D.C. DEPARTMENT OF HEALTH
Environmental Health Administration
Bureau of Environmental Quality
Water Quality Division

DISTRICT OF COLUMBIA

FINAL
TOTAL MAXIMUM DAILY LOADS
FOR
ORGANICS AND METALS
IN THE
ANACOSTIA RIVER, FORT CHAPLIN TRIBUTARY, FORT DAVIS TRIBUTARY, FORT DUPONT CREEK, FORT STANTON TRIBUTARY, HICKEY RUN, NASH RUN, POPES BRANCH, TEXAS AVENUE TRIBUTARY, AND WATTS BRANCH

August 2003

Government of the
District of Columbia
Anthony A. Williams, Mayor

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BUREAU OF ENVIRONMENTAL QUALITY
WATER QUALITY DIVISION
WATER QUALITY CONTROL BRANCH

AUGUST 2003

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Final D.C. TMDL For Organics and Metals in the Anacostia River and Tributaries

1. Introduction

1.1. TMDL Definition and Regulatory Information

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

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

Further, Section 303(d) (1)(C) states:

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

Section 303(d) of the Clean Water Act and EPA's Water Quality Planning and Management Regulations (40 CFR Part 130) require states to develop Total Maximum Daily Loads (TMDLs) for waterbodies, which are exceeding water quality standards.

In 1996, the District of Columbia (DC), developed a list of impaired waters that did not or were not expected to meet water quality standards as required by Section 303(d)(1)(A). This list, submitted to the Environmental Protection Agency every two years, is known as the Section 303(d) list. This list of impaired waters was revised in 1998 based on additional water quality monitoring data. EPA, subsequently, approved each list. The Section 303(d) list of impaired waters contains a priority list of those waters that are the most polluted. This priority listing is used to determine which waterbodies are in critical need of immediate attention. For each of the listed waters, states are required to develop a Total Maximum Daily Load (TMDL), which establishes the maximum amount of a pollutant that a waterbody can receive without violating water quality standards and allocates that load to all significant sources. Pollutants above the allocated loads must be eliminated. By following the TMDL process, states can establish water-quality based controls to reduce pollution from both point and nonpoint sources to restore and maintain the quality of their water resources.

1.2. Anacostia Watershed Location

The Anacostia River is a major tributary to the Potomac River (which ultimately flows into the Chesapeake Bay) and the mainstem is predominantly located within the District of Columbia. It begins at the confluence of the Northeast Branch and the Northwest Branch in Maryland and flows south through the District. The watershed area is approximately 117,353 acres with 49 percent of the drainage area located in Prince George's County, 34 percent in Montgomery

County, and 17 percent in the District of Columbia (Figure 1-1). The Hydrologic Unit Code (HUC) for the Anacostia River basin is 02070010.

There are nine small tributaries that flow into the Anacostia. They include: Fort Chaplin Tributary, Fort Davis Tributary, Fort Dupont Creek, Fort Stanton Tributary, Hickey Run, Nash Run, Popes Branch, and Watts Branch. See Appendix A for the maps of these tributaries.

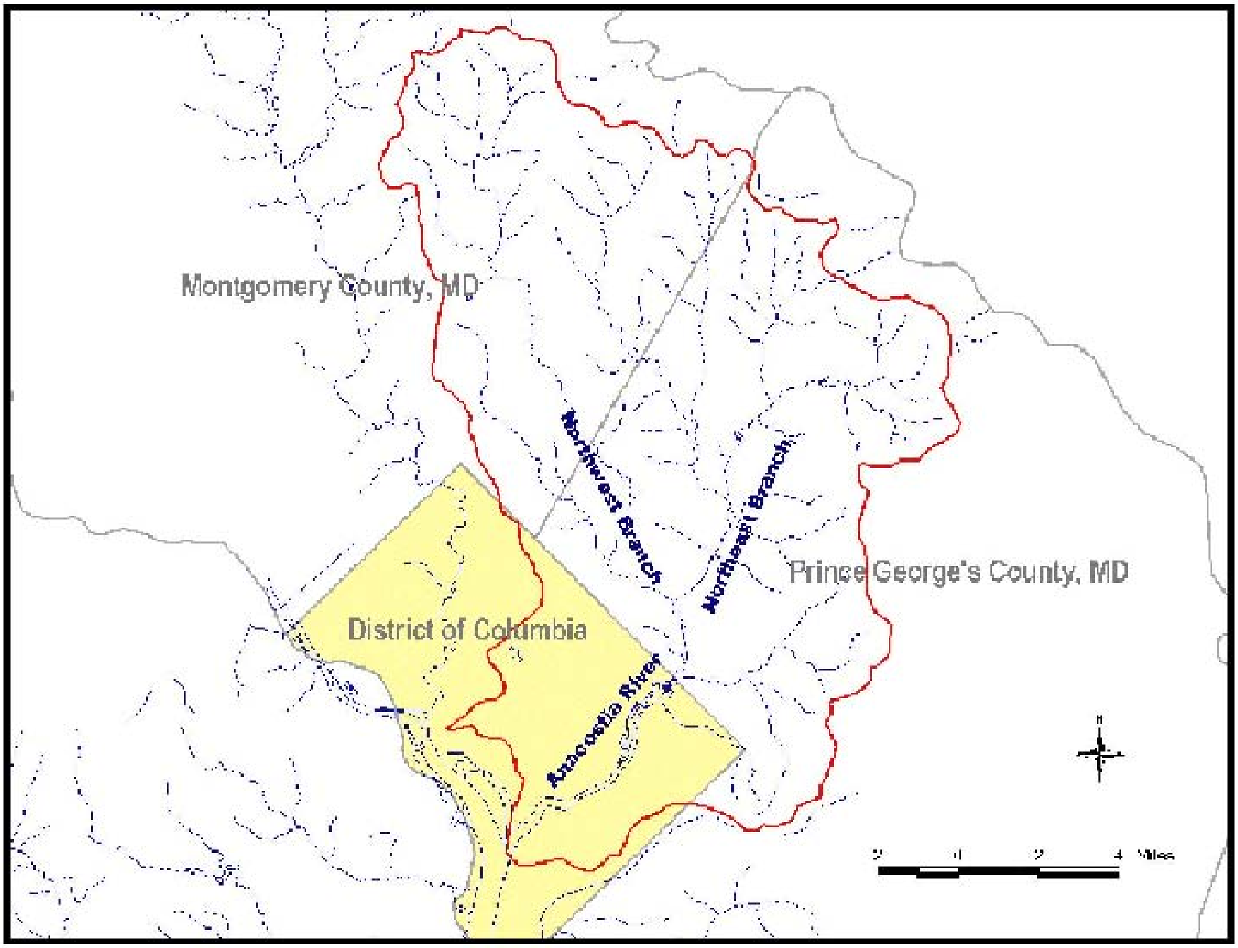

Figure 1-1: Anacostia Watershed Location Map

1.3. Impairment Listing

The District of Columbia's Section 303 (d) list divides the Anacostia into two segments, Lower and Upper Anacostia River. The demarcation in the list has no legal meaning other than to try to isolate the areas not attaining the applicable standards. This TMDL is for the river as a whole and applies to both the upper and lower Anacostia River and the Small Tributaries of the Anacostia. Figure 1-2 and 1-3 represents the impaired segments for the Anacostia River and Small Tributaries, respectively.

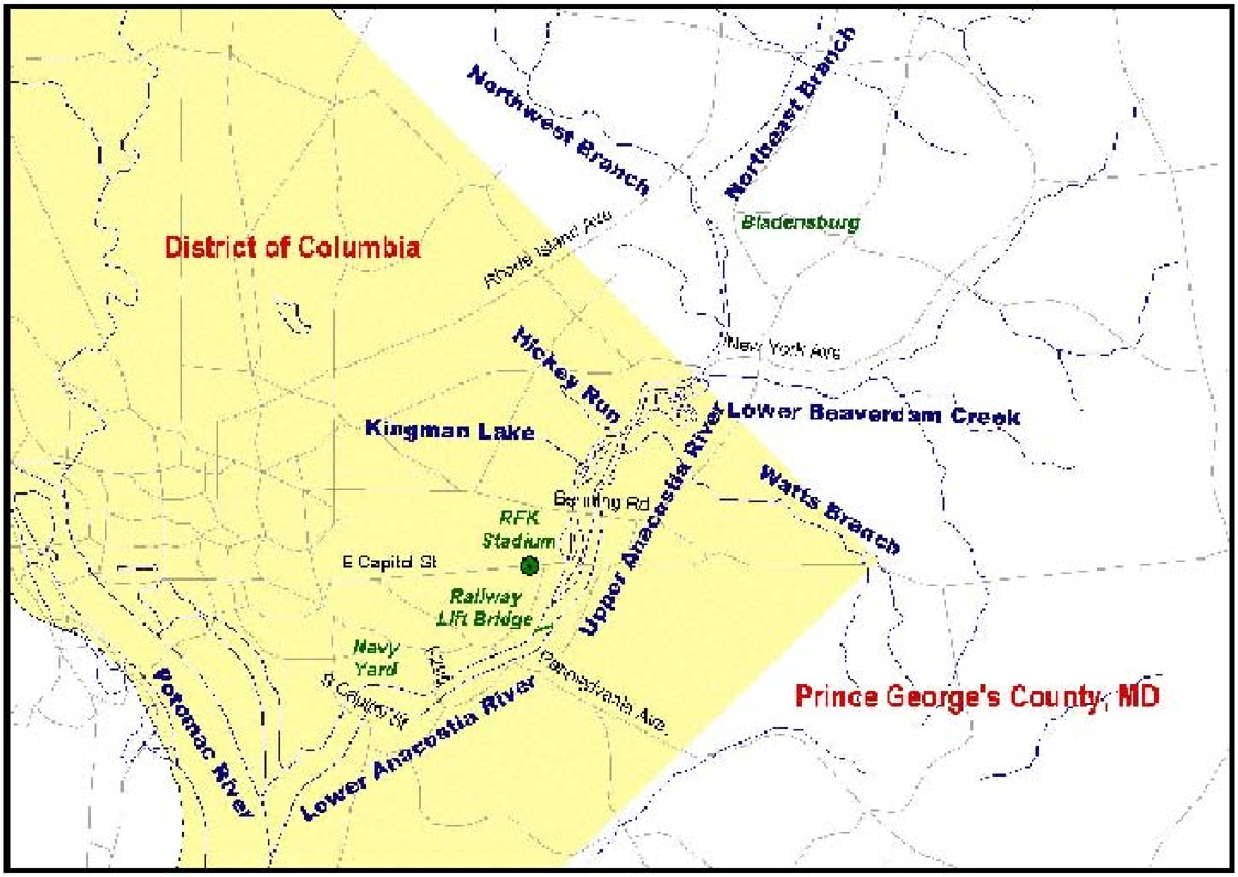

Figure 1-2: Anacostia River Impairment Segments

The Lower Anacostia is identified as that portion of the river extending from the mouth of the river to the John Philip Sousa Bridge at Pennsylvania Avenue and the Upper Anacostia from the John Philip Sousa Bridge to the Maryland border.

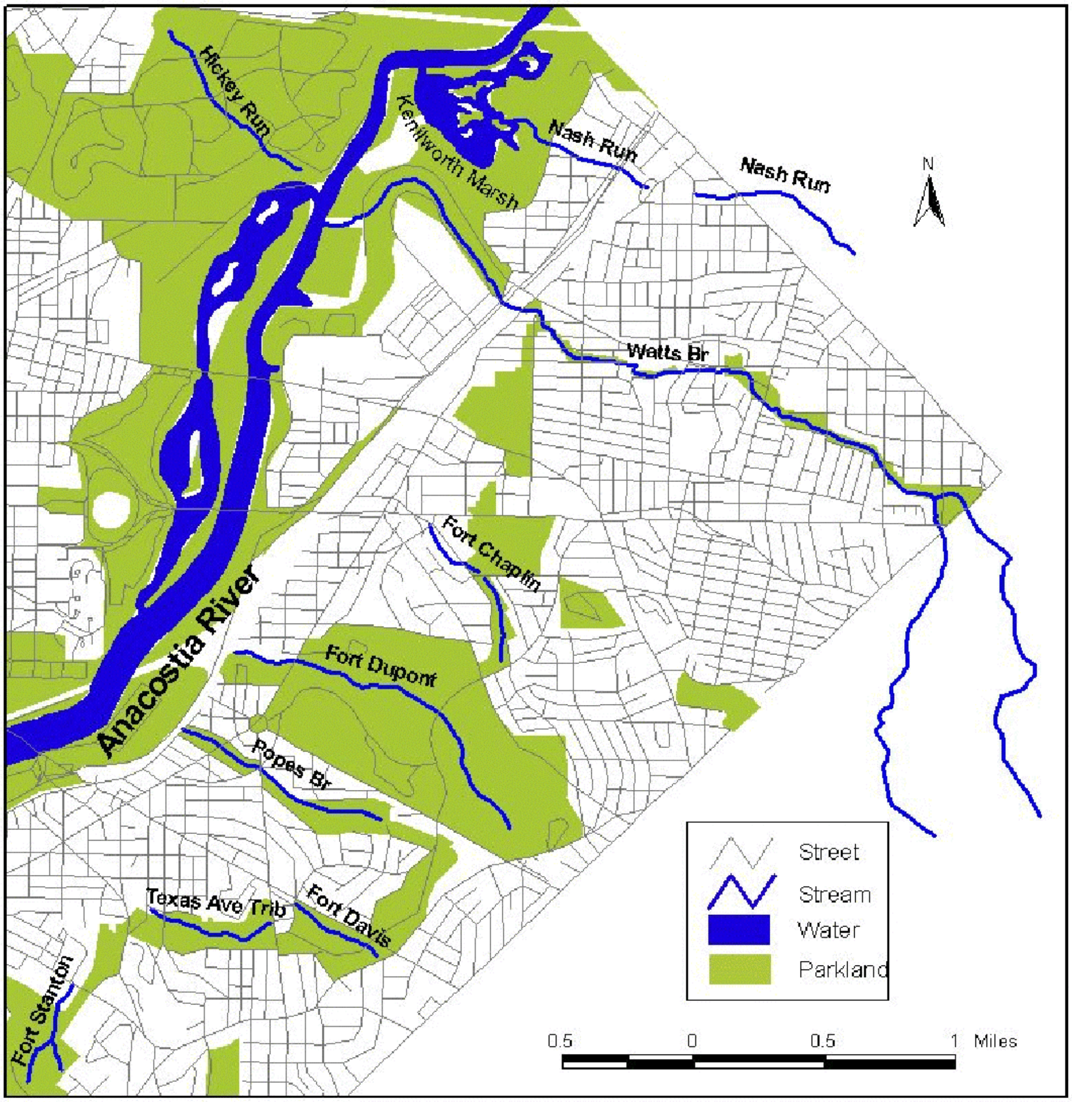

Figure 1-3: Anacostia River Small Tributary Impairment Segments

The upper and lower segments of the Anacostia River and its small tributaries were listed as impaired on DC's 1996 and 1998 Section 303(d) list as shown on Table 1-1 and Table 1-2, because of excessive for organics and metals in fish tissue and sediment.

Table 1-1: 1996 Section 303(d) Listing Information

1996 Section 303(d) Listing					
S. No	Waterbody	Pollutant of Concern	Priority	Ranking	Action Needed
1.	Lower Anacostia (below Pennsylvania Ave Bridge)	BOD, f. coliform and toxics in sediment and fish	High	1	Control CSO and nonpoint source (NPS) pollution
2.	Upper Anacostia (above Pennsylvania Ave Bridge)	BOD, f. coliform and toxics in sediment and fish	High	2	Control CSO and NPS pollution

1996 Section 303(d) Listing					
S. No	Waterbody	Pollutant of Concern	Priority	Ranking	Action Needed
3.	Hickey Run	Oil and grease	High	3	Control NPS pollution
4.	Upper Watts Branch (above tidal boundary)	Organics, toxics and solids	High	4	Control NPS pollution
5.	Lower Watts Branch (below tidal boundary)	Organics, toxics and solids	High	5	Control NPS pollution
7.	Fort Dupont Creek	F. Coliform and metals	High	7	Control NPS pollution
11.	Fort Chaplin	Metals and Pathogens	High	11	Control NPS pollution
12.	Fort Davis Tributary	Metals and f. coliform	Medium	12	Control NPS
13.	Fort Stanton Tributary	Metals and f. coliform	Medium	13	Control NPS pollution
14.	Nash Run	F. coliform, BOD and metals	Medium	14	Control NPS pollution
16.	Popes Branch (Hawes Run)	Metals and f. coliform	Medium	16	Control NPS pollution
17.	Texas Ave. Tributary	Metals and f. coliform	Medium	17	Control NPS pollution

Table 1-2: 1998 Section 303(d) Listing Information

1998 Section 303(d) Listing					
S. No	Waterbody	Pollutant of Concern	Priority	Ranking	Action Needed
1.	Lower Anacostia (below Pennsylvania Ave Bridge)	BOD, bacteria, organics, metal, total suspended solids, and oil & grease	High	1	Control CSO, point and nonpoint source (NPS) pollution
2.	Upper Anacostia (above Pennsylvania Ave Bridge)	BOD, bacteria, organics, metal, total suspended solids, and oil & grease	High	2	Control CSO, point and NPS pollution
3.	Hickey Run	Organics, bacteria, oil and grease	High	3	Control NPS pollution
4.	Upper Watts Branch (above tidal boundary)	Organics, bacteria, and total suspended solids	High	4	Control NPS pollution
5.	Lower Watts Branch (below tidal boundary)	Organics, bacteria, and total suspended solids	High	5	Control NPS pollution
7.	Fort Dupont Creek	Bacteria and metals	High	7	Control NPS pollution

1998 Section 303(d) Listing					
S. No	Waterbody	Pollutant of Concern	Priority	Ranking	Action Needed
8.	Fort Chaplin	Metals and bacteria	High	8	Control NPS pollution
9.	Fort Davis Tributary	BOD, metals and bacteria	Medium	9	Control NPS
10.	Fort Stanton Tributary	Organics, metals and bacteria	Medium	10	Control NPS pollution
11.	Nash Run	Organics, metals and bacteria	Medium	11	Control NPS pollution
13.	Popes Branch (Hawes Run)	Organics, metals and bacteria	Medium	13	Control NPS pollution
14.	Texas Ave. Tributary	Organics, metals and bacteria	Medium	14	Control NPS pollution

CSO – combined sewer outfall

2. Chemical of Concern Beneficial Uses and Applicable Water Quality Standards

2.1. Chemicals of Concern

The list of organic and metal Chemicals of Concern for this TMDL were determined from data derived from fish tissue[1] and sediment[3] analysis. Fish tissue was harvested and analyzed for the list of suspected contaminants. The contaminants of concern that were discovered above the allowed concentration were identified and were included in this TMDL. Sediment samples were also collected and analyzed for the contaminants of concern. Those that indicated high levels of exceedance above the screening criteria were identified as contaminants of concern and included in the TMDL. Table 2-1 represents the results of this assessment.

Table 2-1: Fish Tissue and Sediment Data Exceeding Screening Values

Organic/Metal Exceedance	Anacostia Fish tissue Data[1] (ppm)	EPA Screening Value[2] (ppm)	Anacostia Sediment Data[3] (ppm dw)	Sediment Screening value[4] (ppm dw)
Arsenic	0.026	0.026	N/A	N/A
Copper	N/A	N/A	312.5	31.6
Lead	N/A	N/A	586.54	35.8
Zinc	N/A	N/A	1,457.290	121
Chlordane	0.338	0.114	0.1699	0.00324
DDT	0.375	0.117	0.3194	0.00528
Dieldrin	0.0315	0.0025	N/A	N/A
Heptachlor Epoxide	0.0080	0.00439	NA	NA
Total PAHs	0.151	0.00547	97.878	1.61
Total PCBs	2.49	0.020	1.629	0.0598

Notes:

1. U.S. FWS. 2001. Analysis of Contaminant Concentrations in Fish Tissue Collected from the Waters of the District of Columbia. Final Report. Publication number CBFO-C01-01, Chesapeake Bay Field Office, Annapolis, MD.
2. U.S. EPA 2000. Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Volume 1, Fish Sampling and Analysis, Third edition. EPA 823-B-00-007, Office of Water, Washington D.C.
3. Data Assessment Report Anacostia River Sediments Patrick Center for Environmental Research, The Academy of Natural Sciences of Philadelphia, KQS Report Number 134-01R01. Appendix II. September 2000.
4. MacDonald, D.D., C.G. Ingersoll and T.A. Berger. 2000. Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems. *Arch. Environ. Contam. Toxicol.* 29-31.

N/A Data not available.

2.2. Designated Beneficial Uses

Categories of DC surface water beneficial uses and water quality standards are contained in District of Columbia Water Quality Standards, Title 21 of the District of Columbia Municipal Regulations, Chapter 11 (DC WQS, Effective January 24, 2003). Section 1101.1 states:

> *For the purposes of water quality standards, the surface waters of the District shall be classified on the basis of their (i) current uses, and (ii) future uses to which the waters will be restored.*

The categories of beneficial uses for the Anacostia River are as follows:

Class A - primary contact recreation,
Class B - secondary contact recreation and aesthetic enjoyment,
Class C - protection and propagation of fish, shellfish, and wildlife,
Class D - protection of human health related to consumption of fish and shellfish, and;
Class E - navigation.

The categories of beneficial uses for the Anacostia River Tributaries (except as listed below) are as follows:

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

The categories of beneficial uses for Hickey Run and Watts Branch are as follows:

Class B - secondary contact recreation and aesthetic enjoyment,
Class C - protection and propagation of fish, shellfish, and wildlife, and;
Class D - protection of human health related to consumption of fish and shellfish.

2.3. Applicable Water Quality Standards

2.3.1. Narrative Criteria

The District of Columbia's Water Quality Standards include narrative and numeric criteria that were written to protect existing and designated uses.

Section 1104.1 states several narrative criteria designed to protect the existing and designated uses:

> *The surface waters of the District shall be free from substances attributable to point or nonpoint sources discharged in amounts that do any one of the following:*
>
> *(a) Settle to form objectionable deposits;*
> *(b) Float as debris, scum, oil, or other matter to form nuisances;*
> *(c) Produce objectionable odor, color, taste, or turbidity;*
> *(d) Cause injury to, are toxic to, or produce adverse physiological or behavioral changes in humans, plants, or animals;*
> *(e) Produce undesirable or nuisance aquatic life or result in the dominance of nuisance species; or*
> *(f) Impair the biological community that naturally occurs in the waters or depends on the waters for its survival and propagation.*

2.3.2. Numerical Criteria

2.3.2.1. Metals Numerical Criteria

Table 2-2: Dissolved Metals Numerical Criteria

Constituent – Metals[1]	Criteria for Classes (ug/L)					
	C				D	
	CCC Four Day Average		CMC One Hour Average		30 Day Average	
Arsenic	150		340		0.14	
	Anacostia[2]	Small Tribs[3]	Anacostia[2]	Small Tribs[3]	Anacostia[2]	Small Tribs[3]
Copper[4]	10.31	17.77	15.31	27.90	N/A	N/A
Lead[5]	2.23	4.43	57.15	113.78	N/A	N/A
Zinc[6]	95.04	163.02	104.08	178.52	N/A	N/A

Notes:

1. D.C. Water Quality Standards, Effective January 24, 2003, Table 2. The criteria for the hardness dependant constituents (Copper, Lead and Zinc) were calculated utilizing the applicable formulas in the Notes for Table 2. To calculate the dissolved criteria, the formula results were multiplied by their respective EPA Conversion Factor. The respective EPA Conversions Factors were derived in accordance with subsection 1105.10 from 60 Fed. Ref. 22,231 (1995).
2. For the Anacostia River the Class C Criteria Maximum Concentration (CMC) and Criteria Continuous Concentration (CCC) standards were computed from the published District of Columbia standards Section 104.7 Table 2 Note 4 (listed below under note 3, 4, and 5) at a hardness of 89.4 mg/L as $CaCO_3$, the mean hardness computed from (1989) DC DOH monitoring data for the Anacostia River.
3. The Class C Criteria Maximum Concentration (CMC) and Criteria Continuous Concentration (CCC) standards were computed from the published District of Columbia standards (listed below under note 3, 4,

and 5) assuming a hardness of 169 mg/L as $CaCO_3$, the mean hardness computed from recent (1998-2000) DC DOH routine monitoring data for the Anacostia River Small Tributaries.

4. Copper is expressed as a function of hardness calculated using the following formula: $CCC = e^{(0.8545[\ln(hardness)]-1.465)} \times 0.96$; $CMC = e^{(0.9422[\ln(hardness)]-1.464)} \times 0.96$
5. Lead is expressed as a function of hardness calculated using the following formula: $CCC = [e^{(1.2730[\ln(hardness)]-4.705)}] \times [1.46203-[(\ln(hardness)(0.145712)]]$; and $CMC = [e^{(1.2730[\ln(hardness)]-1.460)}] \times [1.46203-[(\ln(hardness)(0.145712)]]$
6. Zinc is expressed as a function of hardness calculated using the following formula: $CCC = [e^{(0.8473[\ln(hardness)]+0.7614)}] \times 0.986$; $CMC = [e^{(0.8473[\ln(hardness)]+0.8604)}] \times 0.978$

2.3.2.2. Organics Numerical Criteria

Table 2-3: WQS Section 1104.7 Table 3 Organics Numerical Criteria

Constituent – Organics[1]	Criteria for Classes (ug/L)		
	C		D
	CCC Four Day Average	CMC One Hour Average	30 Day Average
Chlordane	0.004	2.4	0.00059
DDE	0.001	1.1	0.00059
DDD	0.001	1.1	0.00059
DDT	0.001	1.1	0.00059
Dieldrin	0.0019	2.5	0.00014
Heptachlor Epoxide	0.0038	0.52	0.00011
PAH 1[2]	50	N/A	14000
PAH 2[3]	400	N/A	0.031
PAH 3[4]	N/A	N/A	0.031
Total PCBs	0.014	N/A	0.000045

Notes:
1. WQS for PAH1, 2 and 3 were based on a conservative assumption that applicable water quality standards are the most stringent standard for a single PAH in the group. For example, the Class D water quality standard for fluoranthene, pyrene, benz[a]anthracene, and chrysene are 370, 11000, 0.031, and 0.031 ug/l, respectively. Therefore the most stringent of the individual standards, 0.031 ug/l is given in Table 2-3 as the Class D standard for PAH2.
2. PAH1, is the sum of six 2 and 3-ring PAHs, naphthalene, 2-methyl napthalene, acenapthylene, acenapthene, fluorene, and phenanthrene.
3. PAH2, consists of the four 4-ring PAHs, fluoranthene, pyrene, benz[a]anthracene, and chrysene.
4. PAH3, consists of the six 5 and 6-ring PAHS, benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, and dibenz[a,h+ac]anthracene.

2.4. TMDL Endpoint

Section 1104.2 states:

> *For the waters of the District with multiple designated uses, the most stringent standards or criteria shall govern.*

Therefore, for each of the above organics or metals the most stringent numerical criteria was used to establish their respective TMDL allocations to protect the District of Columbia waters and designated uses.

3. Watershed Characterization

3.1. Background

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

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

3.2. Land Use

3.2.1. Anacostia Watershed

The Anacostia River drainage area covers 117,353 acres (approximately 176 square miles) in the District of Columbia and Maryland. Forty-nine percent of the drainage area is located in Prince George's County, with 34 percent located in Montgomery County, and the remaining 17 percent located in the District of Columbia. The basin lies within two physiographic provinces, two-thirds within the Atlantic Coastal Plain and one-third within the Piedmont. The division between the provinces lies roughly along the boundary between Prince George's County and Montgomery County. The basin is highly urbanized, with a population of 804,500 and a population density of 4,570 per square mile in 1990 (Warner *et al.*, 1997). Only 25 percent of the watershed is forested and another 3 percent is wetlands.

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

The length of the tidal portion of the Anacostia River is 8.4 miles. The average tidal variation in water surface elevation is 2.9 feet all along the tidal river. At Bladensburg, the average depth is six feet, while the average depth at the Anacostia's confluence with the Potomac River is 20 feet. The average width of the river increases from 375 feet at Bladensburg to 1,300 feet at the mouth. Average discharge to the tidal river from the Northeast and Northwest Branches is 133 cubic feet per second (cfs). Under average flow conditions, the mean volume of the tidal river is approximately 415 million cubic feet. Detention time in the tidal Anacostia under average conditions is thus over 36 days and longer detention times can be expected under low-flow conditions in summer months.

Just over 25 percent of the Anacostia Watershed drains into the tidal river below the confluence of the Northwest and Northeast Branches. Storm sewers or combined storm and sanitary sewers control much of this drainage. The two largest tributaries are Lower Beaverdam Creek (15.7 sq. mi. drainage area), and the Watts Branch (3.8 sq. mi. drainage area). Figure 3-1 and Table 3-1 shows the breakdown of land uses in the drainage areas of the Northwest Branch, the Northeast Branch, Lower Beaverdam Creek, and the Watts Branch.

Land use in the Anacostia River watershed is mostly residential and forested (Table 3-1). There are 30 percent park and forest lands evenly dispersed throughout the watershed, such as the National Park Service, the National Arboretum, Greenbelt Park, and Beltsville Agricultural Research Center. The industrial and manufacturing land use is largely confined to the tidal area of the basin such as Hickey Run, Lower Beaverdam Creek, and Indian Creek. These sub-watersheds contain impervious areas as high as 80 percent. A more detailed description of the water body is available in *An Existing Source Assessment of Pollutants to the Anacostia Watershed* (Metropolitan Council of Governments, 1996).

Table 3-1: Land Use in the Anacostia River Basin (acres)

Watershed	Residential	Commercial	Industrial	Parks	Forest	Agriculture	Other
NW Branch	14,044	1,437	117	2,155	6,592	2,428	1,908
NE Branch	16,086	2,333	1,391	1,393	14,445	4,978	5,897
Lower Beaverdam Creek	4,374	314	314	314	2,296	429	364
Watts Branch	1,691	116	23	190	289	0	96

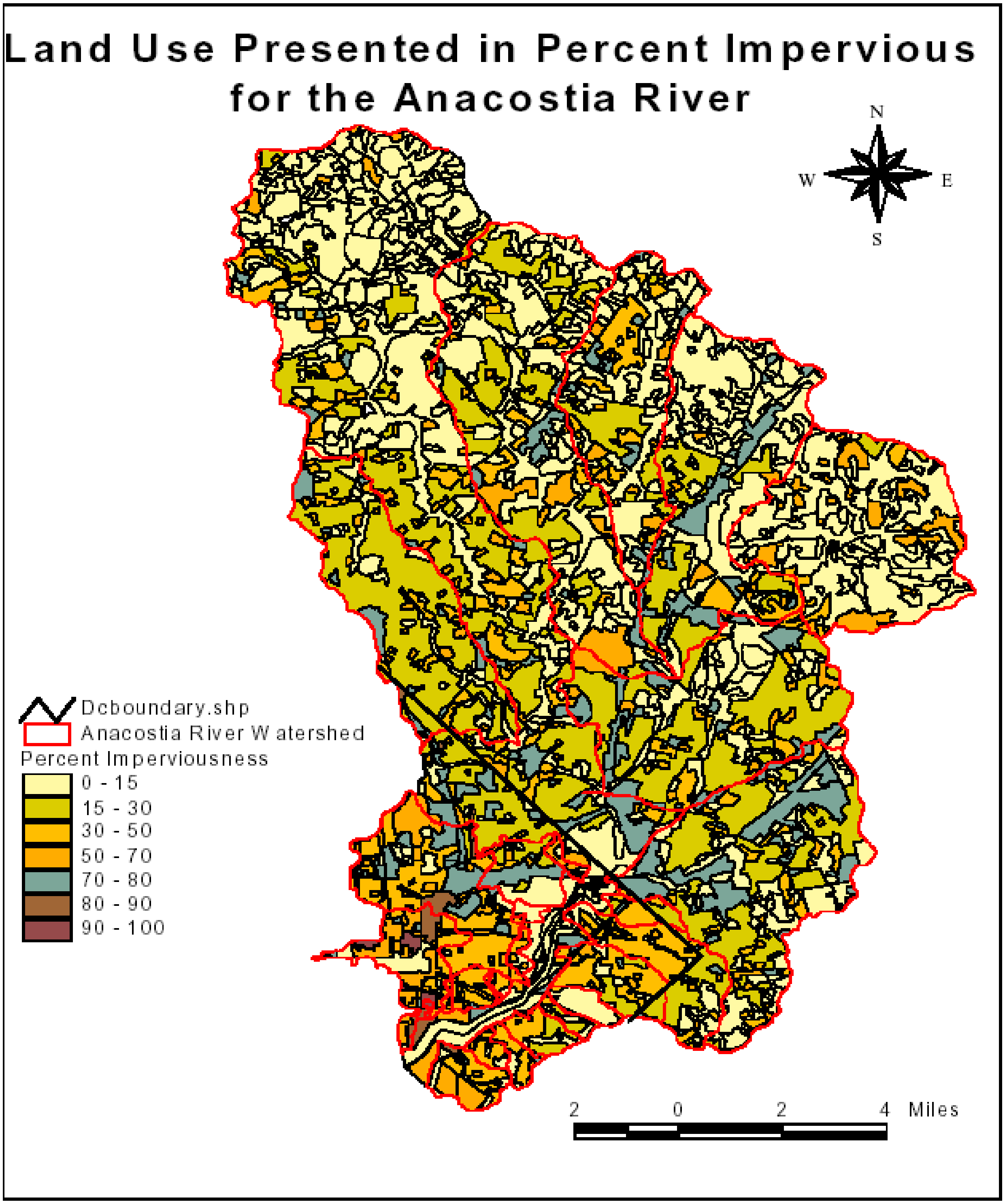

Figure 3-1: Land Use in the Anacostia Watershed

3.2.2. Anacostia River Tributaries (see Appendix A for Small Tributary Maps)

Fort Chaplin

Fort Chaplin Tributary originates from a 6.5 ft. storm discharge near Burns Street and Texas Avenue, Southeast and parallels Burns Street for approximately .57 miles until draining into a pipe at C Street which connects with the East Capitol Street storm drain. Originally, Fort Chaplin would have paralleled what is now Benning Road and parts of East Capitol Street, SE. The mouth of Fort Chaplin is a 21 ft. by 7.5 ft. storm drain which discharges into the Anacostia just south of the eastern foot of the East Capitol Street Bridge. Fort Chaplin's watershed is about .42 mi^2 (270 acres). About 90% of the watershed is residential and 10% is parkland. Most of the stream is buffered by 200 feet of forest on each side.

Fort Davis

Fort Davis is a first order eastern tributary of the Anacostia River. The stream is now conducted by storm drains from Pennsylvania and Carpenter Street SE to a confluent discharge of several storm drains about 2,000 ft. upstream of the Sousa Bridge. The entire watershed measures about .11 mi^2 (70 acres) but about 15% of its watershed is drained away independently of the stream by storm drains. Approximately half of the watershed is forested National Parkland with the other half existing as urban residential and including an elementary school.

Fort Dupont Creek

The stream's watershed measures about 0.64 mi^2 (410 acres) of which approximately 90% falls within Fort Dupont Park. Fort Dupont is piped for nearly 1000 ft prior to entering the Anacostia River. The pipe whose cross section area is eight by six feet, starts under the railroad tracks and Anacostia Freeway, crosses beneath the railroad yard to discharge into the Anacostia River between East Capitol Street Bridge and John Philip Sousa Bridge. Much of the stream is buffered on both sides throughout its length by forested parkland. Several portions of the lower stream main stem have narrow riparian buffer zones, encroached upon by the remnant greens. The primary headwater stream receives impervious runoff from the adjacent neighborhood outside of the park. Other impervious areas within the park are roads and parking lots serving the community center and park maintenance yard.

Fort Stanton

Fort Stanton's watershed measures approximately .28 mi^2 (180 acres). Fort Stanton enters a 5 ft diameter pipe at 1907 Good Hope Rd, SE. The headwaters are piped before emerging above ground through a wooded parkland (Fort Stanton Park) before entering the 5 ft diameter pipe. Roughly half of the watershed is National Park Service parkland with the remaining land existing as residential and commercial property.

Hickey Run

Hickey Run is a western tributary of the Anacostia, which discharges into the river just north of Kingman Lake, near the southern border of the National Arboretum. The mouth of the stream is a broad tidally influenced area. The stream daylights below the historic brick kilns, 1,100ft East-Southeast of the intersection of Bladensburg Road and New York Avenue NE from an 11' x 11' storm water discharge. The watershed is 2 mi^2 (1300 acres). About 20% of the watershed is forest or managed parkland administered by the U.S. Department of the Interior, National Arboretum. The remainder upper reaches of the watershed are residential, commercial and industrial, including easements for railroad as well as a large bus parking and maintenance yard.

Nash Run

The Nash Run watershed measures approximately 0.7 mi^2 (460 acres), with approximately two-thirds of the watershed in the District of Columbia. Nash Run exits a storm sewer pipe west of Kenilworth Ave, NE. The 17.5 by 8 ft outfall is located between Douglas and Polk Streets, NE. Prior to the outfall, Nash run is fed by a network of storm sewer pipes, some originating in Maryland. The remainder of the watershed is in Deanwood Park, Prince George's County, Maryland. All but 5% of the watershed is urban residential and commercial property drained by storm drains.

Popes Branch

The Popes Branch watershed is 0.33 mi^2 (210 acres) and includes Pope Branch Park, a forested section 1.4 miles long and about 400' wide, and all of Fort Davis. Popes Branch enters a 7 by 6 ft pipe at Fairlane and M Sts, SE, traveling nearly 1,700 feet to the Anacostia River. Popes Branch is fed by headwaters from many storm sewer lines with outfalls located at Branch Ave and M St, N St, 34th St and Pope Ave, 35th St and Pope Ave, Nash St and Texas Ave, Pope Ave between 38th St and Texas Ave. Popes Branch, also known as Hawes Run, enters the Anacostia River just north of John Philip Sousa Bridge (at Pennsylvania Ave). The watershed is approximately 15% forested parkland; the remaining 85% is residential and light commercial property.

Texas Avenue Tributary

The Texas Avenue Tributary watershed measures 0.17 mi^2 (110 acres). The Texas Avenue Tributary is a small first order stream segment remotely connected to the Anacostia River by a network of storm water pipes. The open channel stream runs along Texas Ave, goes under 28th Street, and enters a storm pipe at 27th St and Texas Ave. Branches of storm pipes joining at 28th St and Hillcrest Dr discharge into the Texas Ave tributary through a 4.7 ft diameter outfall. The upper part of the open stream is fed by various storm discharges with outfalls located at 29th Pl, 30th St and Park Dr, 32nd St, 32nd Pl, and Branch Ave. The piped portion of the Texas Ave tributary joins with other storm sewer networks to discharge into Anacostia river through a 7.2 ft diameter pipe just above the John Philip Sousa Bridge. The watershed is approximately 40% forested parkland and 60% residential and light commercial property.

Watts Branch

Watts Branch is the largest tributary to the Anacostia River in the District of Columbia. Originating Prince George's County, Maryland, Watts Branch travels for four miles to its mouth on the eastern side of the Anacostia. The watershed measures 3.53 mi^2 (2,260 acres). Approximately 80% of the watershed exists as urban residential and commercial property. Less than 15% is forested, mainly along the parkside riparian stream corridor, and approximately 5% light industrial property. Approximately 53% of the watershed lies in Maryland and 47% in the District of Columbia. Watts Branch receives stormwater discharges.

3.3. Stream Flow

Because of the episodic nature of rainfall and storm sewer runoff, developing a daily load is not an effective means of determining the assimilative capacity of the receiving waters. Rather, looking at total loads over a range of conditions is a more relevant way to determine the maximum allowable loads. When the CSO Long Term Control Plan was developed, CSO controls required meeting water quality during an average year. The plan performed a statistical analysis of the rainfall records and identified a dry year, a wet year, and an average rainfall year, based on total annual rainfall. Coincidentally, these were the consecutive years of 1988, 1989, and 1990, respectively. These three years were considered the period of record for determining compliance with the water quality standards. Compliance with the water quality standards was based on the frequency of violations as calculated by the models for these three years.

3.3.1. Anacostia Watershed

The Anacostia River is mostly an embayment of the Potomac River, with very low flow rates compared to the Potomac. Because of the low flows and tidal influence, travel times through the River can exceed 30 days exhibiting poor flushing rates. Flow in many segments of the tidal of the river can move either upstream or downstream, depending on tidal conditions. In the downstream portions of the river, hydrodynamics are dominated by the direction and magnitude of the tidal surge. The mean annual stream flow for the Anacostia, as measured at the upstream flow gages, is 139 cubic feet per second. Average Precipitation and Average Annual flows in cubic feet per second (cfs) for the years used in this TMDL are shown in Table 3-2. The Harmonic Mean Flows for the three U.S. Geological Survey monitoring stations are shown in Table 3-3.

Table 3-2: Average Precipitation and Average Annual Flow Data

Year	Total Precipitation (in)	Days of Precipitation	Average Northeast Branch Flows (cfs)	Average Northwest Branch Flow (cfs)	Combined Flow (cfs)
1988	31.7	107	72.5	43.9	116.4
1989	50.3	128	111.3	67.0	178.3
1990	40.8	127	93.2	60.4	153.6

The year 1988 is 35% below average flow, the year 1989 is 30% above average flow, and the year 1990 is an average year. The Average Annual Loads in this TMDL are calculated for the years 1988, 1989 and 2000. However, the design flow for carcinogenic constituents in stormwater and NPDES permits shall be the harmonic mean flow.

Table 3-3: Harmonic Mean Flow at USGS Gauging Stations (cfs)

USGS Gage Number	River Body	Harmonic Mean Flow	1Q10	7Q10	30Q5
01649500	Anacostia NE Branch	32.5	4.9	5.8	11.3
01651000	Anacostia NW Branch	14.8	1.6	2.0	4.9
01651800	Watts Branch	1.6	0.4	0.5	0.7

3.3.2. Anacostia River Small Tributaries

Table 3-4: Anacostia River Tributaries Stream Flow Data

Waterbody	**Area (mi Sq)**	**Avg. Width (ft)**	**Estimated Flow (cfs)**
Fort Davis Tributary	0.11		0.10
Fort Dupont Tributary	0.64	9	0.70
Fort Chaplin Tributary	0.42	22	0.19
Fort Stanton Tributary	0.28	6	0.05
Hickey Run	2.00	100	8.0
Nash Run	0.70	7	2.0
Pope Branch Tributary	0.33	5	0.24
Texas Avenue Tributary	0.17	10	0.75
Watts Branch	3.53	20	15.00

4. Source Assessment

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

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

4.1. Assessment of Non-Point Sources

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

4.2. Major Tributaries, Stromwater Runoff, Minor Tributaries, and CSOs

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

4.3. Assessment of Point Sources

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

5. Technical Approach

The first section describes the modeling framework for simulating pollutant loadings, hydrology, and water quality responses. The second and third sections present the modeling results in terms of a TMDL, and allocate the TMDL between point sources and nonpoint sources. The fourth section explains the rationale for the margin of safety and a remaining future allocation.

5.1. Tidal Anacostia Model

The TAM/WASP Toxics Screening Level Model simulates the loading, fate, and transport of toxic chemical contaminants in the tidal portion of the Anacostia River, and can predict the changes over time of concentrations of these contaminants in both the river's water and in the surficial bed sediment. The toxics model is based on ICPRB's TAM/WASP modeling framework, which was first used to construct a eutrophication/sediment oxygen demand model for the District's dissolved oxygen TMDL (Mandel and Schultz, 2000). The sediment transport capabilities of the model were then further developed, resulting in TAM/WASP Version 2.1 (Schultz, 2003), which was used by the District to develop its suspended solids TMDL. The TAM/WASP Toxics Screening Level Model, TAM/WASP Version 2.3, uses, with only minor changes, the hydrodynamic model and the sediment transport model components of Version 2.1.

The TAM/WASP Toxics Screening Level Model includes three primary components:

1. A hydrodynamic component, based on the Tidal Anacostia Model (TAM), originally developed at MWCOG in the 1980's (Sullivan and Brown, 1988). This component simulates the changes in water level and water flow velocities throughout the river due the influence of tides and due to the various flow inputs entering the river. The original 15 segment hydrodynamic model has been upgraded by ICPRB to a 36-segment model with side embayments (Schultz, 2003).

2. A load estimation component, constructed by ICPRB using Microsoft ACCESS. Water containing sediment and chemicals flows into the river every day from a variety of sources, including the upstream tributaries (the Northeast and Northwest Branches), tidal basin tributaries (Lower Beaverdam Creek, Watts Branch and others), the combined sewer system overflows (CSOs), the DC separate storm (SS) sewer system, and ground water. The ICPRB load estimation component estimates daily water flows into the river based on USGS gage data for the Northwest and Northeast Branches and National Airport daily precipitation data for flows from other sources. It also estimates daily sediment chemical loads into the river, based on available monitoring data.

3. A water quality component, based on the EPA's Water Quality Analysis Simulation Program, Version 5 (WASP-TOXI5) for sediments and toxic contaminants (Ambrose al., 1993). This component simulates the physical and chemical processes that transport and transform chemical contaminants that have entered the river. The WASP sediment/toxics transport module has been enhanced by ICPRB to more realistically simulate sediment erosion and deposition processes based on hydrodynamic conditions (see Schultz, 2003).

TAM/WASP is a one-dimensional (1-D) model, that is, it simulates processes in the river by idealizing the river as a long channel where conditions may vary along the length of the channel but are assumed to be uniform throughout any channel transect (i.e. from left bank to right bank). Approximating the river as a one-dimensional system is reasonable given the results of the summer 2000 SPAWAR study (Katz et al., 2001), which concluded that throughout a channel transect, the water in the river was generally well-mixed, and current velocities were relatively homogenous and primarily directed along the axis of the channel. It is also supported by model simulations carried out subsequent to a dye study conducted in 2000 by LimnoTech, Inc. (LTI) (LTI, 2000). These results showed that a 35 segment 1-D model was capable of simulating fairly well the time evolution of dye concentrations in the tidal river (DC WASA, 2001; Schultz, 2003)

In ICPRB's TAM/WASP Version 2, the main channel is divided along its length into 35 model water column segments, extending from the Bladensburg Road Bridge in Prince Georges County, MD, to the Anacostia's confluence with the Potomac in Washington, DC (see Figure 1-2). Additionally, WASP model segment 36, representing Kingman Lake, adjoins segment 19. (Kingman Lake is represented as a tidal embayment to segment 19 in ICPRB's upgraded version of the TAM hydrodynamic model.) Each of these 36 water column segments is underlain by a surficial sediment segment (segments 37 to 72), and each surficial sediment segment is underlain by a segment of the lower sediment layer (segments 73 to 108), as shown schematically in Figure 1-3. Surficial sediment segment 72 and lower sediment segment 108 underlie water column segment 36, representing Kingman Lake, and are not represented in Figure 1-3. In all but the PCB sub-model, the surficial bed sediment layer is 1 centimeter (cm) in thickness and the lower bed sediment layer is 5 cm in thickness. Unlike the other TAM/WASP sub-models, the PCB sub-model has four bed sediment layers instead of two.

Additional information on this model may be found in Appendix E – Final TAM/WASP Toxics Screening Level Model for Anacostia River, prepared by ICPRB.

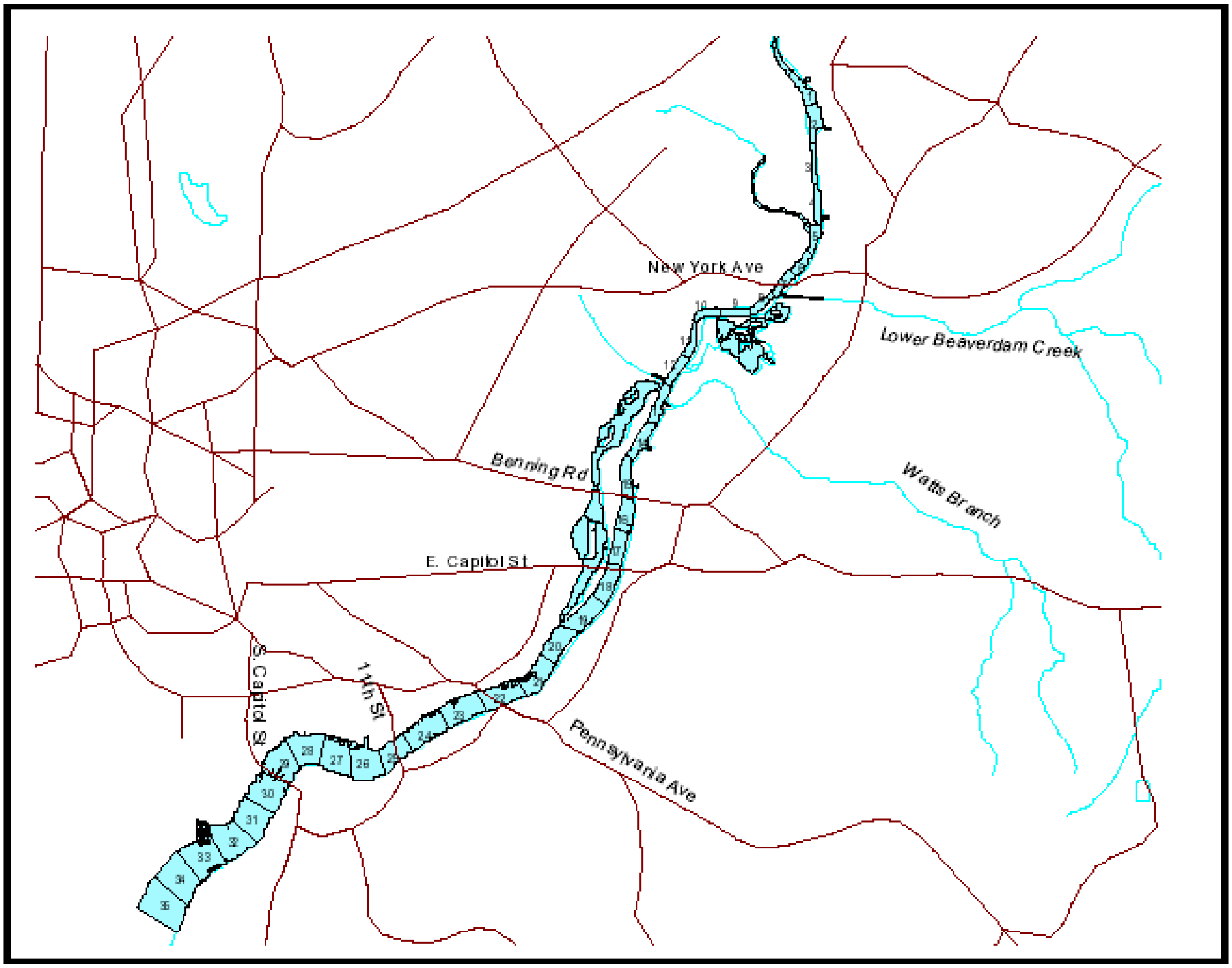

Figure 5-1: Model Segment Geometry for the Anacostia River

The model was calibrated to meteorological, flow, and water quality data for the calendar years 1988, 1989, and 1990. This series of years is a reasonable set of conditions to examine load reduction scenarios because 1988 was a low flow year, followed by 1989 a high flow year, and 1990 an “average” flow year.

5.2. Anacostia Sub-Models

The TAM/WASP Toxics Screening Level Model uses WASP-TOXI5 to simulate many of the chemical and physical transformation processes that affect the fate of toxic chemicals in the river. Because WASP-TOXI5 can only simulate three chemicals at a time, a total of seven sub-models have been constructed. Most of the organic chemicals considered are actually classes of related constituents, including isomers and breakdown products. For a given class of chemicals, for example, DDTs, data was not available for all of constituents in the class, and therefore the submodel only includes those constituents for which there is adequate data support. Also, for some sub-models, constituents are grouped together for convenience because of WASP’s limitation of three chemicals. In these cases an effort is made to group together constituents with similar physical and chemical properties. The sub-models and the constituents represented in each of them are as follows:

The **TAM/WASP Arsenic** sub-model (Metals 2) is a simple model set up for total arsenic, with no speciation to simulate the fate and transport for total arsenic. The transport and fate processes simulated include advection and dispersion, and absorption to the medium- and fine-grained sediment fractions.

The **TAM/WASP Copper Lead and Zinc** sub-model for metals (Metals 1) has been configured to simulate the loading, fate and transport of total zinc, total lead, and total copper. The only fate and transport process simulated, in addition to advection and dispersion, is adsorption to the medium and fine-grained sediment fractions. Chemical speciation of these three metals is not simulated due to lack of data support.

The **TAM/WASP Chlordane and Heptachlor Epoxide** sub-model (PEST1) has been set up to simulate the fate and transport for total chlordane and heptachlor epoxide. The total chlordane group includes cis-chlordane, trans-nonachlor, and oxychlordane. The transport and fate processes simulated include advection and dispersion, and absorption to the medium- and fine-grained sediment fractions, and volatilization.

The **TAM/WASP DDT** sub-model simulates the fate and transport of three DDT isomers/metabolites: p,p DDD, p,p DDE, and DDT. The only fate and transport process simulated, in addition to advection and dispersion, is adsorption to the medium and fine-grained sediment fractions.

The **TAM/WASP Dieldrin** sub-model (PEST2) is a simple model set up to simulate the fate and transport for total dieldrin. The transport and fate processes simulated include advection and dispersion, and absorption to the medium- and fine-grained sediment fractions, and volatilization.

The **TAM/WASP PAH** sub-model has been set up to simulate the fate and transport of 3 groups of PAHs representing a total of 16 chemicals, distributed by the number of benzenoid rings and molecular weigh: PAH1, is the sum of six 2 and 3-ring PAHs, naphthalene, 2-methyl napthalene, acenapthylene, acenapthene, fluorene, and phenanthrene; PAH2, consists of the four 4-ring PAHs, fluoranthene, pyrene, benz[a]anthracene, and chrysene; and PAH3, consists of the six 5 and 6-ring PAHs, benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, and dibenz[a,h+ac]anthracene. The transport and fate processes simulated include advection and dispersion, adsorption to the medium- and fine grained sediment fractions, first-order degradation, and volatilization.

The **TAM/WASP PCB** sub-model simulates the fate and transport of three groups of PCB homologs. The rational for the groupings is based on similarities in molecular weights (MW), partition coefficients (K_d), Henry's Law coefficients, and biodegradation potential. PCB1 includes Dichlorobiphenyl and Trichlorobiphenyl; PCB2 includes Tetrachlorobiphenyl, Pentachlorobiphenyl and Hexachlorobiphenyl; and PCB3 includes Heptachlorobiphenyl, Octachlorobiphenyl, and Nonachlorobiphenyl. The only transport and fate processes simulated are advection and dispersion, adsorption to the medium-grained and fine-grained sediment fractions, and volatilization.

5.3. Anacostia River Small Tributaries Model

The DC Small Tributaries TMDL Model is a simple mass balance model, which predicts water column concentrations of constituents of concern in 23 small tributaries located in the District of Columbia, including 9 Anacostia small tributaries. The model developed by the Interstate Commission for the Potomac River Basin (ICPRB), predicts daily concentrations for this TMDLs organic and metal constituents. Two sub-models were constructed to address these constituents: Organic chemicals model and Metals model. Table 5-1 lists the model that was run for each small tributary.

Table 5-1: Anacostia River Small Tributary Models

Tributary	**Included in Organic Chemicals Model**	**Included in the Metals Model**
Fort Chaplin		U
Fort Davis		U
Fort Dupont		U
Fort Stanton	U	U
Hickey Run	U	
Nash Run	U	U
Popes Branch	U	U
Texas Ave Tributary	U	U
Watts Branch	U	

These sub-models predict daily water column concentrations of each constituent in each of the 23 streams under current conditions and under potential pollutant load reduction scenarios. Because little data exists concerning the presence or the concentrations of specific toxic chemicals in these streams, the list of constituents modeled was taken from the list of constituents addressed in the District's Anacostia River TMDL for toxic chemicals (Behm et al. 2003).

The constituents of the organic chemicals sub-model include the pesticides, chlordane, dieldrin, heptachlor epoxide, and dichloro-diphenyl-trichloroethane (DDT), none of which are currently in use. The organic chemicals sub-model also includes polycyclic aromatic hydrocarbons (PAHs), a class of chemicals present in coal, motor oils, gasoline, and their combustion products, and polychlorinated biphenyls (PCBs), the chemical constituents of a type of heavy oil that was formerly used in transformers, capacitors, heat exchangers, fluorescent light bulbs, and other products. The constituents of the metals sub-model are arsenic, which is has been used in pesticides, herbicides and wood preservatives, lead, which has been used as an additive in paints and gasoline, and also the metals, zinc and copper.

The simulation is carried out using the most recent available monitoring data to estimate base flow and storm flow constituent concentrations and using ICPRB's Watts Branch HSPF (Hydrologic Simulation Program - FORTRAN) model output to estimate storm and base flow input volumes (Mandel and Schultz, 2000). For TMDL model runs to evaluate potential load reduction scenarios, the Watts Branch HSPF model uses precipitation data for the three-year time period, 1988, 1989, and 1990. This time period includes a relatively wet year, a relatively dry year, and an average precipitation year, and has been used in a number of studies to represent a typical range of hydrologic conditions (Mandel and Schultz, 2000; DCWASA, 2002).

Additional information on this model may be found in Appendix F – Final D.C. Small Tributary TMDL Model Report, prepared by ICPRB.

5.4. Anacostia River Scenarios and Model Runs

Numerous scenarios were run at different combinations of concentration levels for the known point sources including the upstream loads from the Northeastern and Northwestern Branches, the Lower Beaver Dam Creek, Watts Branch and the CSOs while the storm water runoff drained by the MS4s, other tributaries and naturally drained, following topography, into the river along the banks as non point sources (Sub Watersheds).

The degree of source contribution to the existing pollution level has been considered in the allocation of load reductions for the different scenarios. As Maryland contributes considerably larger volume of the load to the Anacostia River, a strategy to allocate a bigger reduction of the load on Maryland side to a level that will ensure that the water coming from Maryland will meet the District of Columbia's Water Quality Standards at Model Segment #7, which designates the boundary line between the two jurisdictions.

In the case of Sub Watersheds and Watts Branch, both the District of Columbia and Maryland contribute to the flows generated by these sources. The load allocation between the District of Columbia and Maryland due to these sources was taken in proportion to the proportion of the drainage areas situated within each jurisdiction. This is done assuming the land use and other factors affecting pollutant loads to be similar in both cases. Accordingly, for Sub Watersheds the load allocation assumed 84.1% towards the District and 15.9% towards Maryland while the allocation to Watts Branch assumed 47% towards the District and 53% towards Maryland.

Five to fifteen scenarios were performed before attaining an optimum balance that will eliminate any violations of the most stringent criteria within a constituent. A discussion of the scenario runs for each constituent/model group is as follows:

5.4.1. TAM/WASP Metals 2 (Arsenic)

The output from this sub-model produces results for in terms of both Total (Dissolved + Particulate) and Dissolved metals concentrations and loads. To determine attainment of the WQS, only the Dissolved output concentrations were evaluated. A load reduction on the Dissolved metals portion proportionally reduces the loads of the Total metals portion. Therefore loads in this TMDL are in terms of Total metals. The critical criterion for Arsenic was the DC WQS Class D criteria at 0.14 ug/l.

In the calibration of the model, the boundary concentration at the Potomac River was set at 0.35 ug/l, which is equal to the mean of two pre-storm Potomac River concentrations reported in the Velinsky 1998 water column data set. Due to this high concentration level fixed at the Potomac River, it was not possible to achieve compliance specifically at the lower reaches of the

Anacostia. Tidal action causes wash back of the chemical from the Potomac. It has been observed that between segments 25-34 of the Anacostia model, the WQS (0.14 ug/l) was consistently exceed even at larger degrees of reduction (99%) of source loads. The number of times the WQS were exceeded, in a particular month, increases as the segments get closer to the Potomac. This is generally due to the larger concentration values associated with the Potomac River during model calibration.

The Arsenic concentrations at the Potomac must attain the WQS criteria in order for the Anacostia River water column to achieve compliance. Moreover, ultimately the Potomac must attain the WQS criteria in the Potomac's TMDL. Therefore it is reasonable to assume that the Potomac River will attain the WQS, and the boundary conditions will come down to, at least 0.14 ug/l. Consequently, Potomac River boundary condition has been adjusted to 0.14 ug/l in this sub-model. With this adjustment, the sub-model for Arsenic was run for a period of six years (two consecutive hydrological periods) to get a complete compliance in all the segments. Compliance was achieved at reduction level of 85% from all sources. A three-year run at the same reduction level resulted in a two instants of violation in month of February 1988. The following percent reductions on Arsenic existing loads were necessary to achieve compliance in six years:

Northeast & Northwest Branches	85%
Sub Watersheds	85%
Watts Branch	85%
Lower Beaver Dam Creek	85%
CSOs	85%

5.4.2. The TAM/WASP Metals 1 (Copper, Lead and Zinc)

The output from this sub-model produces results for in terms of both Total (Dissolved + Particulate) and Dissolved metals concentrations and loads. To determine attainment of the WQS, only the Dissolved output concentrations were evaluated. A load reduction on the Dissolved metals portion, proportionally reduces the loads of the Total metals portion. Therefore loads in this TMDL are in terms of Total metals.

Attainment of the respective WQS was performed utilizing a post processor program, developed by Limnotech. The Class C CCC and CMC WQS criteria for Copper, Lead and Zinc are dependent on the hardness value of water under consideration. The hardness value used in the post processor is 89.4 mg/l as $CaCo_{3,}$ which is the average hardness value for the Anacostia River in 1989 (Scott Rybarczyk, Limnotech). The following are the WQS criteria values (in ug/l) established based on this hardness figure for the Chronic Class-C Standard CCC and Acute Class-C Standard CMC:

Constituent	Class C Criteria ug/L	
	CCC	CMC
Copper	10.31	15.31
Lead	2.23	57.15
Zinc	95.04	104.08

The initial (Calibration) run for the metals 1 sub-model did not show violation of any of the dissolved metal in the water column. The calibration condition represents the existing conditions. Therefore, this TMDL allocates the existing loads to all sources minus a 1% margin of safety.

5.4.3. TAM/WASP Chlordane (Chlordane and Heptachlor Epoxide)

The sub-model for Chlordane includes Chlordane and Heptachlor Epoxide. The critical criterion for chlordane is Class D criteria at 0.00059 ug/l and Heptachlor Epoxide at 0.00011 ug/L. Numerous model scenarios with different apportionment of load to sources were run. Compliance was met for both constituents of the sub-model. The load reduction factors for these constituents that achieved compliance are as follows.

	Chlordane	Heptachlor Epoxide
Northeast & Northwest Branches	90%	90%
Sub Watersheds	90%	80%
Watts Branch	90%	90%
Lower Beaver Dam Creek	90%	90%
CSOs	90%	80%

5.4.4. TAM/WASP DDT

This group consists of DDD, DDE and DDT. The critical criteria for DDT group was the Class-D criteria, which is a 30-day geometric mean value of 0.00059 ug/l. Taking into consideration the proportionality of the load from the different sources, the following percent reductions were necessary for DDD, DDE and DDT water column concentrations to achieving compliance in a six-year model run:

Northeast & Northwest Branches	75%
Sub Watersheds	90%
Watts Branch	75%
Lower Beaver Dam Creek	75%
CSOs	90%

5.4.5. TAM/WASP Pest (Dieldrin)

The critical criteria for Dieldrin is Class-D criteria at 0.00014 ug/l. Numerous model scenarios were run with varying proportion of input load from the different sources until the critical criterion was met. Reductions generally followed the proportion of input load (concentration) generated by the sources. The following are the percentage reductions that achieved compliance:

Northeast & Northwest Branches	85%
Sub Watersheds	30%
Watts Branch	80%
Lower Beaver Dam Creek	80%
CSOs	30%

5.4.6. TAM/WASP PAHs

Numerous model runs were conducted to determine the TMDL for PAHs. The Model for PAH has been modified by reducing the calibration load multiplying factor. Attaining DC WQS for flows from Maryland had been a challenge. No acceptable concentration values could be achieved without reducing the Maryland loads to almost zero and simulating the model for three consecutive hydrologic periods (Nine years). The following load reduction percentages scenario selected to achieve the critical WQS criteria for PAH 1 was Class C-CCC at 50 ug/L, and for PAH 2 and PAH 3 was Class D at 0.031 ug/l is based on the:

Northeast & Northwest Branches	99.6%
Sub Watersheds	98.0%
Watts Branch	98.0%
Lower Beaver Dam Creek	99.6%
CSOs	98.0%

5.4.7. TAM/WASP PCBs

The model for PCBs was the most difficult case to achieve any compliance to the DC WQS. The critical criteria is based on Class-D Standard with a concentration value of $4.5x10^{-5}$ ug/l. Such level of criteria could not be achieved even with 100% load reduction. The 100% load reduction scenario has been run continuously for seven consecutive runs (21 years) by taking the outputs of the previous run as starting values for the new run. However, even at the end of this period considerable occurrences of WQS violations were observed. An evaluation of the contaminant source determined that the primary source impairing compliance is the contaminated sediment. This issue is discussed further below.

5.5. Anacostia River Small Tributary Scenarios and Model Runs

The D.C. Small Tributary Model was prepared for the tributaries of Anacostia River, Potomac River and Rock Creek, and is divided into three parts two of which are the focus of this TMDL. The first part simulates metals specifically: Arsenic, Copper, Lead and Zinc. The second addresses organics: Chlordane, DDD, DDE, DDT, Dieldrin, Heptachlor Epoxide, PAH1, PAH2, PAH3 and Total PCBs.

A series of scenarios were simulated to achieve compliance to the WQS. It was observed that most of the tributaries respond uniformly to the degree of load reductions applied for a specific constituent, while other required additional reductions to attain the respective WQS.

The selected scenarios for each part of the model resulted in the following load reduction levels to meet the desired standards.

5.5.1. Anacostia Small Tributary Reductions for Metals

Tributary	**Arsenic**	**Copper**	**Lead**	**Zinc**
Fort Chaplin	70%	60%	65%	0%
Fort Davis	70%	60%	65%	0%
Fort Dupont	70%	60%	60%	0%
Fort Stanton	70%	60%	65%	0%
Nash Run	75%	60%	70%	0%
Popes Branch	70%	60%	65%	0
Texas Ave Trib	70%	60%	65%	0%

5.5.2. Anacostia Small Tributary Reductions for Organics

Constituent	**Fort Stanton**	**Hickey Run**	**Nash Run**	**Popes Branch**	**Texas Avenue**	**Watts Branch**
Chlordane	85.0%	85.0%	85.0%	85.0%	85.0%	85.0%
DDD	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
DDE	92.0%	92.0%	92.0%	92.0%	92.0%	92.0%
DDT	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%
Dieldrin	80.0%	80.0%	80.0%	80.0%	80.0%	80.0%
Heptachlor Epoxide	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
PAH1	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
PAH2	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
PAH3	98.0%	98.0%	98.0%	98.0%	98.0%	98.0%
TPCB			See Discussion Below			

6. Anacostia River Loads TMDL Allocations and Margins of Safety

6.1. Total Arsenic

Arsenic occurs naturally in the environment in soil and weathering of rocks and water. It has been recognized from ancient times to be poisonous. It is primarily used as an active ingredient in pesticides, paints, dyes and wood preservative and metallurgical applications. High levels of arsenic tend to be found more in ground water sources than in surface water sources. Long-term exposure to arsenic via drinking-water causes cancer of the skin, lungs, urinary bladder, and kidney, as well as other skin changes such as pigmentation changes and thickening (hyperkeratosis). Increased risks of lung and bladder cancer and of arsenic-associated skin lesions have been observed at drinking-water arsenic concentrations of less than 0.05 mg/L. Sediments are major sources of arsenic. (U.S. EPA, 2000)

6.1.1. Total Arsenic Loads

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

Existing Arsenic Average Loads in pounds/year

MARYLAND LOADS	
NORTHEAST AND NORTHWEST BRANCHES	2.68E+02
SUB WATERSHEDS (15.9% OF AREA IN MD)	6.31E+00
LOWER BEAVER DAM CREEK	6.44E+01
WATTS BRANCH (53% OF AREA IN MD)	5.11E+00
TOTAL	3.44E+02

DISTRICT OF COLUMBIA LOADS	
SUB WATERSHEDS (84.1% OF AREA IN DC)	3.34E+01
WATTS BRANCH (47% OF AREA IN DC)	4.53E+00
CSO	1.59E+01
TOTAL DC LOADS	5.38E+01

6.1.2. Arsenic TMDL

For the Maryland and District of Columbia sources, the following tables show the allowable Arsenic loads, which meet the following WQSs: CCC at 150 ug/l, CMC at 340 ug/l; and Class D at 0.14 ug/L with a margin of safety. The total allowable loads for Arsenic reflects the following reductions needed in order to meet the WQS Class D criteria: NE/NW Branches at 85%, Sub Watersheds at 85%, Watts Branch at 85% LBD Creek at 85%, and CSO's at 85%.

For Maryland a targeted annual load to be achieved is 51.6 pounds of Arsenic per year, less a Margin of Safety 0.516 pounds/year, which equals a total allocable load of 51.1 pounds of Arsenic per year.

MARYLAND ALLOABLE LOAD – LBS/YR	
NORTHEAST AND NORTHWEST BRANCHES	4.02E+01
SUB WATERSHEDS (15.9% OF AREA IN MD)	9.47E-01
LOWER BEAVER DAM CREEK	9.66E+00
WATTS BRANCH (53% OF AREA IN MD)	7.67E-01
TOTAL	5.16E+01
MARGIN OF SAFETY 1%	5.16E-01
TOTAL ALLOCABLE	5.11E+01

For District of Columbia Sources, the following table shows the allowable Arsenic loads in pounds/year, which meet the water quality standards with a margin of safety.

DISTRICT OF COLUMBIA ALLOWABLE LOAD – LBS/YR	
SUB WATERSHEDS (84.1% OF AREA IN DC)	5.01E+00
WATTS BRANCH (47% OF AREA IN DC)	6.80E-01
CSO	2.38E+00
TOTAL	8.07E+00
MARGIN OF SAFETY (1%)	8.07E-02
ALLOCABLE	7.99E+00
CSO	2.36E+00
Stormwater Runoff (Sub watershed + Watts Br.)	5.63E+00

6.1.3. Arsenic Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 2.36 pounds per year of Arsenic. This is estimated to be an 85% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are assigned an 85% reduction of loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 5.63 pounds per year Arsenic. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after an 85% reduction to Watts Branch sources and 85% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the Southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there are about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River is federally owned. Each federal facility is allocated a 85% reduction of its Arsenic loads per year. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data.

Other Sources and Reserve

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

6.1.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for Arsenic is 8.07E-02 pounds/year.

6.2. Total Copper, Lead and Zinc

Copper is an essential element for plant growth and it is important in various biochemical processes, but at toxic concentrations it interferes with numerous physiological processes. Copper is a heavy metal that is toxic in the unbound form. Copper is highly toxic in aquatic environments and has effects in fish, invertebrates, and amphibians (EPA 1992; Horne and Dunson 1995). Copper is highly toxic to amphibians, with adverse effects in tadpoles and embryos, and also mortality and sodium loss (Horne and Dunson 1995; Owen 1981). Toxic effects in birds include reduced growth rates, lowered egg production, and developmental abnormalities (Owen 1981). Toxicity in mammals includes a wide range of animals and effects such as liver cirrhosis, necrosis in kidneys and the brain, gastrointestinal distress, lesions, and low blood pressure. (U.S. EPA, 2000)

Lead is a naturally occurring element that has been used almost since the beginning of civilization. Lead poisoning has been a significant public health problem for centuries since lead is a cumulative poison. Exposure to lead and lead compounds can be toxic to humans and wildlife. Potential effects in humans are abdominal cramps, learning disabilities, attention deficit disorder, constipation, anemia, tiredness, nerve damage, vomiting, convulsions, anorexia, and brain damage. Wildlife and waterfowl are also frequently poisoned through the ingestion of lead and lead shot. Toxic effects occur to the central nervous system and resulting long-term neurobehavioral and cognitive deficits occur even with mildly elevated blood lead levels. (U.S. EPA, 2000)

Zinc is used primarily in galvanized metals and metal alloys, but zinc compounds also have wide commercial applications as chemical intermediates, catalysts, pigments, vulcanization activators and accelerators in the rubber industry, UV stabilizers, and supplements in animal feeds and fertilizers. They are also used in rayon manufacture, smoke bombs, soldering fluxes, mordants for printing and dyeing, wood preservatives, mildew inhibitors, deodorants, antiseptics, and astringents. In addition, zinc phosphide is used as a rodenticide. (U.S. EPA, 2000; ATSDR)

6.2.1. Total Copper, Lead and Zinc Loads

Copper, Lead and Zinc existing concentrations are affected by all of the previously mentioned sources. The average annual loads for the three year period 1988, 1989, and 1990, in pounds, are calculated below for Maryland, CSO, and DC storm water.

Existing Copper, Lead and Zinc Average Loads in pounds/year

MARYLAND LOAD	**COPPER**	**LEAD**	**ZINC**
NORTHEAST AND NORTHWEST BRANCHES	5930	6032	15226
SUB WATERSHEDS (15.9% OF AREA IN MD)	242	119	724
LOWER BEAVER DAM CREEK	1084	1580	7893
WATTS BRANCH (53% OF AREA IN MD)	197	97	589
TOTAL	7452	7828	24432

DISTRICT OF COLUMBIA LOAD	**COPPER**	**LEAD**	**ZINC**
SUB WATERSHEDS (84.1% OF AREA IN DC)	1279	630	3828
WATTS BRANCH (47% OF AREA IN DC)	174	86	522
CSO	748	854	2332
TOTAL	2201	1570	6682

6.2.2. Copper, Lead and Zinc TMDL

For the Maryland sources, the following table shows the allowable Copper, Lead and Zinc loads, which meet the following WQSs: Copper, CCC at 10.31 ug/l and CMC at 27.90 ug/l; Lead CCC at 2.23 ug/L and CMC at 57.15 ug/l; and Zinc CCC at 95.04 ug/L and CMC at 104.08 ug/L all with a margin of safety. The total allowable loads for Copper, Lead and Zinc reflect a 0% reduction needed in order to meet the WQS.

For Maryland a targeted annual load to be achieved are 7,452 pounds/year of Total Copper, 7,828 pounds/year of Total Lead, and 24,432 pounds/year of Total Zinc, less a Margin of Safety of 75, 78, and 244 pounds/year, respectively. Therefore, the total allocable load is 7,378 pounds/year Copper, 7,750 pounds/year of Lead, and 24,187 pounds/year Zinc.

Copper, Lead and Zinc Average Allocated Loads in Pounds/Year

MARYLAND LOAD	**COPPER**	**LEAD**	**ZINC**
NORTHEAST AND NORTHWEST BRANCHES	5930	6032	15226
SUB WATERSHEDS (15.9% OF AREA IN MD)	242	119	724
LOWER BEAVER DAM CREEK	1084	1580	7893
WATTS BRANCH (53% OF AREA IN MD)	197	97	589
TOTAL	7452	7828	24432
MARGIN OF SAFETY (1%)	75	78	244
ALLOCABLE	7378	7750	24187

For the District of Columbia sources, the following table shows the allowable Copper, Lead and Zinc loads, which meet the above WQS with a margin of safety. This total allowable load for Copper, Lead and Zinc reflects a 1% reduction for this TMDL.

Copper, Lead and Zinc Average Loads in Pounds/Year

DISTRICT OF COLUMBIA LOAD	COPPER	LEAD	ZINC
SUB WATERSHEDS (84.1% OF AREA IN DC)	1279	630	3828
WATTS BRANCH (47% OF AREA IN DC)	174	86	522
CSO	748	854	2332
TOTAL	2201	1570	6682
MARGIN OF SAFETY (1%)	22	16	67
ALLOCABLE	2179	1555	6615
CSO	741	846	2309
Stormwater Runoff (Sub watershed + Watts Br.)	1461	725	4373

6.2.3. Copper, Lead and Zinc Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 741, 846, and 2,309 pounds per year of Copper, Lead and Zinc, respectively. This is estimated to be a 1% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are assigned a 1% reduction of loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 1,300, 3,880, and 638 pounds per year Copper, Lead and Zinc, respectively. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after a 1% reduction to Watts Branch sources and 1% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

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

Other Sources and Reserve

The allocation of Copper, Lead and Zinc to boats, ships, houseboats, and floating residences is zero. The allocation of Copper, Lead and Zinc to reserve is zero.

6.2.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for Copper, Lead and Zinc are 22, 16, and 67 pounds/year, respectively.

6.3. Chlordane

Chlordane is an organochlorine pesticide was used on crops like corn, citrus and to control termites, in the United States from 1948 to 1988. It was also used as wood preservative and as a protective treatment for underground cables. Chlordane is not a single chemical but mixture of pure chlordane mixed with related chemicals. Due to concern about damage to the environment and hazard to human health, the Environmental Protection Agency (EPA) banned all uses of chlordane in 1988. (U.S. EPA, 2000)

Chlordane sticks strongly to soil particles at the surface. Chlordane is highly persistent in the environment and residues in sediment were found three years after application has a high bioaccumulation potential. Exposure to chlordane occurs mostly from eating contaminated food such as root crops, fish, shell fish and meat. Since it is persistent exposure from contaminated soil can also occur. Chlordane can readily absorbed by skin, inhalation and ingestion. It builds up in tissues of fish, birds and mammals. Chlordane affects nervous system, digestive system and cause liver damage. Experimental studies from animals suggest that chlordane can cause tumors and it is a possible human carcinogen and classified as B2. (U.S. EPA, 2000)

6.3.1. Total Chlordane Loads

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

Existing Chlordane Average Loads in pounds/year

MARYLAND	
NORTHEAST AND NORTHWEST BRANCHES	1.833
SUB WATERSHEDS (15.9% OF AREA IN MD)	0.043
LOWER BEAVER DAM CREEK	0.449
WATTS BRANCH (53% OF AREA IN MD)	0.035
TOTAL MD LOADS	2.360
DISTRICT OF COLUMBIA	
SUB WATERSHEDS (84.1% OF AREA IN DC)	0.227
WATTS BRANCH (47% OF AREA IN DC)	0.031
CSO	0.107
TOTAL DC LOADS	0.365

6.3.2. Chlordane TMDL

For the Maryland sources, the following table shows the allowable Chlordane loads which meet the WQS Class D criteria at 0.00059 ug/L with a margin of safety. This total allowable load for Chlordane reflects a 90% reduction needed in order to meet the WQS.

MD Chlordane Average Loads in Pounds/Year

MARYLANDLOAD ALLOCATION	
NORTHEAST AND NORTHWEST BRANCHES	1.833E-01
SUB WATERSHEDS (15.9% OF AREA IN MD)	4.287E-03
LOWER BEAVER DAM CREEK	4.492E-02
WATTS BRANCH (53% OF AREA IN MD)	3.480E-03
TOTAL	2.360E-01
MARGIN OF SAFETY (1%)	2.360E-03
ALLOCABLE	2.337E-01

For the District of Columbia sources, the following table shows the allowable Chlordane loads which meet the WQS Class D of 0.00059 ug/l with a margin of safety. The total allowable loads for Chlordane reflects the following reductions needed in order to meet the WQS criteria: NE/NW Branches at 90%, Sub Watersheds at 90%, Watts Branch at 90% LBD Creek at 90%, and CSO's at 90%.

DC Chlordane Average Loads in Pounds/Year

DISTRICT OF COLUMBIA LOAD ALLOCATION	
SUB WATERSHEDS (84.1% OF AREA IN DC)	2.268E-02
WATTS BRANCH (47% OF AREA IN DC)	3.086E-03
CSO	1.071E-02
TOTAL	3.647E-02
MARGIN OF SAFETY (1%)	3.647E-04
ALLOCABLE	3.611E-02
CSO	1.060E-02
Stormwater Runoff (Sub watershed + Watts Br.)	2.550E-02

6.3.3. Chlordane Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 1.060E-02 pounds per year of chlordane, which is estimated to be a 90% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are also assigned a 90% reduction of chlordane loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 2.550E-02 pounds per year. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after a 90% reduction to Watts Branch sources and 90% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the Southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there is about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River are federally owned. Each federal facility is allocated a 90% reduction of its chlordane loads. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data.

Other Sources and Reserve

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

6.3.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for chlordane is 1.16E-02 pounds/year.

6.4. DDD, DDE and DDT

DDT, dichlorodiphenyltrichloroethane, once popular organochlorine pesticide was used to control insect pests, on crop and forest lands, around homes and gardens, and for industrial and commercial purposes. It is banned from general use in the US since 1972. DDT was found to be resistant to degradation easily accumulated in tissues of aquatic organisms and birds. Many fish kills were reported due to the toxic exposure to DDT. Eggshell thinning, embryo mortality and decreased survival have been linked to chronic exposure to DDT in the diet of birds and poultry. (U.S. EPA, 2000)

DDT is degraded to DDE and DDD. These metabolites are more toxic than their parent compound and cause changes in enzyme production, hormonal balance, calcium metabolism which may cause changes in behavior and reproduction. (U.S. EPA, 2000)

6.4.1. DDD, DDE, and DDT Total Loads

DDD, DDE, and DDT existing concentrations are affected by all of the previously mentioned sources. The average annual loads for the three year period 1988, 1989, and 1990, in pounds, are calculated below for Maryland, CSO, and DC storm water.

Existing DDD, DDE, and DDT Average Loads in pounds/year:

MARYLAND LOAD	**DDD**	**DDE**	**DDT**
NORTHEAST AND NORTHWEST BRANCHES	0.8924	0.1906	0.1150
SUB WATERSHEDS (15.9% OF AREA IN MD)	0.0273	0.0666	0.1784
LOWER BEAVER DAM CREEK	0.1645	0.6244	0.0810
WATTS BRANCH (53% OF AREA IN MD)	0.0215	0.0537	0.0072
TOTAL	1.1056	0.9354	0.3816

DISTRICT OF COLUMBIA LOAD	**DDD**	**DDE**	**DDT**
SUB WATERSHEDS (84.1% OF AREA IN DC)	0.1443	0.3524	0.9437
WATTS BRANCH (47% OF AREA IN DC)	0.0191	0.0476	0.0064
CSO	0.0752	0.1707	0.4602
TOTAL	0.2386	0.5708	1.4103

6.4.2. DDD, DDE, and DDT TMDL

For the Maryland and District of Columbia sources, the following tables show the allowable DDD, DDE, and DDT loads, which meet the following WQSs: CCC at 0.001 ug/l, CMC at 1.1 ug/l, and; Class D at 0.00059 ug/L with a margin of safety. The total allowable loads for DDD, DDE, and DDT reflects the following reductions needed in order to meet the WQS Class D criteria: NE/NW Branches at 75%, Sub Watersheds at 90%, Watts Branch at 75% LBD Creek at 75%, and CSO's at 90%.

For Maryland a targeted annual load to be achieved is 5.09E-02, 5.37E-04, and 6.15E-02 pounds/year of DDD, DDE, and DDT, respectively, less a Margin of Safety of 1%, which equals a total allocable load of 0.2697, 0.2216, and 0.0680 pounds/year of DDD, DDE, and DDT.

	ALLOWABLE LOAD IN LB/YEAR		
MARYLAND LOAD	**DDD**	**DDE**	**DDT**
NORTHEAST AND NORTHWEST BRANCHES	0.2232	0.0476	0.0288
SUB WATERSHEDS (15.9% OF AREA IN MD)	0.0027	0.0067	0.0178
LOWER BEAVER DAM CREEK	0.0411	0.1561	0.0202
WATTS BRANCH (53% OF AREA IN MD)	0.0054	0.0134	0.0018
TOTAL	0.2724	0.2238	0.0686
MARGIN OF SAFETY (1%)	0.0027	0.0022	0.0007
ALLOCABLE	0.2697	0.2216	0.0680

For District of Columbia Sources, the following table shows the allowable DDD, DDE, and DDT loads in pounds/year, which meet the water quality standards with a margin of safety.

	ALLOWABLE LOADS IN LB/YEAR		
DISTRICT OF COLUMBIA LOAD	**DDD**	**DDE**	**DDT**
SUB WATERSHEDS (84.1% OF AREA IN DC)	0.0144	0.0352	0.0944
WATTS BRANCH (47% OF AREA IN DC)	0.0048	0.0119	0.0016
CSO	0.0075	0.0171	0.0460
TOTAL	0.0267	0.0642	0.1420
MARGIN OF SAFETY (1%)	0.0003	0.0006	0.0014
ALLOCABLE	0.0264	0.0636	0.1406
CSO	0.0074	0.0169	0.0456
Stormwater Runoff (Sub watershed + Watts Br.)	0.0190	0.0467	0.0950

6.4.3. DDD, DDE, and DDT Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 0.0074, 0.0169, and 0.0456 pounds per year of DDD, DDE, and DDT, respectively. This is estimated to be a 90% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are assigned a 70% reduction of loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 0.0190, 0.0467, and 0.0950 pounds per year DDD, DDE, and DDT, respectively. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after a 75% reduction to Watts Branch sources and 90% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the Southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there is about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River are federally owned. Each federal facility is allocated a 90% reduction of its DDD, DDE, and DDT loads. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data.

Other Sources and Reserve

The allocation of DDD, DDE, and DDT to boats, ships, houseboats, and floating residences is zero. The allocation of DDD, DDE, and DDT to reserve is zero.

6.4.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for DDD, DDE, and DDT are 0.0003, 0.0006, and 0.0014 pounds/year, respectively.

6.5. Dieldrin

Dieldrin is one of the most persistent chlorinated pesticides used in United States for mosquito and locust control. Dieldrin has been found in at least 162 of 1,300 National Priorities List sites identified by the Environmental Protection Agency (EPA), and defines dieldrin as hazardous solid waste. In 1987, EPA banned all uses of dieldrin. Dieldrin is very toxic to aquatic organisms, birds, mammals and is capable of producing carcinogenic, teratogenic and reproductive effects. Teratogenic effects include cleft palate, webbed foot and skeletal anomalies. Reproductive effects include decreased fertility, increased fetal death and effects on gestation. Dieldrin is commonly found in the brain, tissues and eggs of fish eating birds. (U.S. EPA, 2000)

6.5.1. Total Dieldrin Loads

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

Existing Dieldrin Average Loads in pounds/year

MARYLAND LOAD	
NORTHEAST AND NORTHWEST BRANCHES	2.61E-01
SUB WATERSHEDS (15.9% OF AREA IN MD)	3.28E-03
LOWER BEAVER DAM CREEK	1.71E-02
WATTS BRANCH (53% OF AREA IN MD)	2.57E-03
TOTAL	2.84E-01
DISTRICT OF COLUMBIA LOAD	
SUB WATERSHEDS (84.1% OF AREA IN DC)	1.73E-02
WATTS BRANCH (47% OF AREA IN DC)	2.28E-03
CSO	9.18E-03
TOTAL	2.88E-02

6.5.2. Dieldrin TMDL

For the Maryland and District of Columbia sources, the following tables show the allowable Dieldrin loads, which meet the following WQSs: CCC at 0.0019 ug/l, CMC at 2.5 ug/l, and Class D at 0.00014 ug/L with a margin of safety. The total allowable loads for Dieldrin reflects the following reductions needed in order to meet the WQS Class D criteria: NE/NW Branches at 85%, Sub Watersheds at 30%, Watts Branch at 80% LBD Creek at 80%, and CSO's at 30%.

For Maryland a targeted annual load to be achieved is 4.54E-02 pounds of Dieldrin per year, less a Margin of Safety of 4.54E-04 pounds/year, which equals a total allocable load of 4.49E-02 pounds of Dieldrin per year.

MARYLAND LOAD	
NORTHEAST AND NORTHWEST BRANCHES	3.92E-02
SUB WATERSHEDS (15.9% OF AREA IN MD)	2.29E-03
LOWER BEAVER DAM CREEK	3.43E-03
WATTS BRANCH (53% OF AREA IN MD)	5.14E-04
TOTAL	4.54E-02
MARGIN OF SAFETY (1%)	4.54E-04
ALLOCABLE	4.49E-02

For District of Columbia Sources, the following table shows the allowable Dieldrin loads in pounds/year, which meet the water quality standards with a margin of safety.

DISTRICT OF COLUMBIA LOAD	
SUB WATERSHEDS (84.1% OF AREA IN DC)	1.21E-02
WATTS BRANCH (47% OF AREA IN DC)	4.55E-04
CSO	6.42E-03
TOTAL	1.90E-02
MARGIN OF SAFETY (1%)	1.90E-04
ALLOCABLE	1.88E-02
CSO	6.36E-03
Stormwater Runoff (Sub watershed + Watts Br.)	1.25E-02

6.5.3. Dieldrin Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 6.36E-03 pounds per year of Dieldrin. This is estimated to be a 30% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are assigned a 30% reduction of loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 1.25E-02 pounds per year Dieldrin. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after a 80% reduction to Watts Branch sources and 30% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the Southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there is about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River are federally owned. Each federal facility is allocated a 30% reduction of its Dieldrin loads. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data.

Other Sources and Reserve

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

6.5.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for Dieldrin is 1.33E-04 pounds/year, respectively.

6.6. Heptachlor Epoxide

Heptachlor epoxide is a white powder that smells like camphor (mothballs) and was extensively used in the past for killing insects in homes, buildings and food crops especially corn. Heptachlor epoxide adsorbs strongly to sediments and bioconcentrated in aquatic and terrestrial organisms. Contaminated fish and shellfish have been found to contain 0.1-480 ppb Heptachlor epoxide. Animal studies suggest liver and central nervous system are the primary target organs for Heptachlor epoxide toxicity. US EPA classified heptachlor epoxide a group B2, probable human carcinogen. (U.S. EPA, http)

6.6.1. Total Heptachlor Epoxide Loads

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

Existing Heptachlor Epoxide Average Loads in pounds/year

MARYLAND LOAD	
NORTHEAST AND NORTHWEST BRANCHES	0.24647
SUB WATERSHEDS (15.9% OF AREA IN MD)	0.00597
LOWER BEAVER DAM CREEK	0.04720
WATTS BRANCH (53% OF AREA IN MD)	0.00477
TOTAL	0.30440

DISTRICT OF COLUMBIA LOAD	
SUB WATERSHEDS (84.1% OF AREA IN DC)	0.03158
WATTS BRANCH (47% OF AREA IN DC)	0.00423
CSO	0.01580
TOTAL	0.05161

6.6.2. Heptachlor Epoxide TMDL

For the Maryland sources, the following table shows the allowable Heptachlor Epoxide loads which meet the WQS for CCC of 0.0038 ug/l, CMC of 0.52 ug/l, and D of 0.00011 ug/ with a margin of safety. The total allowable loads for Heptachlor Epoxide reflects the following reductions needed in order to meet the WQS: NE/NW Branches at 90%, Sub Watersheds at 80%, Watts Branch at 90% LBD Creek at 90%.

MD Heptachlor Epoxide Average Loads in Pounds/Year

MARYLAND LOAD ALLOCATION	
NORTHEAST AND NORTHWEST BRANCHES	2.46E-02
SUB WATERSHEDS (15.9% OF AREA IN MD)	1.19E-03
LOWER BEAVER DAM CREEK	4.72E-03
WATTS BRANCH (53% OF AREA IN MD)	4.77E-04
TOTAL	3.10E-02
MARGIN OF SAFETY (1%)	3.10E-04
ALLOCABLE	3.07E-02

For the District of Columbia sources, the following table shows the allowable Heptachlor Epoxide loads which meet the WQS for CCC of 0.0038 ug/l, CMC of 0.52 ug/l, and D of 0.00011 ug/l with a margin of safety. The total allowable loads for Heptachlor Epoxide reflects the following reductions needed in order to meet the WQS: Sub Watersheds at 80%, Watts Branch at 90%, and CSO's at 80%.

DISTRICT OF COLUMBIA LOAD ALLOCATION	
SUB WATERSHEDS (84.1% OF AREA IN DC)	6.32E-03
WATTS BRANCH (47% OF AREA IN DC)	4.23E-04
CSO	3.16E-03
TOTAL	9.90E-03
MARGIN OF SAFETY (1%)	9.90E-05
ALLOCABLE	9.80E-03
CSO	3.13E-03
Stormwater Runoff (Sub watershed + Watts Br.)	6.67E-03

6.6.3. Heptachlor Epoxide Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a load allocation of 3.13E-03 pounds per year of Heptachlor Epoxide, which is estimated to be a 80% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are assigned a 80% reduction of loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 6.67E-03 pounds per year Heptachlor Epoxide. Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after a 90% reduction to Watts Branch sources and 80% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

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

Other Sources and Reserve

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

6.6.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for Heptachlor Epoxide is 1.53E-03 pounds/year.

6.7. Total PAH: PAH1, PAH2, and PAH3

PAHs are highly potent carcinogens that can produce tumors in some organisms at even single doses; but other non-cancer-causing effects are not well understood. Their effects are wide-ranging within an organism and have been found in many types of organisms, including non-human mammals, birds, invertebrates, plants, amphibians, fish, and humans. However, their effects are varied and so generalizations cannot be readily made. However, it has been shown that the fungus *Cunninghamella elegans* can inhibit the mutation-causing properties of various PAHs, including: benzo(a)pyrene and benzo(a)anthracene. Effects on benthic invertebrates include inhibited reproduction, delayed emergence, sediment avoidance, and mortality. Fish exposed to PAH contamination have exhibited fin erosion, liver abnormalities, cataracts, and immune system impairments leading to increased susceptibility to disease. PAHs, especially those with four of more benzene rings, have been established as carcinogens in animals. (ATSDR)

As discussed above, the modeling for PAHs were divided into three groups PAH1, PAH2, and PAH3. PAH1 is the sum of six 2 and 3-ring PAHs, naphthalene, 2-methyl napthalene, acenapthylene, acenapthene, fluorene, and phenanthrene; PAH2, consists of the four 4-ring PAHs, fluoranthene, pyrene, benz[a]anthracene, and chrysene; and PAH3, consists of the six 5 and 6-ring PAHS, benzo[k]fluoranthene, benzo[a]pyrene, perylene, indeno[1,2,3-c,d]pyrene, benzo[g,h,i]perylene, and dibenz[a,h+ac]anthracene. The representative water quality standard for each group was based on the constituent with the most stringent water quality standard. (ATSDR)

6.7.1. Total PAH, PAH1, PH2, and PH3 Loads

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

Existing PAH Average Loads in pounds/year

MARYLAND LOAD	**PAH1**	**PAH2**	**PAH3**	**TOTAL PAH**
NORTHEAST AND NORTHWEST BRANCHES	113.470	671.859	421.775	1207.105
SUB WATERSHEDS (15.9% OF AREA IN MD)	2.932	17.521	11.183	31.636
LOWER BEAVER DAM CREEK	30.209	188.931	121.599	340.739
WATTS BRANCH (53% OF AREA IN MD)	2.376	14.250	9.100	25.726
TOTAL	148.987	892.561	563.657	1605.206

DISTRICT OF COLUMBIA LOAD	**PAH1**	**PAH2**	**PAH3**	**TOTAL PAH**
SUB WATERSHEDS (84.1% OF AREA IN DC)	15.508	92.673	59.152	167.333
WATTS BRANCH (47% OF AREA IN DC)	2.107	12.637	8.070	22.814
CSO	7.353	43.484	27.687	78.523
WASHINGTON GAS	26.400	30.800	17.600	74.800
TOTAL	51.368	179.594	112.509	343.470

6.7.2. PAH TMDL

For the Maryland and District of Columbia sources, the following tables show the allowable PAH loads, which meet the following WQSs: CCC at 50 ug/l for PAH 1; and Class D at 0.031 ug/L for PAH 2 and PAH 3 with a 1% margin of safety. The total allowable loads for PAH reflects the following reductions needed in order to meet the WQS Class D criteria: NE/NW Branches at 99.6%, Sub Watersheds at 98%, LBD Creek at 99.6%, Watts Branch at 98% and CSO's at 98%.

For Maryland a targeted annual load to be achieved for Total PAH is 7.31 pounds per year (0.6.82, 4.06, and 2.57 pounds per year of PAH1, PAH2, and PAH3, respectively) less a 1% Margin of Safety, resulting in a total allocable load of 7.24 pounds/year of Total PAH (0.675, 4.02, and 2.54 pounds/year of PAH1, PAH2, and PAH3, respectively).

MARYLAND LOAD	**PAH1**	**PAH2**	**PAH3**	**TOTAL PAH**
NORTHEAST AND NORTHWEST BRANCHES	4.54E-01	2.67E+00	1.68E+00	4.80E+00
SUB WATERSHEDS (15.9% OF AREA IN MD)	5.87E-02	3.51E-01	2.24E-01	6.33E-01
LOWER BEAVER DAM CREEK	1.21E-01	7.55E-01	4.86E-01	1.36E+00
WATTS BRANCH (53% OF AREA IN MD)	4.79E-02	2.87E-01	1.83E-01	5.19E-01
TOTAL	6.82E-01	4.06E+00	2.57E+00	7.31E+00
MARGIN OF SAFETY 1%	6.82E-03	4.06E-02	2.57E-02	7.31E-02
ALLOCABLE	6.75E-01	4.02E+00	2.54E+00	7.24E+00

For District of Columbia Sources, the following table shows the allowable PAH loads in pounds/year, which meet the water quality standards with a margin of safety.

DISTRICT OF COLUMBIA TMDL	**PAH1**	**PAH2**	**PAH3**	**TOTAL PAH**
SUB WATERSHEDS (84.1% OF AREA IN DC)	3.10E-01	1.86E+00	1.18E+00	3.35E+00
WATTS BRANCH (47% OF AREA IN DC)	4.18E-02	2.51E-01	1.60E-01	4.53E-01
CSO	1.47E-01	8.70E-01	5.54E-01	1.57E+00
WASHINGTON GAS	0.00E+00	0.00E+00	0.00E+00	0.00E+00
TOTAL	4.99E-01	2.98E+00	1.90E+00	5.37E+00
MARGIN OF SAFETY 1%	4.99E-03	2.98E-02	1.90E-02	5.37E-02
ALLOCABLE	4.94E-01	2.95E+00	1.88E+00	5.32E+00
CSO	1.46E-01	8.62E-01	5.49E-01	1.56E+00
Stormwater Runoff (Sub watershed + Watts Br.)	3.49E-01	2.08E+00	1.33E+00	3.76E+00

6.7.3. PAH Allocations

Waste Load Allocation

Combined sewer overflows are point sources and are assigned a total load allocation of 1.56 pounds/year of Total PAH (0.146, 0.862, and 0.549 pounds per year of PAH1, PAH2, and PAH3, respectively). This is estimated to be a 98% reduction of the total load. Storm water discharges from storm sewers are point source discharges and are assigned a 98% reduction of loads; however, the exact magnitude of this load in pounds is not currently known.

Load Allocation

The total allocation for point source and non-point source storm water is 3.76 pounds/year of Total PAH (0.349, 2.08, and 1.33 pounds per year of PAH1, PAH2 and PAH3, respectively). Those storm water discharges, which are nonpoint sources are assigned a reduction of loads that is necessary to achieve the total after a 98% reduction to Watts Branch sources and 98% reductions to the Sub Watersheds.

Storm Water Sub-Allocation

The non-CSO area in DC that generates storm water loads to the Anacostia is about 14,830 acres of which the National Park Service owns about 1,843 acres, the National Arboretum owns about 434 acres, and the Southeast Federal Center and Washington Navy Yard combined about are 147 acres. Anacostia Naval Station drains about 227 acres to the Anacostia River and there is about 50 acres of miscellaneous facilities. Consequently, about 18% of the land generating storm water loads to the Anacostia River are federally owned. Each federal facility is allocated a 98% reduction of its Total PAH (PAH1, PAH2 and PAH3) loads. Where federal facilities have storm water permits and monitoring data, calculations should be based upon real data.

Other Sources and Reserve

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

6.7.4. Margin of Safety

The final load allocations and targets include a 1% margin of safety from the total load allocations. The one percent for Total PAH is 0.0537 pounds/year (4.99E-03, 2.98E-02, and 1.90E-02 pounds/year for PAH1, PAH2, and PAH3, respectively).

6.8. Total PCBs: PCB1, PCB2, and PCB3

Polychlorinated biphenyls are one of the most recognizable man made contaminants. PCBs are mixtures of synthetic organic chemicals. Due to their non-flammability, chemical stability and electrical insulation properties, PCBs were used in hundreds of industrial and commercial applications especially in capacitors, transformers and other electrical equipment. Because of the evidence that PCBs persist in the environment and cause harmful effects their manufacture was significantly curtailed in 1977. Their presence in landfills and industrial spills continues to be a significant concern. PCBs are highly soluble in lipids and are absorbed by fish and other animals and tend to accumulate. The rates of metabolism and elimination are slow and vary by species and by congener. Bioaccumulation through food chain leads to concentrate higher chlorine congeners and appear to be more toxic than commercial PCBs. The acute toxicity of PCBs appears to be relatively low, but results from chronic toxicity tests indicate that toxicity is directly related to the duration of exposure. (U.S. EPA, 2000)

PCBs are wide spread in the environment and humans are exposed through multiple pathways. PCBs are carcinogenic and can cause melanoma, stomach and liver cancer. Animal studies link

PCBs to problems with pregnancy including stillbirths and spontaneous abortions. Contaminated fish and shell fish are potential sources of human exposure to PCBs. PCBs also have significant ecological and human health effects other than cancer, including neurotoxicity, reproductive and developmental toxicity, immune system suppression, liver damage, skin irritation and endocrine disruption. Toxic effects have been observed from acute and chronic exposures to PCB mixtures with varying chlorine content. The levels in air, water, soil and sediment vary over several orders of magnitude, often depending on proximity to a source of release into the environment. The toxic mechanisms in humans and cancer studies are in progress. (U.S. EPA, 2000)

As discussed above, the modeling for PCBs was divided into three groups PCB1, PCB2, and PCB3. PCB1 includes Dichlorobiphenyl and Trichlorobiphenyl; PCB2 includes Tetrachlorobiphenyl, Pentachlorobiphenyl and Hexachlorobiphenyl; and PCB3 includes Heptachlorobiphenyl, Octachlorobiphenyl, and Nonachlorobiphenyl. The representative water quality standard for each group was based on the constituent with the most stringent water quality standard.

6.8.1. PCB1, PCB2 and PCB3 Loads

PCB1, PCB2 and PCB3 existing concentrations are affected by all of the previously mentioned sources. Two additional sources were identified as contributors to the PCB Loads: 1) Watershed Atmospheric Deposition and 2) Sediment Flux and Resuspension. The average annual loads for the three year period 1988, 1989, and 1990, in pounds, are calculated below for Maryland, CSO, and DC storm water.

Existing PCB1, PCB2 and PCB3 Average Loads in pounds/year

MARYLAND LOAD	**PCB 1**	**PCB 2**	**PCB 3**	**TOTAL PCB**
NORTHEAST AND NORTHWEST BRANCHES	5.155E-01	4.951E+00	3.624E+00	9.090E+00
SUB WATERSHEDS (15.9% OF AREA IN MD)	1.003E-01	2.045E-01	5.851E-02	3.633E-01
LOWER BEAVER DAM CREEK	1.066E+00	2.069E+00	5.695E-01	3.705E+00
WATTS BRANCH (53% OF AREA IN MD)	8.146E-02	1.655E-01	4.724E-02	2.942E-01
TOTAL	1.763E+00	7.391E+00	4.299E+00	1.345E+01

DISTRICT OF COLUMBIA LOAD	**PCB 1**	**PCB 2**	**PCB 3**	**TOTAL PCB**
SUB WATERSHEDS (84.1% OF AREA IN DC)	5.303E-01	1.082E+00	3.095E-01	1.921E+00
WATTS BRANCH (47% OF AREA IN DC)	7.224E-02	1.468E-01	4.189E-02	2.609E-01
CSO	2.496E-01	5.152E-01	1.487E-01	9.135E-01
TOTAL	8.522E-01	1.744E+00	5.000E-01	3.096E+00

6.8.2. PCB TMDL

Watershed Atmospheric Deposition of Total PCB was calculated (see Appendix C for calculations) based on Average Annual Atmospheric Deposition Fluxes provided by Chesapeake Bay Program data, 1999, (CPB 1999) yielding a Total Atmospheric Load of 16.38 pounds/year of Total PCB. This value was adjusted by the Runoff Coefficient values provided by the D.C Strom Water management Report, 2002, resulting in a Total Available Atmospheric Load of 11.64 pounds per year. This load represents much of the source of the CSO and Stormwater Loads to the Anacostia River. Distribution of this Atmospheric load to Maryland and the District of Columbia is based on the percentage of the Total PCB, 81.29 % and 18.71%, or 9.46 and 2.18 pounds/year, respectively.

Atmospheric loads impact all stormwater and CSO in the Maryland and the District of Columbia watershed, and represent 70.34 % of the total loads. Therefore a 70.34% load has been allocated to Atmospheric Deposition and the remaining loads are allocated to Maryland and the District as follows:

Allocated Maryland Loads in pounds/year

MARYLAND LOAD	**PCB1**	**PCB2**	**PCB3**	**TOTAL PCB**
NORTHEAST AND NORTHWEST BRANCHES	1.529E-01	1.469E+00	1.075E+00	2.696E+00
SUB WATERSHEDS (15.9% OF AREA IN MD)	2.974E-02	6.066E-02	1.735E-02	1.078E-01
LOWER BEAVER DAM CREEK	3.161E-01	6.138E-01	1.689E-01	1.099E+00
WATTS BRANCH (53% OF AREA IN MD)	2.416E-02	4.909E-02	1.401E-02	8.726E-02
TOTAL	5.229E-01	2.192E+00	1.275E+00	3.990E+00

Allocated DC Loads in pounds/year

DISTRICT OF COLUMBIA	**PCB1**	**PCB2**	**PCB3**	**TOTAL PCB**
SUB WATERSHEDS (84.1% OF AREA IN DC)	1.573E-01	3.208E-01	9.179E-02	5.699E-01
WATTS BRANCH (47% OF AREA IN DC)	2.143E-02	4.353E-02	1.243E-02	7.738E-02
CSO	7.404E-02	1.528E-01	4.410E-02	2.709E-01
TOTAL	3.233E-01	6.614E-01	1.897E-01	9.183E-01

The above data inputs were run through the TAM/WASP PCB sub-model for seven consecutive years (21 years) at 100 % load reduction. However, the final model output concentrations continued to violate the water quality standards, Class D criteria of $4.5x10^{-5}$ ug/l. Sediment flux and resuspension due to existing levels of PCB sediment contamination was identified as the primary barrier to water quality attainment.

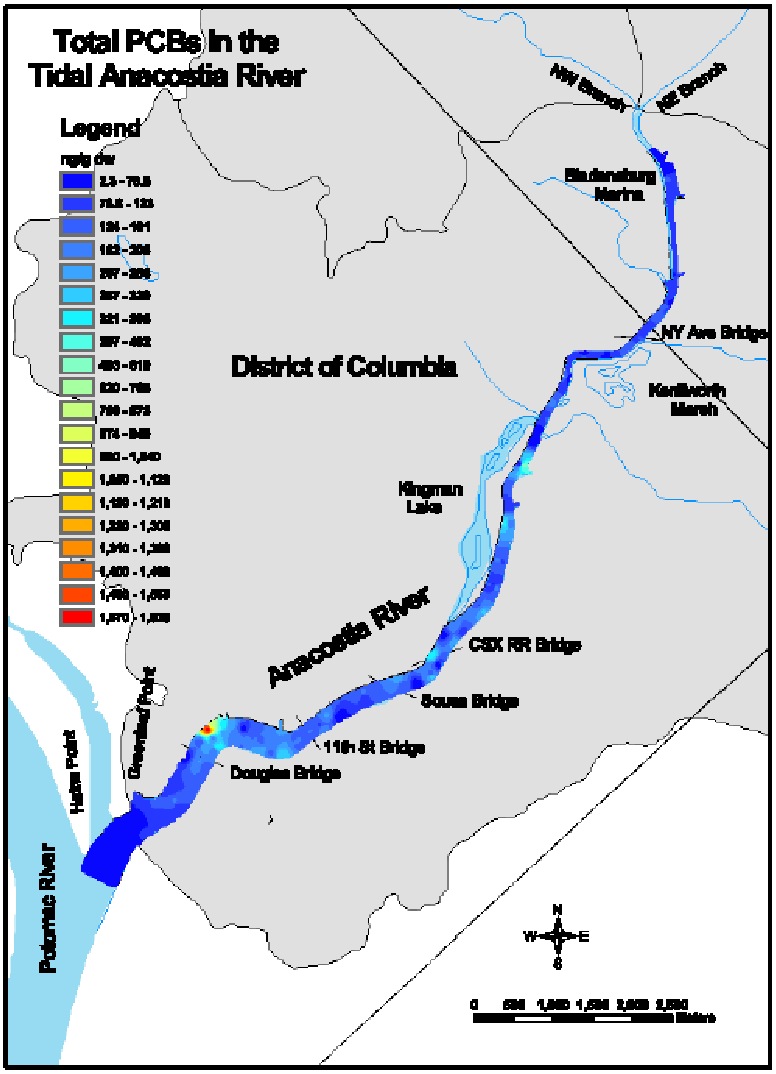

Figure 6-1: Spatial Distribution of Total PCB Sediment Contamination

6.8.3. PCB Allocations

The Anacostia River is located in a watershed in which the PCB impairment is predominately due to atmospheric deposition 70% and historic spills, landfill releases, land applications, *e.g.,* dust suppression, and sediment contamination. Consequently, 70.34 % of the PCB loads have been allocated to Atmospheric Deposition. Atmospheric Deposition is expected to decrease since the production and use of PCBs was banned in the 1970's, the load from atmospheric deposition will decrease over time. The releases from unidentified land sources are accounted for in the model by the CSO and storm water loads from the MS4 storm sewers. Implementation of this TMDL may require identification of potential PCB sources, *e.g.,* rail yards, and refinements of local air deposition fluxes.

In 1997, Total PCB Load in the lower tidal Anacostia River was estimated at 4.7 MT (metric tons) or 4,700 kg. Further, the data obtained through the sediment analysis study performed by Velinsky et.al., (1999) demonstrates the spatial extent and degree of the historic sediment contamination. That studies Total PCB sediment concentration results in the tidal river ranged from .0023 to 1.630 ppm dw with an average concentration of 0.162 ppm dw compared to the sediment screening value of 0.0598 ppm dw. (MacDonald, et.al. 2000). Figure 6-1 shows the spatial distribution of Total PCB contamination concentrations.

As proposed by CPB 1999, only 5% of a tributaries PCB load is transported to the Potomac, the remaining 95% are trapped because the "dilution by downstream transport is not an effective cleansing mechanism for tributaries." The TAM/WASP Toxics Screening Model estimated that the load to the Potomac may be as high as 33%. In both cases, the flux and resuspension of the contaminated sediment load creates a continuous source to the water column, inhibiting attainment of the water quality standards. To effectively achieve attainment of the water quality standards, a sediment management plan must be developed and implemented. Without implementing a sediment management plan, the sediment contamination will remain a continuous source of PCBs impairing the ability to attain the water quality standards. Because DOH believes that a sediment management plan will allow water quality standards to be met, no further reductions to the remaining Maryland and District loads will be imposed at this time.

Finally, for any storm water permit, the design flow shall be the Mean Harmonic Flow as provided in section 3.3.1.

7. Anacostia Small Tributary: Loads TMDL Allocations and Margins of Safety

7.1. Fort Chaplin Loads and TMDL – pounds/year

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Fort Chaplin Metals that met the applicable WQS with a margin of safety. The total allowable loads for Fort Chaplin reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L and Class C, CCC criteria for Copper, Lead, and Zinc at 17.77, 4.43, and 163.02 ug/L, respectively. The reductions required to meet these WQS: Arsenic at 70%; Copper at 60%; Lead at 65%; and Zinc at 0%.

7.1.1. Total Loads and TMDL – pounds/year

Constituent	Fort Chaplin Load			Total SS Allocation	1% MOS	Total Allocable Stormwater
	SS Load	CSO Load	Total Load			
Arsenic	1.589	0.000E+00	1.589	0.477	4.7677E-03	0.472
Copper	57.987	0.000E+00	57.987	23.195	2.3195E-01	22.963
Lead	27.794	0.000E+00	27.794	9.728	9.7278E-02	9.631
Zinc	171.477	0.000E+00	171.477	171.477	1.7148E+00	169.762

7.2. Fort Davis Loads and TMDL

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Fort Davis Metals that met the applicable WQS with a margin of safety. The total allowable loads for Fort Davis reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L and Class C, CCC criteria for Copper, Lead, and Zinc at 17.77, 4.43, and 163.02 ug/L, respectively. The following reductions were required to meet these WQS: Arsenic at 70%; Copper at 60%; Lead at 65%; and Zinc at 0%.

7.2.1. Total Loads and TMDL – pounds/year

Constituent	Fort Davis Load			Total SS Allocation	1% MOS	Total Allocable Stormwater
	SS Load	CSO Load	Total Load			
Arsenic	0.509	0.000E+00	0.509	0.153	1.5264E-03	0.151
Copper	18.271	0.000E+00	18.271	7.308	7.3082E-02	7.235
Lead	8.674	0.000E+00	8.674	3.036	3.0358E-02	3.005
Zinc	53.808	0.000E+00	53.808	53.808	5.3808E-01	53.270

7.3. Fort Dupont Creek Loads and TMDL

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Fort Dupont Metals that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Fort Dupont reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L and Class C, CCC criteria for Copper, Lead, and Zinc at 17.77, 4.43, and 163.02 ug/L, respectively. The reductions required to meet WQS: Arsenic at 70%; Copper at 60%; Lead at 60%; and Zinc at 0%.

7.3.1. Total Loads and TMDL – pounds/year

Constituent	Fort Dupont Load			Total SS Allocation	1% MOS	Total Allocable Stormwater
	SS Load	CSO Load	Total Load			
Arsenic	2.859	0.000E+00	2.859	0.858	8.5759E-03	0.849
Copper	99.398	0.000E+00	99.398	39.759	3.9759E-01	39.362
Lead	46.250	0.000E+00	46.250	18.500	1.8500E-01	18.315
Zinc	290.254	0.000E+00	290.254	290.254	2.9025E+00	287.352

7.4. Fort Stanton Loads and TMDL

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Fort Stanton Organics and Metals that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Fort Stanton reflects the following reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L; Class C, CCC criteria for Copper at 107.77, Lead at 4.43, and Zinc at 163.02 ug/L; Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; Class D for PAH2 and PAH2 at 0.031 ug/L, respectively; and Class D for Total PCB at 0.000045 ug/L.

The following reductions were required to meet these WQS: Arsenic at 70%; Copper at 60%; Lead at 65%; Zinc at 0%; Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; PAH 3 at 98%; and TPCB at 99.90%.

7.4.1. Fort Stanton Total Loads and TMDL – pounds/year

Constituent	Fort Stanton Load			Total SS Allocation	1% MOS	Total Allocable Stormwater
	SS Load	CSO Load	Total Load			
Arsenic	1.055E+00	0.000E+00	1.055E+00	3.164E-01	3.164E-03	3.132E-01
Copper	3.895E+01	0.000E+00	3.895E+01	1.558E+01	1.558E-01	1.542E+01
Lead	1.880E+01	0.000E+00	1.880E+01	6.580E+00	6.580E-02	6.515E+00
Zinc	1.155E+02	0.000E+00	1.155E+02	1.155E+02	1.155E+00	1.144E+02
Chlordane	7.025E-03	0.000E+00	7.025E-03	1.054E-03	1.054E-05	1.043E-03
DDD	5.860E-03	0.000E+00	5.860E-03	5.860E-04	5.860E-06	5.801E-04
DDE	1.176E-02	0.000E+00	1.176E-02	9.409E-04	9.409E-06	9.315E-04
DDT	3.210E-02	0.000E+00	3.210E-02	9.629E-04	9.629E-06	9.532E-04
Dieldrin	7.334E-04	0.000E+00	7.334E-04	1.467E-04	1.467E-06	1.452E-04
Heptachlor Epoxide	1.154E-03	0.000E+00	1.154E-03	1.154E-04	1.154E-06	1.142E-04
PAH1	4.861E-01	0.000E+00	4.861E-01	4.861E-01	4.861E-03	4.812E-01
PAH2	2.811E+00	0.000E+00	2.811E+00	5.622E-02	5.622E-04	5.566E-02
PAH3	1.783E+00	0.000E+00	1.783E+00	3.565E-02	3.565E-04	3.530E-02

	SS Load	CSO Load	Total Load	Atmospheric Load	Total Allocable Load
TPCB	6.070E-02	0.000E+00	6.070E-02	1.851E-02	4.219E-02

7.5. Hickey Run Loads and TMDL

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Hickey Run Organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Hickey Run reflects the reductions needed in order to meet the following WQS: Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; Class D for PAH2 and PAH2 at 0.031 ug/L, respectively; and Class D for Total PCB at 0.000045 ug/L.

The following reductions were required to meet these WQS: Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues discussed in section 6.8 impacting the Anacostia

Watershed, equally impact the tributaries. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

Hickey Run Total Loads and TMDL – pounds/year

Constituent	**Hickey Run Load**			**Total SS Allocation**	**1% MOS**	**Total Allocable Stormwater**
	SS Load	**CSO Load**	**Total Load**			
Chlordane	9.585E-02	0.000E+00	9.585E-02	1.438E-02	1.438E-04	1.423E-02
DDD	5.427E-02	0.000E+00	5.427E-02	5.427E-03	5.427E-05	5.373E-03
DDE	1.449E-01	0.000E+00	1.449E-01	1.159E-02	1.159E-04	1.147E-02
DDT	3.850E-01	0.000E+00	3.850E-01	1.155E-02	1.155E-04	1.143E-02
Dieldrin	6.370E-03	0.000E+00	6.370E-03	1.274E-03	1.274E-05	1.261E-03
Heptachlor Epoxide	1.250E-02	0.000E+00	1.250E-02	1.250E-03	1.250E-05	1.237E-03
PAH1	6.525E+00	0.000E+00	6.525E+00	6.525E+00	6.525E-02	6.459E+00
PAH2	3.947E+01	0.000E+00	3.947E+01	7.893E-01	7.893E-03	7.814E-01
PAH3	2.525E+01	0.000E+00	2.525E+01	5.049E-01	5.049E-03	4.999E-01

	SS Load	**CSO Load**	**Total Load**	**Atmospheric Load**	**Total Allocable Load**
TPCB	8.067E-01	0.000E+00	8.067E-01	1.559E-01	6.508E-01

7.6. Nash Run Loads and TMDL

For Maryland and District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Nash Run Organics and Metals that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Nash Run reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L; Class C, CCC criteria for Copper at 107.77, Lead at 4.43, and Zinc at 163.02 ug/L; Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; Class D for PAH2 and PAH2 at 0.031 ug/L, respectively; and Class D for Total PCB at 0.000045 ug/L.

The following reductions were required to meet these WQS for both Maryland and District of Columbia sources: Arsenic at 75%; Copper at 60%; Lead at 70%; Zinc at 0%; Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues discussed in section 6.8 impacting the Anacostia Watershed, equally impact the tributaries. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

7.6.1. Nash Run Total Loads and TMDL

Approximately thirty-eight percent of the Nash Run drainage area is in Prince George's County, Maryland. Accordingly 38.49% of the Total Loads and Allocations are directed to Maryland.

Nash Run – Maryland – pounds/year

Constituent	Load	Total Allocation	1% MOS	Total Allocable
Arsenic	2.195E+00	5.488E-01	5.488E-03	5.433E-01
Copper	8.473E+01	3.389E+01	3.389E-01	3.355E+01
Lead	4.193E+01	1.258E+01	1.258E-01	1.245E+01
Zinc	2.540E+02	2.540E+02	2.540E+00	2.515E+02
Chlordane	1.497E-02	2.246E-03	2.246E-05	2.223E-03
DDD	8.899E-03	8.899E-04	8.899E-06	8.810E-04
DDE	2.289E-02	1.831E-03	1.831E-05	1.813E-03
DDT	6.101E-02	1.830E-03	1.830E-05	1.812E-03
Dieldrin	1.055E-03	2.110E-04	2.110E-06	2.088E-04
Heptachlor Epoxide	2.005E-03	2.005E-04	2.005E-06	1.985E-04
PAH1	1.021E+00	1.021E+00	1.021E-02	1.011E+00
PAH2	6.147E+00	1.229E-01	1.229E-03	1.217E-01
PAH3	3.928E+00	7.857E-02	7.857E-04	7.778E-02

	Maryland Load	Atmospheric Load	Total MD Allocable Load
TPCB	1.264E-01	1.615E-02	1.103E-01

Nash Run – District of Columbia – pounds/year

Sixty-two percent of the Nash Run drainage area is in the District of Columbia. Accordingly 61.51% of the Total Loads and Allocations are directed to the District of Columbia.

Constituent	DC Nash Run Load			Total SS Allocation	1% MOS	Total Allocable Stormwater
	SS Load	CSO Load	Total Load			
Arsenic	3.507E+00	0.000E+00	3.507E+00	8.768E-01	8.768E-03	8.681E-01
Copper	1.354E+02	0.000E+00	1.354E+02	5.415E+01	5.415E-01	5.361E+01
Lead	6.699E+01	0.000E+00	6.699E+01	2.010E+01	2.010E-01	1.990E+01
Zinc	4.059E+02	0.000E+00	4.059E+02	4.059E+02	4.059E+00	4.018E+02
Chlordane	2.392E-02	0.000E+00	2.392E-02	3.5882E-03	3.588E-05	3.552E-03
DDD	1.422E-02	0.000E+00	1.422E-02	1.422E-03	1.422E-05	1.408E-03
DDE	3.657E-02	0.000E+00	3.657E-02	2.925E-03	2.925E-05	2.896E-03
DDT	9.747E-02	0.000E+00	9.747E-02	2.924E-03	2.924E-05	2.895E-03
Dieldrin	1.685E-03	0.000E+00	1.685E-03	3.371E-04	3.371E-06	3.337E-04
Heptachlor Epoxide	3.204E-03	0.000E+00	3.204E-03	3.204E-04	3.204E-06	3.172E-04
PAH1	1.631E+00	0.000E+00	1.631E+00	1.631E+00	1.631E-02	1.615E+00
PAH2	9.821E+00	0.000E+00	9.821E+00	1.964E-01	1.964E-03	1.945E-01
PAH3	6.277E+00	0.000E+00	6.277E+00	1.255E-01	1.255E-03	1.243E-01

	SS Load	CSO Load	Total Load	Atmospheric Load	Total Allocable Load
TPCB	2.019E-01	0.000E+00	2.019E-01	2.581E-02	1.761E-01

7.7. Popes Branch Loads and TMDL

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Popes Branch Organics and Metals that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Popes Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L; Class C, CCC criteria for Copper at 107.77, Lead at 4.43, and Zinc at 163.02 ug/L; Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; Class D for PAH2 and PAH2 at 0.031 ug/L, respectively; and Class D for Total PCB at 0.000045 ug/L.

The following reductions were required to meet these: Arsenic at 70%; Copper at 60%; Lead at 65%; Zinc at 0%; Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues discussed in section 6.8 impacting the Anacostia Watershed, equally impact the tributaries. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

7.7.1. Total Popes Branch Loads and TMDL – pounds/year

Constituent	**Popes Branch Load**			**Total SS**	**1% MOS**	**Total Allocable**
	SS Load	**CSO Load**	**Total Loads**	**Allocation**		**Stormwater**
Arsenic	1.899E+00	0.000E+00	1.899E+00	5.697E-01	5.697E-03	5.640E-01
Copper	6.982E+01	0.000E+00	6.982E+01	2.793E+01	2.793E-01	2.765E+01
Lead	3.362E+01	0.000E+00	3.362E+01	1.177E+01	1.177E-01	1.165E+01
Zinc	2.069E+02	0.000E+00	2.069E+02	2.069E+02	2.069E+00	2.048E+02
Chlordane	1.262E-02	0.000E+00	1.262E-02	1.893E-03	1.893E-05	1.874E-03
DDD	1.084E-02	0.000E+00	1.084E-02	1.084E-03	1.084E-05	1.073E-03
DDE	2.132E-02	0.000E+00	2.132E-02	1.706E-03	1.706E-05	1.689E-03
DDT	5.831E-02	0.000E+00	5.831E-02	1.749E-03	1.749E-05	1.732E-03
Dieldrin	1.362E-03	0.000E+00	1.362E-03	2.724E-04	2.724E-06	2.697E-04
Heptachlor Epoxide	2.113E-03	0.000E+00	2.113E-03	2.113E-04	2.113E-06	2.092E-04
PAH1	8.746E-01	0.000E+00	8.746E-01	8.746E-01	8.746E-03	8.658E-01
PAH2	5.036E+00	0.000E+00	5.036E+00	1.007E-01	1.007E-03	9.972E-02
PAH3	3.191E+00	0.000E+00	3.191E+00	6.383E-02	6.383E-04	6.319E-02

	SS Load	**CSO Load**	**Total Load**	**Atmospheric Load**	**Total Allocable Load**
TPCB	1.093E-01	0.000E+00	1.093E-01	2.182E-02	8.748E-02

7.8. Texas Avenue Tributary Loads and TMDL

For the District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Texas Avenue Tributary Organics and Metals that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Texas Avenue

Tributary reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L; Class C, CCC criteria for Copper at 107.77, Lead at 4.43, and Zinc at 163.02 ug/L; Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; Class D for PAH2 and PAH2 at 0.031 ug/L, respectively; and Class D for Total PCB at 0.000045 ug/L.

The following reductions were required to meet these: Arsenic at 70%; Copper at 60%; Lead at 65%; Zinc at 0%; Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues discussed in section 6.8 impacting the Anacostia Watershed, equally impact the tributaries. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

7.8.1. Total Texas Avenue Tributary Loads and TMDL – pounds/year

Constituent	Total Texas Avenue Tributary Load			**Total SS Allocation**	**1% MOS**	**Total Allocable Stormwater**
	SS Load	**CSO Load**	**Total Loads**			
Arsenic	1.583E+00	0.000E+00	1.583E+00	4.748E-01	4.748E-03	4.700E-01
Copper	5.896E+01	0.000E+00	5.896E+01	2.358E+01	2.358E-01	2.335E+01
Lead	2.861E+01	0.000E+00	2.861E+01	1.001E+01	1.001E-01	9.912E+00
Zinc	1.753E+02	0.000E+00	1.753E+02	1.753E+02	1.753E+00	1.735E+02
Chlordane	1.059E-02	0.000E+00	1.059E-02	1.589E-03	1.589E-05	1.573E-03
DDD	8.331E-03	0.000E+00	8.331E-03	8.331E-04	8.331E-06	8.248E-04
DDE	1.743E-02	0.000E+00	1.743E-02	1.394E-03	1.394E-05	1.380E-03
DDT	4.735E-02	0.000E+00	4.735E-02	1.421E-03	1.421E-05	1.406E-03
Dieldrin	1.035E-03	0.000E+00	1.035E-03	2.069E-04	2.069E-06	2.048E-04
Heptachlor Epoxide	1.676E-03	0.000E+00	1.676E-03	1.676E-04	1.676E-06	1.659E-04
PAH1	7.307E-01	0.000E+00	7.307E-01	7.307E-01	7.307E-03	7.234E-01
PAH2	4.260E+00	0.000E+00	4.260E+00	8.519E-02	8.519E-04	8.434E-02
PAH3	2.706E+00	0.000E+00	2.706E+00	5.411E-02	5.411E-04	5.357E-02

	SS Load	**CSO Load**	**Total Load**	**Atmospheric Load**	**Total Allocable Load**
TPCB	9.109E-02	0.000E+00	9.109E-02	1.124E-02	7.985E-02

7.9. Watts Branch

For Maryland and District of Columbia Stormwater Runoff sources, the following tables show the Loads and allowable TMDL for Watts Branch Organics that met the applicable WQS with a margin of safety of one percent. The total allowable loads for Watts Branch reflects the reductions needed in order to meet the following WQS: Class D criteria for Arsenic at 0.14 ug/L; Class C, CCC criteria for Copper at 107.77, Lead at 4.43, and Zinc at 163.02 ug/L; Class D criteria for Chlordane at 0.00059 ug/L; Class D criteria for DDD, DDE and DDT at 0.00059, respectively; Class D criteria for Dieldrin at 0.00014 ug/L; Class D criteria for Heptachlor

Epoxide at 0.00011 ug/L; Class C-CCC for PAH 1 at 50 ug/L; Class D for PAH2 and PAH2 at 0.031 ug/L, respectively; and Class D for Total PCB at 0.000045 ug/L.

The following reductions were required to meet these: Arsenic at 70%; Copper at 60%; Lead at 65%; Zinc at 0%; Chlordane at 85%; DDD at 90%; DDE at 92%; DDT at 97%; Dieldrin at 80%; Heptachlor Epoxide at 90%; PAH 1 at 0%; PAH 2 at 98%; and PAH 3 at 98%. The PCB issues discussed in section 6.8 impacting the Anacostia Watershed, equally impact the tributaries. Consequently, the allocations shown below reflect the atmospheric loads and resulting allocations at this time.

7.9.1. Total Watts Branch Loads and TMDL

Maryland – Watts Branch – pounds/year

Approximately fifty-three percent of the Watts Branch drainage area is in Maryland. Accordingly 53.39% of the Total Loads and Allocations are directed to Maryland.

Constituent	Maryland Watts Branch Load	Total Maryland Allocation	1% MOS	Maryland Total Allocable
Chlordane	1.052E-01	1.579E-02	1.579E-04	1.563E-02
DDD	6.504E-02	6.504E-03	6.504E-05	6.439E-03
DDE	1.624E-01	1.299E-02	1.299E-04	1.286E-02
DDT	2.170E-02	6.510E-04	6.510E-06	6.445E-04
Dieldrin	7.767E-03	1.553E-03	1.553E-05	1.538E-03
Heptachlor Epoxide	1.441E-02	1.441E-03	1.441E-05	1.427E-03
PAH1	7.187E+00	7.187E+00	7.187E-02	7.115E+00
PAH2	4.310E+01	8.620E-01	8.620E-03	8.534E-01
PAH3	2.753E+01	5.505E-01	5.505E-03	5.450E-01

	Maryland Load	Atmospheric Load	Total MD Allocable Load
TPCB	8.904E-01	1.246E-01	7.658E-01

District of Columbia – Watts Branch – pounds/year

Approximately forty-seven percent of the Watts Branch drainage area is in the District of Columbia. Accordingly 46.61% of the Total Loads and Allocations are directed to the District of Columbia.

Constituent	District of Columbia Load SS Load	CSO Load	Total Loads	Total SS Allocation	1% MOS	Total Allocable Stormwater
Chlordane	9.189E-02	0.000E+00	9.189E-02	1.378E-02	1.378E-04	1.365E-02
DDD	5.679E-02	0.000E+00	5.679E-02	5.679E-03	5.679E-05	5.622E-03
DDE	1.418E-01	0.000E+00	1.418E-01	1.134E-02	1.134E-04	1.123E-02
DDT	1.894E-02	0.000E+00	1.894E-02	5.683E-04	5.683E-06	5.626E-04
Dieldrin	6.781E-03	0.000E+00	6.781E-03	1.356E-03	1.356E-05	1.343E-03
Heptachlor Epoxide	1.258E-02	0.000E+00	1.258E-02	1.258E-03	1.258E-05	1.246E-03
PAH1	6.275E+00	0.000E+00	6.275E+00	6.275E+00	6.275E-02	6.212E+00
PAH2	3.763E+01	0.000E+00	3.763E+01	7.526E-01	7.526E-03	7.451E-01
PAH3	2.403E+01	0.000E+00	2.403E+01	4.806E-01	4.806E-03	4.758E-01

	SS Load	CSO Load	Total Load	Atmospheric Load	Total Allocable Load
TPCB	7.774E-01	0.000E+00	7.774E-01	1.088E-01	6.686E-01

8. Reasonable Assurance

The District of Columbia has several programs in place to control the effects of storm water runoff and promote nonpoint source pollution prevention and control. Because nonpoint source pollution problems are best addressed on a watershed-wide basis, the District also has joined with the State of Maryland, Prince George's and Montgomery Counties, the Army Corps of Engineers, and other federal agencies to form the Anacostia Watershed Restoration Committee, whose goal is to coordinate efforts to improve water quality in the Anacostia Watershed. The District is also a signatory to the Chesapeake Bay Agreement, pledging to reduce nutrient loads to the Bay by 40 percent or more by the year 2010.

8.1. Agreements

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

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

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

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

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

8.2. Source Control Plan

8.2.1. Upstream Target Load Reductions for Maryland

Based upon the best available information, load reductions for the above organics and metals were selected to achieve DC WQS at the DC/MD line. DOH estimates that the controls needed to achieve the allocated reductions will concomitantly achieve at least an 80% reduction of the TSS loads.

8.2.2. CSO Load Reductions

WASA is currently engaged in the following CSO reduction programs.

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

8.2.3. Storm Water Load Reductions

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

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

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

1. Street sweeping programs by the Department of Public Works.
2. Requirements for storm water treatment on all new development and earth disturbing activities such as road construction. The BMP and removal efficiencies that have been installed in the Anacostia drainage area in accordance with DC Law 5-188, The Water Pollution Control Act of 1985 are included in the appendix.

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

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

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

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

8.2.4. NPDES Permits

Additional requirements, as necessary, will be added to all permits that are issued, reissued or modified by U.S. EPA and certified by DC DOH after the approval of this TMDL. Permits, as an EPA policy, are not reopened to incorporate TMDL requirements. However, in rare cases, a permit would be reopened, upon approval of a TMDL to incorporate necessary requirements of the TMDL, when egregious impacts to the environment are observed or if the permittee is determined to be a significant contributor and there is obvious environmental impact that needs immediate attention. Per EPA guidance, the requirements that will be incorporated into storm water permits are in most cases, BMPs and not numeric effluent limits.

Each source/permit holder in a category will not be required to make the same reductions. Reductions will be determined on a facility-by-facility basis and, in most cases for storm water permit holders, reductions are required in the form of BMPs. EPA will give credit to facilities that are implementing BMPs at the time of permit Reissuance. BMPs will be required to be checked for effectiveness and if additional controls are needed, additional BMPs would be required upon permit reissuance.

Point source facilities that currently have no monitoring for certain TMDL parameters will not necessarily be considered to be a source. However, this will be determined as follows:

First, the facility may be asked to volunteer to monitor for that particular constituent in order to determine whether or not they are a source. Second, the permit may be modified upon reissuance to require monitoring for the constituent with no limit placed. Third the permit may be modified upon reissuance to require monitoring with a clause that if the parameter is detected at levels above the TMDL WLA then the facility must take measures to determine the particular source of the constituent and enact controls to reduce. If levels are not reduced, the next permit may have limits. A fourth option, if a permittee refuses to take a voluntary sample, EPA can require sampling by issuing a 308 order.

8.2.5. Washington Gas Light

In 1999, the EPA Region III Superfund program issued a Record of Decision (ROD) for the Washington Gas Light (WGL) East Station Site (EPA ID# DCD077797793) to address contaminated surface and subsurface soil, ground water, DNAPLE and sediment. With respect to contaminated groundwater, the selected remedy required WGL to (1) protect ecological and human receptors from excessive influx of chemicals to the river by continuing to pump and treat ground water that otherwise would enter the river and by continuing to extract coal tar, a DNAPL, from areas where it accumulates above residual concentration and where it may enter the river. This has been implemented by restricting the movement of contaminated ground water into the river so that ambient river-water quality criteria are not exceeded and contaminants do not present a potential risk to human or ecological receptors. WGL is also required to undertake or participate in additional environmental studies that might influence future remedial action at the site and in the Anacostia River. (US EPA ROD 1999)

On January 6, 2000, the District of Columbia and Washington Gas signed the East Station Agreement (Agreement) requiring WGL to conduct a triennial evaluation of the effectiveness of ground water pumping and treatment in preventing contaminated ground water from entering the Anacostia River. The Agreement also requires WGL to perform other remedial actions, install cluster wells near the seawall, and to monitor the quality of ground water and river sediment. Remedial actions required by the ROD are included in the triennial review. (Hydro-Terra, 2003)

Since 1976, WGL has pumped and treated contaminated groundwater and monitored ground water quality since 1994. (US EPA ROD 1999) All ground water moving towards the river is captured and treated. (Hydro-Terra, 2003) Therefore, in accordance with the Agreement and ROD, the zero load allocation noted above is expected to be achieved. As discussed in the ROD, because the selected remedy would results in hazardous substances remaining underground on the site above health-based levels, WGL will be required to conduct a five-year review (2004) after the implementation of their remedial plan to ensure that their remedy continues to provide adequate protection of human health and the environment. Further actions may be required during the triennial and five-year review to ensure compliance with this TMDL. For additional information, please see the East Station Site Agreement, dated January 6 2000 and EPA Superfund Record of Decision, dated September 22, 1999.

8.2.6. Boat Discharges

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

8.3. Monitoring

The Department of Health maintains an ambient monitoring network, which includes the Anacostia River and tributaries. Further DOH has contracted to obtain additional sediment data and is working with ICPRB to revise the Anacostia Toxics Model. Therefore, a revised TMDL is expected based on this new data.

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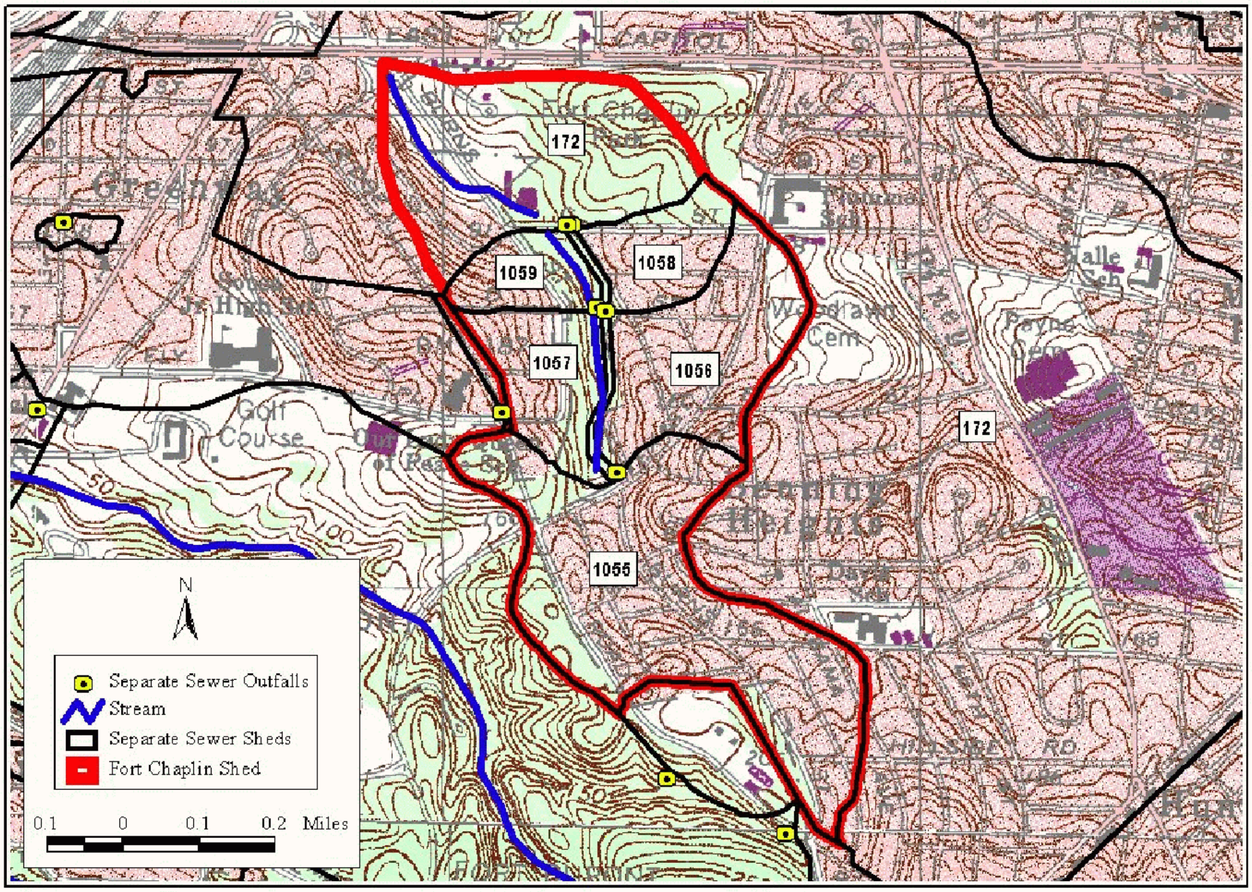
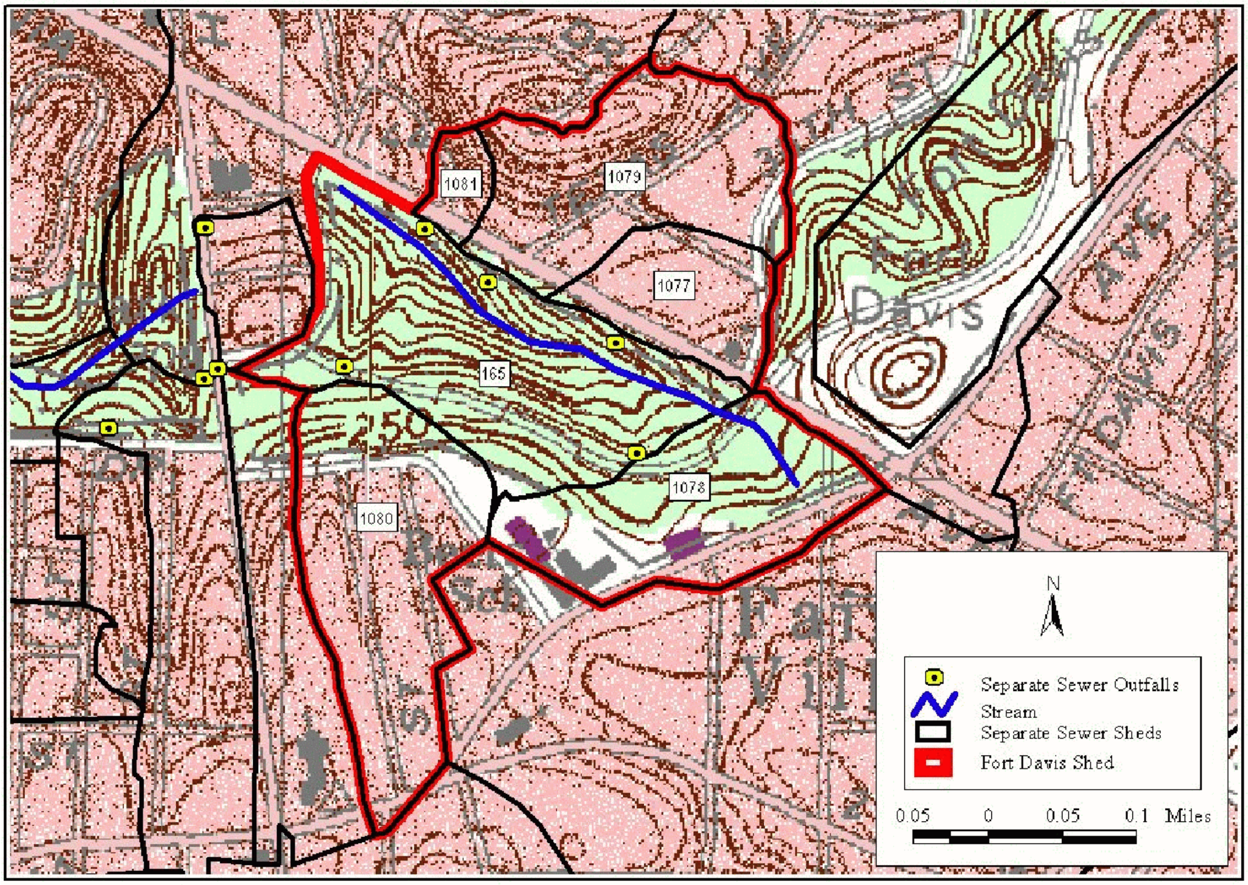
APPENDIX A

Maps of Anacostia River Small Tributaries

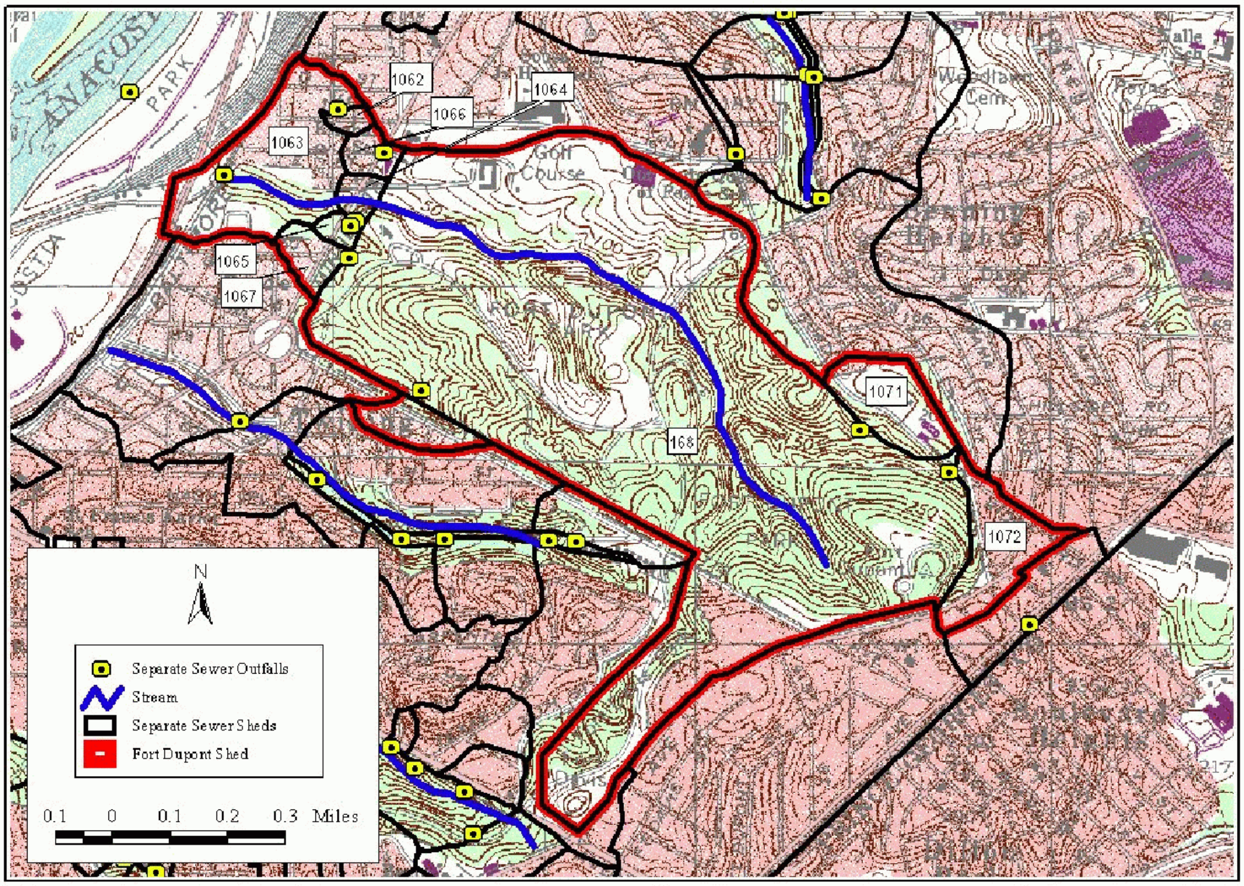
FORT CHAPLIN TRIBUTARY



FORT DAVIS TRIBUTARY



FORT DUPONT TRIBUTARY



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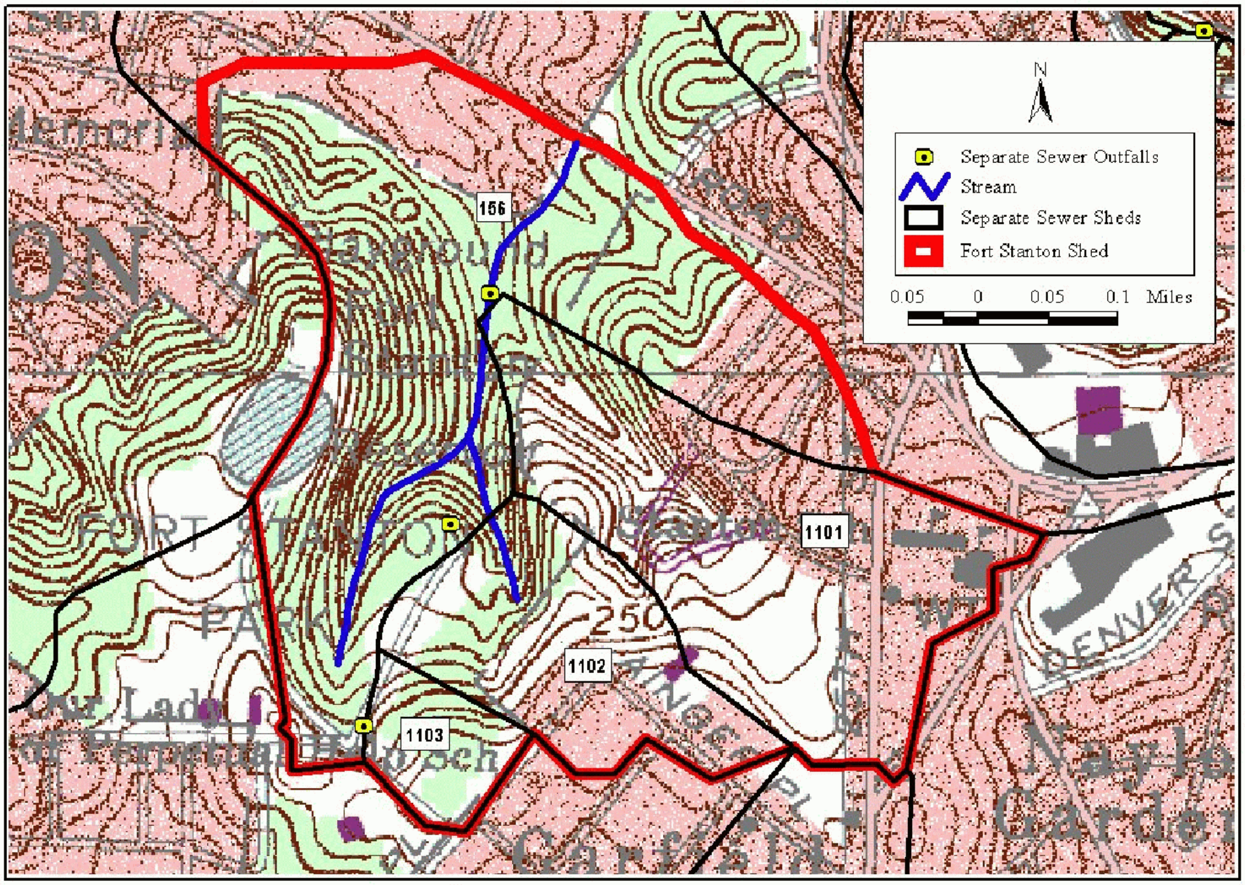
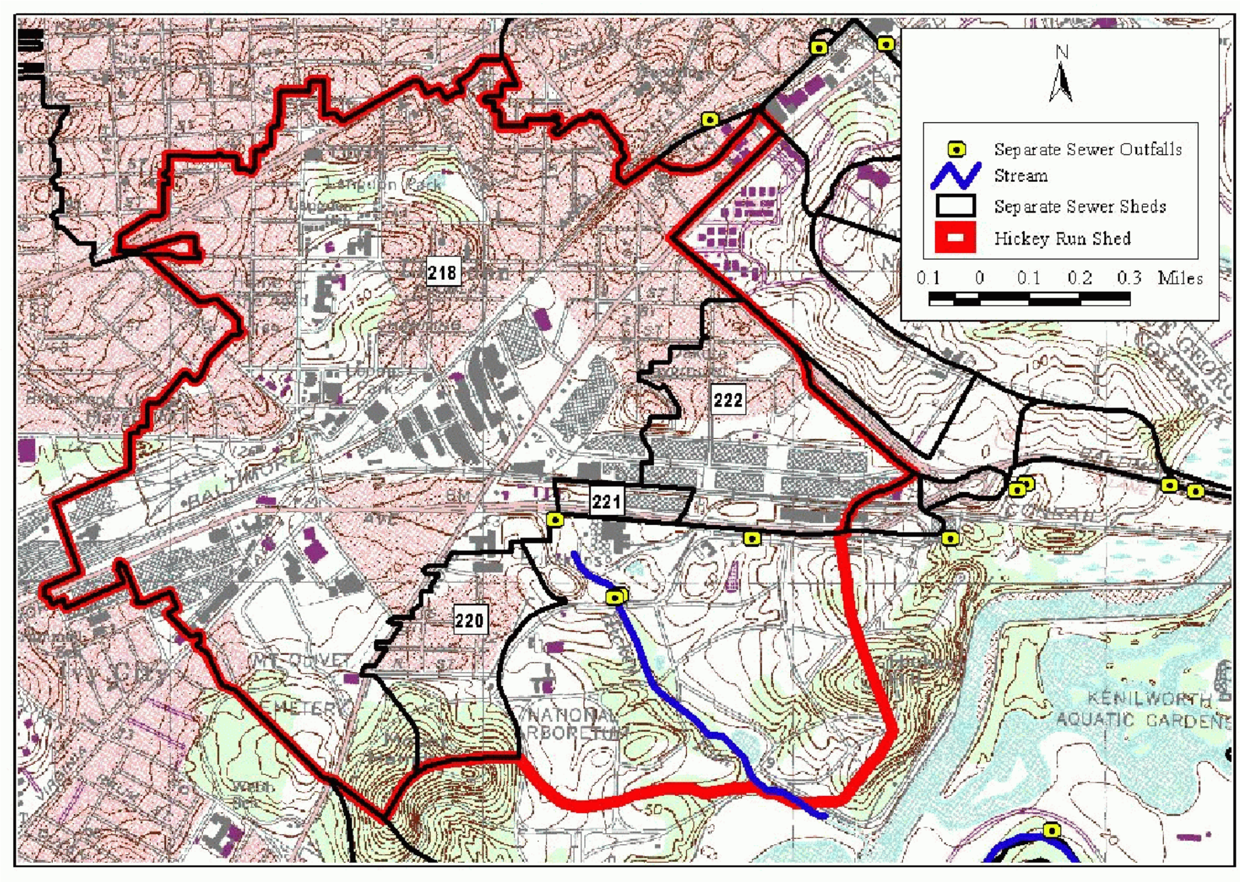
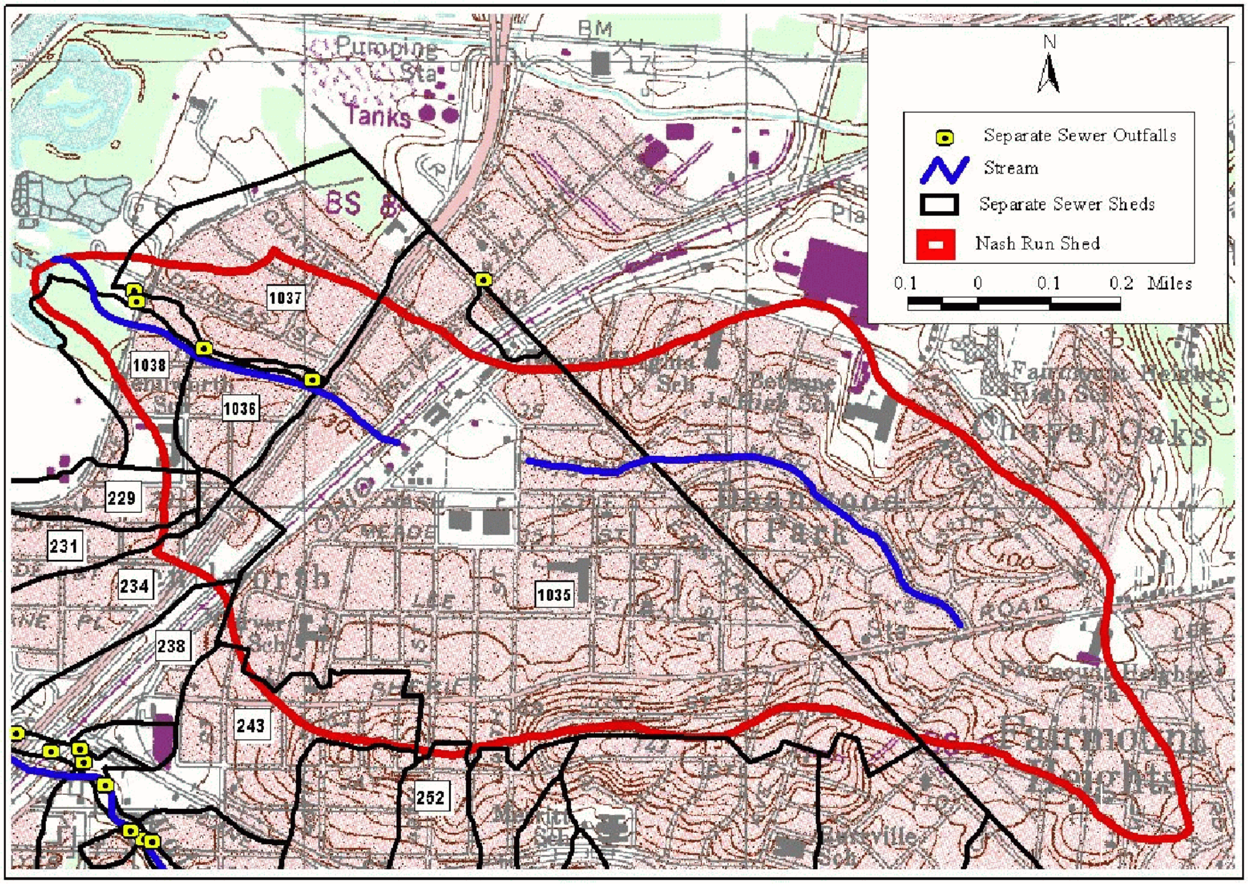


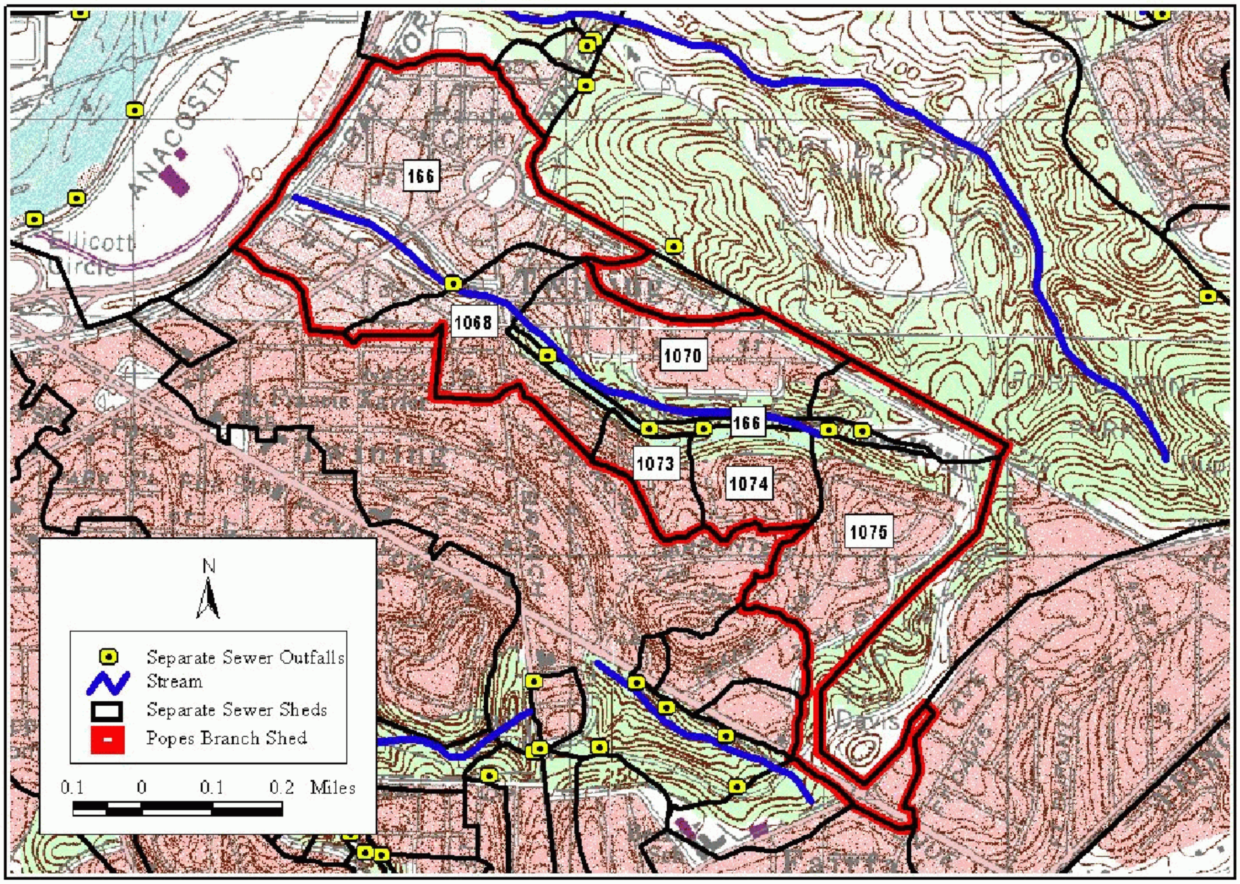
HICKEY RUN TRIBUTARY



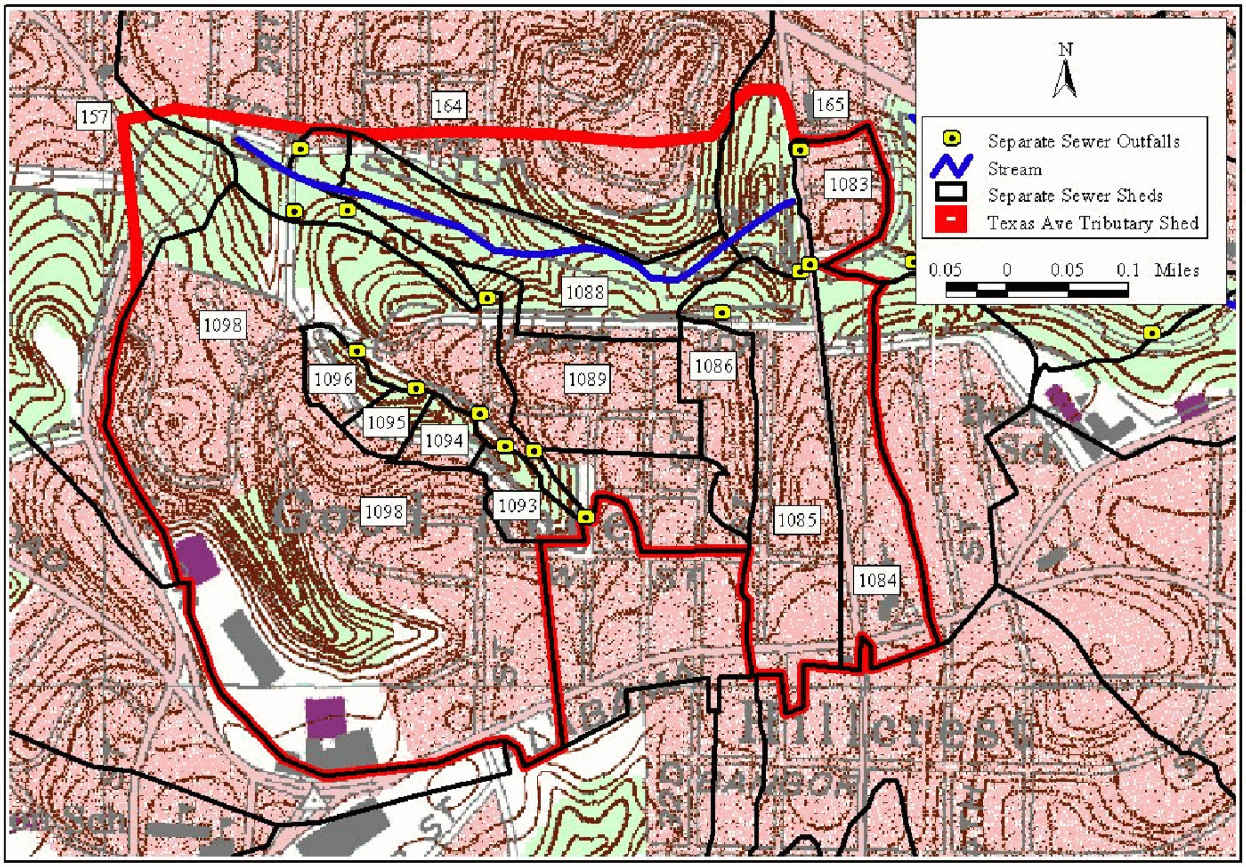
NASH RUN TRIBUTARY



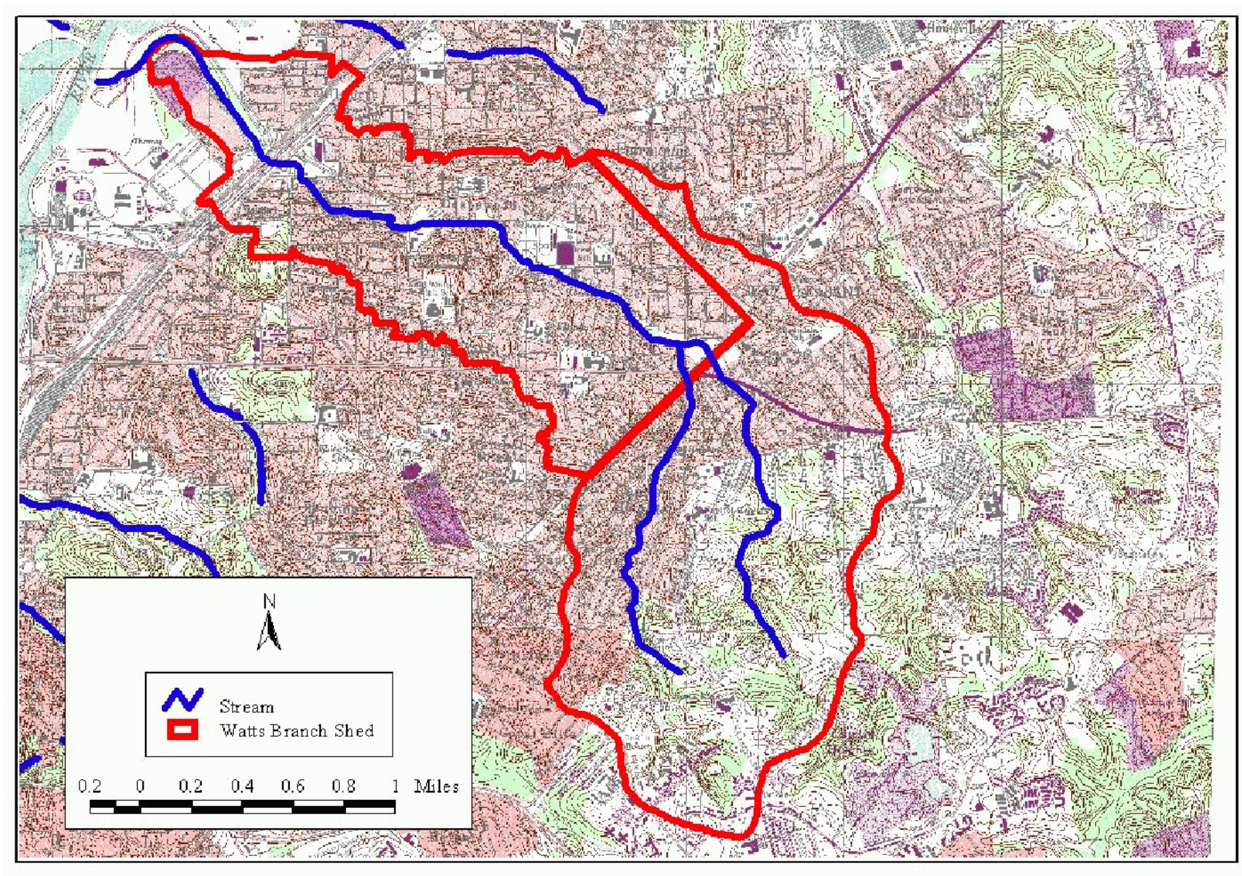
POPES BRANCH TRIBUTARY



TEXAS AVENUE TRIBUTARY

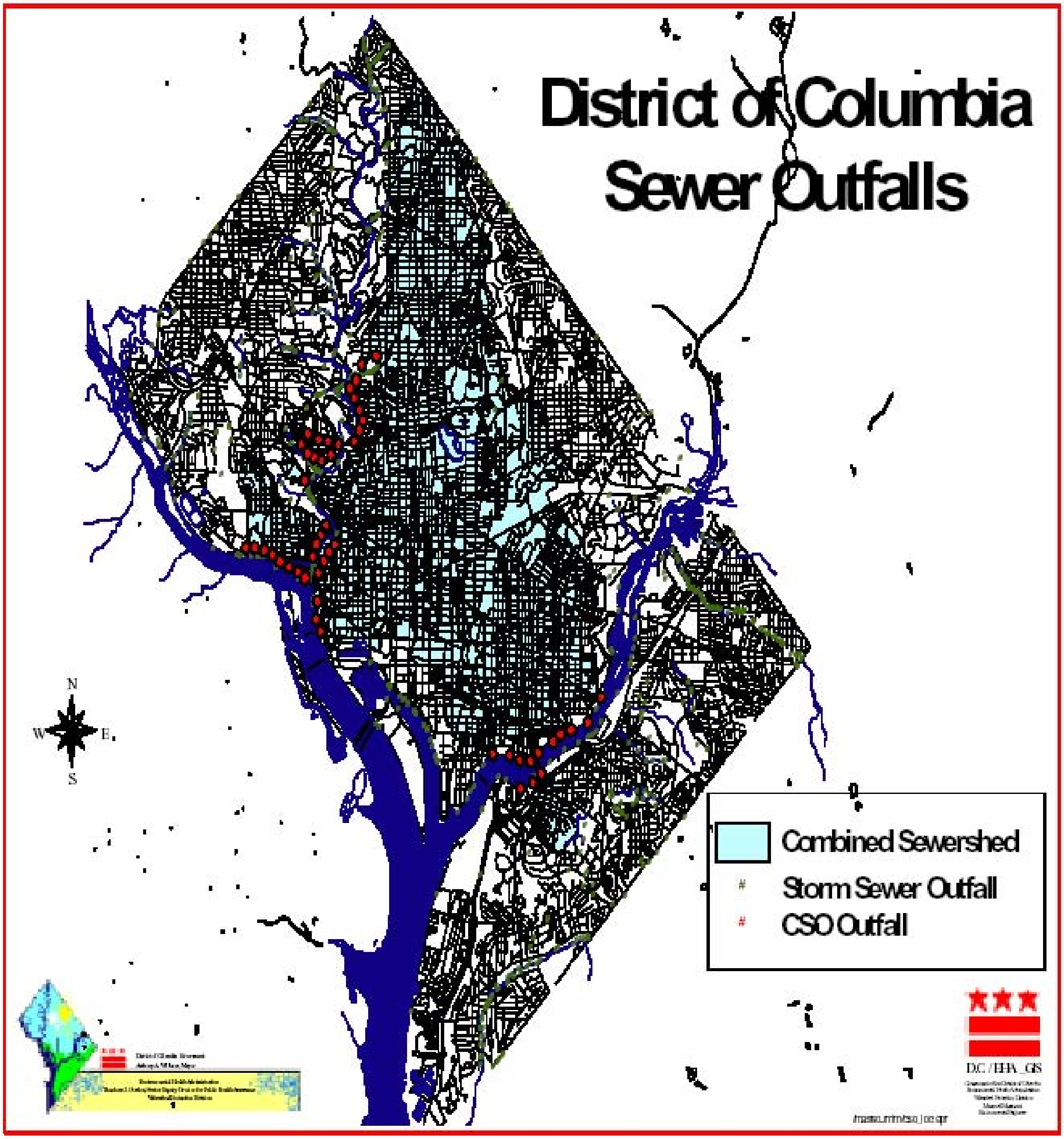


WATTS BRANCH TRIBUTARY



APPENDIX B

Map of District of Columbia Storm Sewer and CSO Outfalls


District of Columbia
Sewer Outfalls
N
W
E
S
Combined Sewershed
Storm Sewer Outfall
CSO Outfall
D.C / EHA _GIS

APPENDIX C

PCB Atmospheric Deposition

The following are the calculations that were performed to determine the Total Available Atmospheric Load of Total PCB to the Anacostia Watershed.

Average Annual Atmospheric Deposition Flux to Chesapeake Bay (Chesapeake May, 1999):

8.3 ug/m2-year Wet Urban Deposition
8.0 ug/m2-year Dry Urban Deposition

Total Wet-Dry Deposition = 16.3 ug/m^2-year

The calculated deposition flux to the Anacostia Watershed was calculated by multiplying the flux rate by the watershed area to generate an average annual loading directly to the waterbody from stormwater and CSOs.

Anacostia drainage Area = 176 $miles^2$ = 455,839,735.66 $meter^2$

Total Wet-Dry Deposition/Year = 7430.19 g/year
= 16.38 lbs/year

Total PCB Atmospheric Load = 16.38 lbs/yr

Total PCB Loads from MD and DC = 16.55 lbs/yr

The total available Atmospheric Load was calculated by multiplying the Total Atmospheric Load by the Average Weighted Runoff Coefficient for the Anacostia Watershed. An average of the weighted average runoff coefficients was used to take into consideration the differences in imperviousness and land within the watershed. The Weighted Average Runoff Coefficients for the Anacostia Sewersheds (D.C. SWMP. 2002) are:

Anacostia Sewershed	Runoff Coefficient
Stickfoot	0.59
"O" Street	0.95
Anacostia H.S.	0.665
Nash Run	0.644
E. Capitol	0.7025
	3.5515/5 = 0.7103

Average Anacostia Watershed RC = 0.7103

Total Available Atmospheric Load = 11.64 lbs/yr

APPENDIX D

Anacostia Tributary PCB Atmospheric Deposition

The following are the calculations that were performed to determine the Total Available Atmospheric Load of Total PCB to the Anacostia Tributary Watersheds.

Average Annual Atmospheric Deposition Flux to Chesapeake Bay (Chesapeake May, 1999):

8.3 ug/m2-year Wet Urban Deposition; 8.0 ug/m2-year Dry Urban Deposition: Total Wet-Dry Deposition = 16.3 ug/m^2-year

The calculated deposition flux to the Anacostia Tributary Watersheds was calculated by multiplying the flux rate by the respective watershed area to generate an average annual loading directly to the waterbody from stormwater and CSOs. This result was then multiplied by the watersheds runoff coefficient to determine the available atmospheric load. For the tributaries with unavailable runoff coefficients, the average weighted runoff coefficient for the Anacostia watershed was used.

The results of these calculations are as follows:

Waterbody	Drainage Area sqr.mile	Drainage Area sqr.meter	Total Atmospheric Load	Runoff Coefficient	Available Atmospheric Load lbs/yr	Total MD Existing PCB Load	Allocated MD Load	Total DC Existing PCB Load	Allocated DC Load
Fort Stanton	0.28	725196.7	0.0261	0.7103	1.851E-02	0	0	0.0607	4.219E-02
Hickey Run	2	5179976	0.1861	0.8375	1.559E-01	0	0	0.8067	6.508E-01
Nash Run	0.7	1812992	0.0651	0.644	4.196E-02	0.1264	1.615E-02	0.2019	1.761E-01
Popes Branch	0.33	854696.1	0.0307	0.7103	2.182E-02	0	0.000E+00	0.1093	8.748E-02
Texas Ave	0.17	440298	0.0158	0.7103	1.124E-02	0	0.000E+00	0.09109	7.985E-02
Watts Branch	3.53	9142658	0.3285	0.7103	2.334E-01	0.8904	7.658E-01	0.7774	6.686E-01

APPENDIX E

Final TAM WASP Toxics Screening Level Model For Anacostia River

APPENDIX F

Final D.C. Small Tributaries TMDL Model Report