CITY OF TAKOMA PARK
WATERSHED IMPLEMENTATION PLAN
NARRATIVE REPORT SUBMITTAL

November 18, 2011

Takoma Park WIP Strategy Description

The City of Takoma Park occupies 1280 acres of land located in the southeastern corner of Montgomery County, Maryland. All of this land is defined as Urban Land, and only the Urban Land Use sector is planned for within the WIP submittal. Takoma Park borders Prince George's County to the east, and Washington D.C. to the South. Takoma Park lies within the Sligo Creek Sub watershed to the Anacostia River. The Sligo Creek sub watershed is one of the oldest developed areas of the Anacostia watershed, having been largely developed during the 1930's - 50's; well before the advent of modern stormwater management controls. Although there have been many various restoration projects and numerous stormwater BMPs (Best Management Practices) constructed in the Sligo Creek subwatershed, water quality and aquatic habitat and terrestrial habitat remains degraded. Sligo Creek exhibits moderate to high TSS, nutrient and bacteria loadings, and one of the worst trash problems in the Anacostia watershed.

The City of Takoma Park aims to achieve the goal to meet the Chesapeake Bay Total Maximum Daily Load (TMDL) through fulfilling the requirements of our current National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) – Phase II Permit. We are expecting future permits to call for a 20% retrofit of impervious area for which runoff is not currently managed to the maximum extent practicable (MEP). Our plan is to achieve this goal mainly by employing Environmental Site Design (ESD) techniques in future Capital Improvement Projects (CIP) and Stormwater Management (SWM) projects. Also we plan to promote other structural and nonstructural BMPs for retrofit projects. Additionally other programmatic means to achieve pollution reduction such as public education and outreach campaigns will be intensified in the coming years.

The City's MS4 Phase II Permit requirements include participation in watershed restoration in coordination with Montgomery County's Countywide Coordinated Implementation Strategy. The City of Takoma Park's Watershed Implementation Plan is adapted from this previously coordinated effort of the County, in particular with objectives geared toward Sligo Creek and the Anacostia Watershed.

The Countywide Coordinated Implementation Strategy presents the restoration strategies that are needed to meet the watershed-specific restoration goals and water quality standards as specified in the current County MS4 permit. Specifically, the Strategy will provide the planning basis for the County to:

1. Meet TMDL Wasteload Allocations (WLAs) approved by EPA.
2. Provide additional stormwater runoff management on impervious acres equal to 20% of the impervious area for which runoff is not currently managed to the maximum extent practicable (MEP).
3. Meet commitments in the *Trash Free Potomac Watershed Initiative 2006 Action Agreement* that include support for regional strategies and collaborations aimed at reducing trash, increasing recycling, and increasing education and awareness of trash issues throughout the Potomac Watershed.

4. Educate and involve residents, businesses, and stakeholder groups in achieving measurable water quality improvements.
5. Establish a reporting framework that will be used for annual reporting as required in the County's NPDES MS4 Permit.
6. Identify necessary organizational infrastructure changes needed to implement the Strategy.

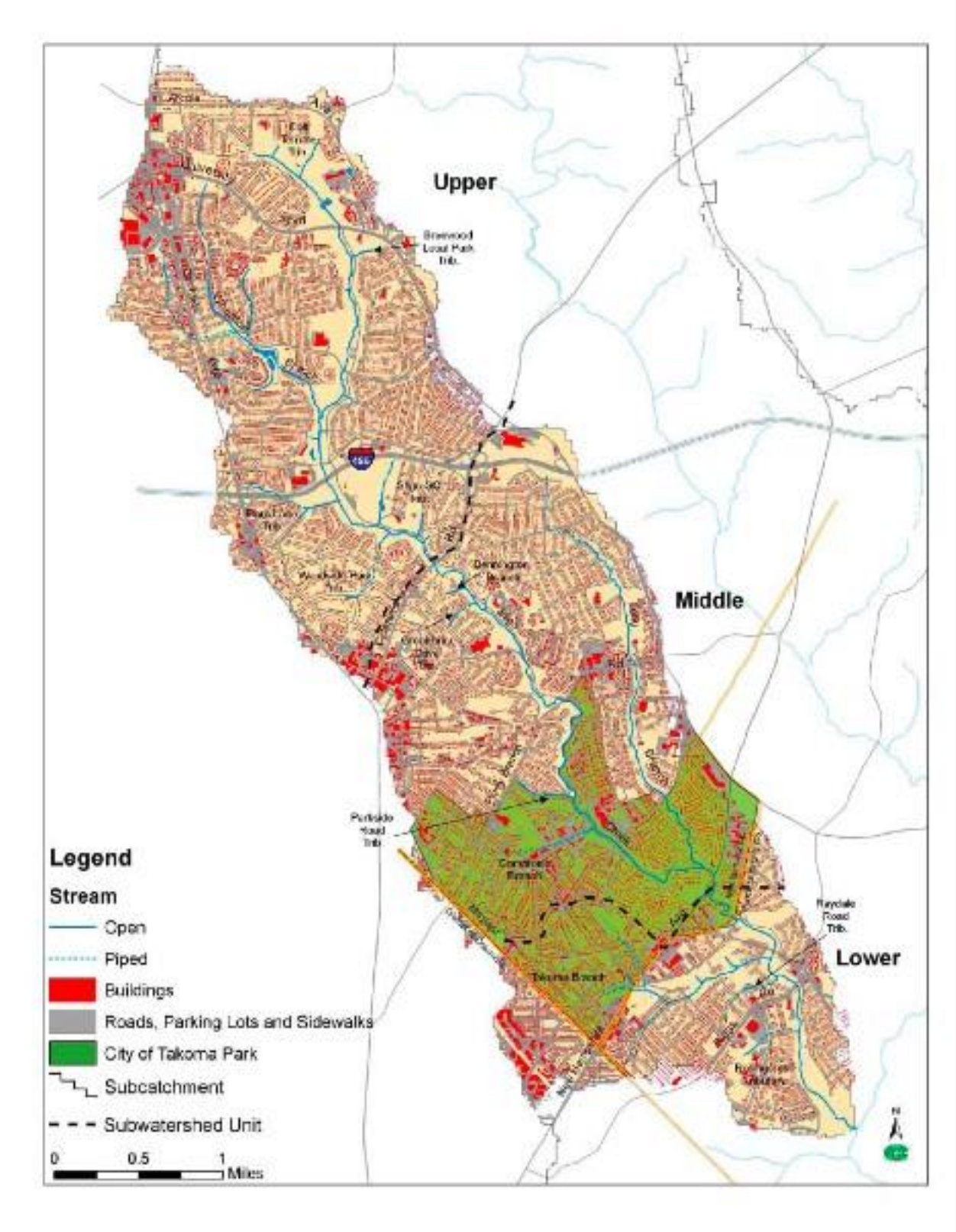

Figure 1: Takoma Park and Sligo Creek Impervious Features, Sligo Creek Sub-Watershed

Current Capacity Analysis for Takoma Park

The following Response Table (Table 1) supports the development of Maryland's Phase II WIP. Specifically, it supports an assessment of Takoma Park's current capacity to conduct implementation actions to help achieve nutrient and sediment reductions.

Takoma Park, as a Phase II municipality will respond to the questions that directly relate to our jurisdiction. In some cases, the County will address the larger issues. We also understand that for some small municipalities such as Takoma Park there might be no information response necessary. In that case, we would like to state that we have reviewed the worksheets (found in MDE WIP Deliverable Guidance, 10-1-11) and have concluded that no responses are necessary.

Program	Program Organization and Description	Budget	Staffing	Estimated Pace of Implementation	Options for Building Capacity	Other
Stormwater Restoration Programs	The City Engineer, Arborist, and Public Works Director identify developed areas that do not have stormwater management or that have inadequate stormwater management controls and prioritize those areas for restoration. When older inadequate stormwater management facilities are present, these facilities are retrofitted. In areas without stormwater management, ESD/LID practices are installed to the Maximum Extent Practicable. A Stormwater Fee in Takoma Park is used to support the Stormwater Program, which includes CIP Project Funding, maintenance of the drainage infrastructure; protecting properties from flooding; protecting our streams and wetlands from erosion and pollution; and complying with state and federal regulatory mandates.	– FY 2012 Stormwater Utility Budget: $454,500 (based on SWM Fee of $48/ERU) – SWM components for other Capital Projects (traffic calming, sidewalks) also funded through separate Budget – Describe Expenditures: Personnel $80,500; Maintenance and repair $207,000; Capital Projects $167,000 Expenditure projections for 2013: $450,000 - $500,000	Number of Full Time Employees: .75 Contractors supplement staffing: $80,000 - $100,000 average Other: Some maintenance activities funded through General Fund	Provide an estimation of the average annual pace of stormwater retrofit implementation (ESD): Approximately 3 impervious acres/year	Intentions for stormwater fee system to be reconsidered and possibly raised. Currently the Fee is based on FY2007 needs. Grant options are evaluated as they become available.	Collaboration with SHA, MGC, and Chesapeake Bay Trust for Flower Ave. Green Streets Project with a budget of $916,000 total.
Urban Nutrient Management Program	Programs that account for local educational and outreach programs to promote fertilizer management. In addition to this, the Maryland Department of Agriculture regulation of lawn care companies and the State's new Fertilizer Use Act of 2011 will be coming into effect. *The State plan will address the later two forms of urban nutrient management in the WIP on behalf of local teams.	N/A, State's new Fertilizer Use Act of 2011 is expected to greatly reduce fertilizer use and promote proper application timing.				
Watershed Management Planning	Takoma Park has adopted the County's Plan for the Anacostia (and Sligo Creek Subwatershed). Additionally, watershed management and land use programs are described in City of Takoma Park Master Plan.					
Land Use Planning	The City Housing and Community Development office actively participates with land use planning coordinated by MNCPPC.					
Land Conservation	City has purchased designated areas for Open Space Preservation and retains a list of potential sites for future procurement. The City of Takoma Park Open Space Plan was adopted in December 12, 1994 and is the primary document providing policies and guidelines for planning vacant land.					
Forest Conservation Programs	The City has an Urban Forest Office that oversees the public tree canopy and implements the tree removal permit process, requiring replanting for any live tree removal. In addition the City funds new tree planting (100-120 trees per year) to increase canopy in the right of way. The City also administers a program for residents to purchase reduced cost trees for private property planting (50-100 trees per year).	FY2012 budget of 250,000 Describe Expenditures: $22,000 tree planting $20,000 public rebate program $91,000 personnel/training $115,500 subcontractor costs $1,500 postage	1 FTE	100-120 trees per year on public space 50-100 trees per year private property	Capacity has been increased in FY2012, with $20,000 being added to the budget for private tree planting within the Urban Forest Office.	

Table 1. Responses to Current Capacity Analysis Questions

Current Status of Retrofitting Effort (BMPs installed since 2006)

As stated previously in our *WIP Strategy Description*, the City of Takoma Park aims to achieve the goal to meet the Chesapeake Bay Total Maximum Daily Load (TMDL) through fulfilling the requirements in the current National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) – Phase II Permit.

Responding to our current NPDES MS4 Phase II Permit, while striving toward the 20% retrofit goal for impervious surfaces, the City has used Geographic Information System (GIS) tools to better understand our overall impervious surface quantities, and the implications of a possible 20% retrofit, which are **approximated** as follows:

Total City Area: **1280 Acres**
Total Area Impervious: **397 Acres**
- Roads: 138 Acres
- Buildings: 158 Acres
- Parking Lots: 85 Acres
- Sidewalks: 16 Acres

Total retrofit effort to meet possible 20% goal: **79 Acres**

Since 2006 Takoma Park has planned, designed, and installed several ESD Stormwater Best Management Practices (BMPs), mainly as Capital Improvement Projects funded through the SWM Fund. Our current ESD BMP retrofitting effort for impervious surfaces, through Permitted BMPs and City BMPs is **14 Acres** (detailed in Table 2).

Additionally, Takoma Park has been working toward the TMDL goals through Alternative Restoration Credits. These credits are given for alternative BMPs that give jurisdictions greater flexibility toward meeting stormwater permit requirements. The BMPs that Takoma Park employs in this category include street sweeping, stream restoration, and tree planting. Totals for these categories are listed below (calculations for Equivalent Impervious Acres Treated from MDE's *Accounting For Stormwater Wasteload Allocations and Impervious Acres Treated, Guidance for NPDES Stormwater Permits June (Draft) 2011), page 12, 22, and 26*).

Total Regenerative Street Sweeping: 40 Acres per Year at 0.13 Impervious Acres Equivalent yields **5 Acres.**

Total Stream Restoration/Stabilization: 550 Linear Feet (LF) at 0.01 Impervious Acres Equivalent yields **6 Acres.**

Total Tree Planting: 5 Acres on Pervious Urban (500 trees, assuming tree planting typically occurs piecemeal across the urban landscape and that 100 trees per acre or greater is necessary with at least 50% of the trees being 2 inches or greater in diameter at 4 ½ feet above ground level.) at 0.38 Impervious Acres Equivalent yields **2 Acres.**

The sum of Impervious Acres Treated via ESD BMPs (14 Acres) and Alternative Restoration Credit (13 Acres) is **27 Acres Treated of 79 total Impervious Acres,** yielding at this point **52 Impervious Acres** that currently has no stormwater treatment.

A comprehensive list and description of currently installed City Stormwater BMPs is described in *Appendix A.*

2013 Milestones and Strategy to achieve the Final Target Loads (2020) and Interim Target Loads (70% of Final Load by 2017)

An outline of The City of Takoma Park's *2013 Milestones* are presented in this section, followed by a detailed *Strategy to achieve the Final Target Loads (2020) as well as Interim Target Loads (70% of Final Load by 2017).* Both Milestones and Strategies will address two categories of action: Implementation Actions and Program Development Actions.

Implementation Actions are designed and installed structural actions (i.e. restoration activities or ESD/LID SWM Projects) resulting in direct pollution load reductions. The quantities can be expressed in various units, such as "acres implemented," and converted to an associated nutrient and sediment load reduction in pounds.

The Program Development category is defined as measures that will increase our capacity and thereby accelerating implementation actions in the medium-term future. Such program enhancement milestones will, in most cases, coincide with scheduled strategy implementation steps to be described in the Phase II WIP to address funding needs, the need for additional legal authority, enhancing existing programs, and designing and establishing new programs.

2013 Milestones

Fiscal Year 2012 and FY2013 will bring about several Implementation Actions for stormwater projects. It is notable that two of these projects will be funded from other sources, in addition to projects already scheduled within the Stormwater Restoration Program. Both the Wildwood Ave. and Flower Ave. Projects are expected to add several Impervious Acres Treated to our current capacity.

In FY2012, Programmatic Actions include continuing to refine our strategy for achieving TMDL goals, refining our cost estimates, and beginning to evaluate whether our stormwater fee system rates are adequate. In 2013, we will complete the refinement of our strategy, implement change to the fee rate if needed and look into other potential funding options for stormwater retrofits in the form of grants.

A descriptive list of 2013 Milestone Implementation Actions follows:

<u>Prince George's Ave. and Circle Ave. Bioretention Project</u> –

Strategy: A Green Infrastructural Retrofit to capture runoff from a residential neighborhood. The project will add a bioretention BMP to catch Water Quality Volume, and include a recharge zone

to infiltrate stormwater for groundwater recharge. Many trees (and shrubs) will be added to the Cities Urban Tree Inventory.

Funding: $25,000. The city SWM Fund will cover costs, as this is a targeted stormwater project.

Schedule:
– 2011: Design completed and construction being sourced.
– 2012: Begin and complete project installation and planting

Wabash Ave. Bioretention and Erosion Control Project –

Strategy: A Green Infrastructural Bioretention and Erosion Control Project to eliminate runoff problems from the street before the stormwater can reach Sligo Creek. The project will add a bioretention BMP to catch Water Quality Volume, and a swale to slow runoff velocities.

Funding: $25,000. The city SWM Fund will cover costs, as this is a targeted stormwater project.

Schedule:
– 2011: Conceptual design
– 2012: Complete design phase, installation and planting

Circle Woods Stream Restoration and Stabilization Project –

Strategy: Stabilize the stream where the culvert daylights, using bioengineering and vegetation plantings. Approximately 400 LF of restoration is anticipated.

Funding: $35,000. Subject to availability.

Schedule:
– 2011: Conceptual design
– 2012: Complete design phase, installation and planting

Wildwood Green Streets Project –

Strategy: A Green Streets Retrofit to capture runoff from new sidewalks that will be installed, while adding capacity to capture street runoff and other runoff from neighboring properties.

Funding: Up to $200,000

Schedule:
– 2011: Assess and identify initial retrofit project sites, or equivalent nutrient/sediment reductions; plan and budget funding through General Fund and SWM Fund if necessary.
– 2012: Begin project designs and installation

Flower Ave. Green Streets Project –

Strategy: Flower Avenue, between Carroll Avenue and Piney Branch Road, is Maryland State Highway 787, and runs north-south along the City of Takoma Park border with unincorporated Silver Spring. The road does not function as a State Highway and Maryland would like to remove it from their State Highway inventory. The Maryland State Highway Administration (SHA) will pay the City $696,000 if the City makes street and sidewalk improvements as a "green street." These funds would have otherwise been spent by SHA on the scheduled repaving of Flower Avenue. Once the project is complete, Flower Avenue will no longer be a State Highway.

Montgomery County is also contributing funds to the project – $200,000. Montgomery County had wanted to undertake a study to see if a sidewalk could be installed on the east side of Flower Avenue and had expected to allocate money in a future year for this study. Funds it would have spent on the study have been allocated towards this project.

The Chesapeake Bay Trust has granted the City of Takoma Park $20,000 towards this project as it will help address stormwater runoff into Sligo Creek and Long Branch creek that ends up in the Chesapeake Bay, along with the contaminants the stormwater picks up along the way.

Together, these funds will pay for a community planning process, engineering design work, construction of a sidewalk on the east side of the roadway, installation of rain gardens and vegetated swales (to slow and filter stormwater), new crosswalks, and repaving of Flower Avenue. If funds are available after these improvements are made, additional improvements to bus stops, street lighting and stormwater facilities will be made.

Funding: see above

Schedule:
– 2011: Community Meetings, Survey
– 2012: Bid Project Design, award design contract, schedule community input sessions to review design.
– 2013: Begin construction

<u>Urban Tree Planting Projects</u> –

Strategy: Over 500 public space trees have been planted in the past 5 years, and Takoma Park's Urban Forest Office is planning to continue expanding the urban forest at 120+ public trees per year. Additionally, Takoma Park citizens have averaged planting 50-100 "bulk buy" trees per year on private property.

Funding: The Urban Forest Office has an annual budget of $250,000 that is used to cover all costs.

Strategy to achieve the Final Target Loads (2020) and Interim Target Loads (70% of Final Load by 2017), Implementation Actions

Although it has not been formally communicated to the City of Takoma Park, it is possible that our future NPDES MS4 Phase II Permit renewal conditions may include a stipulation to retrofit 20% of impervious urban area that currently has no stormwater treatment. With this in mind, we forecast that we may be required to retrofit **52 Impervious Acres** that currently has no stormwater treatment, as defined in the *Current Status of Retrofitting Effort* above.

At our current capacity we will treat 3 Impervious Acres through ESD BMPs, 1 Impervious Acre through Stream Restoration, and 1 Impervious Acre through our Urban Forest plantings each year. This 5 Impervious Acres Treated each year, over the course of 9 years until 2020, is estimated to yield a total of **45** Impervious Acres Treated. This estimate is only **7 Acres** short of our goal. With a potential SWM Fee hike, funded Green Streets Projects, and other Stormwater retrofit projects that are funded from our General Fund or other sources, we feel confident that we have the potential to reach the TMDL goals.

The focus of our future retrofitting effort will be on ESD stormwater BMPs (constructed wetlands, filtering practices, infiltration practices, etc.). Where erosion is a problem, and when site problems justify effort, we will be constructing stream restoration projects, much of which will be installed downstream of ESD BMP projects to reduce the hydrologic energy to the streams. The remainder of projects will be a combination of street sweeping, micro-projects on City and residential properties (down-spout disconnects, rain barrels, rain gardens, etc.), removal of impervious cover, urban nutrient management, and urban tree plantings on residential and public property.

An outline of Capital Improvement Projects scheduled through FY2017 is presented below in Table 3.

Strategy to achieve the Final Target Loads (2020) and Interim Target Loads (70% of Final Load by 2017), Program Development Actions

The following Programmatic Actions will be taken by the City of Takoma Park to increase our capacity and thereby eventually accelerate implementation in the medium-term future. These program enhancement milestones will, in most cases, coincide with scheduled strategy implementation steps described in the section above, *Implementation Actions*, and in more detail in the previous section, *2-Year Milestones*.

In FY2012, we will continue to refine our strategy for achieving TMDL goals, refine our cost estimates, and begin to evaluate whether our stormwater fee system rates are adequate. In FY2013, we will complete the refinement our strategy, implement change to the fee rate if needed and look into other potential funding options for stormwater retrofits in the form of grants. From FY2013-FY2015, we will maintain the current pace of retrofits, which is about 3 acres treated per year. We hope to accelerate project identification and project design and permitting in the period of FY2015 – FY2017 as new resources become available. Between FY2018 and FY2020 we will retrofit as needed to achieve our 2020 TMDL allocations.

Additionally, Takoma Park is committed to pursuing revenue sources in coordination with the State. Given the anticipated costs, we expect that a combination of federal, State and local

revenue sources will likely be needed. We will work with the State in 2012 and coming years, as needed, to refine cost estimates and identify funding options including the possible crafting of State legislation. If State and federal funding is insufficient, we will conduct contingency planning beginning in 2013 for potential adoption of revenue sources as we deem necessary to meet our current and future anticipated permit obligations.

PERMITTED BMP NAME/LOCATION	BMP TYPE	DATE COMPLETED	DRAINAGE AREA TOTAL (ACRE)	DRAINAGE AREA IMPERVIOUS (ACRE)	LINEAR FEET STABILIZED/RESTORED
Takoma Park Fire Station	Sand Filter	2008	0.723	0.67	
Takoma Piney Branch Park, Grant and Darwin	Shallow Pond	2011	3.4	0.52	
Takoma Piney Branch Park, Grant and Darwin	Grass Swale	2011	1.6	0.54	
Takoma Piney Branch Park, Grant and Darwin	Bio-filtration	2011	1.44	0.14	
Takoma Piney Branch Park, Grant and Darwin	Bioretention #1	2011	0.86	0.06	
Takoma Piney Branch Park, Grant and Darwin	Bioretention #2	2011	1.22	0.23	
Orchard Ave. Office	Bioretention	2007	0.25	0.25	
Takoma Park Elementary School, Philadelphia and Holly Ave.	BaySaver Filter, Swale, Storage	2010	3.97	2.61	
Costa (Cristo) Ray High School, Larch Ave.	Bioretention, Filtration Basin	2009	0.37	0.2	
Laurel Ave Shopping, Laurel and Eastern Ave.	2 Filterras	2008	1.63	0.32	
Maple Tower Apartments, 7610 Richie Ave	3 Filterras, 120 LF trench	2010	1.04	0.52	
Washington Adventist University Music Bldg, Greenwood	Sand Filter	2011	0.43	0.2	
Walgreens Store, University Blvd.	Green Roof (.13 acre)	2010	1.05	0.82	
6400 5th Ave. (2 houses)	Dry Well (1600 SF)	2008	0.15	0.15	
123 Ritchie Ave.	Dry Well	2008	0.15	0.15	
125 Ritchie Ave.	Dry Well	2008	0.23	0.13	
8411 Piney Branch	Dry Well	2007	0.473	0.12	
DPW 31 Oswego Ave	Filters	2011	1.631	0.79	
		TOTALS	20.617	8.424	
CITY BMP NAME/LOCATION					
Library and City Parking Bioretentions, 7500 Maple Ave	Bioretention	2010	1.04	0.43	
Grant and Holly	Bioretention	2008	1.2	0.23	
Forest Park	Bioinfiltration	2006	1.38	0.26	
Spring Park	Daylighted stream	2007	0	0	150
Spring Park	Wetland	2007	0	0	
Spring Park	Bioretention	2007	1.21	0.04	
4 Cleveland Ave	Bioretention	2008	0.6	0.31	
Comstock Branch, Mississippi Ave.	Stream Stabilization	2009	0	0	
519 New York Ave	Outfall Stabilization, Step Pool	2008	0	0	50
Maple Ave Bridge	Stream Stabilization	2010	0	0	100
Flower Ave Bridge	Stream Stabilization	2010	0	0	75
Old Carroll Ave	Bioretention		0.26	0.2	
City Green Roof, Maple Ave.	Green Roof		0	0.07	
Linden Ave	Bioretention, step pool		1.34	0.98	
Hancock Ave	Bioretention		3.4	1.31	175
Public Works Yard, 31 Oswego	Filters, Roof Catchment				
Westmoreland Ave.	Bioretention		0.07	0.07	
Kennewick, Kirklynn and Hammond Avenues Circle	Bioretention		2.67	1.26	
Glengarry Ave.	Swale		2.01	0.8	
		TOTALS	**15.18**	**5.96**	**550**
		GRAND TOTALS	**35.797**	**14.384**	

Table 2. Current Restoration Effort

No.	FY 2012 Project List CIP	Summary Description	Preliminary Cost Estimate	Status
1	Prince Georges' And Circle Bio Retention Pond	Bioretention within parcel NE of Intersection	$25,000.00	Concept Developed/ Build Ready
2	Wabash Filtration Erosion Control.	Above Sligo Creek inlet infiltration or bioretention	$25,000.00	Initial Concept
3	Wildwood Ave.	Bioretention/Streetscape	$200,000.00	Initial Concept
4	Circle wood Outfall Stabilization	400 LF	$35,000.00	Initial Concept
No.	FY 2013 Project List CIP	Summary Description	Preliminary Cost Estimate	Status
5	Flower Ave. Green Streets Project	Bioretention/Streetscape	$200,000.00	
6	End Of Grant Ave.	Bioretention Intersection within Green	$ 15,000.00	Concept
7	Flower near Cherry Ave to Sligo Creek	Erosion Control rip rap	$ 20,000.00	
8	Outfall at Sligo Poplar Mill	Trash collection Filter	$ 20,000.00	
9	Flower near Cherry Ave to Sligo Creek	Above Sligo Creek In let infiltration Or Bio	$ 20,000.00	
No.	FY 2014 Project List CIP	Summary Description	Preliminary Cost Estimate	Status
10	Sligo Mill Stream Restoration	Remove debris in Installment	$ 50,000.00	
11	Maplewood & Maple Ave	Large run off from apartment buildings retention.	$ 15,000.00	
12	7436 Baltimore Culvert Plugging Over Lot Flood	Settling Basin at Culvert Intake	$ 30,000.00	
13	Columbia and Carroll Coop Parking	Bioretention at Sycamore Coop Parking	$ 30,000.00	
14	6504 Fourth Ave frequent flooding (100-year)	Inlet Improvements/Bio retention	$ 30,000.00	
15	Behind 6719 Convey /Circle	Erosion	$ 30,000.00	
16	Jackson & Long Branch	Erosion Control	$ 20,000.00	
No.	FY 2015 Project List CIP	Summary Description	Preliminary Cost Estimate	Status
17	Davenshire and Glizwood	Bio retention	$ 25,000.00	
18	John Andrews/ Spring Park Slopes Erosion	Erosion Control	$ 30,000.00	
No.	FY 2016 Project List CIP	Summary Description	Preliminary Cost Estimate	Status
19	Eastern-Tulip-Barclay	Realignment/Bio retention	$ 50,000.00	
20	Hayward and Larch to Sligo Creek Parkway	Bioretention - Erosion Control	$ 50,000.00	
21	Larch and Glizwood	Bioretention/Streetscape	$ 50,000.00	
No.	FY 2017 Project List Repair	Summary Description	Preliminary Cost Estimate	Status
22	Richie and Oswego	Curb extension Bioretention	$111,000	Plans ready to go
23	Elm Forest Park and Wood land Stream Bank	Stabilization 400 LF	$ 35,000.00	
		Total Cost thru 2017:	**$1,081,000.00**	

Table 3. FY 2012 – FY 2017 Planned BMP Project List

APPENDIX A

A comprehensive list of currently installed Urban Stormwater BMPs is described below:

1. Takoma Park Municipal Complex Bioretention

The bio-retention gardens constructed at Takoma Park Municipal Complex parking lot at 7500 Maple Ave. attain a twofold objective; removal of non-source pollution while addressing a chronic inlet clogging problem that caused flooding at the back entrance to the Takoma Park Library. A second inlet situated alongside the southern edge of parking lot, adjacent Philadelphia Avenue receives runoff from the southern half of the parking lot. Both bio-retention ponds were constructed adjacent to existing inlets so as to utilized both filtration and infiltration principals. The pond areas were excavated to a depth of 4 feet. Bio-retention soil mix is separated from the sand filter media by a filter fabric. A perforated PVC pipe conveys the water reaching the filtering media into the adjacent catch basin. Water from storm events flows into the bioretention facilities. Once the facilities are saturated both have an overflow outlet to enable water to enter directly into the storm system and avoid flooding. The twin bio-retention ponds were sized to capture and treat the first flush of any storm. Sufficient storage capacity was provided to eliminate the potential for system overloading in intense storm events. The two bioretention facilities encompass a total of 800 SF of infiltration area.

2. Grant and Holly Bioretention

Excess pavement and non-point source pollution from impervious surfaces created problems with stormwater at the corner of Grant and Holly Ave. While working on the Grant Ave. Safe Routes to School project, community members voiced a desire to reduce the amount of asphalt at the intersection. To provide a solution, the Engineering Department removed pavement from the area in front of an existing stormwater inlet and regraded the area to create a planting bed that catches and holds storm runoff to collect pollutants and allow the water to percolate into the soil.

3. Forest Park Bio-Infiltration

Forest Park was experiencing problems with runoff from developments uphill. Compacted soils caused erosion channels through the lower park area. The City and Friends of Sligo Creek formed a partnership on this project to install a rain-garden infiltration basin. The infiltration basin will recharge the water table, reduce flow velocities, and retain silt and suspended solids.

4. Spring Park Daylighted Stream, Rain Garden, Wetland

Spring Park is a City maintained park, which includes a natural spring, recreational facilities, tree covered slopes, pathways and several gardens. Long-standing problems related to spring water control include erosion, wet grounds and seepage over the sidewalks.

Neighborhood Associations participated in planning and development of the project from the early stages. Through collaboration with City staff and landscape architects from Natural Resources Design, Inc. several community meetings were held and participants views were

incorporated in to the design scheme. Once the plans were prepared, City staff undertook the execution of the project directly. Then design was informed by the Spring Park patrons' input this addressed the priority issues so identified. Two bogs were created to simulate a wetland eco-system. Then the spring was day-lighted into a streambed lined with natural river wash gravel and cobbles. The stream crosses the park grounds with trees, a footbridge and natural rock placed over the banks. A rain garden was created at the end where stream infiltrates and enters into a curbside inlet. This project was completed in the spring of 2007.

5. Cleveland Ave. Bioretention (900sf) and Cleveland Ave Bio-Infiltration

The City successfully installed a sustainable stormwater management alternative to standard storm drainpipes within a neighborhood with no stormwater management. The properties located at the end of Cleveland Ave. were recipients of runoff, sediment and to some extent water intrusion into basements.

Conventional stormwater conduction would have required installation of 1,000 LF of pipe through difficult and heavily forested terrain, private property and along a State Highway right-of-way. The City held several public outreach meetings where environmentally sensitive solutions versus conventional pipe placement were discussed.

A landscaping architectural firm Natural Resources Design, Inc. in conjunction with the City Engineer developed the concept of a low impact stormwater management system for the neighborhood (Phase I).

The residents participated in partnership with the City to construct an approximately 1,300 SF bioretention (rain garden) within one of the end properties. The facility will be maintained cooperatively. The rain garden is designed with a capacity sufficient for retention of a 25-yr storm event. This phase was completed in July 2007.

Phase II of the Cleveland Ave. Stormwater Management Project consisted of constructing an infiltration basin to capture, detain, and filter runoff from the pavement and sidewalks. The basin is installed beneath the pavement at the down gradient end of the street. The existing asphalt and concrete base street pavement structure was removed and replaced with permeable pavers to allow the run-off to enter the underlying infiltration basin. The sidewalk adjacent to the basin was reconstructed using porous concrete.

The infiltration basin includes 36 Rainstore3 Units embedded in gravel underlain by a layer of geo-grid to reinforce granular sub-base material and provide a pavement structure capable of withstanding H-20 (heavy trucks) vehicular loading. If the storm event generates runoff sufficient to fill the infiltration basin's reservoir, the overflow is discharged through a series of pipes into an abutting collection trench, which in turn discharges into a 1,300 SF rain garden (Phase I).

The infiltration basin is capable of retaining runoff generated from a 2-year storm event (3.2"). The Phase II project was designed and overseen by ATR Associates, Inc.

In combination, the Phase I and II Stormwater Management System at Cleveland Ave. is designed to store runoff generated by a 100-year storm event.

6. Comstock Branch Restoration and Streambed Stabilization

Erosion of the stream bank caused the edge of the road to fail along Mississippi Ave. Erosion caused increased sediment transport into Sligo Creek. The solution to the problem was for stabilization of the roadside streambank with imbricated rip-rap for road support and bioengineering and installation of crossvane structures to prevent further erosion and down-cutting of the stream bed.

7. 519 New York Ave. Outfall Stabilization and Step-pool

At the storm drain outfall at 519 New York Avenue, the storm drain pipe daylighted into a large undermined broken concrete structure flowing over an eroded streambed. The intermittent stream flows over a steeply sloping streambed located in the backyard of residential lots and ends in a culvert near Baltimore Avenue, where it joins the storm drain system. As a result of erosion, the storm drain channel that leads into the stream channel was badly deteriorated. The City developed a plan to construct an environmentally sensitive structure to dissipate the energy of the water entering the stream channel, thereby eliminating the erosion problem and stabilizing the outfall area. The plan consist of creating a series of short, step pools at the end of the stormwater channel to receive the stormwater and provide an energy dissipating transition zone for the water as it enters the stream channel. The remnants of the concrete structure and large imbricated rock and class II ripraps were used to stabilize the outfall area and create the step pools.
The project aimed to improve the water quality and address the erosion problems associated with the stream channel. The project plans were developed so as to minimize impact on mature trees in the area. The work area is located in the back yards of properties that front on Baltimore Avenue, Takoma Avenue and Philadelphia Avenues.

8. Maple Ave. Bridge and Flower Ave. Bridge Stream Stabilizations

Two bridges, crossing Sligo Creek, were built in the 1930's and were undergoing structural decay along with streambed scouring, erosion and foundation undermining. A rehabilitation program was developed by the City Engineer with technical help from Montgomery County Engineers. The repairs were carried out through a jointly funded program between the City and Montgomery County. Issues of concern noted for the Maple Avenue bridge included spall, exposed corroded reinforcement in concrete beams, abutment and deck elements, as well as progressive undermining of the central pier. The major structural concerns at the Flower Avenue Bridge included scouring and severe deterioration of concrete encased steel beams, the abutment and the deck.

9. Old Carroll Bioretention

The purpose of the project was to create a vegetated area that can absorb water run-off from the street and filter out the sediment and pollution before the water enters Sligo Creek. This bio-

retention area is about 35 feet long and 5 feet deep, placed inside the curb. The curb was removed in several areas to enable water from the street to enter into the bio-retention area.

10. Municipal Green Roof

The green roof project was completed in several phases. The deck itself was constructed as part of a renovation to the City's community center. The deck was then covered with a waterproof membrane in preparation for the green roof. The City received a grant through the Maryland Department of the Environment for the installation of the green roof. The green roof includes a lightweight system with 4 -inch thick media layer. This limits plants to low-growing, hardy herbaceous varieties. The roof has an assortment of 8 different types of sedum currently thriving there.

Stormwater management benefits of the green roof include pollution removal as well as storage of rainwater as it enters the system. This green roof, with its 4-inch deep blanket of sedum plants covering approximately 2,800 square feet of the 4,000 square foot area, will reduce up to 50 percent of runoff compared to impervious roof texture of gravel over waterproofed concrete.

The plants in a green roof filter pollutants from rainwater, like phosphorus and nitrogen. The plants remove particles from the air, like metals, and CO2. In addition, plants absorb water that would otherwise go directly into a storm drain system. On average a green roof could retain about 70% of the rain that falls on the roof. Stormwater quality improvements by installation of green roof has been researched and documented by EPA "Green roofs for Stormwater run off Control" publication EPA/600/R09/026.

11. Linden Ave Modular Wetland and Step Pools

Stormwater inlets and discharge pipes at the end of Linden Avenue had collapsed due to severe erosion. Linden Avenue dead-ends above the banks of a meandering segment of Sligo Creek. The turnabout and parking area included a failed storm inlet structure supported by an "L" shaped retaining wall of about 150 feet in length and 15 feet in height. This brick façade concrete retaining wall was severely distressed and the riprap apron at the outfall was covered with debris. The area houses a large garden style multi-family apartment complex with 96 units (115EDU). The project consisted of reconstruction of the retaining wall, stormwater inlet and pipe work and the addition of a treatment structure known as "Modular™ Wetland System".

This "Modular Wetland System™" (MWS) treats the first flush of runoff by removing debris, sediment and hydrocarbon pollution. The inlet is equipped with sediment collection baskets, which require periodic inspection and cleaning. The Modular Wetland System contains granular shale chips that serve as a filtering media intended for pollution removal. According to the manufacturer, the MWS utilizes both physical and biological mechanisms to capture and filter oil and grease. The primary filtration media, Bio Media Green, utilized in the perimeter and drain filters, has excellent hydrocarbon removal abilities. Within the wetland filter biological processes break down oil and grease. Much of the breakdown and transformation of oil and grease is performed by naturally occurring bacteria.

Water quality testing of the discharge is planned to evaluate the efficiency of this pollution treatment system at Linden Avenue. This project was funded by an ARRA grant in 2009 provided through the Maryland Department of the Environment. The project design and construction management was funded through the City's Stormwater Management Fund.

12. Hancock Bioretention and Outfall Step Pool (Opal Daniel Park), online MS4, catches all Sheridan and Hancock

The site is located at the intersection of Hancock Avenue and Sheridan Avenue, adjacent to the main entrance to Opal Daniels Park. An 18-inch concrete storm line discharged stormwater from the surrounding neighborhood on to the top of the steep slopes. Hancock Avenue project was launched to address the erosion problem as well as provide treatment of the street run-off. The project created a series of step pools to dissipated run-off energy and to eliminate erosion while allowing stormwater to infiltrate the sand layers below the step pools and recharge the ground water. Additionally, a stormwater bio-retention garden was constructed directly adjacent to the top of the slope to capture and treat the first 1-inch of run-off. Due to presence of fill, a slope stability evaluation of the area was undertaken prior to commencing the project. A weir structure was constructed at the concrete swale, directing street run off through the curb to deflect the first flush (1inch) of run-off into the 1,000 square foot bio-retention area. The storm-drain pipe outfall, bio-retention spillway and excess street runoff are directed into the step pools serving as infiltration and recharge basins.

The neighborhood has been an integral partner in the development of this project. The residents participated in planting many of the native plants for the bio-retention garden and cared for them during the summer drought. The combined effect of the bio-retention pond and step pool conveyance will provide enormous water quality improvements.

13. Public Works Yard, Hydrocarbon Filters and Rooftop Catchment

The original Public Works Facility was constructed in 1959 and included three buildings—an Administration office; a three-bay garage; locker room, equipment storage and staff office building; and a small storage building. In the mid 1960s, two additional storage bays were added, one for sanitation vehicles and repair parts storage and another for street maintenance equipment storage. Minimal improvements had been made to the Public Works Facility over the years and this area is considered a pollutant hotspot due to the high traffic, high impact activity. In Fiscal Year 2009, the City Council agreed to proceed with a renovation of the Public Works Facility and retained Bignell Watkins Hasser Architects as the project architect in the spring of 2009.

The project design included a rainwater recycling system, where a rooftop catchment is used for irrigation and other non-potable water uses. Also, stormwater filters on site to filter hydrocarbons using a proprietary filter media called Smart Sponge. The filter also removes other pollutants such as sediment, debris, and trash before discharge flows enter Sligo Creek.

14. Westmoreland Ave Bioretention

This project was a collaboration between the local commercial business association (Old Takoma Business Association, an art group (Art for the People) and the City. The City provided the site preparation for the rain garden by removing a section of concrete sidewalk and installing an underdrain approximately 50 feet long to serve as the connection to a nearby storm inlet. A 2-foot wide rain garden was placed directly adjacent to a retaining wall along a sloping wide sidewalk. The rain garden was sited to receive runoff from the steep sidewalk as well as an adjacent parking area above. The trench was excavated to a depth of 2 to 3 feet. The underdrain system consisted of a 6 inch perforated PVC pipe wrapped in free draining gravel covered in filter fabric. The underdrain was covered by a minimum of 12 inches of a bio-retention soil mix. The soil was topped with a 4 to 6 inch layer of leaf mulch. The plant selection and planting was done by the association and art group. The maintenance of the garden is also to be undertaken by the same.

15. Traffic Circle Bioretention at Kennewick, Kirklynn and Hammond Avenues

A traffic calming measure was developed to address speeding traffic near a commercial zone in proximity to New Hampshire Avenue and University Boulevard. The 36-foot diameter roundabout is situated at the intersection of Kennewick, Kirklynn and Hammond Avenues. The center of the circle was designed to act as a bio-retention garden for receiving sheet flow from the street. The 800 SF bio-retention garden at center of the roundabout coupled with the addition of several hundred feet of added green space along the right of way resulted in a substantial amount of impervious surface reduction through removal of the existing asphalt.

16. Glengarry Ave. Swale and Erosion Control

Glengarry Avenue is a paved alley off Sligo Creek Parkway providing access to residences on Sligo Creek parkway and Heather Avenue. The street has a westward slope of 8 percent and an intermittent drainage swale that runs the length which channels run-off from Heather Avenue, a dead-end street. Several attempts to partially stabilizing the eroded water pathway have been made. Reoccurrence of high velocity flow had partially undermining the pavement on Glengarry Avenue while continually transporting sediment into the creek. Re-grading, re-alignment and riprap lining of the swale was done to dissipate run-off energy to eliminate erosion and reduce sediment transport into the stream.