Total Maximum Daily Loads of Nutrients/Biochemical Oxygen Demand for the Anacostia River Basin, Montgomery and Prince George's Counties, Maryland and The District of Columbia

FINAL

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and

District of Columbia Department of the Environment - Natural Resources Administration

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U.S. Environmental Protection Agency, Region III
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List of Abbreviations

ARCWP	Anacostia River and Tributaries Comprehensive Watershed Plan
AWRC	Anacostia Watershed Restoration Committee
BARC	Beltsville Agricultural Research Center
BMPs	Best Management Practices
BOD	Biochemical Oxygen Demand
CBPO	Chesapeake Bay Program Office
CFD	Cumulative Frequency Distribution
Chla	Chlorophyll *a*
COMAR	Code of Maryland Regulations
CSO	Combined Sewer Overflow
CWA	Clean Water Act
CWAP	Clean Water Action Plan
DC	The District of Columbia
DCDOH	District of Columbia Department of Health
DCMR	District of Columbia Municipal Regulations
DCR	District of Columbia Register
DCWASA	District of Columbia Water and Sewer Authority
DDOE	District of Columbia Department of the Environment
DNR	Maryland Department of Natural Resources
DO	Dissolved Oxygen
EMC	Event Mean Concentration
ENR	Enhanced Nutrient Removal
EPA	U.S. Environmental Protection Agency
ESD	Environmental Site Design
FDC	Flow Duration Curve
GIS	Geographical Information Systems
HDR	High-Density Residential
HSPF	Hydrologic Simulation Program – FORTRAN
ICPRB	Interstate Commission on the Potomac River Basin
LA	Load Allocation
LBC	Lower Beaverdam Creek
LDR	Low-Density Residential
LID	Low Impact Development
LTCP	Long Term Control Plan
MCDEP	Montgomery County Department of Environmental Protection
MD	Maryland
MDE	Maryland Department of the Environment
MDP	Maryland Department of Planning
MDR	Medium-Density Residential
mg/L	Milligrams per Liter
MGD	Million Gallons per Day

MGE	Municipal Growth Element
MOU	Memorandum of Understanding
M-NCPPC-PG	Maryland National Capital Park and Planning Commission – Prince George's County
MOS	Margin Of Safety
MS4	Municipal Separate Storm Sewer System
MWCOG	Metropolitan Washington Council of Governments
NEB	Northeast Branch of the Anacostia River
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NPS	Nonpoint Source
NRI	National Resource Inventory
NWB	Northwest Branch of the Anacostia River
PCBs	Polychlorinated Biphenyls
PGDER	Prince George's County Department of Environmental Resources
PS	Point Source
SAV	Submerged Aquatic Vegetation
SOD	Sediment Oxygen Demand
STATSGO	State Soil Geographic Data Base
SWM	Stormwater Management
SWMP	Stormwater Management Plan
TAM	Tidal Anacostia Model
TMDL	Total Maximum Daily Load
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WASP	Water Analysis Simulation Program
WLA	Waste Load Allocation
WQLS	Water Quality Limited Segment
WQSs	Water Quality Standards
WRAS	Watershed Restoration Action Strategy
WRE	Water Resources Element
WSSC	Washington Suburban Sanitary Commission
WWTP	Wastewater Treatment Plant
µg/L	Micrograms per Liter

EXECUTIVE SUMMARY

This document, upon approval by the U.S. Environmental Protection Agency (EPA), establishes Total Maximum Daily Loads (TMDLs) for Biochemical Oxygen Demand (BOD), nitrogen, and phosphorus in Maryland's (MD) tidal and non-tidal portions of the Anacostia River ("the Anacostia") and the District of Columbia's (DC) tidal Anacostia. Section 303(d) of the federal Clean Water Act (CWA) and EPA's implementing regulations direct each state to identify and list waters, known as water quality limited segments (WQLSs), in which current required controls of a specified substance are inadequate to achieve water quality standards. For each WQLS, the State is required to either establish a TMDL of the specified substance that the waterbody can receive without violating water quality standards, or demonstrate that water quality standards are being met.

In Maryland, the Anacostia and its tributaries have been variously designated as Use I-P, II, III and IV waters [Code of Maryland Regulations (COMAR) 26.08.02.08 O]. These uses are defined as follows: Use I-P – Water Contact Recreation, Protection of Aquatic Life and Public Drinking Supply; Use II: Tidal Waters: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting Use III – Natural Trout Waters; and Use IV – Recreational Trout Waters. The Maryland Department of the Environment (MDE) has identified the Anacostia (MD basin number 02140205) on the State's 303(d) List as impaired by the following (listing years in parentheses): nutrients (1996); sediments (1996); fecal bacteria (2002); impacts to biological communities—non-tidal waters (2002); toxics: polychlorinated biphenyls (PCBs) and heptachlor epoxide—non-tidal waters (2002); trash/debris (2006); and PCBs in fish tissue in tidal waters (2006). Fecal bacteria TMDLs for MD tidal and non-tidal areas of the Anacostia were submitted in 2006 and subsequently approved by EPA. Inter-jurisdictional TMDLs addressing MD's sediment and tidal PCBs listings were submitted in 2007 and subsequently approved by EPA.

The District of Columbia (DC) has classified the Anacostia for current and designated uses including category Class C: "Protection & Propagation of fish, shellfish and wildlife." [District of Columbia Municipal Regulations (DCMR), Chapter 11, Section 1101.2], DC's 303(d) List divides the Anacostia within the District's borders 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 and Pennsylvania Avenue and the upper Anacostia from the bridge to the Maryland border. The upper and lower segments of the Anacostia were listed on DC's 1998 Section 303(d) List as impaired by biochemical oxygen demand (BOD), bacteria, organics, metals, total suspended solids (TSS), and oil and grease. DC has previously developed TMDLs to address all of these impairments in its portion of the Anacostia; however, a 2006 court decision required the development of new BOD and TSS TMDLs for the Anacostia that include maximum daily load expressions in addition to longer-term (average annual, seasonal) loads.

A watershed-wide TMDL for sediment/TSS, addressing the listings for those impairments to the Anacostia in their respective jurisdictions, was submitted jointly by DC and MD in 2007 and subsequently approved by EPA. A multi-jurisdictional TMDL for PCBs in the tidal portions of the Potomac and Anacostia Rivers was submitted jointly in 2007 by MD, DC and the State of Virginia, and subsequently approved by EPA.
The overall objective of the TMDLs proposed in this document is to reduce nitrogen, phosphorus, and BOD loads to levels that are expected to result in the attainment of the water quality criteria that support the designated uses for the tidal Anacostia River in DC and MD and the nontidal watershed in MD, i.e., the protection of aquatic life and water contact recreation uses. Both jurisdictions have adopted dissolved oxygen (DO), chlorophyll *a* (Chla), and water clarity standards based on the regional guidance provided by EPA's Chesapeake Bay Program Office (CBPO 2003). Both MD and DC have adopted seasonal DO criteria for tidal waters that protect spawning and migratory fish, from February 1 through May 31, and generally protect aquatic life the remainder of the year. MD and DC have also both adopted seasonal numerical criteria for Secchi depth that protect submerged aquatic vegetation (SAV) critical to shallow water tidal habitats. MD has adopted CBPO's recommended narrative criteria for Chla while DC has established seasonal numeric criteria for Chla from July through September. The TMDLs for nitrogen, phosphorus, and BOD are intended to:

1. resolve violations of DO criteria associated with BOD and excessive nutrient enrichment of the tidal Anacostia River in DC and ensure that MD's DO standards are met in its portion of the tidal Anacostia;
2. resolve violations of MD's Chla narrative criteria and ensure that DC's Chla criteria are met in its portion of the tidal Anacostia; and
3. ensure that both DC and MD's water clarity criteria are met under the load allocations for the approved Anacostia sediment/TSS TMDLs.

To develop a TMDL, a linkage must be defined between the selected targets or goals and the pollutant sources. Once defined, the linkage yields the estimate of total loading capacity or TMDL (USEPA 1999). The computer modeling framework used to develop the nutrient and BOD TMDLs for the tidal Anacostia River is the Tidal Anacostia Model/Water Analysis Simulation Program (TAM/WASP). The TAM/WASP modeling framework was developed for use in DC's original BOD TMDL (DCDOH 2000; Mandel and Schultz 2000), the DC sediment TMDL (USEPA 2001; Schultz 2001), and the DC Water and Sewer Authority's (WASA) Long Term Control Plan (LTCP) (DCWASA 2001). It was most recently used to develop the joint MD-DC sediment TMDL for the Anacostia (MDE and DDOE 2007; Schultz et al. 2007). The modeling framework has the following three components: (1) the TAM, a continuous hydrodynamic model of the tidal Anacostia River first developed by the Metropolitan Washington Council of Governments (MWCOG) (Sullivan and Brown 1991); (2) a modified version of TOXIWASP that simulates sediment transport; and (3) a modified version of EUTROWASP, with enhanced capabilities of simulating sediment oxygen demand (SOD) and light extinction. Baseline loads were calculated from the calibration simulation using the simulation period 1995-1997, the three-year simulation period chosen to determine the TMDLs. This three-year period includes a wet year (1996), a dry year (1995), and an average year (1997), thus taking into account a wide variety of hydrological conditions, and addressing the critical condition and seasonality.

The following table provides the overall baseline loads, the overall TMDL loading caps, and the percent reductions from the baseline loads required in order to attain water quality standards in the Anacostia, for each of the three impairing constituents, BOD, total nitrogen (TN), and total phosphorus (TP).

Constituent	**BOD (lbs/yr)**	**TN (lbs/yr)**	**TP (lbs/yr)**
Baseline Load	3,795,400	948,966	104,436
Loading Cap	1,491,715	196,788	20,757
Percent Reduction	61%	79%	80%

The TMDLs shown below are distributed between: 1) waste load allocations (WLAs) to National Pollutant Discharge Elimination System (NPDES) municipal and industrial point source (PS) discharges, municipal separate storm sewer systems (MS4s) and other NPDES-regulated stormwater (SW) discharges, and DC Combined Sewer Overflows (CSOs); 2) load allocations (LAs) to forest and agricultural lands; and 3) a margin of safety (MOS), which, in the case of nutrients, is 5% of the TMDLs for TN and TP; in the case of BOD, the MOS is implicitly incorporated in the TMDL through conservative analytical assumptions.

The following three tables give the TMDLs for BOD, TN, and TP, respectively, expressed as average annual loads. As the tables indicate, TMDLs have been developed for each of the four listed segments: the MD non-tidal and MD tidal portions of the river, and DC's Tidal Upper Anacostia and Tidal Lower Anacostia segments. (Although analysis of recent monitoring data shows that MD's water quality standards are met in the State's non-tidal waters, MD non-tidal TMDLs are required to ensure that applicable standards are met in the tidal waters.) Each upstream segment's overall load (minus the MOS in the TN and TP TMDLs) is rolled into the succeeding downstream segment as an "upstream load," resulting in a cumulative, watershed-wide TMDL. Note that the MD non-tidal segment includes an upstream load from DC sources that drain to MD waters in the Northwest Branch (NWB); similarly, loads from MD's portion of Watts Branch and LBC are added to the upstream load for the DC Tidal Upper segment where they discharge. Loads from DC's portion of those two subwatersheds are included in the MS4-WLA for the DC Tidal Upper Anacostia.

The average annual TMDLs were calculated to meet all applicable water quality standards in the Anacostia for the three constituents, BOD, TN and TP, including: the defined spawning season (February through May) when stricter DO criteria are in effect; the period of the Open Water Designated Use subcategory (June through January); and the specific seasonal standards for chlorophyll *a* (July through September) and water clarity (April through October).

Summary of Average Annual BOD TMDLs for the Anacostia Watershed (lbs/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
16,300[1]	855,456	18,857	Implicit	890,614

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
746,939[2]	76,576	179	Implicit	823,694

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4/Other SW WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia PS WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
967,369[3]	205,854[4]	52,472	501	66,548	Implicit	1,292,744

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4/Other SW WLA	DC Lower Anacostia CSO WLA	DC PS WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
1,292,744	114,154	56,801	1,005	29,704	Implicit	1,494,409

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (14,082) and Lower Beaverdam Creek (129,593). Because these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (14,082) and Lower Beaverdam Creek (129,593).

[4]Includes loads from DC non-tidal waters in Watts Branch (14,252) and Lower Beaverdam Creek (403).

Summary of Average Annual Total Nitrogen TMDLs for the Anacostia Watershed (lbs/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
1,986[1]	119,827	24,588	7,705	154,107

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
131,235[2]	5,345	98	7,194	143,871

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4/Other SW WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
151,844[3]	12,692[4]	5,061	4,123	9,143	182,863

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4/Other SW WLA	DC Lower Anacostia CSO WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
173,719	5,882	5,479	1,868	9,839	196,788

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (1,631) and Lower Beaverdam Creek (13,536). Because these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (1,631) and Lower Beaverdam Creek (13,536).

[4]Includes loads from DC non-tidal waters in Watts Branch (1,731) and Lower Beaverdam Creek (45).

Summary of Average Annual Total Phosphorus TMDLs for the Anacostia Watershed (lbs/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
166[1]	13,584	888	770	15,408

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
12,782[2]	521	4	700	14,007

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4/Other SW WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
15,162[3]	1,266[4]	1,047	361	939	18,776

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4/Other SW WLA	DC Lower Anacostia CSO WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
17,837	587	1,134	162	1,038	20,757

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (210) and Lower Beaverdam Creek (1,646). Because these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (210) and Lower Beaverdam Creek (1,646).

[4]Includes loads from DC non-tidal waters in Watts Branch (248) and Lower Beaverdam Creek (6)

The three additional tables that follow provide corresponding maximum daily loads for each of the constituents, based on the average annual TMDLs given above. See Appendix D for a detailed explanation of the technical methods used to determine these daily expressions.

Summary of Annually-Based Maximum Daily Loads of BOD for the Anacostia River Watershed (lbs/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max : avg)
< 0.89	4.37 : 3.419	303	209	0.652	Implicit	517 : 239
0.89 - 2.34	14.2 : 6.22	1,629	225	12.6	Implicit	1,881 : 394
2.34 - 3.48	29.0 : 12.0	6,931	225	24.8	Implicit	7,210 : 712
3.48 - 10.75	189 : 31.8	12,525	225	121	Implicit	13,060 : 1,812
> 10.75	1,216 : 304	77,499	225	2,832	Implicit	81,772 : 16,455

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max : avg)
All	81,772 : 2,438	6,797	34.0	Implicit	88,603 : 2,648

Summary of Annually-Based Maximum Daily Loads of BOD for the Anacostia River Watershed (cont'd) (lbs/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max : avg)	DC LBC MS4-WLA (max : avg)	DC LBC LA (max : avg)	MOS	Total TMDL (max : avg)
All	10,163 : 355	32.3 : 1.10	- : -	Implicit	10,195 : 356

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max : avg)	DC WB MS4-WLA (max : avg)	DC WB LA (max : avg)	MOS	Total TMDL (max : avg)
All	1,213 : 38.5	1125 : 39.0	- : -	Implicit	2,338 : 77.5

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia Other PS-WLA	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	88,603 : 2,648	18,331 : 564	125	49,674 : 14,311	6,212 : 182	Implicit	162,944 : 17,830

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max : avg)	DC Lower Anacostia Other PS-WLA	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	162,944 : 17,830	9,588 : 312	8.56	34,334 : 15,491	2,644 : 81.3	Implicit	209,519 : 33,717

Summary of Annually-Based Maximum Daily Loads of Total Nitrogen for the Anacostia River Watershed (lbs/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max : avg)
< 0.89	0.775 : 0.331	41.9	27.4	5.74	3.99	79.8 : 51.7
0.89 - 2.34	3.34 : 1.32	182	27.4	29.0	12.7	254 : 109
2.34 - 3.48	5.64 : 2.39	703	27.4	50.4	41.4	828 : 187
3.48 - 10.75	25.1 : 4.80	1,367	27.4	142	82.2	1,644 : 375
> 10.75	215 : 30.8	13,919	27.4	3,604	935	18,700 : 2,331

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max : avg)
All	17,765 : 401	397	9.96	956	19,128 : 438

Summary of Annually-Based Maximum Daily Loads of Total Nitrogen for the Anacostia River Watershed (cont'd) (lbs/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max : avg)	DC LBC MS4-WLA (max : avg)	DC LBC LA (max : avg)	MOS	Total TMDL (max : avg)
All	1,082 : 37.1	3.57 : 0.124	- : -	57.1	1,143 : 39.2

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max : avg)	DC WB MS4-WLA (max : avg)	DC WB LA (max : avg)	MOS	Total TMDL (max : avg)
All	145 : 4.46	138 : 4.74	- : -	14.9	298 : 9.68

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	18,172 : 416	964 : 34.7	4,791 : 1,380	334 : 11.3	1,277	25,538 : 1,939

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	24,261 : 1,842	433 : 16.1	3,312 : 1,494	141 : 5.11	1,481	29,628 : 3,534

Summary of Annually-Based Maximum Daily Loads of Total Phosphorus for the Anacostia River Watershed (lbs/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max : avg)
< 0.89	0.0309 : 0.00900	3.57	2.05	0.0698	0.301	6.02 : 2.83
0.89 - 2.34	0.192 : 0.0421	18.6	2.05	0.401	1.12	22.4 : 5.01
2.34 - 3.48	0.403 : 0.0857	85.0	2.05	0.853	4.65	93 : 9.2
3.48 - 10.75	2.26 : 0.238	162	2.05	5.47	9.04	181 : 22.8
> 10.75	30.2 : 3.51	3,119	2.05	375	186	3,712 : 316

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max : avg)
All	3,526 : 40.0	43.4	0.515	187.9	3,758 : 43.6

Summary of Annually-Based Maximum Daily Loads of Total Phosphorus for the Anacostia River Watershed (cont'd) (lbs/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max : avg)	DC LBC MS4-WLA (max : avg)	DC LBC LA (max : avg)	MOS	Total TMDL (max : avg)
All	152.2 : 4.50	0.470 : 0.0160	- : -	8.04	160.7 : 4.75

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max : avg)	DC WB MS4-WLA (max : avg)	DC WB LA (max : avg)	MOS	Total TMDL (max : avg)
All	18.8 : 0.576	20.1 : 0.678	- : -	2.047	40.9 : 1.32

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	3,570 : 41.4	104.2 : 3.46	991 : 286	31.6 : 0.989	247	4,944 : 349

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	4,697 : 332	47.6 : 1.61	685 : 309	13.7 : 0.443	286	5,730 : 677

Both MD and DC have several well-established programs to draw upon that provide the basis for reasonable assurances that the nitrogen, phosphorus, and BOD TMDLs will be achieved and maintained. In MD, these include: the Water Quality Improvement Act of 1998 (WQIA), the Stormwater Management Act of 2007, and the Clean Water Action Plan (CWAP) framework. The District of Columbia Water Pollution Control Act (DC Law 5-188) authorizes the control of source of pollution through stormwater management (21 DCMR, Ch. 5). Montgomery and Prince George's Counties in MD, as well as DC, are subject to NPDES permits for their urban stormwater systems. Stormwater best management practices (BMPs) and programs implemented as required by NPDES stormwater permits shall be consistent with available WLAs developed under the TMDL.

In addition, there are several initiatives specific to the Anacostia that help to provide reasonable assurance for the implementation of these TMDLs. These include (1) DCWASA's LTCP for CSOs; (2) MD's and DC's commitments under the revised 2000 Chesapeake Bay Agreement, which includes a specific commitment to reduce pollutant loads to the Anacostia River; and (3) MD's and DC's participation in the Anacostia Watershed Leadership Council and the Anacostia Watershed Restoration Partnership, which coordinates the overall restoration effort in the Anacostia watershed.

MD and DC intend for the required reductions to be implemented in an adaptive and iterative process, in which ongoing implementation efforts are evaluated, increased or improved, and re-evaluated to achieve continuing progress toward the water quality goals. Thus, an iterative approach to implementation will involve a coordinated sequence of actions designed to approximate the desired result more and more closely. Given the significant nutrient reductions required by the TMDL, this approach is well-suited to the magnitude of the task, and will have the benefits of tracking water quality improvements following BMP implementation through follow-up stream monitoring; providing a mechanism for developing public support through periodic updates on BMP implementation; and helping to ensure that the most cost-effective practices are implemented first.

MDE and DDOE expect that the significant reductions of nutrient loads required by the TMDL to protect aquatic life will also be protective of other uses such as primary and secondary contact recreation. MD and DC will continue to monitor and assess the water quality in the Anacostia as load reductions take place in the watershed. If it is determined through implementation of the TMDL that additional reductions are necessary to protect uses such as primary (swimming) and secondary contact recreation (boating), then the TMDL can be revised and further reductions applied.

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1.0 INTRODUCTION

Section 303(d)(1)(C) of the Federal Clean Water Act (CWA) and the U.S. Environmental Protection Agency's (EPA) implementing regulations direct each state to develop a Total Maximum Daily Load (TMDL) for each impaired water quality limited segment (WQLS) on the Section 303(d) List, taking into account seasonal variations and a protective margin of safety (MOS) to account for uncertainty. A TMDL reflects the total pollutant loading of the impairing substance a waterbody can receive and still meet water quality standards.

TMDLs are established to determine the pollutant load reductions needed to achieve and maintain water quality standards. A water quality standard is the combination of a designated use for a particular body of water and the water quality criteria designed to protect that use. Designated uses include activities such as swimming, drinking water supply, and shellfish propagation and harvest. Water quality criteria consist of narrative statements and numeric values designed to protect the designated uses. Criteria may differ among waters with different designated uses.

In Maryland, the Anacostia River ("the Anacostia") and its tributaries have been variously designated as Use I-P, II, III and IV waters [Code of Maryland Regulations (COMAR) 26.08.02.08 O]. These uses are defined as follows: Use I-P – Water Contact Recreation, Protection of Aquatic Life and Public Drinking Supply; Use II: Tidal Waters: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting Use III – Natural Trout Waters; and Use IV – Recreational Trout Waters. The Maryland Department of the Environment (MDE) has identified the Anacostia (MD basin number 02140205) on the State's 303(d) List as impaired by the following (listing years in parentheses): nutrients (1996); sediments (1996); fecal bacteria (2002); impacts to biological communities—non-tidal waters (2002); toxics: polychlorinated biphenyls (PCBs) and heptachlor epoxide—non-tidal waters (2002); trash/debris (2006); and PCBs in fish tissue in tidal waters (2006). Fecal bacteria TMDLs for MD tidal and non-tidal areas of the Anacostia were submitted in 2006 and subsequently approved by EPA. Inter-jurisdictional TMDLs addressing MD's sediment and tidal PCBs listings were submitted in 2007 and subsequently approved by EPA.

The District of Columbia (DC) has classified the Anacostia for current and designated uses including category Class C: "Protection & Propagation of fish, shellfish and wildlife." DC's 303(d) List divides the Anacostia within the District's borders 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 and Pennsylvania Avenue and the upper Anacostia from the bridge to the Maryland border. The upper and lower segments of the Anacostia were listed on DC's 1998 Section 303(d) List as impaired by biochemical oxygen demand (BOD), bacteria, organics, metals, total suspended solids (TSS), and oil and grease. DC has previously developed TMDLs to address all these impairments in its portion of the Anacostia.

The 2002 BOD and TSS TMDLs for the tidal portion of the Anacostia in DC were determined for average annual loads or growing season loads. The U.S. Court of Appeals for the DC Circuit, in response to a suit filed by Friends of the Earth, Inc., ruled that the specification of average annual or growing season loads was not sufficient, and that the CWA specifies that TMDLs must be expressed as daily loads. The court's decision vacated EPA's 2002 approval of the BOD and TSS TMDLs. In response to the court's decision, MDE and the Natural Resources Administration of the DC Department of the Environment (DDOE) jointly submitted sediment/TSS TMDLs to EPA in 2007, addressing the listings for those impairments to the Anacostia in their respective jurisdictions. These MD-DC TMDLs for sediment/TSS, expressed in daily loads as well as average annual and growing season loads, were subsequently approved by EPA. A multi-jurisdictional TMDL for PCBs in the tidal portions of the Potomac and Anacostia Rivers was submitted jointly in 2007 by MD, DC and the State of Virginia and subsequently approved by EPA.

This document, upon EPA approval, establishes TMDLs for nutrients and BOD in the tidal and non-tidal portions of the Anacostia watershed in both MD and DC that will allow for the attainment of their respective designated uses. The BOD TMDLs established herein replace the DC BOD TMDLs vacated by the DC Circuit Court.

The decay of organic material in the water column, expressed as BOD, is a primary cause of low dissolved oxygen (DO) concentrations that fail to support aquatic life. The decay of deposited organic material in the sediments, which is the cause of sediment oxygen demand (SOD), also is a major factor in low DO. Nitrification of ammonia also contributes to oxygen demand. Eutrophication is the over-enrichment of aquatic systems by excessive inputs of nutrients, especially nitrogen and/or phosphorus. The nutrients act as fertilizer, leading to excessive growth of algae and aquatic plants, which eventually die and decompose, contributing to SOD. Excessive algal biomass also reduces the amount of light reaching aquatic plants and can cause a decline or disappearance of communities of submerged aquatic vegetation (SAV), a key component of tidal ecosystems.

The water quality goal of the nutrient and BOD TMDLs is to reduce high chlorophyll *a* (Chla) concentrations that reflect excessive algal blooms, and to maintain DO at a level supportive of the designated uses in the Anacostia. The TMDL will address water clarity problems and associated impacts to aquatic life in the Anacostia caused by eutrophication and excess algal growth; in so doing, the TMDL will also be protective of water contact recreation and aesthetic quality in the Anacostia.

The Anacostia is an interstate watershed: most of the non-tidal tributaries lie within MD, most of the tidal waters within DC's boundaries. This nutrient/BOD TMDL for the Anacostia watershed was developed through a cooperative agreement between EPA Region III, DDOE, and MDE. This document, upon EPA approval, establishes TMDLs for nutrients and BOD that: 1) are protective of aquatic life in the tidal and non-tidal waters of the Anacostia; 2) meet MD's and DC's DO water quality standards in their respective portions of the river; 3) meet MD's and DC's nutrient-related water quality standards in their respective portions of the river, and 4) meet the numeric criteria for water clarity in the tidal waters.

2.0 SETTING AND WATER QUALITY DESCRIPTION

2.1 Background and General Setting

The Anacostia River watershed comprises a 173 square mile drainage area that includes highly urbanized areas in DC, old and newly developing suburban neighborhoods in the surrounding metropolitan area, croplands and pastures at the U.S. Department of Agriculture's (USDA) Beltsville Agricultural Research Center (BARC), and forested parklands throughout the watershed. The Anacostia and many of its tributaries cross interstate boundaries, with 145 square miles of the watershed (84%) lying in MD, and 28 square miles (16%) in DC. The location of the watershed is shown in Figure 1.

The main channel of the Anacostia is 8.4 miles (13.5 kilometers) in length, extending from the confluence of its two largest tributaries, the Northwest Branch (NWB) and the Northeast Branch (NEB), in Bladensburg, MD, to the location where the Anacostia discharges into the Potomac River in DC. The main channel of the Anacostia is an estuary with a variation in water level of approximately three feet over a tidal cycle. Tidal influence extends into the lower reaches of the river's tributaries to approximately the locations of the U.S. Geological Survey (USGS) gage stations 01649500 on the NEB and 01651800 on Watts Branch, and to the bridge at U.S. Route 1 (Rhode Island Avenue) on the NWB, as indicated in Figure 2. Approximately 70% of the watershed is drained by the two largest tributaries, the NWB and the NEB. The other two major tributaries of the Anacostia, Lower Beaverdam Creek (LBC) and Watts Branch, drain highly urbanized areas in Prince George's County and DC.

2.1.1 Geology and soils

The watershed lies within two physiographic provinces, the Piedmont and the Coastal Plain, whose division runs approximately along the line dividing Montgomery and Prince George's Counties, MD. The upper northwestern portion of the watershed is in the Piedmont Plateau province, characterized by steep stream valleys and well-drained loamy soils underlain by metamorphic rock. The Piedmont portion of the watershed ranges in elevation from 200 to 400 feet above sea level, and streambeds tend to be rocky, with relatively steep gradients. The remainder of the basin lies within the Coastal Plain province, a wedge-shaped mass of primarily unconsolidated sediments covered by sandy soils. The Coastal Plain portion of the watershed, ranging from 0 to 200 feet above sea level, is characterized by lower relief, and is drained by slowly meandering streams with shallow channels and gentle slopes.

The NWB tributary lies predominantly in the Manor-Glenelg-Chester soil series. Soils in this series are fine-loamy, mixed, mesic Typic Hapludults and are very deep and well-drained (Maryland Soil Conservation Service, Montgomery County, MD 1995).

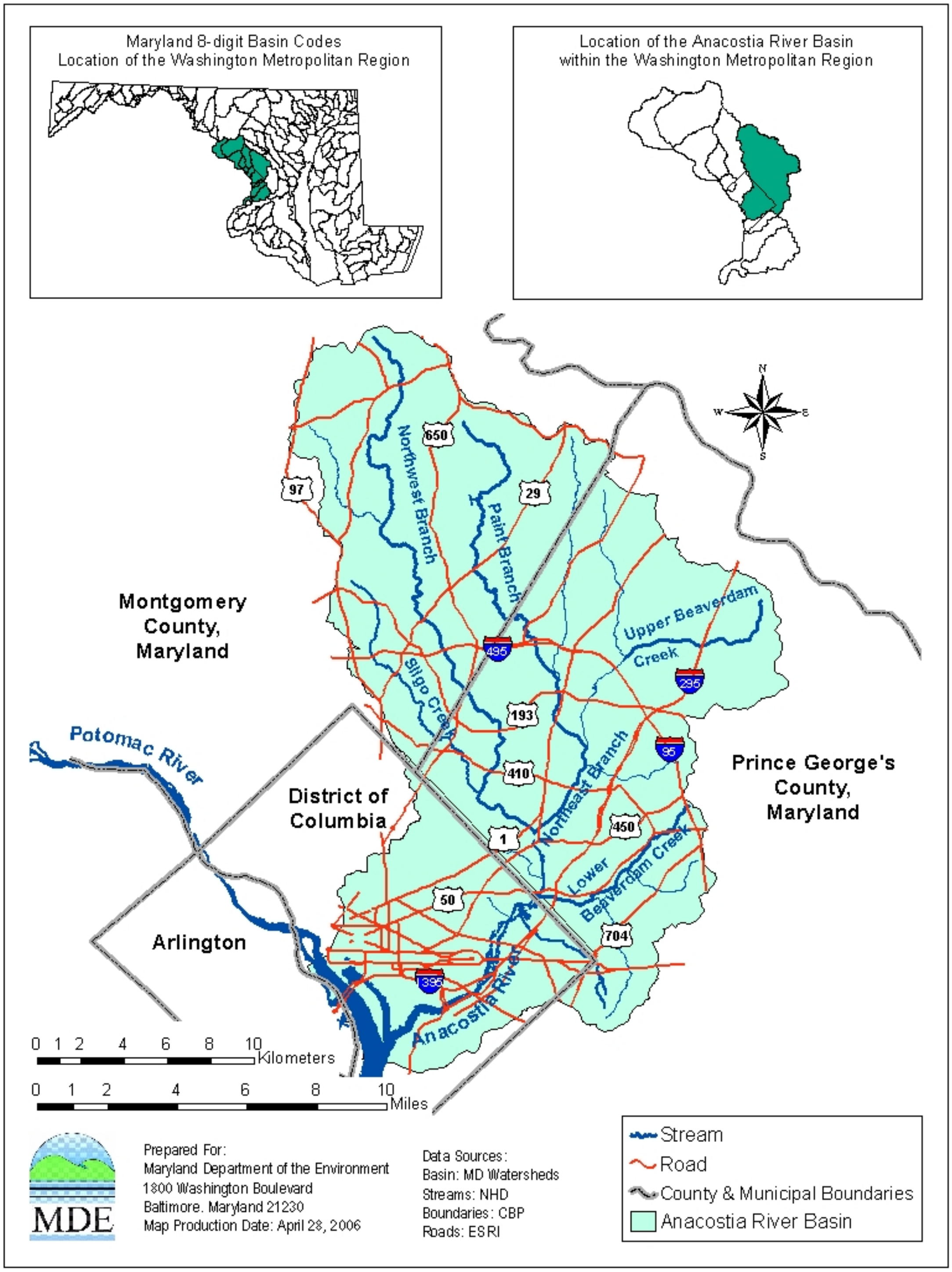


Figure 1. Location Map of the Anacostia River Watershed

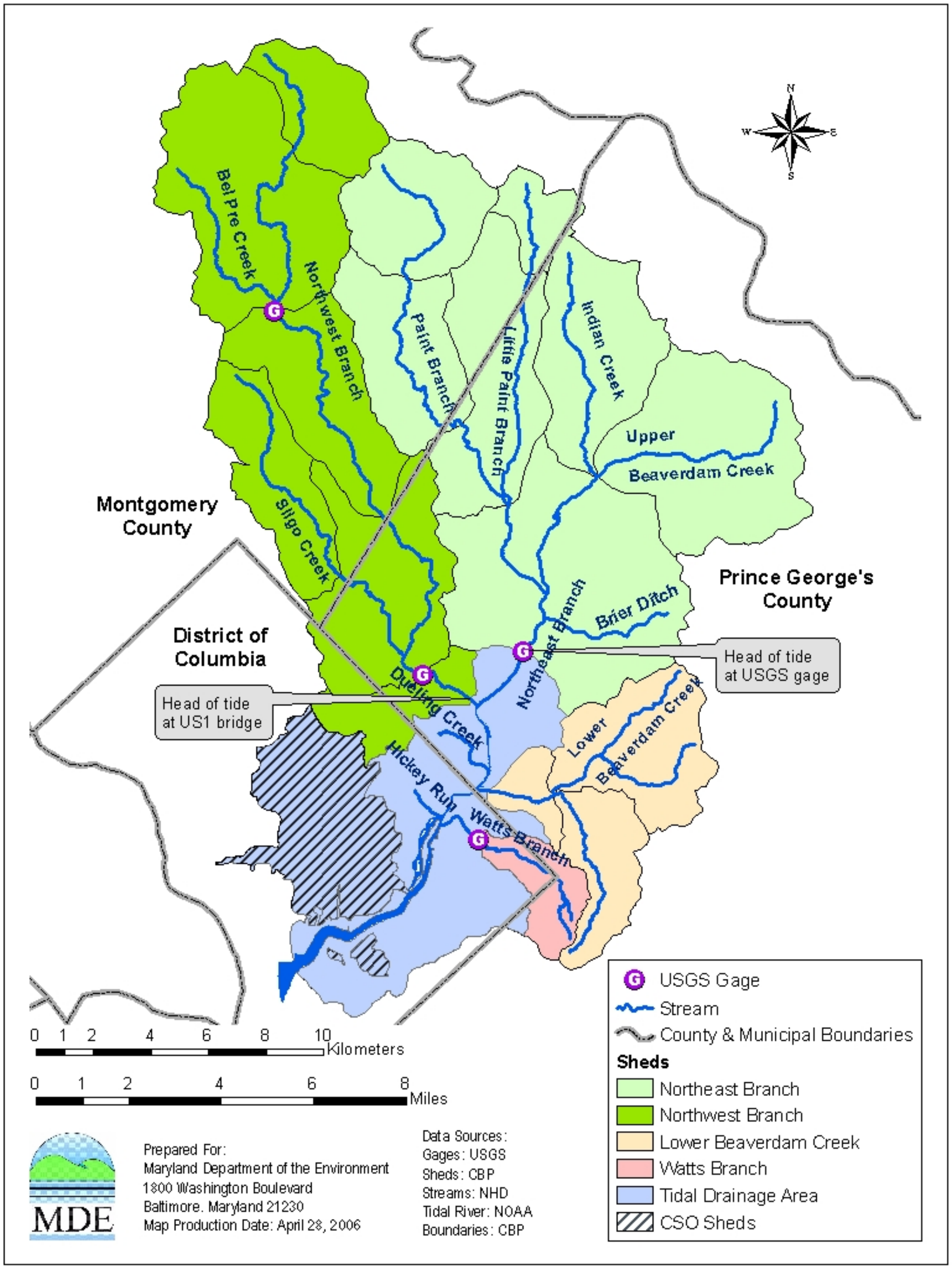


Figure 2. Anacostia River Subwatersheds

The NEB lies mostly in the Sunnyside-Christiana-Muirkirk soil series. The Sunnyside soils are mostly red, deep, and well-drained. The Christiana-Muirkirk are also red and deep soils but are less permeable than the Sunnyside soils (Maryland Soil Conservation Service Prince George's County, MD 1967). The portion of the watershed below the NWB and NEB drainage areas lies mainly in the Sunnyside-Christiana-Muirkirk soil series, and the Beltsville-Croom-Sasafras soil series (STATSGO). These soils are gently sloping to steep and dominantly gravelly soils (Maryland Soil Conservation Service, Prince George's County, MD 1967).

2.1.2 Land use

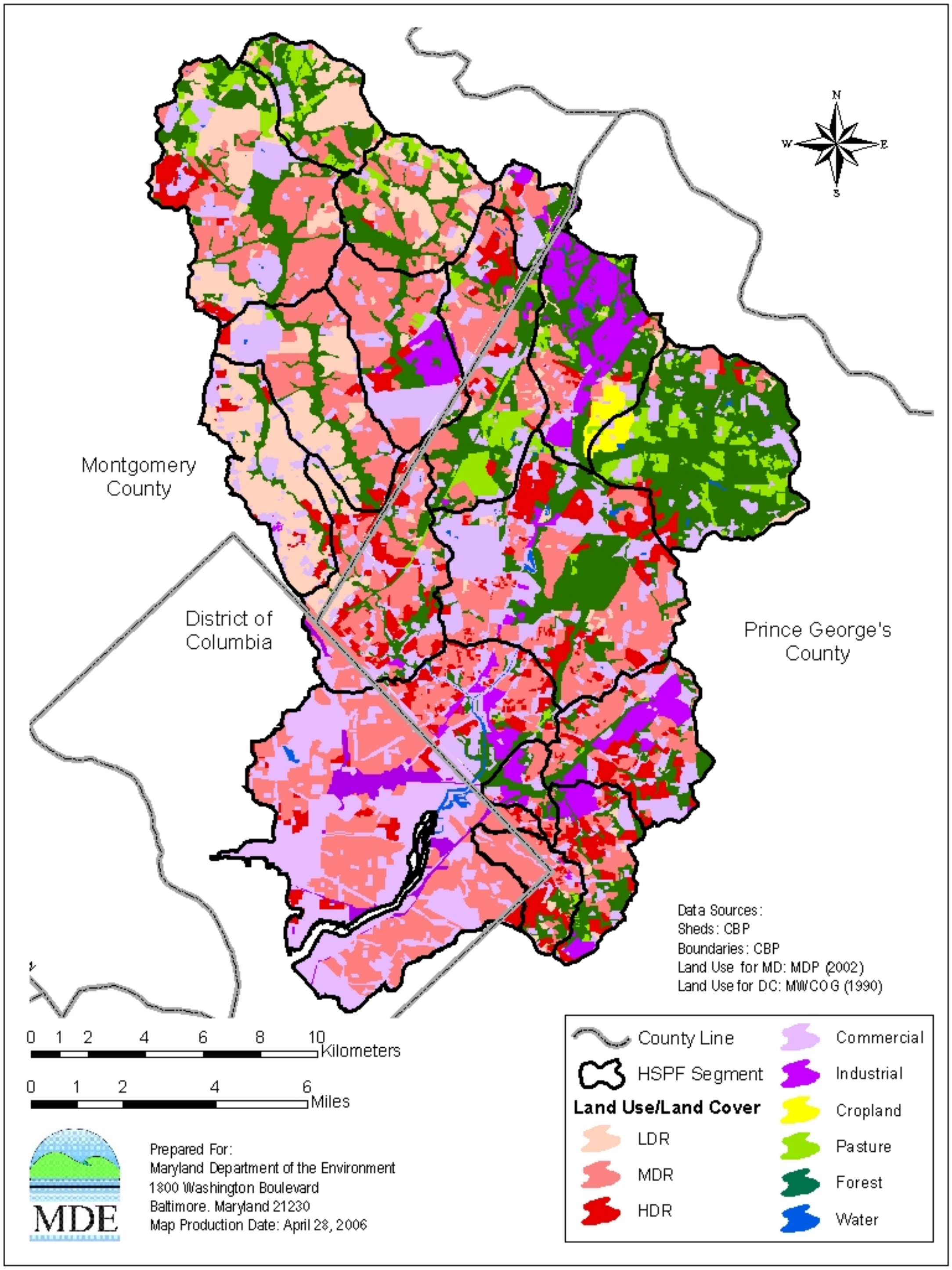
An updated analysis of Anacostia basin land use was done for this project in order to improve consistency in results for Prince George's and Montgomery Counties. The Maryland Department of Planning (MDP) Geographical Information Systems (GIS) land use data were used to determine land use area boundaries. MDP land use types were aggregated by the Interstate Commission on the Potomac River Basin (ICPRB) into the categories shown in Figure 3. Percent imperviousness, by land use category, was calculated for each Anacostia subwatershed (see Figure 2), based on GIS data on building footprints, paved roads, and parking lots provided by Montgomery County DEP and by the Maryland National Capital Park and Planning Commission – Prince George's County (M-NCPPC-PG). For portions of the watershed lying within DC, data from the Metropolitan Washington Council of Governments (MWCOG) DC Planned Land Use Cover (Warner et al. 1997) were used.

Connected impervious surfaces do not allow infiltration into the ground and discharge stormwater runoff to nearby streams, either directly or via a storm sewer system, leading to excessive stream flows during storm events. Conversely, *disconnected* impervious surfaces discharge stormwater runoff to nearby pervious surfaces, providing infiltration. In this study, it is assumed that buildings in low-density residential areas are disconnected impervious surfaces, because rooftop runoff in these areas tends to discharge to adjacent lawns and eventually percolate into the ground. Additionally, it is assumed that impervious surfaces in forest and agricultural land in the Anacostia watershed are disconnected. On the other hand, it is assumed that all impervious surfaces in medium-density residential, high-density residential, commercial, and industrial lands are connected.

Land use in the watershed is predominantly urban, with 23% of the watershed covered by impervious surfaces such as rooftops, paved roads, and parking lots. Urban land (primarily residential, commercial, and industrial) occupies approximately 75% of the watershed, with 20% of the watershed forested, and 5% in agricultural use. Much of the agricultural land in the basin is associated with the BARC, located primarily in the Upper Beaverdam Creek subwatershed. A summary of land use by major subwatershed is given in Table 1, where "Urban" land represents the categories: Low-density residential (LDR), Medium-density residential (MDR), High-density residential (HDR), Commercial, and Industrial. "Agricultural" land represents Cropland and Pasture.

Table 1. Summary of Anacostia Watershed Land Use (acres)

	Urban	Agricultural	Forest	Total	Impervious	Connected Impervious	%Connected Impervious
NWB	27,276	1,103	5,332	33,711	6,794	5,880	17%
NEB	28,326	3,756	14,210	46,291	8,490	7,710	17%
LBC	7,580	85	1,966	9,631	2,660	2,514	26%
Watts	1,823	28	269	2,119	578	558	26%
Tidal	19,155	0	166	19,321	7,447	7,447	39%
Total	84,160	4,971	21,943	111,073	25,968	24,108	22%
%Total	75%	5%	20%	100%			



Note: LDR, MDR, and HDR denote low-, medium-, and high-density residential

Figure 3. Land Use in the Anacostia Watershed

2.2 Source Assessment

Nutrient and BOD loads in the Anacostia River basin come from a variety of sources, including: stormwater runoff; subsurface drainage; erosion and in-stream scour; industrial and municipal point sources; and combined sewer overflows. Loadings of TN, TP, and BOD from these sources to impaired waters in the Anacostia were estimated by the following methods:

1. Northeast and Northwest Branches: The USGS software ESTIMATOR was used to determine the overall TN, TP, and BOD loads for NEB and NWB, based on available monitoring data collected at the USGS gages 01651000 and 01649500 on the NWB and NEB, respectively. The contribution by land use was determined using HSPF models of the NEB and NWB, calibrated to monthly loads determined with ESTIMATOR.
2. Lower Beaverdam Creek and Watts Branch: HSPF models of Lower Beaverdam Creek and Watts Branch were used to determine overall loads and loads by land use in these two watersheds.
3. Storm sewers drainage and direct drainage to the tidal Anacostia River in MD and DC: Flows were estimated based on the Watts Branch HSPF Model. Loads were determined from modeled flows and average event mean concentrations (EMCs) of stormwater monitoring data collected in the Anacostia Watershed under the MS4 program.
4. Combined Sewer Overflows: Loads from CSOs were determined using simulated flows from DCWASA's MOUSE Model of the DC combined sewer system and average EMCs determined for monitoring performed for DCWASA's Long-term Control Plan (LTCP).
5. Municipal and Industrial Point Sources: There are two municipal wastewater treatment plants (WWTPs) in the Anacostia River watershed permitted to discharge nutrients and BOD, the USDA West Side WWTP (MD0020851) and the USDA East Side WWTP (MD0020842), both located in MD. One industrial facility in MD, NASA-Goddard Space Flight Center (MD0067482), is permitted to discharge BOD from landfill leachate. In DC, there are two industrial facilities, Super Concrete (DC0000175) and CTIDC (DC0000191), permitted to discharge wastewater from concrete manufacturing processes. A PEPCO facility in DC (DC0000094) is permitted to discharge BOD from a hydrostatic testing tank. Discharges from the tank only occur, at most, once or twice a year; in the last two years, no discharges have occurred. Table 2 shows basic facility information. Table 3 gives the estimated daily loads from these facilities, if they are non-negligible, as well as permit limits for nutrients and BOD. For the USDA facilities, loads for the baseline period 1995-1997 were estimated using monitoring data reported for their permits. Data for the baseline period were not available for the Goddard Space Center, so an estimated daily average load was determined from monitoring data reported for its permit 2005-2007. Under a pending Memorandum of Understanding (MOU) between the USDA and MDE, the BARC facilities are scheduled to adopt Enhanced Nutrient Removal (ENR),

which would reduce their permitted nutrient concentrations to the levels shown in Table 3.

6. Other: MD nonpoint source contributions of nutrients and BOD attributable to sanitary sewer overflows (SSOs), broken sanitary lines, illicit connections, etc., are included in the overall nutrients and BOD baseline loads calculated from monitoring data for the upper portion of the watershed (above the NEB and NWB monitoring gages). Additional loadings from this source in the lower watershed are considered to be non-significant. SSOs are prohibited by the facilities' permits and therefore must be reported to MDE's Water Management Administration in accordance with COMAR 26.08.10, to be addressed under the State's enforcement program. Total loads from this source, calculated from information in MDE's database of reported SSOs in the Anacostia watershed, are estimated to be less than 1% of the corresponding baseline loads for TN, TP, and BOD, and therefore are not included as a separate source category in the TMDL. The Washington Suburban Sanitary Commission (WSSC) is under a consent decree to remedy recurrent SSOs. See *United States et al. v. Washington Suburban Sanitary Commission*, C.A. No. PJM 04-3679 (Greenbelt Division), 2005.

Table 2. Municipal and Industrial Discharge Permits in Anacostia Watershed

Type	NPDES No.	Name	Design Flow (MGD)	Waterbody
MD Municipal	MD0020842	USDA BARC East Side WWTP	0.62	NEB
MD Municipal	MD0020851	USDA BARC West Side WWTP	0.20	NEB
MD Industrial	MD0067482	NASA Goddard Center	Not Applicable	NEB
DC Industrial	DC0000175	Aggregate Super Concrete Industries	Not Applicable	NWB
DC Industrial	DC0000191	CTIDC	Not Applicable	Lower Tidal Anacostia
DC Industrial	DC0000094	PEPCO	0.50	Upper Tidal Anacostia

Table 3. Estimated Point Source Loads for Baseline Conditions, and Permitted Concentrations

NPDES No.	Average Daily Load (lbs/d) Baseline Conditions			Maximum Permitted Concentration (mg/l)		
	BOD5	TN	TP	BOD5	TN	TP
MD0020842	7.5	12.5	5.0	26 (4/1-9/30) 45 (10/1-3/31) Weekly average	4.0	0.3
MD0020851	4.5	3.7	2.3	30 (4/1-10/31) 45 (11/1-3/31) Weekly Average	4.0	0.3
MD0067482	0.34	0.02 (Ammonia-N)	NA	45 Daily Maximum	Report Ammonia-N	NA
DC0000175	Insignificant	NA	NA	Report	NA	NA
DC0000191	Insignificant	NA	NA	Report	NA	NA
DC0000094	Insignificant	NA	NA	30 mg/l Daily Average	NA	NA

Mandel et al. (2008) provides a detailed description of how loads were determined for all of these sources, including descriptions of the use of ESTIMATOR and HSPF to determine nutrient and BOD loads. Tables 4–6 give the BOD, TN, and TP loads by source and watershed for the baseline period for determining the TMDLs, 1995-1997. The contribution by land use includes loads from both surface and subsurface drainage. Over 80% of the BOD load comes from developed land, 17% from CSOs, and negligible loads from other sources. About 80% of the TN load also comes from developed land, 9% from agriculture, and 7% from CSOs. For TP, developed land is again the dominant source, accounting for 67% of the load; in-stream scour accounts for 14%, CSOs account for 13%, agriculture accounts for 3%, and other sources account for 2% or less of the overall load. The tables reflect that in-stream scour is a source of TP, but not, to any significant degree, of TN or BOD.

Table 4. Average Annual BOD Baseline Loads, 1995-1997

Waterbody	Forest	Agriculture	Developed	Point Sources	CSOs	Total
NEB	12,654	20,556	990,390	3,597		1,027,197
NWB	3,142	5,253	585,595			593,990
LBC	2,890		305,666			308,556
Watts	403		33,124			33,528
MD Nontidal	19,089	25,809	1,914,775	3,597		1,963,270
MD Tidal	427		182,324			182,751
DC Upper			648,576		330,662	979,238
DC Lower			342,519		327,623	670,142
Total	19,516	25,809	3,088,194	3,597	658,285	3,795,400
% of Total	0.5%	0.7%	81.4%	0.1%	17.3%	100%

Table 5. Average Annual Total Nitrogen Baseline Loads, 1995-1997

Waterbody	Forest	Agriculture	Developed	Point Sources	CSOs	Total
NEB	31,898	72,051	273,647	4,189		381,785
NWB	6,644	17,731	240,091			264,466
LBC	1,655		70,025			71,680
Watts	230		8,405			8,635
MD Nontidal	40,428	89,782	592,167	4,189		726,565
MD Tidal	517		28,305			28,822
DC Upper			89,043		31,894	120,936
DC Lower			41,042		31,601	72,642
Total	40,945	89,782	750,556	4,189	63,494	948,966
% of Total	4.3%	9.5%	79.1%	0.4%	6.7%	100%

Table 6. Average Annual Phosphorus Baseline Loads, 1995-1997

Waterbody	Forest	Agriculture	Developed	Scour	Point Sources	CSOs	Total
NEB	957	3,187	26,836	6,841	2,164		39,984
NWB	240	207	17,857	7,757			26,061
LBC	108		8,260	369			8,737
Watts	17		1,076	24			1,117
MD Nontidal	1,322	3,394	54,030	14,990	2,164		75,899
MD Tidal	19		2,766	0			2,785
DC Upper			8,623	15		6,600	15,238
DC Lower			3,975	0		6,539	10,514
Total	1,340	3,394	69,394	15,005	2,164	13,139	104,436
% of Total	1.3%	3.2%	66.4%	14.4%	2.1%	12.6%	100%

2.3 Water Quality Characterization

As will be discussed below, water quality impacts of nutrients and BOD in the Anacostia watershed tend to occur primarily in the tidal river. The Chesapeake Bay Program Office (CBPO) has developed a framework for assessing the water quality impacts of nutrients and sediment in the Chesapeake Bay and its tidal tributaries, such as the Anacostia (CBPO 2003; 2007). This framework develops guidance for setting nutrient and sediment enrichment criteria in terms of dissolved oxygen, water clarity, and chlorophyll *a*. When these criteria are met, habitat conditions "…will ensure the protection of the living resources of the Chesapeake Bay and tidal tributaries (CBPO 2003, p. x)," and will support the specific designated uses. Five essential habitats, delineated in both space and time, form the basis for recommended designated uses for the Bay and its tidal tributaries. Three of these designated uses are relevant to the Anacostia: (1) migratory fish spawning and nursery designated use, which protects migratory and resident fish during the spawning season, February 1 through May 31; (2) the shallow-water bay grass designated use, which protects the submerged aquatic vegetation (SAV) essential to shallow water habitats during the growing season, April 1 through October 31; and (3) the open-water fish and shellfish designated use, which protects menhaden, striped bass, and other fish in surface water habitats. The open-water designated use provides the DO criteria for the spawning use and shallow-water use outside of the spawning season. Both MD and DC have water quality standards based on the 2003 CBPO guidance. The applicable standards relevant to the Anacostia River nutrients/BOD TMDL are provided in detail in Section 2.4, "Water Quality Impairment."

Subsections 2.3.1 and 2.3.2 below characterize existing water quality conditions in the tidal and non-tidal waters of the Anacostia River, in terms of the available monitoring data for various constituents relevant to the TMDL analysis and assessment of water quality impairments due to excessive nutrients and BOD in the Anacostia. The data, presented in time periods applicable to the designated uses described above, are derived from numerous water quality samples collected from an array of monitoring stations, whose locations are also provided herein.

2.3.1 Tidal waters

Maryland Department of Natural Resources (DNR) conducts water quality monitoring in the tidal Anacostia River at Station ANA0082, located at Bladensburg Road. Figure 4 shows the location of ANA0082. Table 7 shows which constituents are reported at ANA0082. DDOE has maintained as many as thirty water quality monitoring stations in the tidal Anacostia River. At six stations—ANA01, ANA08, ANA14, ANA21, ANA29, and ANA30—DDOE collects nutrient data on a monthly basis. Figure 4 shows the location of these stations. Table 7 shows which constituents are analyzed from those stations. At four other stations, ANA05, ANA11, ANA19, and ANA24—DDOE also analyzes water quality samples for DO, water temperature, and pH. Figure 4 also shows the location of these stations. Between 1995 and 1997, approximately 10 samples per year were collected at 20 other stations and analyzed for DO, water temperature, and pH. Data from these stations were included in the analysis below.

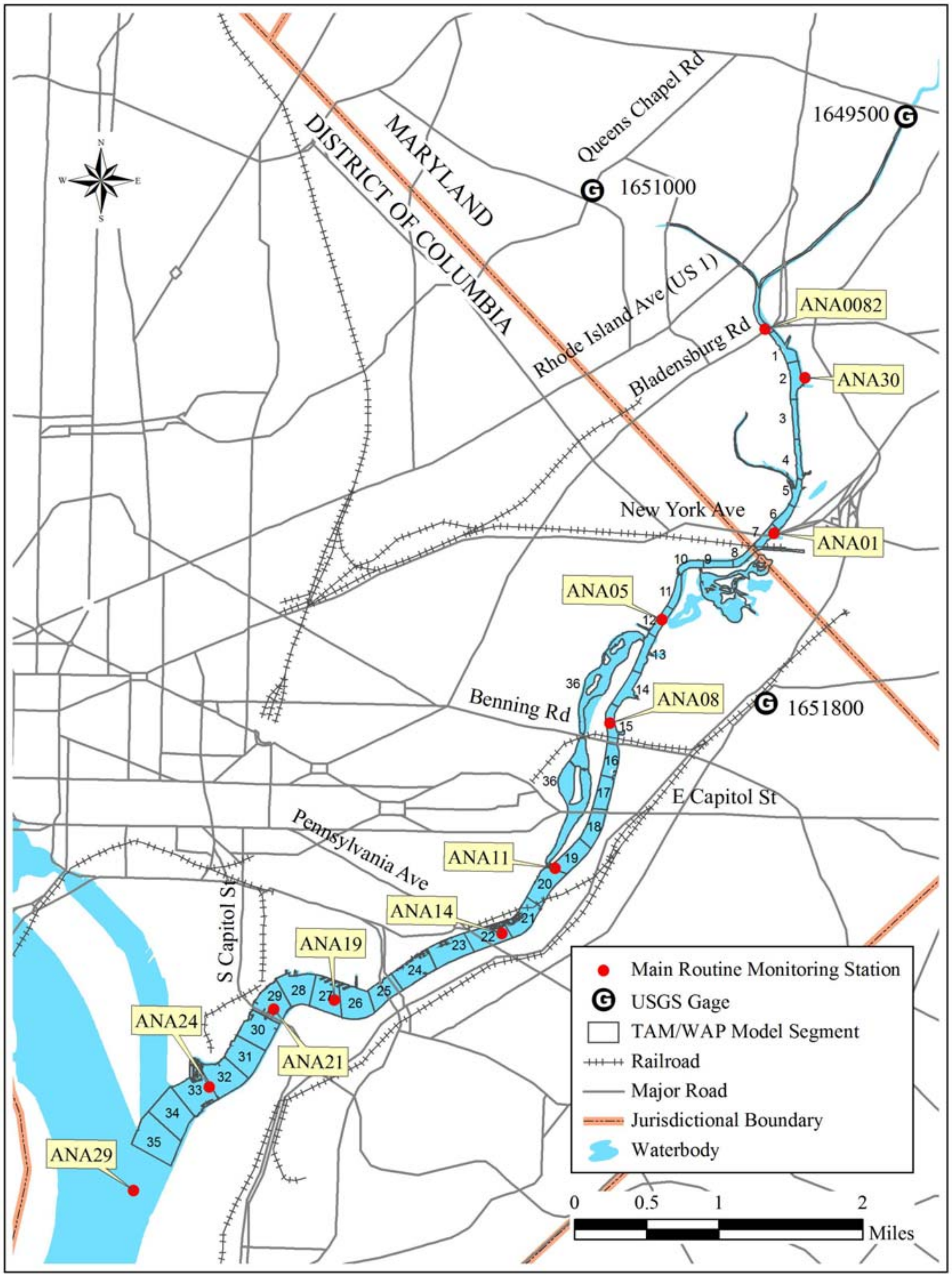


Figure 4. Tidal Anacostia River, with Monitoring Locations, and TAM/WASP Model Segmentation

Table 7. Constituents Reported By Program, Tidal Anacostia River

Constituent	MDDNR	DDOE
5-day Total BOD	X	X
Active Chlorophyll *a*	X	X
Dissolved Oxygen	X	X
Dissolved Inorganic Nitrogen	X	X
Dissolved Ammonia Nitrogen	X	X
Dissolved Nitrite-Nitrate Nitrogen	X	X
Total Organic Nitrogen	X	
Total Kjeldahl Nitrogen	X	
Total Nitrogen	X	
Dissolved Phosphate Phosphorus		X
Total Inorganic Phosphorus	X	
Total Organic Phosphorus	X	
Total Phosphorus	X	

Dissolved Oxygen

Figure A.1 in Appendix A shows the cumulative distribution of observed DO concentrations by waterbody for the spawning period, February through May, 1995-2005. Figure A.2 shows the same information for June through January, the period of the year that the open-water designated use is in effect in the tidal Anacostia. Figure A.3 in Appendix A shows the annual distribution of DO concentrations by station for the primary monitoring stations. As Figure A.3 shows, DO concentrations tend to be higher near the head of tide and at the Anacostia's confluence with the Potomac, and drop off between ANA08 and ANA21, which is approximately between Benning Road and South Capitol Street in the District. Table 8 gives summary statistics for observed DO concentrations by waterbody.

Table 8. Summary Statistics for DO in Tidal Anacostia River, 1995-2005

Statistic	February - May			June - January		
	MD	DC Upper	DC Lower	MD	DC Upper	DC Lower
Min	4.5	1.4	2.1	2.2	1.4	1.7
1st Q	10.4	6.4	7.3	7.3	4.5	6.0
Median	11.6	8.7	9.3	9.0	6.2	7.3
3rd Q	12.3	10.5	10.7	11.3	8.2	8.8
Max	19.2	17.4	16.8	16.7	16.8	16.4
Average	11.2	8.4	9.1	9.3	6.6	7.6
Std. Dev.	2.0	2.9	2.9	2.6	2.9	2.7
# Samples	82	339	278	170	652	521

DDOE, MWCOG, and MDDNR deployed equipment for continuous monitoring of DO, temperature, and pH at several stations in the tidal Anacostia River. Table 9 shows the location of these stations and the years for which some continuous monitoring data were available. Figure A.4 in Appendix A shows the daily minimum, daily maximum, and daily average DO concentrations at PO4 off the Benning Road Bridge, 1998.
Hinz (2007) analyzed the available continuous monitoring data to determine the relation between the observed daily average DO and daily minimum DO concentrations. Hinz determined that the median difference between the daily average and the daily minimum DO concentration was 0.81 mg/l, February through May, 1.28 mg/l, June through January, and 1.12 mg/l overall.

Table 9. Available DO Continuous Monitoring Data in the Anacostia River

Station	Location	Agency	Years Available
PO4	Benning Road	MWCOG	1996-2000; 2002
PO7	Seafarer's Marina	MWCOG	1996-2000; 2002
ANA0082	Rt. 1 Bridge	MDDNR	2002
ANA01	New York Avenue Bridge	DDOE	2000-2002
ANA13	Conrail Bridge	DDOE	2000-2001
ANA21	S. Capitol Street Bridge	DDOE	1998-2002

Chlorophyll *a*

DDOE restarted monitoring for Chla in 1999. Figure A.5 in Appendix A shows the average annual distribution of Chla concentrations by monitoring station. The average and median concentrations tend to be around 20 µg/l or lower, but concentrations can range above 100 µg/l. Concentrations tend to be lower near head of tide and near the confluence with the Potomac. Figure A.6 shows the distribution of Chla concentrations during the growing season. The pattern is similar to the annual distribution. Table 10 gives summary statistics for observed Chla by waterbody.

Figures A.7–A.9 in Appendix A show the average monthly observed Chla concentration by year for MD Tidal, DC Upper Anacostia, and DC Lower Anacostia, respectively. There is considerable inter-annual variability in Chla concentrations, but there is also a fairly consistent seasonal pattern, in which the highest concentrations tend to occur primarily in July and August, with a second peak sometimes occurring in November.

Table 10. Summary Statistics for Chla (μg/l) in Tidal Anacostia River, 1999-2002

Statistic	Annual			July - September		
	MD	DC Upper	DC Lower	MD	DC Upper	DC Lower
Min	0.3	0.3	0.4	1.4	2.0	1.0
1st Q	1.7	4.9	4.0	3.0	13.2	16.0
Median	3.0	11.0	10.0	4.9	25.0	28.0
3rd Q	5.6	25.0	26.3	8.4	49.4	41.8
Max	80.0	103.0	65.0	68.0	103.0	65.0
Average	5.7	18.2	16.6	8.2	32.2	30.0
Std. Dev.	9.9	19.7	15.7	11.7	24.3	17.6
# Samples	171	161	103	45	55	33

Secchi Depth

Figure A.10 in Appendix A shows the distribution of Secchi depths by monitoring station during the growing season. Median Secchi depths range from 0.4 at ANA01 and ANA08 in the DC Upper Anacostia to 0.8 at ANA29 at the confluence with the Potomac. On average, the lowest observed Secchi depths tend to occur mid-river. Table 11 gives summary statistics for observed Secchi depth by waterbody. Additional analysis of observed Secchi depths can be found in Schultz et al. (2007).

Table 11. Summary Statistics for Secchi Depth (m) in Tidal Anacostia River, 1995-2005

Statistic	Annual			May - October	April - October	
	MD	DC Upper	DC Lower	MD	DC Upper	DC Lower
Min	0.0	0.0	0.0	0.1	0.1	0.0
1st Q	0.4	0.3	0.4	0.4	0.3	0.5
Median	0.6	0.4	0.6	0.6	0.4	0.6
3rd Q	0.8	0.5	0.8	0.7	0.5	0.8
Max	1.8	1.8	2.2	1.2	1.0	2.1
Average	0.7	0.4	0.6	0.5	0.4	0.6
Std. Dev.	0.3	0.2	0.3	0.2	0.1	0.3
# Samples	118	755	568	63	516	388

BOD

Figure A.11 in Appendix A shows the annual distribution of BOD concentrations by monitoring station. With the exception of ANA0082, where concentrations are higher, the 75th percentile concentration tends to be below 3.0 mg/l, with median concentrations around 2.0 mg/l. Concentrations tend to drop off from mid-river to the Potomac confluence. Concentrations tend to be highest near head of tide. The longitudinal pattern of BOD concentrations could reflect either a drop in concentration with residence time, as BOD is consumed, or a significant solid-phase BOD component which deposits downstream of head of tide. Table 12 gives summary statistics for observed BOD concentration by waterbody.

Table 12. Summary Statistics for BOD (mg/l) in Tidal Anacostia River, 1995-2005

Statistic	February - May			June - January		
	MD	DC Upper	DC Lower	MD	DC Upper	DC Lower
Min	0.7	0.9	0.6	0.2	0.3	0.2
1st Q	1.9	1.7	1.3	1.9	1.8	1.1
Median	2.0	2.1	1.8	2.1	2.3	1.6
3rd Q	2.9	2.6	2.3	3.2	3.1	2.4
Max	8.2	6.9	3.9	10.7	10.0	4.0
Average	2.6	2.2	1.8	2.8	2.5	1.8
Std. Dev.	1.4	0.8	0.7	1.8	1.3	0.9
# Samples	75	114	78	165	247	168
# BDL	20	1	4	25	0	2
% BDL	26.7	0.9	5.1	15.2	0.0	1.2

Nutrients

DDOE only analyzes water quality samples for dissolved inorganic nitrogen and phosphorus species—ammonia, nitrate, and phosphate. It is not possible, therefore, to give an analysis of total nitrogen, total phosphorus, or the organic forms of nutrients.

Figures A.12–A.14 in Appendix A show the distribution of ammonia, nitrate, and phosphate by monitoring station, respectively. Ammonia concentrations tend to be highest in mid-river, while nitrate concentrations show the opposite longitudinal trend. Phosphate concentrations, on the other hand, tend to show no longitudinal trend. Tables 13–15 give summary statistics by waterbody for ammonia, nitrate, and phosphate, respectively.

Table 13. Summary Statistics for Ammonia-N (mg/l) in Tidal Anacostia River, 1995-2005

Statistic	Annual			July - September		
	MD	DC Upper	DC Lower	MD	DC Upper	DC Lower
Min	0.004	0.004	0.004	0.004	0.040	0.009
1st Q	0.034	0.121	0.060	0.032	0.139	0.048
Median	0.063	0.218	0.134	0.057	0.208	0.086
3rd Q	0.120	0.316	0.239	0.121	0.271	0.158
Max	0.520	1.760	0.997	0.405	0.495	0.997
Average	0.093	0.244	0.172	0.092	0.210	0.132
Std. Dev.	0.090	0.168	0.139	0.091	0.108	0.149
# Samples	253	450	284	64	49	79
# BDL	6	0	2	1	0	0
% BDL	2.4	0.0	0.7	1.6	0.0	0.0

Table 14. Summary Statistics for Nitrite-Nitrate-N (mg/l) in Tidal Anacostia River, 1995-2003

Statistic	Annual			July - September		
	MD	DC Upper	DC Lower	MD	DC Upper	DC Lower
Min	0.020	0.042	0.052	0.020	0.042	0.220
1st Q	0.681	0.468	0.663	0.501	0.318	0.486
Median	0.865	0.629	0.890	0.785	0.467	0.760
3rd Q	1.115	0.835	1.230	0.888	0.609	1.093
Max	3.200	2.180	3.760	1.890	2.170	3.060
Average	0.920	0.692	1.007	0.719	0.494	0.879
Std. Dev.	0.420	0.361	0.537	0.326	0.287	0.560
# Samples	184	339	231	47	102	62
# BDL	1	0	2	1	0	0
% BDL	0.5	0.0	0.9	2.1	0.0	0.0

Table 15. Summary Statistics for Dissolved Inorganic Phosphorus (mg/l) in Tidal Anacostia River, 1995-2002

Statistic	Annual			July - September		
	MD	**DC Upper**	**DC Lower**	**MD**	**DC Upper**	**DC Lower**
Min	0.001	0.001	0.001	0.001	0.001	0.001
1st Q	0.006	0.006	0.007	0.005	0.004	0.004
Median	0.012	0.014	0.013	0.010	0.010	0.010
3rd Q	0.015	0.022	0.029	0.026	0.022	0.021
Max	0.057	0.301	0.260	0.043	0.051	0.091
Average	0.014	0.017	0.020	0.015	0.015	0.017
Std. Dev.	0.012	0.020	0.023	0.014	0.013	0.018
# Samples	57	369	268	15	102	71
# BDL	1	2	2	1	0	1
% BDL	1.8	0.5	0.7	6.7	0.0	1.4

Sediment Oxygen Demand and Sediment Nutrient Fluxes

Two recent studies have attempted to quantify sediment oxygen demand and nutrient fluxes between sediment and the water column. As part of the LTCP, MWCOG and the Naval Research Laboratory made two sets of measurements of SOD at nine sites in the Anacostia in September and December, 1999 (MWCOG 2000). The September measurements were made under “hypoxic” conditions in the water column; DO concentrations ranged as low as 3.4 mg/l. Estimated SOD rates were all less than 1.0 $g/m^2/d$, possibly due to the low DO water column concentrations. In the second set of measurements taken in December, SOD rates ranged from 0.39 to 3.45 $g/m^2/d$. The study also attempted to quantify the fate of gaseous methane released from anaerobic diagenesis in the sediments, without obtaining consistent results.

Bailey et al. (2003) measured SOD and nutrient fluxes at five locations in the tidal Anacostia in June, July, August, and September 2002. DO concentrations in the water column were generally above 5.0 mg/l with only a few observations 3.0 mg/l or less in the upper reaches of the tidal Anacostia River in June. Measured SOD ranged from 1.37 to 3.6 $g/m^2/d$ and averaged 2.3 $g/m^2/d$. Measurements of nutrient fluxes yielded the following conclusions:

- Ammonia fluxes from the sediments are high (> 500 μmols-N/m^2/h) in the Anacostia, particularly in the upper reaches of the tidal river;
- The nitrate flux from the water column to the sediment is extremely high (~100 μmols-N/m^2/h), compared with other sites in the Chesapeake Bay region; and
- Phosphate fluxes were directed from the sediments to the water column but were very small (~ 3 μmols-P/m^2/h).

It is unclear, however, what effect the extremely dry conditions in the summer of 2002 had on these observations.

2.3.2 Non-tidal waters

The Anacostia River was first placed on Maryland's 303(d) List in 1996. The basis of the listing is the Maryland Water Quality Inventory, 1993-1995 (DNR 1996), which is a report mandated by Section 305(b) of CWA. At the time of the original listing, the tidal and non-tidal portions of the Anacostia were not separately listed, but the narrative description of water quality in the Anacostia makes it clear that erosion, sediment, and high-levels of bacteria are the primary causes of impaired water quality in the non-tidal portions of the watershed. High levels of nutrients, chlorophyll, and turbidity are said to characterize the tidal portion of the river at station ANA0082.

The analysis of recent monitoring data in the non-tidal portion of the watershed also shows that observed nutrient concentrations do not lead to violations of Maryland's water quality standards in the non-tidal portion of the watershed. MDE, USGS, and the Metropolitan Washington Council of Governments (MWCOG) have all recently conducted water quality monitoring at the USGS gages on the Northeast and Northwest Branches. Table 16 characterizes their sampling programs. Tables 17 and 18 give summary statistics for DO, BOD, Chla, and nutrient concentrations observed in their programs for NWB and NEB, respectively. As Tables 17 and 18 show, minimum observed DO concentrations were greater than 7.0 mg/l. No observed Chla concentration was greater than10 µg/l, indicating that in the non-tidal river, algal concentrations do not reach nuisance levels.

Table 16. Characterization of Non-tidal Anacostia River Watershed Monitoring Programs

Program	**Sampling Period**	**Approx. No. of Nutrient Samples per Location**		**Description**
		NEB	NWB	
LTCP	**8/1999 – 3/2000**	34	33	Baseflow grab samples and flow-weighted composite storm samples
MDE	8/2004 – 8/2005	15	15	Monthly ambient sampling
USGS	7/2003 – 8/2005	70	65	Instantaneous storm and grab samples

Table 17. Summary Statistics for Constituent Concentrations, NE Branch Anacostia River, 1999-2005

Statistic	BOD5 mg/l	DO mg/l	NH4 mg/l	NO3 mg/l	[1]TN mg/l	DIP mg/l	[1]TP mg/l	CHLa µg/l
Count	69	103	119	119	118	109	118	13
Min	0.10	7.40	0.00	0.020	0.40	0.003	0.017	0.43
1st Quartile	1.00	8.80	0.02	0.613	1.30	0.009	0.040	1.92
Median	1.00	10.50	0.06	0.803	1.61	0.017	0.118	2.56
3rd Quartile	3.20	11.70	0.10	0.980	2.26	0.022	0.330	3.49
Max	13.00	17.30	0.45	1.440	3.50	0.090	0.670	6.73
Avg	2.09	10.60	0.08	0.780	1.78	0.020	0.187	2.69
Std. Dev.	2.04	2.03	0.09	0.271	0.66	0.017	0.169	1.64

[1] High LTCP outlier excluded

Table 18. Summary Statistics for Constituent Concentrations, NW Branch Anacostia River, 1999-2005

Statistic	BOD5 mg/l	DO mg/l	NH4 mg/l	[1]NO3 mg/l	TN mg/l	DIP mg/l	TP mg/l	CHLa µg/l
Count	70	121	112	112	112	103	113	11
Min	0.10	7.10	0.00	0.21	0.55	0.003	0.01	1.28
1st Quartile	1.00	8.70	0.01	0.60	1.44	0.005	0.03	1.73
Median	1.00	10.40	0.03	0.85	1.82	0.010	0.10	1.92
3rd Quartile	3.00	12.40	0.09	1.12	2.66	0.020	0.42	3.74
Max	17.50	16.00	0.50	1.99	6.14	0.080	1.07	8.22
Avg	2.38	10.82	0.07	0.88	2.17	0.017	0.24	3.14
Std. Dev.	2.81	2.31	0.09	0.36	1.10	0.017	0.25	2.21

2.4 Water Quality Impairment

The District of Columbia Municipal Regulations (DCMR), Chapter 11, Section 1101.2, classifies both segments of the tidal Anacostia River as Class C: Protection and Propagation of Fish, Shellfish, and Wildlife. The Maryland Water Quality Standards Stream Segment Designation for the tidal Anacostia River is Use II: Tidal Waters: Support of Estuarine and Marine Aquatic Life and Shellfish Harvesting [COMAR 26.08.02.08O(2)]. Designated uses present in the tidal Anacostia River include (1) Migratory Spawning and Nursery Use, (2) Open Water Fish and Shellfish Use, and (3) Seasonal Shallow Water Submerged Aquatic Vegetation Use. The Maryland Water Quality Standards Surface Water Use Designations for the non-tidal Anacostia watershed are: Use I-P – Water Contact Recreation, Protection of Aquatic Life and Public Drinking Supply; Use III – Natural Trout Waters; and Use IV – Recreational Trout Waters [COMAR 26.08.02.08O(1)(3) & (5)]. Table 19 specifies the location of each designated use in both tidal and non-tidal waters.

The specific water quality impairments addressed in these TMDLs are (1) the violation of DC's DO criteria in its tidal waters and (2) the violation caused by excess Chla of MD's General Water Quality Criteria, which prohibit pollution of waters of the State by any material in amounts sufficient to create a nuisance or directly or indirectly interfere with designated uses [COMAR 26.08.02.03B(2)], and MD's narrative Chla criterion for tidal waters "Concentrations of chlorophyll a in free-flowing microscopic aquatic plants (algae) shall not exceed levels that result in ecologically undesirable consequences that would render tidal waters unsuitable for designated uses." [COMAR 26.08.02.03-3 C (10)] The applicable water quality standards, however, extend beyond the listed impairments. In addition to resolving the listed impairments, the TMDLs for nutrients and BOD must demonstrate that (1) DO criteria are met for all designated uses in MD and DC portions of the Anacostia; (2) DC chlorophyll *a* criteria are met in DC's segments in the tidal river; and (3) water clarity standards are met in both MD's and DC's tidal waters.

Table 19. Designated Uses in the Anacostia Watershed

Waterbody	Designated Use	Geographic Extent
MD non-tidal	Use I-P: Water contact recreation, protection of non-tidal warmwater aquatic life, public drinking supply	All non-tidal MD streams except those designated Use III and IV
	Use III: Non-tidal cold water (supporting self-sustaining trout populations)	Paint Branch above Interstate 495 (Capital beltway)
	Use IV: Recreational trout waters	NWB above highway 410
MD tidal	Use II: Support of estuarine and marine aquatic life and shellfish harvesting, including (1) Migratory Spawning and Nursery Subcategory; (2) Open Water Fish and Shellfish Subcategory; and (3) Seasonal Shallow Water Submerged Vegetation Subcategory	MD portion of tidal Anacostia
DC tidal	Class C: Protection & propagation of fish, shellfish and wildlife	DC portion of tidal Anacostia

Table 20 shows the DO criteria associated with each designated use. Both MD's and DC's definitions of tidal designated uses and their associated DO criteria are based on CBP (2003) guidance, and have been formally incorporated into MD and DC regulations, respectively. [See COMAR 26.08.02.03-3C(8)(g) and DCMR 1104.8] Distinct numerical criteria are used for Seasonal Migratory Fish Spawning and Nursery Use, which is in effect February 1 through May 31. During this period DO concentrations can be no less than 5.0 mg/l. During the rest of the year, the instantaneous minimum DO concentration can be no less than 3.2 mg/l. As Table 20 shows, the criteria also specify minimum seven-day average DO concentrations of 6.0 mg/l and 4.0 mg/l for the spawning season and the remainder of the year, respectively. The minimum 30-day average concentration of 5.5 mg/l holds year-round.

According to CBP guidance (2003), a percentage of DO concentrations in space and time can be below the criteria without interfering with the designated uses they are supposed to protect. CBP recommends the development of biologically-based "reference curves" which show the extent to which the DO criteria can be "exceeded" for each designated use.

DC has numerical chlorophyll *a* criteria applicable to Class C waters. The DCMR (1104.8) specifies that the average Chla concentration in a segment, July 1 through September 30, is not to exceed 25 µg/l. MD has not adopted numerical criteria for nutrients or Chla, but MD has adopted a narrative criterion for Chla in tidal waters, as stated above. Based on guidance in the EPA Technical Guidance Manual for Developing Total Maximum Daily Loads, Book 2, Part 1 (1997) and Thomann and Mueller's (1987) analysis of nuisance levels of phytoplankton, which recognizes that "'[u]ndesirable' levels of phytoplankton vary considerably depending on water body characteristics," MDE has determined that maintaining Chla concentrations below a maximum of 100 µg/l and, with some flexibility, maintaining a 30-day rolling average of no more than 50 µg/l is compatible with the tidal Chla narrative criterion (MDE 2007).

Both MD and DC have adopted water quality criteria for water clarity in tidal waters, based on CBP guidance (2003). In DC, the average Secchi depth in a segment should be no less than 0.8 meters over the growing season, April 1 through October 31. In MD, the average Secchi depth should not be less than 0.4 meters, May 1 through October 31, averaged over a three-year period, in waters less than 0.5 meters deep.

EPA (2007) has approved joint MD-DC sediment TMDLs (2007) that address MD's and DC's water clarity standards. Those TMDLs implicitly assumed that algal concentrations, as represented by Chla concentrations, would not increase under sediment TMDL loading rates. The nutrient TMDLs for the tidal Anacostia will have to confirm that water clarity standards are met under nutrient allocations, assuming the sediment TMDL allocations determined in the previous sediment TMDLs.

Table 20 also shows the DO criteria applicable to MD's non-tidal waters in the Anacostia. MD's non-tidal waters are not listed for DO impairments, and there are no monitoring data that indicate that there are violations of water quality standards for DO. MD does not have numerical standards for Chla. MD's General Water Quality Criteria prohibit pollution of waters of the State by any material in amounts sufficient to create a nuisance or directly or indirectly interfere with designated uses [COMAR 26.08.02.03B(2)]. As the monitoring data discussed in the previous section show, all observed Chla concentrations in non-tidal waters collected within the last ten years are less than 10 µg/l. Thus there is no evidence that MD's General Water Quality Criteria are violated by Chla concentrations in non-tidal waters. As the analysis of the 1996

305(b) Report shows, the nutrient impairment was based on the impact of nutrient loads on the tidal waters at station ANA0082. Resolution of the violation of the tidal narrative criteria for Chla will therefore address the nutrients listing in non-tidal waters, and the tidal water TMDL Chla endpoint can serve as the endpoint for the non-tidal waters as well.

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Table 20. DO Criteria for Designated Uses in the Anacostia Watershed

Designated Use	Period Applicable	DO Critiera
MD Use I-P	Year-round	≥ 5 mg/l (instantaneous)
MD Use II: Migratory Fish Spawning and Nursery Subcategory	2/1 – 5/31	≥ 5.0 mg/l (instantaneous) ≥ 6.0 mg/l (7-day average)
MD Use II: Open Water Fish and Shellfish Subcategory	6/1 – 1/31	≥ 3.2 mg/l (instantaneous) ≥ 4.0 mg/l (7-day average) ≥ 5.5 mg/l (30-day average)* ≥ 4.3 mg/l (instantaneous for water temperature > 29 C for protection of Shortnose Sturgeon)
MD Use III	Year-round	≥ 5 mg/l (instantaneous) ≥ 6 mg/l (1-day average)
MD Use IV	Year-round	≥ 5 mg/l (instantaneous)
DC Class C	2/1 – 5/31	≥ 5.0 mg/l (instantaneous) ≥ 6.0 mg/l (7-day average)
	6/1 – 1/31	≥ 3.2 mg/l (instantaneous) ≥ 4.0 mg/l (7-day average) ≥ 5.5 mg/l (30-day average) ≥ 4.3 mg/l (instantaneous for water temperature > 29 C for protection of Shortnose Sturgeon)

*Applies year-round

An explanation of how these various DO criteria are interpreted in the TMDL analysis and addressed by the average annual TMDLs is provided in Appendix C.

3.0 TARGETED WATER QUALITY GOAL

The overall objective of the TMDLs proposed in this document is to reduce nitrogen, phosphorus, and BOD loads to levels that are expected to result in the attainment of the water quality criteria that support the designated uses for the tidal Anacostia River in DC and MD and the contributing watershed in MD, including the protection of aquatic life and water contact recreation uses.

The DO TMDL endpoints are determined by the DO criteria for the Spawning and Migratory Fish Nursery Designated Use, effective February 1 through May 31, and the Open Water Fish and Shellfish Designated Use, effective June 1 through January 31. Table 21 summarizes DO criteria applicable to the tidal Anacostia River in MD and DC. In the case of the Anacostia, DO criteria will be applied without the reference curves that would permit concentrations below the criteria for a limited spatial or temporal extent.

The Chla endpoint in DC is determined by DC's Chla standard, which requires that the Chla concentration in a segment, averaged between July 1 and September 30, be no more than 25 µg/l. The Chla endpoint in the MD portion of the tidal Anacostia River is set by MDE's interpretation of MD's narrative Chla criteria. On that interpretation, Chla concentrations should be no more than 100 µg/l and the 30-day moving average Chla concentration should be no more than 50 µg/l. Since the nutrients listing in the non-tidal Anacostia River is based on the impact of nutrients on the tidal river, the TMDL endpoint for MD's portion of the non-tidal Anacostia River is the tidal Chla endpoint. As will be shown in Section 4.3, the DC Chla endpoint is the most stringent and will therefore provide the *de facto* endpoint for the nutrient TMDLs for MD's portion of the Anacostia basin.

The nutrient TMDLs will also have to meet MD and DC standards for water clarity. The MD standard requires that the median Secchi depth, April 1 through October 31, taken over a three-year period, be no less than 0.4 meters. The DC standard requires that the median Secchi depth in a segment between April 1 and October 31 be no less than 0.8 meters annually. The nutrient TMDLs will assume the sediment load allocations given by the sediment/TSS TMDLs for the Anacostia River (MDE and DDOE 2007).

In summary, the TMDLs for nitrogen, phosphorus, and BOD are intended to:

1. resolve violations of DO criteria associated with BOD and excessive nutrient enrichment of the tidal Anacostia River in DC and ensure that MD's DO standards are met in its portion of the tidal Anacostia;
2. resolve violations of MD's Chla narrative criteria and ensure that DC's Chla criteria are met in its portion of the tidal Anacostia; and
3. ensure that both DC and MD's water clarity criteria are met under the load allocations for the approved Anacostia sediment/TSS TMDLs.

4.0 TOTAL MAXIMUM DAILY LOADS AND ALLOCATIONS

4.1 Overview

Section 4.2 describes the modeling framework for simulating hydrodynamics, nutrient and BOD loads, and water quality responses in the tidal Anacostia River. Section 4.3 describes the scenarios developed on the basis of modeling results. Section 4.4 explains how the nutrient and BOD TMDLs, waste load allocations for point sources, and load allocations for nonpoint sources were developed for the three waterbodies constituting the tidal Anacostia River, based on computer modeling of the water quality response to reduced nutrient and BOD loads. Section 4.5 presents the modeling results in the proper format for TMDLs and allocates the TMDLs between point sources and nonpoint sources. Section 4.6 explains the rationale for the margin of safety (MOS). Finally, in Section 4.7 the elements of the equations are combined in a summary of TMDLs for total nitrogen, total phosphorus, and BOD for (1) the MD nontidal Anacostia River watershed, (2) the MD tidal Anacostia watershed, (3) the DC tidal upper Anacostia River, and (4) the DC tidal lower Anacostia River.

4.2 Analysis Framework

To develop a TMDL, a linkage must be defined between the selected targets or goals and the identified sources. This linkage establishes the cause-and-effect relationship between the pollutant of concern and the pollutant sources. The relationship can vary seasonally, particularly for nonpoint sources, with factors such as precipitation. Once defined, the linkage yields the estimate of total loading capacity or TMDL (USEPA 1999).

The computer modeling framework used to develop the nutrient and BOD TMDLs for the tidal Anacostia River waterbodies is the Tidal Anacostia Model/Water Analysis Simulation Program (TAM/WASP). The TAM/WASP modeling framework was developed for use in DC's original BOD TMDL (DCDOH 2000; Mandel and Schultz 2000), the DC sediment TMDL (USEPA 2001; Schultz 2001), and DCWASA's LTCP (DCWASA 2001). It was most recently used to develop the joint MD-DC sediment/TSS TMDL for the Anacostia (MDE and DDOE 2007; Schultz et al. 2007). The modeling framework has the following three components: (1) the Tidal Anacostia Model (TAM), a continuous hydrodynamic model of tidal Anacostia River first developed by MWCOG (Sullivan and Brown, 1991); (2) a modified version of TOXIWASP that simulates sediment transport; and (3) a modified version of EUTROWASP, with enhanced capabilities of simulating SOD and light extinction.

Figure 5 schematically represents the TAM/WASP framework. Observed flows and tidal heights are input into the TAM hydrodynamics model. The output of the TAM model is used to simulate the flows and segment depths in both the TOXIWASP and EUTRO components of WASP. Daily sediment loads based on ESTIMATOR, HSPF, MOUSE, and other sources are used in the modified TOXIWASP model to simulate the fate and transport of sediment. Hourly sediment concentrations, along with daily nutrient and BOD loads based on ESTIMATOR, HSPF, and MOUSE, and other sources, are used to simulate eutrophication, DO dynamics, and light extinction in the modified EUTRO model. The output of the EUTRO model includes simulated daily average DO and Chla concentrations, simulated Secchi depths, and nutrient concentrations for each model segment.

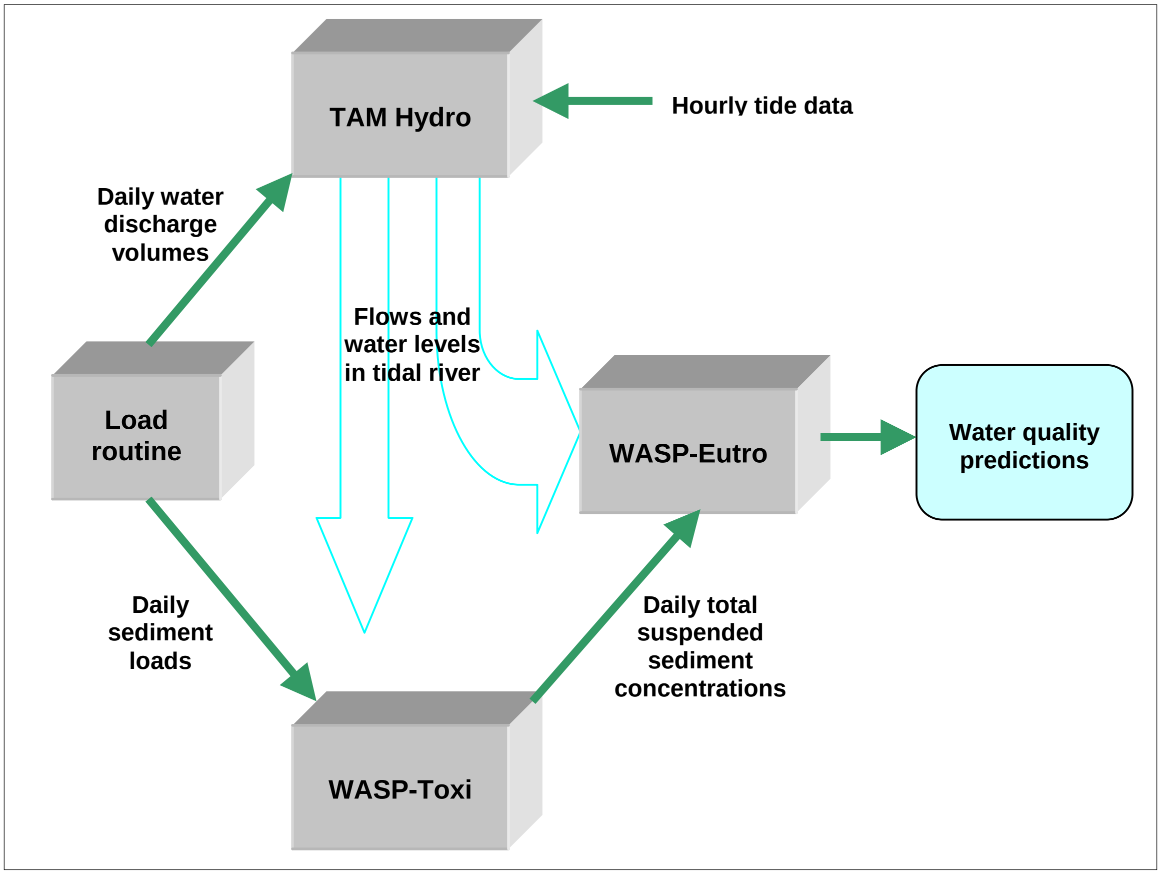

Figure 5. Schematic Diagram of TAM/WASP Modeling Framework

The WASP models are continuous simulation models with a long history of successful employment and were recommended by EPA for use in the original Anacostia TMDLs. The following modifications were made to the 5.0 WASP modeling package to strengthen the linkage between input loads and predicted water quality response:

- W. S. Lung of the University of Virginia implemented enhanced methane dynamics, based on the work of DiToro et al. (1990), into the sediment component of EUTRO (Lung 2000). In the enhanced sediment component, SOD is a function of deposited BOD, and simulated SOD rates take into account methane saturation and gaseous methane release, which is a feature of SOD demand in many freshwater systems.

- The continuous simulation of sediment deposition and scour was incorporated in TOXIWASP, based on the work of Colby (1964) and Partheniades (1962), as implemented in HSPF (Bicknell et al. 2001).

- EUTRO was modified so that light extinction and Secchi depths could be simulated based on simulated sediment concentrations from the modified TOXIWASP model and simulated Chla concentrations from the EUTRO model.

The modifications made to WASP and other aspects of the modeling framework are described in more detail in Mandel et al. (2008), as well as earlier TMDL and modeling reports cited above. The WASP models themselves are described in more detail in Ambrose et al. (1993).

Figure 4 (p. 14) shows the segmentation used in the TAM/WASP model, waterbody boundaries, and the location of key monitoring stations. The segmentation consists of one-dimensional water column segments with matching underlying sediment segments. The segmentation is identical to that used in the EUTRO model for the joint MD-DC sediment/TSS TMDL.

The models were calibrated for the years 1995-2002. This is the most recent period for which observed data was available for development of the sediment TMDLs. As mentioned previously, DDOE restarted sampling for Chla in 1999. This period represents a wide range of hydrologic conditions. Figures 6 and 7 show, respectively, annual precipitation and combined NEB and NWB flows compared with their long-term mean values. For the period of record, 1939-2004, 2002 had the lowest combined upstream flow, while 2003 had the highest upstream flow.

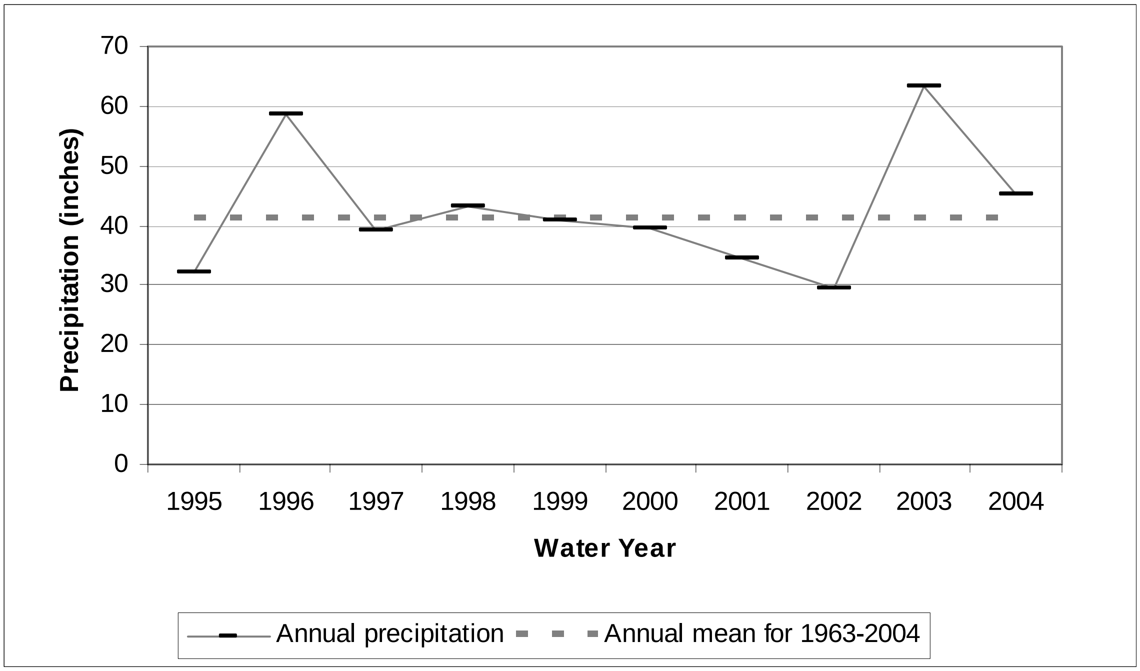

Figure 6. Annual Precipitation at Reagan National Airport

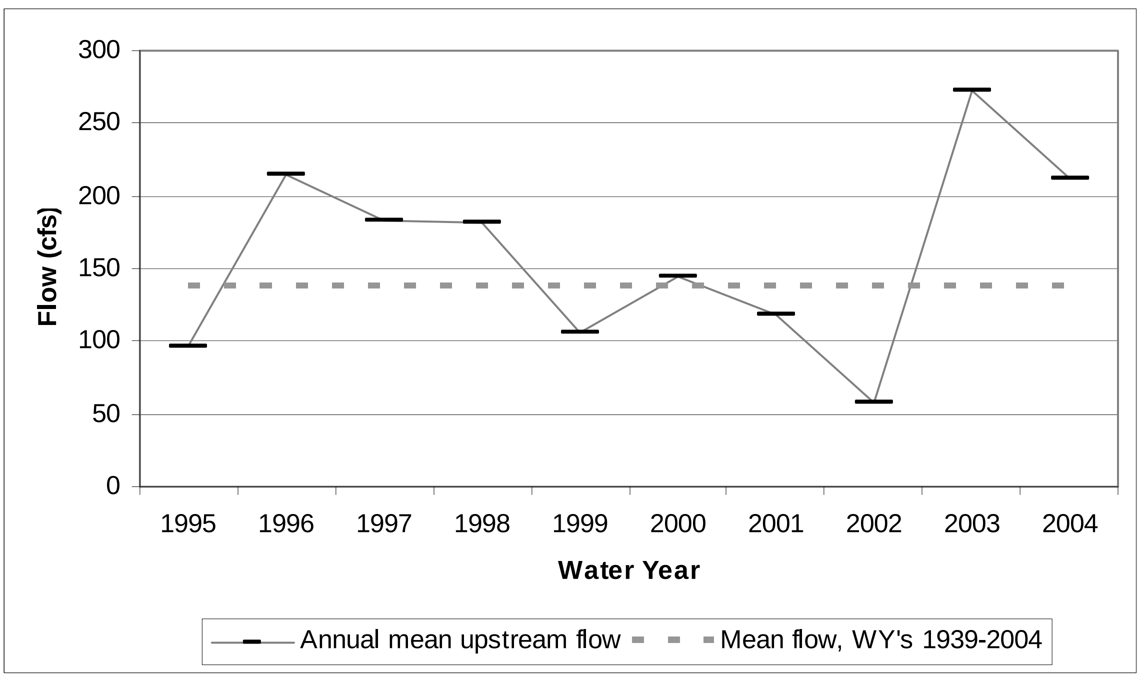

Figure 7. Annual Combined Mean Flow for Northeast and Northwest Branch

Baseline loads were calculated from the calibration simulation using the simulation period 1995-1997, the three-year simulation period chosen to determine the TMDLs. The critical condition and seasonality were accounted for in the TMDL analysis by the choice of this simulation period, which includes a wet year (1996), a dry year (1995), and an average year (1997), thus taking into account a wide variety of hydrological conditions.

4.3 Scenario Descriptions and Results

TMDL development for the Anacostia involved the following two scenarios:

1. **Baseline Scenario**: The Baseline Scenario represents actual loads over the simulation period 1995-1997, based on the calibration of the TAM/WASP model framework for the longer simulation period 1995-2003. In the Baseline Scenario, (1) loads from the wastewater treatment plants are based on reported flows and concentrations for the period; (2) loads from CSOs are based on MOUSE model flows simulating actual conditions 1995-1997 and average event mean concentrations from LTCP monitoring; (3) upstream loads from NWB and NEB are determined by ESTIMATOR; (4) loads from Lower Beaverdam Creek and Watts Branch are determined by HSFP models; and (5) loads from smaller tributaries and direct drainage are based on simulated Watts Branch flows and average EMC concentrations from the jurisdictions' water quality monitoring for their MS4 permits. The Baseline Scenario uses sediment concentrations from the Baseline Scenario in the sediment TMDL to calculate water clarity.

2. **TMDL or Future Scenario**: The TMDL Scenario represents the maximum allowable nutrients and BOD such that the computer simulation framework predicts water quality standards will be met for DO, Chla, and water clarity in the three tidal Anacostia River listed segments. In the Baseline Scenario, (1) loads from the wastewater treatment plants are based on design flows and maximum permitted concentrations and (2) loads from CSOs are based on MOUSE model flows simulating hydrological conditions 1995-1997 under LTCP implementation and average event mean concentrations from LTCP monitoring. Upstream loads, loads from Watts Branch and Lower Beaverdam Creek, as well as loads from direct drainage and smaller tributaries, are reduced from baseline conditions until the simulation demonstrates that water quality standards are met. To calculate water clarity, the TMDL Scenario uses the sediment concentrations from the Anacostia sediment TMDL that were determined to meet water clarity criteria. The simulation period is 1995-1997.

4.3.1 Model Calibration for the Baseline Scenarios

The TAM/WASP model was calibrated with respect to the three constituents that form the basis of the applicable water quality standards: DO, Chla, and Secchi depth.
The general goal of the DO calibration was for minimum simulated DO at the segments representing the major ambient monitoring stations to be at or below the minimum observed DO annually. Figures B.1–B.6 in Appendix B compare simulated and observed DO concentrations at ANA0082, ANA30, ANA01, ANA08, ANA14, and ANA21, respectively. As the figures show, the calibration goals were met.

Similarly, the goal of the Chla calibration was for the maximum simulated Chla at the segments representing the major ambient monitoring stations to be at or above the observed Chla annually. The calibration also meets this goal. Figures B.7– B.12 compare simulated and observed Chla concentrations at ANA0082, ANA30, ANA01, ANA08, ANA14, and ANA21, respectively.

The Secchi depth calibration is dominated by suspended sediment under baseline conditions and thus for the sake of consistency follows the simulation in the Anacostia sediment TMDL. Schultz et al. (2007) describes the TAM/WASP sediment model and its calibration in more detail. Figures B.13–B.18 compare simulated and observed Secchi depths at ANA0082, ANA30, ANA01, ANA08, ANA14, and ANA21, respectively.

Figures B.19–B.24, B.25–B.30, B.31–B.36, and B.37–B.42 in Appendix B compare observed and simulated concentrations of BOD5, ammonia, nitrate, and phosphate, respectively, at the major ambient monitoring stations. Further details on the calibration of DO, Chla, and other constituents can be found in Mandel et al. (2008).

4.3.2 TMDL Scenario Results

The goal of the TMDL Scenario is to demonstrate that water quality standards for DO, Chla, and water clarity would be met under the proposed TMDL load allocations.

To test whether the DO criteria are met under the TMDL Scenario, water quality criteria were applied to daily simulated values for each monitoring cell. As explained in Appendix C, the simulated daily average DO concentrations were used to calculated the daily minimum DO concentration and 7-day and 30-day moving averages for each model segment. The following criteria were used to determine whether water quality standards would be met under TMDL loading rates:

- The simulated daily minimum DO concentration must be no less than 5.0 mg/l February through May and no less than 3.2 mg/l the remainder of the year;
- The 7-day average DO concentration must be no less than 6.0 mg/l February through May and no less than 4.0 mg/l the remainder of the year.
- The 30-day average DO concentration must be no less than 5.5 mg/l year-round.

Under the TMDL Scenario, all three criteria are met every day in every model segment. Figure 8 compares the simulated daily minimum DO concentration for ANA08 with the seasonal instantaneous criteria, Figure 9 compares the simulated seven-day average concentration with the seasonal 7-day average criteria, and Figure 10 compares the 30-day average concentration with the year-round 5.5 mg/l 30-day average criterion. Figures showing these comparisons for other major ambient monitoring stations are found in Appendix C.

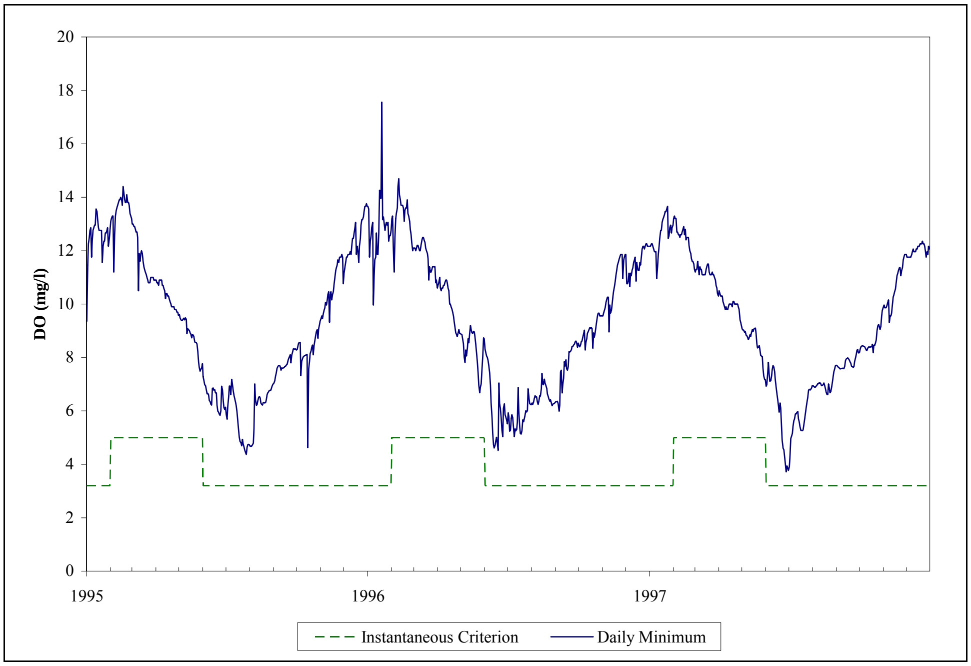

Figure 8. Simulated Daily Minimum DO (mg/l) and Corresponding DO Criteria, TMDL Scenario, ANA08

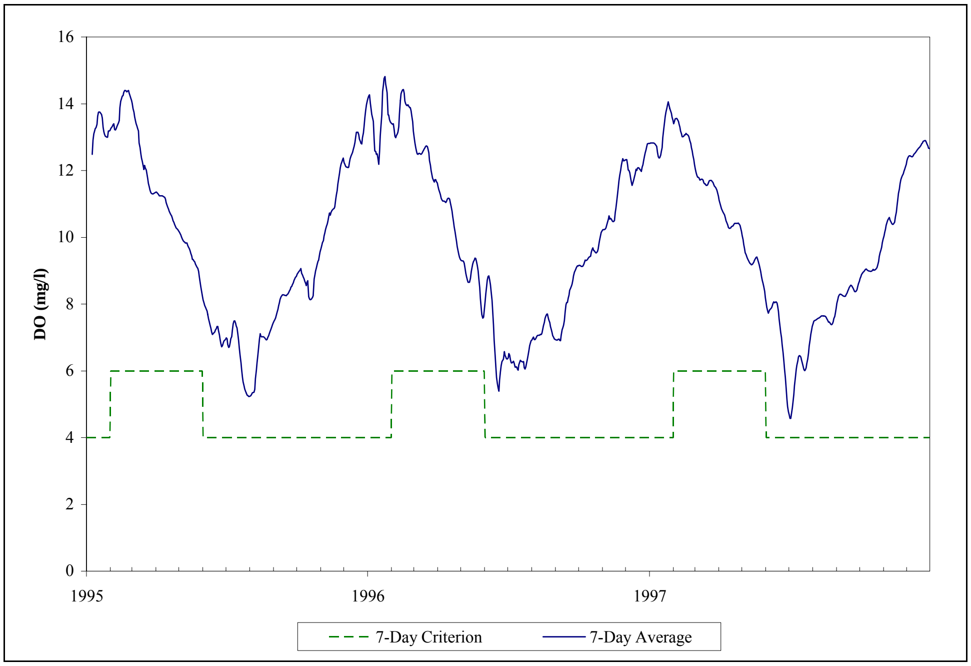

Figure 9. Simulated Seven-Day Average DO (mg/l) and Corresponding DO Criteria, TMDL Scenario, ANA08

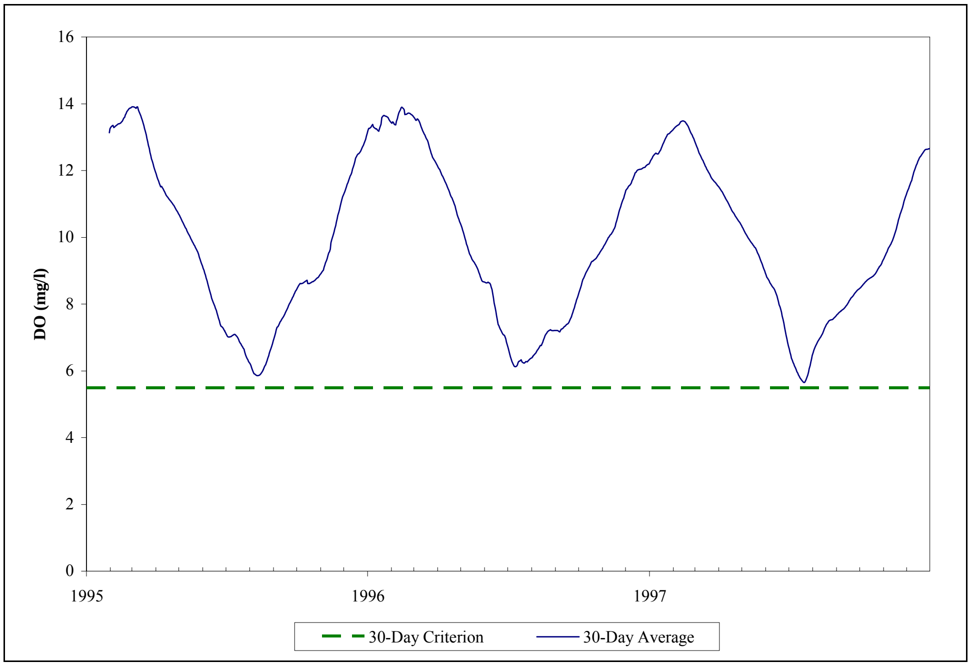

Figure 10. Simulated 30-Day Average DO (mg/l) and Corresponding DO Criteria, TMDL Scenario, ANA08

For Chla, summer average concentrations were calculated for each year, July through September, from daily simulated Chla concentrations over all segments in the DC portion of the tidal Anacostia, which constitute a single assessment unit under CBPO guidance (CBPO 2003; 2007). These yearly averages were then compared to the 25 µg/l DC Chla criterion. As the results shown in Figure 11 indicate, the Chla criteria are met every year of the simulation period. For MD, the daily simulated Chla concentration and a rolling 30-day average were compared to the 100 µg/l and 50 µg/l action levels, respectively, under the interpretation of MD's narrative Chla criteria described in Section 2.4. Under the TMDL Scenario, there is no modeling segment in MD with daily concentrations greater than 100 µg/l or 30-day average concentrations greater than 50 µg/l. Figure 12 compares the simulated time series of daily and 30-day average Chla concentrations for station ANA0082 with the 100 and 50 µg/l levels, respectively.

To test whether MD's water clarity standard (average Secchi depth of 0.4 meters) would be met under the TMDL Scenario, the median Secchi depth over the three-year TMDL simulation period was calculated from daily Secchi depths from all MD segments (1 through 6) May 1 through October 30. To assess attainment of the DC standard (average Secchi depth of 0.8 meters), the median Secchi depth was calculated each year from the daily Secchi depths, April through October, over all segments in the DC portion of the tidal Anacostia, which constitutes a single assessment unit under CBPO guidance (2003, 2007). Figure 13 compares the median Secchi depths with the standards. In both MD and DC, under the TMDL Scenario, water clarity standards are met.

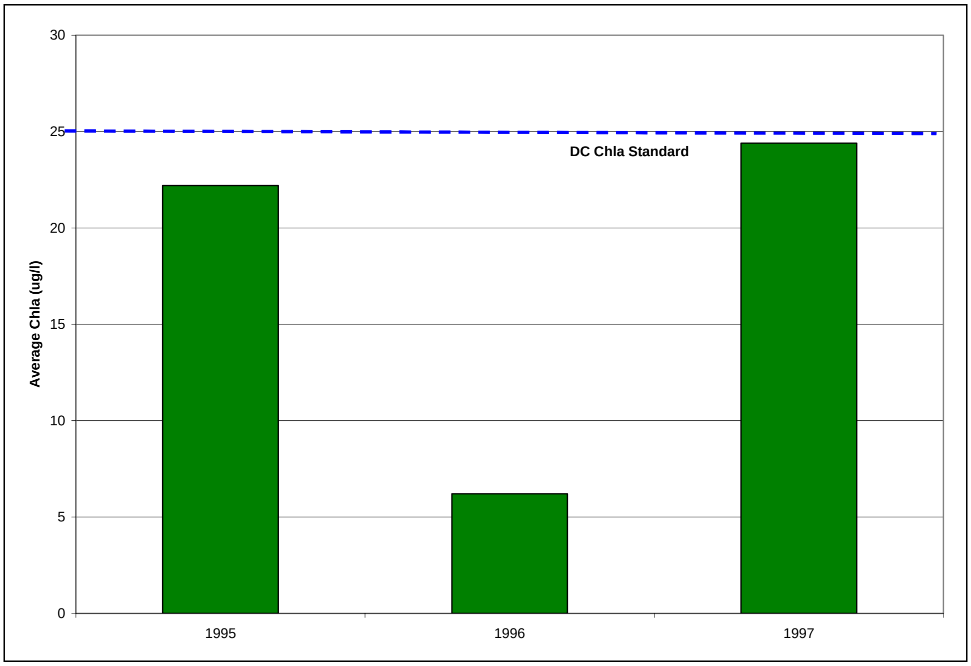

Figure 11. Average Annual Chla Concentration, July – September, DC Segments, TMDL Scenario

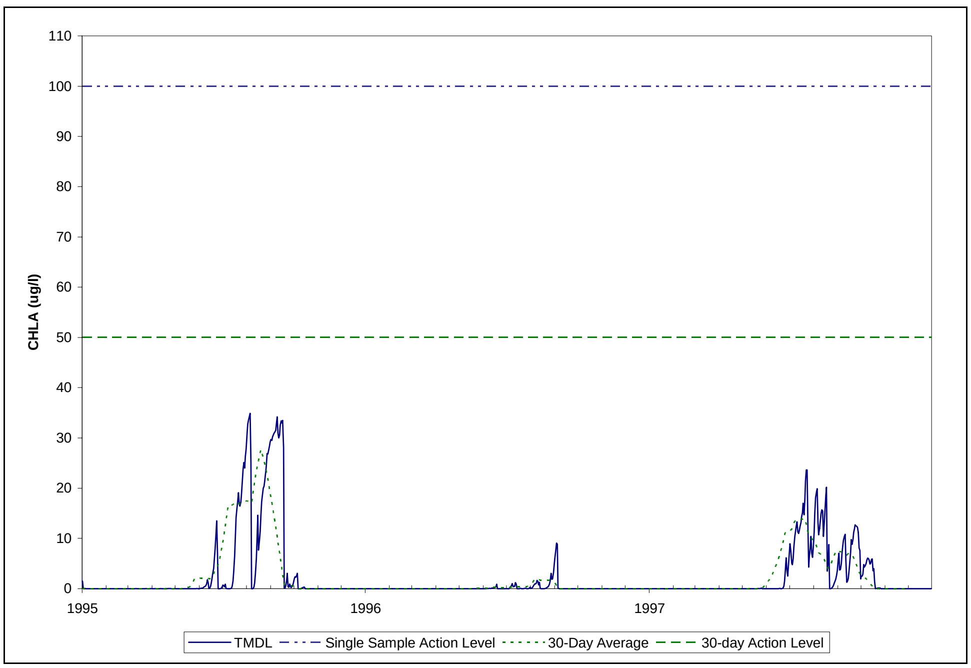

Figure 12. Simulated Daily Average and 30-Day Average Chla Concentrations, TMDL Scenario, ANA0082

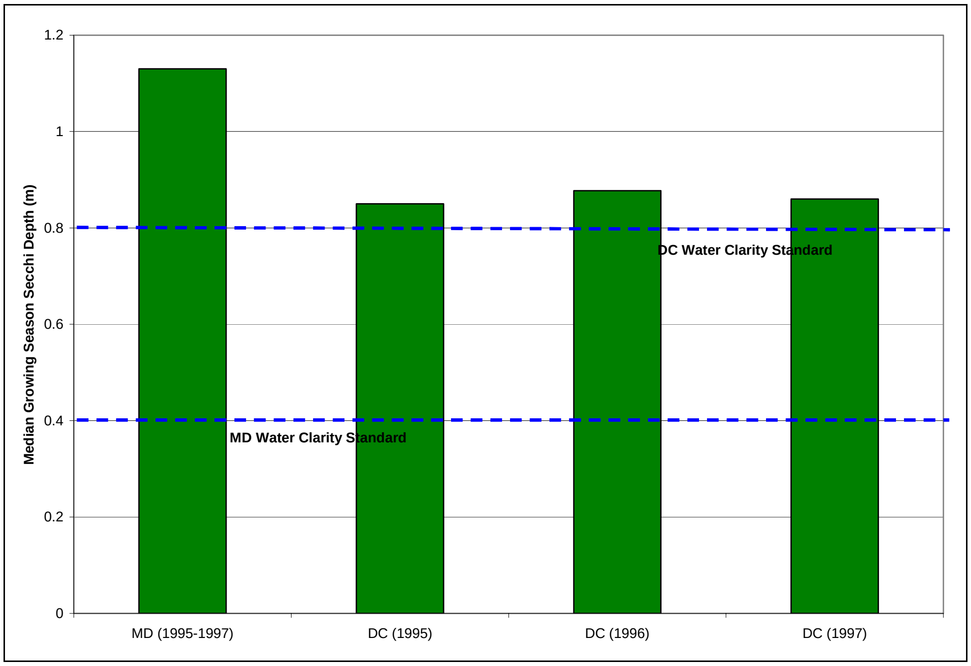

Figure 13. Median Secchi Depths by Jurisdiction, TMDL Scenario

4.4 TMDL Loading Caps

This section presents TMDL loading caps for BOD, total nitrogen, and total phosphorus for each of the four listed segments: MD non-tidal Anacostia River, MD tidal Anacostia River, DC tidal Upper Anacostia River, and DC tidal Lower Anacostia River. The critical condition and seasonality was accounted for in the TMDL analysis by the choice of simulation period, 1995-1997. This three-year time period represents a relatively dry year, wet year, and average year, based on precipitation data, and accounts for various hydrological conditions.

4.4.1 BOD TMDL Loading Caps

The BOD TMDLs were estimated based on the BOD loadings as explained in Section 4.3 and the resulting water quality in the tidal Anacostia River for the simulated years 1995-1997. Average annual TMDL loads for BOD were calculated to meet all applicable water quality standards, including specific criteria for the spawning season and the open water period. Average annual loads reflect the fact that residence times in the Anacostia can be on the order of months under low-flow conditions and that the SOD can result from diagenic organic material accumulated over years.

Average Annual BOD TMDL Loading Caps

MD Non-tidal Anacostia	**889,426 lbs/year**
MD Tidal Anacostia	**822,506 lbs/year**
DC Tidal Upper Anacostia	**1,295,384 lbs/year**
DC Tidal Lower Anacostia	**1,491,715 lbs/year**

4.4.2 Total Nitrogen TMDL Loading Caps

The total nitrogen TMDLs were estimated based on the nitrogen loadings as explained in Section 4.3 and the resulting water quality in the tidal Anacostia River for the simulated years 1995-1997. Average annual TMDL loads for TN were calculated to meet all applicable water quality standards, including specific criteria for the summer season, growing season, spawning season, and the open water period. Average annual loads reflect the fact that residence times in the Anacostia can be on the order of months under low-flow conditions and that the impact on eutrophication of SOD can potentially span years.

Annual TN TMDL Loading Caps

MD Non-tidal Anacostia	**154,107 lbs/year**
MD Tidal Anacostia	**143,871 lbs/year**
DC Tidal Upper Anacostia	**183,302 lbs/year**
DC Tidal Lower Anacostia	**196,788 lbs/year**

4.4.3 Total Phosphorus TMDL Loading Caps

The total phosphorus TMDLs were estimated based on the phosphorus loadings as explained in Section 4.3 and the resulting water quality in the tidal Anacostia River for the simulated years 1995-1997. Average annual TMDL loads for TP were calculated to meet all applicable water quality standards, including specific criteria for the summer season, growing season, spawning season, and the open water period. Average annual loads reflect the fact that residence times in the Anacostia can be on the order of months under low-flow conditions and that the impact of eutrophication on SOD can potentially span years.

Annual TP TMDL Loading Caps

MD Non-tidal Anacostia	**15,408 lbs/year**
MD Tidal Anacostia	**14,007 lbs/year**
DC Tidal Upper Anacostia	**18,866 lbs/year**
DC Tidal Lower Anacostia	**20,757 lbs/year**

4.5 Allocation Categories for Point Sources and Nonpoint Sources

This section describes the categories of nonpoint sources and point sources that are assigned load allocations (LAs) and waste load allocations (WLAs), respectively, distributing the TMDLs for nitrogen, phosphorus, and BOD among those sources. The allocations are intended to maintain allowable loadings that, when implemented, will achieve water quality standards in the Anacostia. The annual allocations are provided in Tables 22-24 below; corresponding maximum daily loads are provided in Tables 25-27.

Additionally, two technical memoranda that accompany this report provide scenarios of more detailed allocations to point sources and nonpoint sources by jurisdiction, including separate aggregate WLAs for stormwater and WLAs for WWTPs. All of these allocations show that the sum of nitrogen, phosphorus, and BOD loadings to the river from existing point and nonpoint sources can be maintained safely within the TMDLs established herein. The State of Maryland and the District of Columbia reserve the right to revise the allocations, provided such revisions are consistent with the achievement of water quality standards.

- Nonpoint Source (NPS) Loads

  Nonpoint source loads, both natural and human-induced, including agricultural and forest loads, are assigned to the TMDL as the Load Allocation (LA). Section 2.2 of this report describes the assignment of loads to sources in the Baseline Scenario. Also, see "*Significant Significant Biochemical Oxygen Demand, Nitrogen, and Phosphorus Nonpoint Sources in the Anacostia River Watershed*," for a more detailed discussion of the NPS loads and how they are addressed in the TMDL.

- Stormwater Loads

  Although MS4s and other NPDES-regulated stormwater dishcharges transport rainfall-driven nonpoint source loads to surface waters, they are technically categorized as *point sources*, because they are subject to NPDES permit regulations. As such, MS4s and other permitted stormwater discharges are assigned WLAs. See the technical memorandum "*Significant Biochemical Oxygen Demand, Nitrogen, and Phosphorus Point Sources in the Anacostia River Watershed*," for a more detailed explanation of how the stormwater allocations were determined.

- Combined Sewer Overflows

  The EPA has approved a Long-Term Control Plan (LTCP) for the District of Columbia's Combine Sewer Overflows (CSOs). CSO WLAs of nutrients and BOD were determined consistent with the LTCP.

- Wastewater Treatment Plant (WWTP) Loads

  Among a number of such facilities in the Anacostia watershed, there are only two municipal WWTPs, located in MD, that are permitted to discharge nutrients and BOD. In addition, there are three industrial facilities in DC permitted to discharge BOD, and one industrial facility MD is permitted to discharge BOD from landfill leachate. All significant point sources are addressed by this WLA and are described further in the technical memorandum entitled "*Significant Nutrient and BOD Point Sources in the Anacostia River Watershed,*" which also provides seasonal loads for the continuous discharge facilities that will meet DO criteria for certain designated use subcategories.

Sanitary sewer overflows (SSOs) and associated exfiltration of pollutants from broken or leaking infrastructure and illicit connections are *not* assigned an allocation, since they are prohibited by facility permits. Furthermore, under an existing consent decree, WSSC is required to remedy recurrent SSOs and to maintain, identify, and repair problem areas within a 5200-mile sewer system. WSSC has entered into a “Clean Water Partnership” with several environmental and watershed advocacy groups and developed a 12-year plan to carry out the requirements of the consent decree.

4.6 Margins of Safety

A MOS is required as part of a TMDL in recognition of many uncertainties in the understanding and simulation of water quality in natural systems. For example, knowledge is incomplete regarding the exact nature and magnitude of pollutant loads from various sources and the specific impacts of those pollutants on the chemical and biological quality of complex, natural waterbodies. The MOS is intended to account for such uncertainties in a manner that is conservative from the standpoint of environmental protection.

Based on EPA guidance, the MOS can be achieved through two approaches (USEPA 1999). One approach is to reserve a portion of the loading capacity as a separate term in the TMDL, i.e., TMDL = Load Allocation (LA) + Waste Load Allocation (WLA) + MOS. The second approach is to incorporate the MOS as conservative assumptions used in the TMDL analysis. Maryland and the District of Columbia have adopted a MOS for nutrient TMDLs using the first approach. The reserved load allocated to the MOS was computed as 5% of the total loads for nitrogen and phosphorus.

For BOD, an implicit MOS was adopted. Both DC’s and MD’s water quality standards incorporate by reference the 2003 U.S. EPA Chesapeake Bay Program (CBP) guidance document, "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and its Tidal Tributaries (EPA 903-R-03-002)" and the "Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll a for the Chesapeake Bay and its Tidal Tributaries—2004 Addendum (EPA 903-R-04-005)." [See COMAR 26.08.02.03-3C(8)(g) and DCMR 1104.8] Thus, the EPA CBP guidance is an intrinsic part of MD’s and DC’s standards. The guidance recognizes that DO criteria can be “exceeded” to a limited extent in both space and time with no discernible impact to designated uses. The guidance calls for the development of biologically-based reference curves that identify the extent in space and time that criteria can be exceeded and still support designated uses. However, for the Anacostia BOD TMDL, no exceedance of the DO criteria in either space or time was allowed in determining the TMDL allocations; therefore, the TMDL is stricter than necessary to protect aquatic life designated uses. This conservative approach to determining the conditions under which water quality standards are met justifies the implicit MOS for BOD.

Table 21 gives the overall annual MOS for the TMDLs for each constituent.

Table 21. Overall Margin of Safety for Anacostia Nutrient/BOD TMDLs

BOD	TN	TP
Implicit	9,839	1,038

4.7 Summary of BOD, Nitrogen, and Phosphorus TMDLs for the Anacostia Watershed

The final average annual BOD TMDL for all MD and DC non-tidal and tidal waters of the Anacostia River is **1,491,715 lbs/year**. The loading cap constitutes a 61% overall reduction of BOD from the baseline loads determined for the TMDL analysis period, 1995-1997.

The final average annual nitrogen TMDL for all MD and DC non-tidal and tidal waters of the Anacostia River is **196,788 lbs/year.** The loading cap constitutes a 79% overall reduction of nitrogen from the baseline loads determined for the TMDL analysis period, 1995-1997.

The final average annual phosphorus TMDL for all MD and DC non-tidal and tidal waters of the Anacostia River is **20,757 lbs/year**. The loading cap constitutes an 80% overall reduction of phosphorus from the baseline loads determined for the TMDL analysis period, 1995-1997.

The average annual TMDLs for each of the four listing segments are presented in Tables 22-24 below. Tables 25-27 provide maximum daily loads corresponding to the annual TMDLs. See Appendix D for a detailed explanation of the technical methods used to determine these daily expressions.

The TMDLs are distributed between: 1) WLAs to NPDES municipal and industrial PS discharges, MS4s and other NPDES-regulated stormwater (SW), and DC CSOs; 2) LAs to forest and agricultural lands; and 3) a 5% margin of safety (MOS) for nutrients, and an implicit MOS for BOD.

As Tables 22–24 indicate, TMDLs have been developed for each of the four listed segments: the MD non-tidal and MD tidal portions of the river, and DC's Tidal Upper Anacostia and Tidal Lower Anacostia segments. (Although analysis of recent monitoring data shows that MD's water quality standards are met in the State's non-tidal waters, MD non-tidal TMDLs are required to ensure that applicable standards are met in the tidal waters.) Each upstream segment's overall load (minus the MOS in the TN and TP TMDLs) is rolled into the succeeding downstream segment as an "upstream load," resulting in a cumulative, watershed-wide TMDL. Note that the MD non-tidal segment includes an upstream load from DC sources that drain to MD waters in the NWB; similarly, loads from MD's portion of Watts Branch and Lower Beaverdam Creek are added to the upstream load for the DC Tidal Upper segment where they discharge. Loads from DC's portion of those two subwatersheds are included in the MS4-WLA for the DC Tidal Upper Anacostia in the annual TMDL tables, and detailed separately in the tables of maximum daily loads.

The average annual TMDLs were calculated to meet all applicable water quality standards in the Anacostia for the three constituents, BOD, TN and TP, including: the defined spawning season (February through May) when stricter DO criteria are in effect; the period of the Open Water Designated Use subcategory (June through January); and the specific seasonal standards for chlorophyll *a* (July through September) and water clarity (April through October). An explanation of how the various DO criteria are interpreted in the TMDL analysis and addressed by the average annual TMDLs is provided in Appendix C.

Table 22. Summary of Average Annual BOD TMDLs for the Anacostia Watershed (lbs/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
16,300[1]	855,456	18,857	Implicit	890,614

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
746,939[2]	76,576	179	Implicit	823,694

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4/Other SW WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia PS WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
967,369[3]	205,854[4]	52,472	501	66,548	Implicit	1,292,744

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4/Other SW WLA	DC Lower Anacostia CSO WLA	DC PS WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
1,292,744	114,154	56,801	1,005	29,704	Implicit	1,494,409

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (14,082) and Lower Beaverdam Creek (129,593). Because these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (14,082) and Lower Beaverdam Creek (129,593).

[4]Includes loads from DC non-tidal waters in Watts Branch (14,252) and Lower Beaverdam Creek (403).

Table 23. Summary of Average Annual Total Nitrogen TMDLs for the Anacostia Watershed (lbs/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
1,986[1]	119,827	24,588	7,705	154,107

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
131,235[2]	5,345	98	7,194	143,871

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4/Other SW WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
151,844[3]	12,692[4]	5,061	4,123	9,143	182,863

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4/Other SW WLA	DC Lower Anacostia CSO WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
173,719	5,882	5,479	1,868	9,839	196,788

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (1,631) and Lower Beaverdam Creek (13,536). Because these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (1,631) and Lower Beaverdam Creek (13,536).

[4]Includes loads from DC non-tidal waters in Watts Branch (1,731) and Lower Beaverdam Creek (45).

Table 24. Summary of Average Annual Total Phosphorus TMDLs for the Anacostia Watershed (lbs/year)

MD Non-Tidal Anacostia

Upstream Load from DC	MD Non-Tidal WLA	MD Non-Tidal LA	MOS	MD Non-Tidal TMDL
166[1]	13,584	888	770	15,408

MD Tidal Anacostia

Upstream Load	MD Tidal WLA	MD Tidal LA	MOS	MD Tidal TMDL (does not include non-tidal loads from Watts Br & LBC)
12,782[2]	521	4	700	14,007

DC Tidal Upper Anacostia

Upstream Load (all MD loads including Watts Br & LBC)	DC Upper Anacostia MS4/Other SW WLA	DC Upper Anacostia CSO WLA	DC Upper Anacostia LA	MOS	DC Tidal Upper TMDL
15,162[3]	1,266[4]	1,047	361	939	18,776

DC Tidal Lower Anacostia

Upstream Load	DC Lower Anacostia MS4/Other SW WLA	DC Lower Anacostia CSO WLA	DC Lower Anacostia LA	MOS	TOTAL TMDL
17,837	587	1,134	162	1,038	20,757

[1]This load drains to MD waters from DC's portion of the NWB subwatershed

[2]Does not include MD non-tidal loads from Watts Branch (210) and Lower Beaverdam Creek (1,646). Because these drain to DC tidal waters, they are included in the upstream load to the DC Tidal Upper Anacostia.

[3]Upstream load comprises all MD tidal and non-tidal loads, including MD loads from Watts Branch (210) and Lower Beaverdam Creek (1,646).

[4]Includes loads from DC non-tidal waters in Watts Branch (248) and Lower Beaverdam Creek (6)

Tables 26-28 provide corresponding maximum daily loads for each of the constituents, based on the average annual TMDLs given above. See Appendix D for a detailed explanation of the technical methods used to determine these daily expressions.

Table 25. Summary of Annually-Based Maximum Daily Loads of BOD for the Anacostia River Watershed (lbs/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max : avg)
< 0.89	4.37 : 3.419	303	209	0.652	Implicit	517 : 239
0.89 - 2.34	14.2 : 6.22	1,629	225	12.6	Implicit	1,881 : 394
2.34 - 3.48	29.0 : 12.0	6,931	225	24.8	Implicit	7,210 : 712
3.48 - 10.75	189 : 31.8	12,525	225	121	Implicit	13,060 : 1,812
> 10.75	1,216 : 304	77,499	225	2,832	Implicit	81,772 : 16,455

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max : avg)
All	81,772 : 2,438	6,797	34.0	Implicit	88,603 : 2,648

Table 25 (cont'd). Summary of Annually-Based Maximum Daily Loads of BOD for the Anacostia River Watershed (lbs/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max : avg)	DC LBC MS4-WLA (max : avg)	DC LBC LA (max : avg)	MOS	Total TMDL (max : avg)
All	10,163 : 355	32.3 : 1.10	- : -	Implicit	10,195 : 356

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max : avg)	DC WB MS4-WLA (max : avg)	DC WB LA (max : avg)	MOS	Total TMDL (max : avg)
All	1,213 : 38.5	1125 : 39.0	- : -	Implicit	2,338 : 77.5

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia Other PS-WLA	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	88,603 : 2,648	18,330 : 564	125	49,674 : 14,311	6,212 : 182	Implicit	162,944 : 17,830

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max : avg)	DC Lower Anacostia Other PS-WLA	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	162,944 : 17,830	9,588 : 312	8.56	34,334 : 15,491	2,644 : 81.3	Implicit	209,519 : 33,717

Table 26. Summary of Annually-Based Maximum Daily Loads of Total Nitrogen for the Anacostia River Watershed (lbs/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max : avg)
< 0.89	0.775 : 0.331	41.9	27.4	5.74	3.99	79.8 : 51.7
0.89 - 2.34	3.34 : 1.32	182	27.4	29.0	12.7	254 : 109
2.34 - 3.48	5.64 : 2.39	703	27.4	50.4	41.4	828 : 187
3.48 - 10.75	25.1 : 4.80	1,367	27.4	142	82.2	1,644 : 375
> 10.75	215 : 30.8	13,919	27.4	3,604	935	18,700 : 2,331

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max : avg)
All	17,765 : 401	397	9.96	956	19,128 : 438

Table 26 (cont'd). Summary of Annually-Based Maximum Daily Loads of Total Nitrogen for the Anacostia River Watershed (lbs/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max : avg)	DC LBC MS4-WLA (max : avg)	DC LBC LA (max : avg)	MOS	Total TMDL (max : avg)
All	1,082 : 37.1	3.57 : 0.124	- : -	57.1	1,143 : 39.2

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max : avg)	DC WB MS4-WLA (max : avg)	DC WB LA (max : avg)	MOS	Total TMDL (max : avg)
All	145 : 4.46	138 : 4.74	- : -	14.9	298 : 9.68

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	18,172 : 416	964 : 34.7	4,791 : 1,380	334 : 11.3	1,277	25,538 : 1,939

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	24,261 : 1,842	433 : 16.1	3,312 : 1,494	141 : 5.11	1,481	29,628 : 3,534

Table 27. Summary of Annually-Based Maximum Daily Loads of Total Phosphorus for the Anacostia River Watershed (lbs/day)

Non-Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Non-Tidal MS4-WLA	MD Non-Tidal Other PS-WLA	MD Non-Tidal LA	MOS	Non-Tidal TMDL (max : avg)
< 0.89	0.0309 : 0.00900	3.57	2.05	0.0698	0.301	6.02 : 2.83
0.89 - 2.34	0.192 : 0.0421	18.6	2.05	0.401	1.12	22.4 : 5.01
2.34 - 3.48	0.403 : 0.0857	85.0	2.05	0.853	4.65	93 : 9.2
3.48 - 10.75	2.26 : 0.238	162	2.05	5.47	9.04	181 : 22.8
> 10.75	30.2 : 3.51	3,119	2.05	375	186	3,712 : 316

MD Tidal Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	MD Tidal MS4-WLA	MD Tidal LA	MOS	TMDL to MD/DC Border (max : avg)
All	3,526 : 40.0	43.4	0.515	187.9	3,758 : 43.6

Table 27 (cont'd). Summary of Annually-Based Maximum Daily Loads of Total Phosphorus for the Anacostia River Watershed (lbs/day)

DC Tidal Upper Anacostia River

Non-Tidal Lower Beaverdam Creek

Flow Range (m^3/s)	Upstream (max : avg)	DC LBC MS4-WLA (max : avg)	DC LBC LA (max : avg)	MOS	Total TMDL (max : avg)
All	152.2 : 4.50	0.470 : 0.0160	- : -	8.04	160.7 : 4.75

Non-Tidal Watts Branch

Flow Range (m^3/s)	Upstream (max : avg)	DC WB MS4-WLA (max : avg)	DC WB LA (max : avg)	MOS	Total TMDL (max : avg)
All	18.8 : 0.576	20.1 : 0.678	- : -	2.047	40.9 : 1.32

DC Tidal Upper Anacostia

Flow Range (m^3/s)	Upstream (max : avg)	DC Upper Anacostia MS4-WLA (max : avg)	DC Upper Anacostia CSO-WLA (max : avg)	DC Upper Anacostia LA (max : avg)	MOS	TMDL to Upper / Lower Boundary (max : avg)
All	3,570 : 41.4	104.2 : 3.46	991 : 286	31.6 : 0.989	247	4,944 : 349

DC Tidal Lower Anacostia River

Flow Range (m^3/s)	Upstream (max : avg)	DC Lower Anacostia MS4-WLA (max, avg)	DC Lower Anacostia CSO-WLA (max : avg)	DC Lower Anacostia LA (max : avg)	MOS	TOTAL TMDL (max : avg)
All	4,697 : 332	47.6 : 1.61	685 : 309	13.7 : 0.443	286	5,730 : 677

5.0 ASSURANCE OF IMPLEMENTATION

This section provides the basis for reasonable assurances that the nitrogen, phosphorus, and BOD TMDLs will be achieved and maintained. EPA's regulations require reasonable assurance that TMDLs can be implemented. Reasonable assurance indicates a level of confidence that the goals outlined in the TMDL, whether in the form of WLAs or LAs, can be achieved. Load allocations to point and nonpoint sources serve as targets for improvement, but success is determined by the level of effort put forth in making sure that those goals are achieved. Both MD and DC have several well-established programs to draw upon to implement the Anacostia River nutrients/BOD TMDLs.

Point Sources/Stormwater/CSOs/SSOs

For point sources, Federal regulations at 40 CFR 122.44(d)(1)(vii)(B), require effluent limitations for an NPDES permit to be consistent with the assumptions and requirements of any available WLA for the discharge prepared by the state and approved by EPA. Furthermore, EPA has authority to object to issuance of an NPDES permit that is inconsistent with the WLAs established for that point source. Additionally, according to 40 CFR 130.7(d)(2), approved TMDL loadings shall be incorporated into the states' current water quality management plans. These plans are used to direct implementation and draw upon water quality assessments to identify priority point and nonpoint source water quality problems, consider alternative solutions, and recommend control measures.

The municipal and industrial facilities permitted to discharge nutrients and BOD in the Anacostia watershed are assigned WLAs in this TMDL. The water quality-based effluent limitations in the NPDES permits that are issued, reissued, or modified after the TMDL approval date must be consistent with those WLAs.

EPA advises states to treat both individual and general NPDES Phase I and Phase II stormwater permits as point sources subject to WLA assignment in TMDLs (USEPA 2002). The majority of the Anacostia watershed is managed under NPDES MS4 permits for Montgomery County, Prince George's County and the District of Columbia. This provides regulatory assurances that the urban stormwater sources will be managed to the maximum extent practicable.

While MD has required consistency with TMDLs in all MS4 permits issued since 2005, comprehensive watershed assessment and restoration requirements were established in all MD localities beginning in 1999. In the State's NPDES stormwater permits, MD uses the watershed approach for achieving water quality because it is comprehensive and efficient. By examining all pollutants including physical and biological impairments at the same time, cost effective control strategies can be developed. The watershed approach incorporates detailed watershed assessments that include: determining water quality conditions, identifying and ranking water quality problems, identifying all structural and nonstructural water quality improvement opportunities, conducting visual watershed inspections, specifying how restoration efforts are monitored, and providing estimated

costs and detailed implementation schedules for restoration work. Stormwater best management practices (BMPs) and programs implemented as required by MS4 permits shall be consistent with available WLAs developed under the TMDL. Through watershed planning and implementation efforts established through NPDES MS4 permits, the local governments of Prince George's and Montgomery Counties have effective means available to achieve WLAs associated with nutrients in the Anacostia River. Information on Montgomery County's NPDES stormwater management program can be found at:
www.montgomerycountymd.gov/deptmpl.asp?url=/content/dep/NPDES/home.asp.

The District of Columbia Water Pollution Control Act (DC Law 5-188) authorizes the control of source of pollution through storm water management (21 DCMR, Ch. 5). Under its MS4 NPDES permit, DC is implementing a stormwater management plan (SWMP) to control the discharge of pollutants from separate storm sewer outfalls. In November 2007, DC signed a letter agreement with EPA for enhancing BMP implementation efforts within the MS4 permit. This has made it one of the most ambitious permits in the country for implementing green strategies and reducing runoff pollution.

The DC Water and Sewer Authority (DCWASA) is taking several major steps to reduce CSOs. WASA is implementing a Nine Minimum Controls Plan for combined sewers. In addition, it is rehabilitating the existing inflatable dams, Northeast Boundary Swirl Concentrator, the East Side Interceptor, and the O-Street Pump Station to improve system performance. WASA has also established a Long Term Control Plan (LTCP) for the reduction of CSOs and the nutrient loads associated with them. The goal of the LTCP is to reduce CSOs by 98% within 20 years.

In 2004, the United States and the State of Maryland brought suit against WSSC in the U.S. District Court for the District of Maryland to remedy recurrent SSOs from the WSSC system (*United States et al. v. Washington Suburban Sanitary Commission,* C.A. No. PJM 04-3679 (Greenbelt Division). A consent decree was negotiated among the United States, Maryland, several intervenor citizen groups and WSSC, and lodged on July 26, 2005. WSSC has entered into a "Clean Water Partnership" with several environmental and watershed advocacy groups and developed a 12-year plan to carry out the requirements of the consent decree, which include including maintaining, identifying, and repairing problem areas within a 5200-mile sewer system.. WSSC already reports overflows to MDE as required by Environment Article, Section 9-331.1, Annotated Code of Maryland, and COMAR 26.08.10.

Nonpoint Sources

MD envisions TMDL implementation for nonpoint sources as a partnership between the State and local governments, with stakeholder involvement and public participation. As a starting point in this partnership, MDE recommends that local jurisdiction officials and watershed advocacy groups give serious consideration to "Maryland's 2006 TMDL Implementation Guidance for Local Governments," available on MDE's web site at:

http://www.mde.state.md.us/Programs/WaterPrograms/TMDL/TMDL_implementation_2006_guidance_document.asp.

In January 2005, MD's Section 319 Nonpoint Source Program was transferred from DNR to MDE to focus resources on the implementation of TMDLs. In addition, the grant associated with the 319 Program is used to fund a small number of targeted stream restoration and protection projects each year. The Anacostia watershed is being considered for such projects.

The Anacostia River is classified as a priority watershed of the State within MDE's Integrated Project Priority System (IPPS), which is used for selecting grant and loan requests. This status will help to assure implementation in the Anacostia watershed.

Prince George's County, in partnership with DNR, has developed a Watershed Restoration Action Strategy (WRAS) for the Anacostia watershed. Information on the WRAS, including a stream corridor assessment, can be found at: http://www.dnr.state.md.us/watersheds/wras/index.html.

MD's Water Quality Improvement Act of 1998 (WQIA) requires that comprehensive and enforceable nutrient management plans be developed, approved and implemented for all agricultural lands throughout MD. This act specifically required such plans for nitrogen be developed and implemented by 2002, and plans for phosphorus be completed by 2005. Additional potential funding sources for implementation include MD's Agricultural Cost Share Program (MACS) which provides grants to farmers to help protect natural resources, and the Environmental Quality and Incentives Program, which focuses on implementing conservation practices and BMPs on land involved with livestock and production.

MD uses a five-year watershed cycling strategy to manage its waters. Pursuant to this strategy, the State is divided into five regions and management activities cycle through those regions over a five-year period. The cycle begins with intensive monitoring, followed by computer modeling, TMDL development, implementation activities, and follow-up evaluation. The choice of a five-year cycle is motivated by the five-year federal NPDES permit cycle. The follow-up monitoring performed as part of this continuing strategy establishes a TMDL evaluation process that ensures accountability by regularly measuring implementation progress.

DC is implementing a nonpoint source management plan through its Nonpoint Source Management and Chesapeake Bay Implementation programs, and has developed a tributary strategy as part of the Bay's restoration efforts. The strategy provides the framework for implementation efforts for achieving nutrient reduction goals. The tributary strategy allocations were established through the 2000 Chesapeake Bay Agreement process. DDOE is also committed to ongoing monitoring and assessment of the tidal Anacostia River.

Legislative and Regulatory Changes in Maryland

Several major coordinated state and local policies and regulations have been recently put in place to help accelerate the implementation of BMPs and prevention of degradation of existing waters. At the state level, recent legislation was passed in 2006 and 2007 that requires comprehensive planning measures to address nonpoint sources and greater stormwater control to reduce pollutant loadings. Detailed information on legislative acts from 2006 addressing NPS loads, titled "HB 1141" and "HB 2," can be found at http://www.mdp.state.md.us/hb1141.htm. Detailed information on legislative action, titled the Maryland Stormwater Act of 2007, is available at: http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/swm2007.asp. A brief synopsis of each is provided below:

(i) House Bill 1141, Land Use – Local Government Planning, and House Bill 2, The Agricultural Stewardship Act, were enacted by the General Assembly in 2006 (Chapters 381 and 289, respectively). These laws establish new and modified local comprehensive plan elements under Article 66B of the Annotated Code of Maryland, the local planning and zoning enabling statute. The first new element mandated in HB 1141 is the Water Resources Element (WRE) that addresses the relationship of planned growth to planning area water resources. For each watershed, counties and municipalities that exercise zoning authority are required to calculate current land use patterns, identify best management practices (BMP) with respect to locations and types and to calculate current stormwater loads. The second new element, related to the WRE, is titled the Municipal Growth Element (MGE). Under the MGE, counties and municipalities must identify suitable receiving waters and land areas to meet the storm water management and wastewater treatment and disposal needs of existing and future development proposed in the land use element of the plan. The WRE and MGE were designed to ensure that the land use planning process is used as an effective nonpoint source pollution management instrument. This, in conjunction with the management of point source pollution, will help a jurisdiction achieve and maintain its water quality standards and assess potential impacts of proposed land use changes on nonpoint source loads.

(ii) Effective October 1, 2007, MD's "Stormwater Management Act of 2007" requires that, for new development and re-development, environmental site design (ESD) be implemented to the maximum extent practicable, through the use of nonstructural BMPs and other better site design techniques. MDE is in the process of addressing the requirements of the Act, including changes to regulations, the 2000 Maryland Stormwater Design Manual (MDE 2000), and other guidance materials. Technical presentations to assist local jurisdictions were provided throughout the State in early 2008.

In addition to these new measures, the Maryland General Assembly concluded a Special Legislative Session in late 2007 that passed HB 23, a special, continuing, non-lapsing Chesapeake Bay 2010 Trust Fund, to begin on July 1, 2008. The Trust Fund is intended to address NPS runoff pollution by providing a funding stream to accelerate the tributary strategies framework goals. While the details of the legislation have not been spelled out because further legislation is anticipated during the Regular 2008 Session, the aim of the funding source is clearly to reduce overall NPS loads. For information see: http://mlis.state.md.us/2007s1/billfile/HB0023.htm. The tributary strategies framework is an example of an ongoing statewide effort to reduce loadings and protect the Chesapeake Bay. MD's Tributary Strategies are broad implementation plans for achieving and maintaining nutrient allocations for the ten major watersheds that drain to the Chesapeake Bay. These allocations were established through the 2000 Chesapeake Bay Agreement process. Local governments should actively support development of Tributary Strategy implementation basin plans as an initial phase of MD's nutrient TMDL implementation planning process. More information is available at: http://www.dnr.state.md.us/BAY/TRIBSTRAT/archives.html

Inter-jurisdictional Cooperative Agreements

In 1983, the District of Columbia and the States of Maryland, Pennsylvania, and Virginia, the Chesapeake Bay Commission, and the U.S. EPA joined in a partnership to restore the Chesapeake Bay. In 1987, through the Chesapeake Bay Agreement, DC and MD made commitments to reduce nutrient loads to the Chesapeake Bay. In 1992, the Chesapeake Bay Agreement was amended to include the development and implementation of plans to achieve these nutrient reduction goals. The revised 2000 Chesapeake Bay Agreement includes a specific commitment to reduce pollutant loads to the Anacostia River. Maryland and the District of Columbia, together with Montgomery County and Prince George's County, EPA Region III, and the U. S. Army Corp of Engineers, Baltimore District (USACE), have formed the Anacostia Watershed Leadership Council, which leads the reformed Anacostia Watershed Restoration Partnership (AWRP). The AWRP coordinates the overall restoration effort in the Anacostia watershed. The AWRP builds on the 1987 Anacostia Watershed Restoration Agreement and the work of the Anacostia Watershed Restoration Committee (AWRC). Staff support and technical assistance to the AWRP is provided by MWCOG. The AWRP has reaffirmed the AWRC Six-Point Action Plan, which includes (1) reducing pollutant loads (including nutrients and BOD), (2) protecting and restoring the ecological integrity of Anacostia River watershed, (3) restoring natural range of resident and andromonous fish, (4) increasing tidal and non-tidal wetlands, (5) protecting and expanding forest cover, and (6) increasing public usage, stewardship, and advocacy. The reduction of nutrient loads will most directly be address by stormwater management retrofits and increased use of low impact development under the first goal, but stream restoration under the second goal, as well as increased forest and wetland cover, are also are likely to help reduce nutrient loads. Details on the plans and activities of the AWRP can be found at http://www.anacostia.net.

USACE, in partnership with local jurisdictions, is currently developing a Feasibility Study for an Anacostia Watershed Restoration Plan (USACE 2005). One of the goals of the Restoration Plan will be to determine the "efficient and effective" controls on nutrients and sediments in the Anacostia watershed.

MD and DC intend for the required reductions to be implemented in an adaptive and iterative process, in which ongoing implementation efforts are evaluated, increased or improved, and re-evaluated to achieve continuing progress toward the water quality goals. Thus, an iterative approach to implementation will involve a coordinated sequence of actions designed to approximate the desired result more and more closely. Given the significant nutrient reductions required by the TMDL, this approach is well-suited to the magnitude of the task, and will have the benefits of tracking water quality improvements following BMP implementation through follow-up stream monitoring; providing a mechanism for developing public support through periodic updates on BMP implementation; and helping to ensure that the most cost-effective practices are implemented first.

MDE and DDOE expect that the significant reductions of nutrient loads required by the TMDL to protect aquatic life will also be protective of other uses such as primary and secondary contact recreation. MD and DC will continue to monitor and assess the water quality in the Anacostia as load reductions take place in the watershed. If it is determined through implementation of the TMDL that additional reductions are necessary to protect uses such as primary (swimming) and secondary contact recreation (boating), then the TMDL can be revised and further reductions applied.

Table 28 provides a summary of planned and ongoing Anacostia watershed restoration activities in Montgomery and Prince George's Counties, and in DC.

Table 28. Montgomery County, Prince George's County, and DC Activities in Support of Anacostia Watershed Restoration

Montgomery County
1. Conducts NPDES MS4 permit monitoring in Lower Paint Branch. 2. Funds flow gages and water quality monitoring by USGS in Anacostia watershed. 3. Monitors and evaluates the effectiveness of selected stormwater practices. 4. Conducts monthly street sweeping. 5. Plans and develops new and enhanced stormwater management retrofits, LID (low impact development) retrofits, and stream restoration projects. See http://www.montgomerycountymd.gov/content/dep/Publications/pdf/anacostia_restoration.pdf
Prince George's County
1. Conducts NPDES MS4 permit monitoring in Lower Beaverdam Creek. 2. Funds flow gages and water quality monitoring by USGS in Anacostia watershed. 3. Conducts routine storm drain-inlet cleaning, pipe cleaning and street sweeping. 4. Planning and/or implementing stream restoration, bioretention, and LID at sites in Beaverdam Creek, Lower Beaverdam Creek, and Sligo Creek watersheds; participating in construction of wetlands downstream of Bladensburg Marina for mitigation of Wilson Bridge Project.
District of Columbia
1. Develops and implements a range of stormwater management and LID retrofits. 2. Monitors and evaluates the effectiveness of selected stormwater practices. 3. Funds flow gages and water quality monitoring by USGS in Anacostia watershed. 4. Conducts routine catch basin cleaning and street sweeping. 5. Develops and implements stream restoration projects. 6. Protects and restores wetlands.

6.0 PUBLIC PARTICIPATION

Stakeholders in the Anacostia River nutrients/BOD TMDL were informed of the planned project by a February 2007 MDE mailing of a notice of intent to develop both sediment and nutrients TMDLs for the Anacostia. The notice letters provided contact information and announced plans for joint MD-DC public meetings on the proposed TMDLs, to be scheduled during the public comment period. A follow-up notification was mailed in early February 2008 to announce the imminent release of the TMDL documents for public review and the scheduled public meeting.

A public notice of intent to establish the nutrients/BOD TMDL, announcing the opening and closing dates of the formal 30-day Public Comment Period, was published in the DC Register in the District, and in the Montgomery County Gazette and Prince George's County Enquirer-Gazette in MD. The notice was also sent to MD and DC stakeholders. The public notice announces the availability of the draft TMDL documents, which have been placed in certain public libraries located in the District and in each of the two MD Counties, and provides links for accessing the draft TMDL documents on MDE's and DDOE's websites. The notice invites all interested parties to send written comments on the draft TMDL to MDE and/or DDOE, and also announces a planned public meeting on the TMDL.

A public meeting on the nutrients/BOD TMDL was held in Washington, D.C., on Friday, March 14, 2008. The meeting was facilitated by staff from EPA Region 3. Staff from MDE and DDOE, as well as technical support contractors involved in developing the TMDL, provided an informational presentation and addressed comments and questions regarding the TMDL. Attendees were invited to send formal written comments to MDE and/or DDOE before the close of the public comment period. All written comments received by the close of the comment period have been recorded and formally responded to in a Comment Response Document (CRD), included in the draft final TMDL documentation package submitted to EPA for the Agency's approval. Receipt of each set of comments was acknowledged either by letter or email. Following EPA approval of the TMDL, the responses will be made available when the CRD is posted on MDE's and DDOE's websites, together with the final approved TMDL documentation.

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Appendix A – Additional Water Quality Analysis Figures

Appendix B – Additional Calibration Figures

Appendix C – Addressing DO Criteria in the Anacostia Watershed

Appendix D – Technical Approach Used to Generate Maximum Daily Loads