TOTAL MAXIMUM DAILY LOADS
UPPER ANACOSTIA RIVER
LOWER ANACOSTIA RIVER
DISTRICT OF COLUMBIA

TOTAL SUSPENDED SOLIDS

DEPARTMENT OF HEALTH
ENVIRONMENTAL HEALTH ADMINISTRATION
BUREAU OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION
WATER QUALITY CONTROL BRANCH

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INTRODUCTION

Section 303(d)(1)(A) of the Federal Clean Water Act (CWA) states:

> Each state shall identify those waters within its boundaries for which the effluent limitations required by section 301(b)(1)(A) and section 301(b)(1)(B) are not stringent enough to implement any water quality standards applicable to such waters. The State shall establish a priority ranking for such waters taking into account the severity of the pollution and the uses to be made of such waters.

Further section 303(d)(1)(C) states:

> Each state shall establish for the waters identified in paragraph (1)(A) of this subsection, and in accordance with the priority ranking, the total maximum daily load, for those pollutants which the Administrator identifies under section 304(a)(2) as suitable for such calculations. Such load shall be established at a level necessary to implement the applicable water quality standards with seasonal variations and a margin of safety which takes into account any lack of knowledge concerning the relationship between effluent limitations and water quality.

In 1996, the District of Columbia (DC), developed a list of waters that do not or are not expected to meet water quality standards as required by section 303(d)(1)(A). The list was revised in 1998. The list of water bodies contains a priority list of those waters which are the most polluted. This priority listing is used to determine which of those water bodies are in critical need of immediate attention. This list, submitted to the Environmental Protection Agency every two years, is known as the Section 303(d) list. For each of the listed waters, states are required to develop a Total Maximum Daily Load (TMDL) which calculates the maximum amount of a pollutant that can enter the water without violating water quality standards and allocates that load to all significant sources. Pollutants above the allocated loads must be eliminated.

The District of Columbia's section 303(d) list divides the Anacostia into two segments. The lower Anacostia is identified as that portion of the river extending from the mouth of the river to the John Philip Sousa Bridge at Pennsylvania Avenue and the upper Anacostia from the bridge to the Maryland border. The demarcation in the list has no legal meaning other than to try to isolate the areas not attaining the applicable standards. The Water Quality Standards for clarity do not divide the river into two segments, but specify attainment for the whole. This TMDL is for the river as a whole and applies to both the upper and lower Anacostia River.

APPLICABLE WATER QUALITY STANDARDS

The Anacostia River is listed on DC's 1996 and 1998 303(d) lists because excessive concentrations of Total Suspended Solids (TSS). Title 21 of the District of Columbia Municipal Regulations (DCMR) Chapter 11 contains the Water Quality Standards (WQS). The Anacostia River has the designated beneficial uses of:

1. Class A- primary contact recreation,
2. Class B- secondary contact recreation,
3. Class C- protection and propagation of fish, shellfish, and wildlife,
4. Class D - protection of human health related to consumption of fish and shellfish, and;

5. Class E- navigation.

Class C waters must achieve or exceed water quality standard for clarity as measured by secchi disc. The water body must meet an average of 0.8 meters secchi disc depth during the period of April through October during an average flow year. The number is derived as a multi-year average with large variations in flow both with years and within the season. Consequently, a design flow of the long term average will include high flow years where clarity is less that 0.8 m and low flow years where clarity is more than 0.8 m. This value is based upon the requirements by submerged aquatic vegetation for an adequate amount of light for photosynthesis. The factors which affect light penetration are particulate matter and color. Particulate matter is referred to as Total Suspended Solids and includes both inert and volatile solids. One of the components of the volatile solids is algae. Algae concentrations are measured and reported as the amount of chlorophyll “a” that they contain. Color may absorb differentially some components of light and has been shown to be a very minor component in the Chesapeake Bay system of rivers. There are some short periods of time such as immediately following leaf fall that material such as tannic acid may cause a larger effect on clarity, but this is usually at the end of the SAV growing season. Color does not appear to be a significant factor in the Anacostia River. In 1981 the District of Columbia deleted the water quality criteria for total suspended solids from the Water Quality Standards because it was not protective of the Class C uses. A turbidity criteria was added at that time in order to control localized activities such as dredging and point source discharges.

The District of Columbia Department of Health Fisheries and Wildlife Division conducts annual SAV surveys of District waters and investigates the relationship of SAV with fish. Several fish species show distinct relationships with SAV, in terms of coexistence, which would suggest that they are extremely sensitive to the presence and density of SAV. A direct relationship between several fish species and the cover density of SAV was observed in the two Potomac sites (P2E and P3E) that had fluctuating SAV cover densities from year to year. At both P2E and P3E, largemouth bass, yellow perch, goldfish, bluegill and pumpkinseeds all display relative abundance numbers that change according to the SAV cover density. At sampling site P2E, all five of these fish species showed their lowest relative abundance numbers in 1997 after three straight years of coexisting with SAV that had a cover density value of only one. A similar pattern was observed at P3E where the lowest relative abundance numbers for largemouth bass, yellow perch, goldfish, and bluegills all occurred in 1998 after three straight years of no SAV. To further support the existence of a relationship, the data showed that the relative abundance of each of these fish significantly increased as the SAV in these areas returned and flourished.

There has been little change in the SAV growth in the D.C. section of the Anacostia River since monitoring in this area began. The Upper Anacostia fails to produce any observable SAV, and the Middle Anacostia has produced only weakly populated sections over the past eight years. The Lower Anacostia continues to be the only section of this river that can support a consistently returning SAV grassbed. This SAV fails to undergo any great increase in species diversity or abundance, never exceeding a cover density of two. Even when all areas of the Potomac River experience tremendous increases in cover density, diversity, and abundance, as in 2000, the grass beds of the lower Anacostia remain immature.

Several reasons may explain the inability for SAV to thrive here, most obvious being the turbidity of the water. In fact the reason growth does occur in the lower portions of the river could be directly related to higher secchi disk readings recorded here. Higher readings are primarily due to the tide induced mixing of clearer water from the Washington Channel, and Potomac River, and the lower velocities of the Anacostia River in this section, which allow for some particulate settling.

Only three species of SAV were discovered in the entire Anacostia River and all were found in the lower portion of the river in four different beds. One area that continued to show minimal but consistent growth was the bed that grew alongside the wall that borders the military base and extended from the mouth of the Anacostia River upstream to the Douglass Bridge. During 2000, this bed actually extended beyond the Douglass Bridge to include some of the shallow area along the Anacostia Park directly across from the Washington Navy Yard. Growth was sporadic with a cover density of one. Of the two species present, *Vallisneria americana* (90%) dominated the bed with only traces of *Heteranthera dubia* (10%) being observed.

The third species identified in the Anacostia was Hydrilla verticillata. This species appeared in two small beds. Adjacent to the Washington Navy Yard, and directly downstream of the Douglass Bridge, was a small cove that contained a bed of *Hydrilla verticillata* (100%) with a cover density of one. A little further downstream another shallow cove just prior to Buzzard Point contained smaller amounts of *Hydrilla verticillata* (20%), along with considerably more *Vallisneria americana* (80%). This bed had a cover density of one. The last bed examined in the Anacostia River is actually an extension of the Washington Channel bed, but because of its location and the fact that it had a different cover density, it was included with the Anacostia findings. Directly downstream of the James Creek Marina begins a wall that borders Fort McNair. The wall continues downstream and makes an abrupt right hand turn into the Washington Shipping Channel. The Anacostia grass bed starts at this wall and runs parallel to it right to the point where the Washington Channel and Anacostia River meet. The bed is completely dominated by one species, *Vallisneria americana* (100%), and has a cover density of three. The continuation of the bed is picked up in the Washington Channel observations.

BACKGROUND

Around 1800, the Anacostia River was a major thoroughfare for trade in the area now known as the District of Columbia, particularly for Bladensburg, a deep water port in Maryland. By 1850, however, the Anacostia River had developed sedimentation problems due to deforestation and improper farming techniques related to tobacco farms and settlements. Channel volumes were greatly decreased and stream flow patterns were altered. Due to the continuation of the urbanization process, the river was never able to flush out the excessive amount of sediment and nutrients.

The District of Columbia, as many cities in the 19^{th} and early 20^{th} centuries, developed a combined sewer system, which transported both rainfall and sanitary sewage away from the developed areas and discharged it into the rivers. The two major combined sewage outfalls were at the present location of the “O” Street Pump Station and at the Northeast Boundary Sewer just below Kingman Lake. In the 1930s, Blue Plains Wastewater Treatment Plant (WWTP) was constructed and dry weather sewage flows were transported across the Anacostia River to Blue Plains. However, the wet weather flows were and are often greater than the transmission capacity of the pump stations and piping system and resulted in overflows. Later, sewer system construction techniques utilized two pipes so that the storm water could be kept separate from the sanitary sewage. Storm water is transported to the nearest stream channel and discharged while the sanitary sewage is transported to Blue Plains WWTP for treatment. There are a number of small tributaries which flow into the Anacostia and may carry significant loads of sediment during wet weather. The largest of these is Watts Branch.

CURRENT LAND USE

The Anacostia watershed is approximately 117,353 acres with the drainage area being 49% in Prince George's County, 34% in Montgomery, and 17% in the District of Columbia. Two thirds of the basin lies within the Coastal Plain and the remaining is in the Piedmont. The range in elevation in the catchment's area is very slight according to the USGS topographic quadrangle maps. The head of tide for the Anacostia River is at Bladensburg, MD.

The non-tidal portion of the Anacostia River is composed of the two branches, the Northeast Branch and the Northwest Branch. Their confluence is at Bladensburg, MD. For all practical purposes the tidal portion of the Anacostia River can be considered to begin at their confluence, although the Northeast and Northwest Branches are tidally-influenced up to the location of the USGS gages on each branch: Station 01649500 at Riverdale Road on the Northeast Branch and Station 01651000 at Queens Chapel Road on the Northwest Branch.

Land use in the Anacostia River watershed is mostly residential and forested. There are 30% park and forest lands evenly dispersed throughout the watershed, such as the National Park Service, the National Arboretum, Greenbelt Park, and Beltsville Agricultural Research Center. The industrial and manufacturing land use is largely confined to the tidal area of the basin such as Hickey Run, Lower Beaverdam Creek, and Indian Creek. These sub-watersheds contain impervious areas as high as 80%. (See Figure 2.) A more detailed description of the water body is available in "An Existing Source Assessment of Pollutants to the Anacostia Watershed" (Metropolitan Council of Governments, 1996).

STREAM FLOW

The mean annual stream flow for the Northwest Branch is 48.6 cubic feet per second and the mean annual flow for the Northeast Branch is 86.4 cubic feet per second. These tributaries provide a combined mean annual flow of 135 cubic feet per second. The lowest seven day consecutive average that has a recurrence interval of once in ten years is known as the 7Q10. The 7Q10 for the Northeast Branch is 5.9 cubic feet per second and the 7Q10 for the Northwest Branch is 1.8 cubic feet per second. Average annual flows in cubic feet per second (cfs) for the years used in this TMDL are as follows:

	Northeast	Northwest	Combined
1988	72.5	43.9	116.4

1989	111.3	67.0	178.3
1990	93.2	60.4	153.6

The year 1988 is 35% below average flow and the year 1989 is 30% above average flow.

The average monthly flows during the period of record for the SAV growing period for the three gauged streams according to USGS published reports are shown below:

	Northeast Branch-CFS	Northwest Branch-CFS	Watts Branch CFS
April	110	61.5	4.62
May	95.1	55.8	4.5
June	68.4	42.3	2.99
July	59.8	34.2	2.8
August	63.7	37.1	2.74
September	62.3	39.5	4.07
October	54.3	29.2	3.31

The average flow for the growing period is 73.4 CFS for the Northeast Branch, 42.8 CFS for the Northwest Branch and 3.6 CFS for Watts Branch.

WATER QUALITY STANDARDS

The Anacostia River has several designated uses as detailed in DC's Water Quality Standards (WQS). Class C waters have an associated seasonal segment average minimum numeric criteria for clarity measured as secchi disc depth of 0.8 meters. When TSS increases in the water body, secchi disc depths decrease. Algal growth can contribute to the amount of TSS and is included in the measurement of TSS. The purpose of this TMDL is to determine the limit to which TSS must be reduced to achieve and maintain the Water Quality Standards for clarity. The numerical criteria must be achieved for flows between the 7Q10 and the average seasonal flow. Point source discharges of TSS should be designed for compliance at the average seasonal flow.

SOURCE ASSESSMENT

Within the District of Columbia, there are three different networks for conveying waste water. Originally, a combined sewer system was installed which collected sanitary waste and storm water and transported the sanitary flow to the waste water treatment plant. When storm water caused the combined flow to exceed the pipe capacity leading to the treatment plant, the excess flow was discharged, untreated, through the combined sewer overflow to the river. There are 17 combined sewer overflows to the Anacostia River.

In the upper two thirds of the drainage area, a separate sanitary sewer system and a storm sewer system were constructed. A separate sanitary sewer line has no storm water inlets to the system and it flows directly to the waste water treatment facility. Storm water pipes collect storm water from the streets and parking lots and are discharged to the rivers.

Point Sources

A map of the Combined Sewer Overflows on the Anacostia River is included in the appendix. The CSO outfalls are located downstream of Kingman Island.   There is approximately 1.9 billion gallons per year total CSO flow to the Anacostia, dependent upon meteorological conditions. This flow contains organic and inorganic suspended solids.   U.S. EPA has issued a storm water permit to DC that regulates storm sewer discharges as point sources and this flow is rainfall driven and contains both organic and inorganic suspended solids.

Nonpoint Sources

For the purposes of this TMDL, storm sewer flow is considered part of the non-point source load. Some of these storm sewers such as Hickey Run and the Stickfoot sewer are actually small streams that have been either partially or totally piped.   Watts Branch and lower Beaverdam Creek are explicitly included as streams while all of the smaller streams are only implicitly modeled as loads.

Upstream (Maryland) Sources

Storm water runoff from the large drainage area in Maryland contributes significantly to the clarity problem in the both Maryland's tidal portions and DC's portion of the Anacostia River. Loads for the Maryland portion of the basin are calculated using data primarily for the years 1988-1990. All of the Lower Beaver Dam Creek loads and 53% of the Watts Branch loads are assigned to Maryland. The Fort Totten area of the District has some separate storm sewers which daylight near the MD District boundary and flow into Maryland.

Total Loads
TSS concentrations are affected by all of the previously mentioned sources. The average seasonal loads for the three year period 1988, 1989, and 1990, in pounds, are calculated below for Maryland, CSO, and DC storm water.

TSS AVERAGE LOADS IN POUNDS DURING APRIL THROUGH OCTOBER

MARYLAND	
NORTHEAST & NORTHWEST BRANCHES	17,526,000
SMALL TRIBS-15.9%	119,000
LOWER BEAVER DAM CREEK	419,000
WATTS BRANCH 53%	224,000
TOTAL MD LOADS	18,288,000
DISTRICT OF COLUMBIA	
SMALL TRIBS – 84.1%	630,000
WATTS BRANCH 47%	199,000
CSO	587,000
TOTAL DC LOADS	1,416,000
TOTAL ALL LOADS	19,704,000

The average chlorophyll "a" concentrations for the period for the District of Columbia portion of the tidal Anacostia River was about 15 micro grams per liter.

TOTAL MAXIMUM DAILY LOADS AND ALLOCATION

Overview

This section describes how the TSS TMDL and total loading allocations for point sources and nonpoint sources were developed for the Anacostia River. The first section describes the modeling framework for simulating TSS loads, hydrology, and water quality responses. The second and third sections summarize the scenarios that were explored using the two models. The assessment investigates water quality responses assuming different loading conditions. The fourth and fifth sections present the modeling results in terms of a TMDL, and allocate the TMDL between point sources and nonpoint sources. The sixth section explains the rationale for the margin of safety and a remaining future allocation. Finally, the pieces of the equation are combined in a summary accounting of the TMDL for seasonal loads.

Analysis Framework

There are two models used to establish the TMDL. Toxi Wasp is used to simulate TSS and converts loads into concentrations. The Tidal Anacostia Model (TAM) has been modified to accept TSS concentration and compute clarity in the form of secchi disc.

WASP TOXI5 Sediment Transport Model

The WASP TOXI5 model, modified by ICPRB, simulates advective and dispersive transport and deposition and erosion patterns in the tidal Anacostia River. It predicts sediment concentration in the water column. The sediment transport model uses output generated by the TAM hydrodynamic model.

Sediments are modeled as three grain size fractions. Sediment load values are based on available tributary, storm sewer, and CSO monitoring data for TSS. The relative proportions of sediment size fractions were estimated from bed sediment grain size data and adjusted based on model calibration results.

Table 8.1 Sediment Grain Size Fraction Simulated

Size Fraction	Diameter (um)	Relative Proportion of Bed Sediment	Description
Fine grained sediments	<30	0.22	Clays and fine silts
Medium grained sediments	30 < X < 120	0.24	Fine silts to very fine sands
Course grained sediments	X > 120	0.54	Fine sands to gravel

Transport of fine and medium grained sediments are simulated as cohesive sediments as a function of bed shear stress. Erosion occurs when shear stress exceeds critical shear stress and is proportional to the extent it exceeds critical shear stress. Deposition occurs when shear stress is less than critical shear stress and is proportional to the extent it is less than critical shear stress.

Transport of coarse grained sediments, sand and gravel, is simulated as a function of the carrying capacity of the flow, which is dependent on the hydrodynamic properties of the flow. The carrying capacity is modeled as a power function of the average segment flow velocity. If the carrying capacity of flow exceeds the concentration of course sediments in the water column, coarse sediments will be eroded from the bed. If the carrying capacity is exceeded by the concentration of coarse sediments in the water column, coarse sediments will be deposited on the bed.

Daily loads of TSS are represented as the product of the daily flow and the estimated mean TSS concentration for storm and non-storm events for each loading source. Daily flow values were separated into non-storm and storm components using the local minimum method in the USGS hydrograph separation program (HYSEP). Northeast and Northwest Branch event mean concentration of TSS were based on provisional monitoring data from District of Columbia Water and Sewer Authority / Council of Governments Long Term Control Plan (WASA/COG LTCP). CSO event mean concentration of TSS were derived from preliminary results of the WASA/COG LTCP. Watts Branch storm estimated mean concentration was based on results from *Estimation of nonpoint source loads to the Anacostia River in the District of Columbia for the total maximum daily load process* prepared by COG. Watts Branch non-storm estimated mean concentration of TSS was derived from DC DOH monitoring data from station TWB01**.** Lower Beaverdam Creek daily TSS loads were taken directly from the Lower Beaverdam Creek HSPF model output.

TSS concentrations at the boundary condition at the confluence of the Anacostia and Potomac Rivers are based on suspended sediment size fraction composition and concentration data at monitoring station ANA29. The average sediment size fraction composition was 86% fine grained, 14% medium grained, and 0% course grained and the average TSS concentration was 14 mg/l. This value was adjusted to 22 mg/l based on initial model calibration results. The boundary condition was adjusted during allocation runs to assess secchi depth under the conditions where the flows from the Potomac met applicable water quality standards for the Anacostia at the Anacostia boundary.

Size Fraction	Observation Data at the confluence of Anacostia and Potomac Rivers (mg/l)	Calibration boundary condition at the confluence of Anacostia and Potomac Rivers (mg/l)
Fine grain sediments	12	20
Medium grain sediments	2	2
Course grain sediments	0	0

TIDAL ANACOSTIA MODEL

The computational framework has four components, which include the Tidal Anacostia Model (TAM), Water Quality Simulation Program (WASP), Water Transport, and the Sediment Diagenesis Model. The inputs for TAM include tidal heights, upstream loads, and tributary subwatershed flows. TAM will create flows and loads, which will then serve as inputs for the WASP. This water quality simulation program provides a generalized framework for modeling water quality and transport in surface waters and is based on the finite-segment approach (Di Toro *et al.*, 1983). WASP5 is supported and distributed by U.S. EPA's Center for Exposure Assessment Modeling (CEAM) in Athens, GA (Ambrose *et al.*, 1988).

The Sediment Diagenesis model is the second generation WASP model which has been incorporated into TAM/WASP. This model was modified by Dr. Winston Lung of the University of Virginia from an earlier version done by Dr. Di Toro. It takes into account the BOD and nutrients moving between the sediment and the water column. More precisely, the sediment layers allow an interaction between the sediment oxygen demand and the water column. This model also describes changes in aqueous methane, gaseous methane, ammonia, and gaseous nitrogen. This is accomplished by keeping a mass balance of carbonaceous biochemical oxygen demand and organic nitrogen.

The model was modified by the Interstate Commission on the Potomac River Basin to compute clarity. The equation used by the Chesapeake Bay water quality model was adapted for the Anacostia. The formula allows light extinction to vary according to the concentration of color, TSS and chlorophyll. Regression analysis with the data was used to establish the coefficients and it was determined that color was of not a significant variable. Concentrations of TSS are read into the model from output files generated by Toxi-WASP. Chlorophyll concentrations are computed internally and used with the input daily average TSS concentrations to generate a light extinction measured as secchi disc depth in meters. The equation was generated by performing a linear regression of secchi disc depth on TSS and adding to that equation a chlorophyll term. This methodology tends to double count algal biomass that is included in the TSS measurement. Consequently, there is a requirement to either back out the embedded algae or ensure that output is correctly interpreted.

The conversion of the light formulation caused the model to be recalibrated for algae growth. Calibration for other parameters was performed only to the extent necessary to insure an accurate computation of clarity.

The Anacostia TAM/WASP model divides the river into 15 segments from Bladensburg to its confluence with Potomac River shown in Figure 5. The upstream load from Maryland was calculated from land use and data that was provided by the Montgomery and Prince George's County storm water monitoring programs. The Combined Sewer Overflows, which start in segment 9 and go through 14, are also entered into the model. Segment 15 is the boundary between the Anacostia and the Potomac Rivers. TAM/WASP also incorporated storm sewer loads in all segments and tributaries such as Watts Branch and Lower Beaverdam Creek. Segments 1, 2, and 3 are located in Maryland and Segments 4-15 are in DC. Lower Beaverdam Creek, which enters segment 4, is predominantly in Maryland and all loads were counted as Maryland Loads. Watts Branch enters segment 6 and 53% of its loads originate in Maryland and 47% percent of the loads originate in DC.

The model was calibrated to meteorological, flow, and water quality data for the calendar years 1988, 1989, and 1990. This series of years is a reasonable set of conditions to examine load reduction scenarios because 1988 was a low flow year, followed by 1989 a high flow year, and 1990 an "average" flow year. There are no continuous permitted point source loads that contribute to the TSS problem. The problem is due to a precipitation induced pollution load. Storm sewers and nonpoint source loads were computed using a BASINS (Better Assessment Science Integrating Point and Non Point Sources) model of Watts Branch. BASINS uses the watershed model, Hydrodynamic Simulation Program - FORTRAN (HSPF) with a Geographical Information Systems interface to calculate loads. These values were then used in a ratio between land use and basin size to calculate the loads for all of the other basins contributing to the river.

Scenarios

The Interstate Commission on the Potomac River Basin (ICPRB) revised the TAM model to include the new light formulation but did not include the DOH adjusted CSO loads of about 1.5 billion gallons per year. The model was not adjusted to improve the dissolved oxygen calculations. To set the TMDL, a series of computer simulations were run to determine the amount of reduction of loads that would be needed to meet water quality standards. It is assumed that the Chesapeake Bay nutrient reductions of about 30% nitrogen and phosphorus would be met. No attempt was made to determine the limiting nutrient. Because the regression of light versus TSS included algae as a component of the TSS there was in effect a double counting of algae up to a concentration of about 15.6 ug/l. Downstream boundary conditions were adjusted to reflect improved water quality coming down the Anacostia. The water quality criteria for clarity can be met by a number of different allocations between the sources. The draft TMDL proposed an allocation of about 85% reductions in Maryland and about 90% reductions of the District sources. The final allocation is about an 86% reduction for Maryland and about an 83 % reduction for District sources

CRITICAL CONDITIONS AND SEASONAL VARIATIONS

The water quality standards establish the critical conditions as the average clarity at the average flow for the growing season of April through October. Clarity may vary in other seasons and there is no criteria for the other seasons. The criteria of 0.8 meters must be met over a period of years and recognizes that in high flow years the secchi disc depth will be less than 0.8 and that during dry years will be greater than 0.8 meters. The design flow for point sources is the long term season average and compliance must be achieved at flows between the 7Q10 and the long term seasonal average. The criteria does not apply to flows above the seasonal average and below the 7Q10.

ALLOCATIONS, REDUCTIONS, MARGIN OF SAFETY, AND THE TMDL

The total allowable load of TSS reflects the reduction needed in order to allow clarity to remain over 0.8 m as stated in the WQS criteria at the average seasonal flow. At higher flow regimes the clarity will be less and at lower flow regimes the clarity will be greater. The TMDL was then allocated between the waste load allocation (WLA) for the point source contribution, the load allocation (LA) for the nonpoint sources, and an explicit margin of safety (MOS) to further account for uncertainties in the analysis.

For Maryland, a target average seasonal load to be achieved is 2,584,000 pounds of TSS, less a Margin of Safety of 26,000 pounds, which equals an average seasonal load of 2,558,000 pounds of TSS.

TSS AVERAGE LOADS IN POUNDS DURING APRIL THROUGH OCTOBER
MARYLAND

NORTHEAST & NORTHWEST BRANCHES	2,454,000
SMALL TRIBS-15.9%	21,000
LOWER BEAVER DAM CREEK	71,000
WATTS BRANCH 53%	38,000
TOTAL	2,584,000
MARGIN OF SAFETY	26,000
TARGET	2,558,000

For District of Columbia sources, the following table shows the allowable TSS loads which meet the WQS of 0.8 meters with a margin of safety.

DISTRICT OF COLUMBIA

SMALL TRIBS-84.1%	113,000
WATTS BRANCH 47%	34,000
CSO	100,000
TOTAL	247,000
MARGIN OF SAFETY	3,000
ALLOCABLE	244,000
CSO	99,000
Stormwater Runoff	145,000

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 99,000 pounds per season of TSS, which is estimated to be an 83% reduction DOH model input. Storm water discharges from storm sewers are point source discharges and are assigned an 80% reduction of loads; however, the exact magnitude of this load in pounds is not currently known. There will be 0 discharge allocated for boats.

Load Allocation

The total allocation for point source and nonpoint source storm water is 145,000 pounds per season. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after an 80% reduction by point source storm water.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the Southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there is about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River are federally owned. Each federal facility is allocated an 80% reduction of its TSS loads. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data.

Other Sources and Reserve

The allocation of TSS to boats, ships, houseboats, and floating residences is zero. The allocation of TSS to reserve is zero.

Margin of Safety

The final load allocations and targets include slightly over a 1% margin of safety from the total load allocations. The one percent for TSS is 3,000 pounds.

Additional Considerations

The distribution of the pollution loads by jurisdiction under this allocation is not equivalent to the land area. The District occupies about 17% of the land and generates only 7% of the load and is allocated 9% of the TSS load. Maryland occupies 83% of the basin generates 93% of the load and is allocated 91% of the load.

The water quality standards criteria for light of 0.8m secchi disc depth is met at algal concentrations of about 43 ug/l which is well above the water quality standard criteria for algae of 25 ug/l/. Thus any nutrient reductions needed in the future to control algae will be more than that necessary to achieve the light criteria. It is estimated that the current nutrient reductions of 40% will be satisfactory to prevent the light criteria from being violated.

Implementation

On May 10, 1999, Mayor Williams signed a new Anacostia Watershed Restoration Agreement with Maryland, Prince George's County, Montgomery County, and U.S. EPA to increase efforts to improve water quality. The Agreement has six major goals. The first one pertains to this TMDL:

> Goal #1: dramatically reduce pollutant loads, such as **SEDIMENT**, toxics, CSOs, other nonpoint inputs and trash, delivered to the tidal river and its tributaries to meet water quality standards and goals.

On June 28, 2000, Mayor Williams, Governor Glendening, U.S. EPA and others signed the new Chesapeake Bay Agreement which states:

> By 2010, the District of Columbia, working with its watershed partners, will reduce pollution loads to the Anacostia River in order to eliminate public health concerns and achieve the living resources, water quality, and habitat goals of this and past agreements.

Thus, an agreement is in place which clearly demonstrates a commitment to the restoration of the river by the year 2010. This establishes a completion date for implementation of those activities necessary to achieve the load reductions allocated in this TMDL.

Source Control Plan

Upstream Target Load Reductions for Maryland

Based upon the best available information, load reductions TSS were selected to achieve DC WQS for clarity at the DC/MD line. Maryland has committed to a 40% nitrogen and phosphorus reduction in the Bay Agreement and has developed tributary strategies that will achieve that reduction in the Anacostia basin. DOH estimates that the controls needed to achieve the nutrient reductions will concomitantly achieve at least an 80% reduction of the TSS loads. As a Chesapeake Bay signatory Maryland will assign load reductions for sediment for each of its tributaries within the next year. Maryland will also adopt water clarity standards that are conducive to the growth and propagation of SAV in the tidal Anacostia River above DC. Mitigation measures for Woodrow Wilson Bridge will include the rehabilitation of wetlands in the Anacostia basin in Maryland, which will function as a removal mechanism for TSS. Both Prince Georges and Montgomery Counties have aggressive and effective stormwater management programs.

CSO Load Reductions

WASA is currently engaged in the following CSO reduction programs.

1. Nine Minimum Controls Plan.
2. Development of the Long-Term Control plan for CSOs which meets the requirements of this TMDL. The completion of the LTCP is contingent upon approval from U.S. EPA and DC DOH. The LTCP must also meet the requirement of the BOD TMDL.
3. East side interceptor cleaning to remove sedimentation and restore transmission capacity.
4. Pump station rehabilitation to increase transmission capacity to the treatment plant.
5. Inflatable dam rehabilitation to restore the dam's ability to hold sewage inside the pipe, hence reduce overflows.
6. Swirl concentrator rehabilitation and performance enhancements to improve treatment.

Storm Water Load Reductions

The DC Department of Health issued the Nonpoint Source Management Plan II in June, 2000. The plan contains descriptions of the current programs and activities that are performed by DC Government to reduce nonpoint source pollution.

Under the U.S. EPA issued Municipal Separate Storm Sewer Permit there are a number of requirements. The most pertinent of these is the requirement to develop a storm water management plan by April, 2002. The plan should provide additional mechanisms for achieving the load reductions needed.

Major currently operating programs in DC which reduce loads are as follows:

1. Street sweeping programs by the Department of Public Works.
2. Requirements for storm water treatment on all new development and earth disturbing activities such as road construction. The BMP and removal efficiencies that have been installed in the Anacostia drainage area in accordance with DC Law 5-188, The Water Pollution Control Act of 1985 are included in the appendix.
3. Regulatory programs restricting illegal discharges to storm sewers and enforcing the erosion control laws.
4. Kingman Lake –This project restored over 40 acres of freshwater tidal wetlands in the Kingman Lake area in order to increase plant and animal diversity. These wetlands will improve water quality by reducing the amount of sediment in the water by an estimated 1,600,000 pounds per growing season. This project was completed in 2000. Monitoring efforts are continuing in connection with other wetlands that have been restored in Kenilworth Park. Funding for this project was cost shared by the USACE, Maryland and USEPA.
5. River Fringe Wetlands -The goal of this project is to restore 15 acres of tidal wetlands along the shores of the Anacostia River above Kingman Island. As with the Kingman Lake wetlands, these wetlands will increase the number of beneficial plants and fish in the river and will reduce the amount of sediment in the water an estimated 369,000 pounds per growing season. The USACE has completed the design for this project. Construction is scheduled for Spring 2002. Funding for this project was cost shared with the USACE and USEPA.
6. Kenilworth Marsh Restoration- This project was constructed in a cooperative effort by the Department of Health, USACE and USNPS. The project involved the restoration of 33 acres of wetlands and it is estimated that they remove 2,720,000 pounds of sediment per growing season.
7. Kingman Island- The goal of this project is to restore the southern half of the island as a natural park recreational area. This project is being closely coordinated with Office of Planning and Department of Parks Recreation. The USACE has completed preliminary sampling for contaminants on both Heritage and Kingman Island and is currently completing a feasibility study of the islands. The USACE is also assisting the District in meeting the National Environmental Policy Act, a legal requirement when the land was transferred back to the District. The USACE Aquatic Restoration program is designing the habitat component of this project. Design and implementation is cost shared: 65% federal, 35% District. Habitat restoration efforts on Heritage Island are scheduled for implementation by the USACE in FY02. EHA also funded and facilitated the reconstruction of the pedestrian bridges by the US Navy (completed 04/01).
8. River Terrace & RFK BMPs- The goal of this project is to install stormwater management facilities at the end of two stormwater outfalls. The outfalls are located along the RFK Stadium parking lot and the River Terrace community. The purpose of these facilities will be to filter pollutants from the stormwater before the water is discharged into the Anacostia River. Currently, the USACE is conducted a feasibility study to determine different design options. Cost sharing and funding is provided by the USACE and USEPA for these projects.
9. Fort Dupont-The goal of this project is to restore habitat in and the flow conditions of the Fort Dupont stream. The project is being conducted in phases. The initial phase was funded by the US Geological Service and reviewed by the National Park Service. This phase included a study of the physical, chemical, and biological conditions and a preliminary design for reducing stormwater flows into Fort Dupont. A stormwater management facility will be constructed to remove sediment, oil and grease, and other street runoff pollutants as well as stem stormwater flows causing erosion in Fort Dupont creek. The second phase will restore in stream habitat and determine additional methods for managing stormwater within Fort Dupont Park and will be cost shared with and implemented by the USACE.

10. Fort Chaplin-The goal of this project is to completely restore the Fort Chaplin tributary by stabilizing the stream banks and reducing amount of sediment entering the stream and the Anacostia. This project is also examining the possibility of reforming the stream to better accommodate stormwater flows. This project will be implemented after the restoration of Fort Dupont. The USACE is currently conducting a feasibility study of the stream to determine design options.
11. Pope Branch-The goal of this project is to restore habitat and improve water quality in the lower Anacostia Park. Restoration efforts will include planting of native trees, restoring tidal and non-tidal wetlands, and opening a portion of Pope Branch that is currently piped under the Park. The US Army Corps of Engineers Aquatic Restoration program is currently designing this project. Design and implementation is cost shared: 65% federal, 35% District. As part of this project, the District has funded a study of Pope Branch to determine restoration options within the watershed.
12. Hickey Run- The objective of this project is to improve water quality and habitat conditions of Hickey Run. Improvements include installation of a stormwater management facility where Hickey Run enters the National Arboretum. This facility will filter pollutants such as oil and grease originating from industrial areas north of New York Avenue. Funding has been transferred to the Arboretum for this facility. This project will also rebuild channelized portions of the stream to a more natural flow pattern to better control sediments and protect fish and other wildlife. Partners on this project include US National Arboretum and USEPA, Chesapeake Bay program.
13. Environmental education and citizen outreach programs to reduce pollution causing activities.
14. Stickfoot Creek- This small stream will be daylighted and wetlands will be rehabilitated to provide water quality and aquatic life improvements. The project is scheduled for completion in 2004.

Federal lands encompass approximately 18 percent of the land inside DC that contribute flow to storm water to the Anacostia River. Consequently, load reductions are assigned to the federal government to achieve. The Washington Navy Yard, GSA-Southeast Federal Center, and Anacostia Naval Air Station have or will have storm water permits issued by U.S. EPA and certified by DC DOH. Under these permits, the federal facilities are required to have storm water management plans to control storm water runoff. The remaining federal facilities such as the National Park Service and National Arboretum will need to develop storm water management plans to reduce their loads and implement those plans.

The District of Columbia Water Pollution Control Act (DC Law 5-188) authorizes the establishment of the District's Water Quality Standards (21 DCMR, Chapter 10) and the control of sources of pollution such as storm water management (21 DCMR, Chapter 5). The storm water management regulations require the hydraulic control of the once in 15 years storm and the water quality treatment of the first one half inch of rainfall.

Boat Discharges

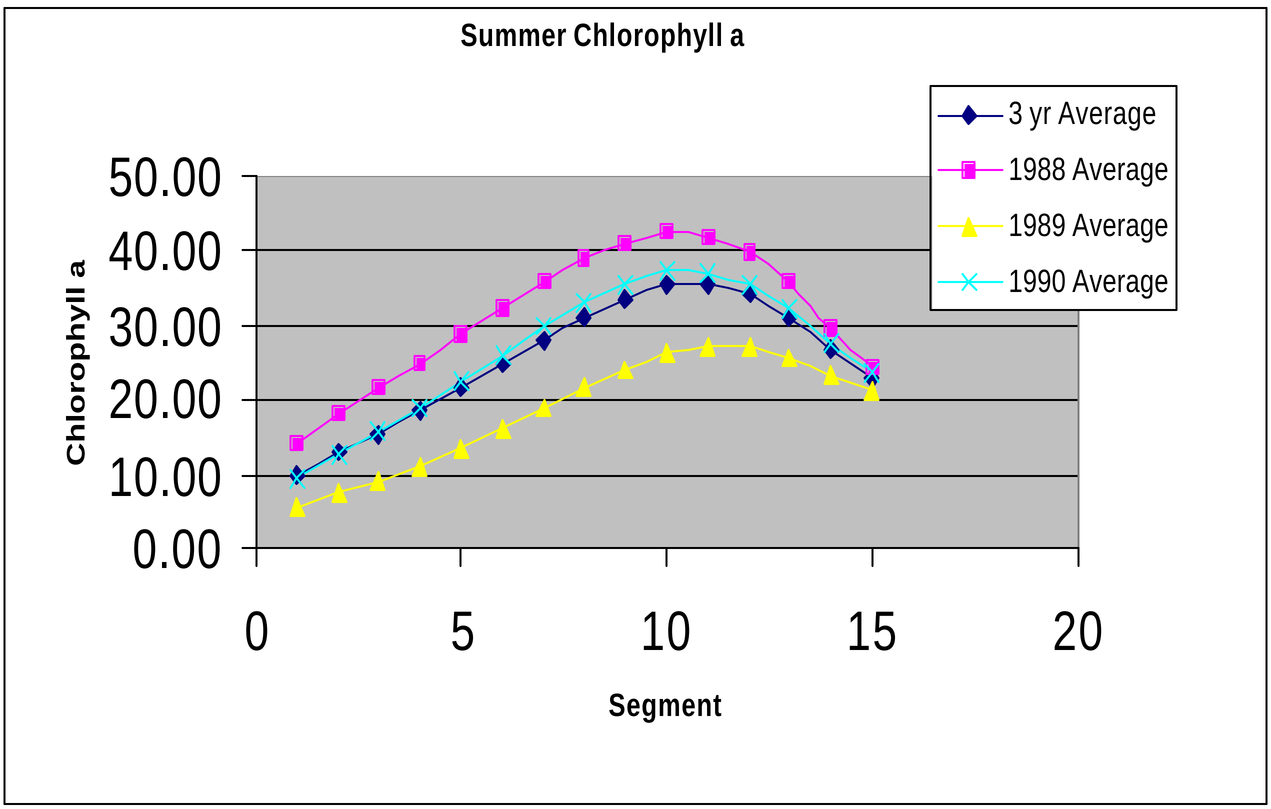
The Anacostia River has been allocated a Zero Discharge from watercraft in this document. In the Chesapeake Bay 2000 Agreement which was signed by the signatory states, the District of Columbia, and US EPA, has a provision that by 2003 there will be no discharge of human waste from any boats. These wastes contribute TSS to the water column. DOH has funded pump out stations at every marina in the Anacostia River.

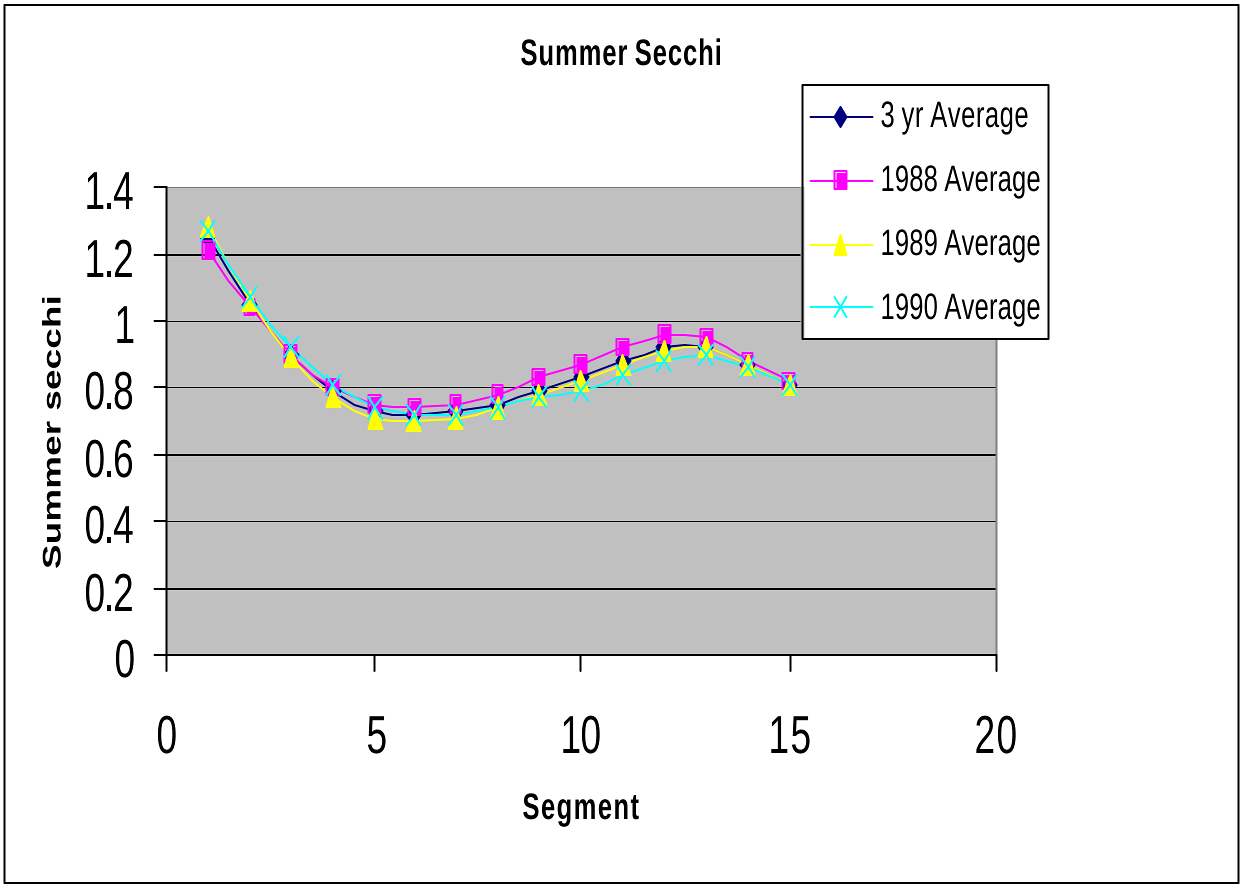
Construction and Dredging

Activities authorized under section 404(e) such as dredging can generate TSS loads which affect clarity. These activities are normally restricted to periods when fish spawning activities are at a minimum. In addition the criteria for turbidity of less than a 20 NTU increase above ambient applies to these types of activities. The Department of Health will consider the impact of these activities during the water quality certification process.

Monitoring

The Department of Health maintains an ambient monitoring network which includes the Anacostia River and tributaries. Data is collected on clarity, TSS and algae at least monthly.




Summer Secchi
3 yr Average
1988 Average
1989 Average
1990 Average
Summer secchi
1.4
1.2
1
0.8
0.6
0.4
0.2
0
0
5
10
15
20
Segment

Segment	3 yr Average	1988 Average	1989 Average	1990 Average
1	1.253114	1.211547	1.277347	1.270449
2	1.052833	1.035201	1.055425	1.067874
3	0.903871	0.898098	0.891467	0.922047
4	0.792229	0.795846	0.77478	0.806061
5	0.733019	0.746883	0.712346	0.739827
6	0.720785	0.739388	0.702986	0.719981
7	0.729751	0.754042	0.714537	0.720673
8	0.752187	0.780636	0.740364	0.735561
9	0.79081	0.825547	0.780991	0.765893
10	0.827442	0.86964	0.817743	0.794944
11	0.87643	0.92279	0.866491	0.840009
12	0.920277	0.963804	0.912271	0.884757
13	0.922793	0.952528	0.919949	0.895902
14	0.8704	0.883748	0.871547	0.855907
15	0.81231	0.817841	0.813028	0.806061
Average	0.812369	0.837724	0.802253	0.797131
Segment 4-15 Average	0.81	0.84	0.80	0.80

Segment	3 yr Average	1988 Average	1989 Average	1990 Average
1	9.75	14.30	5.54	9.42
2	12.82	18.28	7.44	12.74
3	15.41	21.46	9.15	15.63
4	18.36	24.93	11.17	18.98
5	21.48	28.54	13.41	22.47
6	24.77	32.15	16.00	26.15
7	28.13	35.71	18.84	29.83
8	31.17	38.80	21.64	33.07
9	33.56	41.01	24.12	35.55
10	35.53	42.56	26.51	37.52
11	35.30	41.69	27.14	37.08
12	34.16	39.79	27.05	35.63
13	31.27	35.64	25.78	32.39
14	26.88	29.59	23.36	27.71
15	23.00	24.30	21.10	23.61
Average	25.43895	31.2495	18.55	26.51735
Segment 4-15 Average	28.63	34.56	21.34	30.00

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