Anacostia River Watershed Implementation Plan (WIP)

January 2012

Completed by the
District Department of the Environment
Watershed Protection Division

DISTRICT DEPARTMENT OF THE ENVIRONMENT
green forward

GOVERNMENT OF THE DISTRICT OF COLUMBIA
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Background

Overview & Purpose

In May 2001 and in January 2002 the Government of the District of Columbia (DC) submitted and the Environmental Protection Agency (EPA) accepted final Total Maximum Daily Load (TMDL) reports for Biological Oxygen Demand (BOD) and Total Suspended Solids (TSS) respectively for the main stem of Anacostia River. These submissions were followed by the acceptance of TMDLs for Fecal Coliform (June 2003) and Organics and Metals (August 2003) for the main stem of the Anacostia River and its tributaries in the District of Columbia. In 2005 the District Department of the Environment (then called District Department of Health, Environmental Health Administration) researched and wrote a Watershed Implementation Plan (WIP) for the Anacostia River basin in an effort to develop a plan to begin to address the pollutants impairing the water body and ultimately delist the Anacostia for these impairments.

The DC Government also submitted an “Anacostia River Watershed Total Maximum Daily Load Waste Load Allocation Implementation Plan” to be in compliance with its National Pollutant Discharge Elimination System (NPDES) Municipal Separate Storm Sewer System (MS4) Permit issued in 2004 which stated that the:

> “Permittee shall further submit implementation plans to reduce discharges consistent with any applicable EPA-approved waste load allocation (WLA) component of any established Total Maximum Daily Loadings (TMDL).” Furthermore, Part III.A. states that ”the permittee shall also submit Implementation Plan(s) for the Anacostia River watershed Total Maximum Daily Loads (TMDLs) six months after the effective issuance date of the Permit”

To complete its draft WIP, DDOE contracted the Army Corps of Engineers and their sub-contractors to inventory the Anacostia and its tributaries for restoration opportunities. Based on this fieldwork, the Anacostia Watershed Restoration Partnership (AWRP) developed the Anacostia Watershed Restoration Plan (AWRP) which was released in February, 2010. The Restoration Plan, although a start, did not meet the standards for a Watershed Implementation Plan set by the EPA.

The document that follows uses the AWRP as a base but has gone further to create a watershed-based non-point source pollution control plan that meets the EPA’s requirements for acceptance while providing a realistic and adaptable guide for agencies responsible for the restoration of the Anacostia River and its tributaries.

Plan Outline & Objectives

This Implementation Plan is divided into eight sections:

- The Background section discusses the purpose of the Anacostia River Watershed Implementation Plan and provides an overview of important aspects of the watershed.
- The Causes and Sources of Impairments details what pollutants are impairing the Anacostia and its tributaries, their current loads, where the pollutants originated, and finally their required load reductions.
- The Current and Proposed Management Measures section provides details on what is being done and what will be done to control pollutants in the Anacostia Watershed.
- The Expected Load Reductions section shows how pollutant loads to the Anacostia will be reduced through the implementation of the management measures.
- The Implementation Schedule and Milestones Section lays out the timeline to restoring the watershed and how it will be tracked.
- The Financial and Technical Resources section depicts the price tag to achieve the proposed management measures and does a gap analysis on the monetary and technical needs of the District to implement the Anacostia Watershed Implementation Plan.
- The Outreach Strategy provides insight into the stakeholders in the Anacostia Watershed and how the District plans to work with them to restore the watershed.
- The Monitoring Strategy section is the final section of the document which lays out the District's current monitoring protocol and puts forward enhanced monitoring measures to better gage progress toward the proposed milestones.

As with any multi-year implementation plan, this is a living document which will be continually evaluated and updated as needed based on "lessons learned" during the implementation phase. The implementation of this plan will be monitored and evaluated, and the Watershed Implementation Plan will be updated every five years to reflect the results of the monitoring program, the efficacy of the pollutant reducing activities, advances in technology, and availability of financial and technical resources.

Geographic and Historical Background

Description of the Anacostia Watershed

The 176 sq. mi. (456 sq. km.) Anacostia River Watershed covers portions of the District of Columbia, Prince George's and Montgomery County in Maryland. Roughly 25% of the watershed lies in the District and 75% lies in Maryland. The river is entirely tidal in the District, and primarily non-tidal in Maryland. The watershed is a targeted restoration watershed for EPA and the District Government and is the focus of the redevelopment focused Anacostia Waterfront Initiative.

On average, the entire watershed is 22.5% impervious. The District contains some of the most impervious subwatersheds, such as Hickey Run (37%) as well as the least developed watersheds such as Ft. Dupont (13.3 %). The combined sewer system of the District is the most significant negative impact upon water quality in the tidal Anacostia. It is estimated that over 80 overflow events occur in an average year. All of these overflow events dump raw sewage into the tidal Anacostia River.

Geology and Soil Conditions

The Anacostia watershed has seen major alterations to its soil from the past 150 years of development. Major alteration of the tidal portion of the Anacostia by the US Army Corps of Engineers, beginning in the 1920s has left fill materials (urthordents) along much of the riparian buffer in the District portion of the river. These soils are not contaminated (except for active dump areas) but contain significant amounts of construction material such as bricks, asphalt, and concrete. These urthordents are typically poorly drained, a function of their compaction and high clay content.

On the ridges east of the tidal Anacostia, a sandier Christiana soil association dominates. This soil association is noted for its highly permeable sandy upper layers underlain by 50-100 inches of red loamy clay. This marine clay layer can be seen in the stream bank cuts along the upper portions of the Pope Branch and Ft. Dupont tributaries. Other common soil associations are described below:

Luka-Linside-Codorus
Several Anacostia tributaries flow through the Luka-Linside-Codorus association. These are deep, level, and moderately well drained soils that are underlain by stratified alluvial sediment, or man-deposited dredged material on flood plains.

Urban land-Christiana-Sunnyside
The most prevalent general soil association in the District portion of the watershed is the Urban land-Christiana-Sunnyside association. These predominantly upland soils are deep, nearly level to steep, well-drained soils that are underlain by unstable clayey sediment.

Urban land-Galestown-Rumford
A third minor association of the Anacostia watershed is the Urban land-Galestown-Rumford association. These soils are deep, nearly level to moderately sloping, and somewhat excessively drained soils that are mostly sandy throughout, and are a part of old terraces.

One important consideration when looking at soils in the Anacostia watershed is the importance of upper watershed soil contributions to the tidal portion. From the period of colonization by Europeans to the civil war, agriculture (tobacco, corn, cotton) was installed as the dominant land use of the Anacostia Watershed. By 1860, most of the watershed was under cultivation. The clearing of forest and tilling associated with agriculture led to the erosion of thousands of tons of sediment, most of which deposited as mudflats in the tidal portion of the Anacostia. The deposition of upper watershed sediment was so extensive that the tidal port of Bladensburg had been rendered unreachable by high draft boats by 1850. This led to the call for dredging assistance from the Corps of Engineers.

Hydrology

There are three major drainage areas comprising the Anacostia watershed: the Northwest Branch, the Northeast Branch, and the tidal drainage. The Northwest and Northeast branches are free-flowing (non-tidal) streams, and their confluence forms the tidal Anacostia River in the vicinity of Bladensburg, Maryland. The tidal drainage area consists of the tidal river and its floodplain, as well as small Coastal Plain streams that flow directly to the tidal river; most of these streams are enclosed in storm sewer systems. The tidal reach of the Anacostia River is 8.4 miles (13.5 kilometers) in length from the confluence of the Northwest and Northeast branches downstream to the Potomac River. The river joins the Potomac approximately 108 miles (174 kilometers) upstream of the Chesapeake Bay.

Most of the watershed is impacted by flashy stormwater flows. The high level of urbanization of the watershed has increased the imperviousness of the watershed to an average of 22%. The higher quantity of the stormwater water discharge compared to historic pre-colonial conditions as well as the higher level of sediments and pollutants has had great impacts upon the tidal portion of the Anacostia. Water clarity has decreased to the point where submerged aquatic vegetation is not present in the Anacostia. High BOD (and resultant low DO) due to combined sewer overflows, sewer leaks, and urban runoff create the conditions for frequent fish kills.

Table 1 - Anacostia River Hydrography (Scatena, 1986)

Average Daily Discharge (cfs)[1]	Maximum Discharge, June 1972[2] (cfs)	Minimum Discharge, Sept. 1966 (cfs)	Surface Area of Tidal River (acres)	Average Volume of Tidal River (gallons x 10^9)	Average Tidal Volume (gallons x 10^6)	Average Tidal Range (feet)
138	**31,180**	**1.8**	**850**	**3.72**	**765.6**	**2.95**

[1] 1 cfs (cubic feet per second) = 7.48 gallons per second or 448.8 gallons per minute.
[2] Maximum discharge associated with Hurricane Agnes.

Flow Characteristics

The Anacostia River is an embayment of the Potomac River, with very low flow rates compared to the Potomac. Because of the low flows and tidal influence, travel times through the River can exceed 30 days. Flow in many segments of the tidal of the river can move either upstream or downstream, depending on tidal conditions. In the downstream portions of the river, hydrodynamics are dominated by the direction and magnitude of the tidal surge. The mean annual stream flow for the Anacostia, as measured at the upstream flow gages, is 139 cubic feet per second.

Stream flows in the tributaries are also comparatively low. A number of storm water outfalls discharge to the streams increasing the flows by several fold during rainfall. Estimated base flow for the tributaries is shown in the table below.

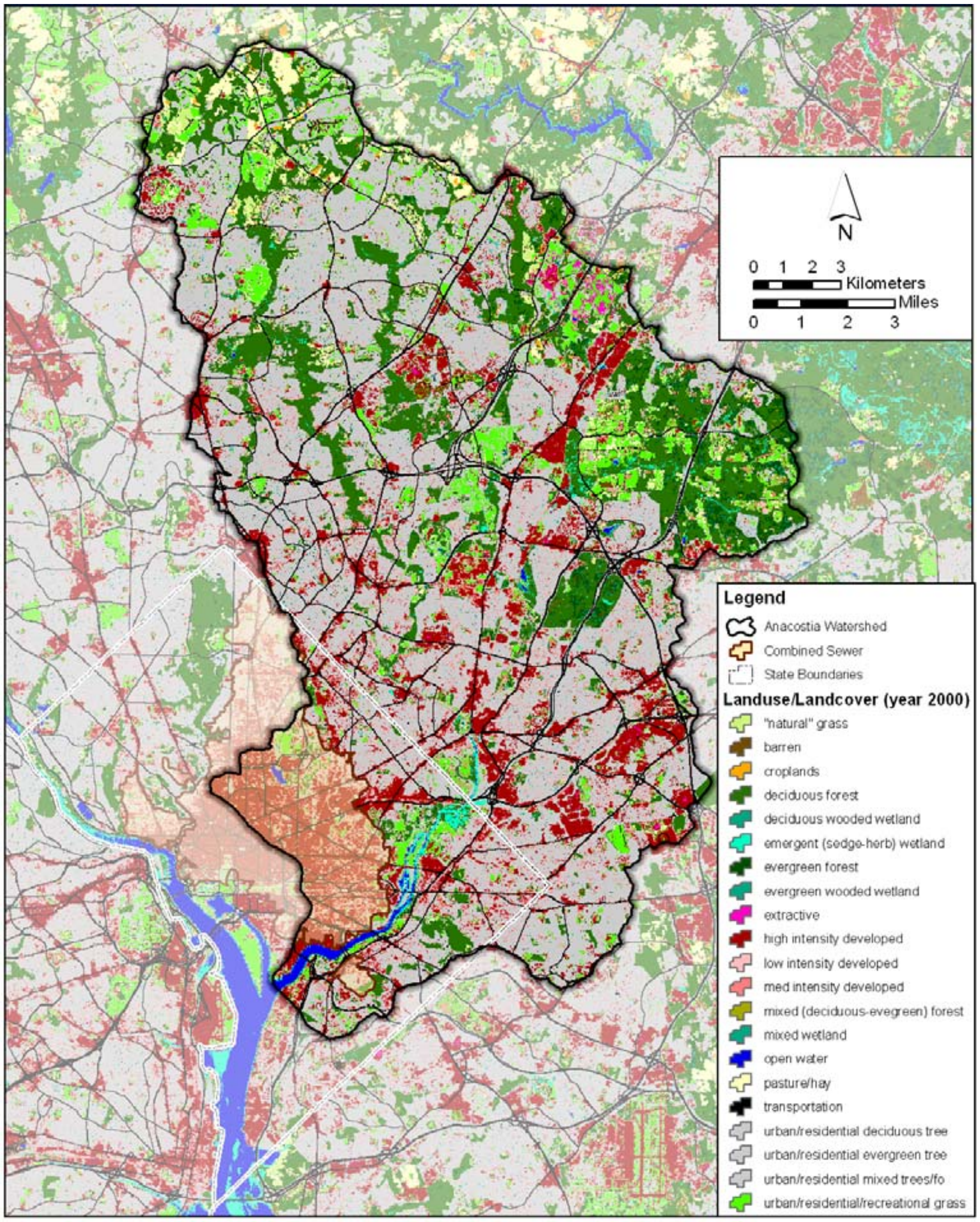
Table 2 – Estimated Flows for Selected Tributaries of the Anacostia

Anacostia River Tributaries	Estimated Flow (cubic feet per second (cfs))
Fort Chaplin Tributary	0.19
Fort Dupont	0.70
Fort Davis Tributary	0.10
Fort Stanton Tributary	0.05
Hickey Run	8.00
Nash Run	2.0
Popes Branch	0.24
Texas Avenue Tributary	0.75
Watts Branch	5.00

Land Use

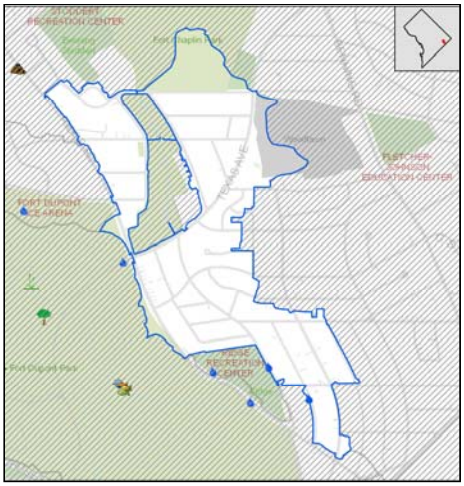
As of 1990, nearly 70 percent of the Anacostia watershed has been developed. Residential development (single family houses, townhouses and apartments) is the single largest land use, comprising 43 percent of the watershed (Figure 1). Impervious surfaces associated with development, such as parking lots, roads, and roof tops, cover approximately 23 percent of the watershed (Warner et al., 1997). Runoff from these areas carries a variety of pollutants to streams and can seriously degrade aquatic habitat. Streams typically become degraded when impervious surfaces cover more than 10 percent of a watershed, unless mitigated by effective stormwater management controls. As Figure 4 shows, imperviousness in individual subwatersheds ranges from a low of 11 percent in Beaverdam Creek to 48 percent for the tidal Northwest Bank portion in the District of Columbia.

Figure 1 - Anacostia Land Use & Land Cover



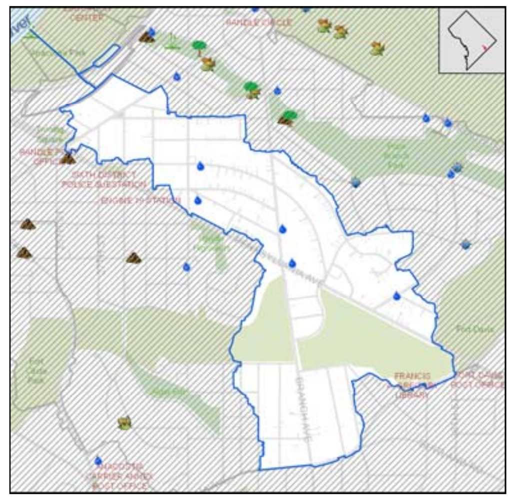
Sub-watersheds

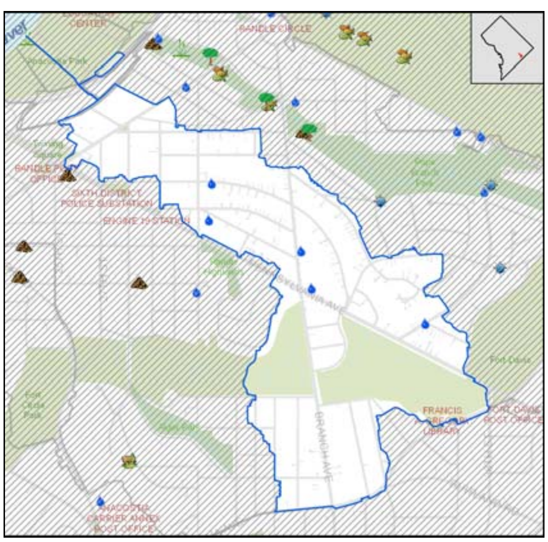
There are several streams to the D.C. portion of the Anacostia River which are impaired and have been inventoried for potential restoration sites (see Appendices for further detail). These streams include Fort Dupont, Hickey Run, Nash Run, Pope Branch, and Watts Branch (see Figure 2). There are other tributaries to the Anacostia that have been altered to the point where they function primarily as storm sewers. These tributaries that lack the true connectivity of a stream but are listed as impaired include Fort Chaplin, Fort Stanton, Gallatin Avenue, Texas Avenue, and the Stickfoot sewer.



Fort Chaplin: Fort Chaplin is a minor ephemeral tributary which discharges into the Anacostia just south of the East Capitol Street Bridge. The non-piped section of Fort Chaplin measures 0.57 miles long and the watershed is approximately 0.42 sq. miles (270 acres) in size. It is comprised of about 90 percent residential and commercial land use with parkland making up the remaining ten percent land use. Stormwater retrofits and trash collectors could have some benefit in reducing trash and sediment flowing into the tidal Anacostia.

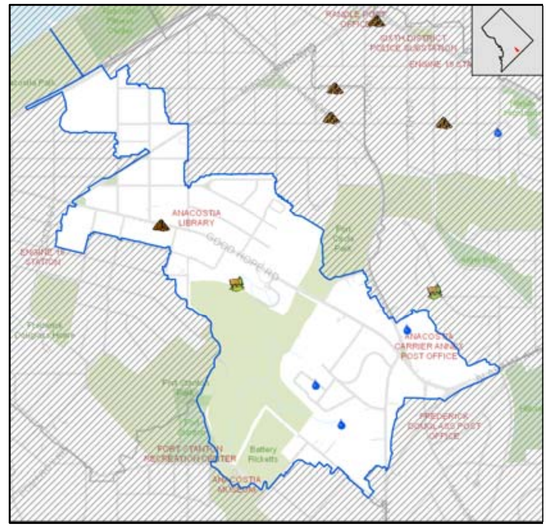
Fort Davis:
Fort Davis is a tributary of the Anacostia which is now conducted by storm drains from Pennsylvania and Carpenter Street SE and discharges about 2,000 feet upstream of the Sousa Bridge. The entire watershed measures only about 0.11 sq. miles (70 acres) and bordered by Alabama Avenue, Pennsylvania Avenue, and Branch Avenue. The watershed's small size and its disconnection from the Anacostia makes sustaining fish populations difficult. Anaerobic conditions have been observed on this tributary suggesting organic pollution in the form of sewer leaks.

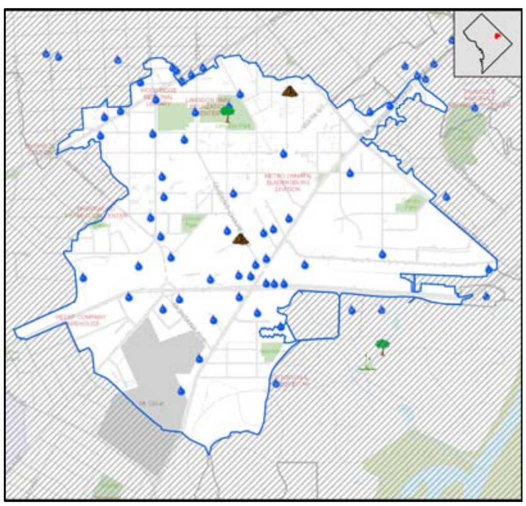




Fort Dupont: The Ft. Dupont tributary is a 3rd order tributary to the Anacostia River that encompasses an area of 0.72 square miles (460 acres). The National Park Service owns approximately 85 percent (376 acres) of the land that is drained by Ft. Dupont and its three small tributaries. Roughly 80 percent of this NPS land is forested by mature eastern hardwoods. The average impervious level in the watershed is 13.3 percent, which is located primarily in the headwaters of the watershed. Despite this relatively low level of imperviousness, the impacts of uncontrolled stormwater are clearly evident in the stream channel. The land use of the remaining lands is residential with a small amount of commercial development adjacent to Alabama and Massachusetts Avenues.

Fort Stanton: Fort Stanton is a primarily piped tributary of the Anacostia River that discharges into the Anacostia River near Anacostia High School at 16th Street and Ridge Place, SE. The surface portion of the stream is about 2/3 mile long, originating near Erie Street and Pearson Place SE, just north of Erie St. from the Smithsonian's Anacostia Museum. The watershed, which measures about 0.28 sq. mi (180 acres) forms a rough square about 3,000 feet on each side. It is bordered throughout its length by a wide margin of forest and parkland. Roughly half of the free flowing watershed is parkland; the other half is residential and commercial property. The stream receives some storm drains, especially in the southeast part of the watershed, but is not crossed by sewers.

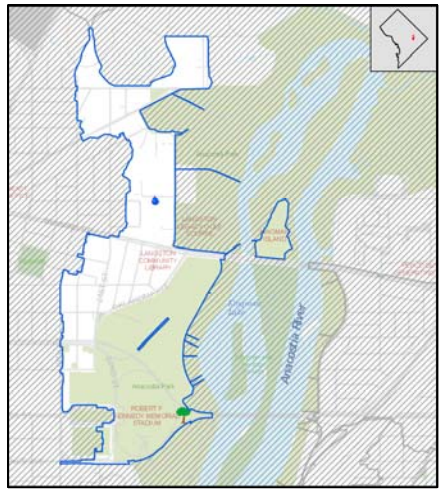




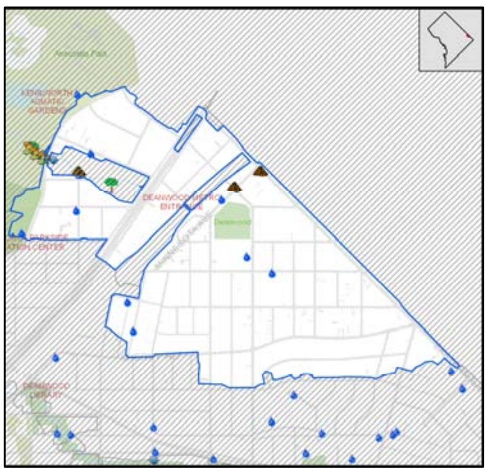
Hickey Run: Hickey Run is a western tributary of the Anacostia River which discharges into that river just north of Kingman Lake, near the southern border of the US Department of Agriculture National Arboretum. The above ground portion of the creek runs to New York Avenue. Above New York Avenue, the tributary is piped in a series of storm sewers that drain a moderately dense industrial and residential area, comprised of small auto shops, warehouses, and residences. The tributary is 36 percent impervious, however the open portion of the stream (roughly 20 percent of the watershed) is within the highly pervious open space.

The stream is about 3,500 feet long, including the tidal portions and is buffered by forested areas and grasslands. The watershed measures approximately two square miles (1,300 acres). This tributary was once impaired by oil and grease but it has since been removed from the impaired waters list for this pollutant. Additionally the tributary shows evidence of high levels of suspended sediment, potential sewer leaks, trash, and bank instability due to flashy stormwater flows.

Kingman Lake: Kingman Lake was created by the Army Corps of Engineers in the 1920's during a dredging and channelization project on the Anacostia River. As a part of this project the Anacostia was straightened and Kingman Lake was constructed as a pseudo oxbow lake. The lake's watershed is approximately 367 square acres made up of parklands and golf courses (50 percent), residential lands (25 percent), and RFK stadium and parking lot lands (25 percent).



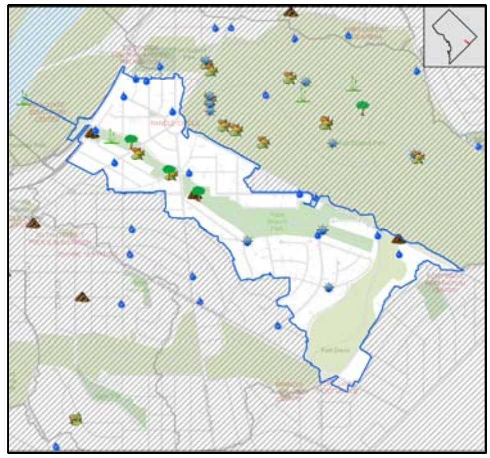
Kingman Lake is open to the Anacostia River at two points and like the river it is tidally influenced. The lake was originally 94 acres in size however 44 acres were converted into wetlands and just 50 acres of open lake remain. The tidal amplitude within the lake is three feet. The total lake volume at low tide is 5,662,000 cubic feet and 7,623,000 cubic feet at high tide.

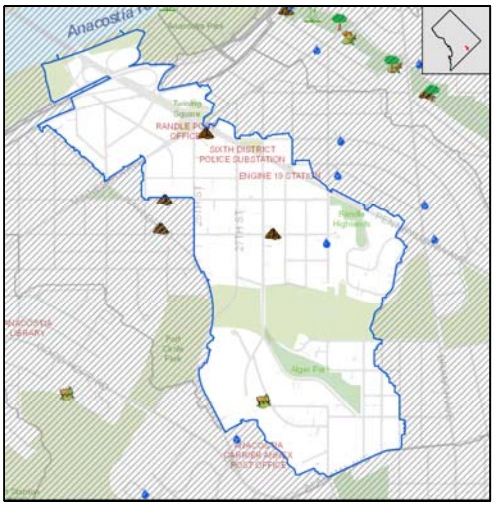


Nash Run: Nash Run is a tributary of the Anacostia whose mouth is a series of interlocking marsh ponds inside the grounds of the Kenilworth Aquatic Gardens. Nash Run has been heavily altered; only a few hundred feet of its lower reaches can be considered a natural stream. The upper portion of this tributary originates from storm drain discharges in Prince George's County, Maryland. It then runs as a canalized stream for a half mile, where it crosses into the District of Columbia for about 1100 feet. The stream is then piped for about 900 feet before emerging again to runs another 2,900 feet to its mouth near the western end of Douglass St. NE. The stream receives discharges from numerous storm drains along both its above and below ground portions and is paralleled and crossed by numerous sewers. Nash Run's watershed measures approximately 0.7 square miles (460 acres).

According to the Banta Report (1993), "Nash run is a seriously impaired stream with widespread habitat degradation, probably due largely to storm runoff diversion, and sever water pollution. Absence of clear signs of anaerobiosis and apparent depression of all life forms suggests toxic pollution. The toxic discharge of this stream presumably has negative impact on the Anacostia and marshlands of the Kenilworth Aquatic Gardens."

Pope Branch: Pope Branch is a 1.6 mile long tributary to the Anacostia that discharges through a 1,600 foot stormwater conduit to a point north of the Sousa Bridge. This piped section runs underneath the National Park Service's Lower Anacostia Park and represents about 20 percent of the stream's length. The upper section is free flowing and flows though DC Department of Parks and Recreation parkland. This 0.39 square mile (248.5 acre) watershed lies entirely within the District and drains a primarily residential area. Roughly 46% of the watershed is a city park (Pope Branch Park) that features large second growth deciduous forest with a native understory of Mountain Laurel. The remaining 54% of the watershed is comprised of single-family residential houses. Pope Branch's waters are impaired by sewer leaks, excessive erosion from flashy stormwater flows, and urban stormwater runoff.

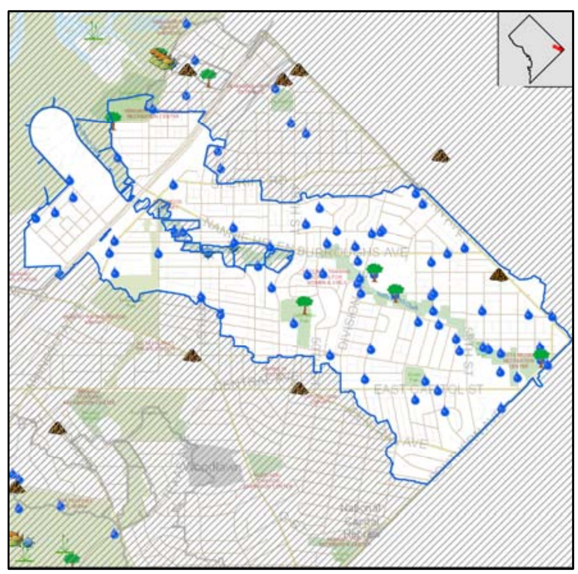




Texas Avenue: The remaining surface portion of the Texas Avenue tributary is now remaining is about 2,000 feet long. Its watershed, which measures 0.17 square miles (110 acres) is about 40 percent forested and 60 percent residential.

The tributary is piped in its downstream reaches and discharges into the Anacostia about 600 feet north of the Sousa bridge. Due to the substantial alterations to this tributary, its habitat potential is severely limited, however stormwater retrofits could limit the peak flows that in turn contribute to high sediment loads in the Anacostia.

Watts Branch: Watts Branch is the largest tributary of the Anacostia River in the District of Columbia. Roughly half of the Watts Branch watershed is contained in the District. The headwaters of Watts Branch drain Prince George's County, Maryland, and the main stem of Watts Branch begins just beyond Washington, D.C. city limits, at Southern Avenue, in Southeast, D.C. From the eastern corner of the District, the stream flows four miles, in a northwesterly direction, eventually meeting the Anacostia River in Kenilworth Park, a National Park Service property. The location of the mouth of Watts Branch is also marked by the adjacent Kenilworth Marsh Restoration, as well as the National Arboretum and Kingman Lake, both found on the opposite bank of the Anacostia. The tidal influence of the Anacostia River can be



witnessed throughout approximately one third of a mile, in the initial Kenilworth Park reach of Watts Branch.

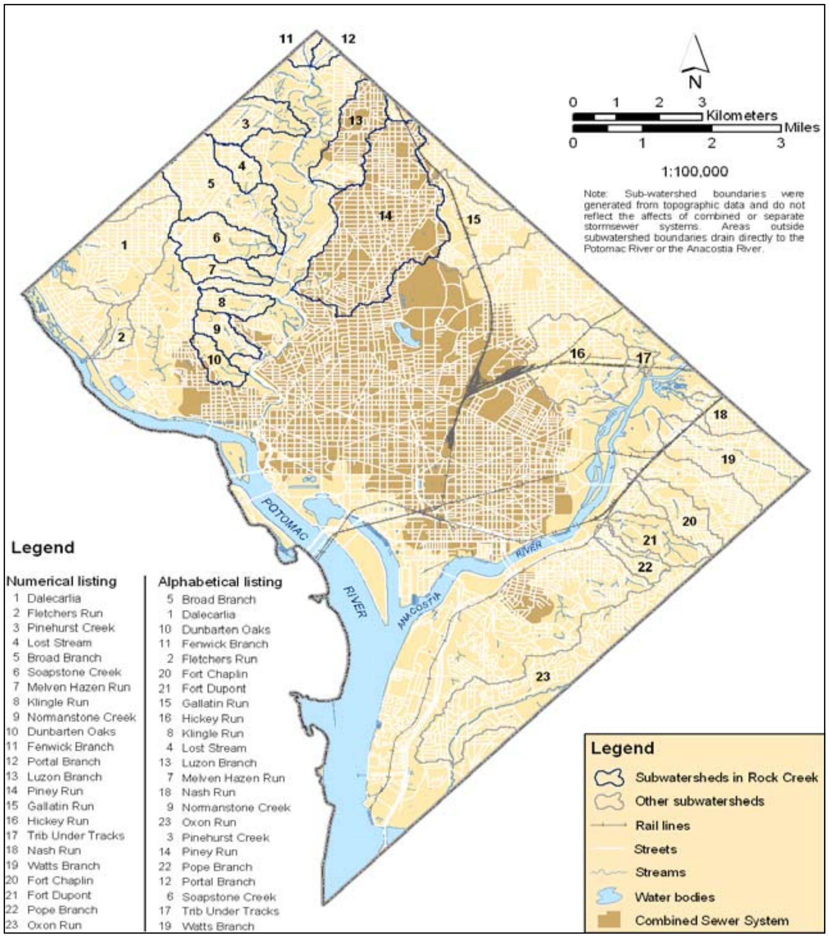
The entire Watts Branch watershed measures 3.53 square miles (2,300 acres). Half a square mile of this area, or less than 15 percent of the watershed, is forested. Most of this forest area lies along the Watts Branch stream corridor which serves both as parkland and riparian buffer. The U.S. National Park Service once controlled all of this parkland surrounding Watts Branch, however a 1973 agreement with the District transferred authority of the park, upstream of the Kenilworth Park property, to the D.C. Department of Parks and Recreation.

The majority of the stream in Prince George's county is affected by extensive channelization and floodplain loss. In the District, portions of the stream are impacted by stormwater outfalls and confinement in concrete channels or culverts. Currently Watts Branch is undergoing a massive stream restoration effort using natural channel design. This effort is correcting years of bank stabilization efforts which have used hardened structures such as rock walls, asphalt berms, gabion baskets, and imbricated rip-rap to stabilized bank sloughing and down-cutting due to the extremely flashy nature of stormwater discharges to the stream and the loss of floodplain. Concurrently DC Water is realigning and strengthening sewer lines to reduce illicit discharges to the stream.

Sewer Systems

Approximately two-thirds of the District is served by separate storm sewers, which consist of two independent piping systems: one system for "sanitary" wastewater (i.e., sewage from homes and businesses) and one system for storm water. The remaining one-third of the District is served by a combined sewer system (CSS), which conveys both storm water and sanitary wastewater in one piping system. The Municipal Separate Storm Sewer System (MS4) serves 9,460 acres of the Anacostia River – comprising 51 percent of the city's MS4 system. The boundaries of the area served by the MS4 and CSS in the District are shown in Figure 2.

Figure 2 - Sub-watersheds of the District of Columbia



Sewer System - Late 1800s to 1950s

Prior to the 1800s, sewage in the District drained through natural streambeds and natural waterways such as Tiber Creek and Slash Run, which became open sewers. In 1871, the Board of Public Works initiated underground sewer pipe construction. Combined sewers discharged untreated sewage and storm water runoff into rivers and canals, with some interceptors built piecemeal to enclose parts of the old canals and move discharge points away from developed downtown areas. In 1890, President Harrison sent Congress an overall engineering plan for new interceptors to carry sanitary and storm water runoff considerably farther from the then-populated areas for discharge into the Potomac River downstream from the developed City. In 1916, Congress authorized the State of Maryland to connect to the District's sewer system. Agreements were subsequently developed to accept wastewater from Montgomery County and Prince George's County. In 1938, the Blue Plains Waste Water Treatment Plant was placed in operation.

The rapid population expansion of the city during and after World War II greatly taxed the sewer system. Major studies of the city's combined sewer system were conducted in the mid-1950s, resulting in the preparation of two reports documenting the then-current conditions of the system and recommending a major capital program for system development.

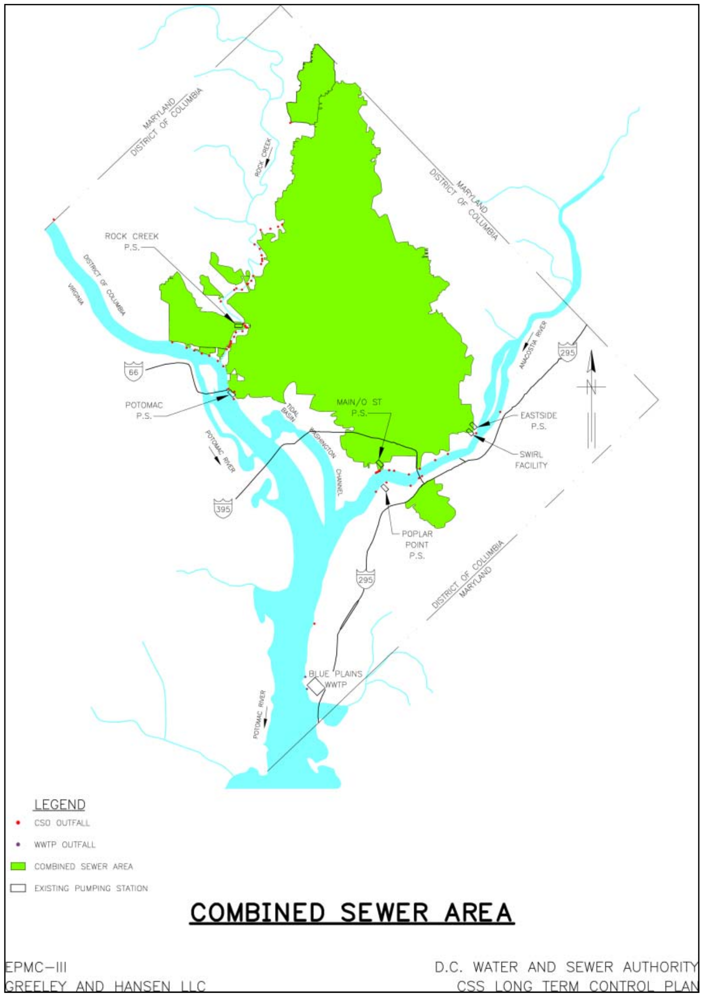
1960 Separate System Policy

In 1960, the District adopted a policy to separate the combined sewers over an extended period, extending well past the year 2000. Following the policy, active separation projects were undertaken in several smaller drainage areas on the west side of Rock Creek in the early 1960s. However, the difficulty associated with the construction of these projects brought the active program to a halt.

The Combined Sewer Overflow Long Term Control Plan

In 1994, EPA issued a national Combined Sewer Overflow (CSO) Policy, which requires municipalities to develop a Long-Term Control Plan (LTCP) for controlling CSOs (see Figure 3 for a map of the combined sewer system). The CSO Policy became law with the passage of the Wet Weather Water Quality Act of 2000 in December 2000. In July 2002, the District of Columbia Water and Sewer Authority (now called DC Water) completed its combined sewer system LTCP that analyzed the following elements: system characterization, monitoring and modeling; public participation; consideration of sensitive areas; evaluation of alternatives; cost/performance consideration; operational plan; maximizing treatment at the treatment plant; implementation schedule; post construction compliance monitoring program and coordination with state water quality standards. To insure compliance with the CSO policy, EPA published a proposed consent decree in the Federal Register for public comment on January 5, 2005. The proposed consent decree provides for compliance with the Wet Weather Water Quality Act of 2000 within 20 years.

Figure 3 - The District Combined Sewer System



Municipal Separate Storm Sewer System Permit

The EPA issued a MS4 NPDES permit to the District on April 19, 2000. The Permit allows discharges from the MS4 to the Potomac and Anacostia Rivers and their tributaries in accordance with the conditions of the Permit. On June 12, 2001, the “Storm Water Permit Compliance Amendment Act of 2000” was made final by the District of Columbia to amend the powers of WASA to engage in certain MS4 permit compliance activities. The Act created a Storm Water Administration within DC Water and established it as its lead agency to coordinate actions among other District agencies in connection with permit compliance activities. The act also created the Storm Water Permit Compliance Enterprise Fund to fund administration and compliance activities related to the MS4 permit.

On October 19, 2002, the District applied for a new NPDES permit and submitted an upgraded Storm Water Management (SWM) Plan for approval. This SWM plan describes the District’s SWM Program to control pollutant discharge from the MS4 to the Potomac and Anacostia Rivers and their tributaries. On August 19, 2004, EPA reissued the District's MS4 NPDES permit for a five-year term.

A sign warning about the dangers of combined sewer overflows.

In 2006 the District Department of Environment (DDOE) was formed from the Department of Health's Environmental Health Administration, the DC Energy Office, policy functions of the DDOT Urban Forestry Administration and policy functions of the DPW Office of Recycling. Furthermore, the status of lead agency of the Storm Water Administration was transferred from DC Water to DDOE.

In November 2007 the District provided the EPA with a Letter of Agreement that laid out plans for the city to utilize more LID projects to stem stormwater overflow. The plans are known as the MS4 Best Management Practices (BMP) Enhancement Package. The strategies adopted by the District will improve the water quality its rivers and streams; however, the increased efforts have increased the overall cost associated with maintaining the stormwater management system.

In order to address these increased costs and distribute them more equitably among ratepayers, the District worked to update the stormwater fee. In May of 2009, the stormwater fee began being charged based on impervious surface, a more accurate surrogate for the stormwater runoff generated by properties, where each Equivalent Residential Unit in the District is charged $2.57 per month.

In addition to changes in the fee for existing ratepayers, this revised fee now recovers costs from properties that are "Impervious Only Properties." These properties did not have an existing DC Water account since they do not receive water and sanitary sewer service from DC Water. The changes in the rates are expected to increase the funding to meet with the EPA requirements for the 2009 permit.

Causes and Sources of the Anacostia's Water Quality Impairments

Anacostia TMDLs

The water quality of the Anacostia River and its tributaries has been monitored for over twenty years. Over that time, monitoring has shown that pollutants in the Anacostia regularly exceed the District's water quality standards for all of its designated uses. The Anacostia's designated uses include Classes A through D:

- Class A - Primary contact – activities such as swimming and wading;
- Class B - Secondary contact – pursuits such as boating;
- Class C - Aquatic life – the ability for the stream to sustain fish and other aquatic life; and

- Class D - Fish consumption – being able to safely eat fish caught in the stream.

Stormwater flowing down an alley

Because the pollutants in the Anacostia River and its tributaries exceed the city's standards, the District of Columbia was required to develop Total Maximum Daily Loads (TMDL) for each of the pollutants that impair the waterway. A TMDL is a calculation of the maximum amount of a pollutant that a water body can receive from point and nonpoint sources (including a margin of safety) and still meet applicable water quality standards. It also provides an allocation of that maximum amount among the water body's pollutant sources.

The Clean Water Act (Act), section 303, establishes the water quality standards and TMDL programs. States, territories, and tribes set water quality standards. These entities identify specific designated uses (e.g., drinking water, contact recreation, and aquatic life support) for each water body in their jurisdiction and identify the scientific water quality standards to support those uses. TMDLs are established for water bodies that, following implementation of technology-based effluent limits, fail to meet existing water quality standards for pollutants of concern.

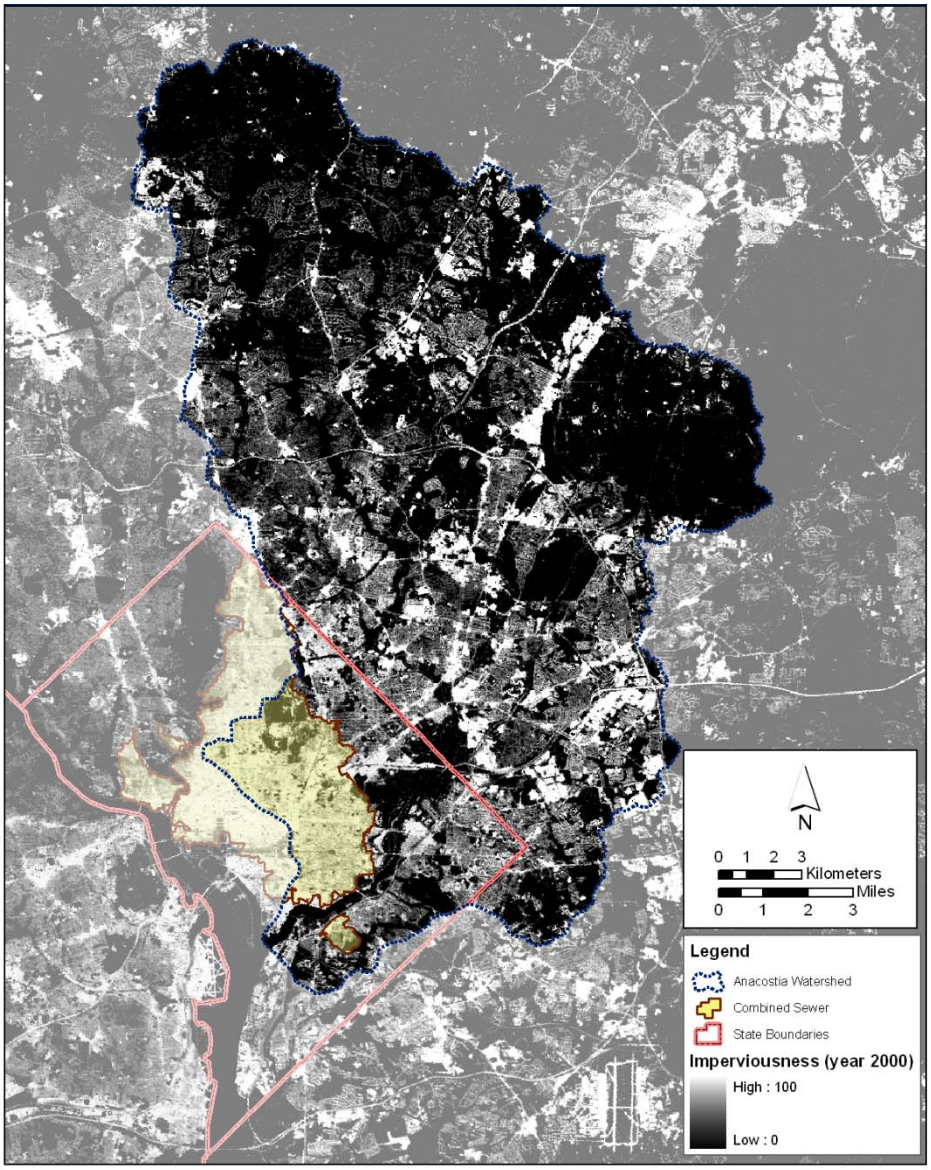
Section 303(d) of the Act requires the District to identify water bodies (or segments of water bodies) for which the existing effluent limitations are not rigorous enough to support water quality standards. The District is also required to rank these water bodies by priority of severity of pollution and their associated uses.

The District assesses its water bodies every two years as required by section 305(b) of the Act. In doing so, approximately 30 total water bodies in the District were identified as impaired for various pollutants (e.g. metals, organics, coliform bacteria, oil and grease, etc.) and included on the TMDL 303(d) list in 2002. Within the Anacostia Watershed, the main stem and a number of its tributaries are listed as impaired water bodies.

Causes of Impairments

The major proximal causes of impairment to the Anacostia are biological oxygen demand, total suspended solids, pathogens, metals and persistent chemical pollutants also called organics. The ultimate source of these pollutants is large quantities of uncontrolled and untreated stormwater and combined sewer overflows carrying with it these pollutants and delivering them to the Anacostia and its tributaries. The large amount of impervious area in the watershed impedes stormwater from infiltrating naturally as it would in a forested environment (see Figure 4 - Anacostia Impervious Cover). Instead it flows off rooftops and roadways into storm drains where it is delivered – hot, fast, and dirty to the stream and its tributaries. In addition to the pollutants carried to the stream, the volume, velocity, and temperature of the water impacts aquatic life by eroding stream banks, raising stream temperatures, and scouring stream beds. The high percent of impervious surface in the watershed has a second impact on aquatic habitat.

Figure 4 - Anacostia Watershed Imperviousness



Some impacts of stormwater in the main stem Anacostia are different from its tributaries. In the smaller tributaries, because rain water cannot infiltrate and recharge the ground water, some streams go dry during dry periods because the water table drops below the stream level. The main stem of the Anacostia is wide and tidal so water tends to move slowly through this system. This means that pollutants that wash out of tributaries such as nutrients and sediments tend to accumulate in the slow-moving main stem.

Specific Pollutants of Concern

EPA Region III has currently approved nine TMDL documents issued by the District of Columbia (Table 4), establishing TMDLs for 16 pollutants in the Anacostia River watershed (DC DOH 2001, DC DOH, 2002, DC DOH 2003a; DC DOH 2003b; DC DOH 2003c, DC DOH 2003d, DC DOH 2003e, DC DOH 2003f, DC DOH 2003g). TMDLs were established for the 13 segments of water bodies within the Anacostia watershed in the District of Columbia listed below (total number of pollutants for each segment is included in parentheses):

- Upper Anacostia River (16)
- Lower Anacostia River (16)
- Kingman Lake (11)
- Fort Chaplin Tributary (3)
- Fort Davis Tributary (3)
- Fort Dupont Creek (3)
- Fort Stanton Tributary (11)
- Hickey Run (8)
- Nash Run (11)
- Pope Branch (11)
- Texas Avenue Tributary (11)
- Watts Branch (9)

The Fort Davis tributary has the lowest number of TMDLs identified at 4 pollutants, and the main stem Anacostia River and Kingman Lake have the highest number of TMDLs identified at 16 pollutants. The complete TMDL documents and backup materials are available online at: www.epa.gov/reg3wapd/tmdl/dc_tmdl/index.htm.

Table 3: District of Columbia Anacostia TMDL Documents Approved by EPA

TMDL Document	Date Approved
Total Maximum Daily Load for Biochemical Oxygen Demand in the Upper and Lower Anacostia River	May 2001
Total Maximum Daily Load for Total Suspended Solids in the Upper and Lower Anacostia River	January 2002
Final Total Maximum Daily Loads for Total Suspended Solids in Watts Branch	June 2003
Final Total Maximum Daily Loads for Organics and Metals in the Anacostia River, Fort Chaplin Tributary, Fort Davis Tributary, Fort Dupont Creek, Fort Stanton Tributary, Hickey Run, Nash Run, Pope Branch, Texas Avenue Tributary, and Watts Branch	October 2003
Final Total Maximum Daily Load for Fecal Coliform Bacteria in the Anacostia River, Watts Branch Fort Dupont Creek, Fort Chaplin Tributary, Fort Davis Tributary, Fort Stanton Tributary, Hickey Run, Nash Run, Pope Branch, Texas Avenue Tributary	October 2003
Final Total Maximum Daily Loads for Oil and Grease in the Anacostia River	October 2003
Final Total Maximum Daily Loads for Fecal Coliform Bacteria in Kingman Lake	October 2003
Final Total Maximum Daily Loads for Organics and Metals in Kingman Lake	October 2003
Final Total Maximum Daily Loads for Total Suspended Solids, Oil and Grease, and Biochemical Oxygen Demand in Kingman Lake	October 2003
Total Maximum Daily Loads of Trash for the Anacostia River Watershed, Montgomery and Prince George's Counties, Maryland and the District of Columbia	August 2010

The main stem Anacostia River was simulated using an upgrade to the Tidal Anacostia Model (TAM) originally developed by MWCOG in the late 1980s and the EPA's Water Quality Analysis Simulation Program (WASP). The Interstate Commission on the Potomac River Basin (ICPRB) developed this hybrid model for the District of Columbia TMDLs. The TAM/WASP model used the hydrodynamic elements of the TAM model and the water quality elements of the WASP model to simulate the fate and transport of the pollutants once they reached the tidal portion of the River.

The DC Small Tributaries TMDL Model was utilized to model the Anacostia's side streams. It was a simple mass balance model which predicts water column concentrations of pollutants in the tributaries. For certain pollutants, the mass balance model apportioned loads to numerous tributaries based upon loading in the mainstem, rather than direct measurement in the tributary. The model, developed by ICPRB, predicted daily concentrations of pollutants. The simulation was carried out for a three-year time period using recent monitoring data to estimate base flow and storm flow concentrations and using ICPRB's Watts Branch HSPF model output to estimate storm and base flows. The Watts Branch HSPF model used hydrologic inputs from the three-year period of record, 1988, 1989, and 1990.

Based on the analysis of the model results for each specific pollutant, the TMDL documents estimate historic pollutant loads and the maximum loads allowable to comply with the water quality standards. Each TMDL document contains an Implementation Plan that allocates the reduction required among identified sources. These plans are generic and allocate the same percentage reduction to each identified source. Specific pollutants of concern identified in the ten TMDL documents for the Anacostia River watershed for reductions in discharges from the MS4 include:

- Fecal coliform bacteria
- Biochemical Oxygen Demand
- Total Suspended Solids
- Oil and Grease
- Lead
- Copper
- Arsenic
- Polynuclear aromatic hydrocarbons (PAHs), including:
  - PAH-2 - fluoranthene, pyrene, benzo[a]anthracene, and chrysene;
  - PAH-3 - benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, and dibenzo[a,h+ac]anthracene.
- Chlordane
- Heptachlor epoxide
- Dieldrin
- DDT (dichloro-diphenyl-trichloroethane)
- DDE (dichloro-diphenyl-dichloroethylene)
- DDD (dichloro-diphenyl-dichloroethane)
- Total polychlorinated biphenyls (PCBs)
- Trash

The following chart identifies the tributaries to and main stem portions of the Anacostia that are required to have TMDLs. The Water Quality Division of the District Department of Environment is the lead division in developing TMDLs for District water bodies.

Table 4 - TMDLs for the Anacostia and its Tributaries

Tributary	Pollutant
Upper/Lower Anacostia	Pathogens, oil/grease, organics, metals, trash
Fort Chaplin Tributary	Pathogens, metals
Fort Davis Tributary	Pathogens, metals, BOD
Fort Dupont Creek	Pathogens, metals
Fort Stanton Tributary	Organics, pathogens, metals
Hickey Run	Organics, pathogens
Kingman Lake	Organics, pathogens, metals, BOD, TSS, oil/grease
Nash Run	Organics, pathogens, metals
Pope Branch	Organics, pathogens, metals
Texas Avenue Tributary	Organics, pathogens, metals
Watts Branch	Organics, pathogens, TSS

Description of the Pollutants of Concern

The 16 pollutants of concern that have TMDL waste load allocations for the Anacostia and its tributaries can be categorized into six typical groups that include: oil and grease, nutrients (BOD), sediment (TSS), pathogens, metals, and organic chemicals. The Anacostia TMDLs are established because pollutants are found to exceed water quality standards established by the District of Columbia to protect human heath and the health of fish and wildlife (Table 5).

Table 5 - Categories of Uses that Determine Water Quality Standards

Class	Use
A	Primary Contact Recreation (Recreation “in” the water)
B	Secondary Contact Recreation (Recreation “on” the water)
C	Protection and propagation of fish, shellfish, and wildlife
D	Protection of human health related to fish and shellfish consumption
E	Navigation

Oil and grease are organic hydrocarbons generally used for the lubrication and operation of machinery including motor vehicles as well as home heating and electrical power generation. When not properly recycled or disposed of, they can be toxic and contribute to water quality impairments.

Biochemical Oxygen Demand (Nutrients) is an indicator of the amount of organic pollution in water. BOD indicates the amount of oxygen needed by bacteria to consume organic matter in water. High BOD numbers indicate low available oxygen in the water which can kill fish and other aquatic organisms. High levels of nutrients such as nitrogen and phosphorous in waterways generally lead to high BOD numbers.

Total Suspended Solids (Sediment) are the total amount of particulate material found in a given amount of water. The primary source of TSS is sediment washing off the land or being eroded from stream banks during storm events. TSS impacts aquatic life in many ways including:
Reducing the amount of light available for aquatic vegetation;

- Reducing plant matter for food and habitat;
- Reducing available oxygen;
- Reducing the ability of visual insect and fish predators to find their prey and each other for reproduction;
- Clogging gills, abrading soft tissues, and scouring algae and microbes growing on rocks;
- Suffocating newly hatched larvae and interfering with particle feeding activities; and
- Filling spaces between rocks used by organisms for homes.

Pathogens are disease-causing microorganisms, such as bacteria and viruses, which can be found in fecal waste of humans and animals. The group of bacteria known as fecal coliforms is the only pathogen that is a TMDL pollutant in the Anacostia watershed. Pathogens generally wash off the land from wild animal, farm animal, and pet waste, and can enter waterways from improperly functioning septic tanks, leaky sewer lines, CSOs, and boat sanitary disposal systems. Exposure to pathogens that reach water bodies can cause a number of health problems. The primary reduction strategy for pathogens is source control to eliminate pathogens from entering the watershed.

Pet waste is a source of pathogens in the Anacostia

Metals *a*re common inorganic chemical pollutants that are very resistant to breakdown, tend to be passed through the food chain, and therefore concentrate in top animal and fish predators. Metals listed as TMDL pollutants for the Anacostia watershed include lead, arsenic, and copper. In addition to industrial point source discharges, metals can enter water bodies through the disposal and combustion of fuels. Metals have the tendency to accumulate in sediments and can be found in point bars and depositional areas. The toxicity of metals varies greatly with pH, water hardness, dissolved oxygen concentrations, salinity, temperature, and other parameters; physiological impacts (e.g. mortality, lack of reproduction) can be elicited in aquatic systems from relatively low concentrations of metals. The primary reduction strategies for metals include source control and source reduction. In addition, most metals are positively charged and tend to bond with negatively charged soil particles such as clay and silt. Therefore, removal practices that manage TSS have also been identified as strategies to remove metals from the watershed.

Organic Chemicals include persistent, organic substances that have similar chemical characteristics, are generally hydrophobic, and have the affinity to bind to carbon, TSS, and other particles. Organic chemicals persist in the environment, bioaccumulate through the food web, and pose a risk of causing adverse effects to human health and the environment. Categories of organic chemicals that are listed as TMDL pollutants for the Anacostia watershed include manufactured pesticides and chemicals. Pesticides that are listed as TMDL pollutants for the Anacostia watershed include chlordane, dieldrin, heptachlor epoxide, DDT, DDE, and DDD. All manufacturing of the pesticides mentioned above, with the exception of heptachlor epoxide for limited uses has been banned in the U.S. Manufactured chemicals that are listed as TMDL pollutants for the Anacostia watershed include total PCBs and PAHs. Total PCBs are manufactured industrial chemicals that have been banned in the U.S. PAHs are a byproduct of combustion from the burning of wood, garbage, coal, and organic substances. Some PAHs are still used to make dyes and plastics. Most organic chemicals that are listed as TMDL pollutants in the Anacostia watershed, as mentioned above, have been banned from use. However, these organic chemicals continue to persist in the environment in low concentrations and are extremely hard to target for removal. Direct removal techniques for organic chemicals from storm water are not known at present, and since most of the organic chemicals have an affinity to bind with soil particles, removal practices that manage TSS have been identified as strategies to remove organic chemicals from the watershed.

For each pollutant, a brief definition is provided below, followed by common sources of the pollutant and finally, general strategies for reduction of the pollutant in the MS4. Pollutant reduction strategies for these pollutants of concern are discussed in detail in Section 3 of this Watershed Implementation Plan.

Oil and Grease

Definition – Oil and grease are hydrocarbons that are insoluble in water. Low levels of oil pollution can reduce aquatic organisms' ability to reproduce and survive. Oils can also create chemical oxygen demand

Common Sources - Sources of oil and grease are mainly anthropogenic. The most common oils polluting water are ones used for fuel and lubrication and operation of machinery especially motor vehicles. Other sources of oil and grease are, cooking oil, and animal-derived fats as well as home heating and electrical power generation.

Reduction Strategies - There are many strategies for reducing oil and grease, many of which have already been shown to be successful in the District of Columbia. Strategies in use in the District include offering free oil and grease recycling, vehicle inspection programs, outreach and education to do-it-yourself mechanics as well as to auto repair shops, street sweeping, conventional BMPs such as sand filters, LID such as pervious paving and bioretention, catch basin inserts, end-of-pipe systems, planting wetlands, and aggressive leak detection and enforcement. http://www.seas.ucla.edu/stenstro/j/j21

Biochemical Oxygen Demand

Definition – Biological Oxygen Demand is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period. High BOD numbers indicate low dissolved oxygen (DO) levels in water. High BOD numbers (and therefore low DO numbers) can lead to fish kills or reduce the reproductive success of aquatic organisms.

Common Sources – There are two main sources of BOD:

- Natural inputs such as leaf fall, vegetation, and wild animal waste; and
- Human inputs from sources such as sewage leaks, combined sewer overflows, waste water treatment plants, pet waste, and runoff from fertilizers

Reduction Strategies - One reduction strategy is public outreach, such as educating homeowners and businesses on proper fertilizing techniques and pet owners on the importance of collecting and disposing of waste. Another important strategy is to reduce sanitary discharges to waterways by finding and repairing sewer leaks and reducing combined sewer overflows. The management of CSOs is the responsibility of WASA. Under a separate program for a reduction strategy, WASA has developed an LTCP for the District's CSOs, dated July 2002, and submitted to EPA for review.

Total Suspended Solids

Definition – TSS is simply the amount of particular mater found in a given volume of water. Suspended solids are a natural part of aquatic ecosystems, however when found in high amounts, TSS can impair waterways by impacting aquatic life and reducing visibility for navigation. Sediment is the primary source of water pollution in the United States.

Common Sources – Primary sources of TSS in urban environments include sediment washing off the land or being eroded from stream banks during storm events. Additional sources include particulate matter from decomposing plants and animals, and point sources such as combined sewer outfalls.

Reduction Strategies – The primary strategies for reducing TSS are controlling stormwater flows to reduce stream bank erosion through stream restoration activities and reducing stormwater volumes through conventional best management practices and low impact development techniques. Additional management measures include developing and enforcing erosion and sediment control standards for land disturbance activities and public education and outreach for proper yard care to retain soil.

Fecal Coliform Bacteria

Definition - Fecal coliform bacteria are not all pathogenic or harmful. As a group, they have been used historically as an "indicator" organism that signifies the presence of pathogenic bacteria, viruses, and protozoa that live in human and animal digestive systems. Pathogen-specific analyses can be difficult, time consuming, and expensive; therefore, tests for fecal coliform are used to indicate the potential for pathogens to be present in water. EPA now recommends specific testing for the *Escherichia coli* (*E. coli*) as the indicator organism, since it is the most common organism associated only with the fecal material of humans and other animals. The presence of fecal coliform bacteria in aquatic environments indicates that the water has been contaminated with the fecal material of humans or other animals.

Common Sources - Common sources of fecal coliform in storm water include birds, such as geese or pigeons, and pets, especially dogs. Other sources in an urban environment are illegal sanitary sewer connections to the storm drain, failed septic tanks linked to the storm drain, cross connections between a sanitary sewer and the storm drain, and sanitary sewer exfiltration (either directly or indirectly via groundwater seepage to the storm drain). There are seventeen CSO outfalls on the Anacostia River. Although this plan will address actions in the CSS, required actions for the reduction of CSOs are covered in the LTCP. WASA is in the process of building a storage system in Anacostia watershed and other parts of the combined sewer system in the Final CSO LTCP (DC WASA, 2002).

The CSO LTCP has been approved by DDOE, and as it is implemented, the plan will significantly reduce CSOs to the Anacostia River (DOH, 2003c). In addition, the wildlife that currently inhabits Anacostia Park and other natural areas of the watershed are not considered primary polluting sources in the Anacostia watershed.

Reduction Strategies- For fecal coliform bacteria, the primary reduction strategy is public outreach, such as educating pet owners on the importance of collecting and disposing of waste. The primary strategy for reducing sanitary discharges to the storm sewers is to identify and eliminate pathways such as illicit connections and leakage from sanitary systems to the MS4. CSOs are a contributor of fecal coliform bacteria to the Anacostia River. The management of CSOs is the responsibility of WASA. Under a separate program for a reduction strategy, WASA has developed an LTCP for the District's CSOs, dated July 2002, and submitted to EPA for review.

Lead

Definition - Lead is also a naturally occurring metal. Lead and its compounds tend to bind to soil and sediment particles, and are not easily dissolved in water. Lead's primary uses are for automobile batteries and ammunition manufacturing, but lead is also used in medical equipment and computer components.

Common Sources - Lead sources include industrial processes and atmospheric and airborne particulate matter from burning fuel and solid waste. Acid rain can release this matter to soluble form in runoff to drains and streams. Lead was commonly used in plumbing pipes and paints and as gasoline additives, but the use of lead in these applications has been phased out or greatly reduced. Sources of lead in urban environments include contaminated soil from automobile exhaust and paint chips from old houses and buildings prior to when lead based paint use was prohibited.

Reduction Strategies - Source reduction and source control are the best strategies for lead. This may include proper vehicle operation and maintenance, proper disposal of batteries, and monitoring waste streams from industrial dischargers. Because lead bonds with soil particles and has a low solubility in water, treatment techniques that manage TSS are a potential reduction strategy.

Copper

Definition - Copper is a naturally occurring metal and an essential element for all living organisms. Copper readily forms inorganic and organic compounds, and is used in the manufacture of alloys such as brass and bronze. Copper is found in atmospheric particulate matter, which can be made soluble by acid rain in runoff. Copper compounds are used in agricultural

Roadway pollutants being captured in a bioretention cell

applications to treat plant diseases and as preservatives for wood and fabrics. Copper compounds tend to bind to soil and sediment, and are not easily water-soluble.

Common Sources - Common industrial sources of copper and its alloys include electrical wiring, sheet metal, pipes, and metal plating including automobiles. Copper is also an important component of pesticides, fungicides, and insecticides, including the preservative used to weatherproof wood products.

Reduction Strategies - For copper, source reduction and source control are the best strategies. This may include using alternatives to copper-containing fungicides and insecticides or proper management of fungicides and insecticides, and monitoring waste streams from industrial dischargers. Because copper bonds with soil particles and has a low solubility in water, treatment techniques that manage TSS are a potential reduction strategy.

Arsenic

Definition - Arsenic is a naturally occurring metalloid that readily forms inorganic and organic compounds in the environment.

Common Sources - Arsenic is naturally released into the atmosphere during volcanic emissions. Arsenic is also released into the atmosphere from industrial sources such as power plants, ore processing, and smelters. Arsenic can be naturally occurring in soils or added as pesticides into soils. Arsenic may also get into water as a result of soil erosion and resuspension. Arsenic is primarily used to make the preservative chromated copper arsenate (CCA), which is used to weatherproof wood used in construction. As a wood preservative, it can be found in plywood, wood decking and patios, wood utility poles, wood pilings, and piers. Arsenic-containing particulates can be released to the air from the burning of wood containing this preservative. Arsenic and arsenic alloys are also used in automobile batteries, semiconductors, and metal finishing. Organic arsenic compounds are used in insecticides and pesticides.

Reduction Strategies - Naturally occurring and particulate arsenic sources in an urban environment are best controlled through erosion and sediment regulations and source control.

Polynuclear Aromatic Hydrocarbons (PAHs)

Definition - PAHs are hydrogen compounds with multiple benzene rings and result from the combustion of petroleum, coal, oil, and wood. The TMDL pollutants for the Anacostia include PAH-2, and PAH-3, which are groups of specific compounds. In general, PAHs do not easily dissolve in water, but instead bind tightly to soil and sediment particles.

Common Sources - Sources of PAHs include vehicles, heating and power plants, industrial processes, and open burning of wastes. PAHs are typical components of fuels, oils, greases, vehicle (diesel and gasoline) emissions, asphalt roads, and tobacco smoke. PAHs typically enter surface water through runoff.

Reduction Strategies - Source control is a potential strategy for PAH reduction. However, many sources are dispersed and/or cross-jurisdictional boundaries. Because PAHs bond with soil particles, treatment techniques that manage TSS are the best reduction strategy for removal of PAHs in MS4 discharges.

Chlordane

Definition - Chlordane is a synthetic chemical made up of several components, including transchlordane, cis-chlordane, beta-chlordane, heptachlor, and trans-nonachlor. Chlordane has been banned for use in the U.S. since 1988 because of concerns about cancer risk, persistence in the environment, and danger to wildlife. Chlordane was used as a pesticide on agricultural crops, lawns, and gardens and as a fumigating agent. It has also been used to control termites in homes by applying underground around the foundations of homes. Chlordane has a very low solubility in water.

A bottle of chlordane collected at a hazardous waste collection day.

Common Sources - Chlordane is persistent in the environment and remains as a residue in soils; therefore, chlordane can still exist today in agricultural, lawn and garden soils, and soils along the foundations of homes.

Reduction Strategies - Source control is not a potential reduction strategy for chlordane in MS4 discharges. Although no longer in use, the historic widespread use of chlordane in agriculture and termite control has resulted in dispersed small sources today that are difficult to identify and control. Because chlordane bonds with soil particles and has a low solubility in water, treatment techniques that manage TSS are the best reduction strategies for removal of chlordane.

Heptachlor Epoxide

Definition - Heptachlor epoxide is a breakdown product of the insecticide heptachlor; it was never manufactured and used as an insecticide itself. Heptachlor is a manufactured pesticide that was used to kill insects in homes and buildings and on food crops. Heptachlor is also a component of the pesticide chlordane. There are no known natural sources of heptachlor or heptachlor epoxide. Use of heptachlor as an insecticide was banned in 1988, with the exception of killing fire ants in power transformer boxes, underground cable television, and telephone cable boxes. Heptachlor epoxide strongly binds to soils and is persistent in the soil.

Common Sources - Heptachlor epoxide may exist as a residue in soils (upper soil layers) that have been treated with heptachlor or chlordane. Heptachlor epoxide can also be found in plants and crops grown in soil treated with heptachlor.

Reduction Strategies - Source control is not a potential reduction strategy for heptachlor epoxide in MS4 discharges. Although heptachlor is no longer used, its historic widespread use in agricultural and residential applications has resulted in dispersed small sources that are difficult to identify and control. EPA has approved granular activated carbon for removal of heptachlor epoxide in drinking water treatment. However, the use of activated carbon for the treatment of storm water is not feasible. Because heptachlor epoxide binds with soil particles and has a low solubility in water, treatment techniques that manage TSS are the best reduction strategies for removal of heptachlor epoxide. This will include street sweeping, inlet cleaning, and use of structural BMPs.

Dieldrin

Definition - Dieldrin is a synthetic pesticide with no known natural source. Dieldrin is also formed from the breakdown of aldrin, another pesticide. Dieldrin was used in agriculture on cotton, corn, and citrus crops; for public health control of diseases carried by insects, such as mosquitoes and tsetse flies; for termite control; and as a wood preservative. Use of dieldrin and aldrin was banned in the U.S. in 1985 and 1987, respectively. However, dieldrin is persistent and is found in areas where it or aldrin was previously used. Dieldrin does not easily dissolve in water.

Common Sources - Dieldrin (and aldrin) may exist as a residual in soils (upper soil layers) that have been treated with dieldrin and aldrin. Dieldrin (and aldrin) may be found in soils near homes where the compounds were used to kill termites. It can also be found in plants grown in soils treated with dieldrin and aldrin, as well as in animals that feed on these plants.

Reduction Strategies - Source control is not a strategy for dieldrin reduction in storm water discharges. Although banned in the U.S. today, the historic widespread use of dieldrin in numerous applications has resulted in dispersed small sources that are difficult to identify and control. Because dieldrin bonds with soil particles and has a low solubility in water, treatment techniques that manage TSS are the best reduction strategies for removal of dieldrin. This will include street sweeping, inlet cleaning, and use of structural BMPs.

DDT, DDE, and DDD

Definition - DDT is a manufactured pesticide with no known natural sources, and DDE and DDD are breakdown products of DDT. DDT was one of the first man-made chemicals used to control insects that carry diseases, such as malaria and typhus. DDT is not soluble in water and tends to bind tightly to particles of soil or sediment. DDT was banned in the U.S. in 1972 because of its deleterious effects on the reproductive capabilities of birds, and persistence in the environment.

Common Sources - DDT and its breakdown products initially entered soils during their manufacture and use as insecticides. They are persistent chemicals that remain in the soil for a long time; therefore, the majority of the DDT and DDD found in the environment today is a residue from past use. DDE is only found in the environment as a breakdown product of DDT, and some DDD is also a breakdown product of DDT. DDT can be transferred to crops grown in DDT-contaminated soils.

Reduction Strategies - Source control is not a reduction strategy for DDT, DDD, and DDE. Although DDT is banned in the U.S. today, DDT, DDD, and DDE can exist dispersed as residual in areas used for farming and landscaping. At known contaminated sites, a strategy is to maintain ground cover, provide dust control, and minimize soil disturbance. Because of their bonds with soil, sediment and erosion control and subsequent removal of TSS is an optional reduction strategy for control and removal of DDT, DDD, and DDE. This will include providing sediment and erosion control at construction sites, soil stockpile sites, and rubble and sanitary landfills. In addition, reduction control strategies include street sweeping, inlet cleaning, and use of structural BMPs.

Total PCBs

Definition - PCBs are manufactured compounds with no known natural sources. PCBs do not burn easily and are good insulating materials that were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. Other uses included heat transfer fluid, hydraulic fluid, dye carriers in carbonless copy paper, and plasticizers in paints, adhesives, and caulking compounds. PCBs were banned in 1977 because of their wide range of harmful health effects. Many electrical transformers and capacitors filled with PCBs are still in service today. In older buildings, PCB-containing fluorescent lights (i.e., in the ballast), electrical devices, and appliances still exist. PCBs are persistent in the environment and tend to bind to particulates such as dust, soil, or sediment during transport.

Common Sources - Point sources of PCBs in most urban environments such as the District are not delineated. PCBs manufactured prior to the 1977 ban can still be a residue in soils, and PCB wastes were placed in landfills. Despite the controls and restriction that are in place, demolition and removal of PCB-containing facilities (such as transformers, capacitors, fluorescent lights), accidental leaks and spills from landfills or during transport, and burning of PCB containing wastes in municipal and industrial incinerators are all potential PCB sources.

Reduction Strategies - There is no effective reduction strategy for control of PCBs in MS4 discharges. However, proper demolition and disposal of PCB-containing facilities and related spill remediation is an ongoing and standard procedure to follow.

Current Loads and Required Load Reductions for Specific Pollutants

EPA regulations define a TMDL as the sum of the waste load allocations assigned to point sources, the load allocations to nonpoint sources and natural background, and a margin of safety (MOS). The TMDL is commonly expressed as:

TMDL = WLAs + LAs + MOS

Load allocations and existing loads are modeled annual averages based on average concentrations measured in stormwater and stream base flow monitoring data. Loads are allocated to both Maryland and the District based on the proportion of the watershed area found in each jurisdiction; Maryland loads are listed as upstream loads. Given that the Anacostia watershed is split between Maryland and the District, for the District to achieve its TMDLs, Maryland's own load allocations must also be met.

The approved Anacostia TMDLs and their associated reductions for the two main stem segments of the Anacostia are detailed in Table 6. Table 7 shows the TMDL tributary watersheds and their associated WLA reduction percentages required.

Table 6 - Approved TMDLs and Percent Reductions for the Anacostia Main Stem

Upper Anacostia River

Pollutant	Existing Load (MS4)	Waste Load Allocation (MS4)	Units	Required Reduction to Achieve TMDL	CSO Waste Load Allocation	Units
Fecal Coliform Bacteria		4.40E+14	MPN/100ml	90%	1.190E+15	MPN/100ml
BOD	1.677E+05	8.108E+04	lbs/yr	50%	NA	lbs/yr
Nitrogen	4.382E+04	2.92E+04	lbs/yr	30%	NA	lbs/yr
Phosphorus	7.205E+03	4.887E+03	lbs/yr	30%	NA	lbs/yr
TSS	1.468E+06	1.133E+02	tons/growing season	77%	2.972E+02	Tons/growing season
Arsenic	1.217E+01	2.054E+00	lbs/yr	85%	1.302E+00	lbs/yr
PAH1	9.759E+00	1.932E-01	lbs/yr	98%	8.022E-02	lbs/yr
PAH2	5.777E+01	1.144E+00	lbs/yr	98%	4.718E-01	lbs/yr
PAH3	5.777E+01	1.144E+00	lbs/yr	98%	2.999E-01	lbs/yr
Chlordane	1.423E-01	4.089E-03	lbs/yr	90%	5.832E-03	lbs/yr
Heptachlor Epoxide	2.065E-02	8.192E-03	lbs/yr	80%	1.780E-03	lbs/yr
Dieldrin	1.182E-02	8.192E-03	lbs/yr	31%	3.726E-03	lbs/yr
DDD	5.265E-02	5.212E-03	lbs/yr	90%	2.784E-03	lbs/yr
DDE	1.286E-01	1.273E-02	lbs/yr	90%	6.321E-03	lbs/yr
DDT	3.443E-01	3.409E-02	lbs/yr	90%	1.703E-02	lbs/yr

Lower Anacostia River

Pollutant	Existing Load (MS4)	Waste Load Allocation (MS4)	Units	Required Reduction to Achieve TMDL	CSO Waste Load Allocation	**Units**
Fecal Coliform Bacteria		7.70E+13	MPN/100ml	90%	7.440E+14	MPN/100ml
BOD	1.070E+05	5.172E+04	lbs/yr	50%	1.529E+05	lbs/yr
Nitrogen	2.299E+04	1.532E+04	lbs/yr	30%	1.217E+04	lbs/yr
Phosphorus	3.769E+03	2.631E+03	lbs/yr	30%	8.047E+03	lbs/yr
TSS	7.101E+05	7.546E+01	Tons/growing season	77%	1.001E+02	Tons/growing season
Arsenic	2.025E+01	3.415E+00	lbs/yr	83%	1.056E+00	lbs/yr
PAH1	5.330E+00	1.055E-01	lbs/yr	98%	6.5.37E-02	lbs/yr
PAH2	3.240E+01	6.415E-01	lbs/yr	98%	3.892E-01	lbs/yr
PAH3	3.240E+01	6.415E-01	lbs/yr	98%	2.483E-01	lbs/yr
Chlordane	7.855E-02	7.777E-03	lbs/yr	90%	4.771E-03	lbs/yr
Heptachlor Epoxide	1.008E-02	2.082E-03	lbs/yr	79%	1.349E-03	lbs/yr
Dieldrin	5.019E-03	3.478E-03	lbs/yr	31%	2.632E-03	lbs/yr
DDD	8.746E-02	8.658E-03	lbs/yr	90%	4.660E-03	lbs/yr
DDE	2.136E-01	2.115E-02	lbs/yr	90%	1.058E-02	lbs/yr
DDT	5.720E-01	5.663E-02	lbs/yr	90%	2.853E-02	lbs/yr

Table 7 - Approved TMDLs and Percent Reductions for the Tributaries of the Anacostia River

Fort Chaplin						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	1.266E+00	3.760E-01	lbs/3 yrs	70%	NA	
Copper	4.620E+01	1.829E+01	lbs/3 yrs	65%	NA	
Lead	2.214E+01	7.670E+00	lbs/3 yrs	65%	NA	
Fort Davis						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	3.300E-01	9.800E-02	lbs/3 yrs	70%	NA	
Copper	1.184E+01	4.690E+00	lbs/3 yrs	60%	NA	
Lead	5.624E+00	1.949E+00	lbs/3 yrs	65%	NA	
Fort Dupont						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	5.560E-01	1.651E-01	lbs/3 yrs	70%	NA	
Copper	1.933E+01	7.654E+00	lbs/3 yrs	50%	NA	
Lead	8.994E+00	3.561E+00	lbs/3 yrs	60%	NA	
Fort Stanton						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	1.699E-01	5.046E-02	lbs/3 yrs	70%	NA	
Copper	6.273E+00	2.484+00	lbs/3 yrs	55%	NA	
Lead	1.704E-01	6.748E-02	lbs/3 yrs	65%	NA	
Chlordane	1.132E-03	1.682E-04	lbs/3 yrs	85%	NA	
DDD	9.440E-04	9.346E-05	lbs/3 yrs	90%	NA	
DDE	1.895E-03	1.486E-04	lbs/3 yrs	92%	NA	
DDT	5.171E-03	1.536E-04	lbs/3 yrs	97%	NA	
Dieldrin	1.170E-04	2.340E-05	lbs/3 yrs	80%	NA	
Heptachlor Epoxide	7.513E-03	1.841E-05	lbs/3 yrs	90%	NA	
PAH2	4.528E-01	8.875E-03	lbs/3 yrs	98%		
PAH3	2.871E-01	5.629E-03	lbs/3 yrs	98%	NA	

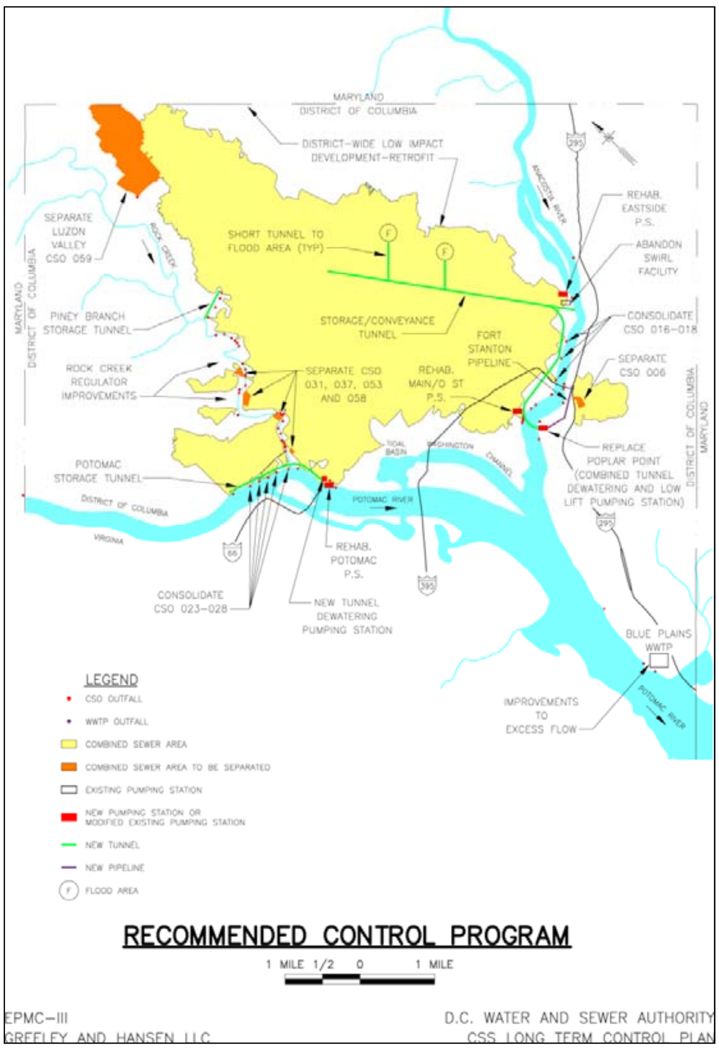
Hickey Run						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Chlordane	5.761E-02	8.556E-03	lbs/3 yrs	85%	NA	
DDD	3.261E-02	3.197E-03	lbs/3 yrs	90%	NA	
DDE	8.707E-02	6.896E-03	lbs/3 yrs	92%	NA	
DDT	2.314E-01	6.872E-03	lbs/3 yrs	97%	NA	
Dieldrin	3.436E-02	6.872E-03	lbs/3 yrs	80%	NA	
Heptachlor Epoxide	7.510E-03	7.435E-04	lbs/3 yrs	90%	NA	
PAH2	2.372E+01	4.649E-01	lbs/3 yrs	98%	NA	
PAH3	1.502E+01	3.004E-01	lbs/3 yrs	98%	NA	
Nash Run						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	3.462E+00	8.569E-01	lbs/3 yrs	75%	NA	
Copper	1.337E+02	5.293E+01	lbs/3 yrs	60%	NA	
Lead	6.614E+01	1.965E+01	lbs/3 yrs	65%	NA	
Chlordane	2.349E-02	3.488E-03	lbs/3 yrs	85%	NA	
DDD	1.404E-02	1.390E-03	lbs/3 yrs	90%	NA	
DDE	3.610E-02	2.859E-03	lbs/3 yrs	92%	NA	
DDT	9.623E-02	2.858E-03	lbs/3 yrs	97%	NA	
Dieldrin	1.645E-03	3.290E-04	lbs/3 yrs	80%	NA	
Heptachlor Epoxide	3.146E-03	3.115E-04	lbs/3 yrs	90%	NA	
PAH2	9.696E+00	1.920E-01	lbs/3 yrs	98%	NA	
PAH3	6.150E+00	1.230E-01	lbs/3 yrs	98%	NA	

Pope Branch						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	1.763E+00	5.237E-01	lbs/3 yrs	70%	NA	
Copper	6.483E+01	2.567E+01	lbs/3 yrs	60%	NA	
Lead	3.122E+01	1.082E+01	lbs/3 yrs	65%	NA	
Chlordane	1.172E-02	1.740E-03	lbs/3 yrs	85%	NA	
DDD	1.007E-02	7.582E-04	lbs/3 yrs	90%	NA	
DDE	3.610E-02	1.568E-03	lbs/3 yrs	92%	NA	
DDT	5.414E-02	1.608E-03	lbs/3 yrs	97%	NA	
Dieldrin	1.250E-03	2.500E-04	lbs/3 yrs	80%	NA	
Heptachlor Epoxide	1.962E-03	1.942E-04	lbs/3 yrs	90%	NA	
PAH2	4.675E+00	9.166E-02	lbs/3 yrs	98%	NA	
PAH3	2.950E+00	5.900E-02	lbs/3 yrs	98%	NA	
Texas Avenue						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
Arsenic	1.341E+00	3.984E-01	lbs/3 yrs	70%	NA	
Copper	4.996E+01	1.978E+01	lbs/3 yrs	60%	NA	
Lead	1.343E+00	4.653E-01	lbs/3 yrs	65%	NA	
Chlordane	8.975E-03	1.333E-03	lbs/3 yrs	85%	NA	
DDD	7.059E-03	6.989E-04	lbs/3 yrs	90%	NA	
DDE	1.477E-02	1.170E-03	lbs/3 yrs	92%	NA	
DDT	4.012E-02	1.180E-03	lbs/3 yrs	97%	NA	
Dieldrin	8.700E-04	1.740E-04	lbs/3 yrs	80%	NA	
Heptachlor Epoxide	1.420E-03	1.406E-04	lbs/3 yrs	90%	NA	
PAH2	3.609E+00	7.075E-02	lbs/3 yrs	98%	NA	
PAH3	2.250E+00	4.500E-02	lbs/3 yrs	98%	NA	
Watts Branch						
Pollutant	**Existing Load (MS4)**	**Waste Load Allocation (MS4)**	**Units**	**Required Reduction to Achieve TMDL**	**CSO Waste Load Allocation**	**Units**
TSS	3.040E+01	1.360E+01	Tons/growing season	55%	NA	
Chlordane	8.987E-02	1.335E-02	lbs/3 yrs	85%	NA	
DDD	5.556E-02	5.501E-03	lbs/3 yrs	90%	NA	
DDE	1.387E-01	1.099E-02	lbs/3 yrs	92%	NA	
DDT	1.853E-02	5.504E-04	lbs/3 yrs	97%	NA	
Dieldrin	6.565E-03	1.313E-03	lbs/3 yrs	80%	NA	
Heptachlor Epoxide	1.231E-02	1.219E-04	lbs/3 yrs	90%	NA	
PAH2	3.681E+01	7.215E-01	lbs/3 yrs	98%	NA	
PAH3	2.325E+01	4.650E-01	lbs/3 yrs	98%	NA	

Long Term Control Plan

It is important to note that many of the TMDLs, particularly those for fecal coliform bacteria, were developed in coordination with the $2.2 billion DC Combined Sewer Overflow (CSO) Long Term Control Plan (LTCP) (WASA, 2002), as CSOs have been determined to be a primary source of degradation of the District's water quality. The LTCP is designed to minimize the amount of polluted water discharged to the receiving waters, allowing these waters to meet the designated uses stipulated in the water quality standards. Approximately $1 billion will be spent on Anacostia watershed projects/upgrades, which under the LTCP include:

Figure 5 - WASA Long-Term Control Plan



- Separate CSO 006 (underway)
- Rehabilitate pumping stations (complete)
- Build a 49-million gallon storage and conveyance tunnel from Poplar Point along the Anacostia to the second tunnel (underway)

- Build a 77-million gallon storage and conveyance tunnel from West Virginia Avenue to the Anacostia storage tunnel
- Consolidate several existing CSO outfalls
- Utilize low impact development (LID) at WASA facilities

These LTCP elements are expected to reduce CSO events from an average of 82 a year down to two per year. During the study period used for the LTCP, an estimated 2,142 million gallons/year of CSO overflow volume discharged into the Anacostia River. After the plan is implemented, it is anticipated that the annual CSO volume will be 54 million gallons/year, a reduction of over 97 percent (WASA, 2002). The plan is anticipated to be implemented over the next ten years, creating a dramatic stepwise change in the water quality of the Anacostia.

Chesapeake Bay Agreement Requirements

The District is still committed to reducing total nitrogen, phosphorous, and total suspended solids loads both to meet TMDL requirements for the Anacostia River and in accordance with the Chesapeake Bay Agreement. As the EPA moves to enforce the Chesapeake Bay TMDL it is expected that load reductions for nitrogen, phosphorus and TSS will be assigned to the its tributaries which may mean additional required reductions for the Anacostia.

The main causes of the Bay's poor water quality and aquatic habitat loss are elevated nutrient levels. Occurring naturally in soil, animal waste, plant material, and even the atmosphere, nitrogen and phosphorous are delivered to the District's waterways and the Chesapeake Bay by both point and nonpoint sources. Most point source nitrogen and phosphorous discharges come from municipal wastewater treatment plants, although some come from industrial sources. Nonpoint sources of Chesapeake Bay nutrient pollution include croplands, feedlots, lawns, parking lots, streets, forests, septic tanks, and even air pollution. In order to address nonpoint nutrient sources in the highly urbanized Anacostia watershed, DDOE is promoting the use of low impact development practices.

Current and Proposed Management Measures

General Management Measures

General management measures are tasks that are taking place throughout the watershed. These measures are generally non-structural best management practices (BMPs), which seek to reduce pollutants before they enter the Anacostia or its tributaries. Non-structural BMPS include legal regulation, construction plan review and regulation, public education, illicit discharge detection and enforcement, and the management of the District's solid waste through street sweeping, trash collection, catch basin cleaning, and floatable reduction as primary means to control pollutants. General management measures also include programs to encourage the installation of structural BMPs through voluntary measures on private lands. Tables 8 through 17 provide details on

DDOE's proposed general management measures, the area that they are assumed to treat, and their associated load reductions.

Pollution Prevention Plans

Pollution Prevention Plans (P3) are low-cost, effective tools for reducing organics and metals in the Anacostia watershed. As a part of the District's MS4 permit, the permit stakeholder agencies are developing pollution prevention plans for each facility under their control. These plans detail procedures to avoid the accidental spill of hazardous materials and provide guidance on how to properly clean up a spill should one occur. The Department of Public Works has completed their P3 plans and several other agencies are currently in the process of inventorying their current practices so that the can update and/or create P3s. DDOE offers technical assistance and quality assurance review for agencies in the process of creating P3s. In an effort to delist the Anacostia and other District tributaries, DDOE inspectors will coordinate with Federal and District agencies to ensure that pollution prevention plans are created and followed.

Catch Basin Cleaning

Catch basin cleaning is a significant BMP to remove pollutants from the MS4 before they are flushed into receiving waters. Catch basin cleaning has proven to be one of the most cost effective methods to capture and remove gross pollutants in urban areas.


A vacuum truck cleaning a catch basin

Catch basin sumps such as those used in the District trap substantial quantities of debris, sediment, and particulate pollutants. Catch basins with a baffle or siphon attached to the outlet can also trap significant amounts of floatable debris and oil and grease. Either mechanical equipment or a vacuum truck is used to remove sediment and pollutants on a regular schedule. WASA seeks to clean each of the District's 25,000 catch basins once every six to twelve months through annual clean outs and in response to public comments.

More efficient and frequent cleaning of the catch basins will remove solids and pollutants, and prevent overfilling of the sumps and subsequent washout to receiving waters. Improved catch basin containment and removal of pollutants near the source will be a major benefit toward TMDL compliance. Primary pollutants of concern removed during catch basin cleaning are nutrients, BOD, TSS, metals and other pollutants sorbed to particulate matter, and oil and grease in catch basins with a baffle or siphon device.

Between 2007 and 2009 WASA performed a pilot project to document the gross amount of pollutants removed during catch basin cleaning and to optimize the frequency of catch basin cleaning to maximize the removal of pollutants of concern. Based on the evaluation of the pilot program, including a cost-benefit analysis, the recommended cleaning methods and frequency will be expanded into the Anacostia MS4 area. For purposes of our load reduction model we assume 25% annual catch basin cleaning in the Anacostia watershed over the long-term (30 years).

Street Sweeping

Street sweeping has also been identified as one of the most cost-effective methods of removing particulate debris from streets and roadways. Street sweeping with high efficiency sweepers that are able to collect particulate and fine material is especially effective for removal of TSS and other pollutants, such as metals that are commonly attached or collocated with organic and particulate material.

Street sweeping removes particulate pollutants from District roadways before they are introduced to the MS4 by runoff events. It has been documented that the removal of fine particulate will also remove many pollutants including metals that are associated with particulates (Schueler and Holland, 2000).

A regenerative air street sweeper

Traditionally, street sweeping has focused on removal of litter, leaves, and other large, visible trash. The benefit of street sweeping for removal of pollutants of concern in the MS4 system is the collection and disposal of fine particulate matter that is hardly noticeable by visual inspection. Improved collection of the fine particulates in street sweeping activities is the focus of this component of the implementation plan.

Compared with traditional mechanical street sweepers, modern regenerative air and high efficiency vacuum assisted sweepers can remove up to 60 percent and 35 percent more TSS and nitrogen, respectively (Sutherland, 2004). Heavy metals (copper, lead, and zinc) are also removed more effectively. The use of vacuum assisted and/or regenerative air sweepers greatly increases the removal efficiency of the fine particulate matter and the particulate pollutants and pollutants that may bind to particulate matter.

The District Department of Public works currently cleans all streets several times a year. The mechanical street sweeping program currently operates from March to November. The District, through funding made available from the Stormwater Enterprise Fund, has already initiated a program to accelerate the purchase of high-efficiency street sweepers. This program will result in improved pollutant removal from street sweeping throughout the District and in the Anacostia watershed. In addition, DPW has recently completed a study of all regularly scheduled and signed street sweeping routes. The results of this study suggest that through improved route efficiency, on existing signed routes, DPW can expand mechanical sweeping, so called environmental sweeping, to other parts of the District. For the Anacostia WIP load reduction model, we use a street sweeping scenario that assumes 20% of the streets in the MS4 areas of the Anacostia will be swept.

Erosion and Sediment Control

Erosion and Sediment Control comes in two forms – strict regulations and inspection and enforcement. The District already has strong erosion and sediment control regulations in place – requiring that and land disturbance over 50 square feet apply for an erosion and sediment control permit. In comparison, other jurisdictions require these permits be filed when more than 5,000 square feet of soil are disturbed. Furthermore, the DDOE has published the District of Columbia Soil Erosion and Sediment Control Standards and Specifications and the DC Storm Water Management Guidebook. These documents are used by DDOE in the plan review process for new construction.

Failing silt fencing at a construction site

Federal facilities within the District are required to comply with District regulations under the Soil Erosion and Sediment Control Act. The US General Services Administration (GSA) and DDOE signed a consent agreement in fiscal year (FY) 2000 that requires work under contracts through GSA to comply with the same sediment and erosion control requirements as commercial, residential, and industrial operations in the District. In the same year, DDOT and WASA signed agreements, in an MOU between District agencies, requiring their contractors to comply with the same sediment and erosion control requirements as commercial, residential, and industrial operations in the District.

The District also has a strong inspection and enforcement branch that inspects construction sites throughout the District to make sure they are incompliance with District regulations. The need for expanded inspection and enforcement will be continually evaluated. DDOE also regularly inspects existing stormwater management facilities to ensure that they are in proper working order. Although the District will continue to vigorously enforce erosion and sediment control regulations, we are not including erosion and sediment control enforcement in our modeling.

Illicit Discharge and Industrial Facility Inspection and Enforcement

The District has already evaluated and expanded inspection and enforcement activities industrial facilities. The District will continue to evaluate and expand other inspection and enforcement activities to ensure compliance with District regulations and to minimize pollutant discharges to the Anacostia watershed from these sources. The District has mapped MS4 and CSO outfalls and is inspecting each outfall for dry weather flow and conducting field evaluation of any flows observed.

The expanded inspection program will result in the identification of a number of sites or facilities that are sources of pollution to the MS4 program. Owners of the sites or facilities will be required voluntarily or through enforcement actions to correct these sources of pollution. After a source of pollution is corrected, there is no further cost, and with the pollutant source removed, the benefit is continuous and cumulative each year. Removing polluting sources can collectively represent significant progress toward TMDL compliance.

An outfall discharging during dry weather

Inspectors routinely visit auto service shops, dry cleaners, and car washes in the District to ensure compliance with Water Pollution Control Act regulations. Witnessing Water Pollution Control Act violations during an inspection, however, is rare. For this reason, education and outreach is an important component of this program. Inspectors work closely with these businesses to develop better housekeeping practices and ensure compliance with existing regulations (See Appendix B for examples of educational materials).

The District's illicit discharge elimination program will be evaluated to identify potential improvements using the Center for Watershed Protection Guidance Manual for Illicit Discharge Detection and Elimination. This manual considers eight major components for developing an effective illicit discharge detection and elimination program. The eight major components are:

1. Audit existing city resources and programs
2. Establish responsibility, authority, and tracking
3. Complete a desktop assessment of illicit discharge
4. Develop program goals and implement strategies
5. Search for illicit discharge problems in the field
6. Isolate and correct discharges
7. Prevent illicit discharges
8. Evaluate the program.

After completing the evaluation of the illicit discharge elimination program, resources will be directed toward increased inspection and enforcement activities as necessary to reduce pollutant loading and towards compliance with the WLA in the TMDL documents. Although the District will continue to inspect illicit discharges, we do not include this best management practice in our load reduction model.

Public Roads and Alleyways

The District Department of Transportation (DDOT) is responsible for maintaining streets, roads, alleyways and sidewalks in the city. DDOT has begun to adopt the use of Low Impact Development (LID) strategies to control stormwater and stormwater pollution. The city is currently demonstrating many types of LID including:

- Infiltration tree box planters – tree boxes that accept runoff from sidewalks and roadways to treat the stormwater and provide water for the trees.
- Silva Cells, structural soils, and other tree root expansion techniques – These tools help expand the space available for the growth of tree roots which allows for a larger and healthier tree and the greater potential for the uptake of stormwater and stormwater pollutants.
- Bioretention – This can take the form of standard bioretention cells or bump outs into the street that are generally placed near intersections. These bump outs provide a safer crossing area for pedestrians by reducing the street area that they have to cross; they slow traffic by narrowing the road; and they accept runoff and treat stormwater pollution.
- Permeable pavements – Permeable pavements take many forms including paving stones, porous concrete, and porous asphalt. The District is testing different permeable pavements in different applications such as alleyways, sidewalks, and roadways to determine which are appropriate and cost effective.

A Silva Cell being installed

DDOT is also working to reduce pollutants to the city's waterways by encouraging commuters to use alternative forms of transportation. DDOT is expanding the number of bike lanes in the city, installing bike-share racks, creating trolley and high speed bus lanes, and operating lower polluting hybrid and natural gas powered busses for its "Circulator" routes.

For purposes of our load reduction model we propose that the public right of way will be retrofitted with LID at a rate consistent with the "aggressive" assumptions of Green Build-Out Model (GBOM) – a model of the potential LID practices to control stormwater in the District of Columbia that was funded by the EPA and created by LimnoTech. The GBOM "aggressive" model assumes that 50 percent of all potential sites will have bump outs installed and 10 percent will install infiltration tree boxes.

Catch Basin Inserts and Screens and Water Quality Catch Basins

Catch basin inserts are devices designed to remove oil and grease, trash, debris, and sediment can improve the efficiency of catch basins. Some inserts are designed to drop directly into existing catch basins, while others may require retrofit construction. Catch basin inlet screens are placed at the mouth of a catch basin and are effective at collecting trash and debris, but less effective at removing oil, grease and sediment. DDOE in partnership with the Department of Public Works and Department of Transportation is currently piloting the use of

A catch basin insert with collected pollutants

catch basin inserts and screens to reduce trash and pollutant loads to our local waterways.

Water quality catch basins are three-chambered catch basins specifically designed to reduce trash, collect sediment and trap oil, grease, and other metals and organics. The District Water and Sewer Authority and the District Department of Transportation currently retrofit existing catch basins with water quality catch basins whenever major road or sewer work is undertaken. For purposes of our load reduction model we assume that 20 percent of the watershed will be retrofitted with water quality catch basins and 20 percent of the Anacostia will be fitted with catch basin inserts over the long-term (30 years).

Leaf Collection

DPW conducts curbside vacuum collection of leaves from residences in the District. Residents are mailed a flyer prior to leaf collection, and DPW leaf vacuum trucks make a minimum of two passes per year on each District street. The collection of leaf litter helps keep catch basins from clogging which allows them to work efficiently to remove solids and pollutants. Leaf litter collection also collects some pollutants. Primary pollutants of concern removed during leaf collection are nutrients, TSS, metals and other pollutants sorbed to particulate matter. Due to lack of reduction information, leaf collection was not modeled for load reductions.

RiverSmart Homes Program

Over the past three years DDOE has slowly developed and matured an LID retrofit program aimed at single family homes. The program started with eight demonstration sites – one in each Ward of the city. It then expanded to a pilot program in the Pope Branch watershed of the city. The program is now mature and open city-wide.

A rain barrel at a RiverSmart Homes site

Through this program, DDOE performs audits of homeowner's properties and provides feedback to the homeowners on what LID technologies can be safely installed on the property. The city also offers up to $1,600 to the homeowner to help cover the cost of installation of any LID the homeowner chooses. Currently the program offers five different landscaping items including shade trees, native landscaping to replace grass, rain gardens, rain barrels and permeable pavement.

The District has recognized the importance of targeting homeowners for pollution reduction measures because the residential property is the largest single land use in the city and is the slowest of all construction areas to be redeveloped. RiverSmart homes is an important tool in our Anacostia restoration efforts and we include the BMPs installed through this program reduction model in the bioretention category. We assume that 50 percent of the households in the MS4 portion of the Anacostia watershed will participate in the RiverSmart Homes program over the long term (30 years).

Rain Leader Disconnect Program

A disconnected downspout

Under old construction codes in the District, new or reconstructed houses were required to connect the rain leaders from rooftop drainage to the Combined Sewer System (CSS) or into the street, which then drains to local waterways. The District has revised the District's Construction Codes Supplement to encourage downspout disconnection where feasible and infiltrate runoff before it enters the storm sewer system. Furthermore the city has revised its codes to allow this work to be done by anyone – not just licensed plumbers as was previously required.

DDOE has begun a pilot program to encourage downspout disconnection by a) paying homeowners to do the work themselves and/or b) paying non-profit organizations to disconnect the downspouts of interested property owners. This pilot program is based on a highly successful downspout disconnection incentive program by the city of Portland, Oregon. Rain leader disconnection has been shown to be one of the most cost effective methods for reducing stormwater thereby reducing TSS and other pollutants such as metals and organics that are commonly attached or collocated particulate material. Although this new program is an important tool for reducing pollutants to the Anacostia, we do not include it in our load reduction model.

Green Roof Retrofit Program

For the last two years the District has offered a rebate for installation of a new green roof or the retrofit of an existing roof. This program, offered through DDOE, provides $5 a square foot for the installation of a green roof on a new structure less than 5,000 square feet in size and $5 a square foot for the retrofit of a green roof on older roofs of any size (no maximum dollar limit).

Additionally the city has been aggressively retrofitting their existing rooftops with green roofs and installing vegetated roofs on new city-owned buildings. As a result of this push, Washington, DC is second only to Chicago in the square footage of green roofs installed. We envision that the city will continue this trend and we have adopted the assumptions of the "aggressive" GBOM model for our long term pollutant load reduction. GBOM calls for green roofs on 50 percent of rooftops with over 2,000 square feet to have green roofs. For modeling purposes this translates to 6 percent of the area in the Anacostia watershed installing green roofs over the next 30 years.

Permeable Pavement

As noted earlier, the District is testing different permeable pavements in to determine which are appropriate and cost effective for the public right of way. In addition to the use of permeable pavement in roads, alleys, and sidewalks, this technology has promise in commercial parking lot applications. Our model adopts the "aggressive" assumptions proposed in the Green Build Out Model of a 90 percent adoption rate for this technology in parking lots. We predict a high rate of acceptance for this land use partly because of the new storm water fee that has gone into effect in the last year. Previously parking lots did not pay a stormwater fee because the fee was assessed as a part of water use. Now the stormwater fee has been tied to impervious cover – something that greatly impacts parking lots. In the coming years property owners that undertake retrofits to reduce impervious surfaces will be able to reduce their stormwater fee by up to 50 percent. For modeling purposes this translates to 5 percent of the area in the Anacostia watershed installing green roofs over the next 30 years.

A pervious paver patio

Education of Public on Pet Wastes/Enforcement of Pet Waste Regulations

DDOE has developed educational materials such as fliers and videos that inform citizens of their legal obligations to manage pet waste, proper application and disposal of fertilizers, and the use of landscaping to control storm water runoff. These materials are regularly distributed at public events such as community meetings, Earth Day celebrations, and community cleanup days. Furthermore this information is distributed door to door in communities where storm drain marking is taking place. Finally this information is available on the DDOE website.

The District has also begun installing dog parks in communities throughout the city. These dog parks are placed and designed to reduce the impact of pets on the environment while allowing dogs to play and exercise. Dog parks reduce TSS, nitrogen, phosphorous, and fecal coliform flowing to the Anacostia through their design and by the concentrating the impact of dogs in one area. Finally dog parks increase the compliance with pet waste regulations through peer pressure from other dog owners.

Although education is important, enforcement of existing laws can be a stronger tool for reducing pet borne fecal coliform. Currently enforcement of pet waste and leash laws has been lax. Through this Watershed Implementation Plan enforcement efforts will be stepped up. Although pet waste education and enforcement is an important pollution prevention strategy for the District, we do not include it in our load reduction model.

Household Hazardous Waste Collection and Disposal

In the past, the District promoted the collection and disposal of household hazardous waste through twice annual collection days when residents may bring hazardous wastes for proper disposal. In the past year, DPW stepped up the household hazardous waste program and now residents can drop their hazardous wastes off at the Fort Totten waste transfer station any Saturday. The frequent and convenient collection of household hazardous waste is a low-cost and effective way to reduce organics and metals into the Anacostia and its tributaries. The collection of household hazardous waste was not modeled for pollutant load reductions.

Integrated Pest Management and Nutrient Management

DDOE has developed an education and outreach program on Integrated Pest Management (IPM) and Nutrient Management. The purpose of the program is to better inform the public on the proper use and disposal of pesticides and on the use of safer alternatives. The program provides education and outreach activities designed to property owners and managers about environmentally sound practices with regard to the use of pesticides in the yard or garden and the introduction of "good" pests into the landscape. Through DDOE's Nutrient Management Program, the property owners receive education regarding the proper amount of fertilizer to use on a lawn. In addition to fertilizer use, this program addresses the proper way to mow, use of mulch, and the effects of applying too much mulch.

This management area focuses on the control of storm water pollutants originating from the use of pesticides, herbicides, and fertilizers within the District. Emphasis is placed on educational and training programs provided for both District property managers and private residents.

Furthermore the DDOE Pesticide Management Program trains commercial applicators in the legal and safe appliance of pesticides and herbicides. Commercial applicators must receive a certification through the program to legally apply pesticides and herbicides in the District. A part of this program involves the use of IPM.

The District Department of Real Estate Services has committed to utilize IPM and nutrient management on their properties and other District and Federal agencies are exploring similar efforts. IPM was not modeled for pollutant load reductions.

Tree Planting

The District of Columbia has been called "The City of Trees." It has a tree canopy cover of 35 percent, which is high for a dense urban environment. The Urban Forestry Administration (UFA) maintains the city's street trees pruning and planting to manage trees in a harsh environment of power and sewer lines, impervious surfaces, road salt, and punishing summer heat. UFA plants an average of 4,150 trees annually, maintains the thousands of existing city trees, and works to improve growing conditions for street trees by removing unneeded impervious areas, experimenting with new tree box technology such as structural soils and Silva cells, and watering trees and pruning trees.


A river birch being planted

In addition, DDOE with help from non-profit partners such as Casey Trees and Washington Parks and People help plant trees on private, federal, and other District lands. Casey Trees, a non-profit dedicated solely to expanding and caring for the District's tree canopy is an especially important partner. Casey runs community tree planting programs, a tree rebate program, and plants trees for RiverSmart Homes. Additionally Casey leads classes in the identification and care of trees and performs monitoring and modeling of canopy cover.

In 2009 the District committed to expand its canopy cover over the next 30 years. For the purposes of this WIP, we have adopted the assumptions of the "aggressive" GBOM model for our long term pollutant load reduction. GBOM calls for a 50 percent canopy cover in 30 years which will mean an approximate 15 percent increase in the Anacostia watershed. We assume that most of this tree planting will occur in areas outside of national park lands.

Public Outreach and Education

Public outreach is a community involvement program that focuses on informing the public about MS4 pollution issues and provides citizens with the tools and ideas to help eliminate the cause of pollution. Source control of pollutants of concern through public outreach is important to the success of this plan.


A rain garden demonstration site at a recreation center

The goals of the public outreach program are to mobilize the community and increase public awareness of storm water pollution issues and to stop or prevent pollution where it occurs. Public outreach may include education, training, and promotion of volunteer activities, as well as private and community projects to reduce pollutants of concern in the Anacostia. Projects include pet waste control, reduction of fertilizer and pesticide application, hotline reporting of dumping, proper use and care of trash receptacles and dumpsters, and pollution prevention through public awareness such as storm drain marking and school programs.

The major benefit of public outreach is to prevent pollutants from being discarded or deposited to the ground and entering the Anacostia River. By educating the public on methods to reduce the generation of pollutants, public participation can reduce the quantity of oil and grease, bacteria, BOD, pesticides, fertilizers, and other pollutants introduced into the MS4. Public outreach is a major component of the District's efforts to control the source of pollutants towards compliance with the TMDL for the Anacostia and its tributaries.

The District's public education efforts entail a mixture of programs emphasizing the city web sites, education and outreach activities, household hazardous waste collection events, the pesticide, fertilizer and pet waste programs, industrial and construction site operator's programs, and cooperative programs with other agencies. Many of these programs are both pollution control activities and public outreach opportunities.

Furthermore DDOE has developed several outreach programs targeted to teachers, environmental educators and students throughout the District. These programs are:

- **Environmental Education Resource Center** – This center provides resources and materials that teachers and other environmental educators may use to enhance the classroom curriculum and implement conservation projects.
- **Conservation Education (Project Learning, Project Water Education for Teachers, Project WILD)** – These internationally recognized programs are utilized to train educators in innovative techniques for exploring a wide range of environmental concepts with students and teaching critical thinking skills that lead to environmental stewardship (grades K-12).
- **Teacher Training Workshops** – These workshops assist teachers in meeting their teaching and learning standards while helping students develop environmental ethics and responsible stewardship.
- **RiverSmart Schools** – RiverSmart schools works with applicant schools to install Low Impact Development (LID) practices to control stormwater. These practices are specially designed to be functional as well as educational in order to fit with the school environment. Additionally schools that take part in the RiverSmart Schools program receive teacher and site manager training on how to use the sites to teach to curriculum standards and how to properly maintain the site.
- **The District of Columbia Environmental Education Consortium** – DDOE helps to organize a network of environmental educators throughout the city so that ideas and resources can be shared among them. DCEEC provides opportunities for networking, event coordination and program partnering among its members. They also facilitate professional development and educational opportunities that support required learning standards. The members provide environmental expertise, professional development opportunities, curricula and resources, and hands-on classroom and field studies to District schools.
- **Aquatic Resources Education Center (AREC) -** Located in Anacostia Park, AREC has a variety of live exhibits of fish and other aquatic species from local rivers and surrounding environment. This unique partnership between the National Park Service, the Fish and Wildlife Service and

DDOE affords school groups, teachers, and District residents to learn about the Aquatic Resources in the District. Stewardship of natural resources is a key component of the AREC curriculum.

DDOE also performs outreach to industrial and construction facilities through workshops, brochures, and site inspections. DDOE personnel use inspections to promote awareness of the proper methods of facility maintenance for stormwater regulation compliance. To aid facilities in ensuring proper maintenance of storm water management facilities, DDOE has established and published guidelines for their proper maintenance.

Coal Tar Ban

The Anacostia has TMDLs for several types of organic chemicals including two classes of polycyclic aromatic hydrocarbons (PAHs) with a total reduction of 98% required. One major source of PAHs throughout the watershed is coal-tar based pavement sealants. Coal-tar based pavement sealants have PAH concentrations that are 1,000 times greater than alternative asphalt-based sealants. Coal-tar sealants are applied to asphalt and pavement surfaces ostensibly to extend the life of that surface. The sealant, however, flakes off with ware and is washed away by stormwater or otherwise mobilized by winds. To address this issue the DC Council passed Comprehensive Stormwater Enhancement Amendment Act of 2008 that bans the sale and use of coal-tar based sealants within the District of Columbia. DDOE has mailed informational fliers about the ban to all District business that may sell these products and local and regional contractors who may use it. DDOE is in the process of hiring a full time inspector to augment the enforcement staff and focus on the coal tar ban.

District of Columbia Bag Bill

The Anacostia now has a TMDL for trash and one major component of trash in the river is plastic bags. In an attempt to abate the amount of plastic bags reaching the District's waterways the District Council passed the "Anacostia River Clean Up and Protection Act of 2009" which levies a 5 cent fee on each disposable paper and plastic bag sold at any business that sells food. The retailer retains 1 cent for administration and transfers the remaining 4 cents a restoration fund which is administered by DDOE. These funds are meant to pay for restoration activities in impaired watersheds in the District. Although the law has only been in effect since January 1, 2010, some businesses have reported over a 50% decline in the sale of disposable bags.

Bag bill educational material

Specific Projects

In the development of this Watershed Implementation Plan, DDOE worked through the Anacostia Watershed Restoration Partnership (AWRP) to contract with the Army Corps of Engineers and the Louis Berger Group to perform project inventories for the Anacostia River and its tributaries. The contractor spent the equivalent of several months in the field searching for appropriate locations for the installation of Low Impact Development practices to reduce stormwater pollution to the Anacostia River. Due to the large size of the Anacostia watershed and the time available for this effort, Louis Berger's effort concentrated on LID in the public space and in highly visible private property locations. Some additional projects on private property were added when the size of the property or its proximity to the Anacostia elevated its importance. Inventories of the identified projects are found in Appendices C through I of this document and online at www.anacostia.net. The majority of these projects focus on three major pollution reducing practices: low impact development installation, stream restoration, and reforestation. In addition, other projects that benefit fish and wildlife were identified. These projects include removal of barriers to fish passage, the purchase of land for parkland, trash reduction projects, and the installation or rehabilitation of wetlands.

Many of the projects identified in these inventories will be among the first projects installed through the WIP effort, however not all the projects identified will be installed in the coming years. Some projects will be found to be infeasible due to costs or unseen barriers to installation such as buried infrastructure or unwilling land owners. In short, identifying restoration projects will be an iterative process using adaptive management principles. We do not utilize the load reductions from the specific projects identified in the course of our field work in calculating load reductions for the specific watersheds. Instead we calculate the load reductions solely on the identified general management measures and assume that the specific projects are incorporated there to avoid double-counting.

Low Impact Development

Low Impact Development Practices focused on four practices: cistern installation, establishment of bioretention cells, retrofit of vegetated (green) roofs and installation of pervious pavers.

Bioretention

A bioretention cell is a shallow depression with porous soils and planted with plant material. Stormwater runoff is directed into the cell where water pollutants are taken up by the plants, the soil mixture, and the microbes that they contain. Bioretention differs from stormwater ponds in that they are generally smaller, treat a more localized source of stormwater, and are more efficient in their uptake of pollutants.

A green roof on the American Psychological Association building

Green Roofs

Green roofs are rooftops that are partially or entirely covered by vegetation. There are two types of green roofs: intensive and extensive green roofs. Intensive green roofs are roofs with thick layers of soil or growing media that are able to support deeper rooting plants such as perennials, shrubs and sometimes trees. Intensive roofs are less common than the extensive roofs. Extensive roofs are green roofs with very shallow, light growing media. These types of green roofs support only the most drought tolerant, shallow rooted vegetation. Green roofs extend the life of roofs, conserve energy, and create habitat. Most importantly green roofs reduce stormwater volume and peak flows and capture pollutants.

Cisterns and Rain Barrels

A cistern is a tank or reservoir designed to capture rain water, generally from roof tops. A rain barrel is a small cistern, generally between 60 and 120 gallons in size. Cisterns and rain barrels allow for the capture and reuse of rainwater for landscaping, toilet flushing, or other non-potable use. Because cisterns capture water for later use, they function much like green roofs in that they reduce stormwater volume and peak flows and capture first flush pollutants.

Permeable Pavement

Permeable pavements take many forms including paving stones, porous concrete, and porous asphalt. These pavements are underlain by varying depths of compacted crushed stone. The crushed stone provides void space for rain water to filter down and eventually infiltrate into the soil while also creating a stable base for the paving stones. The depth of the crushed stone base will vary depending on the amount of stormwater the permeable pavement system will receive as well as the weight of the vehicles it must support and the frequency of the pavement's use.

The AWRP's study identified 290 individual LID projects in the Anacostia watershed. All told, these projects could treat 1,328 acres of the watershed where there are currently no stormwater controls; this amount to about five percent of the District's portion of the Anacostia watershed. The cost of implementing these projects is estimated at approximately $152,000,000. Appendix A includes a map of the LID projects that we identified in the AWRP survey and Appendices C through I provide details about each individual project.

A regenerative stormwater conveyance just after installation

Stream Restoration

Stream restoration is the act of modifying the current channel of a stream in an attempt to improve the environmental health and habitat of the waterway. Urban streams face immense pressure from high stormwater flows due to runoff from impervious surfaces. The erosion we see in urban streams is the stream's way of adjusting to accommodate the new (geologically) flow regime it is experiencing. Stream restoration attempts to create a new channel that is in stasis with the flows it experiences.

The District prefers the use of natural channel design techniques that protect stream banks, reduce erosion, and provide habitat for fish and wildlife. These techniques preferred over bank hardening such as the use of rip-rap, gabion baskets, and cement culverts. There are, however cases where high flows, human infrastructure, and threats to safety sometimes limit the use of natural stream channel design. Fortunately, the Anacostia and many of its tributaries are surrounded by large buffers of parkland (by urban standards) that provide space for the regrading of stream banks that is often required. A mixed blessing is the human infrastructure that is present in the Anacostia watershed. The roads, paths, and sewer lines that are present create challenges for stream restoration, but their presence ensures that there is generally easy access to the stream by restoration equipment.

The AWRP identified 16 stream restoration projects at a potential cost of approximately $8,000,000. These projects are comprehensive in nature, given that every stream in the Anacostia is impacted by the affects of high stormwater flows from the impervious surfaces of our densely developed city. Over two miles of stream restoration are documented in this WIP and the LID projects proposed will also help stabilize stream valleys by reducing stormwater flows. Maps of the stream restoration projects and details about each project can be found in Appendices C through I.

Reforestation and Riparian Buffers

Urban trees have many known and quantified benefits. They have recently been touted as valuable tool for carbon sequestration. They are known to improve air quality, to cool their surroundings, to reduce energy consumption, and to provide valuable food and habitat for wildlife. Trees have documented human health benefits as well – from reducing asthma rates to improving mental health.

A riparian buffer planting at the National Zoo

From the standpoint of this plan however, we focus on trees' ability to reduce pollution. Trees reduce topsoil erosion, prevent harmful land pollutants contained in the soil from getting into our waterways, slow down water run-off, and help ensure that our groundwater supplies are continually being replenished. For every 5% of tree cover added to a community, stormwater runoff is reduced by approximately 2% (Coder, 1996). Along with breaking the fall of rainwater, tree roots remove nutrients harmful to water ecology and quality. Trees act as natural pollution filters - keeping particulate matter out of the flow toward the storm sewers and reducing the flow of stormwater.

Trees that make up a healthy riparian buffer also stabilize stream banks – reducing erosion caused by stormwater flows. They also cool streams – reducing the thermal shock streams can experience with stormwater flows. Finally riparian buffers provide valuable habitat to wildlife – especially in urban environments.

The AWRP inventory found 17 sites for tree planting in the Anacostia watershed. Conservatively, we estimate that these sites make up 104 acres of additional tree planting. The cost of planting these areas is estimated at $622,000 dollars. This estimate is likely low as it is based in large scale reforestation with saplings. Tree planting in urban environments often requires planting most costly older trees that can resist mowers, weed-eaters and other human impacts. With these costs, and the additional costs of watering and care for the larger trees, this cost estimate could easily double. Maps of the tree planting project locations and details about each project can be found in Appendices C through I.

Wetland Creation and Rehabilitation

Wetlands provide exceptional habitat and pollution reduction value. They are homes to hundreds of species; play an important role in the breeding lifecycle of some fish, reptiles, amphibians, and insects; and are a vital stopover for migrating birds and bats. Wetlands are sometimes called "nature's sponge" for their abilities both to hold water and prevent flooding and for their ability to sop up pollutants.

A created wetland area

Unfortunately, wetlands and urban areas do not mix well. A combination of development, stream channelization, and flashy stormwater conditions have reduced wetland areas nation-wide by over 50 percent. Wetlands in the District have fared worse. The Anacostia River is thought to have lost approximately 95 of its tidal wetlands. Although more rare than tidal wetlands, there were no doubt a greater number of palustrine and riverine wetlands before many streams were piped and their surrounding lands developed.

In the AWRP assessment, they identified 9 wetlands projects where new wetlands could potentially be installed or existing impacted wetlands could be restored and made more functional. The area of restored wetlands totals 28.5 acres at an estimated cost of $1,425,000. Additionally, a number of the stream restoration project above and several of the LID projects could create additional wetland acres. Maps of the wetland project locations and details about each project can be found in Appendices C through I.

Removal of Barriers to Fish Passage


A barrier to fish passage

Throughout their ranges on the East Coast of the United States, migratory fish stocks are on the decline. Part of the reduction in fish population is due to increased pollution loads in streams and rivers, but part of their decline is due to the loss of habitat. Even if the District is successful in reducing pollutant loads to levels safe for aquatic life, if they do not have access to local streams, they will still face difficulties. Over the past several years many District streams have been opened up to anadromous and catadromous fish. One recent example, the Watts Branch stream restoration project has removed many barriers to fish in the District, yet there are still many opportunities to open additional habitat to fish. In Anacostia Watershed Restoration Partnership inventory, the Army Corps' contractors identified sixteen fish passage projects that could open up more than ten thousand linear feet (2 miles of habitat) to fish. We estimate that the sum total cost of these projects at $5,300,000, however many of these projects could be relatively inexpensive and open up large areas to fish. Maps of the fish passage project locations and details about each project can be found in Appendices C through I.

Trash Removal

Trash removal, although having a minimal impact on pollutant loads, is an excellent activity for involving the public in restoration work and in generating watershed stewards. The inventory identified 24 locations for cleanup projects at a potential cost of $171,000 dollars if performed through contract or staff time. Many of these projects are small and could be easily and safely accomplished by teams of volunteers in one or two days. Some of the projects however, are more extensive involving unstable piles of dumped debris on steep slopes. These projects would require dedicated volunteers working over several weeks or months or trained individuals using machinery. Maps of the trash removal project locations and details about project can be found in Appendices C through I.


Trash collected behind a boom on the Anacostia

Parkland Acquisition

Purchasing land to create parkland aids in providing open space to increase riparian or upland forests and meadows which have lower pollutant loads than developed land. Additionally parkland protects and reduces encroachment upon non-tidal wetlands and improves connectivity of existing habitats and resources. Through the inventory effort, AWRP contractors identified 12 locations where purchasing lands for parkland would have a measurable benefit. These projects would create about 48 acres of new parkland at a cost of about $4,775,000 dollars. Maps of the parkland acquisition project locations and details about project can be found in Appendices C through I.

Expected Load Reductions

Methodology for Calculating Load Reductions

Reductions were calculated for metals, organics, and bacteria using reduction efficiencies as reported in the Anacostia Watershed Total Maximum Daily Load Allocation Implementation Plan written in February 2005 by the District of Columbia Stormwater Administration. The TMDL loads in the District portion of the Anacostia watershed are assigned to the MS4 portion of the watershed.

To calculate load reductions the reduction efficiency for the specific practice is multiplied by the area treated by the specific practice. For example, the reduction efficiency of porous pavement for lead has been estimated at 0.13 pounds per acre treated. In Watts Branch, we assume that over time 90% of all large parking lots will adopt the use of porous pavement, which amounts to a land area of five percent of the watershed, or about 54 acres. So the load reduction calculation for DDT from porous paving looks like this:

0.000126 pounds/acre X 54 acres treated = 0.0068 pound reduction of DDT

We then combined the calculated load reductions of all the management practices to determine the overall load reduction for each watershed. By comparing this number with the required load reduction from the Anacostia TMDLs, we were able to determine if we were able to meet our load reduction goals.

As stated above, investigators identified 290 sites for LID, 16 potential stream restoration projects, 17 areas where tree planting could take place, and 9 possible wetlands restoration efforts. The total treatment area of these projects is about 2,000 acres, or seven percent of the Anacostia watershed. To avoid double counting, the specific projects that we identified are assumed to be a part of the efforts that will be installed though the general management measures. To determine load reductions for the Anacostia and its tributaries we utilized the assumptions outlined in the general management measures section of this document. The management practices were chosen for their cost benefit, ease of implementation, and environmental benefit.

Expected Load Reductions

Using the general management measures described above and applying them to their assumed treatment areas, we were able to achieve the required load reductions for most pollutants for most tributaries. There were some pollutants where the load reductions were not achieved or were not calculated. Most notably, we are uncertain of the load reductions our proposed management measures will have on trash because there are no reliable load reduction estimates for this pollutant. Furthermore, in every subwatershed listed for dieldrin except Fort Stanton, the required load reductions were not achieved. Additionally neither Watts Branch nor the Upper and Lower Anacostia achieved the required load reductions for chlordane. We were unable to achieve the required load reductions for these chemicals without setting the areas treated by the general management measures at unreasonably high levels.

Upper and Lower Anacostia and Kingman Lake

For the purposes of the model we combined the load reductions required for the Upper and Lower Anacostia River. This was necessary because we did not have an accurate delineation of Upper and Lower Anacostia watersheds which made modeling impossible. Furthermore, since Kingman Lake is open to the Anacostia River, we assumed that load reductions achieved in the Anacostia would also benefit Kingman Lake. Combining the three areas together in no way impacts their required load reductions. Table 8 details the suggested scenarios for load reductions in Upper and Lower Anacostia River.

Table 8 - Load Reductions Achieved by Suggested Management Practices in the Anacostia

Management Practice	Bio-retention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Stream Re-storation	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Water-shed	20% of Water-shed	90% of parking lots -5% of Water-shed	15% Increase in areas outside NPS - 50% canopy cover	25% of Water-shed	40% of Water-shed	50% of Roofs Over 2000 Square Feet - 6% of Water-shed	16,850 Linear Feet Restored			
Pollutant	Reductions Expected (lbs/year)										
Arsenic	7.888E+00	4.299E+00	1.101E+00	2.948E+00	3.500E+00	8.282E+00	3.727E-01	N/A	3.242E+01	5.469E+00	2.839E+01
PAH1	2.490E+00	1.030E+00	2.680E-01	7.210E-01	8.310E-01	2.000E+00	1.211E-03	N/A	2.609E+01	2.987E-01	7.341E+00
PAH2	4.272E+01	1.748E+01	4.503E+00	1.213E+01	1.430E+01	3.418E+01	5.364E-03	N/A	9.017E+01	1.786E+00	1.253E+02
PAH3	3.237E+01	1.341E+01	3.418E+00	9.258E+00	1.111E+01	2.590E+01	1.380E-02	N/A	9.017E+01	1.786E+00	9.548E+01
Chlordane	2.542E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.995E-03	1.331E-04	N/A	2.209E-01	2.187E-02	9.959E-03
Heptachlor Epoxide	1.088E-02	4.509E-03	1.154E-03	3.106E-03	3.697E-03	8.703E-03	3.869E-04	N/A	3.658E-02	6.171E-03	3.243E-02
Dieldrin	3.648E-04	1.459E-04	4.075E-05	1.094E-04	1.221E-04	2.918E-04	1.463E-05	N/A	1.684E-02	1.167E-02	1.089E-03
DDD	3.418E-02	1.420E-02	3.615E-03	9.721E-03	1.157E-02	2.734E-02	8.870E-02	N/A	1.401E-01	1.387E-02	1.893E-01
DDE	1.512E-01	6.271E-02	1.604E-02	4.309E-02	5.127E-02	1.209E-01	1.542E+00	N/A	3.422E-01	3.388E-02	1.987E+00
DDT	3.878E-01	1.617E-01	4.141E-02	1.104E-01	1.320E-01	3.102E-01	1.175E+00	N/A	9.163E-01	9.072E-02	2.319E+00
Nitrogen	2.840E+04	1.790E+04	5.100E+03	1.180E+04	3.860E+03	2.920E+04	4.180E+02	3.37E+02	6.681E+04	4.452E+04	9.702E+04
Phosphorous	4.270E+03	1.950E+03	3.940E+02	1.460E+03	1.310E+02	2.730E+03	1.740E+02	5.90E+01	1.097E+04	7.518E+03	1.117E+04
TSS^	1.094E+06	4.520E+05	1.154E+05	3.099E+05	3.706E+05	8.749E+05	3.937E+04	2.14E+01	2.178E+06	1.888E+02	3.256E+06
BOD	6.626E+05	2.915E+05	6.626E+04	1.988E+05	1.988E+05	1.666E+05	2.840E+04	N/A	2.747E+05	1.328E+05	1.613E+06
Bacteria*	1.140E+15	9.649E+13	2.412E+13	6.467E+13	7.608E+13	1.827E+14	7.611E+12	N/A	5.170E+15	5.170E+14	1.592E+15

^Note: TSS Reductions are in tons of sediment

*Note: Bacteria Reductions are in MPN/100 ml

Note: Non-attaining pollutants are indicated in red

Tributaries to the Anacostia

The Anacostia River tributaries have varied water quality impairments. Fort Chaplin, Fort Davis, and Fort Dupont are impaired for arsenic, copper, and lead while the remaining tributaries are impaired by persistent organic chemicals and metals. Watts Branch is the sole tributary listed as impaired for total suspended solids. In the suggested load reduction scenarios for the tributaries to the Anacostia, we balance structural load reduction methods such as bioretention, porous pavement, and green roofs, non-structural techniques such as catch basin cleaning and vacuum sweeping. In all, we utilize seven different methods to optimize load reductions to the tributaries. Tables 9 through 17 demonstrate the suggested scenarios for load reductions in the tributaries to the Anacostia River. Load reductions charts for each general management practice and each watershed can be found in Appendix J.

Table 9 - Load Reductions Achieved by Suggested Management Practices in Fort Chaplin

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Planting	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	4.253E-01	1.766E-01	4.523E-02	9.284E-02	1.438E-01	3.402E-01	1.531E-02	1.266E+00	3.760E-01	1.239E+00
Copper	2.970E+01	1.080E+01	2.835E+00	5.900E+00	8.775E+00	2.376E+01	9.720E-01	4.620E+01	1.829E+01	8.274E+01
Lead	1.350E+01	4.860E+00	1.485E+00	2.795E+00	4.725E+00	1.080E+01	0.000E+00	2.214E+01	7.670E+00	3.816E+01

Table 10 - Load Reductions Achieved by Suggested Management Practices in Fort Davis

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Planting	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	1.103E-01	4.578E-02	1.173E-02	2.407E-02	3.728E-02	8.820E-02	3.969E-03	3.300E-01	9.800E-02	3.213E-01
Copper	7.700E+00	2.800E+00	7.350E-01	1.530E+00	2.275E+00	6.160E+00	2.520E-01	1.184E+01	4.690E+00	2.145E+01
Lead	3.500E+00	1.260E+00	3.850E-01	7.245E-01	1.225E+00	2.800E+00	0.000E+00	5.624E+00	1.949E+00	9.895E+00

Table 11 - Load Reductions Achieved by Suggested Management Practices in Fort Dupont

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Planting	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	7.245E-01	3.008E-01	7.705E-02	1.582E-01	1.543E-03	5.796E-01	2.608E-02	5.560E-01	1.651E-01	1.868E+00
Copper	5.060E+01	1.840E+01	4.830E+00	1.005E+01	1.495E+01	4.048E+01	1.656E+00	1.933E+01	7.654E+00	1.410E+02
Lead	2.300E+01	8.280E+00	2.530E+00	4.761E+00	8.050E+00	1.840E+01	0.000E+00	8.994E+00	3.561E+00	6.502E+01

Table 12 - Load Reductions Achieved by Suggested Management Practices in Fort Stanton

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	2.16E-01	1.177E-01	3.020E-02	8.070E-02	9.590E-02	2.270E-01	1.020E-02	1.699E-01	5.046E-02	7.777E-01
Copper	1.98E+01	7.200E+00	1.890E+00	5.130E+00	5.850E+00	1.440E+01	6.480E-01	6.273E+00	2.484E+00	5.492E+01
Lead	9.00E+00	3.240E+00	9.900E-01	2.430E+00	3.150E+00	7.200E+00	0.000E+00	1.704E-01	6.748E-02	2.601E+01
PAH2	1.17E+00	4.788E-01	1.233E-01	3.321E-01	3.915E-01	9.360E-01	4.223E-02	4.528E-01	8.875E-03	3.474E+00
PAH3	8.87E-01	3.672E-01	9.360E-02	2.535E-01	3.042E-01	7.092E-01	3.218E-02	2.871E-01	5.629E-03	2.646E+00
Chlordane	2.54E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.995E-03	1.331E-04	1.132E-03	1.682E-04	9.959E-03
Heptachlor Epoxide	2.98E-04	1.235E-04	3.159E-05	8.505E-05	1.013E-04	2.383E-04	1.059E-05	7.513E-03	1.841E-05	8.882E-04
Dieldrin	9.99E-06	3.996E-06	1.116E-06	2.997E-06	3.344E-06	7.992E-06	4.007E-07	1.170E-04	2.340E-05	2.984E-05
DDD	9.36E-04	3.888E-04	9.900E-05	2.662E-04	3.168E-04	7.488E-04	3.316E-05	9.440E-04	9.346E-05	2.789E-03
DDE	4.14E-03	1.717E-03	4.392E-04	1.180E-03	1.404E-03	3.312E-03	1.469E-04	1.895E-03	1.486E-04	1.234E-02
DDT	1.06E-02	4.428E-03	1.134E-03	3.024E-03	3.614E-03	8.496E-03	3.780E-04	5.171E-03	1.536E-04	3.169E-02

Table 13 - Load Reductions Achieved by Suggested Management Practices in Hickey Run

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/ year)	Reduction Needed from TMDL Waste Load Allocation (lbs/ year)	Reduction Achieved from Suggested BMPs (lbs/ year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	**Reductions Expected (lbs/year)**									
PAH2	8.450E+00	3.458E+00	8.905E-01	2.399E+00	2.828E+00	6.760E+00	3.050E-01	2.372E+01	4.649E-01	2.509E+01
PAH3	6.403E+00	2.652E+00	6.760E-01	1.831E+00	2.197E+00	5.122E+00	2.324E-01	1.502E+01	3.004E-01	1.911E+01
Chlordane	2.542E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.995E-03	1.331E-04	5.761E-02	8.556E-03	9.959E-03
Heptachlor Epoxide	2.152E-03	8.918E-04	2.282E-04	6.143E-04	7.313E-04	1.721E-03	7.652E-05	7.510E-03	7.435E-04	6.415E-03
Dieldrin	7.215E-05	2.886E-05	8.060E-06	2.165E-05	2.415E-05	5.772E-05	2.894E-06	3.436E-02	6.872E-03	2.155E-04
DDD	6.760E-03	2.808E-03	7.150E-04	1.923E-03	2.288E-03	5.408E-03	2.395E-04	3.261E-02	3.197E-03	2.014E-02
DDE	2.990E-02	1.240E-02	3.172E-03	8.522E-03	1.014E-02	2.392E-02	1.061E-03	8.707E-02	6.896E-03	8.912E-02
DDT	7.670E-02	3.198E-02	8.190E-03	2.184E-02	2.610E-02	6.136E-02	2.730E-03	2.314E-01	6.872E-03	2.289E-01

Note: Non-attaining pollutants are indicated in red

Table 14 - Load Reductions Achieved by Suggested Management Practices in Nash Run

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	6.000E-01	3.000E-01	1.000E-01	2.000E-01	2.000E-01	6.000E-01	0.000E+00	3.462E+00	8.569E-01	2.000E+00
Copper	5.060E+01	1.840E+01	4.800E+00	1.310E+01	1.500E+01	3.680E+01	1.700E+00	1.337E+02	5.293E+01	1.404E+02
Lead	2.300E+01	8.280E+00	2.530E+00	6.210E+00	8.050E+00	1.840E+01	0.000E+00	6.614E+01	1.965E+01	6.647E+01
PAH2	2.990E+00	1.224E+00	3.151E-01	8.487E-01	1.001E+00	2.392E+00	1.079E-01	9.696E+00	1.920E-01	8.879E+00
PAH3	2.266E+00	9.384E-01	2.392E-01	6.479E-01	7.774E-01	1.812E+00	8.225E-02	6.150E+00	1.230E-01	6.763E+00
Chlordane	2.542E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.995E-03	1.331E-04	2.349E-02	3.488E-03	9.959E-03
Heptachlor Epoxide	7.613E-04	3.156E-04	8.073E-05	2.174E-04	2.588E-04	6.090E-04	2.708E-05	3.146E-03	3.115E-04	2.270E-03
Dieldrin	2.553E-05	1.021E-05	2.852E-06	7.659E-06	8.545E-06	2.042E-05	1.024E-06	1.645E-03	3.290E-04	7.625E-05
DDD	2.392E-03	9.936E-04	2.530E-04	6.803E-04	8.096E-04	1.914E-03	8.473E-05	1.404E-02	1.390E-03	7.127E-03
DDE	1.058E-02	4.388E-03	1.122E-03	3.015E-03	3.588E-03	8.464E-03	3.754E-04	3.610E-02	2.859E-03	3.153E-02
DDT	2.714E-02	1.132E-02	2.898E-03	7.728E-03	9.235E-03	2.171E-02	9.660E-04	9.623E-02	2.858E-03	8.100E-02

Note: Non-attaining pollutants are indicated in red

Table 15 - Load Reductions Achieved by Suggested Management Practices in Pope Branch

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	2.980E-01	1.630E-01	4.160E-02	1.110E-01	1.320E-01	3.130E-01	1.410E-02	1.763E+00	5.237E-01	1.073E+00
Copper	2.730E+01	9.940E+00	2.610E+00	7.080E+00	8.080E+00	1.990E+01	8.950E-01	6.483E+01	2.567E+01	7.581E+01
Lead	1.243E+01	4.473E+00	1.367E+00	3.355E+00	4.349E+00	9.940E+00	0.000E+00	3.122E+03	1.082E+01	3.591E+01
PAH2	1.615E+00	6.610E-01	1.702E-01	4.585E-01	5.405E-01	1.292E+00	5.830E-02	4.675E+00	9.166E-02	4.796E+00
PAH3	1.224E+00	5.069E-01	1.292E-01	3.500E-01	4.200E-01	9.791E-01	4.443E-02	2.950E+00	5.900E-02	3.654E+00
Chlordane	2.542E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.616E-03	1.331E-04	1.172E-02	1.740E-03	9.580E-03
Heptachlor Epoxide	4.113E-04	1.705E-04	4.361E-05	1.174E-04	1.398E-04	3.290E-04	1.463E-05	1.962E-03	1.942E-04	1.226E-03
Dieldrin	1.379E-05	5.517E-06	1.541E-06	4.138E-06	4.616E-06	1.103E-05	5.532E-07	1.250E-03	2.500E-04	4.119E-05
DDD	1.292E-03	5.368E-04	1.367E-04	3.675E-04	4.374E-04	1.034E-03	4.577E-05	1.007E-02	7.582E-04	3.850E-03
DDE	5.716E-03	2.371E-03	6.063E-04	1.629E-03	1.938E-03	4.572E-03	2.028E-04	3.610E-02	1.568E-03	1.704E-02
DDT	1.466E-02	6.113E-03	1.566E-03	4.175E-03	4.989E-03	1.173E-02	5.219E-04	5.414E-02	1.608E-03	4.375E-02

Note: Non-attaining pollutants are indicated in red

Table 16 - Load Reductions Achieved by Suggested Management Practices in Texas Avenue

Management Practice	Bioretention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Waste Load from Tributary TMDL (lbs/ year)	Reduction Needed from TMDL Waste Load Allocation (lbs/ year)	Reduction Achieved from Suggested BMPs (lbs/ year)
% Area Treated	50% of Watershed	20% of Watershed	90% of parking lots (5% of Watershed)	15% Increase in areas outside NPS (50% canopy cover)	25% of Watershed	40% of Watershed	50% of Roofs Over 2000 Square Feet (6% of Watershed)			
Pollutant	Reductions Expected (lbs/year)									
Arsenic	1.320E-01	7.190E-02	1.840E-02	4.930E-02	5.860E-02	1.390E-01	6.240E-03	1.341E+00	3.984E-01	4.754E-01
Copper	1.210E+01	4.400E+00	1.160E+00	3.140E+00	3.580E+00	8.800E+00	3.960E-01	4.996E+01	1.978E+01	3.358E+01
Lead	5.500E+00	1.980E+00	6.050E-01	1.485E+00	1.925E+00	4.400E+00	0.000E+00	1.343E+00	4.653E-01	1.590E+01
PAH2	7.150E-01	2.926E-01	7.535E-02	2.030E-01	2.393E-01	5.720E-01	2.581E-02	3.609E+00	7.075E-02	2.123E+00
PAH3	5.418E-01	2.244E-01	5.720E-02	1.549E-01	1.859E-01	4.334E-01	1.967E-02	2.250E+00	4.500E-02	1.617E+00
Chlordane	2.542E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.995E-03	1.331E-04	8.975E-03	1.333E-03	9.959E-03
Heptachlor Epoxide	1.821E-04	7.546E-05	1.931E-05	5.198E-05	6.188E-05	1.456E-04	6.475E-06	1.420E-03	1.406E-04	5.428E-04
Dieldrin	6.105E-06	2.442E-06	6.820E-07	1.832E-06	2.043E-06	4.884E-06	2.449E-07	8.700E-04	1.740E-04	1.823E-05
DDD	5.720E-04	2.376E-04	6.050E-05	1.627E-04	1.936E-04	4.576E-04	2.026E-05	7.059E-03	6.989E-04	1.704E-03
DDE	2.530E-03	1.049E-03	2.684E-04	7.211E-04	8.580E-04	2.024E-03	8.976E-05	1.477E-02	1.170E-03	7.540E-03
DDT	6.490E-03	2.706E-03	6.930E-04	1.848E-03	2.208E-03	5.192E-03	2.310E-04	4.012E-02	1.180E-03	1.937E-02

Note: Non-attaining pollutants are indicated in red

Table 17 - Load Reductions Achieved by Suggested Management Practices in Watts Branch

Management Practice	Bio-retention	Vacuum Sweeping	Porous Pavement	Tree Boxes	Catch Basin Cleaning	Water Quality Catch Basins & Catch Basin Inserts	Green Roofs	Stream Re-storation	Waste Load from Tributary TMDL (lbs/year)	Reduction Needed from TMDL Waste Load Allocation (lbs/year)	Reduction Achieved from Suggested BMPs (lbs/year)
% Area Treated	50% of Water-shed	20% of Water-shed	90% of parking lots - 5% of Water-shed	15% Increase in areas outside NPS - 50% canopy cover	25% of Water-shed	40% of Water-shed	50% of Roofs Over 2000 Square Feet - 6% of Water-shed	9,250 Linear Feet			
Pollutant	Reductions Expected (lbs/year)										
PAH2	7.020E+00	2.873E+00	7.398E-01	1.993E+00	2.349E+00	5.616E+00	2.534E-01	N/A	3.681E+01	7.215E-01	2.084E+01
PAH3	5.319E+00	2.203E+00	5.616E-01	1.521E+00	1.825E+00	4.255E+00	1.931E-01	N/A	2.325E+01	4.650E-01	1.588E+01
Chlordane	2.542E-03	1.553E-03	3.975E-04	1.068E-03	1.271E-03	2.995E-03	1.331E-04	N/A	8.987E-02	1.335E-02	9.959E-03
Heptachlor Epoxide	1.787E-03	7.409E-04	1.895E-04	5.103E-04	6.075E-04	1.430E-03	6.357E-05	N/A	1.231E-02	1.219E-04	5.329E-03
Dieldrin	5.994E-05	2.398E-05	6.696E-06	1.798E-05	2.006E-05	4.795E-05	2.404E-06	N/A	6.565E-03	1.313E-03	1.790E-04
DDD	5.616E-03	2.333E-03	5.940E-04	1.597E-03	1.901E-03	4.493E-03	1.989E-04	N/A	5.556E-02	5.501E-03	1.673E-02
DDE	2.484E-02	1.030E-02	2.635E-03	7.079E-03	8.424E-03	1.987E-02	8.813E-04	N/A	1.387E-01	1.099E-02	7.403E-02
DDT	6.372E-02	2.657E-02	6.804E-03	1.814E-02	2.168E-02	5.098E-02	2.268E-03	N/A	1.853E-02	5.504E-04	1.902E-01
TSS^	1.797E+05	7.427E+04	1.897E+04	5.091E+04	6.090E+04	1.438E+05	6.469E+03	1.18E+01	3.040E+01	1.360E+01	5.350E+05

^Note: TSS Reductions are in tons of sediment
Note: Non-attaining pollutants are indicated in red

Implementation Schedule and Milestones

Implementation Schedule

By analyzing where groupings of potential projects found in the AWRP inventories and adding this data to a list of projects currently underway or about to begin we were able to prioritize watersheds for restoration. Based on this analysis, we broke up Anacostia restoration work into five-year increments, with an average of two watersheds the focus of each five year interval. By prioritizing restoration work by watershed we should be able to better see the results of our work. Furthermore, targeting watersheds will also help us target our monitoring efforts which will allow more money to go towards restoration work.

However because the District Department of the Environment is not a landholder in the City, our implementation schedule relies on the willingness of those that do own or manage land in the city to provide access to install pollution management measures. Moreover, approximately 1/3 of the land in the District is federally controlled, which adds a further burden of coordinating with a second level of bureaucracy. Because of this, and because of the limited financial resources available on an annual basis, it is difficult to lay out an exact implementation schedule. In order to coordinate with, and get buy-in from District landholders and stakeholders, DDOE has laid out a process for performing outreach on this Watershed Implementation Plan (see the section entitled "Strategy for Stakeholder Outreach" for further details).

The District will use the Anacostia WIP, and its WIPs for other watersheds as living documents, constantly being updated as we become aware of new projects from partner agencies and organizations and as timelines for implementation of specific projects becomes clear. Based on the feedback from stakeholders and landholders, we will update the WIP and begin lining up agreements with landholders so that we can commence restoration work as soon as funding becomes available.

The five year increments in this implementation schedule mesh closely with the EPA Chesapeake Bay Program and District MS4 permit timelines. Using the WIP schedule we have created load reduction targets that will allow us to review our progress towards meeting our targets and adjust our implementation plan accordingly.

Milestones

The District will use the number of watersheds attaining water quality standards and the percent of the Anacostia attaining water quality standards as milestones for marking its progress towards delisting the Anacostia watershed (see Table 18). The total restoration effort is estimated to take 30 years with the highest percent of work taking place ten to twenty years from the writing of this plan.

In order to ensure that these milestones are being reached, the District will use its current monitoring efforts combined with enhanced monitoring to show load reductions (see the Monitoring section for more information). Focusing restoration efforts at a sub-watershed scale will allow DDOE to efficiently show load reductions in a cost-effective fashion.

Table 18 - Milestones for Achieving Water Quality Standards

Timeframe (years)	Sub-Watersheds Attaining Water Quality Standards	Locations of Load Reduction Data	Percent of the Anacostia Watershed Attaining Water Quality Standards (Cumulative Percent in Parentheses)	Notes:
0-5 Years	Fort Dupont Pope Branch	Tables 11 and 15	7.5 Percent	Fort Dupont – Several LID retrofits in place. Pope Branch – Stream restoration work to begin 2012.
5-10 Years	Fort Chaplin Fort Davis Nash Run	Tables 9, 10, and 14	8.5 Percent (16.0 Percent)	Forts Chaplin and Davis – small sewersheds where a focus on LID could be effective in short term. Nash Run – Stream restoration in planning stage.
10-15 Years	Watts Branch (Upper and Lower)	Table 17	11.4 Percent (27.4 Percent)	Watts Branch – a great deal of LID has already been installed here and stream restoration work is to be completed in 2011. May be delisted for TSS sooner.
15-20 Years	Hickey Run	Table 13	13.7 Percent (41.1 Percent)	Hickey Run – stream restoration for a tributary of Hickey Run in planning stage. Large stormwater BMP to be completed in 2011.
20-25 Years	Fort Stanton Texas Avenue	Tables 12 and 16	3.1 Percent (44.2 Percent)	Fort Stanton and Texas Avenue – a focus on LID could be effective here. Potential for regenerative stormwater conveyances.
25-30 Years	Upper Anacostia Lower Anacostia	Table 8	55.8 Percent (100 Percent)	Although a great deal of the watershed is NPS land, persistent legacy chemicals will take years to clean up.

Financial and Technical Resources Needed for Management Measures

Financial Assistance Needs

The total cost of implementing the specific project identified in this WIP over an anticipated 30-year timeframe is $172,293,000. This amounts to $5,743,100 per year, not adjusted for inflation. Additionally, the estimated total cost for implementing the general management measures identified in this WIP is estimated to be $236,175,000 which amounts to approximately $7,873,000 annually. It should be noted that these numbers are for installation of the recommended practices, and do not include the cost of their maintenance and upkeep over time. The budget for reducing stormwater pollution throughout the District of Columbia annually is approximately $13,000,000. These funds come from stormwater fees collected for the administration of the MS4 program, an annual grant from the EPA Chesapeake Bay Program, an annual grant from the EPA Non-point Source Pollution Program, and District budget appropriations. These funds are spread to activities throughout the District – not just in the Anacostia watershed. When allocated by percent land area in the Anacostia, the annual budget is approximately equivalent to the estimated need for restoration activities. However, in reality not all funds are used directly on projects. Instead a proportion of these funds are used for their administration, which would lead to an annual shortfall in funds.

Table 19: Cost of Implementing Specific Restoration Projects

Specific Restoration Project Type	Cost of Implementation
LID Installation	$152,000,000
Tree Planting	$622,000
Stream Restoration (linear feet)	$8,000,000
Wetland Restoration	$1,425,000
Trash Removal	$171,000
Fish Passage Installation	$5,300,000
Parkland Acquisition	$4,775,000
Total Cost	**$172,293,000**

In order to restore the Anacostia River in a timely fashion, additional funds will need to be found. Some potential sources of additional funds have been identified. These include:

- Increasing the stormwater fee that District residents pay for the administration of the MS4 permit;
- Increasing the CSS fee that DCWASA charges to implement the LTCP;
- Allocating funds from the recently implemented fee on shopping bags; and
- Being more efficient with funds by such practices as combining projects as other infrastructure work.

Table 20: Cost of Implementing General Management Measures by Watershed

Watershed	Cost
Tidal Anacostia	$ 144,804,915
Fort Chaplin	$ 5,717,590
Fort Davis	$ 1,482,338
Fort Dupont	$ 9,741,080
Fort Stanton	$ 3,965,447
Hickey Run	$ 28,639,341
Nash Run	$ 10,133,920
Pope Branch	$ 5,474,520
Texas Avenue	$ 2,423,328
Watts Branch	$ 23,792,683
Total Cost	**$236,175,162**

Despite any additional funds that the District is able to dedicate to the restoration of the Anacostia, there will still be a need for additional support from the federal government. The District of Columbia is unique in that 1/3 of its lands are held by the federal government. This effectively reduces city revenues because the federal government does not pay taxes and occupies valuable lands that could generate revenue for the city. The federal government provides annual appropriation to the District, but it is difficult to budget for these funds because appropriation is not automatic.

Technical Assistance Needs

In addition to further funding, as a local government, we are in need of additional technical resources. Although we have a strong and knowledgeable staff, we are still a small staff that is required to fulfill the obligations of both a state and local agency. One particular area where we are in need of resources is in monitoring our local waterways. The District could use additional resources to perform TMDL compliance monitoring – from securing monitoring equipment, to taking samples, to performing the analysis and reporting on the samples collected.

A second area where the District requires technical assistance is working with federal landholders. A number of the proposed projects are located on federal lands. To date most of these landholders have been reticent to allow the District access to their lands to treat stormwater pollution. The District could use the weight of a federal agency supporting our efforts and negotiating on our behalf with the major federal landholders – the National Park Service, the military services, the Government Services Administration, and the Architect of the Capitol.

Outreach, Education and Public Participation

Strategy for Stakeholder Outreach

The District Department of the Environment is not a landholder in the city. It relies on the willingness of those that do own or manage land in the city to provide access to install pollution management measures. Moreover, approximately 1/3 of the land in the District is federally controlled, which requires an additional burden of coordinating with a second level of bureaucracy. In order to achieve the load reductions presented in this document, DDOE will need the interest and support of District landowners and other stakeholders.

DDOE recognizes the importance of performing outreach to Anacostia River stakeholders to educate them about water pollution issues and to engage them in the adopting pollution reduction activities on their land. DDOE WPD has already developed a number of outreach and education activities and incentive programs aimed District landowners (see the General Management Measures Section of this document), however, in coordination with its Stormwater Management Division, the WPD will be revising its outreach strategy and developing new outreach programs in the coming months. The DDOE is undertaking the development of a new outreach strategy as a condition for its MS4 permit and to meet Watershed Implementation Plan requirements.

The District Department of the Environment has already identified many key stakeholder organizations that are currently involved in activities to help restore the Anacostia. In order to better identify and prioritize restoration efforts, DDOE will distribute this draft WIP to the following stakeholders for review and comments (see Stakeholder Outreach Task List Timeline Table 21). It is hoped that these stakeholders will identify additional specific and general projects to achieve further pollutant load reductions in the Anacostia. Once comments have been received they will be evaluated and incorporated into this document, as appropriate.

Table 21 - Stakeholder Outreach Task List and Timeline

Task	Completion Date	Notes
Create Master Project List	September 30, 2011	Master project list will include prioritized projects from the Anacostia and other watersheds.
Divide Master Project List by landowner and stakeholder	October 30, 2011	
Meet with MS4 permit partners and provide them with their customized Master Project List	November 2011	MS4 permit partners have an interest in identifying and working to install pollution reducing projects.
Meet with the Anacostia Watershed Partnership to present the Anacostia Watershed Implementation Plan	November 2011	Many of the projects identified in this plan come from AWRP efforts. DDOE's WIP reorganizes and prioritizes this plan differently than their vision.
Meet with the National Park Service and provide them with their customized Master Project List	December 2011	The NPS is a vital partner because much of their land is impacted by Anacostia's uncontrolled stormwater.
Meet with non-profits to seek buy-in and feedback	February 2012	
Meet with ANCs and Civic/Community Associations to seek buy-in and feedback	June 30, 2012	This will be a large undertaking because of the large number of ANCs and the need to divide projects identified geographically
Collect new projects, project priorities, and other feedback from landowners and stakeholders	Ongoing	
Update Master Project List based on the feedback from landowners and stakeholders	Ongoing	The Master Project List will be continuously updated as new projects come up and old projects are completed.

Stakeholders

EPA Chesapeake Bay Program

The District Department of the Environment's goals for the Anacostia are closely aligned with those of the Chesapeake Bay Program. The Anacostia River is one of four "priority urban waterways" identified by the Bay Program for special restoration attention. Additionally, Anacostia restoration efforts will support the agreement's goals of: "Living Resource Protection and Restoration" for fish passage; "Water Quality Protection and Restoration" through reduction of nutrient and sediment loads and for the protection of priority urban waters; and "Sound Land Use" by helping to promote stewardship of natural resources through public education and community engagement.

The Chesapeake Bay is listed as impaired for nitrogen, phosphorous, sediment. The Anacostia is listed as impaired for nitrogen, phosphorus, and total suspended solids in District portion of the watershed. As the EPA moves to enforce the Chesapeake Bay TMDL it is expected that load reductions for nitrogen, phosphorus and TSS will be assigned to the its tributaries which may mean additional required reductions for the Anacostia.

The Chesapeake Bay Program has moved to utilizing specific two-year restoration actions with five and ten year load reduction targets. It is expected that the activities laid out in this WIP will inform the specific restoration actions and the more long-term load reduction targets.

District Department of the Environment

The Department of Environment Watershed Protection Division is responsible for watershed management planning within the District of Columbia. The division manages DC watersheds according to three types of actions that occur within their boundaries:

1. Scheduled, mandated actions
2. Scheduled, “voluntary” actions
3. Unscheduled and unanticipated events

The DDOE’s Watershed Protection Division manages these actions in accordance with its mission to conserve the soil and water resources of the District of Columbia and to protect its watersheds from nonpoint source pollution. The Branches within the Watershed Protection Division are responsible for the following activities:

Planning and Restoration Branch – In addition to being responsible for all watershed planning within the District, this branch also fulfills a number of other mandated responsibilities. The first of these responsibilities is to encourage pollution prevention by carrying out information and education campaigns, and increasing involvement in cleanup efforts in the District of Columbia watersheds and the Chesapeake Bay. Second, the Nonpoint Source Management Branch sponsors activities that protect and restore river, stream, and wetland habitats in DC, increase the DC and Chesapeake Bay watershed's ecological diversity, and protect the health, welfare, and safety of our residents. Lastly, the branch’s education segment sponsors teacher-training workshops in environmental education using nationally accredited environmental curriculums. These curriculums provide teachers with continuing education credits, and provide students with meaningful environmental experiences via outdoor activities, and events. The Watershed Protection Division’s developed its RiverSmart Homes and RiverSmart Schools programs to combine all three missions of the Branch.

RiverSmart Schools provides teachers with the necessary training and financial resources to install conservation sites on their school grounds and utilize them for educational purposes. These innovative schoolyard greening projects focus on incorporating landscape design principles that retain and filter stormwater runoff. Selected schools participate in the program over the course of two school years. RiverSmart Homes is a District-wide program that offers incentives to homeowners interested in reducing stormwater runoff from their properties. Homeowners receive up to $1,200 to adopt one or more practices on their property including shade trees, rain gardens, cisterns, permeable paving, and landscaping with native plants.

Sediment and Stormwater Technical Services Branch – This branch has developed and enacted storm water management and sediment and erosion control regulations for construction sites. The branch reviews construction and grading plans for stormwater management, erosion and sediment control, and flood plain management considerations. As required by EPA regulations regarding new construction permits, all new construction in the District must have Storm Water Pollution Prevention Plans (SWPPPS) that "identify all potential sources of pollution which may reasonably be expected to affect the quality of storm water discharges from the construction site."

Through the work of this branch, many BMPs are installed every year through the plan review process. All construction that disturbs over 5,000 square feet requires a stormwater certification from WPD review engineers. This regulatory process is one that is under a mandate to ensure that post-development flows mimic pre-development stormwater runoff. WPD is currently establishing new regulations that will encourage the development community to focus on the installation of LID. Efficiency percentages for LID practices are higher and will remove a greater percentage of nutrients and sediments. The current focus of WPD is to install LID where appropriate and strongly encourage developers to incorporate this stormwater management technique

Inspection and Enforcement Branch – Following up on these plan reviews, the Inspection and Enforcement Branch makes construction site visits to enforce compliance with the District of Columbia's sediment control and storm water management laws and regulations. In the process, they also inspect Best Management Practices (BMPs) to ensure they are adequately maintained. Lastly, the Branch is also responsible for investigating citizen complaints relating to soil erosion and drainage problems, and recommending appropriate solutions.

In addition to the DDOE's mandated activities, the administration also has the freedom to participate in non-mandated activities that further support watershed protection. Examples of these activities include the majority of the watershed studies and restoration projects that are implemented throughout the District. The DDOE frequently seeks the expertise of private contractors and federal agencies when carrying out these voluntary actions. This gives the administration the flexibility needed to accomplish objectives vital to the overall goal of protecting DC watersheds, in situations that might not otherwise receive attention.

DC Department of Parks and Recreation (DPR)

DPR supervises and maintains area parks, community facilities, swimming pools and spray parks, and neighborhood recreation centers, as well as coordinates a wide variety of recreation programs. DPR is a crucial partner in the implementation of this WIP in that it manages large blocks of city land with the potential to manage stormwater. Even before this WIP was circulated DPR has been working to retrofit Anacostia parks with LID practices to infiltrate stormwater and reduce pollutants to the waterway.

DC Public Schools (DCPS) and Office of Public Education Facilities Modernization (OPEFM)

Similar to the recreational facilities, the DCPS and OPEFM oversee, maintain, and modernize the City's public schools. There are dozens of schools in the

Anacostia watershed, many of which are slated for renovation or are currently under renovation. These renovations offer an opportunity to incorporate LID and providing outdoor learning areas for environmental education.

DC Department of Transportation (DDOT)

The District Department of Transportation (DDOT) is responsible for maintaining streets, roads, alleyways and sidewalks in the city. DDOT has begun to adopt the use of Low Impact Development (LID) strategies to control stormwater and stormwater pollution. The city is currently demonstrating many types of LID including:

- Infiltration tree box planters – tree boxes that accept runoff from sidewalks and roadways to treat the stormwater and provide water for the trees.
- Silva Cells, structural soils, and other tree root expansion techniques – These tools help expand the space available for the growth of tree roots which allows for a larger and healthier tree and the greater potential for the uptake of stormwater and stormwater pollutants.
- Bioretention – This can take the form of standard bioretention cells or bump outs into the street that are generally placed near intersections. These bump outs provide a safer crossing area for pedestrians by reducing the street area that they have to cross; they slow traffic by narrowing the road; and they accept runoff and treat stormwater pollution.
- Permeable pavements – Permeable pavements take many forms including paving stones, porous concrete, and porous asphalt. The District is testing different permeable pavements in different applications such as alleyways, sidewalks, and roadways to determine which are appropriate and cost effective.

DDOT is also working to reduce pollutants to the city's waterways by encouraging commuters to use alternative forms of transportation. DDOT is expanding the number of bike lanes in the city, installing bike-share racks, creating trolley and high speed bus lanes, and operating lower polluting hybrid and natural gas powered busses for its "Circulator" routes.

The District Department of Transportation also houses the City's Urban Forestry Administration (UFA). The Urban Forestry Administration (UFA) maintains the city's street trees pruning and planting to manage trees in a harsh environment of power and sewer lines, impervious surfaces, road salt, and punishing summer heat. UFA plants an average of 4150 trees annually, maintains the thousands of existing city trees, and works to improve growing conditions for street trees by removing unneeded impervious areas, experimenting with new tree box technology such as structural soils and Silva cells, and watering trees and pruning trees.

District Department of Public Works (DPW)

The Department of Public Works provides a number of public services that affect the Anacostia watershed. DPW oversees solid waste collection, the collection of hazardous wastes, recycling, leaf collection, and street and alley cleaning programs. These programs together help trash, hazardous waste, and pollutants and sediment from roadways do not end up in the Anacostia or its tributaries. In addition DPW leads the Solid Waste Education and Enforcement Program (SWEEP) which provides the tools for District residents to combat illegal dumping, clean up vacant lots, and support neighborhood clean-ups.

Anacostia Watershed Restoration Partnership

The Anacostia Watershed Restoration Partnership is a formal cooperating effort between federal, state and local government agencies responsible for the restoration of the Anacostia River. The Partnership first came together Anacostia Watershed Restoration Committee in 1987 in recognition that true restoration of the Anacostia would require cooperation across state, local, and federal agencies. Partnering agencies include:

- District of Columbia Department of the Environment
- Environmental Protection Agency, Water Protection Division
- Prince George's County Department of Environmental Resources
- Maryland Department of the Environment
- Maryland Department of Natural Resources
- Metropolitan Washington Council of Governments
- Montgomery County Department of Environmental Protection
- National Park Service
- National Oceanographic and Atmospheric Administration
- US Army Corps of Engineers

Anacostia Watershed Citizens Advisory Committee

The Anacostia Watershed Citizens Advisory Committee (AWCAC) was formed in 1996 to serve in an advisory capacity to the AWRP. This committee provides a vital link between the watershed community and the AWRC to ensure that public interests are considered during all restoration and protection projects and activities. The citizen-based committee will be comprised of an 18-member Board comprised of six representatives from each of the three jurisdictions (Montgomery and Prince George's Counties, Maryland and the District of Columbia) of the Anacostia Watershed. The qualification for membership on the AWCAC is an active interest in the effort to restore and preserve the Anacostia Watershed. Membership in a local civic association or environmental group active in the watershed is desirable but not essential. AWCAC meetings are open to all interested persons. This committee meets quarterly, often at different locations in the three jurisdictions.

Anacostia Anadromous Fish Workgroup

The ad-hoc Anacostia Anadromous Fish Workgroup consists of an interagency team of experts whose mission is to help the AWRP in achieving its long-term goal of restoring the spawning range of anadromous fish, such as herring, to historical limits. Included among the Workgroup's objectives are: 1) establish fish barrier removal/modification priorities and cost estimates for the Anacostia tributary system; 2) provide a starting point for the ultimate creation of an annually funded anadromous fish monitoring program; 3) identify opportunities for greater citizen participation in areas such as volunteer monitoring, community outreach, etc.; and 4) identify and recommend potential anadromous fish restoration and management funding options, including public-private partnerships. The Workgroup typically meets two to three times per year.

Anacostia Watershed Toxics Alliance

The Alliance was formed in March 1999 under the premise that a voluntary partnership, focused on the task of addressing toxic sediment contamination of the tidal Anacostia, would offer a more efficient and appropriate alternative to address contamination issues. The Alliance operates under a Statement of Purpose and with the combined efforts and resources of all members.

The "Toxics Alliance" aims to work collaboratively on issues of toxics that are frequently unaddressed due to resource or regulatory limitations. The Alliance aims to coordinate with these other organizations wherever possible, serving as a unique partnership between all parties who have a stake in the river—public and private; regulators and regulated; local, state, federal and regional.

Anacostia Watershed Society

The mission of the Anacostia Watershed Society (AWS) is to protect and restore the Anacostia River and its watershed and its watershed communities. For over twenty years the AWS has used it staff and recruited volunteers to help return the Anacostia River to a clean and healthy waterway. They have done this through education, wetlands planting, trash cleanups, boat tours, advocacy and outreach and more.

Earth Conservation Corps

Earth Conservation Corps (ECC) is a nonprofit youth development and environmental service organization located on the heavily polluted Anacostia River in Southeast Washington, DC, one of our nation's most disadvantaged communities. Since 1992, ECC has provided hundreds of unemployed, out of school youth ages 17-25 with hands on workforce and leadership development training, environmental education and media arts training. Earth Conservation Corps links the effort to save the Anacostia River with the engagement of disenfranchised youth in education, job training, and volunteer-recruitment activities.

Groundwork Anacostia River, DC

Launched in Ward 7 and focused on the communities that border the Anacostia River and the region of the Anacostia watershed, Groundwork Anacostia River DC utilizes environmental restoration goals as a vehicle for community development. GWARDC's objectives are to:

- Increase the capacity of residents and stakeholders to improve, care for, and promote their local environment;

- Reclaim vacant and derelict lands for conservation, recreation, and economic development; and
- Reconnect residents to their neighborhoods' environmental assets, including parks, open spaces, and the Anacostia River and its tributaries.

Montgomery County Department of Environmental Protection

The restoration and protection of the Anacostia watershed is a priority for the Montgomery County Department of Environmental Protection (DEP). The County recently undertook a Countywide Stream Protection Strategy initiative to preserve, protect, or restore watersheds by evaluating existing conditions. Based upon the stream analysis as well as several other factors, has undertaken dozens of management and stream restoration projects designed to reduce pollution in tributaries to the Anacostia and restore stream habitat.

Prince George's County Department of Environmental Resources

The mission of the Department of Environmental Resources is to protect and enhance the natural and built environments of Prince George's County by enforcing Federal, State and County laws to create a healthy, safe and aesthetically pleasing environment for all residents and businesses of the County. Prince George's County has been a leader in developing and installing LID technologies, many of which have been demonstrated in the Anacostia watershed.

DC Water and Sewer Authority (WASA)

WASA is responsible for collecting and treating wastewater in the District – including stormwater in the portion of the city served by the Combined Sewer System (CSS). As a part of these duties, WASA maintains the network of pipes and catch basins that collect and convey stormwater throughout the city. WASA has developed and is implementing a long-term control plan for the CSS found in a portion of the Anacostia watershed. As a part of this effort WASA is making upgrades to the CSS, separating combined sewers in some areas, and exploring the potential for using LID to reduce combined sewer overflows – particularly in the Piney Branch sewershed.

Washington Suburban Sanitary Commission

The Washington Suburban Sanitary Commission (WSSC) provides sanitary services to approximately 1.6 million residents in Prince George's and Montgomery counties. Similar to efforts by WASA and other District agencies, the WSCC works to minimize the chances of sewage overflows and to maintain stormwater and sewer infrastructure in the upstream portions of the Anacostia watershed. In 2005 WSSC entered into a consent decree with the EPA where WSSC is required to implement over 14 years numerous reporting, monitoring, inspection, maintenance, repair and replacement remedial measures for its sewer collection system in order to eliminate sewer overflows.

National Park Service (NPS)

The National Park Service manages a great deal of the federally-controlled lands in the Anacostia watershed. Anacostia Park and Fort Dupont are the largest of these landholdings, but the NPS also oversees a large portion of the Fort Circle Parks and many smaller squares and triangle parks. In recent years the NPS and DDOE have worked together to install several bioretention cells in Fort Dupont Park. These projects have reduced stormwater pollution to the Fort Dupont tributary and the Anacostia River. Recently the NPS and DDOE have begun to work together to design and install regenerative stormwater conveyances – a type of LID that treats and infiltrates stormwater while maintaining the natural appearance of protected parkland.

Casey Trees

Casey Trees is a non-profit organization dedicated to expanding and caring for the District's tree canopy. As a part of this effort, Casey runs community tree planting programs, a tree rebate program, and plants trees for DDOE's RiverSmart Homes program. Additionally Casey leads classes in the identification and care of trees and performs monitoring and modeling of canopy cover. Casey has an active and knowledgeable cadre of volunteer "citizen foresters" that aid its paid staff in their mission.

US Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS)

The NRCS of Maryland provides technical assistance to the DDOE in locating and installing stormwater retrofits. In the past NRCS has performed a parkland and recreation center soil assessment for 87 sites within the DPR system that prioritizes recreation centers and parks that suffer from erosion for restoration. NRCS also provides technical services in performing large and local scale soil characterizations that are useful in sighting and sizing LID practices.

Anacostia Advisory Neighborhood Commissions

The Advisory Neighborhood Commissions are elected bodies that weigh in on issues that affect their neighborhoods. ANCs consider a wide range of policies and programs affecting their neighborhoods, including traffic, parking, recreation, street improvements, liquor licenses, zoning, economic development, police protection, sanitation and trash collection, and the District's annual budget. In each of these areas, the purpose of the ANCs is to ensure input from an advisory board that is made up of the residents of the neighborhoods that are directly affected by government action. The ANCs are the body of government with the closest official ties to the people in a neighborhood. The ANCs present their positions and recommendations on issues to various District government agencies, the Mayor, and the City Council. They also present testimony to independent agencies, boards, and commissions.

As a part of outreach efforts for this plan DDOE will bring the projects and findings from this report to the various ANC commissions. ANC partners will be critical partners in helping to galvanize community support for restoration activity.

Anacostia Civic and Community Associations

Civic and community associations are neighborhood groups dedicated to informing, representing, and supporting their communities. These groups disseminate information to help citizens keep abreast of developments and activities that affect their welfare. These groups also represent their residents through testimony and letters on important issues. Unlike ANCs, civic and community associations are not an official part of the District government. District residents, however often better identify with their local civic or community association than their ANC because they are based on a neighborhood identity.

As a part of outreach efforts for this plan DDOE will bring the projects and findings from this report to the various associations. Like ANCs, the community and civic associations are an important resource in educating the community and garnering the support of District residents for restoration activities.

Monitoring

Criteria for Determining Load Reductions

Current Monitoring

The District currently performs a great deal of monitoring in the Anacostia watershed. DDOE performs in-stream monitoring of water quality parameters, takes samples of fish tissue, and surveys aquatic life for the Integrated Report to the EPA as required by the Clean Water Act. Additionally DDOE oversees stormwater monitoring from outfalls as required under the District's MS4 permit.

Integrated Water Quality Assessment Monitoring

The DDOE Water Quality Division monitors two sites on the main stem of Anacostia and on Watts Branch and one site on each of the remaining nine waterbodies of the Anacostia for physical, chemical and bacterial parameters. These sites are monitored based on an annual schedule of monitoring activities that are outlined in Table 22 below. Dates for water quality are set in advance and in-stream water quality monitoring takes place in all weather conditions. Moreover, quarterly water quality monitoring ensures that samples are representative of the various seasons. DDOE also monitors biological activity in Anacostia using benthic macroinvertebrate studies. The District uses the Maryland Biological Stream Survey (MBSS) (Maryland DNR, 2001) protocol for its benthic macroinvertebrate sampling.

Table 22 - Anacostia Water Quality Monitoring Parameters

Parameters Monitored	Frequency	Type of Sample
Bacteria (E. Coli)	Quarterly	Grab Sample
Temperature, Salinity, Dissolved Oxygen %, Dissolved Oxygen Concentration, pH, Turbidity, Chlorophyll, and Hardness	Quarterly	In Situ
Dissolved Metals (Zinc, Lead, Copper, Arsenic)	Quarterly	Grab Sample
Benthic Macroinvertebrates	Annually	District of Columbia Stream Survey (adapted from Maryland Biological Stream Survey)
Habitat Assessment	Annually	District of Columbia Stream Survey (evaluate in-stream habitat, channel morphology, and structural features of bank and riparian vegetation)
Fish Assessment	Annually	Index of Biotic Integrity

Using the data collected, DDOE's Water Quality Division prepares the biannual Integrated Report to the Environmental Protection Agency. This report, which was last prepared in 2008, satisfies the listing requirements of §303(d) and the reporting requirements of §305(b) of the federal Clean Water Act (P.L. 97-117). A summary of the monitoring in Anacostia can be found in Appendix K. Based on the monitoring over the 2006-2008 time period, the Anacostia and its tributaries did not meet its designated uses.

MS4 Permit Monitoring

The other source of water quality data for the Anacostia is stormwater outfall monitoring done to meet the requirements of the city's stormwater permit. Under the most recent permit, the District monitored nine stations in the Anacostia (see Table 23 for a list of monitoring stations). The Anacostia stations are monitored once annually and every three years they are monitored more intensely. In the most recent available Discharge Monitoring Report for the Anacostia (DDOE, 2009), each of the nine stations average was sampled on average three times during storm events. Six of these stations were also sampled over the same time period during dry weather. The samples collected at these stations are analyzed for over 150 parameters. A summary of the most recent storm water outfall findings for the Anacostia can be found in Appendix L.

Table 23 - Anacostia Monitoring Stations

Site Number	Sampling Location	Estimated Drainage Area (acres)
1	Stickfoot Sewer	616.3
2	O St. Storm Water Pump Station	25.4
3	Anacostia High School	251.8
4	Gallatin & 14th St, NE	662.4
5	Varnum and 19th Pl, NE	517.4
6	Nash Run	13.4
7	East Capitol St.	16.7
8	Ft. Lincoln – Newton BMP	5.7
9	Hickey Run	8.5

Enhanced Monitoring Strategy

To ensure that the monitoring program helps to inform the Anacostia restoration effort and to make certain that the restoration effort has a measurable impact on improved water quality, DDOE will carry out a comprehensive monitoring regiment for the Anacostia River and its tributaries. Monitoring data will form an information feedback loop that allows planners to adjust the implementation strategy as new information becomes available. Most importantly appropriate monitoring will demonstrate that the outcome of a clean and healthy water body, which can be enjoyed by the Districts residents, is met.

As is evident from the current monitoring in the Anacostia detailed above, DDOE is committed to gathering comprehensive and relevant water quality data. A fairly comprehensive monitoring strategy has already been implemented, however there are gaps in the available data for the Anacostia watershed that will need be addressed. Building on the existing monitoring strategy, the enhanced monitoring strategy will have the following additional components:

- An analysis of monitoring data taken to date to determine if the Anacostia and its tributaries can be delisted for some pollutants;
- An expansion of water quality monitoring to include targeted in-stream sampling of loads during storm events;
- An integration of existing monitoring efforts;
- Adding monitoring for organic pollutants; and
- Monitoring at both upstream/end of pipe and at the mouth of targeted tributaries to better determine loads and load reductions.

Each of these four proposals is discussed in more detail below.

These additions to current monitoring activities will give a more comprehensive picture of existing conditions and establish a baseline from which progress toward TMDL endpoints can be measured. Using the enhanced monitoring data will then provide an information feedback loop that will allow planners to adjust the implementation strategy as new information becomes available. Most importantly, monitoring data will help ensure that the outcome of a clean and healthy water body, which can be enjoyed by the Districts residents, is met.

Analyze Existing Data

There is some monitoring evidence to suggest that at least a few of the pollutants listed for the Anacostia and its tributaries are no longer present in quantities that impair the waterways. In order to delist these pollutants DDOE should first examine its historical monitoring records to determine if there is sufficient evidence to warrant delisting. If there is some evidence, but not enough to justify delisting, additional focused monitoring should be undertaken.

Expand In-Stream Water Quality Monitoring

As noted above, currently DDOE's Water Quality Division performs only ambient water quality sampling. It is understandable that DDOE has to date focused on ambient sampling; it is predictable, cost-effective, straight forward and can be done during regular working hours. That being said, most pollutant loads are delivered during storm events. For this reason, expanded monitoring will include targeted, in-stream sampling during storm events. Depending on the outcome of the current review of the District monitoring protocols, stormwater sampling could entail:

- Stormwater monitoring in watersheds where focused restoration work is taking place; or
- Stormwater monitoring in watersheds on a rotating basis (as is done for the MS4 permit); or
- A combination of the two.

Integrating Existing Monitoring Efforts

As was already noted, currently monitoring in the Anacostia is performed by both the Water Quality Division and the Stormwater Division. The reasons that the two divisions monitor are different, hence the parameters that they monitor are different as are the monitoring locations and the frequency of monitoring. That being said, under the enhanced monitoring effort, a more integrated approach to monitoring the Anacostia will be used to get better data and to save money.

The first step in taking this approach will be to examine the monitoring sites to make sure that they are representative of the watershed. If sites are physically clumped together, could they be better spread apart to represent the entire watershed? If they are temporally close, could they be spread out better across the year? Next, creating a unified monitoring effort will examine the use of District resources. Would it make more sense to have one contract for in-stream and stormwater sampling to create an economy of scale and reduce duplicative efforts? If the Water Quality Division is out taking ambient samples, could they collect dry weather outfall samples as well? Could DDOE's Fisheries and Wildlife Division perform the rapid bio-assessment instead of the contractor for the Stormwater Division? Finally in addition to integrating the field component, the enhanced monitoring effort will combine monitoring efforts for reporting purposes. Including the results from both stormwater and stream outfalls in reports would give a more complete picture of the health of the waters of the Anacostia.

Adding Monitoring for Organic Pollutants

The District does not currently effectively monitor for organic pollutants. This gap is understandable in that these pollutants are notoriously difficult to monitor. They require complicated monitoring protocols and they require sensitive laboratory equipment. Consequently monitoring for them can be very costly and is not always a good use of resources.

To close this gap DDOE proposes a dual strategy of biological monitoring and continuous in situ water quality monitoring. Biological monitoring will examine fish tissue samples to ascertain the presence of organic pollutants that are harmful to human health. The in situ monitoring will be done using a Continuous Low-Level Monitoring device, or CLAM. The CLAM is a submersible extraction sampler, using EPA approved SPE (Solid Phase Extraction) media to sequester Pesticides, Herbicides, PAH's, TPH, and other trace organics from water.

Using this type of sampling device will allow DDOE to both determine the presence or absence of these chemicals, but also help localize their sources. Sampling using this system would begin at the lowest reaches of the Anacostia and its tributaries and move upstream. By moving upstream with subsequent samples DDOE can pinpoint the source(s) of organic pollution, if any. Similarly, fish tissue analysis will show if there are high levels of organic and metals pollutants which may be harmful to human health if consumed.

Monitor Both Upstream and at the Mouth of Tributaries

As noted in the discussion on integrating monitoring efforts, the enhanced monitoring protocol will examine the monitoring sites to make sure that they are representative of the watershed. It is clear that the District does not have unlimited resources for monitoring. So that expanding our monitoring effort does not reduce DDOE's ability to undertake restoration efforts due to it additional costs, the upstream/downstream monitoring will only take place in targeted watersheds. Like adding in-stream stormwater monitoring, how this expansion takes place will depend on the results of the current review of the District monitoring protocols. Upstream/downstream sampling could entail:

Table 24 - Enhanced Monitoring Task List and Timeline

Task	Completion Date	Notes
Study ambient monitoring program and report on potential ways of improving it	Complete	Internal report is currently being reviewed.
Develop taskforce of Water Quality, Stormwater, and Watershed Protection Divisions to develop enhanced monitoring strategy	Complete	Currently ongoing
Examine new techniques and technologies for monitoring organics	September 2011	This work is currently ongoing.
Examine existing MS4 and ambient monitoring locations for overlaps and gaps	December 2011	
Deploy and test new techniques and technologies for monitoring organics	March 2012	This is dependent on funding availability.
Examine potential targeted stormwater monitoring sites	May 2012	This analysis will feed into the next task.
Determine new monitoring locations based on overlap and gap analysis	June 2012	
Begin monitoring at new monitoring locations	October 2012	
Perform analysis of existing monitoring data	December 2012	This is dependent on funding availability.
Decide upon methodology for monitoring organics and commence use in targeted areas	December 2012	
Commence targeted stormwater monitoring	March 2013	
Complete overarching enhanced monitoring strategy	18 months from issue of new MS4 permit	This will depend on when the new permit is issued.

- Performing this monitoring in watersheds where focused restoration work is taking place; or
- Performing this monitoring in watersheds on a rotating basis (as is done for the MS4 permit).

Establishment of Benchmarks

The District has laid out the methodology to be used in identifying specific technologies that can be installed at proposed locations and how to estimate the pollutant reduction achieved by that technology. Benchmarks for this Plan will vary depending on the project or activity being measured. For instance, constructed LIDs are more easily evaluated based on the number of units installed, the area treated, the efficiency of the unit, and the storm water pollutant load measured at the selected location. The annual measure of success for these projects will be the completion of scheduled projects. On the other hand, the success of public outreach activities cannot be measured by chemical sample analysis of a sewershed or sub-sewershed. The annual success for these types of activities will be measured by indirect benchmarks (e.g., number of citizens reached with a message or number of pamphlets distributed in the case of public outreach).

As noted earlier in this section, the Water Quality Division is currently reevaluating their monitoring program. We have suggested some guidelines for how to more effectively monitor the Anacostia. Regardless of the outcome of DDOE's monitoring program, demonstration of load reductions in the Anacostia will still follow the same method. Load reductions will be calculated using the Simple Method and will be reported by comparing the monitoring data for that pollutant to the required load reductions for each pollutant and each impaired water body.

The aim of this WIP is to utilize the most efficient, cost-effective projects and activities to achieve maximum pollutant load reductions with the resources available to the District, and measure progress based a comprehensive and cost effective monitoring program. The District will continue to seek out additional resources for the control of storm water pollutants entering the Anacostia to quickly and effectively meet its TMDLs.

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