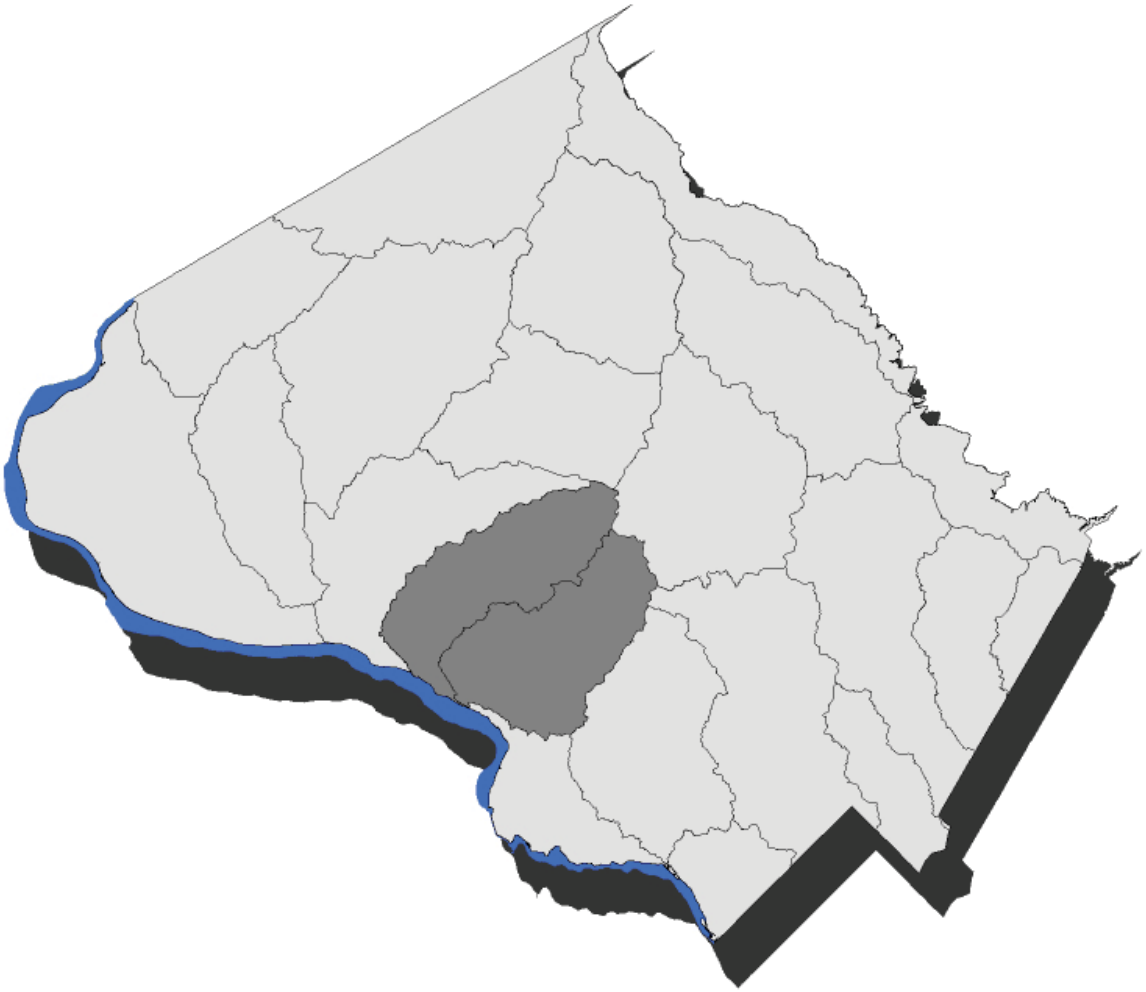
MUDDY BRANCH AND WATTS BRANCH SUBWATERSHEDS IMPLEMENTATION PLAN

PREPARED FOR:

MONTGOMERY COUNTY

DEPARTMENT OF ENVIRONMENTAL PROTECTION

255 Rockville Pike, Suite 120



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Prepared for:

Montgomery County Department of Environmental Protection
255 Rockville Pike, Suite 120
Rockville, MD 20850

Prepared by:

Horsley Witten Group, Inc
90 Route 6A
Sandwich, MA 02563

In collaboration with:

Biohabitats, Inc.
2081 Clipper Park Road
Baltimore, MD 21211

Versar
9200 Rumsey Rd
Columbia, MD 21045-1934

Horsley Witten Group, Inc
90 Route 6A
Sandwich, MA 02563

Capuco Consulting Services
914 Bay Ridge Road, Suite 206
Annapolis, MD 21403

Chesapeake Stormwater Network
117 Ingleside Avenue
Baltimore, MD 21228

RESOLVE
1255 23rd Street, NW, Suite 875
Washington, DC, 2003

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Notes to Reader:

1. Throughout this Plan there are text boxes such as this that focus on public outreach and stewardship elements to consider for the Plan. In addition, there are references to Practice Sheets which have been developed that are general strategies that apply countywide but will require some customization on a watershed basis to reflect certain stakeholder demographics and priorities. These practice sheets are included as an appendix to the Countywide Coordinated Implementation Strategy.
2. Environmental Site Design (ESD) is defined within the 2010 Maryland Stormwater Design Manual as the use of small-scale stormwater management practices, nonstructural techniques, and better site planning to mimic natural hydrologic cycling of rainwater and minimize the impact of land development on water resources. The application of the term is focused on new and redevelopment projects, and does not explicitly address or consider retrofit applications where site constraints such as drainage area, utilities, and urban soil quality are significant factors. This watershed implementation plan uses the term ESD in a more flexible manner to include structural practices such as bioretention, vegetated filters, and infiltration that provide distributed runoff management using filtering, infiltration, and vegetative uptake processes to treat the water quality volume to the maximum extent practicable. These practices are also thought of as Low Impact Development (LID) practices.

Acronym List

BMPs – best management practices

DA – drainage area

DEP – Department of Environmental Protection

DF – discount factor

DU – dwelling unit

EPA – Environmental Protection Agency

ESD – environmental site design

GIS – geographic information systems

HOA – homeowners association

IA – impervious area

IC – impervious cover

LDR – low density residential

LID – low impact development

MDE – Maryland Department of the Environment

MEP – maximum extent practicable

MDP – Maryland Department of Planning

MNCPPC – Maryland National Capital Parks and Planning Commission

MPN – most probable number

MPR – maximum practicable reductions

MS4 – municipal separate storm sewer system

NPDES – National Pollutant Discharge Elimination System

RR – runoff reduction

SPA – Special Protection Area

TFPI – Trash Free Potomac Watershed Initiative

TMDLs – total maximum daily loads

TN – total nitrogen

TP – total phosphorus

TSS – total suspended solids

USACE – Army Corps of Engineers

WLAs – waste load allocations

WQPC – water quality protection charge

WRAP – watershed restoration action plan

WTM – watershed treatment model

1. Goals and Existing Conditions

1.1 Introduction to the Implementation Plan and Restoration Goals

This Implementation Plan (the Plan) for the Muddy Branch and Watts Branch subwatersheds was developed in order to quantitatively demonstrate compliance with the County's National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit. In general, the Plan must meet the MS4 Permit's three major requirements:

- Assigned wasteload allocations (WLAs) for EPA-approved **Total Maximum Daily Loads (TMDLs)**
- Watershed restoration via **runoff management and impervious cover treatment**
- **Trash and litter management** to meet the commitments of the Potomac River Watershed Trash Treaty

Outreach and Stewardship Strategy
The primary messages for delivery in this watershed will pertain to activities the County is undertaking to manage runoff, trash, and litter.

The Plan outlines a roadmap for watershed restoration that targets runoff management and trash and litter management–including information pertinent to effectively include stakeholders in watershed restoration. The County MS4 Permit area comprises **61%** of the combined subwatershed area. The Plan focuses on the restoration effort within this MS4 Permit area. Areas not covered under the County's MS4 Permit include areas with rural zoning and federal and state properties, state roads, and municipalities that have separate MS4 permits, in this case, the Cities of Gaithersburg and Rockville. The County MS4 Permit area has approximately **14%** impervious cover within the Muddy Branch and Watts Branch subwatersheds.

Total Maximum Daily Loads (TMDLs)
As of October 2010, the EPA has not approved any TMDLs for the Muddy Branch and Watts Branch subwatersheds; however, the MDE is expected to develop wasteload allocations for nutrients and sediment for the Chesapeake Bay watershed in 2011. The full suite of BMPs proposed in the Plan can result in **6% load reductions** for total nitrogen (TN), **6%** for total phosphorus (TP), and **7%** for total suspended solids (TSS).

Runoff Management and Impervious Cover Treatment
During the five-year Permit cycle, the County must add stormwater management for an additional 20% of impervious cover within the County's MS4 Permit area that is not currently managed to the maximum extent practicable (MEP). The baseline year for determining the 20% goal is 2009 since the Permit was issued on February 16, 2010. Full implementation of projects identified through the countywide implementation strategy can manage an additional 237 acres of impervious cover not currently managed to the MEP.

Trash and Litter Reduction
The third major permit element is that of trash and litter management to meet the commitments in the Potomac River Watershed Trash Treaty. The County must identify trash and litter reduction measures that are being implemented towards the goal of a Trash Free

Potomac by the year 2013. This Plan also documents trash loading from the subwatersheds via proposed reduction methods. An estimated **6% reduction** of trash loads over baseline conditions is projected based on full implementation of BMPs identified in this plan.

1.2 Existing Conditions in the Muddy Branch and Watts Branch Subwatersheds

Introduction to the Muddy Branch and Watts Branch Subwatersheds

The Muddy and Watts Branches are two adjacent subwatersheds located in the middle portion of the County, between the area called Potomac and the City of Gaithersburg, primarily on the southwestern side of Interstate 270. They are the largest subwatersheds in the Lower Potomac Direct watershed grouping, one of eight being used to track MS4 Permit compliance. Combined, these subwatersheds have a drainage area of approximately **42.4 square miles**. A basic profile of the combined subwatersheds is provided in Table 1, a map depicting existing conditions is presented in Figure 1, and a map depicting stream resource conditions is presented in Figure 2.

Table 1: Combined Muddy Branch and Watts Branch Subwatersheds Profile

Metric	***Acres***	***Percent of Total Subwatersheds***
Drainage Area	27,152	100%
Impervious Cover	4,719	17%
Watershed Area Subject to County MS4 Permit[1]	16,502	61%
Impervious Cover Subject to County MS4 Permit[1]	2,346	14% (of MS4 permit area)
Pervious Cover (e.g., forest, turf, meadow, farm fields)[1]	14,156	86% (of MS4 permit area)

[1] MS4 permit area does not include areas within the Cities of Gaithersburg or Rockville, rural zoning, all MNCPPC lands, Federal and State property, and Federal and State roads.

Muddy Branch Subwatershed

The Muddy Branch originates in the City of Gaithersburg's historic district, one of Montgomery County's oldest development centers. The stream flows southwest for approximately 13 miles, before flowing into the Potomac River. High levels of imperviousness combined with lack of stormwater management and stream buffers have severely impacted the streams, particularly in the headwaters and along major transportation corridors, such as Route 355 and the CSX railroad. The majority of the development in the middle portion of this subwatershed occurred at a very rapid pace after 1970. These developments were subject to some level of environmental standards, but only developments built after 1985 consistently have stream buffers and on-site stormwater BMPs. Regional stormwater BMPs were installed to control runoff from the extensive impervious areas associated with the Shady Grove research and development and commercial corridor. The Maryland-National Capital Park and Planning Commission (MNCPPC) acquired large areas of the stream valley to maintain stream buffers and protect the stream. The lower development densities and higher level of stream protection downstream of Route 28 correspond with improved stream resource conditions.

Watts Branch Subwatershed

Watts Branch originates in the City of Rockville, to the south and east of the intersection of I-270 and Shady Grove Road within the King Farm planned urban development area. The stream flows southwest for approximately 11 miles, and merges with Piney Branch and Sandy Branch before entering the Potomac River. The headwater areas are highly developed and contain commercial, high-density residential, and research and development centers. The upper portion of Watts Branch has been impacted by runoff from the high impervious areas, and the majority of the stream channels are over-widened and have lost their connection to their floodplain (i.e. are entrenched). The runoff from high density developments with inadequate stormwater management has caused streambank erosion, sedimentation, and riffle habitat impairment.

The lower portions of the subwatershed are predominately lower density residential and the streams still support diverse fish populations. The upper and western portions of Piney Branch and Lower Sandy Branch, major tributaries, contain high quality, cool-water streams which are important in maintaining water quality further downstream in the mainstem. In 1995, the Piney Branch tributary was designated as a Special Protection Area (SPA) in recognition of the need to preserve this sensitive resource as its headwaters were developed. Projects proposed within the SPA must go through a special permitting and review process and must comply with more stringent stormwater management design. Applicants must pay fees to support instream monitoring and annual reporting and must also conduct BMP monitoring during construction and post-construction,

Outreach and Stewardship Strategy Methods of Obtaining Information: Given that there are a great number of residences in this watershed, it is assumed that most of the stakeholders in this watershed have access to a personal computer and thus can be reached through electronic messaging and social media. Further, given that resident surveys have indicated that the majority of Montgomery County residents prefer newspapers as their primary source of information, a vigorous press campaign is recommended in this watershed for effective stakeholder outreach and education.

Status of Watershed Management Activities

The two subwatersheds differ in the extent of watershed management activities to date. The City of Gaithersburg has developed a restoration evaluation for the portion of streams that are within the City and will be working closely with the County as restoration projects are implemented.

The County and US Army Corps of Engineers (USACE) are working on a comprehensive restoration project plan for Muddy Branch scheduled for completion in 2011. The Plan identifies all stormwater BMP retrofit and stream restoration opportunities listed in the draft (February, 2009) of the Great Seneca/Muddy Branch Watersheds Ecosystems Restoration Project. The ongoing effort has listed 23 stormwater pond retrofits, various Environmental Site Design (ESD) projects, and approximately 5 miles of stream restoration projects for water quality and stream habitat improvement.

A comprehensive restoration study for Watts Branch was completed in 2006, targeting 14 priority subwatersheds. Potential projects identified through that study include 5 stormwater

pond retrofits, various ESD projects, and over 14 miles of streams in need of restoration to improve the Watts Branch water quality and stream habitat.

Land Uses in Muddy Branch and Watts Branch Subwatersheds

Table 2 includes MS4 Permit area land use in the subwatersheds. Residential land use is dominant, covering almost 70% of the subwatersheds. This is followed by forest at 11% and rural at almost 7%. The subwatersheds have few commercial or industrial land uses, with about 6% of the land area so identified according to MDP. Institutional uses account for less than 3% of the area.

Outreach and Stewardship Strategy Demographic Snapshot:
Stakeholders in this watershed are predominantly Caucasian, well educated, with above average incomes. There is an Asian population which will necessitate providing outreach and education materials in Korean or Chinese as well as English. Groups of stakeholders are already organized in interest groups such as Izaak Walton League which will make information dissemination simpler than in other watersheds.

Table 2: County MS4 Permit Area Land Use

Maryland Department of Planning 2002 Land Cover/Land Use	*Subwatershed Acres*	*Percent of Total (%)*
Low Density Residential (<1 du/acre)	7,472.6	45.9%
Medium Density Residential (1-4 du/acre)	3,619.7	22.2%
High Density Residential (>4 du/acre)	141.5	0.9%
Commercial	556.0	3.4%
Industrial	391.6	2.4%
Municipal/Institutional- Intensive[1]	346.0	2.1%
Municipal/Institutional- Extensive[2]	94.4	0.6%
Roadway[3]	943.4	5.8%
Rural[4]	1,073.1	6.6%
Forest[5]	1,825.8	11.2%
Open Water	38.2	0.2%
Bare Ground	0.0	0.0%
Total for Subwatersheds	16,502.5	100.0%

[1] Institutional land use (churches, schools, municipal buildings)
[2] Open Urban Land and Bare Rock land use (parks, cemeteries, and golf courses)
[3] Combined County and private roads (excludes Federal and State roads)
[4] Orchards, Vineyards, Horticulture, Feeding Operations, Cropland, Pasture, and Agricultural Buildings land use
[5] 2002 Land Use Data.

Existing Stormwater Best Management Practices (BMPs)

There are 307 structural stormwater BMPs within the Muddy Branch and Watts Branch subwatershedsMS4 Permit area, each capturing drainage areas that vary from over 200 acres for regional pond BMPs to less than 0.1 acres for small, on-site BMPs. The current inventory of BMPs was categorized according to design era and historic performance criteria. Performance metrics were used to group the BMPs into the five categories shown in Table 3. The BMPs are classified according to their performance code as established in Appendix B of the Guidance Document.

Outreach and Stewardship Strategy Education Project: To help watershed stakeholders understand why stormwater retrofits and other watershed restoration improvements are under construction, stakeholder outreach such as installing educational signage near all retrofit projects is recommended Messaging should focus on the ways that the treatment of stormwater on roads and public lands is changing. This is a demonstration of the new ways in which we manage stormwater. Implementation details on this stakeholder outreach are described in the Practice Sheet entitled Innovative Stormwater Management Outreach and Stewardship Campaign.

Table 3: Existing Stormwater Management

BMP Performance Code[1]	*Count*	*Acres of Impervious Area (IA) Treatment*	
		Drainage Area Treated	*Total IA in Drainage Area*
(4) Environmental Site Design (ESD) BMPs	48	167.4	41.5
(3) Effective BMPs	88	2,238.9	562.2
(2) Under-performing BMPs	19	79.6	24.8
(1) Non-performing BMPs	71	1,113.8	264.1
(0) Pretreatment & Unknown[2]	81	191.9	90.3
Total	307	3,791.7	983.0

[1]For drainage areas with more than one BMP, the maximum performance code was taken after deleting pretreatment BMPs (Code 0).
[2]Drainage area not associated with a specific BMP type

1.3 Problems Facing the Muddy Branch and Watts Branch subwatersheds

Biological and Habitat Conditions

The most recent countywide, five-year monitoring cycle was completed in 2010. In 2010, 12 tributaries in the Muddy Branch and Watts Branch subwatersheds were sampled for benthic macroinvertebrates, fish species, and habitat metrics in order to assess the stream resource conditions. Results of the survey are in Table 4, summarized by both stream miles and drainage area. The survey data can be used to classify both instream conditions and overall watershed water quality. Therefore, the stream miles summary can be interpreted as an indicator of the

current instream conditions. The drainage area summary can be used to indicate the condition of water quality draining from the subwatersheds.

Currently, the majority of the stream resource conditions in Muddy Branch and Watts Branch subwatersheds were assessed as 'Fair' (75%), and the rest were 'Good' (25%). The majority of the higher quality streams were found in the lower Muddy Branch and Watts Branch subwatersheds. In contrast, the upper subwatershed received 'Fair' ratings, which can mostly be attributed to the increased development near the Cities of Gaithersburg and Rockville.

Table 4: Muddy Branch and Watts Branch subwatersheds Stream Resource Condition Survey Results by Stream Miles and Drainage Area

Resource Condition	***Length (miles)***	***%***	***Area (Acres)***	***%***
Excellent	0.0	0%	0.0	0%
Good	31.3	25%	6,225.6	23%
Fair	93.6	75%	20,536.5	77%
Poor	0.0	0%	0.0	0%
Not Assessed	0.0	0%	0.0	0%
Total	124.9	100%	26,762.0	100%

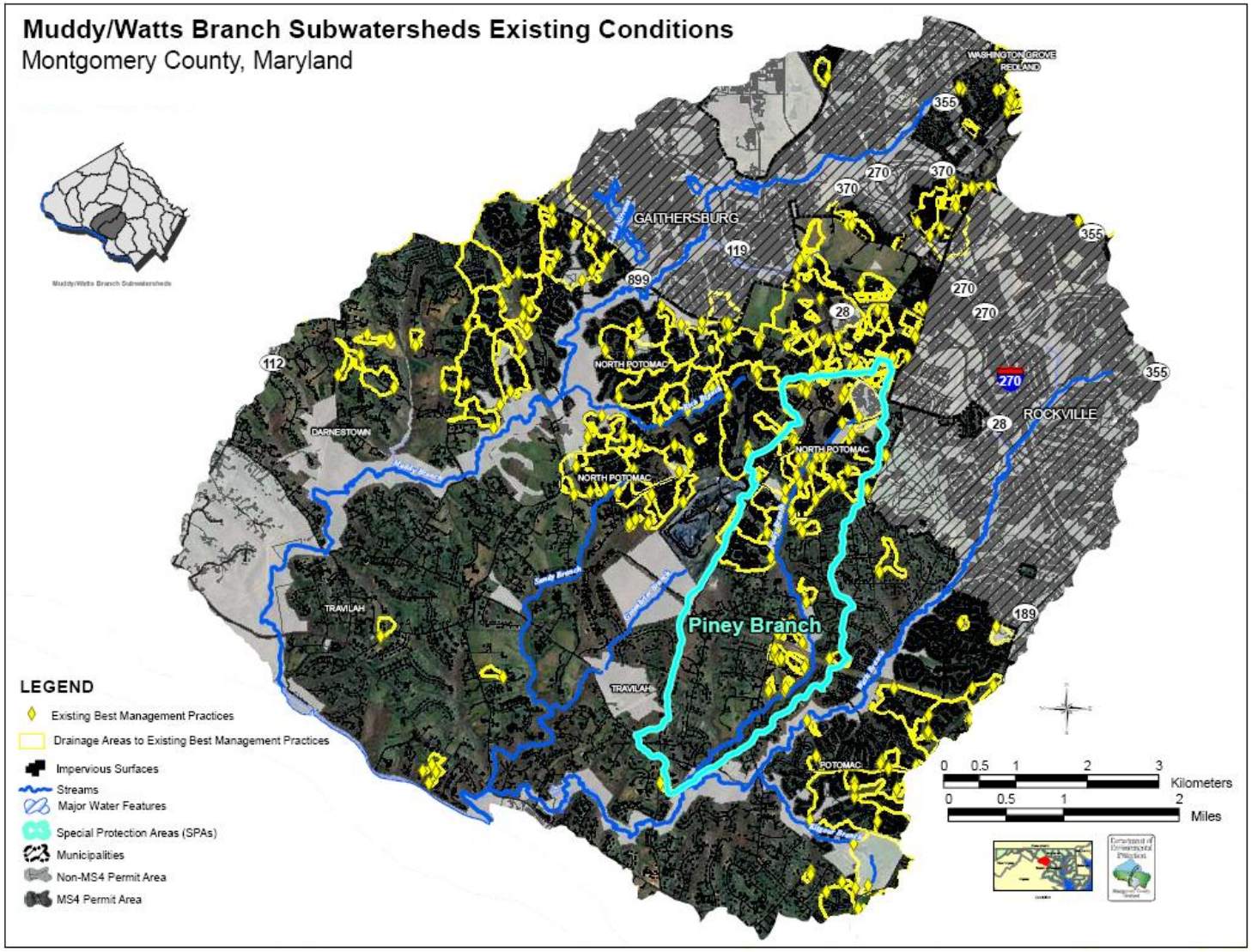

Figure 1: Existing Conditions and BMP Locations for the Muddy Branch and Watts Branch Subwatersheds

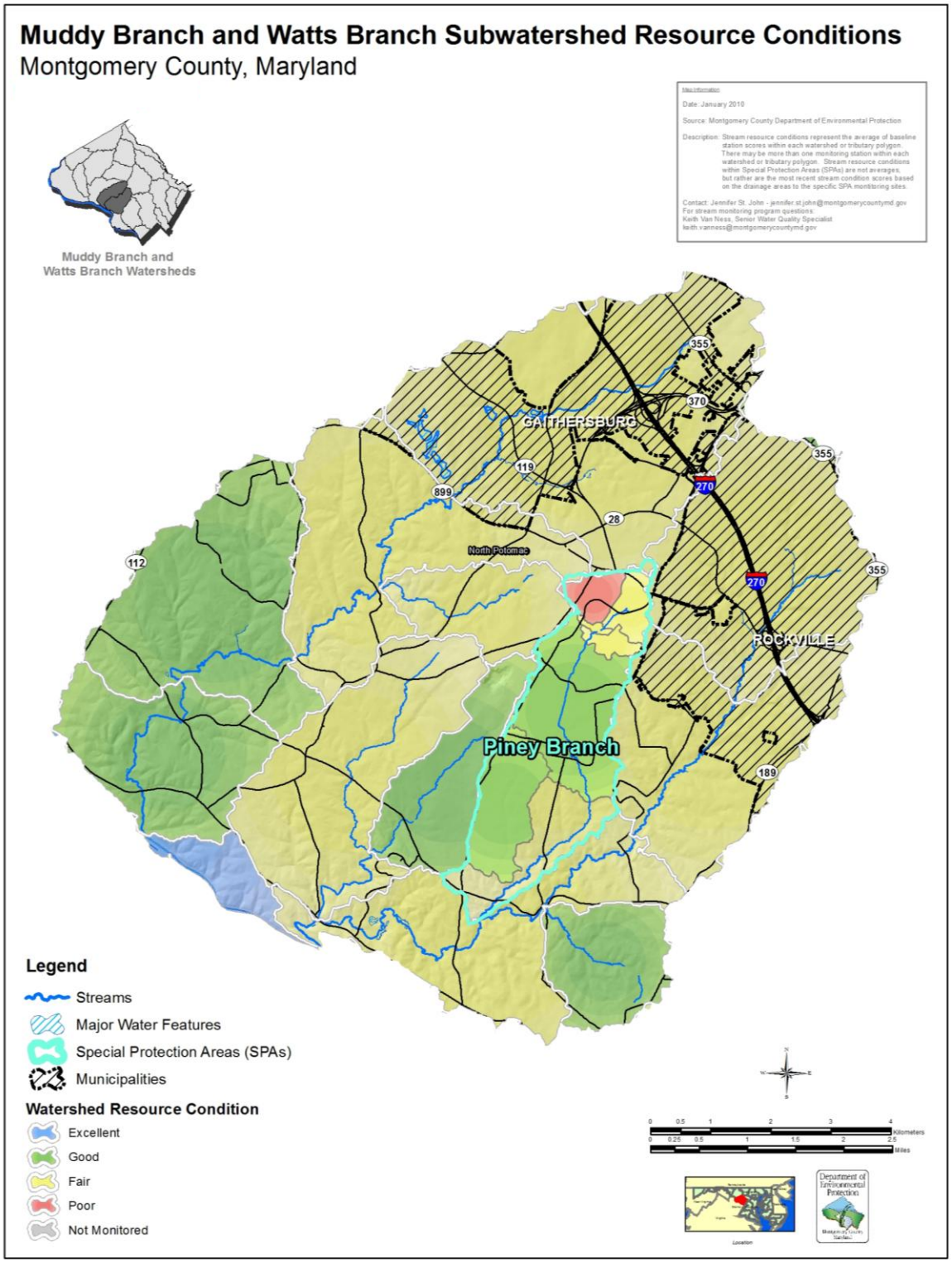

Figure 2: Stream Resource Conditions for the Muddy Branch and Watts Branch Subwatersheds

Water Quality and Trash Issues

As part of its environmental enforcement program, the County tracks citizen complaints regarding water quality and illegal solid waste dumping. Table 5 summarizes the number and type of citizen complaints recorded for Muddy Branch and Watts Branch subwatersheds during the five year cycle from 2004 to 2009. The overwhelming majority of the complaints received were related to stormwater pollutant discharge. Table 6 includes the same complaints summarized by location, and general zoning type. For some properties there were multiple complaints. The majority of complaints recorded were in residential, commercial, and industrial zoned areas that are closer to Cities of Rockville and Gaithersburg.

Outreach and Stewardship Strategy Education Project: To reduce trash hot spots, stakeholder outreach is recommended in partnership with HOAs and county recycling offices. Educating watershed residents on the importance of proper trash can maintenance, keeping playing fields clean, and dumpster maintenance is recommended for success. Implementation details are in the Practice Sheet entitled Anti-littering Outreach and Stewardship Campaign.

Table 5: Recorded Water Quality Complaints[1]

Number by Water Quality Complaint Type				
Total # of cases	***Stormwater-Pollutant Discharge***	***Surface Water-Chemical Discoloration/ Unknown***	***Surface Water-Sewage***	***Surface Water-Petroleum Product in Water***
43	30	9	4	0

[1] From WQCases2004_2009_Locations.shp

Table 6: Water Quality Complaint by Zoning[1]

General Zoning Type[2]	***Acres***	***Total # of Properties***
Apartments	**2.4**	**1**
Residential	**21.3**	**24**
Commercial	**29.1**	**4**
Industrial	**210.5**	**4**
Non-Conforming	**0.0**	**0**
Unzoned	**3.6**	**1**

[1] From SWCases2004_2009_locations.shp
[2] From County PROPERTIES.shp

Solid waste trash dumping sites were also logged by the County to identify trash hotspots. Table 7 includes a summary of the complaint database by complaint type. The majority of complaints were recorded as residential dumping. Table 8 identifies the general zoning type at the site of the complaint. As with Tables 5 and 6, for some properties there were multiple complaints noted in Tables 7 and 8.

Table 7: Solid Waste Trash Dumping Sites[1]

Number per Solid Waste Type				
Total # of cases	***Farm Land***	***Residential***	***Public Land***	***Dumpster***
58	0	42	8	8

[1] From SWCases2004_2009_locations.shp

Table 8: Solid Waste Trash Dumping Sites by Zoning[1]

General Zoning Type[2]	***Acres***	***Total # of Properties***
Apartments	**4.7**	**1**
Residential	**144.0**	**48**
Commercial	**2.9**	**1**
Industrial	**4.8**	**1**
Unzoned	**3.9**	**1**

[1] From SWCases2004_2009_locations.shp
[2] From County PROPERTIES.shp

1.4 Existing Pollutant Loads and Impervious Surfaces

Existing Nutrient and Sediment Loads
During 2011, it is expected that MDE will provide WLAs for nutrients to meet the Baywide nutrient TMDL. This Plan establishes some initial estimates for load reductions from baseline conditions for nutrients and sediment.

Impervious Surfaces
Impervious cover in the subwatersheds, as derived from the County's geographic information system (GIS), is summarized in Table 9. The roofs of single family homes and roads account for the largest percentages of impervious cover in the subwatersheds at 30% and 40%, respectively.

Outreach and Stewardship Strategy Education Project: To reduce stormwater pollution on private property, stakeholder outreach is recommended explaining the need for watershed stakeholders to capture some of the precipitation that falls on their roof and allow for groundwater recharge hence slowing the flow of surface waters and potential erosion impacts. It is recommended that this can be accomplished by expanding existing County programs such as Rainscapes, as described in the Practice Sheet entitled Roof Runoff Reduction Outreach and Stewardship Campaign.

Existing Trash Loads
The Potomac River Watershed Trash Treaty outlines the agreement between local and state elected officials to commit to a Trash Free Potomac by 2013. The agreement includes three major commitments:

- Support and implement regional strategies aimed at reducing trash and increasing recycling;

- Increase education and awareness of the trash issue throughout the Potomac Watershed; and
- Reconvene annually to discuss and evaluate measures and actions addressing trash reduction.

In general, trash reduction strategies fall into four categories: (1) Structural; (2) Educational; (3) Municipal; and (4) Enforcement. Structural stormwater BMPs will be assigned 95% removal credit for trash from the contributing drainage area. BMPs, while not specifically designed to capture trash, are also not very good at passing trash. Debris is prone to build up in forebays, around plants and interior elements, and around the outlet structures. This Plan estimates the percent reduction in trash from Muddy Branch and Watts Branch subwatersheds through structural BMPs.

In addition to trash removal by structural stormwater BMPs, programmatic practices from other activities (i.e., educational, municipal, and enforcement) can provide trash prevention and control. These programmatic practices are specially aimed at reducing trash inputs to roads and streams, including educationally focused programs such as reduce, reuse and recycle campaigns; dumpster management and storm drain marking; and programs tied to operations such as littering and illegal dumping enforcement; stream cleanups; and street sweeping. While not evaluated here, these programmatic practices are further explored in the countywide strategy.

Table 9: County MS4 Permit Area Impervious Cover

Impervious Cover Type	*Impervious Acres*	*Within Subwatersheds*
1. Roads		
a. Low Density Residential[1]	389.8	**16.4%**
b. Other[2]	553.6	**23.3%**
2. Parking Lot		
a. County Small Lots (<1 acre) [3]	5.9	**0.2%**
b. County Large Lots (>=1 acre) [3]	37.2	**1.6%**
c. Private	331.2	**14.0%**
3. Roofs		
a. County[4]	24.0	**1.0%**
b. Single Family Homes[5]	714.4	**30.1%**
c. Other	209.5	**8.8%**
4. Sidewalks[6]	39.3	**1.7%**
5. Other		
a. Schools[7]	27.7	**1.2%**
b. Recreational[8]	41.4	**1.7%**
Total Impervious Acres from GIS[9]	**2374.0**	**100.0%**

[1]All roads in RE2 or R200 property zoning.
[2]Includes County and private roads.
[3]Parking lots located in County-owned parcels, derived using County_pnts from the County's PROPERTY geodatabase.
[4]Buildings located in County-owned parcels, derived using County_pnts from the County's PROPERTY geodatabase.
[5]Buildings located on single family home parcels, derived using MDP_pnts from the County's PROPERTY geodatabase and selecting only single-family dwelling types.
[6]Sidewalks in jurisdiction. Does not include all residential sidewalks or driveways.
[7]Impervious cover located in public school parcels, derived using pubsch points from the County's LOCATIONS geodatabase. Some overlap with other impervious.
[8] Impervious cover identified as Recreational in geodatabase. Some overlap with other impervious.
[9] Sum of all GIS impervious. Excludes overlaps in schools and recreational.
[10] As of 2009

2 Inventory of Provisional Restoration Candidates

2.1 Types of Restoration Practices

Table 10 summarizes the types of watershed restoration practices evaluated for the Muddy Branch and Watts Branch subwatersheds. Restoration practices differ in the mode and manner by which they will be delivered, however, most of those listed here will be implemented via capital budgets and water quality protection charges. Multiple delivery mechanisms are needed to implement enough watershed restoration practices to meet the stringent watershed treatment and pollutant reduction targets set forth in the County's MS4 permit and the Potomac River Watershed Trash Treaty.

Table 10: Restoration Practices Evaluated in the Muddy Branch and Watts Branch Subwatershed Implementation Plans

Description of Practice	***Application in the Rock Creek Watershed***
ESD Practices	
New ESD Retrofit Practices - These include small scale ESD practices applied to County- owned or privately owned buildings, streets and parking lots and rights of way. Examples include rainwater harvesting, green roofs, upland reforestation, soil compost amendments, rooftop disconnection "green street" retrofits and converting swales to dry swales.	Public ESD Retrofits
ESD Upgrades - This category includes retrofit ESD practices within existing publicly-owned or privately-owned stormwater infrastructure, so that their hydrologic and pollutant reduction performance is upgraded.	Code 1 and 2 BMP Upgrades (see WTM 3.0)
Impervious Cover Reduction - This category involves cases where un-needed impervious cover is removed, soils amended and vegetation restored primarily on County schools, streets and parking lots.	Not applicable
Voluntary LID Implementation - ESD practices that are installed as a result of County education and incentive programs (e.g., Rainscapes incentives).	Not applicable
Programmatic and Operational Practices	
MS4 Programmatic Practices – This category deals with reduced pollutants that can be attributed and quantified through MS4 stormwater education (e.g., lawn care), pollution prevention improvements at municipal hotspots, and better housekeeping on County land and facilities. Also includes any pollutant reductions due to product substitution, such as imposing restrictions on N or P content in fertilizer, increased pet waste enforcement, trash prevention and control.	Not applicable
Hotspot Pollution Prevention – This category credits enhanced structural and non-structural practices employed at non-publicly owned stormwater hotspots that are identified through land use analysis.	Not applicable
Enhanced County Street Sweeping - This category includes any pollutant reduction that can be attributed to more intensive and targeted street sweeping in the subwatersheds conducted by the County.	Not applicable

Description of Practice	***Application in the Rock Creek Watershed***
Trash Prevention and Control - This category includes a wide range of programs and practices specially aimed at reducing trash inputs to stream, including reduce, reuse and recycle campaigns, littering and illegal dumping enforcement, dumpster management, storm drain marking, storm drain inlet devices, stream cleanups, instream controls to trap and remove trash, etc. These measures are in addition to any trash trapped and removed by other restoration practices which are computed separately.	Not applicable
Structural Practices	
Traditional Retrofits - This is the traditional retrofit scale where large-scale, non-ESD retrofits are constructed on larger parcels of public or private land as discovered through analysis of MCDEP BMP inventory.	New Ponds
BMP Maintenance Upgrades - Credit for improvement in current permit cycle for major maintenance upgrades of failed stormwater practices that result in significant improvement in hydraulic function and increased treatment capacity using existing County maintenance budget. Credit can only be taken for increased load reduction due to upgrades that significantly rehabilitate BMP function from its installation baseline. (e.g., increase capacity, lengthen flow path, reduce short-circuiting, eliminate design failures) .	Code 1 and 2 BMP Upgrades (see WTM 3.0)
Habitat Restoration - This category includes any pollutant reduction or volume reduction that can be attributed to specific stream restoration or riparian reforestation projects planned for construction in the subwatersheds for the permit cycle.	Not Applicable

2.2 Inventory of Previously Identified Projects

Potential restoration strategies for the subwatersheds set forth in this Plan were drawn from the 2006 Watts Branch Watershed Restoration Study, the 2009 Great Seneca/Muddy Branch Ecosystem Restoration plan, preliminary County and USACE Muddy Branch watershed plan, and the County's restoration sites inventory. Previously identified restoration projects are presented in Figure 3.

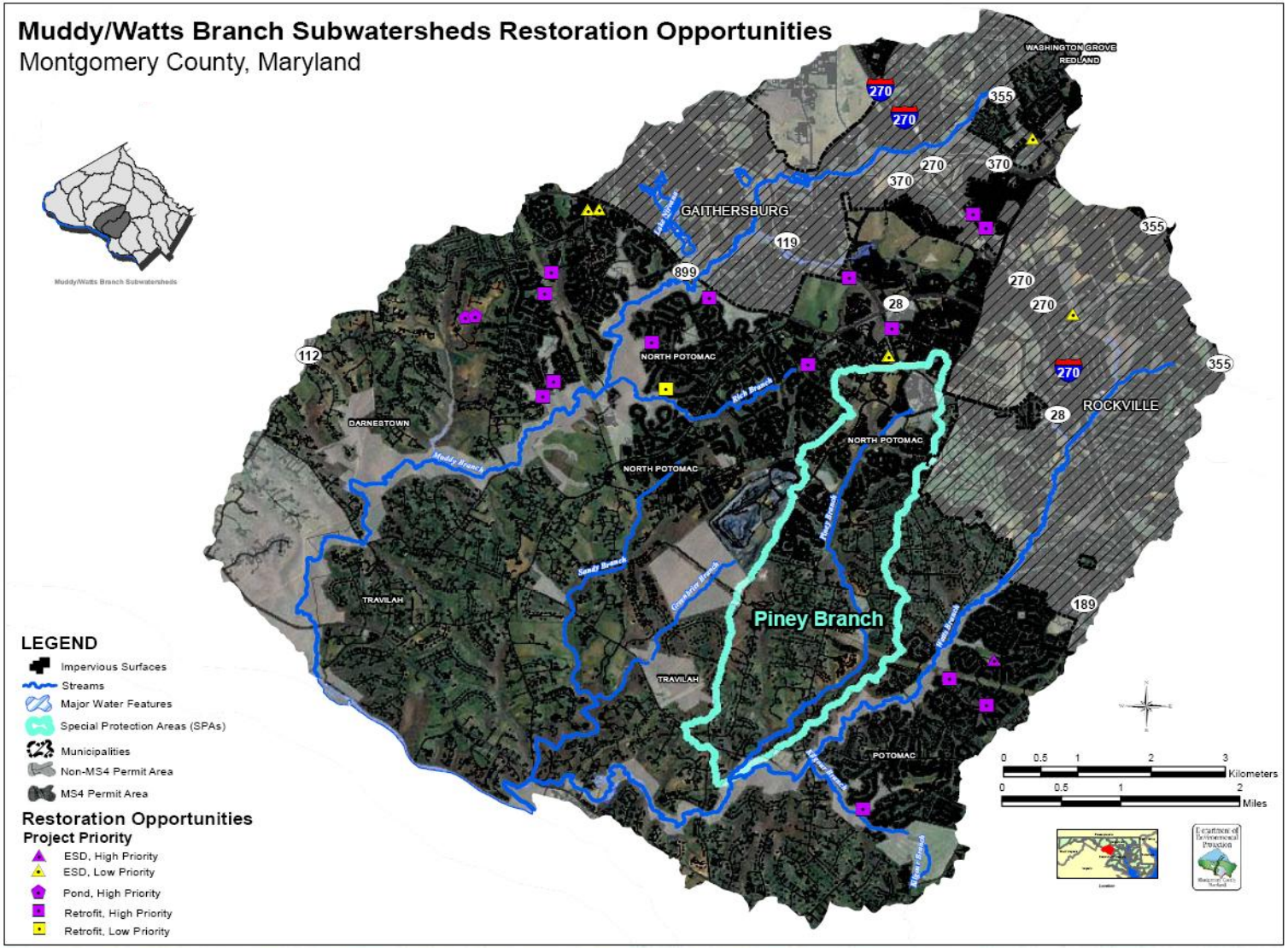

Figure 3: Identified Restoration Opportunity Locations for the Muddy Branch and Watts Branch Subwatersheds

3 Evaluation of the Restoration Strategies to Meet MS4 Permit Requirements

This section of the Plan describes an analysis of existing stormwater BMPs and potential load reductions for the Muddy Branch and Watts Branch subwatersheds. A land use-based model was used in this Plan to develop a primary source load of sediment, nutrients, and trash to the Muddy Branch and Watts Branch subwatersheds using 2002 MDP land use data for consistency with the countywide coordinated implementation strategy. Further information on land use loading rates can be found in the Plan Guidance Document, Section 2.

3.1 Desktop Review of BMP Coverage

A desktop review of BMP coverage was used to analyze the existing BMP coverage and proposed County restoration sites inventory of potential retrofit projects. The BMPs were classified according to their performance code as shown in Table 11. The relative performance of each practice type was based on comparative reviews of pollutant reduction and runoff reduction performances of practices from around the country (CWP, 2007; and CWP and CSN, 2008) or performance studies on individual practices (Schueler, 1998). The composite efficiencies were also compared to recent research values and assumptions used in local models (Chesapeake Bay Program, 2008; and MDE, 2009) to further justify the performance coding. A summary of the BMP modeling assumptions are in Table 11.

Table 11. Composite Runoff Reduction, Effectiveness Factor, and Pollutant Reduction by BMP Performance Code

Performance Code	*Description*	*TSS[1] (%)*	*TN[2] (%)*	*TP[3] (%)*	*FC[4] (%)*	*DF[5] (%)*
1	**Non-performing BMPs**	5	0	0	0	0.05
2	**Underperforming BMPs**	20	5	5	10	0.15
3	**Effective BMPs**	80	40	50	65	0.75
4	**ESD Practices**	90	65	65	75	1.0

[1] TSS: Sediment reduction rate
[2] TN: Total Nitrogen reduction Rate (Mass)
[3] TP: Total Phosphorus reduction Rate (Mass)
[4] FC: Fecal coliform reduction, see rationale in Guidance Document, Section 5.5 for why entercocci could not be used.
[5] DF: Discount Factor: Fraction of contributing impervious acres effectively treated to the Water Quality Volume, used to rate BMP treatability

3.2 Summary of Watershed Treatment Model Scenarios

The Watershed Treatment Model (WTM) was used to estimate pollutant sources and treatment options for the Muddy Branch and Watts Branch subwatersheds. The spreadsheet used was an updated version of the publically available v3.1, which included an expanded runoff volume reduction component (personal correspondence, Deb Caraco, 2009). The WTM was used to track restoration activities across the subwatersheds to illustrate the potential to reduce pollutant loads. For Muddy Branch and Watts Branch subwatersheds, this analysis is limited to

the specific restoration sites identified by the County. The specific layers of analysis are summarized in Table 12 and presented below in more detail, following the nomenclature of WTM 1.0 – WTM 2.0.

Table 12. Summary of WTM Scenarios

Implementation Phase	*Description*
WTM 1.0 Baseline Conditions	The WTM was run under existing conditions approach with the MDP year 2002 land use/land cover data and existing BMPs.
WTM 2.0 Completed as of 2009; High Priority; Low Priority and Other Potential Projects	The WTM was run with a series of future management practices, which were proposed projects from the County inventory of restoration sites. These practices cover new ponds, retrofits of existing facilities, and ESD practices from the proposed projects list.

WTM 1.0 – Baseline Conditions

The WTM was run under existing conditions approach with the MDP year 2002 land use/land cover data (refer to Table 2) and existing BMPs coded under "Existing Management Practices" (Table 13). Table 13 summarizes the number of existing BMPs by performance code, their collective drainage areas, total impervious areas captured in the Muddy Branch and Watts Branch subwatersheds, and the estimated impervious area treated based on the discount factor listed in Table 11.

Table 13: Existing BMP Inventory for Muddy Branch and Watts Branch subwatersheds

BMP Performance Category	*Count*	*Total DA (Acres)*	*Total IA (Acres)*	*IA*DF[1] (Acres)*
ESD Practices (Code 4)	48	167.4	41.5	41.5
Effective BMPS (Code 3)	88	2238.9	562.2	421.7
Underperforming BMPs (Code 2)	19	79.6	24.8	3.7
Non-performing BMPs (Code 1)	71	1113.8	264.1	13.2
Pretreatment BMPs (Code 0)	81	191.9	90.3	13.5

DA: Drainage Area; IA: Impervious Area

[1] IA discounted acres used in WTM, See Guidance Document, Appendix B

WTM 2.0- Completed as of 2009, High Priority, Low Priority and Other Potential Retrofit Projects

The WTM was run with a series of future management practices, which were proposed projects from the County inventory of restoration sites. These practices cover new ponds, retrofits of existing BMPs, and ESD projects, as summarized in Table 14. Drainage area (DA), impervious area (IA), total length, and total cost were all determined from engineering designs or estimated based on the running average per practice values from the County DEP Restoration Sites Database.

Table 14: Three levels of treatment: Complete as of 2009, High Priority, and Other Potential Projects

Restoration Type	*Count*	*Total Cost*	*Total Length (mi)*	*Total DA (acres)*	*Total IA (acres)*
Completed Projects					
ESD	0	$0.00	0.0	0.0	0.0
New Pond	0	$0.00	0.0	0.0	0.0
Retrofit of Non-performing BMPs	0	$0.00	0.0	0.0	0.0
High Priority Projects					
ESD	1	$338,000.00	0.0	1.9	1.7
New Pond	2	$571,195.50	0.0	142.8	54.3
Retrofit of Non-performing BMPs	8	$2,305,822.99	0.0	576.5	104.4
Retrofit of Effective BMPs	5	$1,185,582.82	0	296.4	85.0
Low Priority and Other Potential Projects					
ESD	5	$1,692,000.00	0.0	10.9	8.5
New Pond	0	$0.00	0.0	0.0	0.0
Retrofit of Non-performing BMPs	1	$328,737.79	0.0	82.2	17.1

This step determined how far and at what cost the existing list of restoration projects goes toward meeting the impervious cover, trash, and other pollutant reduction goals. New Ponds were given effective BMP pollutant reduction efficiency, and ESD practices were given full ESD pollutant reduction efficiency.

Retrofits of existing BMPs were reconciled with the existing urban BMP database and given an incremental increase in pollutant reduction efficiency based on an assumed Code 4 BMP efficiency. The actual drainage area and impervious area from the existing practice was used to calculate pollutant and runoff reduction.

In general, the County used the information in Table 15 below to estimate proposed impervious area and costs, where engineering costs were unavailable:

Table 15: Impervious Cover and Cost Estimates used in the Future Management Scenarios

• **38% imperviousness per drainage acre**
• **New Ponds, $6,000 per drainage acre**
• **Retrofit Pond, $4,000 per drainage acre or $12,000 per impervious acre**
• **ESD project, $200,000 per impervious acre**

3.3 Pollutant Load and Trash Reduction Tracking

There are no EPA approved TMDLs as of 2010 for the Muddy Branch and Watts Branch subwatersheds, but nutrients and sediment are pollutants of concern regionally. Trash reductions are important to meeting the commitments of the Potomac River Watershed Trash Treaty. Table 16 provides preliminary results based on the assumptions for WTM 1.0 and 2.0 presented earlier.

Overall, the Total Nitrogen (TN), Total Phosphorus (TP), Total Suspended Solids (TSS), and trash loads from the Muddy Branch and Watts Branch subwatersheds were reduced by **6%**, **6%**, **7%**, and **6%**, respectively if BMPs from all strategies are implemented (Table 16.). Since the same core restoration strategies are being followed for nutrients, sediment, and trash, the cost for implementation remains the same.

Figure 4 compares the pollutant reductions by WTM scenario and the cumulative costs as the projects within each scenario are implemented.

Table 16: Preliminary Results of WTM Modeling

Implementation Phase	***% Reduction from Baseline Load***				***Cumulative Cost***
	TN	*TP*	*TSS*	*Trash*	***Million $***
WTM 1.0—Baseline Load	**0%**	**0%**	**0%**	**0%**	**$0**
WTM 2.0—Completed Projects	0%	0%	0%	0%	$0
WTM 2.0— High Priority Projects	5.5%	5.6%	6.5%	5.6%	$4.4
WTM 2.0— Low Priority and Other Potential Projects	6.2%	6.4%	7.3%	6.3%	$6.4

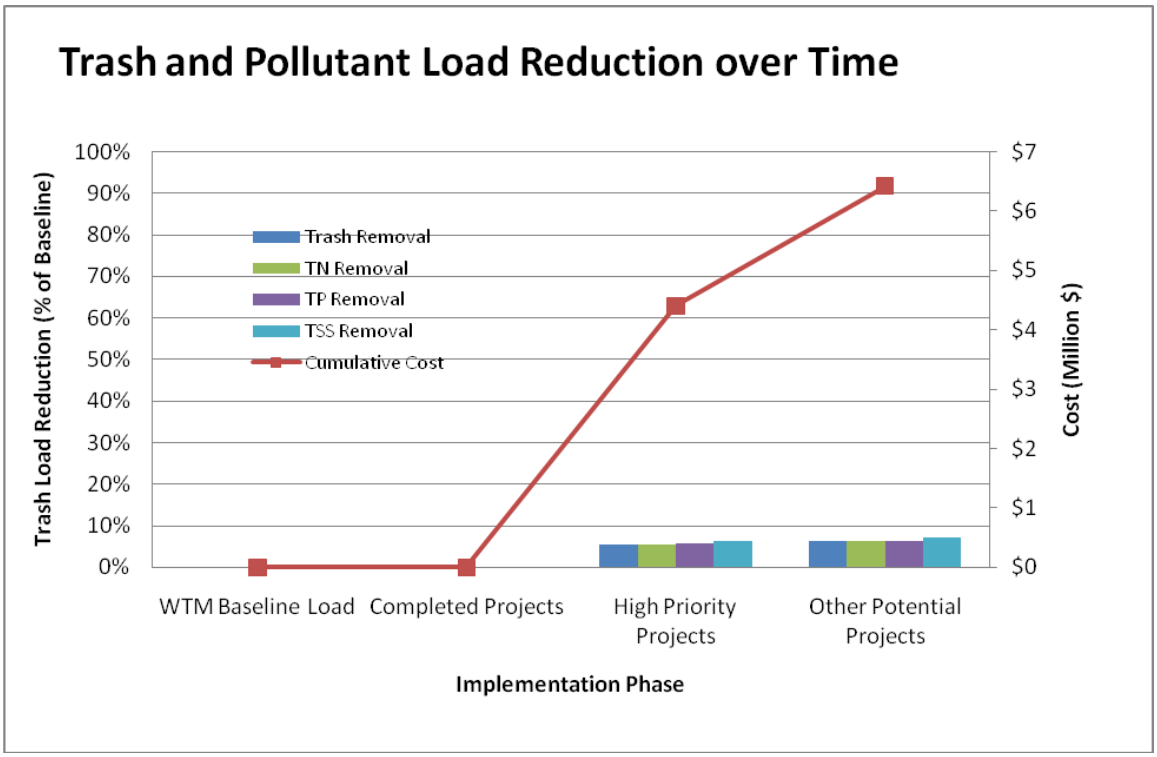

Figure 4: Cumulative trash and pollutant load reduction over time and associated costs modeled using the WTM.

4 Action Inventory Implementation Schedule

The implementation schedule summarized in Table 17 is an action inventory matrix that identifies priorities and timeframes for implementation of the above identified watershed restoration strategies as a function of project synergies and expected funding levels countywide. For the first permit cycle (through 2015), a priority was placed on full implementation of complete, high and low priority projects. A list of the high and low priority projects is provided in Appendix A. There are fewer identified opportunities in Muddy Branch and Watts Branch Subwatersheds than the more urban watersheds (Anacostia and Rock Creek). No other strategies were pursued as there are no existing TMDLs in the Muddy Branch and Watts Branch subwatersheds. In future permit cycles, shown in Table 18, stream restoration is pursued for pollutant load reduction.

Table 17: Summary of Implementation Plan Schedule for the 2015 Fiscal Period, with expected level of ESD and pollutant load reductions

Strategies	*% Complete in Permit Cycle*	*IC Treated (acres)*	*ESD (% IC)*	*Cost (Million $)*	*ESD (% Cost)*	*% Reduction from baseline*				
						TN	*TP*	*TSS*	*Bacteria*	*Trash*
Completed and High Priority Projects	100.0%	211	1%	$4	8%	6.0%	6.0%	6.0%	0.0%	6.0%
Low Priority Projects	100.0%	26	33%	$2	84%	0.2%	0.3%	1.2%	0.0%	0.2%
Other Potential Projects	0.0%	-	0%	$0	0	0.0%	0.0%	0.0%	0.0%	0.0%
Public ESD Retrofits	0.0%	-	100%	$0	100%	-	-	-	-	-
Private ESD Retrofits	0.0%	-	100%	$0	100%	-	-	-	-	-
Riparian Reforestation	0.0%	-	0%	$0	0%	-	-	-	-	-
Stream Restoration	0.0%	-	0%	$0	0%	0.0%	0.0%	0.0%	0.0%	0.0%
Programmatic Practices	100.0%	-	0%	$0	0%	-	-	-	-	-
Subtotal	***100.0%***	***237***	***4.3%***	***$6***	***31.6%***	***6.2%***	***6.3%***	***7.2%***	***0.0%***	***6.2%***

IC: Impervious Cover
ESD: Environmental Site Design
TN: Total Nitrogen
TP: Total Phosphorus
TSS: Total suspended solids

Table 18: Summary of Implementation Plan schedule for the Watts Branch and Muddy Branch Subwatersheds

Fiscal Year		2015	2017	2020	2025	2030	TMDL WLAs
Impervious Treated (acres)		237	237	237	237	237	*None*
ESD (% Impervious)		4%	4%	4%	4%	4%	
Cost (Million $)		6	8	19	25	31	
ESD (% Cost)		32%	27%	11%	8%	7%	
% Reduction from baseline	TN	6%	7%	15%	18%	22%	
	TP	6%	7%	10%	12%	13%	
	TSS	7%	8%	14%	17%	20%	
	Bacteria	0%	0%	0%	0%	0%	
	Trash	6%	6%	6%	6%	6%	

TN: Total Nitrogen
TP: Total Phosphorus
TSS: Total suspended solids
WLA: Waste Load Allocation

5 References

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Appendix A – List of High and Low Priority Projects

High and Low Priority List – Muddy Branch and Watts Branch Subwatersheds

Subwatershed	Project Type	Project Name
Muddy Branch	Environmental Site Design (ESD)	Police - Office of Internal Affairs
		Public Safety Training Academy
		Quince Orchard Library
		Station 31 - Rockville
	Stormwater Pond Retrofit	Brighton Weir
		Christmans Pond
		Dufief (Homes Association)
		Flints Grove HOA Dufief
		Hunting Hills Woods
		Kentlands/Lake Helene
		Lake Placid
		Lakelands/Lake Varuna
		Mediummune/Q.O. Corporate Center
		Mills Farm
		NIST Facility Pond
		Potomac Chase
		Potomac Chase (Fox Hills North CA)
		Quail Run (East Pond #2)
		Quail Run (West Pond #1)
		Shady Grove Development Park (Shell Oil) - Northern Facility
		Shady Grove Development Park (Shell Oil) - Southern Facility
		Shady Grove Life Science Center
		Washingtonian Woods Section 8
		Westleigh (Muddy Branch SVU)
		Woods at Muddy Branch/Woodlands
Watts Branch	Environmental Site Design (ESD)	Cold Spring Elementary School
		Rockville Health and Human Services Center
	Stormwater Pond Retrofit	Bedfordshire SWM
		Fallsberry SWM Pond
		Fallsreach SWM Pond