard Layer
NJF	Northeastern Jones Falls (Watershed)
NPDES	National Pollutant Discharge Elimination System

NSQD	National Stormwater Quality Database
OCRI	Office of Customer Relations and Information (MDOT SHA)
OED	Office of Environmental Design (MDOT SHA)
OOM	Office of Maintenance (MDOT SHA)
OP	Orthophosphate
OPPE	Office of Planning and Preliminary Engineering (MDOT SHA)
PACD	Pennsylvania Association of Conservation Districts
PB	Parsons Brinckerhoff
PCB	Polychlorinated Biphenyl
P_E	Rainfall Target Used To Size ESD Practices
PERC	Perchloroethylene
PG	Prince George's (County)
PGC-DoE	Prince George's County, Department of the Environment
RBP	Rapid Bioassessment Protocol
RGP	Regional General Permit
ROW	Rights-Of-Way
Reqd	Required
RR	Runoff Reduction
RSPSC	Regenerative Step Pool System Conveyance
SAH	Sponsor-A-Highway
SB	Spring Branch subwatershed
SCA	Stream Corridor Assessment
SFEI	San Francisco Estuary Institute
SGW	Submerged Gravel Wetlands
SHA	State Highway Administration
SPR	State Planning and Research
SSO	Sanitary Sewer Overflow
ST	Stormwater Treatment
SW	Stormwater
SWAP	Small Watershed Action Plan
SWM	Stormwater Management
SWS	Subwatershed
SW-WLA	Stormwater Wasteload Allocation
TBD	To Be Determined
TBR	Tidal Back River (Watershed)
TBS	To Be Specified
TCWG	Toxic Contaminants Work Group
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
tPCB	Total Polychlorinated Biphenyl
TSS	Total Suspended Solids
TWGCB	Toxics Work Group Chesapeake Bay Partnership
UBR	Upper Back River (Watershed)
UGF	Upper Gwynns Falls (Watershed)
UJF	Upper Jones Falls (Watershed)
US	United States
USACE	United States Army Corps of Engineers
USDA-NRCS	United States Department of Agriculture, Natural Resources Conservation Service
USGS	United States Geological Survey
USWG	Urban Stormwater Work Group
WA	Washington (County)

WC-DPW	Washington County, Division of Public Works
WCSCD	Washington County Soil Conservation District
WIP	Watershed Implementation Plan
WLA	Wasteload Allocation
WPD	Water Programs Division
WQLS	Water Quality Limited Segment
WQSs	Water Quality Standards
WQv	Water Quality Volume
WQGIT	Water Quality Goal Implementation Team
WRAS	Watershed Restoration Action Strategy
WTM	Watershed Treatment Model
WTWG	Watershed Technical Work Group
WWTP	Waste Water Treatment Plant
yr	Year
12-SW	Maryland General Permit for Discharges from Stormwater Associated with Industrial Activities

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