

Potomac Direct Watershed Assessment

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Table of Contents

Appendices	ii
List of Figures	ii
List of Tables	iii
List of Abbreviations	iv
Executive Summary	ES-1
1. Introduction and Intent	1-1
1.1 Watershed Background	1-1
1.2 Watershed Study and Intent	1-5
2. Existing Watershed Conditions and Pollutant Loads	2-1
2.1 Overall Watershed Health	2-1
2.1.1 Frederick County Stream Survey	2-1
2.1.2 Existing Stormwater Best Management Practices (BMPs)	2-3
2.2 Pollutant Loads	2-5
2.2.1 Potomac Direct (Frederick County) Watershed – No TMDLs Assigned	2-6
2.2.2 Potomac Direct (Montgomery County) Watershed – Sediment TMDL	2-6
2.3 Restoration Goals	2-7
3. Methodology	3-1
3.1 Overall Approach	3-1
3.2 Preliminary Watershed Assessment	3-1
3.3 Desktop Site Assessment	3-3
3.3.1 Stormwater BMP Opportunities	3-3
3.3.2 New Stormwater Opportunities	3-3
3.3.3 Stream Restoration	3-4
3.4 Field Site Assessment	3-5
3.4.1 BMP Assessments	3-5
3.4.2 Stream Assessments	3-5
3.5 Evaluation and Ranking Criteria	3-6
4. Potential Opportunities	4-1
5. Project Prioritization and Implementation Schedule	5-1
5.1 Results of Project Prioritization	5-1
5.2 Implementation Schedule	5-2
6. Recommended Priority Projects	6-1
6.1 Identified High Priority Sites	6-1
6.2 Associated TMDLs and Pollutant Load Reductions	6-2

- 6.2.1 Streams.....6-2
- 6.2.2 BMPs6-3
- 6.2.3 Overall Pollutant Reduction from Prioritized Projects6-3
- 7. Public Education and Outreach.....7-1
 - 7.1 Outreach Related to The Monocacy & Catoctin Watershed Alliance.....7-1
- 8. Monitoring.....8-1
 - 8.1 Load Reduction Evaluation Criteria8-1
 - 8.2 Monitoring8-1
 - 8.2.1 Targeted Restoration Monitoring.....8-2
 - 8.2.2 Frederick County Stream Survey (FCSS)8-2
 - 8.2.3 State Monitoring Efforts8-2
- 9. Limitations9-1
- 10. References 1

Appendices

- Appendix A – Field Site Assessment Summary.....A-1
- Appendix B – Potential Opportunities, Ranking and Summary Information B-1
- Appendix C – Concept DesignsC-1
- Appendix D – GIS D-1

List of Figures

- Figure 1-1. Vicinity Map1-2
- Figure 1-2. Potomac Direct Watershed Land Use Map1-4
- Figure 1-3. General Overview of the Watershed Assessment Process.....1-5
- Figure 2-1. Potomac Direct Watershed Existing BMPs.....2-4
- Figure 2-2. Frederick County Local TMDLs (Frederick County, 2018).....2-5
- Figure 2-3. Aerial Imagery Depicting No Urban Impervious Land within the Frederick County Portion of the Potomac Direct Montgomery County Watershed.2-6
- Figure 3-1. Average BIBI Score Category for Frederick County Watersheds3-2
- Figure 4-1. Priority BMPs Selected for Potomac Direct Watershed.....4-1
- Figure 4-2. Priority Stream Restoration Sites Selected for Potomac Direct Watershed.....4-4

List of Tables

Table 1-1. Land Cover in the Potomac Direct Frederick County Watershed	1-3
Table 2-1. Potomac Direct Watershed – Impervious Surface Ratings from Round 2 FCSS	2-1
Table 2-2. Potomac Direct Watershed – Habitat Ratings from Round 2 FCSS	2-2
Table 2-3. Potomac Direct Watershed – Bank Erosion Ratings from Round 2 FCSS	2-2
Table 2-4. Potomac Direct Watershed – Riparian Buffer Ratings from Round 2 FCSS	2-2
Table 2-5. Potomac Direct Watershed – Water Quality Ratings from Round 2 FCSS	2-3
Table 2-6. Existing BMPs within Potomac Direct MS4 Permit Area, Frederick County.....	2-3
Table 2-7. TMDL Summary for Potomac Direct Watershed	2-6
Table 3-1. OSER BMP Prioritization Criteria	3-6
Table 3-2. OSER Stream Prioritization Criteria.....	3-8
Table 4-1. BMP Opportunities Identified During Desktop Assessment.....	4-2
Table 4-2. Stream Restoration Opportunities Identified During Desktop Assessment	4-5
Table 5-1. BMP Prioritization.....	5-1
Table 5-2. Stream Restoration Opportunities Identified During Desktop Assessment	5-2
Table 6-1. Cost Estimates for Recommended Priority Projects within Potomac Direct, Frederick County.....	6-1
Table 6-2. Anticipated Treatment from Prioritized Stream Restoration Projects.....	6-2
Table 6-3. Anticipated Treatment from Prioritized BMP Retrofit Projects.....	6-3
Table 6-4. Anticipated Treatment from Prioritized Stream Restoration and BMP Retrofit Projects..	6-3

List of Abbreviations

ac	acre
BC	Brown and Caldwell
BIBI	Benthic Index of Biotic Integrity
BMP	best management practice
CBWM	Chesapeake Bay Watershed Model
CWP	Center for Watershed Protection
DNR	Maryland Department of Natural Resources
EPA	Environmental Protection Agency
ESD	Environmental Site Design
FCSS	Frederick County Stream Survey
GIS	geographical information system
HOA	homeowner's association
HUC	hydrologic unit code
lbs	pounds
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MS4	Municipal Separate Storm Sewer System
NPDES	National Pollutant Discharge Elimination System
OSER	Frederick County Office of Sustainability and Environmental Resources
PHI	Physical Habitat Index
RRI	Retrofit Reconnaissance Investigations
RSC	regenerative stormwater conveyance
TN	total nitrogen
TP	total phosphorus
TMDL	total maximum daily load
TSS	total suspended solids (sediment)
WLA	wasteload allocation
WSSI	Wetland Studies and Solutions, Inc.
yr	year

Executive Summary

Frederick County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase I Permit, Chesapeake Bay Total Maximum Daily Load (TMDL), and local watershed TMDLs require the County to identify and prioritize structural and nonstructural water quality improvement projects within its watersheds. Specifically, the County's NPDES MS4 Phase I Permit requires the County to develop detailed watershed assessments for each of its Maryland's hierarchical eight-digit sub-basins located within the entire County. These assessments must identify and rank projects geared towards meeting applicable pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater Waste Load Allocations (WLAs). The goal of this Potomac River Direct Watershed Assessment is to provide a roadmap to use strategic restoration efforts for meeting NPDES MS4 Phase I and Chesapeake Bay TMDL requirements in the most cost-effective manner and to improve water quality.

There are two different Potomac Direct Watersheds - Montgomery County and Frederick County. The Potomac Direct Frederick County watershed does not have any local TMDLs or Stormwater Wasteload Allocations approved by Environmental Protection Agency while the Potomac Direct Montgomery County watershed has an approved sediment allocation. Based on Maryland Department of Planning (MDP) GIS land use layer from 2002 which delineated urban areas for baseline load calculations, the analysis showed no urban area in Frederick County's portion of this small watershed, which was confirmed through review of digital aerial imagery. There are no calculated loads and no feasible sites for treatment within the Potomac Direct Montgomery County portion located within Frederick County.

In 2018, Brown and Caldwell (BC) and Wetland Studies and Solutions, Inc. (WSSI) conducted a Watershed Assessment for the portion of the Potomac Direct Frederick County watershed. Work elements included requirements outlined in Part IV.E.1 of the Frederick County NPDES MS4 permit. These requirements consist of:

- Determination of current water quality conditions;
- Visual watershed inspection;
- Identification and ranking of water quality problems;
- Identification and prioritization of structural and nonstructural water quality improvement projects;
- Development of pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater wasteload allocations (WLAs).

The Potomac Direct watershed assessment addresses the above requirements utilizing the Frederick County Stream Survey Data (FCSS) to identify potential areas of impairments. Based on the available data and background information of the watershed, the assessment included a GIS desktop analysis to identify general areas where there may be potential opportunities to improve water quality. Property owners and stakeholders were then contacted to understand further what impairments they see as well as request permission to access their property to visually assess the area.

During the visual assessments, general sketches and photographs were taken to assist in ranking the potential opportunities through a scoring process. Once projects were ranked, the priority projects were selected, and a general project implementation approach was prepared to assist the

County in achieving water quality improvements within the Potomac Direct Frederick County watershed. This report provides watershed condition information, descriptions of the desktop and field assessment methodologies as well as the prioritization method, and details about the opportunities identified for future implementation.

The Watershed Assessment identified twenty-seven (27) potential stream restoration opportunities and thirty-five (35) stormwater pond retrofits. Of these sites evaluated, BC and WSSI identified the highest priority sites as being 5 stream restoration projects and 25 stormwater pond retrofit projects. These potential opportunities are expected to reduce 592 tons of sediment (TSS), 2,700 pounds of nitrogen (TN) and 1,803 pounds of phosphorous (TP) annually, with an estimated total cost of approximately \$19 million. In addition, this Watershed Assessment assists the County in its future planning and implementation to improve water quality within the Potomac Direct Frederick County Watershed.

Section 1

Introduction and Intent

1.1 Watershed Background

Frederick County encompasses 664 square miles within Maryland's Potomac watershed, bounded on the east and west by Maryland's Carroll and Washington Counties, on the north by Adams County, Pennsylvania, on the southeast by Maryland's Howard and Montgomery Counties. In addition, Frederick County is separated on the southwest from Loudoun County, Virginia by the Potomac River. Approximately 40% of the County's almost 250,000 residents reside in the City of Frederick and 11 other municipalities. Seven of the municipalities are National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Phase II permit holders (Brunswick, Emmitsburg, Frederick, Middletown, Myersville, Thurmont, and Walkersville).

Frederick County is divided into two major and two smaller watersheds. The Monocacy River watershed is on the east of the Catoctin mountains, and is the largest tributary to the Potomac River which flows to the Chesapeake Bay. Approximately 75% of Frederick County's land area lies within the Monocacy River watershed, which contains seven of the County's municipal areas in addition to ten unincorporated communities. The Monocacy is divided into two Maryland watersheds - Upper and Lower Monocacy.

The majority of Frederick County's remaining land area is accounted for in the 8-digit Catoctin Creek watershed, which is located to the west of the Catoctin and South Mountain ridgelines and contains five of the County's municipal areas in addition to two unincorporated communities. The remaining County land area is contained within two smaller watersheds. Double Pipe Creek watershed is located northeast of the Lower Monocacy watershed along the County's boundary with Carroll County, and is part of the Middle Potomac. As shown on **Figure 1-1**, the Potomac Direct Frederick County watershed is located in the southern part of the County along the Potomac River, and is below the Lower Monocacy and Catoctin Creek watersheds. There are two different Potomac Direct Watersheds - Montgomery County and Frederick County. While there is a small portion of Potomac Direct Montgomery County watershed located in the southeast portion of Frederick County, based on Maryland Department of Planning (MDP) GIS land use layer from 2002 which delineated urban areas for baseline load calculations, the analysis showed no urban area in Frederick County's portion of this small watershed, which was confirmed through review of digital aerial imagery. There are no calculated loads and no feasible sites for treatment within the Potomac Direct Montgomery County portion located within Frederick County.

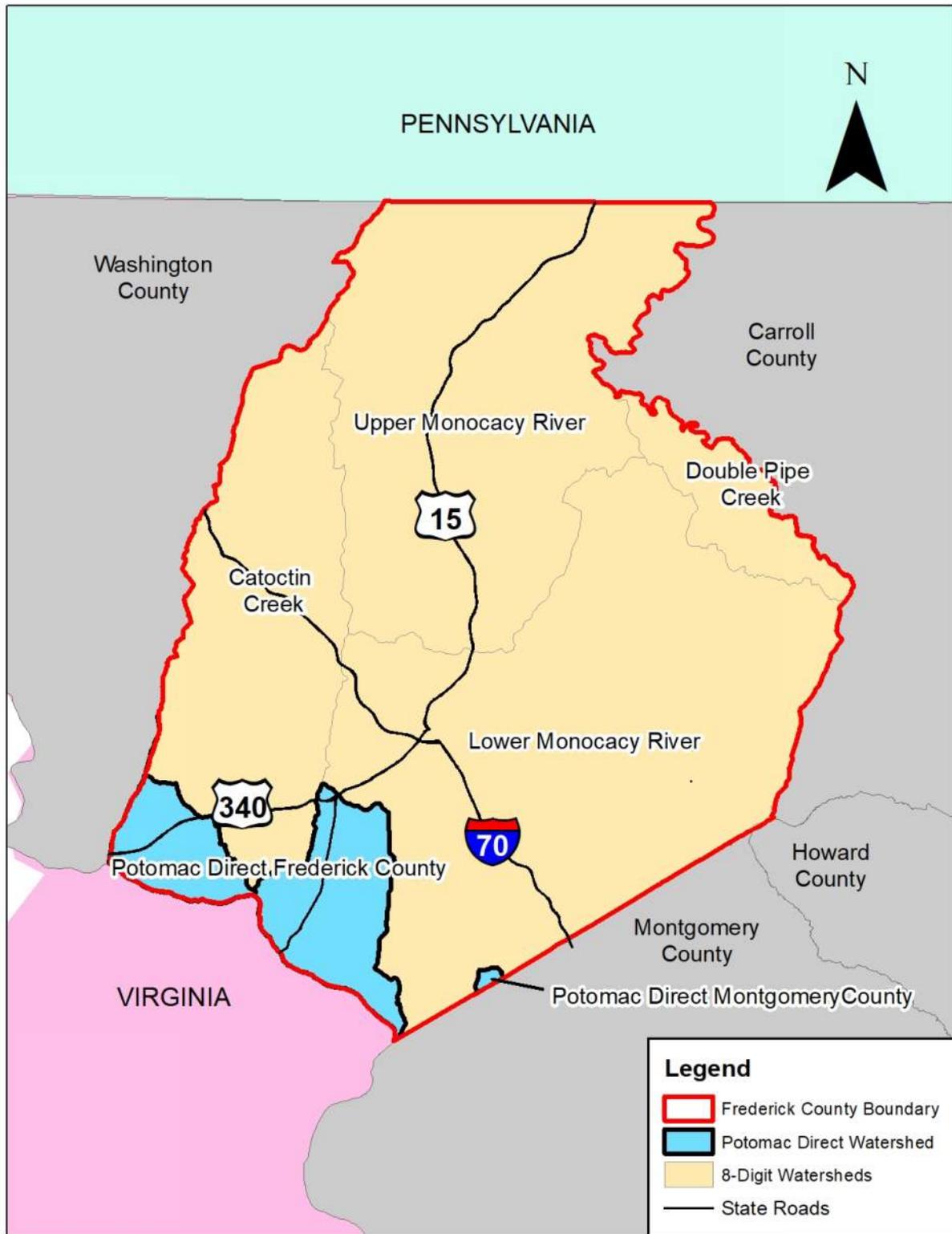


Figure 1-1. Vicinity Map

The Potomac River Frederick County watershed, also known as Potomac Direct, is a Maryland hydrologic unit code (HUC) level watershed (02140301) located in southeastern Frederick County. The watershed encompasses just over 33,000 acres within Frederick County, and includes drainage from interstates Route 15 and Route 340 through portions of Adamstown and Point of Rocks as well as areas to the west including Brunswick and Rosemont. The Potomac River Montgomery County watershed (02140202), located adjacent to the Potomac River to the southeast of Frederick County, contains a small portion of land (i.e., a portion of one property parcel) located within the Frederick County. The majority of this watershed is within forested land and small agricultural farming.

As shown in **Table 1-1** and on **Figure 1-2**, based on available GIS information, land use in the Potomac Direct Frederick County watershed is primarily agricultural with a significant amount of forested land. Less than 18% of land use in the watershed is urban development, and impervious surface comprises under 5% of the land cover.

Table 1-1. Land Cover in the Potomac Direct Frederick County Watershed		
Land Use Type	Acres	Percentage
Agriculture	16,031	48.4%
Forest	8,518	25.7%
Urban	5,767	17.4%
Barren	111	0.1%
Transportation	114	0.1%
Water	1,919	5.8%
Other Developed Land	760	2.5%
Total	33,220	100%
Impervious Cover	Acres	Percentage
Total Impervious Surface	1576.4	4.7%

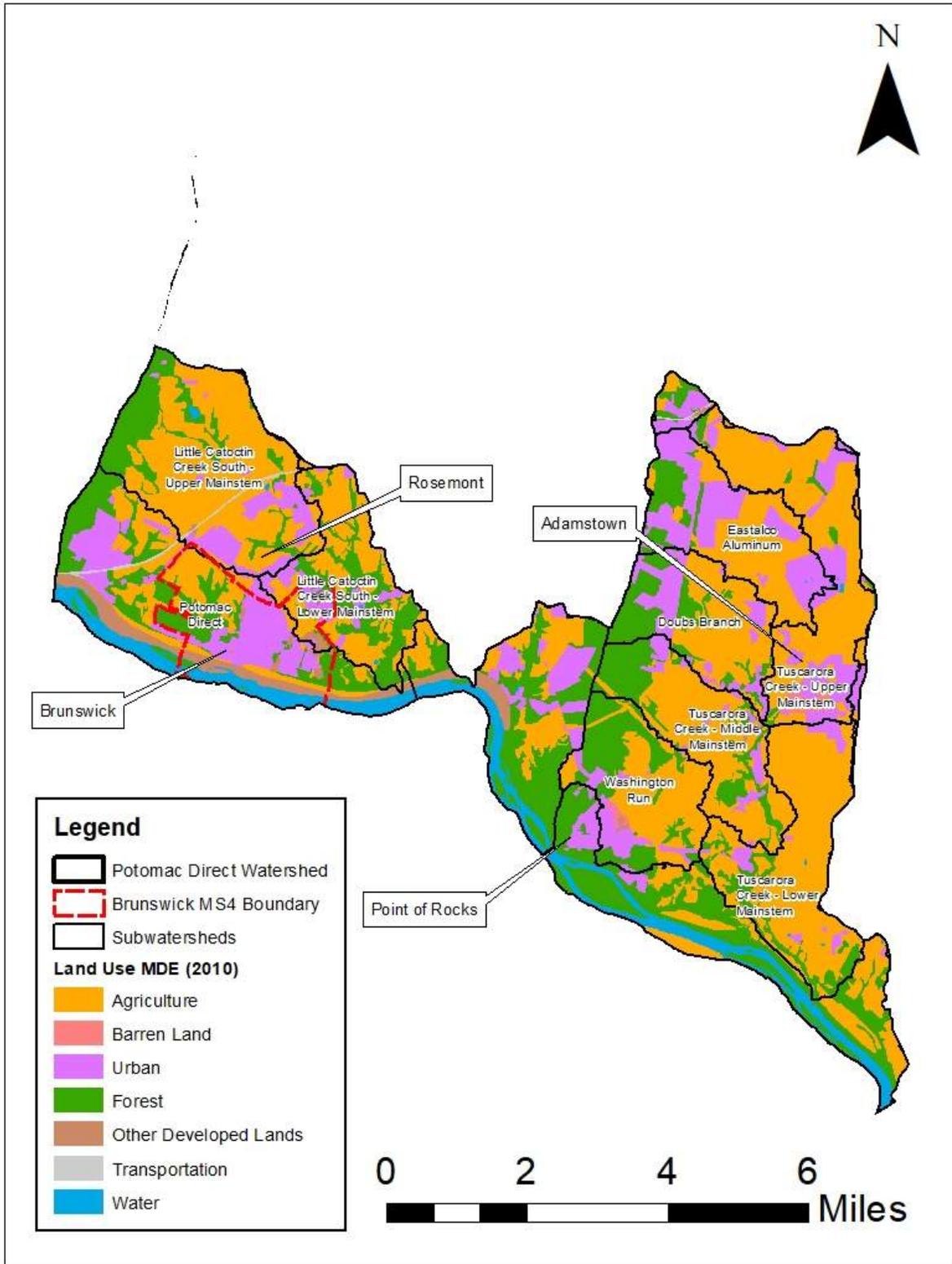


Figure 1-2. Potomac Direct Watershed Land Use Map

1.2 Watershed Study and Intent

BC conducted a Watershed Assessment for the portion of the Potomac Direct Frederick County watershed contained within Frederick County, excluding Brunswick which has its own MS4 Phase II Permit. Work elements included requirements outlined in Part IV.E.1 of the NPDES Permit. These requirements consist of:

- Determination of current water quality conditions;
- Visual watershed inspection;
- Identification and ranking of water quality problems;
- Identification and prioritization of structural and nonstructural water quality improvement projects;
- Development of pollutant load reduction benchmarks and deadlines that demonstrate progress toward meeting all applicable stormwater wasteload allocations (WLAs)

The intent of the Potomac Direct Watershed Assessment Report is to provide a summary of existing watershed conditions and opportunities to improve water quality. The overall watershed assessment process is depicted in **Figure 1-3**.



Figure 1-3. General Overview of the Watershed Assessment Process

Section 2

Existing Watershed Conditions and Pollutant Loads

2.1 Overall Watershed Health

2.1.1 Frederick County Stream Survey

The Frederick County Stream Survey (FCSS) assesses the status of County streams in terms of water quality, and biological and habitat conditions. The first round of the FCSS began in 2008 and continued through 2011. Round 2 of the FCSS began in 2013 and finished its fourth year in 2016. Since its inception, over 400 stream locations in Frederick County have been sampled through the FCSS (Frederick County, 2017). FCSS data were used to identify watershed improvement needs and to inform the team’s evaluations of potential restoration opportunities as described in **Section 3**. A discussion of the Potomac Direct FCSS data is provided below.

In the Round 2 FCSS conducted within the Potomac Direct watershed, the average percent imperviousness in catchments upstream of sampled sites was 6.2%. As shown in **Table 2-1**, Roughly 50% of the 21 sites monitored in the Potomac Direct watershed had impervious surface values below 4% (“Excellent”); 30% had impervious surface values between 4 and 10% (“Sensitive”); and 20% had impervious surface values between 10 and 25% (“Impacted”), with the highest catchment containing just over 20% impervious cover. No catchment areas have stream miles classified in the “Non-Supporting” or “Urban Drainage” categories (Frederick County, 2018).

Impervious Surface Category	Category Characteristics	Percentage of Round 2 FCSS Sites
Excellent	< 4% impervious surface	50%
Sensitive	4 to 10% impervious surface	30%
Impacted	10 to 25% impervious surface	20%
Non-Supporting	25 to 60% impervious surface	0%
Urban Drainage	>60% impervious surface	0%

The FCSS compiled data and provided numerical scores and rankings from six habitat condition categories including instream habitat, epibenthic substrate, remoteness, instream woody debris and rootwads, shading, and bank stability. These compiled scores were combined to provide the Physical Habitat Index (PHI) score for each site, which is used as an overall indicator of habitat quality.

As shown in **Table 2-2**, in PHI scores compiled during the Round 2 FCSS, 25% of Potomac Direct stream miles were classified as “Minimally Degraded” (Good), 20% as “Partially Degraded” (Fair) , 25% as “Degraded” (Poor) and 30% “Severely Degraded” (Very Poor) (Frederick County, 2018).

Based on the Benthic Index of Biotic Integrity (BIBI) scores tabulated as part of the FCSS, the average health of the Potomac Direct watershed is also considered poor. BIBI data collected during Round 2 of the FCSS indicated that 10% of Potomac Direct stream miles were classified as

“Minimally Degraded” (Good), 30% as “Partially Degraded” (Fair) , 55% as “Degraded” (Poor) and 5% “Severely Degraded” (Very Poor) for this indicator (Frederick County, 2018).

Table 2-2. Potomac Direct Watershed – Habitat Ratings from Round 2 FCSS

Habitat Category	PHI Range	Percentage of Round 2 FCSS Sites	BIBI Range	Percentage of Round 2 FCSS Sites
Good/Marginally Degraded	81-100	25%	4.0-5.0	10%
Fair/Partially Degraded	66-80	20%	3.00-3.99	30%
Poor/Degraded	51-65	25%	2.00-2.99	55%
Very Poor/Severely Degraded	0-50	30%	1.00-1.99	5%

Bank erosion was scored on a scale of 0 to three with a score of 0 indicating no erosion and a score of 3 indicating severe erosion. As indicated in **Table 2-3**, the scores compiled for the Potomac Direct watershed indicated that 50% of banks displayed erosion classified as “Severe” (score of 3), 30% as “Moderate” (score of 2) and 20% as “Minimum” (score of 1) (Frederick County, 2018).

Table 2-3. Potomac Direct Watershed – Bank Erosion Ratings from Round 2 FCSS

Bank Erosion Category	Score	Percentage of Round 2 FCSS Sites
No Erosion	0	0%
Minimum	1	20%
Moderate	2	30%
Severe	3	50%

Riparian buffer widths were evaluated as part of the FCSS studies and riparian buffer integrity was determined based on a sum of the widths on both sides of the stream. Riparian buffer scores rated from Category 1 for riparian width sums of 15 meters or less to Category 4 for riparian width sums of greater than 60 meters. As shown in **Table 2-4**, in Round 2 of the FCSS, the majority of the sites evaluated were in Category 4 with greater than 60 meters of combined buffer width, with three sites in Category 3 (30 to 60 meters) and one in Category 2 (15 to 30 meters) (Frederick County, 2017).

Table 2-4. Potomac Direct Watershed – Riparian Buffer Ratings from Round 2 FCSS

Riparian Buffer Integrity Category	Score	Percentage of Round 2 FCSS Sites
≤15 meters	1	0%
15 to ≤30 meters	2	5%
30 to ≤60 meters	3	15%
>60 meters	4	80%

In addition to the physical watershed characteristics described above, the FCSS characterized water quality in terms of Total Phosphorus (TP) and Total Nitrogen (TN). Measured TN concentrations less than 1.5 mg/L are considered low, concentrations from 1.5 to 7 mg/L are considered moderate and concentrations > 7.0 mg/L are considered high. Measured TP concentrations less than 0.025 mg/L are considered low, concentrations from 0.025 to 0.07 mg/L are considered moderate and concentrations > 0.07 mg/L are considered high. As shown in **Table 2-5**, Round 2 of the FCSS indicated that 30% of streams in the Potomac Direct watershed have low and 70% have moderate levels of TN, and 40% of streams have low, 50% moderate, and 10% have high levels of TP

(Frederick County, 2018). There are no TMDLs in Potomac River Frederick County that mandate reduction of TN, TP or other water quality parameters.

Table 2-5. Potomac Direct Watershed – Water Quality Ratings from Round 2 FCSS

TN Concentration Category	Concentration Range	Percentage of Round 2 FCSS Sites	Concentration Range	Percentage of Round 2 FCSS Sites
Low	<1.5 mg/L	30%	<0.025 mg/L	40%
Moderate	1.5 to 7.0 mg/L	70%	0.025 to 0.07 mg/L	50%
High	>7.0 mg/L	0%	>0.07 mg/L	10%

2.1.2 Existing Stormwater Best Management Practices (BMPs)

There are 93 structural stormwater BMPs within the Potomac Direct watershed according to the County's BMP database (Frederick County, 2017), each capturing drainage areas that vary from over 250 acres for regional pond BMPs to 0.1 acres for small, on-site BMPs. The total area draining to these BMPs is 1,672 acres with 329 acres being impervious. A list of existing BMPs, by type, is provided in **Table 2-6** and their locations are shown on **Figure 2-1**.

Table 2-6. Existing BMPs within Potomac Direct MS4 Permit Area, Frederick County

BMP Type	Number of Facilities	Total Drainage Area (acres)	Impervious Area within Drainage Area (acres)
Bioretention	11	33.5	11.7
Dry Pond	3	28.9	21.2
Wet Pond	2	39.5	18.4
Dry Extended Detention Pond	16	223.2	47.2
Wet Extended Detention Pond	14	699.4	115.8
Infiltration Basin	2	1.8	1.3
Infiltration Trench	4	8.7	2.3
Infiltration Trench and Water Quality Exfiltration	3	1.7	0.8
Oil Grit Separator	1	7.7	6.1
Sand Filter	11	52.6	16.7
Sand Filter and Dry Extended Detention Pond	6	54.4	18.5
Bioretention	11	33.5	11.7
Wet Pond	2	39.5	18.4
Shallow Marsh	6	130.3	29.2
Swale	3	4.5	1.3
Miscellaneous and Unknown	11	393.7	44.7
Total	93	1672.1	329.0

Note: Data from County's BMP database

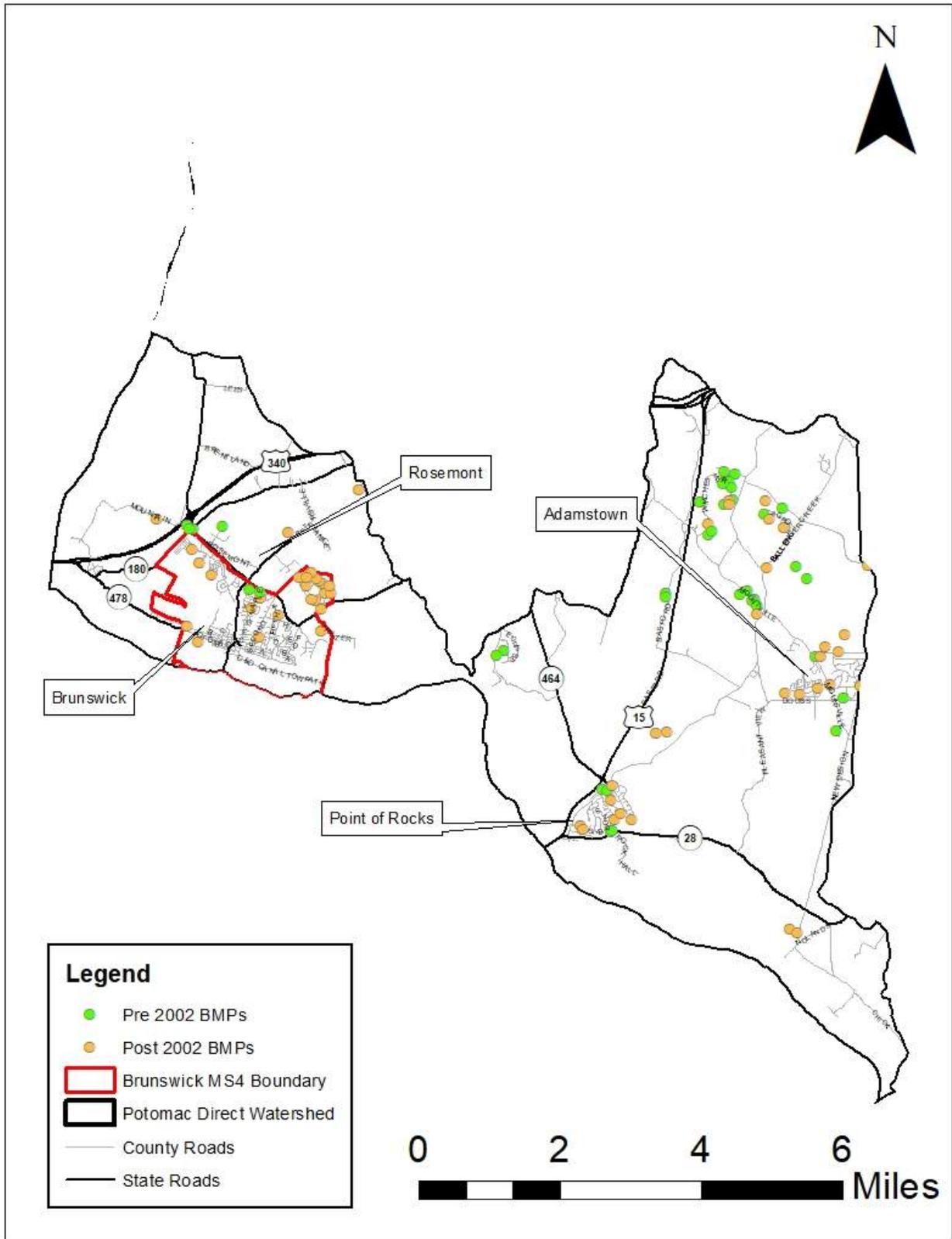


Figure 2-1. Potomac Direct Watershed Existing BMPs

2.2 Pollutant Loads

There are two different Potomac Direct Watersheds - Montgomery County and Frederick County. The Potomac Direct Frederick County watershed does not have any local TMDLs or Stormwater Wasteload Allocations approved by Environmental Protection Agency (EPA), while the Potomac Direct Montgomery County watershed has an approved sediment allocation as shown in **Figure 2-2** that was established by Maryland Department of the Environment (MDE) and approved by EPA. In addition, **Table 2-7** provides a TMDL summary for the Potomac Direct watershed.

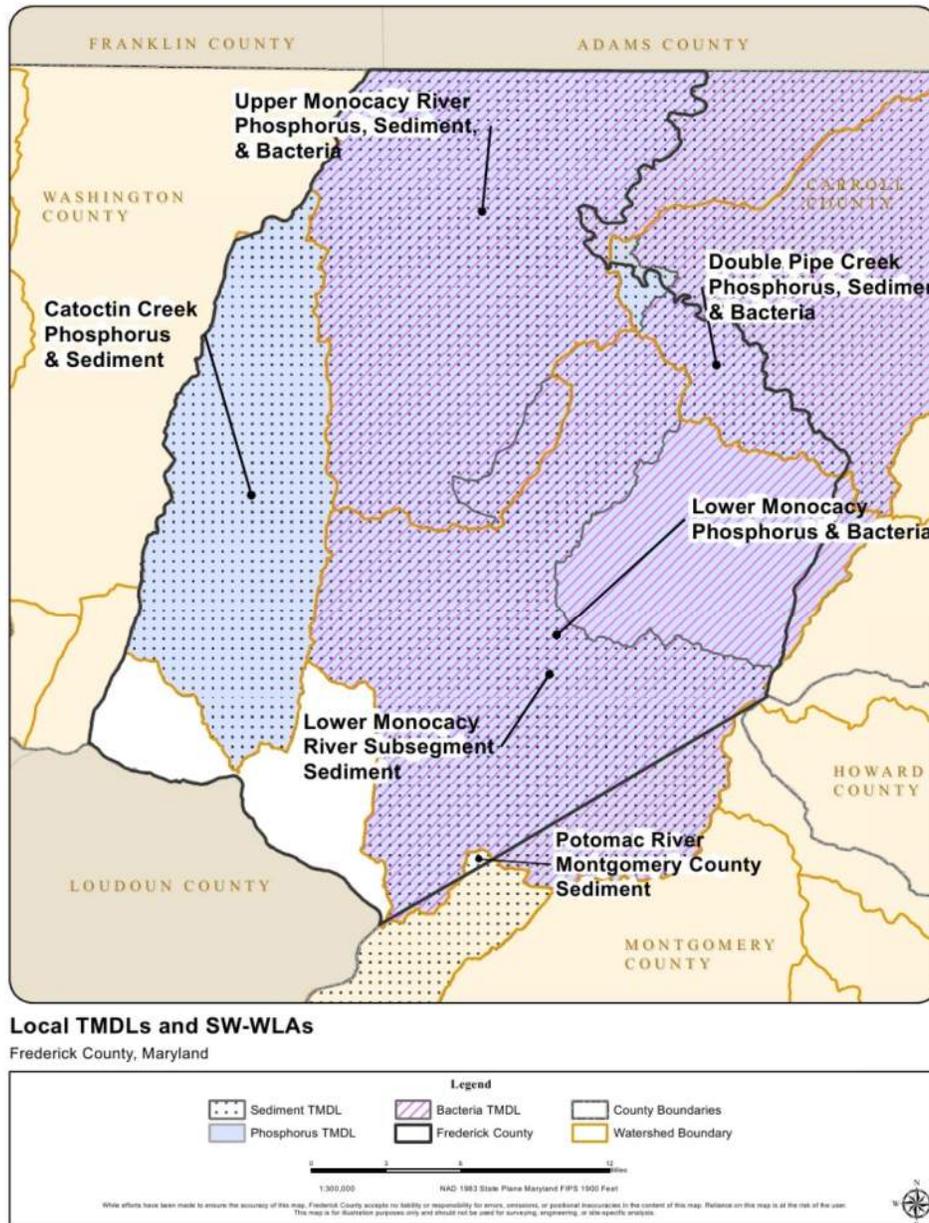


Figure 2-2. Frederick County Local TMDLs (Frederick County, 2018)

Table 2-7. TMDL Summary for Potomac Direct Watershed							
Watershed Name	Watershed ID	Pollutant	MDE Published Reduction Percent	Frederick County Areas		Frederick County Loads	
				Baseline Urban Impervious Area	Baseline Urban Pervious Area	Calibrated Baseline Load	Calibrated Reduction
Potomac River Frederick County	02140301	None	None	None	None	0	0
Potomac River Montgomery Co.	02140202	Sediment	36.2%	None	None	0	0

2.2.1 Potomac Direct (Frederick County) Watershed – No TMDLs Assigned

The Potomac Direct Frederick County watershed 02140301 does not have any assigned Chesapeake Bay or local TMDLs (Frederick County, 2018).

2.2.2 Potomac Direct (Montgomery County) Watershed – Sediment TMDL

The Potomac Direct Montgomery County Sediment TMDL requires a 36.2% reduction from baseline, which was established in 2005. A small parcel of land within the Potomac Direct Montgomery County watershed lies within Frederick County as shown in **Figure 2-3**. The Maryland Department of Planning (MDP) GIS land use layer from 2002 was used to delineate urban areas for baseline load calculations. The analysis showed no urban area in this small parcel, which was confirmed through review of digital aerial imagery which indicates land cover to be predominately forest with some small agricultural practices.

As a result, with the more detailed data and modeling available for this watershed assessment, there are no calculated loads and no feasible sites for treatment, therefore Frederick County is not proposing any restoration activities on the Potomac Direct Montgomery County parcel at this time. The County anticipates that baseline load modeling will be reviewed in the future with potential better information from the Phase 6 Chesapeake Bay Watershed Model (CBWM).



Figure 2-3. Aerial Imagery Depicting No Urban Impervious Land within the Frederick County Portion of the Potomac Direct Montgomery County Watershed.

2.3 Restoration Goals

Although there are currently no mandatory TMDLs for the Potomac River Frederick County watershed, the County is actively working on projects within the Potomac River watershed on the Frederick County side. The completed, ongoing and previously planned projects in the Potomac River Frederick County watershed are found in the Frederick County's MS4 Permit's Annual Report.

Section 3

Methodology

3.1 Overall Approach

In order to conduct the initial evaluation of watershed restoration opportunities in the Potomac Direct Frederick County watershed, BC created a map to indicate existing BMPs, along with treated and untreated impervious areas. The City of Brunswick was excluded from this watershed assessment since it manages its own Phase II MS4 Permit. The portion of the Potomac Direct Montgomery County Watershed located within Frederick County was omitted in identification of potential opportunities because as discussed previously, it does not have any urban section according to the 2002 MDP GIS land layer and land cover is predominately forest with small patches of agricultural activities.

The next step was to identify watershed focus areas using existing information to identify monitoring sites which scored poorly in all four of the key stressors evaluated in the FCSS (Land Use, Habitat, Water Quality, and Biological Condition as discussed in **Section 2**). The BIBI Score and Stream Bank Erosion indicators were used to identify potential “hotspots” where the stream may be reacting to uncontrolled stormwater management (see **Figure 3-1**). In addition, one previously identified opportunity in the County’s geodatabase was incorporated.

3.2 Preliminary Watershed Assessment

Preliminary screening of opportunities was conducted using the Watershed Guidance document provided by the County (Frederick County, 2017), data from the County’s FCSS, and the steps described within the Desktop Site Assessment section below. Desktop screening focused on areas that have high restoration potential based on available information. Areas previously evaluated in the southwest portion of Point of Rocks were excluded since restoration opportunities have already been identified (Frederick County, 2014) in addition to the City of Brunswick and the small parcel of Potomac Direct Montgomery County as described above.

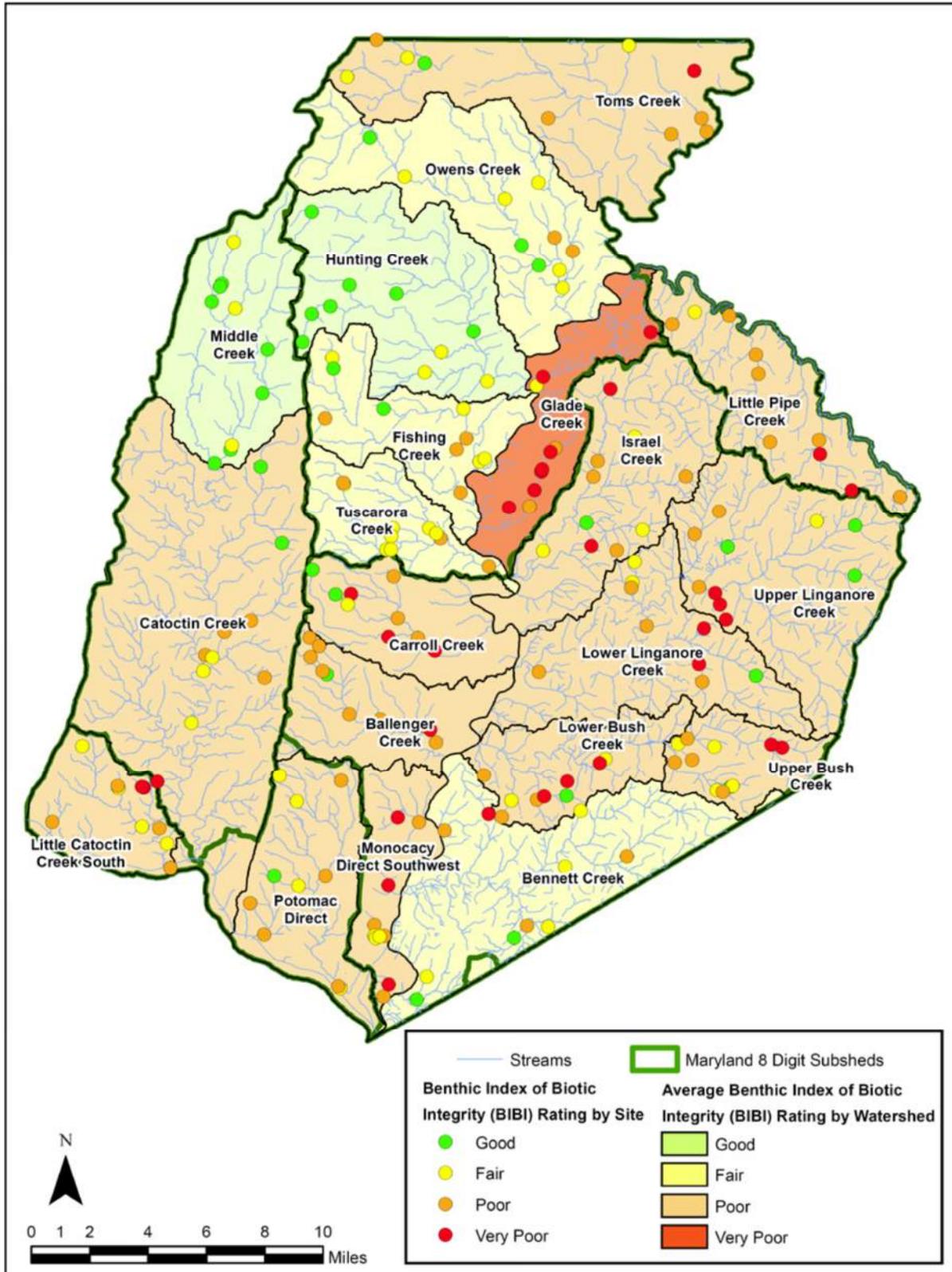


Figure 3-1. Average BIBI Score Category for Frederick County Watersheds (Frederick County, 2017)
 (Note: Potomac Direct Frederick County watershed is depicted as Potomac Direct and Little Catoctin Creek South)

3.3 Desktop Site Assessment

Desktop assessments were performed within GIS to review potential restoration opportunity areas. Uncontrolled areas, as identified in Frederick County's Office of Sustainability and Environmental Resources' (OSER) Urban BMP database (Frederick County, 2017), were a key factor in identifying areas for assessment in addition to information contained within the County's FCSS (described in **Section 2.1**). Opportunities were identified based on the County's Watershed Guidance document as described below. The desktop site assessment was concluded in March 2018 and is described below in more detail by type of opportunity.

3.3.1 Stormwater BMP Opportunities

Thirty-five (35) stormwater BMP opportunities were initially identified through a desktop review of impervious areas and drainage networks to identify opportunities to capture uncontrolled runoff. A preliminary process of prioritization was conducted as detailed below, and further prioritization was conducted following field visits to the potential opportunities. Additional information about the opportunities evaluated during desktop screening is provided in **Section 4**.

3.3.1.1 Stormwater Pond Retrofits

Stormwater pond retrofit opportunities were identified by locating ponds that are not on County owned property and do not currently provide water quality credit as described in the MDE MS4 permit guidance document (MDE, 2014). In addition, OSER provided a list of stormwater facilities which have corrugated metal risers identified by Frederick County's inspectors as requiring future repairs, in addition to one previously identified opportunity.

Once identified as potential opportunities, BC documented key stormwater pond features such as drainage area, impervious area, ownership type (private, HOA, commercial), property tax account number, Frederick County's BMP Asset Number, and structure type. The facilities were then categorized as described below:

- i. Permanent extended detention pond wet pond flagged for a future Maximum Extent Practicable analysis to determine whether it meets the Water Quality volume required by MDE.
- ii. All other BMPs in the County's BMP geodatabase with a corrugated metal riser
- iii. All other BMPs in County's BMP geodatabase without a corrugated metal riser
- iv. Stormwater facilities identified through watershed screening that were not contained within the County's BMP geodatabase

Cost estimates were prepared for each of the identified opportunities using an estimated \$22,000 per treated impervious acre for facilities to be converted to wet ponds and \$75,000 per treated impervious acre for ponds to be converted to bioretention facilities.

Once identified, the list of potential opportunities was provided to OSER. OSER provided easements that were known for these sites or other pertinent landowner information which was then added to the facility data. Additional information about the opportunities evaluated during desktop screening is provided in **Section 4**. There were a total of thirty-five (35) sites originally identified for stormwater retrofits during the desktop assessment, with thirty-one (31) sites recommended for field assessment.

3.3.2 New Stormwater Opportunities

Potential new stormwater opportunities were evaluated by utilizing the County's flow accumulation shapefile which assists in identifying areas with significant potential for sheet flow to form and potentially cause stormwater damage due to the lack of stormwater controls. Once areas of

concentrated stormwater were identified, drainage areas to Points of Interest (POI) were delineated utilizing existing storm drain networks and topography data available in the County's GIS. These opportunities were then categorized based on their drainage areas and impervious as described below:

- i. 30 or greater acres of uncontrolled impervious area
- ii. < 30 acres to 20 acres of uncontrolled impervious area
- iii. < 20 acres to 10 acres of uncontrolled impervious area
- iv. < 10 acres of uncontrolled impervious area

Once these areas were identified, potential sites for new stormwater pond opportunities were evaluated that could provide treatment for the largest drainage areas. If stormwater pond sites were not feasible, the potential for Regenerative Stormwater Conveyance (RSC) sites were evaluated next, then potential locations for sand filter or bioretention facilities were evaluated last.

Once potential opportunities were identified, key restoration attributes were documented including drainage area, impervious area, property ownership type (private, homeowner's association (HOA), commercial), property tax account number and owner, and outfall identification number where the proposed facility would be located.

Cost estimates were prepared for each of the identified opportunities using an estimated \$45,000 per treated impervious acre for new stormwater wet ponds, \$450 per linear foot for RSCs and \$75,000 per treated impervious acre for ponds to be converted to bioretention facilities.

Once identified, the list of potential opportunities was provided to OSER. OSER provided easements that were known for these sites or other pertinent landowner information which was then added to the new BMP opportunity data. Additional information about the opportunities evaluated during desktop screening is provided in **Section 4**. Due to the lack of concentrated impervious surfaces without an existing stormwater BMP in the watershed, there were few opportunities identified (35 in total, with 31 evaluated in the field).

3.3.3 Stream Restoration

The stream restoration desktop assessment consisted of the evaluation of twenty-seven (27) potential stream restoration sites and was conducted based on the Watershed Study Guidance (Frederick County, 2017) and the County's FCSS data (described in **Section 2.1**).

Restoration priority was assigned to streams where the FCSS monitoring sites scored low in all four of the key stressors (Land Use, Habitat, Water Quality, and Biological Condition). If all four stressors were not found to be a problem, severe and moderate Stream Bank Erosion locations were used in conjunction with the habitat analysis to focus in on streams that are degraded and likely contributing large volumes of sediment to downstream receiving waters.

In addition to the FCSS scoring, other factors including upstream and downstream grade control (e.g., a road crossing or a confluence with another tributary), stream order, existing easements, and proximity to stormwater management were considered in the identification of stream restoration opportunities. Priority was given to streams with grade control as well as headwater and lower order streams and streams without existing encumbrances (i.e. a Forest Reserve Ordinance easement). Stream restoration opportunities near other potential BMP opportunities identified in this watershed study as well as other stormwater management retrofits that are actively under design or construction were given priority.

Based on the desktop assessment, eight (8) sites were selected for a Field Site Assessment (described in **Section 3.4.2**). A list of all potential sites identified during the desktop assessment is provided in **Section 4**.

3.4 Field Site Assessment

Field assessments were conducted to ground-truth opportunities identified during the desktop assessments and obtain additional information needed to determine whether the restoration opportunities are a worthwhile investment for the County. Prior to mobilizing, BC and WSSI prepared a landowner notification letter based on the County's GIS property layer and the Maryland Land Records database. Field assessment locations were selected from the opportunities identified during the desktop assessment.

3.4.1 BMP Assessments

Field assessments were conducted at thirty-one (31) of the thirty-five (35) BMP opportunities identified during desktop evaluations. Field assessments were based on a modified version of the Center for Watershed Protection's (CWP) Retrofit Reconnaissance Investigations (RRI) procedure. Information recorded included the following:

- Site details regarding BMP location and ownership as well as defining the site as a new BMP or retrofit
- Existing conditions including details about existing inflows, outflows, embankments, and other site features, along with identification of surrounding land uses and any visible deficiencies such as ponding or broken structures
- Photographic documentation
- Prioritization Criterion – Factors used to evaluate the site's restoration potential based on utility conflicts, constructability, public outreach and acceptance, etc.

3.4.2 Stream Assessments

Field Site Assessments were conducted at eight (8) of the twenty-seven (27) stream sites identified during desktop evaluations. The field assessments included:

- Visual assessment of stream restoration needs (i.e. visible observation of bank erosion)
- Identification of appropriate upstream and downstream tie-ins for viable stream restoration sites
- Assessment of potential site access, public visibility, and utility conflicts
- Identification of potential tree impacts; and,
- Photographic documentation

Information collected as part of the field assessment was used to rank the assessed reaches, and to select stream reaches for concept plan development. In addition to the field observations, stream length and cost were considered in determining which stream reaches were the best candidates for restoration. Unit costs of \$350 per linear foot of stream restoration (or \$600 per linear foot in the case of areas with difficult access and constructability) were used.

Once identified, the list of potential opportunities was provided to OSER. OSER provided easements that were known for these sites or other pertinent landowner information which was then added to the stream restoration opportunity data.

Mobile field data collection forms and field maps were prepared and provided to each field team. Additional information about the opportunities evaluated during field assessment is provided in **Section 4**.

3.5 Evaluation and Ranking Criteria

After completion of field work, the BC team prioritized opportunities using a quantitative scoring method to rank projects in order of total benefit and feasibility. The prioritization was conducted using a process developed by OSER which included parameters such as access and other construction considerations, community and watershed impacts, cost, impervious cover treated, and estimates of pollutant load removal. Summaries of the prioritization criteria, weights, and ratings are provided in **Table 3-1** and **Table 3-2**.

Table 3-1. OSER BMP Prioritization Criteria

Ranking Components	Weight	Rating			Remarks
		1	2	3	
Nutrient and Impervious Acre Credit:					
Estimated TN Removed (lbs/yr)	2	<244	244 - 488	>488	Ranges based on other watershed study ratings
Estimated TP Removed (lbs/yr)	2	<29	29 - 57	>57	
Estimated TSS Removed (lbs/yr)	2	<14,000	14,000 - 29,000	>29,000	
Impervious Acre Credit (ac)	4	<5	5 - 15	>15	
Stormwater Era	10	1985-2002 BMP providing treatment of 1" or greater	1985-2002 BMP		This is based on the design approval date from the County's Urban BMP database. If no date was available, the SWM BMP should be assigned a rating of 1.
Subtotal	60				
Cost:					
Overall Planning Level Costs	6	> \$800K	\$200K - \$800K	< \$200K	Ranges are based on acceptable costs to move projects forward as well as guidance provided by the Chesapeake & Atlantic Coastal Bays Trust Fund
Cost/Pound of Nitrogen Removed	2	> \$2,000	\$149 - \$2,000	\$149	
Cost/Pound of Phosphorus Removed	2	> \$5,000	\$800 - 5,000	\$800	
Cost/Pound of Sediment Removed	2	> \$10	\$1.55 - \$10	\$1.55	
Cost/Impervious Acre Treated	8	>80,000	\$54,000 - \$80,000	<\$54,000	
Subtotal	60				
Construction:					
Utility Conflicts	2	Extensive Conflicts	Minor Conflicts	No Conflicts	Extensive conflicts impact 2 or more utilities and require significant design and construction efforts to move multiple utilities (i.e. sewer); Minor conflicts impact two or less utilities and do not require significant design and construction (i.e. cable)
ROW Requirements/ Property Ownership	5	Easement required	Temporary construction	No additional ROW requirements	Easement Required = the proposed retrofit will occur on private property and the County will be required to obtain an easement from the current property owner

Table 3-1. OSER BMP Prioritization Criteria

Ranking Components	Weight	Rating			Remarks
		1	2	3	
			access easement only		in order to implement the project; Temporary Construction Access Only = the proposed retrofit is located on County-owned property but in order to access the site for construction, a temporary easement will need to be acquired
Constructability/ Access	3	Difficult	Moderate	Easy	Criteria evaluated to rank constructability/access includes; property ownership, site constraints, potential utility conflicts, site topography, and proposed grading.
Maintenance Burden	4	High Maintenance Requirements	Moderate Maintenance Requirements	Low Maintenance Requirements	Based on Table 4.5 from MD 2000 Manual
Proximity to Karst	2	Within karst area	Within ¼ mile distance of karst	Outside karst area	Karst geology regions are characterized by formations underlain by carbonate rock and typified by the presence of limestone caverns and sinkholes. Specific design considerations are required for BMPs proposed within karst areas.
Local/State/ Federal Permitting Requirements	4	High	Moderate	Low	High = extensive permitting requirements including full wetland/stream permitting, forest resource ordinance, NOI for construction requiring public comment, etc. Moderate = significant permitting requirements including minor stream/wetland impacts, FRO, NOI for construction under the public comment threshold. Low = minor permitting requirements, likely just local permitting for grading and stormwater management review
Subtotal	60				
Community and Watershed Impacts:					
Proximity to Stream Restoration	10	No known stream restoration projects within or downstream of BMP	Proposed or existing stream restoration located upstream of BMP	Proposed or existing stream restoration located downstream of BMP	Frederick County NPDES BMP data (STREAM_RESTORATION and STREAM_SITE_SELECTION feature classes) and projects proposed during this watershed study should be used to determine the presence/absence of nearby stream restoration projects.
Public Acceptance	2	Low	Moderate	High	
Public Safety	4	Proposed SWM BMP condition presents a potential public safety concern Fencing is proposed	-	No public safety concern	Sites either pose a potential public safety concern or they do not pose a potential public safety concern. There are no sites with a 2 rating for this public safety category.

Table 3-1. OSER BMP Prioritization Criteria

Ranking Components	Weight	Rating			Remarks
		1	2	3	
Partnership Opportunities	2	No partnership opportunities	Opportunities to partner with 1-3 outside stakeholders	Opportunities to partner with >3 outside stakeholders	
Public Visibility/Outreach Opportunity	2	Low visibility	Moderate visibility	High visibility	Low visibility sites have minimal opportunities for education/outreach. Moderate visibility sites have some opportunities for education/outreach. High visibility sites have significant opportunities for education/outreach.
Subtotal	60				
	240				

Table 3-2. OSER Stream Prioritization Criteria

Ranking Components	Weight	Rating			Remarks
		1	2	3	
Nutrient and Impervious Acre Credit:					
Estimated TN Removed (lbs/yr)	2	<150	150 - 225	>225	Use revised default rates of 0.075 lb/ft/yr for TN; 0.068 lb/ft/yr for TP; and 44.88 lb/ft/yr for TSS, unless consultant strongly believes that a higher removal rate can be achieved through the use of an expert panel protocol, in which case best professional judgement should be used.
Estimated TP Removed (lbs/yr)	2	<136	136 - 204	>204	
Estimated TSS Removed (lbs/yr)	2	<89,760	89,760 - 134,640	>134,640	
Linear Feet	4	<1,500	1,500-3,000	>3,000	
Impervious Acre Credit (ac)	10	<15	15-30	>30	Based on the impervious acre equivalent of 0.01 acres per LF for non-RSC projects, or drainage area for RSC projects.
Subtotal	60				
Cost:					
Overall Planning Level Costs	3	>\$800K	\$600K - \$800K	<600K	Use construction cost of \$350 per LF and professional judgement if site requires additional costs
Cost/Pound of Nitrogen Removed	1	> \$2,000	\$149 - \$2,000	\$149	
Cost/Pound of Phosphorus Removed	1	> \$5,000	\$800 - 5,000	\$800	
Cost/Pound of Sediment Removed	1	> \$10	\$1.55 - \$10	\$1.55	
Cost/Impervious Acre Treated	4	>\$80,000	\$60,000 - \$80,000	<\$60,000	
Subtotal	30				

Construction:

Utility Conflicts	4	Extensive Conflicts	Minor Conflicts	No Conflicts	Extensive conflicts impact 2 or more utility crossings and require significant design and construction efforts to move multiple utilities (i.e. sewer) or significant impacts to healthy riparian/upland habitats; Minor conflicts impact two or less utility crossings and do not require significant design and construction (i.e. cable) and minimal impacts to healthy riparian/upland habitats
Easement Requirements	2	Easement required	Temporary construction access easement only	No additional ROW requirements	Easement Required = the proposed retrofit will occur on private property and the County will be required to obtain an easement from the current property owner in order to implement the project; Temporary Construction Access Only = the proposed retrofit is located on County-owned property but in order to access the site for construction, a temporary easement will need to be acquired
Constructability/ Access	2	Difficult	Moderate	Easy	Criteria evaluated to rank constructability/access includes; property ownership, site constraints, potential utility conflicts, site topography, and proposed grading.
Existing Forest Retention Ordinance (FRO) Present	2	Yes, >25% of the LOD	Yes, ≤25% of the LOD	No FRO present	Use the Frederick County Forest Resource GIS layer
Subtotal	30				

Community and Watershed Impacts:

Benthic IBI Score	4	Good/Fair	Poor	Very Poor	Use FCSS BIBI data
Land use/Impervious Cover Within Watershed	2	Damaged	Impacted	Sensitive	Use FCSS Land use and Impervious data. Damaged = Urban, actively urbanizing, or primarily agricultural. Typically, less than 20% forest or >15% impervious. Impacted = Suburban development or active agriculture occurring. Typically, 20-70% forested or 7-15% impervious. Sensitive = Rural communities or slow growth. Primarily forested and <7% impervious
Floodplain Connectivity	4	Connected	Incised with limited floodplain area	Incised with large floodplain area	Floodplain Connectivity should be based on field observations of incision, approximate bankfull height ratio (low top of bank height/bankfull height), and the adjacent floodplain or flood prone area. Connected = The stream channel is not incised, and stormflows appear to have frequent access to the floodplain. Incised with limited floodplain area = Stormflows access the floodplain on rare occasions and floodplain area available for reconnection may be limited. Incised with large floodplain area = Only the largest stormflows are able to access the floodplain; bank height is nearly twice bankfull

					depth throughout the reach. A large floodplain is available for reconnection.
Lateral Stability of Stream Channel	5	Stable	Moderately Stable	Unstable	The lateral stability of the reach should be based on field observations of active erosion and BEHI factors that are noted during the assessment. Stable = Stream banks are stable and have properties that should allow for continued resistance to erosion (i.e. low BEHI parameter ratings). Moderately Stable = Stream banks are moderately resistant to erosion, but signs of active erosion are present. Unstable = Stream banks are actively eroding, and banks will likely continue to erode. Field indicators are typically raw banks, numerous fallen bank trees, and high BEHI parameters.
Proximity to Stormwater Management	2	No known stormwater management upstream	Underperforming/pre-2002 era stormwater management upstream	Post 2002 era stormwater management upstream or proposed retrofit	Frederick County NPDES BMP data (existing and proposed BMPs) and projects proposed during this watershed study should be used to determine the level of stormwater management upstream of the stream site.
Functional Lift Potential	3	Geomorphic Level	Physiochemical Level	Biological Level	This should take into account both existing and proposed conditions.
Subtotal	60				
	180				

Using these prioritization processes, a total combined score was generated for each of the proposed opportunities. Projects receiving a higher score were considered to be better candidates than those receiving lower scores, and therefore received higher prioritization.

Initial screening was conducted in September 2018 and the prioritization was finalized with the County in October 2018. Additional information about the opportunities ranked through this process is provided in **Section 4**, and **Section 5** provides the results of the potential opportunity scoring and ultimate prioritization.

Section 4

Potential Opportunities

This section summarizes the opportunities evaluated through desktop and field assessments. The priority BMPs selected through the process described in Section 3 are shown in Figure 4-1, and the priority stream restoration sites are shown in Figure 4-2.

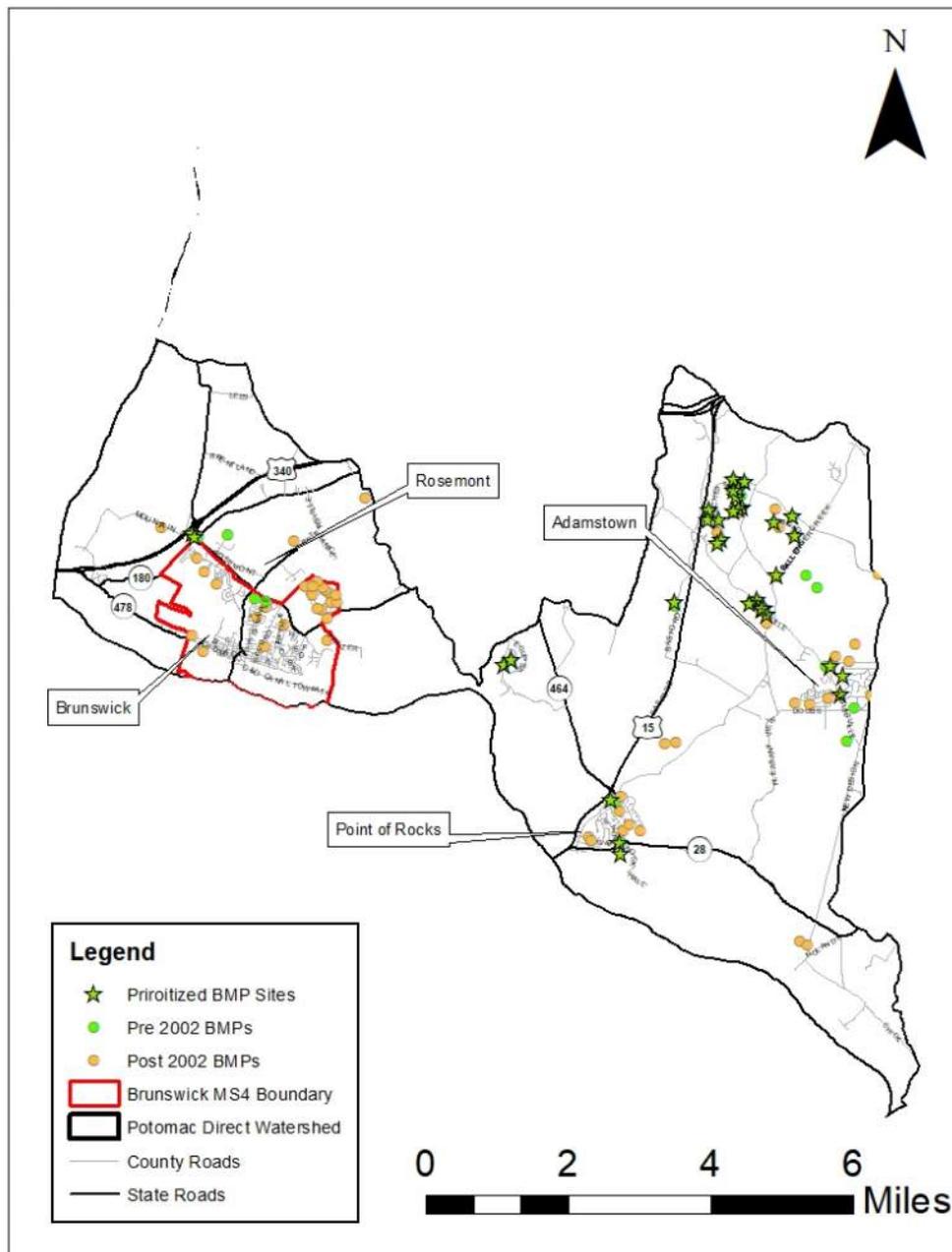


Figure 4-1. Priority BMPs Selected for Potomac Direct Watershed

A total of thirty-five (35) potential BMP opportunities were evaluated during the desktop assessment. **Table 4-1** provides a list of the BMP opportunities evaluated during the desktop assessment and indicates which of those opportunities were recommended for further evaluation through field assessment.

Table 4-1. BMP Opportunities Identified During Desktop Assessment			
Project Name	Proposed Restoration	Recommended for Field Assessment	Desktop Assessment Notes
BMP 015	Wet Pond Retrofit	Yes	
BMP 068	Wet Pond Retrofit	Yes	CMP Riser
BMP 090	Sand Filter	Yes	
BMP 103	Bioretention	Yes	
BMP 175	Wet Pond Retrofit	Yes	
BMP 243	Wet Pond Retrofit	Yes	CMP Riser
BMP 316	Bioretention	Yes	
BMP 317	Bioswale	Yes	
BMP 318	Wet Pond Retrofit	Yes	
BMP 362	Bioretention	Yes	
BMP 423	Wet Pond Retrofit	Yes	
BMP 494	Wet Pond Retrofit	Yes	
BMP 558	Micropool Extended Detention	Yes	
BMP 606	Bioretention	Yes	
BMP 630	Bioretention	Yes	
BMP 632	Bioretention	Yes	
BMP 656	Wet Pond Retrofit	Yes	
BMP 657	Wet Pond Retrofit	Yes	
BMP 783 (Bio)	Bioretention	Yes	
BMP 783 (RSC)	RSC	Yes	
BMP 784	Bioretention	Yes	
BMP 800	Bioretention	Yes	
BMP 669	Wet Pond Retrofit	Yes	
BMP 127	Bioretention	Yes	
OID 55	Bioretention	Yes	
BMP 588	Bioretention	Yes	
BMP 685	Submerged Gravel Wetland	Yes	
OID 32	Bioretention	Yes	
OID 50	Bioswale	Yes	

Table 4-1. BMP Opportunities Identified During Desktop Assessment			
Project Name	Proposed Restoration	Recommended for Field Assessment	Desktop Assessment Notes
BMP 857	Wet Pond Retrofit	No	The site was under design, therefore no site visit conducted.
OID 48 (RSC)	RSC	Yes	
OID 46	N/A	No	Not approved by landowner.
OID 40	N/A	No	Not approved by landowner.
OID 47	N/A	Yes	
OID 56	N/A	No	Not approved by landowner.

A total of twenty-seven (27) potential stream restoration opportunities were evaluated during the desktop assessment. The priority stream restoration sites selected through the process described in **Section 3** are shown in **Figure 4-2**.

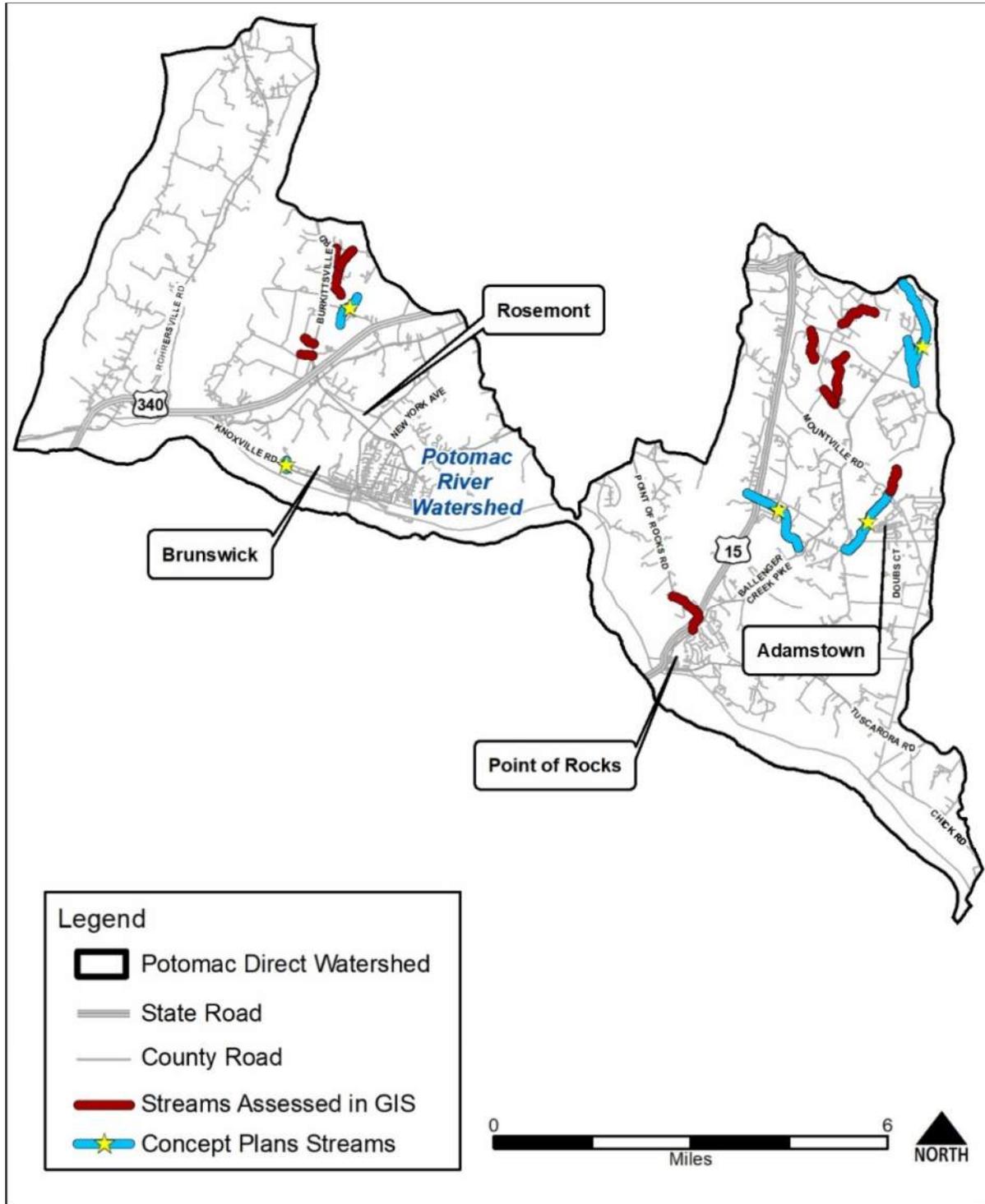


Figure 4-2. Priority Stream Restoration Sites Selected for Potomac Direct Watershed

Table 4-2 provides a list of the stream restoration opportunities evaluated during the desktop assessment and indicates which of those opportunities were recommended for further evaluation through field assessment.

Table 4-2. Stream Restoration Opportunities Identified During Desktop Assessment

Site	Recommended for Field Assessment	Desktop Assessment Notes
POTD-106-R-2013	No	Not Selected as stream is in decent condition based on PHI and BIBI
POTD-107-R-2013	No	Not Selected as stream is in decent condition based on PHI and BIBI
POTD-120-R-2014	No	Not Selected as stream is in decent condition based on PHI and BIBI
POTD-131-R-2015	Yes	Selected based on PHI, BIBI, stream order, and presence of grade control
POTD-132-R-2009	Yes	Selected based on PHI, BIBI, stream order, and presence of grade control
POTD-133-R-2009	Yes	Selected based on PHI, BIBI, stream order, and presence of grade control
POTD-135-R-2015	No	Not selected because stream is 4th order
POTD-139-R-2010	Yes	Selected based on PHI, BIBI, and stream order
POTD-141R-2010	No	Not Selected as stream is in decent condition based on PHI and BIBI
POTD-152-R-2011	Yes	Selected based on PHI, BIBI, stream order, and presence of grade control
POTD-152-R-2016	No	Not Selected as stream is in decent condition based on PHI and BIBI
POTD-156-R-2016	No	Not Selected as site is in a FRO
POTD-158-R-2011	No	Not Selected as site is in a FRO, 60% concept plan exists for site
POTD-160-R-2011	No	Not selected as site is heavily forested, good PHI, minimal bank erosion
POTD-205-R-2008	Yes	Selected based on impervious area, HI, BIBI, stream order, and presence of grade control
POTD-244-R-2015	No	Not Selected as site is in a FRO
POTD-301-R-2008	Yes	Selected as alternate because stream is 3rd order
POTD-301-R-2013	Yes	Selected as alternate because stream is 3rd order and is in a FRO
POTD-324-R-2014	No	Not selected because stream is 4th order
POTD-328-R-2009	No	Not selected because stream is 4th order
POTD-2018-STRE-0001	Yes	Permission for 70% of stream
POTD-2018-STRE-0002	No	
POTD-2018-STRE-0003	No	Could be investigated if permission was received from Todd and Martha Estell
POTD-2018-STRE-0004	No	Could be investigated if permission was received from Todd and Martha Estell
POTD-2018-STRE-0005	Yes	Permission for 100% of stream
POTD-2018-STRE-0006	No	Could be investigated if permission was received from Todd and Martha Estell
POTD-2018-STRE-0007	No	Could be investigated if permission was received from Todd and Martha Estell

FRO = Forest Resource Ordinance area

A summary of data collected during the field assessment stage is provided in **Appendix A**. The results of the project prioritization are discussed in **Section 5**.

Section 5

Project Prioritization and Implementation Schedule

5.1 Results of Project Prioritization

The project prioritization process described in **Section 3.5** was used to select opportunities for further development after the field assessments were completed. Initial screening was conducted in September 2018 and selected opportunities were finalized with the County in October 2018. The details used in the prioritization process are provided in **Appendix B**.

The results of the BMP ranking process are provided below in **Table 5-1**. The table also indicates which opportunities were selected for further evaluation through development of concept plans.

Table 5-1. BMP Prioritization			
Project Name	Proposed Restoration	Recommended for Concept Plans	Prioritization Score
BMP 015	Wet Pond Retrofit	Yes	5
BMP 068	Wet Pond Retrofit	Yes	3
BMP 090	Sand Filter	Yes	16
BMP 103	Bioretention	Yes	24
BMP 175	Wet Pond Retrofit	Yes	7
BMP 243	Wet Pond Retrofit	Yes	6
BMP 316	Bioretention	Yes	22
BMP 317	Bioswale	Yes	23
BMP 318	Wet Pond Retrofit	Yes	3
BMP 362	Bioretention	Yes	21
BMP 423	Wet Pond Retrofit	Yes	1
BMP 494	Wet Pond Retrofit	Yes	2
BMP 558	Micropool Extended Detention	Yes	13
BMP 606	Bioretention	Yes	13
BMP 630	Bioretention	Yes	12
BMP 632	Bioretention	Yes	20
BMP 656	Wet Pond Retrofit	Yes	9
BMP 657	Wet Pond Retrofit	Yes	7
BMP 783 (Bio)	Bioretention	Yes	18
BMP 783 (RSC)	RSC	Yes	16
BMP 784	Bioretention	Yes	18

Table 5-1. BMP Prioritization			
Project Name	Proposed Restoration	Recommended for Concept Plans	Prioritization Score
BMP 800	Bioretention	Yes	11
BMP 669	Wet Pond Retrofit	Yes	10
BMP 127	Bioretention	Yes	26
OID 55	Bioretention	Yes	15
BMP 588	Bioretention	Yes	25
BMP 685	Submerged Gravel Wetland	No	27
OID 32	Bioretention	No	27
OID 50	Bioswale	No	27
BMP 857	Wet Pond Retrofit	No	27
OID 48 (RSC)	RSC	No	27

As shown in **Table 5-1**, five BMP opportunities were not recommended for further assessment due to lack of property owner or other reasons as noted in **Appendix B**. The results of the stream opportunity ranking process are provided below in **Table 5-2**. The table also indicates which opportunities were selected for further evaluation through development of concept plans.

Table 5-2. Stream Restoration Opportunities Identified During Desktop Assessment		
Site	Recommended for Concept Plans	Prioritization Score
POTD-131-R-2015	No	7
POTD-133-R-2009	Yes	4
POTD-132-R-2009	No	5
POTD-139-R-2010	No	2
POTD-2018-STRE-0001	Yes	9
POTD-2018-STRE-0005 R1	Yes	3
POTD-2018-STRE-0005 R2	No	8
POTD-205-R-2008	No	6
POTD-301-R-2013	Yes	1
COMBINED POTD-139-R-2010 & POTD-132-R-2009	Yes	2*

*Combined (POTD-132-R-2009 and POTD-139-R-2010 are adjacent but distinct reaches that were combined into one concept plan for restoration)

As shown in **Table 5-2**, five stream restoration opportunities were recommended for further assessment. The five remaining sites were not selected due to difficult access or other reasons as noted in **Appendix A**.

5.2 Implementation Schedule

The projects selected through the prioritization process described above are currently in the planning stage, with opportunity ranking and funding amounts shown in **Section 6**. In addition, there are several completed, ongoing design or construction projects, and previously planned projects in the

Potomac River Frederick County watershed. Information about these projects can be found in the County's MS4 Permit Annual Report (Frederick County, 2018) and the County's Stormwater Restoration Plan (Frederick County, 2018).

Section 6

Recommended Priority Projects

6.1 Identified High Priority Sites

The projects selected through the prioritization process are in the stage of being funded for future implementation. The funding amounts are based on the cost estimates shown in **Table 6-1**.

Table 6-1. Cost Estimates for Recommended Priority Projects within Potomac Direct, Frederick County

Project Name	Opportunity Ranking	Proposed Restoration	Construction Cost ¹	Other Costs ²	Total Estimated Cost	Impervious Credit (IA)	Estimated Cost per IA
BMP 015	5	Wet Pond Retrofit	\$53,240.00	\$15,488.00	\$80,634.40	2.2	\$36,652
BMP 068	3	Wet Pond Retrofit	\$280,720.00	\$81,664.00	\$425,163.20	11.6	\$36,652
BMP 090	16	Sand Filter	\$181,500.00	\$52,800.00	\$274,890.00	2.2	\$124,950
BMP 103	24	Bioretention	\$74,250.00	\$21,600.00	\$112,455.00	0.9	\$124,950
BMP 175	7	Wet Pond Retrofit	\$19,360.00	\$5,632.00	\$29,321.60	0.8	\$36,652
BMP 243	6	Wet Pond Retrofit	\$94,380.00	\$27,456.00	\$142,942.80	3.9	\$36,652
BMP 316	22	Bioretention	\$49,500.00	\$14,400.00	\$74,970.00	0.6	\$124,950
BMP 317	23	Bioswale	\$8,250.00	\$2,400.00	\$12,495.00	0.1	\$124,950
BMP 318	3	Wet Pond Retrofit	\$82,280.00	\$23,936.00	\$124,616.80	3.4	\$36,652
BMP 362	21	Bioretention	\$288,750.00	\$84,000.00	\$437,325.00	3.5	\$124,950
BMP 423	1	Wet Pond Retrofit	\$19,360.00	\$5,632.00	\$29,321.60	0.8	\$36,652
BMP 494	2	Wet Pond Retrofit	\$19,360.00	\$5,632.00	\$29,321.60	0.8	\$36,652
BMP 558	13	Micropool Extended Detention	\$115,500.00	\$33,600.00	\$174,930.00	1.4	\$124,950
BMP 606	13	Bioretention	\$41,250.00	\$12,000.00	\$62,475.00	0.5	\$124,950
BMP 630	12	Bioretention	\$82,500.00	\$24,000.00	\$124,950.00	1	\$124,950
BMP 632	20	Bioretention	\$16,500.00	\$4,800.00	\$24,990.00	0.2	\$124,950
BMP 656	9	Wet Pond Retrofit	\$157,300.00	\$45,760.00	\$238,238.00	6.5	\$36,652
BMP 657	7	Wet Pond Retrofit	\$225,060.00	\$65,472.00	\$340,863.60	9.3	\$36,652
BMP 783 (Bio)	18	Bioretention	\$57,750.00	\$16,800.00	\$87,465.00	0.7	\$124,950
BMP 783 (RSC)	16	RSC	\$49,500.00	\$14,400.00	\$74,970.00	0.7	\$107,100
BMP 784	18	Bioretention	\$41,250.00	\$12,000.00	\$62,475.00	0.5	\$124,950
BMP 800	11	Bioretention	\$107,250.00	\$31,200.00	\$162,435.00	1.3	\$124,950
BMP 669	10	Wet Pond Retrofit	\$206,250.00	\$83,072.00	\$432,493.60	11.8	\$36,652
BMP 127	26	Bioretention	\$222,750.00	\$48,000.00	\$249,900.00	2	\$124,950
OID 55	15	Bioretention	\$285,560.00	\$24,000.00	\$124,950.00	1	\$124,950
BMP 588	25	Bioretention	\$82,500.00	\$21,600.00	\$112,455.00	0.9	\$124,950

Table 6-1. Cost Estimates for Recommended Priority Projects within Potomac Direct, Frederick County

Project Name	Opportunity Ranking	Proposed Restoration	Construction Cost ¹	Other Costs ²	Total Estimated Cost	Impervious Credit (IA)	Estimated Cost per IA
POTD-133-R-2009	3	Stream Restoration	\$791,266.00	-	\$791,266.00	22.61	\$35,000
POTD-2018-STRE-0001	9	Stream Restoration	\$2,341,150.00	-	\$2,341,150.00	66.89	\$35,000
POTD-2018-STRE-0005 R1	4	Stream Restoration	\$191,450.00	-	\$191,450.00	5.47	\$35,000
POTD-301-R-2013	1	Stream Restoration	\$812,000.00	-	\$812,000.00	23.20	\$35,000
COMBINED POTD-139-R-2010 & 132-R-2009	2	Stream Restoration	\$1,816,500.00	-	\$1,816,500.00	51.90	\$35,000

¹ Construction costs estimated using unit costs discussed in **Section 3**, plus 10% contingency.

² Other costs include Design and Engineering (32% of Construction), Inspection (10% of Construction), Project Management (5% of Construction plus Design and Engineering) and Site Improvement (8% of Construction).

Restoration concepts plans were prepared for each of the selected opportunities shown in **Table 6-1**. Concept designs consist of a project fact sheet, project assessment document and a 15% concept design plan. The project fact sheet includes project location, general information, estimated treatment provided, pollutant reduction estimates, and a cost estimate based on County-provided cost data described in **Section 3**. The project assessment document is a more detailed compilation of project details collected in the field, including information such as site conditions, accessibility, feasibility, and photographs. The 15% concept design plan for each opportunity illustrates existing and proposed conditions including site topography and proposed grading. A total of 25 BMP and five stream restoration concept plans were prepared, and are provided in **Appendix C**.

Drainage areas were digitally delineated for new stormwater opportunities as a shapefile and were based on field observations and GIS layers. Drainage areas for stream restoration opportunities were developed based on the County's GIS data. Drainage areas for existing stormwater facilities were taken directly from the County's geodatabase. GIS data files are described in **Appendix D**.

6.2 Associated TMDLs and Pollutant Load Reductions

As stated earlier, there are no TMDLs in Potomac River Frederick County that mandate reduction of TN, TP or other water quality parameters. However, each of the priority projects are anticipated to provide pollutant load reductions and other water quality benefits.

6.2.1 Streams

The anticipated treatment and pollutant load reductions for the five prioritized stream projects are shown in **Table 6-2**. Additional details for each project are provided in the concept designs included in **Appendix C**.

Table 6-2. Anticipated Treatment from Prioritized Stream Restoration Projects

Restoration Type	Number of Projects	Total Cost of Projects	Status	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Estimated Annual Load Reductions		
						TN (lbs)	TP (lbs)	TSS (tons)
Stream Restoration Projects	5	\$12,749,967	Planned	N/A	256.4	1,891	1,714	565.65

6.2.2 BMPs

The anticipated treatment and pollutant load reductions for the 25 prioritized BMP retrofit projects are shown in **Table 6-3**. Additional details for each project are provided in the concept designs included in **Appendix C**.

BMP Type	Number of Projects	Total Cost of Projects	Status	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Annual Load Reductions		
						TN (lbs)	TP (lbs)	TSS (tons)
Stormwater Pond Retrofits	25	\$6,186,191	Planned	198.3	83.6	809	89	26.78

6.2.3 Overall Pollutant Reduction from Prioritized Projects

The total anticipated treatment and pollutant load reductions for the 30 prioritized projects are shown in **Table 6-4**.

BMP Type	Number of Projects	Total Cost of Projects	Drainage Area Treated (acres)	Impervious Area Treated (acres)	Estimated Annual Load Reductions		
					TN (lbs)	TP (lbs)	TSS (tons)
Stormwater Pond Retrofits ²	25	\$6,186,191	198.3	83.6	809	89	26.78
Stream Restoration Projects ²	5	\$12,749,967	N/A	256.4	1,891	1,714	565.65
Total	30	\$18,936,159	198.3	340.0	2,700	1,803	592.43

Section 7

Public Education and Outreach

Frederick County aims to implement permit-suggested outreach topics and meet its own goals and objectives from the County's *Strategic Plan to Improve Water Quality through Public Outreach* (Frederick County, 2003) by conducting outreach and education events and activities with County residents. Outreach activities are used to educate citizens, to direct the course of watershed studies, and to identify landowners/stakeholders for potential restoration activities. This watershed assessment identifies potential restoration opportunities identified through such outreach activities, as well as County research, that could improve water quality and provide community education on the reasoning behind these projects; and how the public can implement additional activities in their own home. OSER understands the importance of engaging with the public early and often and presents this Watershed Assessment Report to the public for feedback so any clarifications necessary to finalize the Watershed Assessment for the Potomac Direct Frederick County Watershed may be addressed.

The draft of the Potomac Direct Frederick County Watershed Assessment will be shared with the general public, soliciting comments and input, and any relevant ideas and program improvements will be incorporated into the final draft. Solicitation of public input will be accomplished through:

- A notice in the local newspapers and on the County's website outlining how the public may obtain information on the development of the watershed assessment;
- Providing copies of the watershed assessment to interested parties upon request; and
- Providing a minimum of thirty (30) day comment period before finalizing the watershed assessment.

In addition to this public document, OSER continually enhances its outreach materials as well as its efforts to provide its citizens with needed educational touchpoints. Some of the County's key public outreach and education initiatives are as follows:

- Outreach related to the Monocacy & Catoctin Watershed Alliance (MCWA) and Green Leader Brigade;
- Outreach related to the Green Homes Challenge (GHC);
- Outreach related to Residential Septic Pump-outs;
- Outreach related to Pet Waste;
- Outreach related to Stormwater Management;
- Outreach related to Watershed Assessments and;
- Other County Outreach Initiatives.

7.1 Outreach Related to The Monocacy & Catoctin Watershed Alliance

The Upper and Lower Monocacy Watershed Restoration Action Strategy (WRAS) Steering Committees developed the Monocacy and Catoctin Watershed Alliance (MCWA, or "the Alliance") in order to continue outreach begun during the Upper and Lower Monocacy WRAS efforts and to begin implementation of the Upper and Lower Monocacy WRAS plans.

MCWA is a mutual, collaborative, non-advocacy effort among individuals and organizations desiring to work together to improve the health of the Monocacy and Catoctin watersheds. The County continues to coordinate MCWA and meet on a bi-monthly basis enabling attendees to discuss educational outreach opportunities, as well as develop restoration and protection projects to support water quality and habitat initiatives, and review and discuss recently developed watershed assessments and restoration plans. Partners involved in MCWA include but are not limited to:

- Local Organizations
 - Audubon Society of Central Maryland
 - Catoctin and Frederick Soil Conservation Districts
 - Catoctin Forest Alliance
 - Frederick County Forest Conservancy District Board
 - Catoctin Land Trust
 - Frederick County Conservation Club
 - Frederick County Master Gardeners
 - Local Citizens
 - Bar-T Mountainside Challenge & Retreat Center
- Regional Organizations
 - Potomac Conservancy
 - Potomac Watershed Partnership
 - Interstate Commission on the Potomac River Basin (ICPRB)
 - Center for Watershed Protection (CWP)
 - Potomac Valley Fly Fishers, Inc.
 - Chesapeake Conservation Corps
 - Trout Unlimited
- Funding Agencies
 - Chesapeake Bay Trust
 - Alice Ferguson Foundation
 - Maryland Dept. of the Environment/U.S. EPA Clean Water Act Section 319 (h) Program
 - Maryland Urban & Community Forestry Committee (MUCFC)
 - National Fish and Wildlife Foundation (NFWF)
 - Chesapeake & Atlantic Coastal Bays Trust Fund
- Educational Institutions
 - Hood College
 - Mount Saint Mary's University
 - University of Maryland Extension Office
 - Frederick County Public Schools (FCPS)
- Government Organizations
 - Frederick County Council
 - Frederick County Executive
 - Frederick County Division of Planning and Permitting
 - Office of Sustainability and Environmental Resources
 - Comprehensive Planning
 - Development Review
 - Permits and Inspections

- Division of Public Works
- Division of Utilities and Solid Waste Management
- Health Department, Environmental Health Section
- Division of Parks and Recreation
- Sustainability Commission
- Municipalities in Frederick County
- Maryland Department of Natural Resources
 - Forest Service
 - Fisheries
 - Watersheds Program
 - Wildlife & Heritage Service
- Maryland Department of the Environment
- Cunningham Falls State Park
- National Park Service
 - Catoctin Mountain Park
 - Monocacy National Battlefield Park
 - Rivers, Trails and Conservation Assistance
- U.S. Environmental Protection Agency
 - Environmental Information and Analysis
- U.S. Fish and Wildlife Service

The Alliance website (watershed-alliance.frederickcountymd.gov) is updated with a list of upcoming of events, past articles, links to quarterly meeting presentations, resources, and publications. Information on MCWA is also available in the OSER quarterly e-newsletter, expanding the Alliance's reach to more than 2,200 County households and/or Alliance partners.

Section 8

Monitoring

The County utilizes all of its Watershed Assessments and Feasibility Studies to continually grow the potential opportunities which then feed into the County's overall Restoration Plan, last published December 2018 (Frederick County, 2018). All identified opportunities have associated water quality benefits including reduction in nutrients and sediments entering into the County's waterways. When projects move into being programmed (under contract or funded), designed, and built (completed) their associated benefits are recalculated based on final project design. These benefits include the success in capturing impervious surface area runoff as well as nitrogen, phosphorous, sediment, and *E. coli* reductions at the local and Chesapeake Bay TMDL level. The County relies heavily on guidance provided by MDE, the Chesapeake Bay Program, and expert panels to assist in quantifying the reduction benefits for each completed restoration project. In addition to guidance documents, the County utilizes targeted restoration monitoring as well as the previously-discussed Countywide Stream Survey to continually learn more about the overall health of the County's streams.

8.1 Load Reduction Evaluation Criteria

The County will then use both a quantitative and qualitative approach to tracking and measuring progress.

Quantitative measures will track project implementation progress and estimated pollutant and impervious area reductions associated with implementation. Calibrated load reductions will be the targets used for TMDL compliance at the Chesapeake Bay and local levels. These target reductions are calculated based on TMDL percent reductions and baseline loads; and modeled using land use loading rates. Reductions for stormwater treatment have been modeled using a custom geodatabase script that uses the most accurate up-to-date information on BMPs with physical locations. These include all Environmental Site Design (ESD) BMPs, all Structural BMPs, and Alternative BMPs. Reductions for operational BMPs including street sweeping, catch basin cleaning, storm drain vacuuming, and septic system improvements have been determined using current data from County agencies working with these programs. Load reductions for each type of BMP are based on the MDE 2014 Accounting Guidance (MDE, 2014).

Qualitative measures will evaluate overall program success. The County will track and report progress annually with the submission of the County's Annual Report for its Phase I NPDES MS4 permit. The County will use the recommendations presented in the Potomac Direct Frederick County Watershed Assessment to establish goals as previously described and evaluate the progress towards meeting those goals in the Annual Report submission.

8.2 Monitoring

Frederick County has a number of initiatives in place to monitor and assess the results of watershed protection and restoration efforts. As documented in its NPDES 2014 Annual Report (Frederick County, 2014), the County has designed a monitoring program to include two (2) separate monitoring efforts: (1) targeted restoration monitoring and (2) Countywide, probability-based stream monitoring, with sites randomly selected and stratified by watershed called the Frederick County Stream Survey (FCSS).

8.2.1 Targeted Restoration Monitoring

The County's targeted stream restoration program assesses the physical, chemical and biological conditions of streams within Frederick County during designated sampling periods. Stream sampling locations vary by year and are based on supporting on-going restoration efforts. In 2018, the County completed targeted restoration monitoring in the Bennett Creek, Fishing Creek, and Potomac Direct (Point of Rocks) NPDES watersheds.

8.2.2 Frederick County Stream Survey (FCSS)

As described in the County's NPDES 2014 Annual Report (Frederick County, 2014), the FCSS is a probability-based survey (with random site selection) which uses rapid benthic macroinvertebrate and physical habitat assessments methods to assess County stream conditions. The program was developed using the similar protocols to the Maryland Biological Stream Survey (MBSS), but on a finer scale.

The County's survey includes 200 sites randomly selected across the County's 20 NPDES watersheds. The survey is carried out over a four (4) year period with 50 sites sampled each year. Establishing the timeframe in such a manner minimizes the influence of wet and dry years on the survey results and the combined four-year results provide a snapshot of stream conditions. Round 1 of the FCSS ran from 2008 – 2011. Round 2 began in 2013 and continued through 2016. Round 3 commenced in 2018 and will end in 2022 and is being conducted using methods outlined in the FCSS Sampling and Analysis Plan (Frederick County, 2018). Sites are visited a single time during the Spring Index Period (March through April). Data collection includes benthic macroinvertebrate sampling; in-situ water quality; stream discharge; aqueous grab samples; and spring and summer MBSS habitat, index period, and vernal pool data. Grab water samples are analyzed for Turbidity, Total Nitrogen, Total Phosphorus, Ammonia-N, TKN (calculated), Nitrate-Nitrogen, Dissolved Organic Carbon, Total Copper, Total Lead, Total Zinc, Chloride, and Total Hardness.

8.2.3 State Monitoring Efforts

State monitoring efforts include the Maryland Biological Stream Survey (MBSS). The MBSS is a probability-based or random design stream monitoring program implemented by the Maryland Department of Natural Resources (DNR). It provides an unbiased estimate of stream condition with known precision at various spatial scales ranging from large 6-digit river basins and medium-sized 8-digit watershed to the entire state. The first statewide round was completed in 1997 and the fourth round of MBSS sampling ended in 2018. There are over 5,300 sampling sites statewide. Data from the three previous rounds can be used as baseline conditions. Results from future rounds can be used to evaluate changes within the County.

Section 9

Limitations

This document was prepared solely for Frederick County Office of Sustainability and Environmental Resources in accordance with professional standards at the time the services were performed and in accordance with the contract between Frederick County Office of Sustainability and Environmental Resources and Brown and Caldwell dated December 27, 2017. This document is governed by the specific scope of work authorized by Frederick County Office of Sustainability and Environmental Resources; it is not intended to be relied upon by any other party except for regulatory authorities contemplated by the scope of work. We have relied on information or instructions provided by Frederick County Office of Sustainability and Environmental Resources and other parties and, unless otherwise expressly indicated, have made no independent investigation as to the validity, completeness, or accuracy of such information.

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Section 10

References

Frederick County (2003). *The Strategic Plan to Improve Water Quality through Public Outreach in Frederick County*.

Frederick County (2010). *Potomac Direct Fact Sheet*.

Frederick County (2014, December). National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Discharge Permit 2014 Annual Report. *2014 NPDES MS4 Annual Report*.

Frederick County (2014). *Point of Rocks Catchment Area F, Assessment for Watershed Restoration Opportunities*.

Frederick County (2017). *Frederick County Stream Survey 2013-2016 Four-Year Report*.

Frederick County (2017). *Urban BMP Geodatabase*.

Frederick County (2017). Watershed Guidance Document. Office of Sustainability and Environmental Resources.

Frederick County (2018). Frederick County Stream Survey Data Tables. Frederick, MD.

Frederick County (2018, December). National Pollutant Discharge Elimination System Municipal Separate Storm Sewer System Discharge Permit 2018 Annual Report. *2018 NPDES MS4 Annual Report*.

Frederick County (2018, May). Sampling and Analysis Plan for the Frederick County Stream Survey. Sparks, MD: KCI Technologies.

Frederick County (2018, December). Stormwater Restoration Plan.

MDE. (2014). *Accounting for Stormwater Wasteload Allocations and Impervious Acres Treated*.