Anacostia River Sediment TMDL

Source Document:	MDE and DDOE (Maryland Department of the Environment and District Department of the Environment). 2007. Total Maximum Daily Loads of Sediment/Total Suspended Solids for the Anacostia River Basin, Montgomery and Prince George's Counties, Maryland and The District of Columbia. Document Version June 14, 2007.
Water Body Type:	Tidal and non-tidal portions of Maryland's and the District of Columbia's Anacostia River basin
Pollutant:	Sediment and total suspended solids (TSS)
Designated Uses:	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
Size of Watershed:	173 square miles (84 percent in Maryland)
Water Quality Standards:	Growing season (April 1– October 30) 3-year median Secchi depth not less than 0.4 meters
Analytical Approach:	Tidal Anacostia Model/Water Analysis Simulation Program (TAM/WASP) with other methods used for various sources and tributaries
Date Approved:	Approved July 24, 2007

Introduction

The Total Maximum Daily Load (TMDL) addresses water clarity problems and associated impacts to aquatic life in the Anacostia River watershed (Figure 1) caused by high sediment and TSS concentrations.

This fact sheet provides summary data related to the TMDL and includes specific information related to allocations made for Prince George's County, Maryland, regulated stormwater sources.

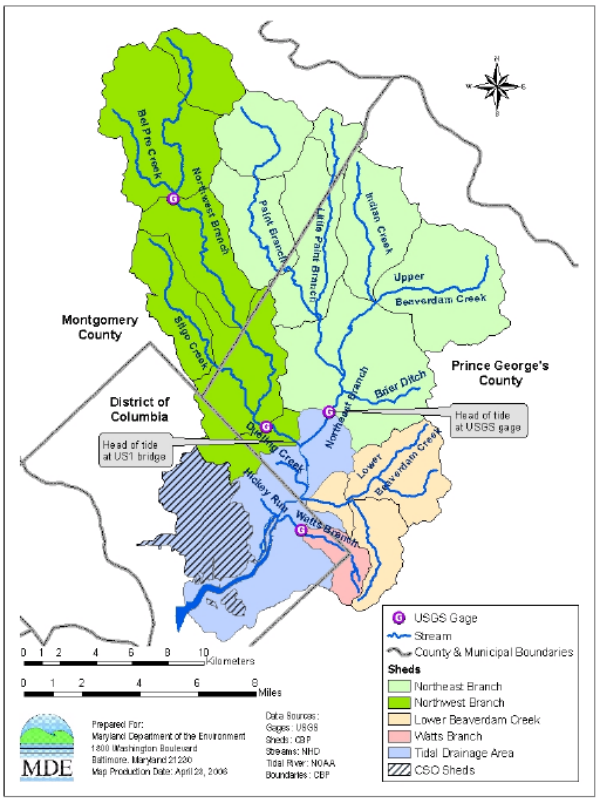

Figure 1. Anacostia River watershed
Source: MDE and DDOE 2007.

Problem Identification and Basis for Listing

Impairments were identified in both the non-tidal and tidal portions of the Anacostia River. Long-term Secchi depth growing season medians for the most upstream segments, representing water clarity conditions from the confluence of the Northeast and Northwest Branches (NEB and NWB, respectively) in Maryland to the New York Avenue Bridge

at approximately the Maryland-DC line, were at or above 0.4 meters, the Maryland criterion. For tidal portions, long-term data showed median Secchi depths were less than the District's 0.8-meter depth criteria in the middle portions of the tidal Anacostia.

Data related to sediment in the non-tidal streams of the Anacostia River watershed included biological monitoring data and measurements of suspended solids in water samples. Biological indices categorize the condition of benthic communities in most sites in the Anacostia River as poor to very poor and fish communities as poor to very good.

Analysis determined that the District's clarity criterion for tidal waters required the most stringent sediment reductions; therefore, that standard is the one driving all allocations in the TMDL.

Applicable Data

Water quality data related to suspended solids and water clarity in the tidal portion of the Anacostia River were available from routine monitoring programs conducted by agencies in Maryland the District, and from several special studies. Available parameters generally included TSS, chlorophyll a, and Secchi depth. Specific studies from which data were used are detailed in the TMDL report.

Various agencies also collected suspended solids data (TSS) or suspended solids concentrations that were used in the impairment assessment and subsequent modeling. Those data sets are described in Appendix A of the TMDL report.

Sources

Historically, activities contributing significant loads include agriculture, sand and gravel mining, and construction activities. Currently, stream channel erosion is considered to be the most significant source of sediment. Tidal resuspension of bed sediments is also a factor in the tidal portions.

Approximately 85 percent of sediment entering the tidal Anacostia from the non-tidal portions stays there, remaining suspended before settling to the bed. Tidal action impedes settling and continually promotes resuspension of sediments. Model scenarios predict that with no incoming sediment loads from non-tidal portions, sediment concentrations in tidal Anacostia would approximate 5 mg/L due to tidal resuspension alone.

Technical Approach

The TMDL allocations were developed using a modeling framework that consisted of a coupled watershed/hydrodynamic water quality model. Hydrological Simulation Program—FORTRAN (HPSF) and the U.S. Geological Survey's (USGS') ESTIMATOR model were used to provide nonpoint source inputs to the receiving water model. A reference watershed approach was used to determine the sediment loads required to meet water quality standards in Maryland's non-tidal waters.

The TAM/WASP model was used to calculate water clarity conditions to determine attainment of water quality standards in the tidal Anacostia.

Estimation of Watershed Inputs

A combination of modeling tools were used to develop load estimates from the watershed for the TMDL development effort.

ESTIMATOR

For the NEB and NWB watersheds, input loads for TAM/WASP were developed using the USGS' multiple regression model, ESTIMATOR. Appendix A provides further details. ESTIMATOR was used to compute time series of daily, monthly, and annual sediment loads for both tributaries. Daily time series were used as input to TAM/WASP. The monthly load time series were used to calibrate the HSPF watershed model (Phase 3) for the non-tidal Anacostia.

HSPF

HSPF was used to simulate hydrologic and erosion processes in the non-tidal drainage areas of the major tributaries (NEB, NWB, Lower Beaverdam Creek [LBC], and Watts Branch). Calibrated against ESTIMATOR loads for 1995–2004, HSPF provided daily flow and sediment loads for LBC and Watts Branch. (ESTIMATOR provides daily flow and sediment loads for NEB and NWB.) HSPF results also provided sediment loads by source (agriculture, forest, urban, streambank erosion).

A reference watershed analysis was conducted with HSPF to evaluate loads needed to satisfy Maryland's non-tidal aquatic life criteria (using unimpaired watersheds of Upper Beaverdam Creek and Upper Paint Creek). Reductions necessary to meet Maryland's non-tidal criteria were found to be less than those needed to meet the District's tidal water clarity criteria.

Other analyses were conducted that could potentially be useful or informative to the TMDL implementation effort. A flow duration/quantile regression analysis was performed to estimate the current-day sediment loads due to altered hydrology. Results suggest that up to 90 percent of the watershed's impervious surfaces would need to be disconnected to return to 1939 hydrologic conditions (Appendix B).

Allocations

The TMDL specifies annual and 7-month growing season allocations for agricultural and forest land uses and streambank erosion; for municipal and industrial facilities, municipal separate storm sewer systems (MS4s), and other regulated stormwater; and for District combined sewer overflows (CSOs) (Tables 1–4). The margin of safety for the Anacostia River sediment TMDL is implicit. An additional technical memorandum provided with the TMDL provides a breakdown between the Maryland MS4 loads by watershed and other regulated stormwater loads.

Baseline loading for the MS4s is not provided in the TMDL report or accompanying appendices; therefore, it is not possible to calculate required percentage reductions specific to the MS4 portion of loads. Overall, the loading caps constitute an 85 percent reduction of sediment and TSS from the baseline loads determined for the TMDL analysis period, 1995–1997. For additional context, the following tables present the baseline annual and seasonal loads and the annual and seasonal load allocations for the entire watershed.

Table 1. MS4 loads by watershed (Prince George's County)

Maryland Point Source Name	Permit Number	TMDL - Annual (tons/year)	TMDL - GS (tons/growing season)
Prince George's County MS4 – NWB	MD0068284	1,090.50	574.70
Other Prince George's County SW-NWB		147.90	77.90
Prince George's County MS4 – NEB	MD0068284	2,449.40	988.50
Other Prince George's County: SW-NEB		678.10	273.70
Prince George's County MS4 – LBC	MD0068284	421.00	263.90
Other Maryland SW-LBC		57.80	36.20
Prince George's County: MS4–Watts Branch	MD0068284	25.80	15.30
Other Maryland: SW-Watts		2.10	1.20
Total Maryland Non-tidal—point sources		6,355.80	3,005.80
Prince George's County MS4 – Tidal	MD0068284	77.30	55.60
Other Maryland SW-Tidal		9.00	6.40
Total Maryland—point sources		6,442.10	3,067.80

Source: MDE and DDOE 2007.

Note: GS = growing season; SW = stormwater.

Table 2. Annual baseline loading by source, entire watershed

Source	Area (acres)	Annual Load (tons)	% Annual Load	Annual Yield (tons/ acre)
Agriculture	4,971	1,290	3%	0.24
Forest	21,942	357	1%	0.02
Urban	77,017	9,331	20%	0.12
Construction	198	624	1%	3.15
Stream Channel	--	34,250	73%	0.31
Point Sources	--	2	0.2%	--
CSOs	6,945	1052	2%	--
Total	111,073	46,906	100%	0.42

Source: MDE and DDOE 2007.

Table 3. Seasonal baseline loading by source, entire watershed

Source	Area (acres)	GS Load (tons)	% GS Load
Agriculture	4,971	150	1%
Forest	21,942	16	0.1%
Urban	77,017	6,483	30%
Construction	198	364	2%
Stream Channel	--	14,565	65%
Point Sources	--	1	0.2%
CSOs	6,945	733	1%
Total	111,073	22,312	100%

Source: MDE and DDOE 2007.

Table 4. Annual allocations, entire watershed

Sediment/ TSS TMDLs	Annual (tons/year)				
	MD WLA	MD LA	DC WLA	DC LA	TMDL
Non-tidal					
NWB	2,254	23	27	0	2,304
NEB	3,595	218	--	--	3,814
LBC	479	5	1	0	484
Watts Branch	28	1	24	0	53
Non-tidal Total	6,356	247	51	0	6,655
Tidal					
Tidal Total	86	0	306	51	443
Total	6,442	247	357	51	7,097

Source: MDE and DDOE 2007.

Note: WLA = wasteload allocation; LA = load allocation.

Table 5. Seasonal allocations, entire watershed

Sediment/ TSS TMDLS	Growing season (Apr 1 – Oct 31) (tons/year)				
	MD WLA	MD LA	DC WLA	DC LA	TMDL
Non-tidal					
NWB	1,216	3	21	0	1,240
NEB	1,473	22			1,495
LBC	300	0	0	0	301
Watts Branch	17	0	16	0	32
NT Total	3,006	25	37	0	3.068
Tidal					
Tidal Total	62	0	231	36	328
Total	**3,068**	**25**	**267**	**36**	**3,396**

Source: MDE and DDOE 2007.

References

MDE and DDOE (Maryland Department of the Environment and District Department of the Environment). 2008. Technical Memorandum: Significant Biochemical Oxygen Demand, Nitrogen, and Phosphorus Point Sources in the Anacostia River Watershed.

Mandel, R., S. Kim, A. Nagel, J. Palmer, C. Schultz, and K. Brubaker. 2008. The TAM/WASP Modeling Framework for Development of Nutrient and BOD TMDLs in the Tidal Anacostia River.