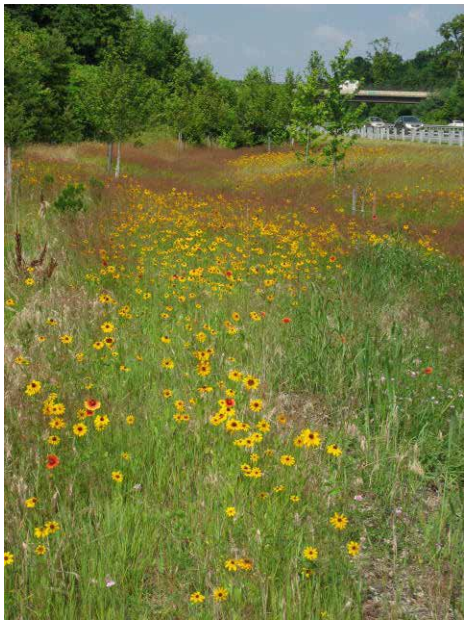
MARYLAND DEPARTMENT OF TRANSPORTATION

STATE HIGHWAY ADMINISTRATION

Lower Gunpowder Falls Watershed Sediment TMDL Implementation Plan

PUBLIC REVIEW DRAFT March 19, 2018



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
LOWER GUNPOWDER FALLS WATERSHED, BALTIMORE 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, Fredrick, 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 Lower Gunpowder Falls Watershed, Baltimore County, Maryland*** on May 4, 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 March 19, 2018 to April 20, 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 April 20, 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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LOWER GUNPOWDER FALLS 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.

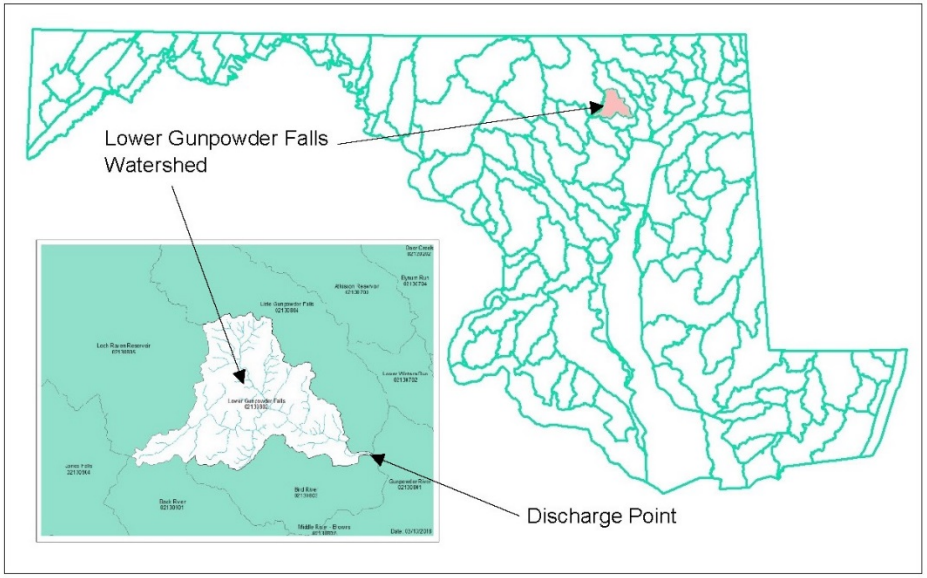


Figure 1: Maryland 8-digit Watershed Example

County Watershed Assessments

Each MS4 county is required to perform 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 is not required to duplicate this effort, but is required to coordinate with the MS4 jurisdictions to obtain and review watershed assessments. Relying on assessments performed by other jurisdictions avoids redundant analysis and places the responsibility for developing the assessments with the jurisdictions that have close connection to local communities and watershed groups.

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 in this Plan 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:

- On-going coordination meetings with each of the MS4 counties to discuss potential partnerships with the mutual goal of improving water quality;
- Perform visual watershed inspections as described below;
- Model MDOT SHA load reductions within the watershed based on MDOT SHA land uses and ROW; and
- Maximize 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 to ensure that it is thoroughly assessed. 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 watershed 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 7 illustrates the 1.5 mile grid system for the Lower Gunpowder Falls 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 from the field analysis. 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 the watershed discussion 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.

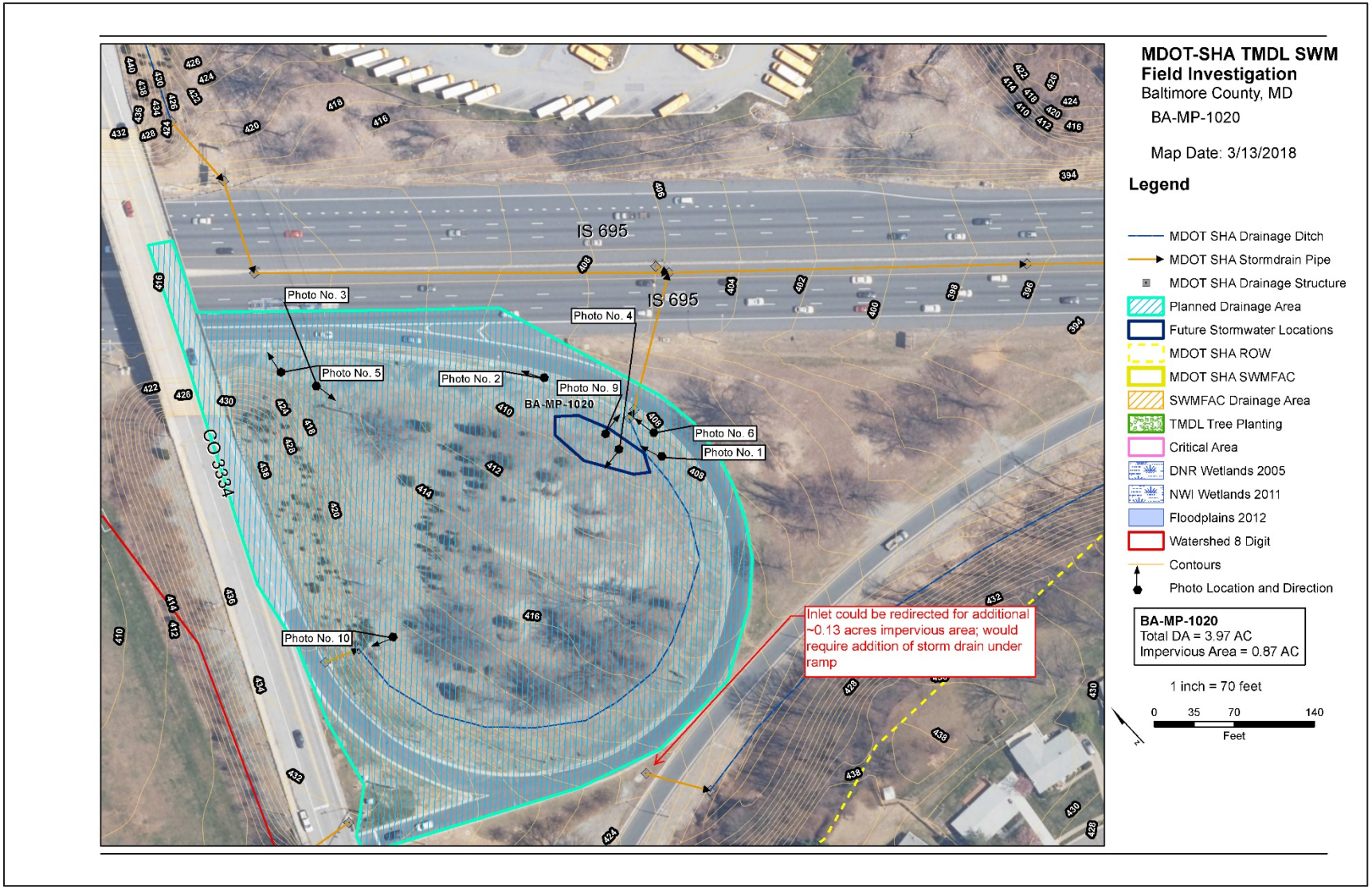


Figure 2: Example Field Investigation Summary Map

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.

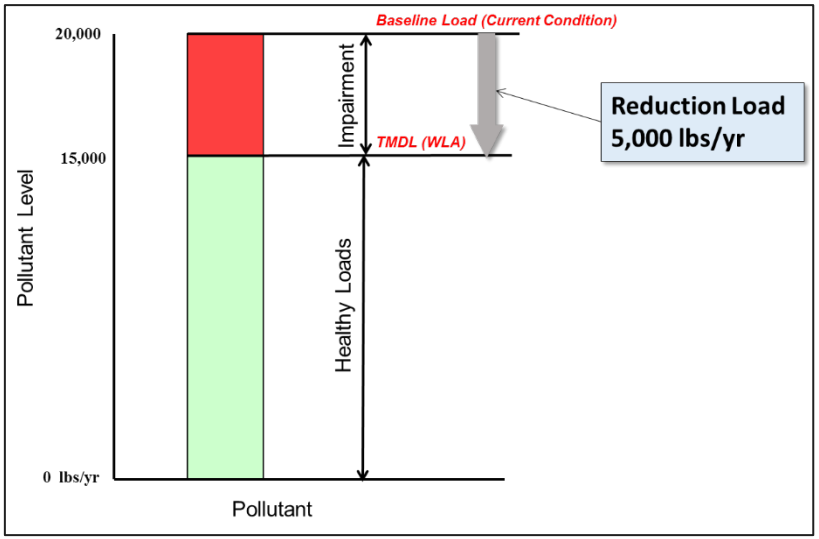


Figure 3: Example TMDL and Reduction Requirement

Pollutants for MDOT SHA Focus

Upon issuance of the MS4 Permit, MDOT SHA was named in TMDLs for five different pollutants within the MS4 coverage area including

- Bacteria;
- PCBs;
- Phosphorus;
- Sediment; and
- Trash.

The MDOT SHA MS4 Permit covers eleven Maryland counties that cross 84 8-digit watersheds representing larger rivers or streams. There are many EPA-approved TMDL documents that assign MDOT SHA to either an individual WLA or an aggregate WLA. Each watershed may be covered by one or more TMDL documents, so there is not a direct correlation between the number of TMDL documents and the number of watersheds affected.

Figure 4 shows a map of MDOT SHA TMDL responsibilities by watershed. **Table 2** on the following page summarizes MDOT SHA's sediment reduction requirement for the Lower Gunpowder Falls watershed and projected compliance by the listed end date. Lists of proposed practices and costs to achieve the required reductions are included in **Section F**.

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. Once approved, this protocol will be available on the MDOT SHA website.

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.

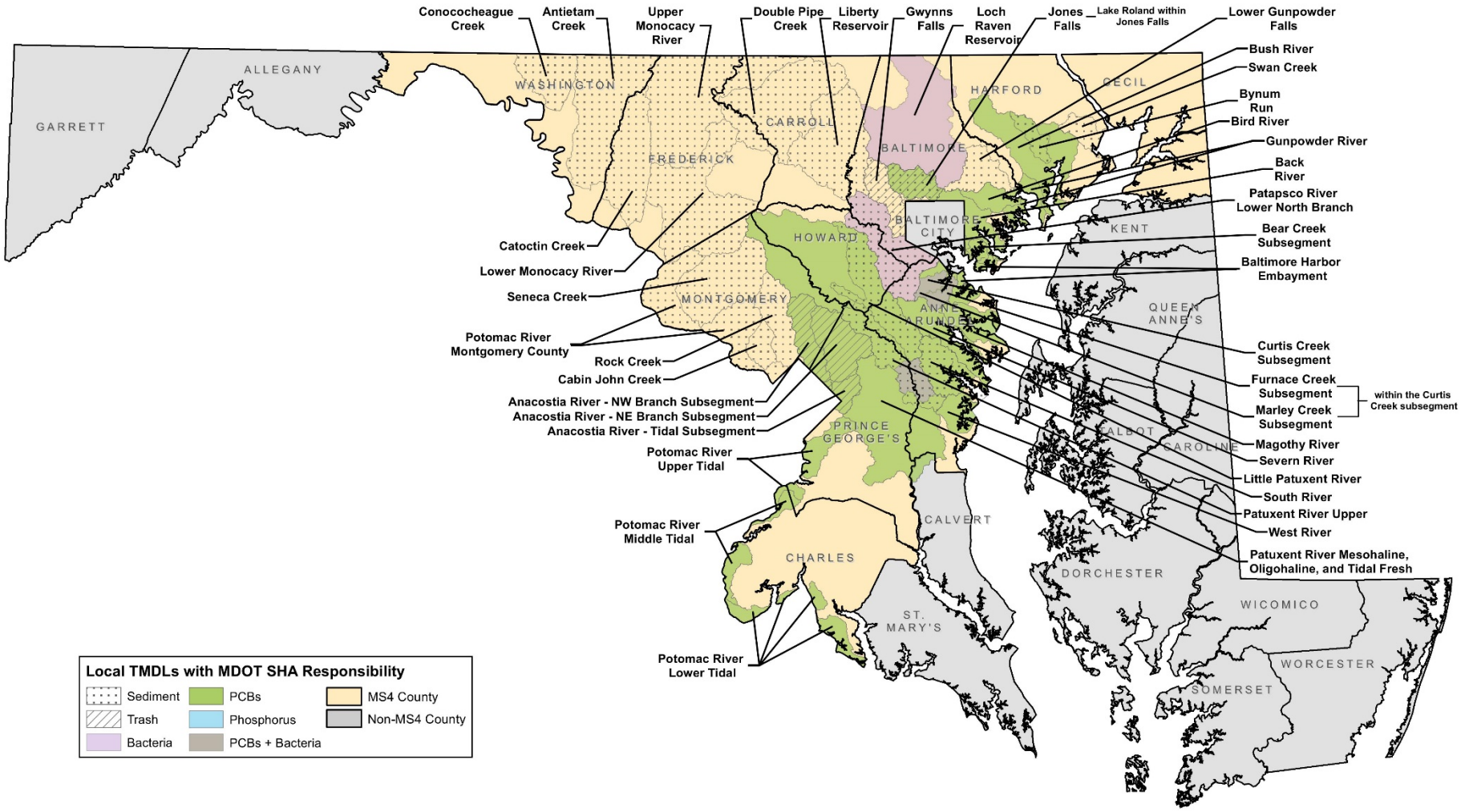


Figure 4: MDOT SHA TMDL Responsibilities in Local Watersheds

Table 2: MDOT SHA Lower Gunpowder Falls 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
Lower Gunpowder Falls	02130802	BA	Sediment	05/04/2017	Individual WLA	2009	Lbs./yr.	259,919	67.0%	174,146	85,773	25,972	2040

E.2. Sediment Pollution Reduction Strategy

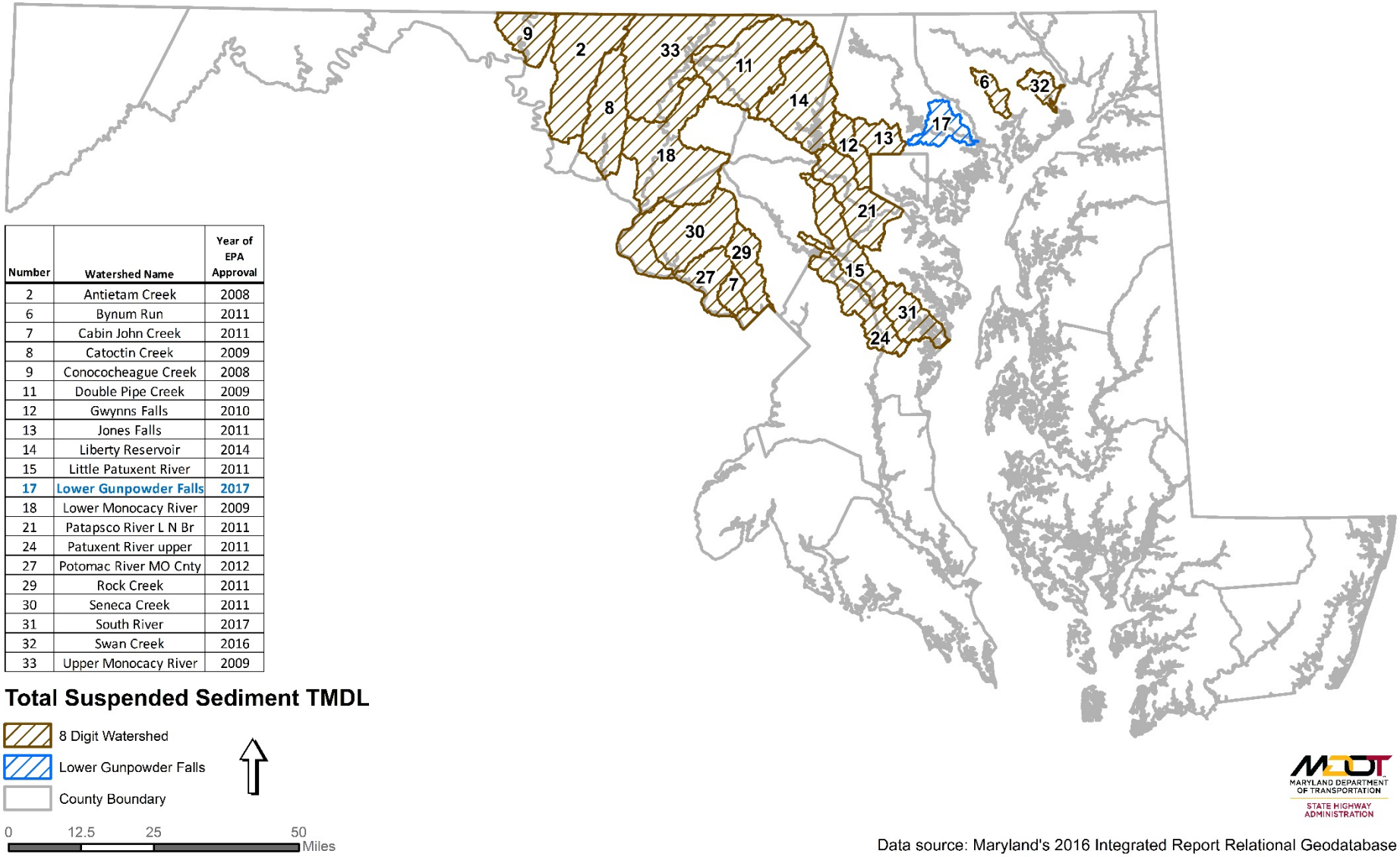
E.2.a. Sediment TMDLs Affecting MDOT SHA

There are many EPA-approved sediment TMDLs within Maryland and **Figure 5** 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 Lower Gunpowder Falls Watershed, Baltimore County, Maryland, approved by EPA on May 4, 2017.*

In **Table 2,** the MDOT SHA reduction target for the Lower Gunpowder Falls sediment TMDL is 67 percent, or 174,146 lbs/yr. The watershed can safely receive 85,773 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 Lower Gunpowder Falls 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 25,972 pounds to the watershed.

Three dates are shown: 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.



Number	Watershed Name	Year of EPA Approval
2	Antietam Creek	2008
6	Bynum Run	2011
7	Cabin John Creek	2011
8	Catoctin Creek	2009
9	Conococheague Creek	2008
11	Double Pipe Creek	2009
12	Gwynns Falls	2010
13	Jones Falls	2011
14	Liberty Reservoir	2014
15	Little Patuxent River	2011
17	**Lower Gunpowder Falls**	**2017**
18	Lower Monocacy River	2009
21	Patapsco River L N Br	2011
24	Patuxent River upper	2011
27	Potomac River MO Cnty	2012
29	Rock Creek	2011
30	Seneca Creek	2011
31	South River	2017
32	Swan Creek	2016
33	Upper Monocacy River	2009

Figure 5: MDOT SHA Sediment TMDL Responsibilities in Local Watersheds

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, adequate numbers of practices have not been identified that reach 100% of the reduction requirement for the Lower Gunpowder Falls, however MDOT SHA believes that it will be able to reach the reduction target by 2040. We will continue assessing this potential and will adjust the end date as needed. MDOT SHA will continue to explore the possibility of nutrient credit trading or partnerships, which cannot be modeled at this time. Also, future changes to current BMP removal rates or efficiencies will be reviewed to determine impacts to our anticipated Lower Gunpowder Falls sediment WLA end date.

F. MDOT SHA LOWER GUNPOWDER FALLS WATERSHED SEDIMENT TMDL IMPLEMENTATION PLAN

F.1. Watershed Description

Located entirely within the central eastern portion of Baltimore County, Maryland, the Lower Gunpowder Falls watershed (Maryland 8-digit Basin Code: 02130802) generally drains eastward toward the tidal portions of the Gunpowder River. The Gunpowder River is formed by the joining of two major tributaries: Little Gunpowder Falls and the mainstem or "Big" Gunpowder Falls (hereinafter referred to as the "mainstem Gunpowder Falls"). Streams within the Lower Gunpowder Falls watershed drain to the mainstem Gunpowder Falls, which joins the Little Gunpowder Falls before flowing into the Gunpowder River. The Gunpowder River, in turn, ultimately flows into the Chesapeake Bay.

The designated use of the non-tidal portion of the Lower Gunpowder Falls is a combination of Use Class I – Water Contact Recreation and Protection of Nontidal Warmwater Aquatic Life; Use Class III – Nontidal Coldwater Aquatic Life; and Use Class IV – Recreational Trout Waters (MDE, 2017).

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

- Chlorides;
- Sulfates; and
- TSS.

MDOT SHA is included in the sediment TMDL (MDE, 2017), with a reduction requirement of 67 percent, as shown in **Table 2**. This TMDL only applies to the non-tidal portion of the Lower Gunpowder Falls watershed. There are no other pollutants with TMDLs and MDOT SHA WLAs for this watershed.

The Lower Gunpowder Falls watershed is approximately 46 square miles (29,000 acres), not including water/wetlands. The water/wetlands within the Lower Gunpowder Falls watershed comprises approximately 0.1 square miles (80 acres). While the lower portion of the watershed extends slightly into Maryland's Coastal Plain geologic province, the majority of the Lower Gunpowder Falls watershed lies within the Eastern Piedmont province. In addition to the mainstem Gunpowder Falls, other major tributaries in the watershed include Cowen Run, Long Green Creek, Haystack Branch, Sweathouse Run, Minebank Run, Jennifer Branch, and Bean Run.

There are 25.93 centerline miles of MDOT SHA roadway located within the Lower Gunpowder Falls watershed. The associated ROW encompasses approximately 222 acres, of which approximately 126 acres are impervious. MDOT SHA facilities located within the Lower Gunpowder Falls watershed consist of three park and ride facilities:

- IS-695 at Cromwell Bridge Road
- IS-695 at Providence Road
- US-1 at Gunpowder Falls

See **Figure 6** for a map of MDOT SHA facilities within the Lower Gunpowder Falls watershed.

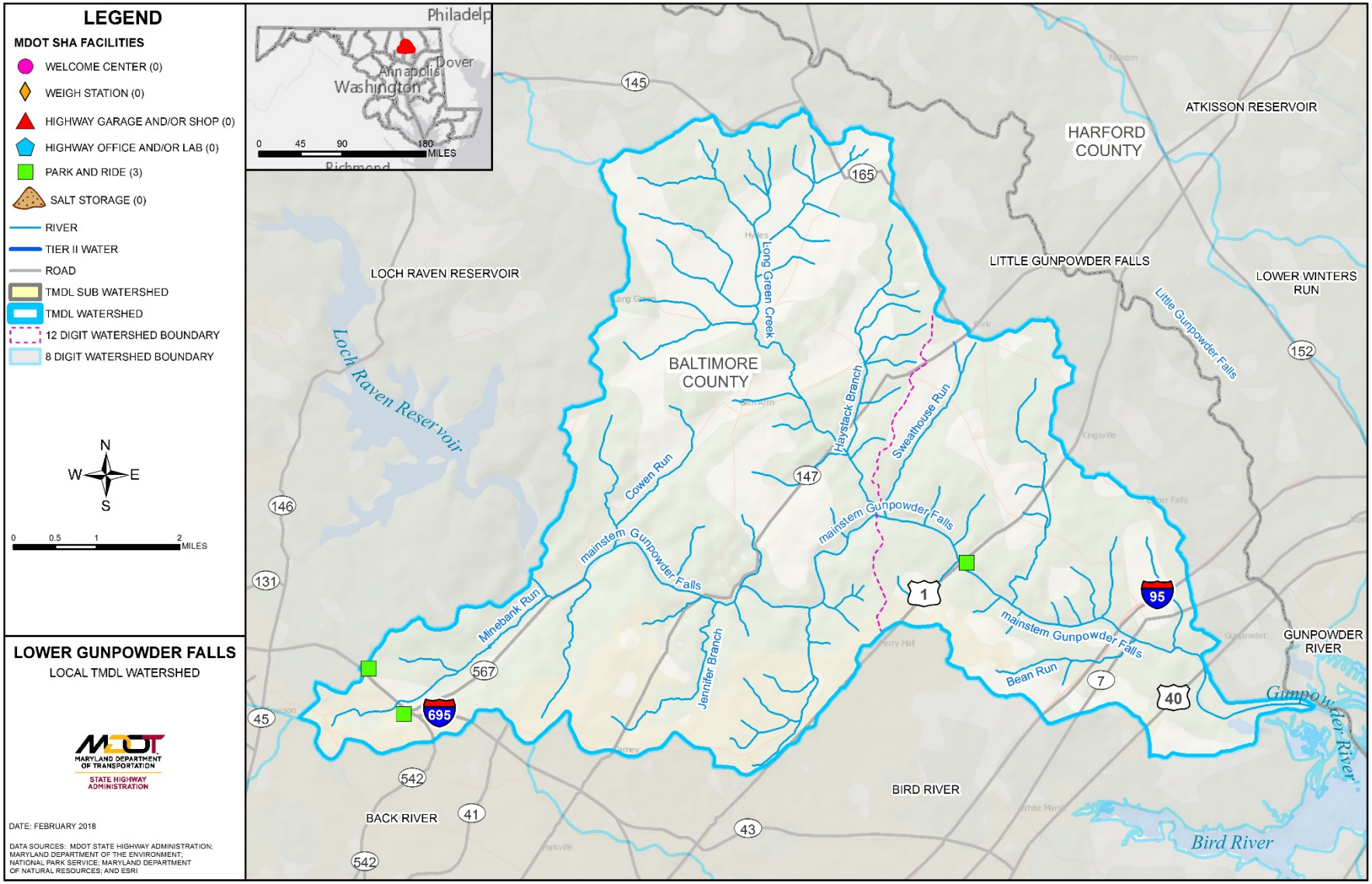


Figure 6: Lower Gunpowder Falls Watershed

F.2. Summary of County Assessment Review

Due to the unique geographic divide that the mainstem Gunpowder Falls creates within the Lower Gunpowder Falls watershed, the Baltimore County Department of Environmental Protection and Sustainability (BC-DEPS) has completed two Small Watershed Action Plans (SWAPs) for the watershed—one for the rural portion above the mainstem Gunpowder Falls (northern side) and one for the urban portion of the watershed below the mainstem Gunpowder Falls (southern side).

More specifically, according to BC-DEPS, there is "very rural countryside to the north and a very urbanized area on the southern side" (BC-DEPS, 2017, "Lower Gunpowder Falls," para. 2). The BC-DEPS further describes the northern and southern side of the mainstem Gunpowder Falls through the watershed as follows:

> *The land to the north is primarily agricultural in nature and includes the communities of Long Green, Hydes, Glen Arm, Fork, Kingsville and Upper Falls. Land south of the river consists of developed areas such as parts of Towson, Carney, and Parkville, the commercial corridor along Joppa Road, and newer, rapidly developing areas such as Perry Hall. The valley forming the Lower Gunpowder Falls main stem consists of heavily forested lands that are part of the Gunpowder Falls State Park. (BC-DEPS, 2017, "Lower Gunpowder Falls," para. 2)*

The following provides a summary of both the rural and urban SWAPS completed for the Lower Gunpowder Falls watershed in 2017 and 2016, respectively. It is important to note that Baltimore County has assigned a letter identifier to all Baltimore County watershed areas with an associated SWAP. Accordingly, Baltimore County has assigned the upper, rural portion of the Lower Gunpowder Falls watershed with the letter "Q" and the lower, urban portion of the Lower Gunpowder Falls watershed with the letter "N."

BC-DEPS SWAP for Lower Gunpowder Falls (Rural) – "Area Q"

Prepared by the Center for Watershed Protection (CWP), KCI Technologies, and Coastal Resources, Inc. for the BC-DEPS, the 2017 *Lower Gunpowder Falls (Rural) Small Watershed Action Plan: Final Report* is Baltimore County's SWAP for the rural portion of the Lower Gunpowder Falls watershed (CWP et al., 2017). According to Baltimore County's letter identifier system discussed above, the rural/upper portion of the Lower Gunpowder Falls watershed is hereinafter referred to as "Area Q" and its associated SWAP as the "Area Q SWAP."

The Area Q SWAP provides an assessment of the following six subwatersheds that compose Area Q:

- Cowen Run;
- Long Green Creek;
- Haystack Branch;
- Sweathouse Run;
- Lower Gunpowder Falls–West; and
- Lower Gunpowder Falls–East.

Each of the subwatersheds are located around its corresponding tributary. The Lower Gunpowder Falls–West subwatershed surrounds the upper, western half of the mainstem Gunpowder Falls while the Lower Gunpowder Falls–East subwatershed surrounds the upper, eastern half of the mainstem Gunpowder Falls. All of the subwatersheds drain south towards the mainstem Gunpowder Falls (see **Figure 6**).

Water quality within Area Q is largely affected by nitrogen, phosphorus, and sediment inputs. Using ranking criteria to prioritize the six subwatersheds within the rural Lower Gunpowder Falls watershed,

Baltimore County numerically ranked the six subwatersheds based on their potential for restoration and need for protection (The final rankings are provided in **Table 4**).

Restoration ranks were assigned based on the following eleven criteria:

- Total Nitrogen and Total Phosphorus Loads;
- Biological Indicators;
- Impervious Surfaces;
- Institutional Site Investigation;
- Hotspot Site Investigation;
- Neighborhood Restoration Opportunity/Pollution Severity Indices;
- Neighborhood Lawn Fertilization Reduction/Awareness;
- Stream Buffer Improvement;
- Stream Restoration Potential;
- Septic Systems; and
- Pervious Area Assessment.

A brief description of each restoration ranking criterion and the results of the ranking are as follows (CWP et al., 2017):

Total Nitrogen and Total Phosphorus Loads: Annual total nitrogen and total phosphorous loads (lbs/year) were calculated using the pre-defined land use-based loading rates (lbs/acre/year) provided by the Baltimore County Land Cover Dataset and the Chesapeake Bay Program. The subwatersheds within Area Q that experience higher rates of nitrogen and phosphorus loading received higher restoration scores and lower protection scores for this criterion. Long Green Creek had the highest nitrogen loading rate and the highest phosphorus loading rate.

Biological Indicators: Both the Fish Index of Biotic Integrity (FIBI) and the Benthic Index of Biotic Integrity (BIBI) were used to score for biological indicators. The data used for these calculations was provided by BC-DEPS and the Maryland Department of Natural Resources-led Maryland Biological Stream Survey. Restoration scores for subwatersheds were higher when biological indicators were lower. Long Green Creek was in the highest need of restoration based on this criterion.

Impervious Surfaces: Impervious surfaces cover 9 percent of Area Q; therefore, Area Q is classified as a "sensitive" watershed, just under the "impacted" classification threshold. Sensitive watersheds have less than 10 percent impervious surface and are typified by stable channels, good habitat, and good to high water quality. In contrast, impacted watersheds have between 10 and 25 percent impervious cover and generally show obvious signs of degradation such as channel widening and a decline in stream habitat. Accordingly, impervious surface cover was estimated for each of the six subwatersheds within Area Q. Lower Gunpowder Falls–West had the lowest amount of impervious surface at 6.5 percent, whereas Cowen Run had the highest amount of impervious surface at 11.6 percent. The Area Q SWAP notes that this relatively low impervious cover range of 6.5 to 11.6 percent may, however, be somewhat misleading because the estimates were provided at the subwatershed scale. This would, for example, not account for potential pockets of concentrated development with much higher impervious cover within Area Q. In addition, the Area Q SWAP cites research showing the inability of brook trout to survive in watersheds with impervious cover percentages above 4 percent.

Institutional Site Investigation: Several institutional sites within Area Q were assessed to identify privately managed properties that have restoration potential. Institutional properties have a high potential for public involvement in restoration activities like stormwater retrofitting and tree planting. Scores were assigned based on the total land area of institutional sites with identified restoration actions within a subwatershed. Containing 170 acres of institutional land sites with identified restoration activities, the Lower Gunpowder Falls–East received the highest score under this criterion. The Haystack Branch

and Lower Gunpowder Falls–West subwatersheds did not receive a score under this criterion because they have no institutional land available for restoration activities.

Hotspot Site Investigation: According to the Area Q SWAP, a hotspot is a designated site where stormwater has a higher probability of transporting above average pollutant concentrations through runoff. Pollutants that may be present in hotspot areas include nutrients, hydrocarbons, metals, chloride, pesticides, bacteria, and trash. Sites that underwent these investigations are categorized as a "confirmed hotspot," "potential hotspot," or "not a hotspot." With four potential hotspots, Long Green Creek contained the highest number of hotspots, thereby scoring the highest for restoration prioritization. The Lower Gunpowder Falls–East received the second highest restoration score and was the only subwatershed found to have a confirmed hotspot. The Area Q SWAP provides specific hotspot BMP recommendations for these two subwatersheds (see **Table 5** below).

Neighborhood Restoration Opportunity/Pollution Severity Indices: Thirty neighborhoods in the various subwatersheds of Area Q were investigated and rated according to a Pollution Severity Index (PSI) and Restoration Opportunity Index (ROI). The Lower Gunpowder Falls–East subwatershed had the most neighborhoods with a high or moderate PSI and ROI score; therefore, it is the most need of restoration based on this criterion.

Neighborhood Lawn Fertilization Reduction/Awareness: Residential lawns within each subwatershed underwent a visual survey to identify properties with high nutrient pollution through fertilizer use. Investigated properties were given a restoration ranking accordingly and are recommended for community engagement to reduce lawn fertilizer. Haystack Branch—the subwatershed with the greatest percentage of high maintenance lawns—received the greatest restoration potential score.

Stream Buffer Improvement: Stream buffer restoration opportunities were identified using GIS to classify the cover within 100-foot stream buffers into three categories: forests, impervious (e.g., roads and buildings), and open pervious (e.g., mowed lawns). Subwatersheds that contain a large amount of open pervious land within stream buffers are a higher priority for restoration. Long Green Creek contains the highest percentage of open pervious area within its stream buffers. Sweathouse Run received the highest protection score due to its high percentage of forested buffer.

Stream Restoration Potential: Subwatersheds were rated for stream restoration potential based on how many feet of potential stream restoration is present in each subwatershed. Subwatersheds with greater amounts of proposed stream restoration scored higher for potential restoration. Long Green Creek scored highest with a recorded 18,140 feet of proposed stream restoration.

Septic Systems: Septic systems are a potential source of pollution and should be monitored for functionality. The greater the number of septic systems in each subwatershed, the greater the restoration score assigned. There are approximately 2,684 septic systems in Area Q. With 860 septic systems, the Long Green Creek subwatershed scored the highest for potential restoration due to having the highest number of septic systems out of the six subwatersheds.

Pervious Area Assessment: A pervious area assessment was conducted in Area Q that identified parcels of land ideal for large scale tree planting. Tree planting activities can reduce runoff and increase community awareness of watershed management. Area Q has approximately 444 acres of planting opportunity. Subwatersheds were ranked based on the number of acres of tree planting opportunity available. Long Green Creek was ranked the highest priority for restoration as it contained the largest amount of land that would be ideal for tree planting.

In addition to restoration scores, protection scores were also assigned. The protection scores were based on the following five criteria:

- Total Nitrogen and Total Phosphorus Loads;
- Biological Indicators;
- Impervious Surfaces;
- Stream Buffer Improvement; and
- Agricultural Land in Easement.

The protection criteria include several of the same criterion and ranking methods as the restoration criteria. One notable exception is the "Agricultural Land in Easement" criterion:

Agricultural Land in Easement: The agricultural land protection scores were based on the amount of agricultural land not located in conservation easements. Conservation easements provide protection of agricultural lands as well as benefits to the land owners. Lower Gunpowder Falls–East has the highest amount of land located outside conservation easements; therefore, it scored the highest out of the six subwatersheds for protection.

Table 4 below provides the overall final ranking of each subwatershed based on the scores it received in each of the aforesaid priority restoration and protection criteria. The numeric scores in **Table 4** are provided to convey the degrees at which one subwatershed ranked higher or lower than another; details on the numeric scoring scale used to determine the overall final scores are provided in the Area Q SWAP.

Currently only 2.8 percent of urban land within Area Q is treated by stormwater BMPs. All suggested BMPs for the subwatersheds located in Area Q are shown in **Table 5**.

Table 4: County Identified Priority Areas for Restoration and Protection within the Lower Gunpowder Falls Watershed - Rural (Area Q)

Subwatershed	Total Restoration Score	Restoration Prioritization Category	Total Protection Score	Protection Prioritization Category
Cowen Run	60	Moderate	62	Moderate
Long Green Creek	88	High	40	Low
Haystack Branch	68	Moderate	58	Moderate
Sweathouse Run	51	Moderate	86	High
Lower Gunpowder Falls–West	33	Low	70	High
Lower Gunpowder Falls–East	74	High	81	High

Source: CWP et al. (2017)

Table 5: County Suggested BMPs for Subwatersheds within the Lower Gunpowder Falls Watershed - Rural (Area Q)						
Recommended Action	Cowen Run	Long Green Creek	Haystack Branch	Sweathouse Run	Lower Gunpowder Falls–West	Lower Gunpowder Falls–East
Tree Planting	✓	✓	✓	✓	✓	✓
Trash Management	✓			✓		✓
Stream Restoration (channel restoration, bank stabilization)	✓	✓	✓	✓	✓	✓
Stream Buffer Improvement/Reforestation	✓	✓	✓	✓	✓	✓
Storm Drain Marking	✓	✓	✓	✓	✓	✓
Downspout disconnection (rain gardens/barrels)		✓	✓	✓		✓
Stormwater Retrofit (includes wetland/SWM pond creation and conversions)	✓	✓	✓		✓	✓
Outfall Retrofit					✓	✓
Fertilizer Reduction (promote proper lawn care, encourage residents to reduce fertilizer use)	✓	✓	✓	✓		✓
Bayscaping		✓		✓		✓
Lot Canopy Improvement		✓		✓		✓
Hotspot Education		✓				✓
Evaluate Hotspot site by reviewing existing Stormwater Pollution Prevention Plan		✓				✓
Refer Hotspot for Enforcement						✓
Test Hotspot for Illicit Discharge						✓
Hotspot Follow-up Inspection						✓
Source: CWP et al. (2017)						

BC-DEPS SWAP for Lower Gunpowder Falls (Urban) – "Area N"

On behalf of BC-DEPS, Versar, Coastal Resources, and McCormick Taylor completed the *Lower Gunpowder Falls (Urban) Small Watershed Action Plan* in March of 2016 (Versar et al., 2016). This document serves as the official Baltimore County SWAP for the urban portion (below mainstem Gunpowder Falls) of the Lower Gunpowder Falls watershed.

According to the aforementioned Baltimore County letter identifier system, the urban/lower portion of the Lower Gunpowder Falls watershed is hereinafter referred to as "Area N" and its associated SWAP as the "Area N SWAP."

According to the Area N SWAP, impervious land cover comprises 1,753 acres (16.6 percent) of Area N and 9.1 percent of the soils within Area N are considered high runoff potential. Agriculture makes up 7.1 percent of the land use in the watershed, while forest makes up 26.2 percent. Baltimore County estimates that impervious urban land use is responsible for contributing 28,536 lbs of nitrogen; 2,483 lbs of phosphorus; and 3,193,080 lbs of sediment in Area N per year. Stormwater runoff was the primary contributor of nutrient and sediment inputs to Area N.

The Area N SWAP is organized around the analysis of the following seven subwatersheds that compose Area N:

- Minebank Run;
- Jennifer Branch;
- Bean Run;
- Lower Gunpowder Falls–A;
- Lower Gunpowder Falls–B;
- Lower Gunpowder Falls–C; and
- Lower Gunpowder Falls–D.

Each of these subwatersheds are located around its corresponding tributary. The Lower Gunpowder Falls–A, B, C, D surround the mainstem Gunpowder Falls on its southern side in alphabetic order, with the Lower Gunpowder Falls–A on the far western side and the Lower Gunpowder Falls–D being the farthest east. All of the subwatersheds drain north towards the mainstem Gunpowder Falls (see **Figure 6**).

Water quality within Area N is largely affected by nitrogen, phosphorus, and sediment inputs. Using ranking criteria to prioritize the seven subwatersheds within the urban Lower Gunpowder Falls watershed, Baltimore County numerically ranked the seven subwatersheds based on their potential for restoration and need for protection.

Restoration and protection ranks were assigned based on the following ten criteria:

- Total Nitrogen and Total Phosphorus Loads;
- Impervious Surfaces;
- Institutional Site Investigation;
- Neighborhood Restoration Opportunity/Pollution Severity Indices;
- Stream Buffer Improvement;
- Stream Restoration Potential;
- Pervious Area Assessment;
- Neighborhood Downspout Disconnection;
- Stormwater Pond Conversions; and
- Illicit Discharge Data.

The ranking criteria for Area N shares several of the same criterion used to rank Area Q discussed above, with the exception of Neighborhood Downspout Disconnection; Stormwater Pond Conversions; and Illicit Discharge Data.

A brief description of each restoration ranking criterion and the results of the ranking are as follows (Versar et al., 2016):

Total Nitrogen and Total Phosphorus Loads: Lower Gunpowder Falls–B had the highest nitrogen loading rate; Lower Gunpowder–D had the highest phosphorus loading rate.

Impervious Surfaces: Lower Gunpowder Falls–B had the highest impervious cover at 21 percent, followed by Minebank Run with 19 percent impervious cover.

Institutional Site Investigation: The Lower Gunpowder Falls–B and Jennifer Branch subwatersheds have the most institutional site restoration opportunities.

Neighborhood Restoration Opportunity/Pollution Severity Indices: Minebank Run and Lower Gunpowder Falls–D contained the most neighborhood area ranked as high priority for restoration.

Stream Buffer Improvement: Lower Gunpowder Falls–C has the highest potential for stream buffer improvement.

Stream Restoration Potential: Stream restoration was recommended in four of the seven subwatersheds, with the Lower Gunpowder Falls–B subwatershed having the most linear feet of stream restoration potential. The three subwatersheds where no stream restoration was recommended were Jennifer Branch, Minebank Run, and Lower Gunpowder Falls–D. This is because Jennifer Branch and Minebank Run have already undergone extensive stream restoration, and there were no identified opportunities in Lower Gunpowder Falls–D.

Pervious Area Assessment: Pervious area assessments were conducted to find sites that were best suited for large-scale tree plantings. Only three subwatersheds contained acreage recommended for reforestation: Jennifer Branch, Lower Gunpowder Falls–B, and Minebank Run. Minebank Run had the most acres recommended for reforestation (13.8 acres).

Neighborhood Downspout Disconnection: Unlike connected downspouts that discharge rooftop runoff directly to the storm drain system or to impervious surfaces, disconnected downspouts allow rooftop runoff to drain to pervious areas such as yards, rain barrels, or rain gardens. Disconnected downspouts allow for slower flow and a reduction in pollution entering streams during storm events. All seven of the subwatersheds contained areas recommended for downspout disconnection.

Stormwater Pond Conversions: The County identified fifteen stormwater management facilities within the watershed that would be good candidates for detention pond conversion to improve water quality treatment. Before the completion of the SWAP, eleven of the fifteen ponds had already been converted, and the remaining four were planned for future conversion. The four planned future conversion projects would take place in Jennifer Branch and Lower Gunpowder Falls–B.

Illicit Discharge Data: Baltimore County tracks illicit discharges via an outfall screening program. Illicit discharges refer to any inputs into the storm sewer system that are not stormwater, or otherwise permitted. Jennifer Branch and Minebank Run were both ranked critical based on this criterion; therefore, illicit discharge in these two subwatersheds should be addressed first.

The subwatersheds were placed into one of four restoration priority categories based on the ranking results: very high, high, medium, and low. The Lower Gunpowder Falls–B subwatershed was ranked as the first priority for restoration, in the Very High prioritization category. The Jennifer Branch, Minebank Run, and Lower Gunpowder Falls–A subwatersheds were ranked second, third, and fourth, respectively, all

in the High prioritization category. The remaining three subwatersheds were in the Low prioritization category: Lower Gunpowder Falls–C was ranked fifth priority, and Bean Run and Lower Gunpowder Falls–D were tied for sixth. Protection priority categories were also assigned. A summary of the final results of the restoration and priority protection rankings can be found in **Table 6**. The numeric scores are provided to convey the degrees at which one subwatershed ranked higher or lower than another; details on the numeric scoring scale are provided in the Area N SWAP.

Baltimore County suggested BMPs for Area N are shown in **Table 7**.

Table 6: County Identified Priority Areas for Restoration and Protection within the Lower Gunpowder Falls Watershed - Urban (Area N)

Subwatershed	Total Restoration Score	Restoration Prioritization Category	Total Protection Score	Protection Prioritization Category
Minebank Run	26	High	26	Medium
Jennifer Branch	29	High	29	Medium
Bean Run	18	Low	18	Very High
Lower Gunpowder Falls–A	25	High	25	Medium
Lower Gunpowder Falls–B	37	Very High	37	Low
Lower Gunpowder Falls–C	19	Low	19	Very High
Lower Gunpowder Falls–D	18	Low	18	Very High

Source: Versar et al. (2016)

Table 7: County Suggested BMPs for Subwatersheds within the Lower Gunpowder Falls Watershed - Urban (Area N)							
Recommended Action	Minebank Run	Jennifer Branch	Bean Run	Lower Gunpowder Falls–A	Lower Gunpowder Falls–B	Lower Gunpowder Falls–C	Lower Gunpowder Falls–D
Tree Planting	✓	✓	✓	✓	✓	✓	✓
Stormwater Retrofit	✓	✓		✓	✓		
Trash Management	✓	✓		✓	✓		
Stream Buffer Improvement	✓	✓	✓	✓	✓	✓	✓
Remove Impervious Cover	✓	✓		✓			
Storm Drain Marking	✓	✓	✓	✓	✓	✓	✓
Downspout Disconnection (rain gardens/barrels)	✓	✓	✓	✓	✓	✓	✓
Bayscaping	✓	✓	✓	✓	✓	✓	✓
Parking Lot/Alley Retrofit	✓	✓		✓	✓		
Pet Waste Education		✓	✓	✓	✓		
Stream Restoration			✓	✓	✓	✓	
Source: Versar et al. (2016)							

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. The implementation teams have preliminarily evaluated each grid and major State route corridors within the watershed as part of a desktop evaluation. The grid-system for this watershed is shown in **Figure 7**.

The current results of this visual assessment are as follows:

- 39 total grids have been reviewed, which encompasses portions of nine State route corridors (**Figure 7**).
- Four new SWM facilities resulting in 7.38 acres of impervious restoration are currently under construction including three bioretention and one grass swale. A number of potential locations have been identified as possible candidate sites for new SWM BMPs; however, MDOT SHA is currently evaluating the cost-effectiveness of these potential opportunities.
- 48.5 acres of tree plantings have been constructed resulting in 18.4 acres of impervious restoration. There are an additional 10.2 acres of tree plantings that are currently in design or under construction. It is anticipated that these will be planted by 2024, which will result in 3.8 acres of impervious restoration.

- Stream restoration investigations have also been completed within this watershed; however, at this time there are no sites under construction or design.

At this time, MDOT SHA has prioritized and focused efforts on developing, adapting, and implementing restoration efforts targeting the overall 20 percent requirement for the eleven MS4 counties by 2020. The complexity and intricacies that have been encountered for implementing each BMP type, limitations in right-of-way, permitting delays, funding constraints, and time constraints imposed for meeting the 2020 deadline make it very difficult for MDOT SHA to prioritize meeting individual watershed TMDLs at this time.

However, overall planning efforts to meet the 20 percent requirement do target local watersheds across the eleven counties. Once the 20 percent restoration requirement is met, MDOT SHA plans to re-prioritize implementation efforts within local TMDL watersheds, considering the most cost-effective strategies along with impending future permit requirements that may be necessary.

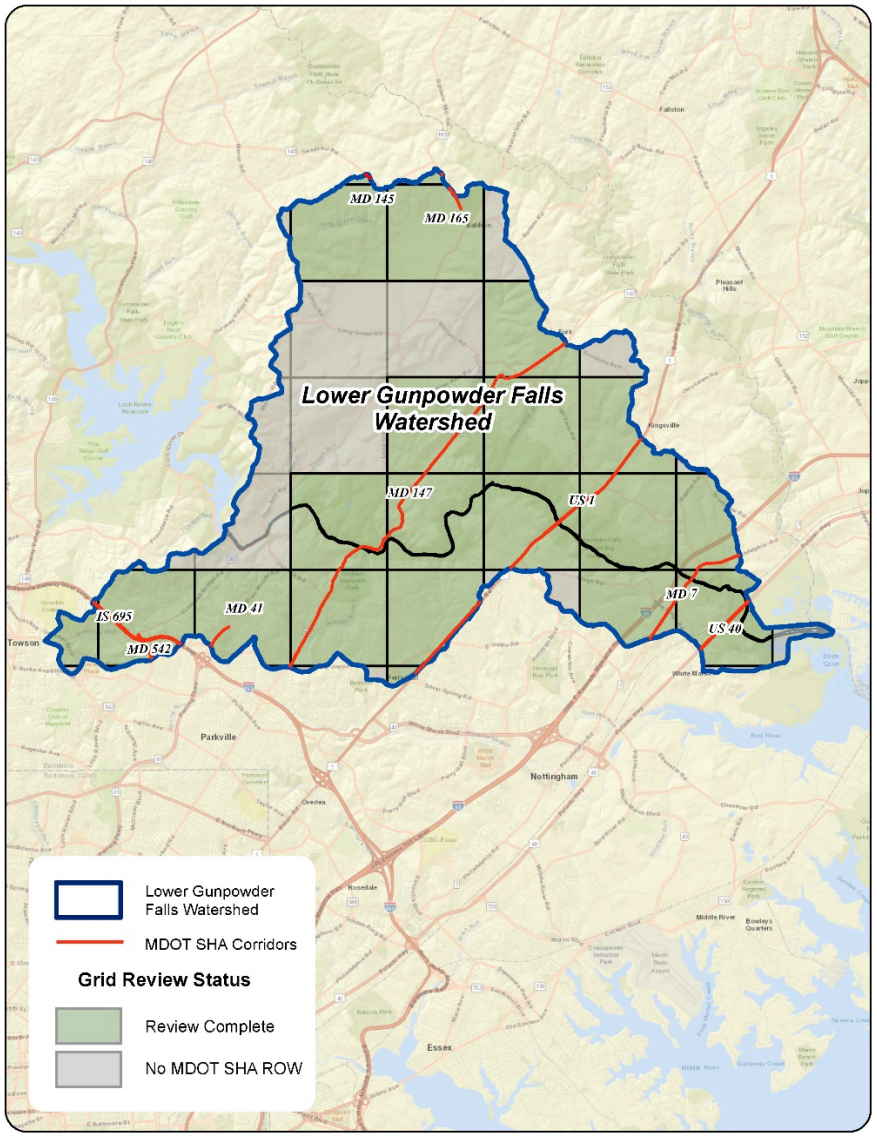


Figure 7: Lower Gunpowder Falls Watershed Site Search Grids

F.4. MDOT SHA Pollutant Reduction Strategies

Proposed practices that are currently programmed for implementation to meet the sediment reductions in the Lower Gunpowder Falls watershed are shown in **Table 8**. Projected sediment reductions using these practices are 25,971 lbs which is 15% 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 calendar year 2017; and
- BMPs built after calendar year 2017 through 2040, the projected target date.

The currently programmed BMPs will not meet the reduction requirement shown in **Table 2**. It is anticipated that MDOT SHA will focus additional efforts to identifying and implementing BMPs for this watershed once the 2020 impervious restoration requirement has been accomplished for the 2020 MS4 permit term.

Estimated Capital Budget costs to design and construct the programmed practices within the Lower Gunpowder Falls watershed total $1,863,727. 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 8 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 8: Lower Gunpowder Falls TSS BMP Implementation

BMP	Unit	Baseline (Before 2010)	Restoration BMPs		Restoration Cost
			Progress (2010 – CY17)	Future (After CY17)	
Stormwater	drainage area acres	12.4		16.9	$1,173,211
Tree Planting	acres of tree planting		48.5	10.2	$690,516
Inlet Cleaning[1]	dry tons		3.0	6.4	$23,790
Load Reductions	**TSS EOS lbs/yr**	**12,885**	**8,637**	**17,334**	

[1] *Inlet cleaning is an annual practice.*

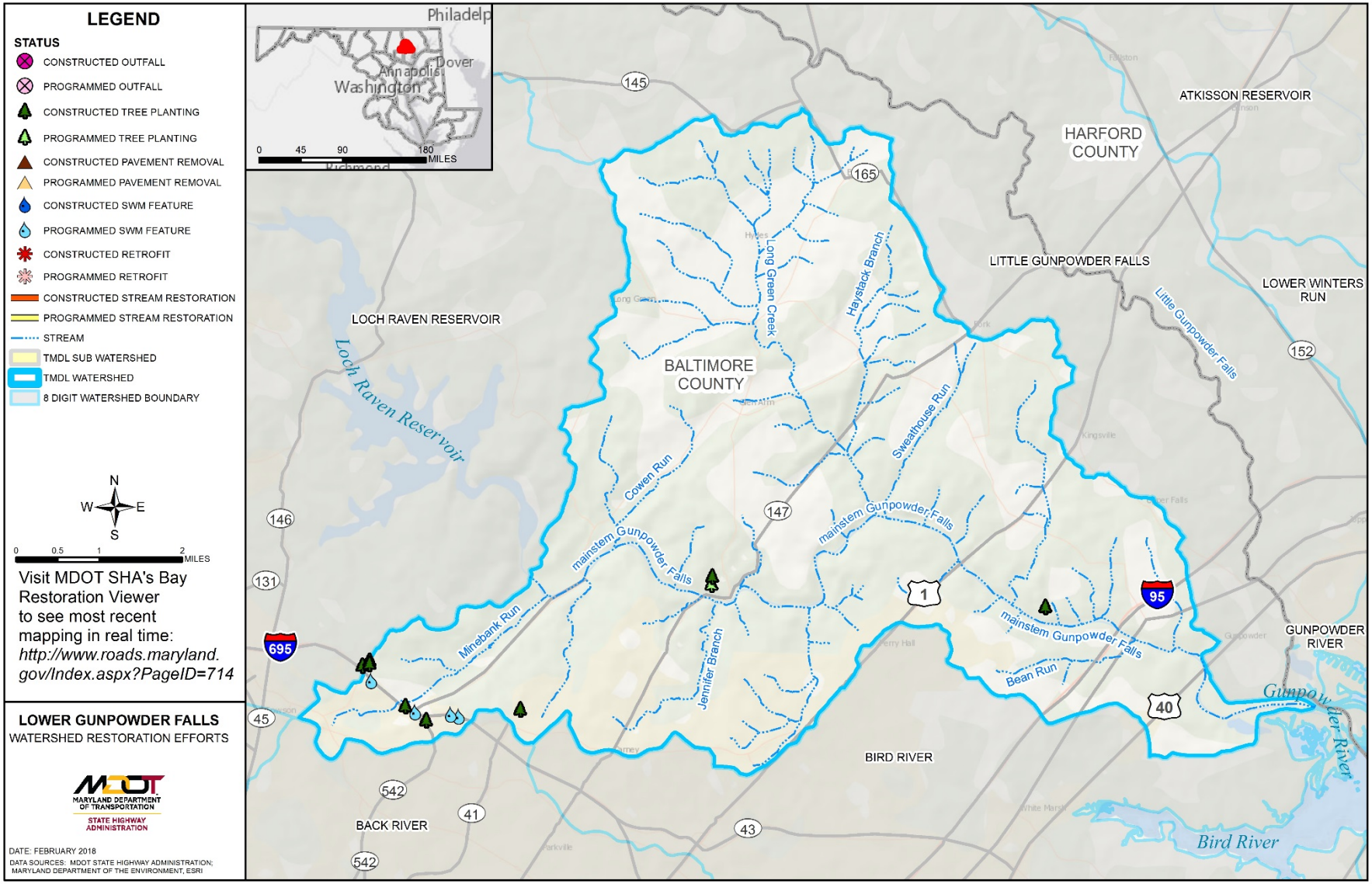


Figure 8: MDOT SHA Programmed Restoration Strategies within the Lower Gunpowder Falls Watershed

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

REFERENCES

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

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