Sediment Contamination Studies of the Potomac and Anacostia Rivers around the District of Columbia
FINAL REPORT

Submitted by:

David J. Velinsky and Carlton Haywood
Interstate Commission on the Potomac River Basin

Terry L. Wade
Geochemical Environmental Research Group
Texas A&M University and

Eli Reinharz
Maryland Department of the Environment
Environmental Assessment Division

Submitted to:

Dr. Mohsin Siddique
DCRA, Water Hygiene Branch
2100 Martin Luther King Ave., SE
Washington, D.C. 20020
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Acknowledgements

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Executive Summary

The objectives of this study are to define the extent of chemical contamination in the sediments around selected areas in the District of Columbia; to determine the extent and possible controlling factors of sediment toxicity to the amphipod Hyalella azteca; and to elucidate the possible source area(s) of organic and inorganic contaminants to the sediments around the District of Columbia.

A total of 54 sediment samples were collected from the Potomac (PR) and Anacostia Rivers (AR), Tidal Basin (TB), Washington Ship Channel (WSC) and Kingman Lake (KL) (Figure 2-1). In conjunction, sediment samples were collected directly in front of 14 major storm and combined sewer outfalls in three areas. Also, bottom sediment material was collected inside selected storm and combined sewers that directly discharge in the Tidal Basin, Ship Channel and Anacostia River. The outfall and sewer sediment samples were used to determine source areas for anthropogenic chemicals to river sediments around the District of Columbia. By combining sediment chemistry with the benthic macroinvertebrate abundance, diversity, and toxicity data it was possible to identify areas that were biologically impacted.

The geographic and spatial trends for both sedimentary trace metals and organics reveal specific areas of concern within the Washington, D.C. area. These locations are indicated by increased river sediment concentrations of both trace metals and hydrocarbons (chlorinated and non-chlorinated) relative to adjacent locations, and within the entire study area. In many cases, both trace metals and organics exhibit the same geographic trend. Substantial concentrations of lead (Pb), cadmium (Cd), and mercury (Hg), as well as organics such as polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and DDT (sum of DDT+DDE+DDD) were observed in many areas, such as near the Washington Navy Yard (AR-4), near Rock Creek in the Potomac River (PR-1), and upper Washington Ship Channel (WSC-1 to WSC-3).

Furthermore, concentration gradients between sewer, outfall, and sediment samples strongly suggest that urban runoff is a major source of these contaminants to the sediments. For certain constituents like total hydrocarbons (THC) and PAH, the outfall sediment distribution indicates a more diffuse input related to the ubiquitous nature of their sources (i.e., fossil fuel combustion, crankcase oils, etc.). Other contaminants have distributions that suggest more of a "point" source to the area. For example, the outfall and sewer sediment concentrations of PCB and to a lesser extent chlordane and total DDT are high only in specific locations. Similar trends are evident in the Tidal Basin, Washington Channel, and Anacostia River.

In the Potomac River, station PR-1 has increased levels of most contaminants compared to other river locations. This station is located below the mouth of Rock Creek which flows through the northwest section of the District of Columbia. Rock Creek accepts numerous storm and combined sewers inputs that could be a major source of these contaminants.

The sediments at TB-1, contain slightly greater concentrations of most contaminants than in other Tidal Basin locations. Located near TB-1 is a large storm sewer that drains the Constitution Avenue area of the Mall, including the Smithsonian Institution. While the outfall sample taken at this location (OTB-1) does not exhibit higher concentrations, the concentrations of most contaminants at nearby outfalls, OTB-3, OTB-4, and OTB-5 are significantly higher than the basin sediments, suggesting a source from runoff through their respective drainage areas.

In the Washington Channel, the increased concentrations of many contaminants in the upper end of the channel (i.e., WSC-1, WSC-2, and WSC-3) suggests that increased loading and retention of sediment contaminants in this area is occurring. While a substantial proportion of the contamination is most likely due to street runoff (i.e., there are no combined sewers in this area), numerous boats and boat related activities also could contribute to the concentrations observed in the sediments.

The concentration differences between sewer, outfall, and river sediment samples in the Anacostia River, along with the spatial trends in trace metals and organics from station KL-5 to PR-4A, suggest that the numerous storm and combined sewers are a major source of contamination to the river. This is especially noted at station AR-4 located just downstream of the Washington Navy Yard, near the South Capital Street Bridge. While the extreme gradient between the sewer, outfall, and sediment at this location indicates urban runoff is a source, past and present activities at the Navy Yard and possibly the U.S. Botanical Gardens (located slightly downstream on the southern side of the river) also could contribute to contamination of the area. Although there is no heavy industry located in the area, there are other facilities that border the area (e.g., oil off-loading terminals, power plants, construction companies) that may have some impact. The net result of all these possible sources are substantially higher concentrations of all contaminants at AR-4, with a large concentration decrease downstream from this area, suggesting a possible greater source function at AR-4 and/or a greater retention of upstream sources (i.e., fine grain sediments) in this section of the river.

Trace metals and organics exhibit a wide range in concentrations throughout this study area. Concentrations were generally higher in either the outfall or sewer sediment samples compared to river sediments from the Tidal Basin, Washington Channel, and Anacostia River. In this study, station AR-4 in the Anacostia River exhibited the highest concentrations, while either one of two Potomac River stations (e.g., PR-2, PR-3) or one station in the Washington Ship Channel (WSC-5) exhibited the lowest concentrations, dependent on the constituent. Sediment concentrations of Cd, copper (Cu), Hg, and Pb at station AR-4 are higher than those found in the mainstem Chesapeake Bay by a factor of two to four, dependent on the metal. Concentrations of all metals are well below those found in Baltimore Harbor and the Schuykill River (Philadelphia, PA). Compared to the estuarine portion of the Potomac River (i.e., Maryland Department of the Environment stations MLE2.2, XDA11, and XEA659), sediment concentrations of all metals are higher in the Washington, D.C., area. For all groups of organics, concentrations measured in this study are higher than those from the mainstem Chesapeake Bay, but lower than those found in Baltimore Harbor. Comparison was based on in-place sediments only. The concentrations of trace metals and organics were substantially higher in most outfalls and sewers, and this material will eventually mix with the sediments in respective areas. These data reflect the effect of an urban environment to the tidal freshwater portion of the Potomac Estuary. On a chemical basis alone, it appears that specific areas within the Washington, D.C., area are moderately contaminated with trace metals and organics and the most severely impacted area is that of the Anacostia River near station AR-4.

Results of sediment toxicity testing and macroinvertebrate community analysis agree that the lower Anacostia River stations (i.e., from AR-1 to AR-4) exhibited the most severe degree of biological impairment. Sediments from these stations generally elicited the highest toxicity and harbored the least diverse benthic macroinvertebrate communities. Sediment contaminant concentrations are highest at these four stations, indicating a strong relationship between sediment contamination and biological impairment. This investigation also identified Kingman Lake sediment as a potential environmental concern. Even though only one station within Kingman Lake exhibited toxicity (i.e., growth impairment at KL-1), amphipod survival was overall quite low, and chemical contaminant levels of Kingman Lake sediments are high. The two other areas, the Washington Ship Channel and the Tidal Basin, showed low sediment toxicity, moderate benthic community parameters, and levels of sediment contamination below those occurring in the Anacostia River. The sole Potomac River site is the most perplexing situation. Sediment toxicity testing and benthic community analysis indicate biological impairment at this station. However, sediment contaminant levels here are the lowest of any station, and sediment toxicity test results may have been the result of high concentrations of ammonia ($NH_4^+ + NH_3$) in the porewaters. Therefore, biological impairment, suggested by benthic community analysis, may instead be a result of temporal variation of the macrofaunal community and impacts related to seasonal dynamics in ammonia, or physical disruption.

This study has succeeded in demonstrating the importance of employing a "burden of evidence approach," such as the sediment quality triad, in sediment contamination assessments. Had the assessment been based entirely on comparing contaminant concentrations in field collected sediment to effects-related criteria (i.e., Long and Morgan's (1990) ER-L and ER-M), it would be concluded that sediment from all stations possessed the potential for biological impairment. Similarly, sediment toxicity tests alone would have included the Potomac River station with those within the stretch of the lower Anacostia River as the most severely biologically impaired. By utilizing synoptic measures of sediment contamination, sediment toxicity, and benthic community parameters, it was possible to firmly justify labeling the lower Anacostia River as the area of greatest concern within the riverine system of Washington, D.C.

Chapter I.

Introduction

Sediment contamination problems have been documented for an increasing number of areas in this country (Lyman, 1987; NOAA, 1990; NAS, 1989). Sediments are a major reservoir for anthropogenic contaminants due to the particle-reactive behavior and low water solubility of many pollutants (Young et al., 1985; Olsen et al., 1982). Contaminants in sediments can affect aquatic life, recreation, and human health by entering the food chain (i.e., animal and plant life), and can also impact the use of navigational waters. Restrictions on the handling and disposal of contaminated sediments may raises the cost of dredging to levels that are prohibitive. It is therefore imperative to have an accurate assessment of the extent of sediment contamination in a given location and knowledge of the source(s) of the pollutants.

Objectives

The objectives of this study are to define the extent of chemical contamination in the sediments around the District of Columbia area; to determine the extent and possible controlling factors of sediment toxicity to the amphipod Hyalella azteca; and to elucidate the possible source area(s) of organic and inorganic contaminants to the sediments around the District of Columbia.

Bottom sediment samples were collected from the Potomac and Anacostia Rivers, Tidal Basin, Washington Ship Channel, and Kingman Lake. In conjunction, sediment samples were collected directly in front of major outfalls that drain into these areas. Also, sedimentary material was collected from the bottom of selected storm sewers that directly discharge to the Tidal Basin, Washington Ship Channel, and Anacostia River. The sewer and outfall sediment samples were used to determine source areas of anthropogenic chemicals to the river sediments around the District of Columbia. Also, sediment chemistry, combined with the benthic macroinvertebrate abundance, diversity, and toxicity data was used to elucidate areas that are biologically impacted.

Background

There are few studies concerning the sources and distribution of potentially toxic inorganic and organic chemicals in the Washington, D.C. area. Friebele et al. (1988) presented an extensive literature survey on the distribution and temporal trends of organics and trace metals in the rivers and streams of the Potomac River Basin, including waters around the District of Columbia. Although this report contained historical information concerning organic and inorganic contaminants in water, little information was reported concerning sediment contamination. Pheiffer (1972) and Martin et al. (1981) investigated the distribution of selected trace metals from samples taken in the Potomac estuary around the District of Columbia. Both studies indicated that the concentration of trace metals were highest around the District of Columbia and decreased down the estuary. Recently, ICPRB conducted a sediment survey in the urban Potomac and Anacostia Rivers (ICPRB, 1990) to assess the extent of sediment contamination, both organic and inorganic, in the urban Potomac and Anacostia Rivers. Though there is a wide range in contaminant concentrations, specific locations (e.g., South Capitol Street Bridge and Tidal Basin) have significantly higher concentrations of both trace metals (e.g., Zn and Pb) and organic chemicals (e.g., total polychlorinated biphenyls (PCB), total polycyclic aromatic hydrocarbons (PAH), and total chlordane; see Table 1-1).

Generally, sedimentary concentrations of trace metals and organics in the Washington D.C. area are much higher than those determined from samples taken in the estuarine portion of the river and at the mouth of the Potomac River (NOAA, 1991; Martin et al., 1981; Goldberg et al., 1977; Pheiffer, 1972; MDE, unpublished data). Results from NOAA's Status and Trends Program (NOAA, 1990) indicate that the concentrations of total PCBs, PAHs, and some pesticides are much lower in many areas of Chesapeake Bay than in the Anacostia River, Tidal Basin, and Washington Ship Channel. The concentration ranges for total PCBs and PAHs in the Chesapeake Bay region are 0.2 to 300, and 30 to 3100 ng/g-dw, respectively (NOAA, 1990) with highest concentrations around Baltimore Harbor and the Elizabeth River. Table 1-2 lists the concentrations of sedimentary trace metals from various studies in the Potomac River and Chesapeake Bay. Although the sample locations may be slightly different and, in this regard, spatial heterogeneity and temporal changes have not been evaluated, these data indicate that trace metal concentrations are higher in the Washington, D.C. area. Generally, these data indicate that the concentrations of chemical contaminants are higher in urban areas.

Transport and Sources of Contaminants

Concentrations of chemical contaminants are variable in surface sediments in both space (cm to km) and time (days to years). These variations are due to changes in source types and locations, and sediment transport processes (Leenaers, 1991; Uncles et al., 1987; Young et al., 1982; Meade, 1972). Both organic and inorganic material, once associated with particles, sink to the bottom and are incorporated into the sediments. However, depending on the bottom conditions, sediment-associated contaminants can be eroded by currents and transported to lower energy areas for final burial.

Sediment transport in tidal rivers such as the Anacostia and Potomac is not a simple function of the transport of water. Storm events, tidal pumping, and spring runoff increase bottom water flows above threshold values, causing movement of specific particle sizes and associated contaminants. For example, Morris et al. (1986) described significant seasonal variations in total metal distributions in the Tamar

Table 1-1. Sedimentary concentrations of selected organics and trace metals from ICPRB (1991)*.

General Locations	TPCB[1] ng/g	TPAH[2] μg/g	DDT[3] ng/g	DDE[3] ng/g	CHL[4] ng/g	Cu[5] μg/g	Pb μg/g	Zn μg/g
ANACOSTIA RIVER								
Bladensburg Marina	82	7	5	10	32	35	29	159
NY Ave. Bridge	130	9	1	10	33	44	29	180
Hickey Hill	220	12	10	<1	6	50	50	241
Benning Rd.	320	11	3	15	50	50	79	265
Kingman Lake	480	16	2	35	65	95	168	479
NE Boundary Sewer	430	17	3	27	96	80	136	415
11th Street Bridge	380	16	3	35	48	103	179	452
South Capitol St. Bridge	1800	45	6	<1	105	207	351	587
Buzzard Point Marina	360	11	1	29	22	92	107	396
POTOMAC RIVER								
Fletchers Boat House	124	6	16	19	4	40	29	181
Key Bridge	190	3	2	7	4	49	10	231
Rock Creek	120	5	9	12	17	31	68	138
Pentagon Lagoon	550	7	1	21	6	48	40	289
Above Nat'l Airport	580	7	<1	4	<1	38	10	148
Along Nat'l Airport	17	<1	<1	<1	<1	34	10	109
Below Nat'l Airport	96	24	<1	3	2	37	10	143
Naval Research Lab	96	3	<1	10	6	47	10	222
PEPCO; Alexandria, VA	220	3	<1	6	4	103	10	253
BP Loading Dock	20	4	<1	<1	<1	44	10	143
Woodrow Wilson Bridge	160	5	<1	8	6	55	69	293
Rosier Bluff, East Side	180	3	<1	6	4	45	20	230
Tidal Basin	1200	11	20	78	15	121	346	529
Washington Ship Channel	650	7	<1	27	15	148	178	475
Watts Branch Tidal	342	7	3	<1	16	29	68	182
Hickey Run Tidal	7	1	<1	<1	<1	30	10	61
Lower Beaverdam	480	7	<1	<1	62	48	96	415
Upper Rock Creek	26	2	<1	<1	<1	19	10	79
Lower Rock Creek	98	4	10	5	9	46	10	63

*[1] TPCB is the sum of 209 individual congeners. [2] TPAH is the sum of 15 individual aromatic hydrocarbons. [3] DDT and DDE are the sum of both o+p and p+p forms. [4] CHL is the sum of α and Γ chlordane. [5] Cu, Pb, Zn are the strong (HCl) acid digestible fraction of the sediment.

Table 1-2. Concentrations of selected trace metals in sediments from the Anacostia and Potomac rivers*.

Location	Cd	Cr	Cu	Pb	Zn	Reference
Anacostia River, near Washington Navy Yard	NR	120-150	103-207	179-351	452-587	ICPRB, 1991
"" "" "" ""	0.4-1.3	16-26	26-29	69-131	100-172	RG&H, 1984
"" "" "" ""	0.6-1.8	40-80	15-45	50-150	200	Harrison, 1984
Westside Potomac River, near National Airport	NR	55-89	34-44	<10-29	109-180	ICPRB, 1991
Eastside Potomac River, opposite airport	0.1-0.2	8.2-11	9.4-13	16-20	52-70	RG&H, 1984
Potomac River, near National Airport	0.4-0.8	25-170	25-30	30-40	180	Harrison, 1984
Potomac River, near Fletcher's Boathouse	NR	87	40	29	181	ICPRB, 1991
"" "" "" ""	<0.1	30-40	30	30-50	200	Pheiffer, 1972
Anacostia River, east of Haines Point	NR	140	92	107	396	ICPRB, 1991
"" "" ""	0.2-0.3	10-11	13-15	19-37	62-79	RG&H, 1984
"" "" ""	0.5-2.2	18-35	31-64	53-194	149-518	COE, 1980
	<0.1-0.6	60-70	30	50-60	300-900	Pheiffer, 1972
Washington Ship Channel	NR	140	148	178	475	ICPRB, 1991
"" ""	1.7	ND	89	162	530	Martin et al., 1981[1]
Smith Point, Potomac River	0.2	90	26	36	121	Goldberg, 1977
Smith Point, Potomac River (ID: MCB)	0.1-0.3	44-76	5-19	2-28	24-96	NOAA, 1991
Ragged Point, Potomac River (ID:PRRP)	0.7	76	4-42	6-42	50-76	NOAA, 1991
Swan Point, Potomac River (ID: PRSP)	0.5	6-36	7-24	35-70	6-320	NOAA, 1991

*All concentrations are in μg per gram dry weight sediment. [1] Average of the top 10 cm of the core. Note that the methods used for the extraction of metals from the sediments varied from study to study. NR - Not Reliable, see Chapter III.

estuary. These variations were related to changes in river discharge and tidal pumping which acted to redistribute sediments with seasonal changes in upstream inputs and particle type. Hugget and Bender (1980) reported that tidal variations affected the resuspension and transport of kepone in the tidal James River. Bopp et al. (1981) showed that during spring run-off and storm events, higher flows, and increased suspended matter transport PCB-contaminated sediments down the Hudson River and estuary. Whereas Sawhney et al. (1981) showed that PCBs were associated and transported with fine grain particles (<0.2 μm fraction), bedload transport of pollutants may be important in certain areas due to the types of coatings on the particles (i.e., Fe-Mn oxides or organic carbon) and the actual mass transported relative to the total transport (Olsen et al., 1982).

Seasonal changes in the total suspended particulate concentration in rivers can also increase the adsorption of certain trace metals and organics due to an increase in available solid surfaces for adsorption and partitioning. The degree of dissolved-particulate partitioning is dependent on many factors, including particle type (i.e., particulate phases such as organic carbon, Fe-Mn oxides, etc.), particle concentration, pH, dissolved organic carbon, and K_d (i.e., the partition coefficient, which is defined as the ratio of the concentration of an element on particles to the concentration dissolved in water). Additional processes that effect the distribution of organic compounds and trace metals in sediments are ion-exchange, precipitation, co-precipitation, complexation, and flocculation (Salomons and Forstner, 1985). Once a contaminant is adsorbed onto a particle it can then be transported out of the system, released back into the "dissolved" state upon dissolution of the specific phase in which the metal or compound is associated, or be permanently incorporated into bottom sediments (Olsen et al., 1982).

Direct dumping, urban runoff, atmospheric deposition, industrial and municipal discharges, as well as upstream runoff are some possible sources that contribute to the loadings of anthropogenic chemicals to riverine and coastal sediments. River runoff includes sources from chemical weathering and erosional processes as well as upstream anthropogenic sources. While direct dumping is difficult to assess, Olsenholler (1991) estimated that urban runoff represents a major source of pollutants to the Anacostia and Potomac Rivers. Low concentrations of U.S. EPA priority pollutants were detected in Washington area urban runoff (MWCOG, 1983). However, many of these metals and organics are particle-reactive and would accumulate in sediments. It should be noted that these data were derived from samples taken around the greater Washington area and not in the central District of Columbia. As such, they may not be totally representative of the Washington, D.C. urban environment.

Runoff from streets, including municipal and industrial land surfaces, is a source of many chemicals in urban area sediments. Street runoff (e.g., water and dust) includes substances from motor vehicle activity (e.g., fossil fuel combustion, tire and brake wear, and lubricants) as well as from atmospheric deposition. Urban runoff was shown to be a major source of petroleum hydrocarbons to riverine and coastal areas (Olsenholler, 1991; Brown et al., 1985; Hoffman et al., 1983; Eganhouse and Kaplan, 1981a,b). Sediments in an urban stormwater catchment basin reflected increasing levels of hydrocarbons over a 120 yr time period (Gavens et al., 1982). Concentrations differences between surface and bottom sediment sections showed a 1 to 3 fold increase in total PAHs and a 3 to 10 fold increase in aliphatic hydrocarbons.

Urban runoff loads for PAHs are higher in industrial and highway areas than in residential or commercial land uses (Hoffman et al., 1984). Estimates of urban loading of hydrocarbons for Narragansett Bay and the Los Angeles River drainage basin were calculated by Hoffman et al. (1983; 1984) and Eganhouse et al. (1981). Their estimates, based on land use and population, are very close: 0.97 (Hoffman et al., 1983; 1984) and 0.88 kg hydrocarbons/capita-yr (Eganhouse et al., 1981). Using the average of these two per capita loading rates and an estimated population in the greater Washington, D.C. area of 3.4×10^6, a mass flux of 3.1×10^6 kg of hydrocarbons per year from urban runoff is possibly introduced to the waters of the Potomac and Anacostia Rivers. This flux compares fairly well with 0.8×10^6 kg hydrocarbons/yr, derived from Olsenholler (1991) for the District of Columbia area. Despite the possible errors and uncertainty in calculating these fluxes, it is clear that urban runoff is a major source of hydrocarbons to the District of Columbia area.

Industrial and municipal discharges are also a major input of inorganic and organic contaminants to the sediments of the Potomac and Anacostia Rivers (Eganhouse and Kaplan, 1982; West and Hatcher, 1980; Helz et al., 1976; Burlingame et al., 1972). Chlorinated hydrocarbons as well as other pollutants are found in industrial and municipal discharges. The primary source of PCBs in sewage sludge is industrial effluents routed into treatment plants, where concentrations can range for 100 to 185000 ng PCB/g-dw sediment (West and Hatcher, 1980). The data presented by Eganhouse and Kaplan (1982) allow a rough estimate of the input of hydrocarbons via municipal treatment plants. Using an average per capita mass emission rate (4.9 g hydrocarbons/capita day) from municipal wastewater treatment plants in southern California (Eganhouse and Kaplan, 1982) and an estimated population in the greater Washington D.C. area of 3.4×10^6, a mass flux of 6.1×10^9 kg hydrocarbons/yr is possibly introduced to the waters of the Potomac and Anacostia rivers. This flux is approximately 30 times higher than the flux from urban runoff calculations. While there are many caveats and assumptions in applying these estimates to the District of Columbia, these calculations indicate that both municipal wastewater treatment plants and urban runoff are a major source of organics and metals to riverine and coastal environments.

Biological Effects of Sediment Contamination

Many anthropogenic chemicals in sediments negatively affect organisms living on or in sediments. While chemical analyses determine the concentration of contaminants in sediments, the biological response (i.e., bioavailability, bioaccumulation, and toxicity) to sediment-borne contaminants is difficult to predict (Hale and Huggett, 1988; Riedal and Sanders, 1988). The biological response to a contaminated sediments can range from subcellular effects (e.g., chromosomal alterations) to modifications in the benthic community structure (e.g., diversity and abundance) (Scott, 1989).

Effects of contaminated sediments are currently measured by quantitative laboratory toxicity tests. By comparing the response of standardized test organisms exposed to contaminated sediments and control sediments, a measure of the degree of contamination is obtained. A variety of organisms including crustaceans, insect larvae, and bacteria are currently employed in sediment toxicity tests. Critical responses, by which toxicity is measured, include mortality, growth, and reproductive measures (e.g., fecundity and time to reproduction) (Scott, 1989; see Swartz et al., 1989 for additional references.)

Organisms exposed to sediments with higher than background concentrations of inorganic or organic chemicals can accumulate these materials from water (i.e., pore waters) or particle ingestion. Active uptake of certain metals which are important for some enzyme systems also occurs. The uptake and subsequent toxicity of a metal is a function of speciation, or chemical form of the metal, and the partitioning on various sediment phases (Sunda et al. 1978; 1990; Tessier et al., 1979; 1984; Luoma, 1983). Other factors that affect the bioavailability of trace metals include organic and inorganic complexation, pH, and in estuarine systems, ionic strength (Riedal and Sanders, 1991). In this regard, different species and life stages can accumulate metals and organics to vary degrees. Many organic compounds and organo-metallic compounds accumulate in the tissue of an organism due to the compounds lipophilic nature. Certain organisms can detoxify metals by changing the speciation and complexation of the metal once accumulated, or by the accumulation of other trace metals (Chau and Wong, 1978; Hallas et al., 1982). Metals like Hg, As, selenium (Se), tin (Sn), and possibly Pb are methylated as a mechanism for detoxification (Chau and Wong, 1978). However, detoxification of a substance by certain organisms, mainly bacteria, can produce products that are either more or less toxic to other organisms (Woods, 1974).

Recently, Di Toro et al. (1989) and others have shown that, regardless of the actual exposure mechanism, toxicity of contaminants compounds to benthic organisms is related more to pore water concentrations than whole sediment concentrations. They have shown that the controlling factors governing the concentration of the more nonpolar organics in the porewaters are particle concentration, amount and type of organic carbon on the sediment particles, sediment concentration of the compound, and the degree of hydrophobicity of the compound (i.e., octanol-water partition coefficient; K_{ow}). Pavlou (1987) and Di Toro et al. (1989; 1991) developed a model to determine the porewater concentration of nonpolar organics using reversible-sorption equilibrium partitioning. For a given nonpolar organic compound with a known K_{ow}, the organic carbon (OC) normalized sediment concentration (e.g., ng of chemical/g OC) is proportional to the porewater concentration. This approach assumes that the predominant sorption phase is OC and that the concentration of OC $>0.2\%$. Comparing these calculated porewater concentrations against water quality criteria is an approach used by the U.S. EPA for the development of national sediment quality criteria (Di Toro et al., 1989; 1991).

The bioavailability and toxicity of sedimentary concentrations of trace metals is also related to porewater concentrations, but unlike non-polar organic compounds, depends on other factors in addition to partitioning between the dissolved phase and particulate organic carbon (Di Toro et al., 1989). Since solubility equilibrium with pure solids is unlikely for trace metals in oxic sediments, adsorption by various solid surfaces is an important mechanism controlling the concentration and speciation of trace metals (Schindler, 1975; Jenne and Zachara, 1987). Major phases that control the porewater concentrations and bioavailability of trace metals are iron and manganese oxides, particulate organic carbon, and sulfur phases such as iron monosulfides (FeS; Jenne, 1968; Lion et al., 1982; Luoma, 1983; Tessier et al., 1985; Jean and Bancroft, 1986; Di Toro et al., 1990). Many models describe adsorption and partitioning of trace metals in sedimentary environments (Oakley et al., 1981; Balistrieri and Murray, 1983; Benjamin and Leckie, 1981; Di Toro et al., 1989). These models indicate that, because of the different geochemical characteristics in each environment (Tessier et al., 1985), the relative importance of various phases in controlling trace metal concentrations in porewaters should be determined. While iron and manganese oxides and organic matter phases may control the adsorption behavior of trace metals in oxic environments, sulfide precipitation, and complexation may be the controlling factors in reducing (i.e., anoxic) environments (see Goldhaber and Kaplan, 1975 and Morse et al., 1987 for reviews on sulfur geochemistry). Works by Davis-Colley et al. (1985), Jean and Bancroft (1986), Boulegue et al. (1983), and Emerson et al. (1983) show that certain trace metal complexes or precipitate with the sulfide ligand. Iron, the dominant metal in most sediments, precipitates with sulfide (i.e., $Fe^{2+} + S^{2-} \longrightarrow FeS_{(s)}$), but in contaminated sediments, other metals, which form more insoluble solid phases with sulfide, like Zn^{2+} or Cd^{2+}, are sequestered by the sulfide, forming $CdS_{(s)}$ or $ZnS_{(s)}$. Adsorption onto already present $FeS_{(s)}$ phases is also possible (Jean and Bancroft, 1986; Stumm and Morgan, 1981). This sulfur phase is operationally defined as acid volatile sulfide (AVS) because it is the sulfide released by dilute acid (Cutter and Oatts, 1987; Cornwell and Morse, 1987). The metals released by this procedure are termed simultaneously extracted metals (SEM; Di Toro et al., 1989). Recently, Ankley et al. (1991) and Carlson et al. (1991) have shown that the bioavailability and toxicity of sedimentary Cd and nickel (Ni) in reducing sediments are related to the amount of these metals bound to the sulfide phase (i.e., SEM) relative to the amount of AVS. However, the usefulness of predicting sediment toxicity with AVS and SEM may be limited. AVS (and related SEM) are very labile phases that can be destroyed once a sediment is oxygenated. The degree to which a sediment is anoxic or oxic changes seasonally as a result of microbial activity, bioturbation, and storm activity. Once a reducing sediment is oxidized, other sediment phases (e.g., Fe/Mn oxides) would be more important than sulfide phases in controlling porewater concentrations of trace metals.

The present study investigates some of the chemical controls of biological toxicity of the sediments in the waters around the District of Columbia. Concentrations of acid volatile sulfur (AVS) along with dilute acid-extractable metals were determined, along with the amount of porewater ammonia ($NH_4^+ + NH_3$). These chemicals could have a major impact on the biological health of the sediments.

Chapter II. Study Area and Methods

General Study Area

The District of Columbia (DC) lies along the fall line at the boundary between the Atlantic Coastal Plain and the Piedmont Plateau and is at the head of navigation of the Potomac estuary (Figure 2-1). The western and northern sections of the DC area are part of the Piedmont which is underlain by deformed metasedimentary and metaigneous rocks of the late Precambrian or early Paleozoic ages. From the mid-section of the city to the south is the Coastal Plain which contains unmetamorphosed fluvial and marine sediments of Cretaceous through Miocene age (Reed and Obermeier, 1989).

Presently, there are three major rivers or streams in the DC area: the Potomac and Anacostia rivers, and Rock Creek, which drains into the Potomac River just south of Georgetown (Figure 2-1). Average yearly flows for the Potomac River at Chain Bridge (US GS Sta. 01646500), Anacostia River (US GS Sta. 01649500 and 01651000), and Rock Creek (US GS Sta. 01648000) are 1.03 X 10^{10}, 1.16 X 10^{8}, and 5.5 X 10^{7} m^3/yr, respectively. Even though the drainage areas of the Anacostia River (122 mi^2) and Rock Creek (62 mi^2) are small compared to the Potomac River at Chain Bridge (11,560 mi^2), both water bodies drain predominantly urban environments and therefore have large inputs of anthropogenic materials.

During the past 200 years, numerous land masses were created within DC because of sedimentation and dredging. These include land that formed the Tidal Basin, Washington Ship Channel and Kingman Lake areas (Williams, 1989). During the late 1800s, both the Tidal Basin and Washington Ship Channel dredging and land reclamation projects were completed. The Tidal Basin (surface area of 0.16 mi^2) is a semi-enclosed area in southwest DC with an average depth of approximately 2 m. The Tidal Basin receives inputs from the Potomac River via floodgates, storm sewers, atmospheric deposition, and direct runoff. The basin was intended as a tidal reservoir that would supply water to the Washington Ship Channel.

The Washington Ship Channel, located in the southeastern section of DC, is connected to the Tidal Basin in the north section via a flood gate and to the Anacostia River at the southern end. The center of this channel has been dredged in the past; currently bottom depths range from < 1 m to approximately 8 m. Bordering the Washington Ship Channel is West Potomac Park (Hains Point) on the western side and residential/commercial development on the eastern side. Inputs to the channel include water from the Tidal Basin (i.e., tidal inputs of water), storm sewers, direct runoff, and

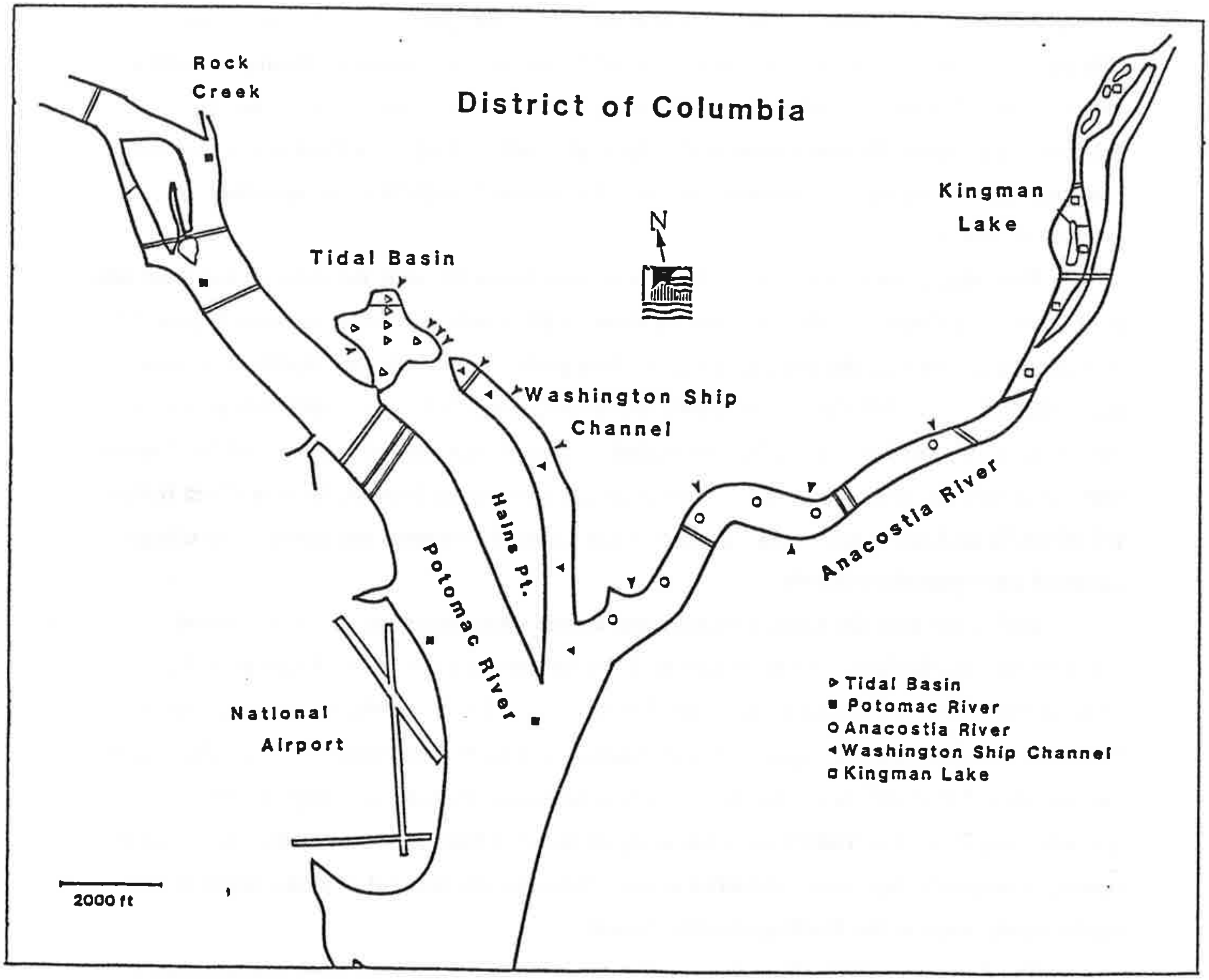

Figure 2-1. General study area showing the locations of the Tidal Basin, Washington Ship Channel, Kingman Lake, and the Potomac and Anacostia rivers. Arrows located around the shoreline of the Tidal Basin, Washington Ship Channel, and Anacostia River indicate approximate location of outfall samples.

atmospheric deposition.

Kingman Lake, a semi-enclosed area located on the Anacostia River in the northeast area of DC, was created in the early 1920s for recreation. Residential units border the area as well as R.F.K. stadium and related parking facilities. In the north section of the area are recreation facilities including a golf course. The depth of this waterbody varies from 3 m to less than 0.5 m in the north section. Water gates, located at both ends of the lake, allow water exchange with the Anacostia River.

Numerous storm sewers drain into the Tidal Basin and Washington Ship Channel (Table 2-1). There are no listed combined sewers in either the Tidal Basin or Washington Ship Channel. Six known storm sewers (1 major and 5 minor) drain into the Tidal Basin, the largest of which drains the Constitution Ave. and the Smithsonian Mall areas. In the Washington Ship Channel area, there are 9 storm sewers that empty into the channel. All of these storm sewers drain urban areas within DC. Other than restaurants and a seafood market, no major industrial facilities are located around the Tidal Basin and Washington Ship Channel. In the Washington Ship Channel there are numerous marinas and boat related activities such as refueling stations.

The flow of the Anacostia River is controlled by streamflow of the Northeast and Northwest Branches which join at Bladensburg (MD). The water in the lower Anacostia River, south of Bladensburg, has a long residence time (e.g., 35 days) due to the large volume to inflow ratio. Therefore, it resembles a lake more than a river (Scatena, 1987) and allows suspended sediments to settle within the tidal portion of the river. Sedimentation rates are reported to be on the average of 3.2 g/cm^2-yr or 1.9 cm/yr on a dry sediment basis (Scatena, 1987). While the center channel of the Anacostia River has been dredged in the past, depths outside the channel generally range from 0.5 - 5m.

The water and sediment quality of the Anacostia River is affected by numerous combined and storm water outfalls. There are approximately 30 storm and 6 combined sewers that can discharge into the lower Anacostia River (i.e., south of the Kingman Lake area to Greenleaf Point at the mouth of the Washington Ship Channel). These storm and combined sewers (Table 2-1) draining into the tidal Anacostia River cover a drainage area of approximately ≥ 5.4 mi^2, or ca. 22% of the drainage area of the Anacostia River within the District of Columbia. Approximately 54% of the total drainage area of the Anacostia Basin is urban (ICPRB, 1988).

There is a potential for historical contamination of the sediments in the Anacostia River due to past shipping and boating uses (e.g., Washington Navy Yard) in the area. While DC is currently not

Table 2-1. Storm and Combined Sewer Outfalls in the District of Columbia Study Area.

Location	Type	Outfall Size (ft)	Drainage Area (mi^2)
Anacostia River and Kingman Lake			
2nd St., south of V St., S.W.	SS	7.5 X 7.5	NA
Anacostia Park, Botanical Gardens, S.W.	CS	5.9 X 5.2	NA
West of South Capitol St., S.E.	SS	7.5	NA
West of South Capitol St., S.E.	SS	4.9 X 5.2	NA
S St., east of South Capitol St., S.E.	SS	3.0	0.042
1 St., south of P St., S.E.	SS	4.9	NA
2nd St., S.E.	CS	4.6	NA
Stickfoot Bridge, east of S. Capitol St.	SS	10.2 X 8.5	1.14
U.S. Navy Yard, S.E.	CS	2.6 X 3.6	NA
U.S. Navy Yard, S.E.	CS	4.6 X 4.3	NA
U.S. Navy Yard, S.E.	SS	18.0 X 13.1	NA
Park Rd. and Fairlawn Ave., S.E.	SS	3.6	NA
Anacostia Bridge, northside, S.E.	SS	4.9 X 12.1	NA
12th St., S.E.	SS	6.9	NA
14th St., S.E.	CS	5.9 X 5.9	NA
Ana. Freeway, 14th and 16th St., S.E.	SS	6.9 X 4.3	0.18
Ana. Freeway, 14th and 16th St., S.E.	SS	5.9 X 5.9	0.18
P St. and Kramer St., S.E.	SS	7.9 X 5.9	0.29
Helen Burroughs Ave., Watts Run, N.E.	SS	3.0	0.05
Young St., south of PA. Ave., S.E.	SS	3.6	0.05
Pennsylvania Ave., S.E.	SS	5.9	0.52
Burns St. and Kenilworth Ave., S.E.	SS	3.6	0.01
N St. and Kenilworth Ave., S.E.	SS	6.9 X 5.9	0.27
M St. and Kenilworth Ave., S.E.	SS	6.9 X 5.9	0.50
Northside East Capitol Bridge, N.E.	SS	3.9	0.05
Ely St. and Kenilworth Ave., S.E.	SS	7.9 X 5.9	0.61
C St. and Kenilworth Ave., S.E.	SS	7.5	0.25
East Capitol St., S.E.	SS	5.9 X 4.9	0.04
East Capitol St., S.E.	SS	21.0 X 18.3	1.03
Blain St., N.E.	SS	3.9 X 3.9	0.03
Clay St., N.E.	SS	9.8 X 6.9	0.76
Benning Rd., N.E.	SS	3.0	0.09
Benning Rd. and Kingman Lake, N.E.	SS	4.6	0.05

Table 2-1. (continued)

Location	Type	Outfall Size (ft)	Drainage Area (mi^2)
Tidal Basin			
Constitution Ave., S.W.	SS	5.9 X 4.6	NA
15th St., N.W.	SS	4 pipes, < 3.0	NA
Near Jefferson Memorial, southside	SS	2.0 X 5.9	NA
Washington Ship Channel			
Main Ave., 14th and 15th Sts., S.W.	SS	3.0	0.07
Main Ave. at 13th St., S.W.	SS	2.6 X 4.3	0.04
Main Ave., 12th and 14th Sts., S.W.	SS	6.6	0.11
Main Ave., 12th St. Expressway, S.W.	SS	3.9	0.01
Main Ave. at 9th St., S.W.	SS	3.0	0.17
Main Ave. at 7th Street, S.W.	SS	7.5	0.16
Main Ave., 6th and 7th Sts., S.W.	SS	8.9	0.06
6th and N St., S.W.	SS	5.9	0.01
P St. west of 4th St., S.W.	SS	9.8 X 6.9	0.11

SS - Storm Sewers; CS - Combined Sewers. Pipes generally > 3.0 ft. Single values are circular pipe diameters, while double values denote rectangular pipes.
NA - Not available

an industrialized area, there are facilities bordering the river that could adversely affect sediment quality. Most industrial facilities in the DC area have pretreatment programs that eventually discharge to Blue Plains Waste Water Treatment Plant (WWTP). Table 2-2 provides a partial listing of industrial facilities with have pretreatment programs that discharge to Blue Plains WWTP. Several federal facilities in DC have National Pollution Discharge Elimination System (NPDES) permits, and there are several other industries with minor permits.

Field Sampling Locations

Tidal Basin

Sediment sampling in the Tidal Basin (ID: TB) occurred on 17 June 1991. Six stations were sampled and 6 additional samples were taken at the mouth of specific outfalls entering the basin (ID: OTB) (i.e., bottom samples around the outfall). The specific location of each station was determined by line of sight (Table 2-3). Station locations are described in Table 2-4 and sample descriptions are provided in Table 2-5. At one station (TB-5), three separate samples of three grabs each were taken within a radius of approximately 5 m to assess small scale spatial variability. These samples were treated in the same fashion as other samples.

In conjunction with the sediment sampling, two samples were obtained from one separate sanitary sewer line that drains along the Tidal Basin area (ID: STB). Bottom "sediment" material in this pipe, draining the area around the Bureau of Engraving and Printing along 15th Street, N.W. (Table 2-6), was sampled on two different occasions (21 May and 4 June 1991) by the DC Department of Public Works Sewer Services personnel. This material should drain into the basin because it is in a separate sewer line. Samples were placed into either glass or plastic containers and immediately frozen in the field as described below. Sample descriptions are provided in Table 2-7. Weather conditions prior to sampling are presented in Table 2-8.

Potomac River, Washington Ship Channel and Anacostia River

The Potomac River (ID: PR), Washington Ship Channel (ID: WSC) and Anacostia River (ID: AR) were sampled on 18 June 1991. The specific location of each station was determined by either Loran or line of sight (Table 2-3). In the Potomac River, four stations were sampled from the mouth of Rock Creek to the confluence of the Anacostia and Potomac Rivers and the Washington Ship Channel. In the Washington Ship Channel, five stations were sampled along the eastern side of the channel, while six stations were sampled in the Anacostia River from between John Philip Sousa Bridge (Pennsylvania Ave., S.E.) and the Potomac River (Table 2-4). Samples in the Anacostia

Table 2-2. **Industries in the District of Columbia that Discharge to Blue Plains WWTP[a].**

Name	Type of Facility
AMTRACK	Railroad
Amoco Oil Co., 14th Street	Petroleum Bulk Station
Amoco Oil Co., Blair Road	Petroleum Bulk Station
Art Display Co.	Paper Products
Bureau of Engraving and Printing	Printing the Big Bucks
Capitol Chemical Industry, Inc.	Chemical (insecticides)
Capitol Printing Ink Co., Inc.	Chemical
Cheveron U.S.A., Inc.	Petroleum Bulk Station
David Taylor Research Laboratory	Research Laboratory
Exxon Co., Macarthur Blvd.	Petroleum Bulk Station
Exxon Co., Penn. Ave.	Petroleum Bulk Station
GSA Central Heating Plant	Electric, Gas and Sanitary
GSA West Heating Plant	Electric, Gas and Sanitary
Government Printing Office	Printer
IBM	Printers
Naval Research Laboratory	Research Laboratory
Palace Laundry Inc.	Industrial Laundry
Smithsonian Institution	Museum and Laboratory
Solid Waste Reduction Center	Incinerator
Sterling Textile Services	Personal Services
Steuart Petroleum Co.	Petroleum Bulk Station
U.S. Capitol Power Plant	Electric, Gas and Sanitary
Washington METRO Transit Authority	Transit
Washington Gas and Light Co.	Electric and Gas
Washington Plating Corporation	Metal Finishing
Washington Post Company	Printer
Washington Times Company	Printer
Washington-Dulles Airport	Airport
Washington Engraving and Plating	Electroplating

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[a] These facilities have pretreatment programs that discharge to Blue Plains Wastewater Treatment Plant. There may be other discharges to sanitary and storm run-off sewers.

Table 2-3. Locations of River Sediment Samples*.

Sta. ID.	Latitude (N)	Longitude (W)
Tidal Basin		
TB-1	38 53’ 15"	77 02’ 19"
TB-1.5	38 53’ 12"	77 02’ 19"
TB-2	38 53’ 08"	77 02’ 21"
TB-3	38 52’ 52"	77 02’ 21"
TB-4	38 53’ 08"	77 02’ 33"
TB-5A	38 53’ 03"	77 02’ 21"
TB-6	38 53’ 03"	77 02’ 07"
Potomac River		
PR-1	77 03’ 26"	38 53" 55"
PR-2	77 03’ 27"	38 53" 17"
PR-3	77 02’ 03"	38 51" 34"
PR-4A	77 02’ 17"	38 51" 11"
Washington Ship Channel		
WSC-1	38 52’ 55"	77 01’ 52"
WSC-2	38 52’ 47"	77 01’ 41"
WSC-3	38 52’ 27"	77 01’ 20"
WSC-5	38 52’ 07"	77 01’ 09"
WSC-6	38 51’ 34"	77 01’ 08"
Anacostia River		
AR-1	38 52’ 35"	76 58’ 51"
AR-2	38 52’ 15"	76 59’ 49"
AR-3	38 52’ 18"	76 59’ 33"
AR-4	38 52’ 13"	77 00’ 20"
AR-5A	38 51’ 52"	77 00’ 35"
AR-6	38 51’ 41"	77 00’ 52"
Kingman Lake		
KL-1	38 54’ 14"	76 57’ 48"
KL-2	38 53’ 46"	76 57’ 57"
KL-3	38 53’ 33"	76 57’ 50"
KL-4	38 53’ 17"	76 58’ 04"
KL-5	38 52’ 54"	76 58’ 13"

* Locations are given in degrees, minutes and seconds.

Table 2-4. Station Locations: General Descriptions

Sta. Loc./#	General Description of Area
Tidal Basin	
TB-1	Northside of Kutz Bridge.
TB-1.5	Southside of Kutz Bridge.
TB-2	Approximately 500 yds south of TB-1.
TB-3	Approximately 500 yds south of TB-2, near Jefferson Memorial.
TB-4	Westside of basin, in small cove.
TB-5	Middle of basin, sampled in triplicate.
TB-6	Near paddleboat area, east end of basin.
OTB-1-1	Pipe on northside of Kutz Bridge, directly in front of outfall.
OTB-1-2	Same as OTB-1-1 except on right side of outfall facing northward.
OTB-2	Outfall on east wall down from Jefferson Memorial.
OTB-3	Round outfall on south wall of paddleboat area.
OTB-4	Outfall closer to paddleboat area on south wall.
OTB-5	Behind paddleboat docks on south wall, near ramp.
Potomac River	
PR-1	Approx. 300' south of Rock Creek (station PMS-13).
PR-2	Southeast of Roosevelt Island, north of Memorial Bridge.
PR-3	Near northend of National Airport, south of VORTAC (station 8).
PR-4	Due south of Haines Pt. (ca. 900 yds), east of buoy C" 1" and north of lighted blk/red buoy, sampled in triplicate.
Washington Ship Channel	
WSC-1	In cove at northend of channel, upstream from Washington Marina, above bridges, directly off of Park Service buildings.
WSC-2	Eastside of channel, off of Flagship Restaurant.
WSC-3	Upstream of Police dock, on eastside of channel, just off of Spirit of Washington dock.
WSC-4	Not Sampled
WSC-5	Eastside of channel, near seawall in Ft. McNair by golf course, within seagrass bed.
WSC-6	Mouth of WSC and AR, northside of Anacostia River channel, near red/green buoy.
OWSC-1	Large outfall, downstream of Police docks, near Titanic statue.
OWSC-2	In boat slip area, down upstream of Phillips Seafood.
OWSC-3	Under Bridge, just downstream from Washington Marina, ca. 50ft from seawall.
Anacostia River	
AR-1	Downstream of Sousa Bridge, northside of river, downstream from large outfall.
AR-2	Downstream of 11 St. Bridge, near bend in river (station ANA-17) on northside.
AR-3	Within Navy Yard, downstream from USS Barry, northside of river.
AR-4	Downstream of Navy Yard, before Douglas Bridge, northside of river, near gravel plant.
AR-5	Downstream from Douglas Bridge, northside of river near bend, Buzzards Point (V St, SW).
AR-6	Northside of river, just off marina piers, upstream from Greenleaf Point.

Table 2-4 (continue)

Sta. Loc./#	General Description of Area
OAR-1	Large outfall, downstream of Sousa Bridge, northside of river, near wreck.
OAR-2	Upstream of Navy Yard, on northside of river, at bend in river.
OAR-3	Near DPW yard (Ost and Half st, SW), about 50ft downstream from outfall.
OAR-4	Large outfall, southside of river across from Navy Yard and USS Barry.
OAR-5	Not Sampled
OAR-6	Northside of river, at end of 2nd St., SW, near brown boathouse, right at large outfall.
Kingman Lake	
KL-1	Northend of lake, downstream from 2nd island, on shallow (1.5ft) mudflat.
KL-2	Downstream from Benning Road bridge, in north side of cove.
KL-3	Midway between footbridge and E. Capitol Street Bridge, mid-channel.
KL-4	Midway between E. Capitol Street Bridge and entrance to Kingman Lake.
KL-5	Mid-Channel Anacostia River, south of entrance to Kingman Lake.

Boldface indicates stations for sediment toxicity, benthic community, AVS and porewater ammonium analysis. Station IDs. starting with the prefix (O) indicate samples that were taken directly in front of an outfall, while stations with the prefix (S) indicate samples that were taken in a sewer.

Table 2-5. Sediments: General Descriptions

Sta. Loc./#	Characteristics of surficial sediments:
Tidal Basin	
TB-1	Mostly oxidized mud with thin black streaks below surface; plant material present; slight oil sheen once sediment was disturbed.
TB-1.5	Thick brown/black mud; plant material present; slight oil sheen.
TB-2	Top 1 cm brown (oxidized) and dark black below; no plant material or oil sheen.
TB-3	Slightly more sand than TB-1; some plant material.
TB-4	Top 1-2 cm brown mud and gray-black below.
TB-5	Top 1-2 cm brown mud, gray below; some plant material; midges present.
TB-6	Very fine mud; oxidized surface.
OTB-1-1	Many dead snails found in front of outfall (sample taken).
OTB-1-2	Some fine material; snails and plant material also present.
OTB-2	Rubbish present; sandy with some fine grain material.
OTB-3	Rubbish present, microfiche material, leaves; some fine grain material.
OTB-4	Sand-sized material with some mud, red chips present.
OTB-5	Leaf material present; sandy with some mud; oil sheen present.
Potomac River	
PR-1	Brown mud with some black streaks below, mica chips present; no strong odor; sheen present on water after sediment is disturbed.
PR-2	Top 1 cm was fluid brown mud; olive/gray below, bubbles present (methane?), worms and boxed *Corbicula* present.
PR-3	Brown mud, oxic layer, *Corbicula* present both alive and dead, fairly compact.
PR-4	Fine grain material; plant material, clams and leaf material present; gas bubbles present, compacted sediment.
Washington Ship Channel	
WSC-1	Consolidated fine grain material; dark green/brown at surface with some black streaks; gas bubbles present.
WSC-2	Green mud above reducing (black) layer, 3rd grab had some gas bubbles and was more consolidated.
WSC-3	Olive green mud with black below, slight sulfide smell.
WSC-4	Not Sampled
WSC-5	Brown fine grain material with live plant material present; some black streaks below surface; snails and clams present.
WSC-6	Black streaks in mud; some gas bubbles present; leaf debris and some worms peeking through.
OWSC-1	Several attempts at a grab; 1 muddy grab taken, brown with some black streaks, oil sheen present.
OWSC-2	Leaves right at outfall; conspicuous odor present, plenty of debris; coarse grain material.
OWSC-3	Dark sandy material; some fine grain with definite oil sheen; plenty of debris; dead *Corbicula* present.

Table 2-5 (continue)

Sta. Loc./#	Characteristics of surficial sediments:
Anacostia River	
AR-1	Brown mud; oil sheen present; plant material; amphipod present on 3rd grab.
AR-2	No description taken, heavy rain.
AR-3	Brown mud; gas bubbles present; oil sheen and leaf material present.
AR-4	Consolidated brown mud with black streaks present; oil sheen on 3rd grab.
AR-5	Brown mud with some black streaks; gas bubbles present; grab 5C had more brown-colored sediment present.
AR-6	Brown-colored fluid mud with black streaks below surface; gas bubbles in sediment; plant material and a live clam was present.
OAR-1	Brown-colored fine grain material.
OAR-2	Fine grain material present; brown-colored, man-made debris present.
OAR-3	Dark coarse grain material; definite oil sheen on sample, no life.
OAR-4	Brown fine grain mud; black streaks below surface; trace of oil sheen.
OAR-5	Not Sampled
OAR-6	Brown-colored coarse grain material with some fines; plenty of debris; oil sheen; coal and slag chips present.
Kingman Lake	
KL-1	Semi-consolidated mud with rust color on surface; some plant material present.
KL-2	Grey/brown mud; gas bubbles and plant material present.
KL-3	Semi-consolidated brown mud; black streaks below surface; gas bubbles present; 3rd grab had oligiochaete present.
KL-4	More consolidated than KL-5, all brown sediment with some gas bubbles.
KL-5	Brown fine grain mud with some lighter brown material; some plant type material; oil sheen on mud.

Table 2-6. Station Locations for Sewer Samples.

Date	ID	General Description of Area
Tidal Basin		
21 May	STB-2-1	Separate-Sanitary Sewer (< 3 ft), at intersection of 15th St. and D St., N.W., on northside of intersection (E-3-SW).
4 June	STB-2-2	Same as above
Washington Ship Channel		
21 May	SWSC-2	Storm sewer (2 ft), on Ramp F and Maine Ave., S.W., west of piers (D-4-SW).
Anacostia River		
21 May	SAR-2	Combined sewer (2.5 ft X 3.7 ft), at entrance to Navy Yard on Maine Ave. and 9th St., S.E. (C-5 and 6-SE).
17 July	SAR-3	Combined sewer (6 ft X 5.2 ft), in Anacostia Park near Park Road (CD-7/8 and 9/10-SE).
17 July	SAR-5	Storm sewer (5 ft), downstream from Navy Yard; O and 1 St., S.E. (A-6 and 7-SE).
21 May	SAR-6	Storm sewer (7.5 ft X 0.5 ft), at Buzzards Point; V St. and 2nd St., S.W. (A-10 and 9-SW).

( ) - indicates either the size of the pipe or map reference location provided by DC Department of Public Works.

Table 2-7. Sewer Samples: General Descriptions.

Sta. ID.	General Characteristics of Sample
Tidal Basin	
STB-2-1	Green with some black colored sand and fine grain material, no odor.
STB-2-2	Green and black with some brown colored sand and fine grain material, white paper within sample, no distinct odor.
Washington Ship Channel	
SWSC-2	Sand-sized with some fine grain material, black and grey colored particles, no distinct odor. Large amounts of debris in line.
Anacostia River	
SAR-2	Coarse with some fine grain material, fecal material, black and grey with some light-colored material, very distinct odor.
SAR-3	Approximately 6 inches of water above bottom material, mainly coarse grain material with some fine grains, black and tan colored sand, no distinct odor.
SAR-5	Black and grey coarse-grained material, distinct odor.
SAR-6	Black and grey sand-sized material with small amounts of fines, no distinct odor.

Table 2-8. Weather Conditions Prior to Sampling Combined or Storm Sewers.

Sampling Dates	Weather of the Preceding Week
21 May 1991	Hot and humid then rain on the 17th (0.3 in), followed by cool and clear.
4 June 1991	Rain (0.4 in) on 30 May then hot and muggy with rain on 1 June (0.2 in.) and 3 June (ca. 0.2 in.).
17 July 1991	Sunny, hot and humid with rain showers on 16 July (ca. <0.1 in.).

River were taken on the northern side of the river outside the main center channel. In both the Potomac and Anacostia Rivers, one station (PR-4 and AR-5, respectively) was sampled in triplicate (i.e., 3 separate samples of 3 grabs each within 5 m of each other). Outfall samples were obtained in both the Anacostia River (ID: OAR) and Washington Ship Channel (ID: OWSC; Tables 2-4 and 1-4).

More than 10 storm sewers empty into the Washington Ship Channel (Table 2-1). These storm sewers drain an area from approximately Independence Avenue (Smithsonian Institution), 13th Street, and 4th Street in southwest Washington, D.C.. As part of this study, three outfalls, just off the end of three sewers, were sampled plus one sample from within a storm sewer (Table 2-5). Additionally, one sample (ID: OWSC-R1) was obtained on 16 September 1991 in the northern section of the channel, within the Washington Marina area. This sample was taken from the dock, just in front of a storm sewer outfall that drains along Maine Avenue and 14th Street, S.W.. Although this sample was taken four months after the other samples, it is presented along with the other outfall samples of the Washington Ship Channel.

As in the Tidal Basin, storm or combined sewer lines were sampled in the Washington Ship Channel and Anacostia River. In the Washington Ship Channel, one sample (ID: SWSC) was obtained (21 May 1991) from a storm sewer that drains along Maine Ave., S.W. (Table 2-6). In the Anacostia River, 4 (1 combined, 3 storm) sewer samples (ID: SAR) were obtained from various locations along the river. Samples were obtained on either 21 May or 17 July 1991 (Table 2-6). Sample descriptions are provided in Table 2-7. No samples were obtained from sewers that drain into the Potomac River. All stations in the Potomac and Anacostia rivers, Tidal Basin and Washington Ship Channel are influenced by semi-diurnal tides of up to 3 ft in amplitude. Weather conditions in the week preceding storm and combined sewer sampling are presented in Table 2-8.

Kingman Lake

Sediment samples from the Kingman Lake area (ID: KL) were sampled on 19 June 1991. A total of 5 sediment samples were obtained, 4 in the lake proper and 1 in the Anacostia River, south of the entrance to Kingman Lake (Tables 2-3 and 2-4; Figure 2-1). Sample descriptions are provided in Table 2-5. No storm or combined sewer samples or outfall samples were obtained in Kingman Lake and all stations are influenced by tides.

Field Sampling Procedures

The procedures for sediment sampling were similar for all stations (see QA/QC documentation for a full description). A Hydrolab Surveyor II was used to collect dissolved oxygen, temperature, conductivity, pH, and water depth just above the sediment surface (Table 2-9). The meter was calibrated before and after each day of the sampling program. Sediments were obtained with a stainless steel petite-Ponar grab sampler (0.06 m^2) that was acetone rinsed at the beginning of each day. The sampler was inspected for possible cross-contamination (i.e., sediment from previous station) and rinsed with ambient water at each station. Next, the sampler was carefully lowered to the sediment bottom and then lifted about 0.5 m above the bottom. At this point the sampler was released to free-fall to the sediment surface, triggered and raised to the boat. Sample acceptance procedures followed U.S. EPA guidelines (US EPA, 1987; EAD, 1990; ASTM, 1990). A visual description (i.e., color of the sediment, presence or absence of living or dead organisms, bicycle helmets, bicyclist, and other unusual artifacts) was made for all accepted samples. The top 2 to 3 cm of sediment not in contact with the sides of the sampler were removed and placed into a pre-cleaned pyrex-glass bowl. This process was repeated until sufficient sediment was obtained.

Sediments were mixed until homogeneous in both texture and color with a pre-cleaned stainless steel spoon. Aliquots of sediment were placed into separate containers for chemical and toxicity testing. Samples for organic analysis were placed in pre-baked (450°C for 12 hours) glass mason jars and capped with pre-baked aluminum foil lined caps. Grain size and trace metals samples were placed into Zip-loc plastic bags. Samples for acid-volatile sulfur (AVS) and porewater ammonium were placed into separate 50 ml plastic centrifuge tubes. Sediment samples for toxicity testing were placed into pre-cleaned glass jars and sealed with Teflon-lined caps. AVS samples were quick frozen on board using dry ice (-78°C), whereas porewater ammonium samples were kept at 4°C until processing within the same day (see below). All other samples were placed in coolers at approximately 4°C while in the field. Once on shore, sediment samples for organic and metal analyses were placed in a freezer at -20°C, while samples for toxicity testing and grain size analysis were kept at 4°C.

Organic and trace metal clean-techniques met or exceeded the criteria of both U.S. EPA (U.S. EPA, 1987) and NOAA (Status and Trends Studies). All materials coming in contact with the samples were either glass or metal that were cleaned of any contaminants prior to use. All glass bowls were soaked in 0.5M HCl overnight, rinsed with distilled deionized water (DDW) and solvent rinsed with methanol, hexane, then dichloromethane (Burrick and Jackson, Inc.) and allowed to air dry in a hood. All metal utensils were washed similarly but without using the dilute acid rinse. During the sampling program, caution was used to avoid contamination from engine fuel or exhausts. Exhaust samples were taken to help asses sample contamination from this source.

Table 2-9. Bottom water characteristics of the various study areas.

Sta. ID.	Depth (ft)	DO (mg O_2/L)	Temperature (°C)	pH
Tidal Basin				
TB-1	5.0	9.2	27.5	8.5
TB-1.5	3.0	7.9	27.4	8.2
TB-2	6.0	9.2	27.5	8.4
TB-3	5.0	9.8	27.4	8.4
TB-4	8.0	9.0	27.4	8.3
TB-5A	7.0	11.2	27.9	8.5
TB-6	8.0	8.8	27.5	8.3
Potomac River				
PR-1	16.0	3.7	26.6	7.3
PR-2	7.0	7.0	27.7	8.0
PR-3	9.0	9.0	27.2	8.1
PR-4A	11.0	7.9	27.0	7.7
Washington Ship Channel				
WSC-1	26.0	6.9	26.7	7.9
WSC-2	29.0	4.0	25.9	7.5
WSC-3	27.0	2.3	25.3	7.2
WSC-5	4.6	8.5	27.1	7.9
WSC-6	12.1	7.7	26.9	7.7
Anacostia River				
AR-1	11.8	6.0	27.0	7.2
AR-2	18.7	6.3	26.5	7.2
AR-3	24.2	6.7	26.9	7.4
AR-4	22.3	7.2	26.7	7.5
AR-5A	24.2	7.5	26.8	7.6
AR-6	26.9	7.5	26.7	7.6
Kingman Lake				
KL-1	2.0	1.3	22.8	6.4
KL-2	7.0	0.5	22.4	6.5
KL-3	3.0	0.7	23.4	6.6
KL-4	3.0	0.6	23.1	6.7
KL-5	9.0	2.6	22.1	6.9

Triplicate grab samples, not pooled, were taken for benthic macro-invertebrate community analysis. Each grab was washed through a U.S. #35 (500 μm) plastic sieve, preserved with 95% (v/v) denatured ethanol. Samples were returned to the laboratory for counting and identification.

Analytical Methods

Biological Analyses

Sediment Toxicity. Fifteen sites were sampled (Table 2-4) for toxicity testing. Reference sediment, chosen to match experimental sediments in physico-chemical properties (i.e., grain size and organic matter), was collected from Corsica River (MD). This sediment is free of chemical contamination (Schlekat et al., 1992). Reference sediment provides a site-specific basis of comparison to individual test sediments (ASTM, 1990; EAD, 1990; Ingersoll and Nelson, 1990). Corsica River sediment also fulfilled criteria for a control sediment that had no significant toxic effect (i.e., sediment known to be non-toxic to and within the geochemical requirements of the test species), and is used to provide a measure of test acceptability. Because the ambient salinity at the Corsica River collection site was 6 ppt, interstitial salinity was adjusted by wet sieving (500 μm sieve) in spring water prior to test initiation (ASTM, 1990; Ingersoll and Nelson, 1990).

Amphipod sediment toxicity tests were conducted according to protocols developed under the guidance of the American Society for Testing and Materials (ASTM, 1990; Ingersoll and Nelson, 1990). The test organism selected for this study was the freshwater amphipod Hyalella azteca. This organism is sensitive to sediment-borne contaminants, and is easily cultured and maintained under laboratory conditions. Additionally, H. azteca is used extensively to assess effects of sediment contaminants on survival, growth, and reproduction (Nebeker et al., 1984; Ingersoll and Nelson, 1990). A 28-day, partial life cycle test with two test endpoints, amphipod survival and growth (as measured by carapace length), was employed.

Experimental chambers consisted of a quart glass jar containing water and sediment in a ratio of 4:1 (v:v). Aeration at a rate of approximately two bubbles per second was provided by a 1-ml pipette. Test water was spring water from Chattolanee Spring, Baltimore County, MD (ave. pH=7.7; hardness=110 ppm as $CaCO_3$; alkalinity=100 ppm as $CaCO_3$). Sediments and water were allowed to equilibrate for 24-h before the random addition of 20 laboratory cultured juvenile H. azteca per replicate. There were 4 replicates per treatment. A discrete size class of H. azteca was obtained by selecting amphipods that were retained on a 250 μm sieve after passing through a 500 μm sieve. Water temperature was maintained at 20°C (± 2°C), and the photoperiod was 16:8 light:dark.

Amphipods were fed a 1:1 mixture of Tetra-Min and Tetra-Conditioning Food (w:w) three times per week. Each replicate received 6 mg per feeding period for the first 10 days and 12 mg per feeding period thereafter. One third of the overlying water was changed twice weekly. Water quality parameters (dissolved oxygen concentration, pH, temperature, and conductivity) were measured daily in one replicate per treatment on a rotating basis so that measurements were taken in each replicate at least 6 times over the course of the exposure period. On the first and last day of the experiment, water quality parameters were measured in all experimental chambers, except that pH was measured in one replicate per treatment. Alkalinity and hardness were determined on days 0, 11, and 28 by measuring a composite sample of overlying water collected from all replicates of each treatment.

At the end of the experimental period, amphipods were retrieved in a five step method described by Ingersoll and Nelson (1990). Approximately 500 ml of overlying water was poured through a 270 μm sieve cup; the remaining water was swirled to suspend the upper 1 cm of sediment. This suspension was poured through a 500 μm sieve. All contents remaining on the sieves were rinsed into sorting pans where adults were recorded as alive or dead. Those individuals exhibiting no movement of limbs or antennae after gentle prodding with a blunt probe were considered dead. Missing organisms were presumed dead. Surviving animals were preserved in 95% denatured ethanol for subsequent length measurements. An ocular micrometer was used to measure adult body length from the base of the first antenna to the base of the third pleon segment along the dorsal surface.

Prior to comparison of means, survival and length data were analyzed for homogeneity of variances using Bartlett's test. The survival data set was found to be heteroscedastic (i.e., variance among samples was not equal), and was transformed using the arcsine-square root. Survival data was analyzed by analysis of variance (ANOVA), followed by contrasts between individual experimental treatments and the control treatment, using the SYSTAT statistical software package (Wilkinson 1989). The length data set met the assumptions for ANOVA, and was not transformed. A nested ANOVA was performed on amphipod length data with replicates nested within treatments, followed by contrasts between individual experimental treatments that did not exhibit significant mortality and the control treatment, using the SAS statistical software package (SAS 1985). In order to maintain a comparison-wise $\propto = 0.05$, significance of individual contrasts was determined by the sequential Bonferroni technique as described by Rice (1989).

Benthic Community Analysis. Triplicate petite ponar grab samples (0.06 m^2, not pooled) were taken at the same stations as for sediment toxicity. Each grab was washed in a U.S. #35 (500 μm), preserved with 95% denatured ethanol, and returned to the laboratory for processing.

Each sample was stained with Rose Bengal, a vital stain which dyes living material red. Large items (e.g., leaves, sticks, and plastics) were rinsed and removed prior to sorting. Sample aliquots were placed in a white enamel pan and organisms were removed by hand under illuminated magnifiers until the entire sample was sorted. The remaining material (i.e., sortate) was saved for subsequent quality assurance checks.

Taxonomic identifications were made using standard invertebrate keys (Merritt and Cummins, 1984; Pennak, 1989; Usinger, 1963; Wiederhol, 1983; 1986; Bousfield, 1973; U.S.G.S., 1982). Organisms were identified under dissecting microscopes, except for Chironomidae (non-biting midge larvae), which were slide mounted and identified with a compound microscope. Organisms were identified to genus if possible, except for Annelids (segmented worms), which were separated according to class. Unidentifiable immature or damaged animals were taken to the lowest possible taxonomic level. Only anterior fragments of Oligochaetes were counted. Samples containing more than 100 Chironomidae were sub-sampled (at 20% of the total count) and counts of each identified taxon were extrapolated to the total.

Identifications were made by a trained aquatic invertebrate taxonomists. Taxa lists were compared to those from other benthic surveys conducted at similar locations and voucher specimens were retained for future reference. Randomly chosen samples were resorted by someone other than the original sorter. None of the resorted samples were different (i.e., within 10%) of the original count. Therefore, all samples sorting was considered acceptable.

Total abundance, taxa richness, evenness, and the relative contribution of each major taxonomic group were determined for each station. Benthic assemblages (using numbers of individuals per taxon per grab) were grouped by clustering strategy developed by Nemec (1988, 1991) that employs the Bray-Curtis similarity coefficient and an unweighted average linkage scheme. This method incorporates the bootstrap computation, which, through a series of randomly simulated data matrix comparisons, tests the hypothesis that two clusters are sufficiently similar to represent a single community. Those cluster linkages with p values < 0.05 were considered significantly different. Qualitative comparisons among sediment chemical concentrations, sediment toxicity, and benthic assemblages were made within each discrete cluster.

Ranking Analysis. Site assessment results produced a variable X station matrix of individual variables which were used in the ranking system. In this study individual variables included: 1) bulk sedimentary trace metals concentrations of Cd, Cr, Cu, Hg, Pb, and Zn; 2) organic carbon normalized concentrations of total PAHs, total PCBs, and pesticides (sum of DDT+DDE+DDD and chlordanes); 3) amphipod mortality; 4) amphipod length; 5) benthic species richness; and 6) proportion of oligochaetes.

The values for each individual variable for all stations were scaled between 1 and 100 (e.g., the lowest concentration of chemical X is 1 and the highest 100), with all other concentrations appropriately scaled between 1 and 100. This scaling allowed the relative magnitude of differences between measurements to be retained and resulted in a consistent and compatible numerical scaling for all variables. In order to avoid disproportionate weighing of chemical data (i.e., 6 trace metal and 3 organic compounds values versus 2 variables each for sediment toxicity and benthic community analysis), the individual chemical variables were collapsed to 2 generic variables - one for metals and one for organic compounds. Generic variables were calculated by summing the scaled individual variables, dividing by the number of variables (6 for metals and 3 for organics) and rescaling the mean values for each station.

The 6 scaled values (i.e., 2 variables for each component of the Triad) were summed for each station. An overall value was obtained for each station and this value was ranked consecutively from 1 to 15, from most to least degraded. The overall results was a rank of stations and their relative degree of degradation.

Sediment Chemical Analyses

Organics (PAH, PCB, and Pesticides).The extraction method was adapted from MacLeod et al. (1985). Approximately 10 grams of freeze-dried sediment was used for the analysis. The sample was soxhlet extracted with methylene chloride. The solvent was concentrated to approximately 20 ml in a flat-bottomed flask equipped with a three-ball Snyder column condenser. The extract was then transferred to Kuderna-Danish tubes, which were heated in a water bath (60°C) to concentrate the extract to a final volume of 2 ml. During concentration of the solvent, dichloromethane was exchanged for hexane.

The extracts were fractionated by alumina:silica (80-100 mesh) open column chromatography. Silica gel was activated at 170°C for 12 hours and partially deactivated with 3% (v/w) distilled water. Twenty grams of silica gel were slurry packed in dichloromethane over ten grams of alumina. Alumina was activated at 400°C for four hours and partially deactivated with 1% distilled water (v/w). The dichloromethane was replaced with pentane by elution, and the extract was applied to the top of the column. The extract was sequentially eluted from the column with 50 ml of pentane (aliphatic fraction) and 200 ml of 1:1 pentane-dichloromethane (aromatic-pesticide fraction). The fractions were then concentrated to 1 ml using Kuderna-Danish tubes heated in a water bath at 60°C.

Quality assurance for each set of ten samples included a procedural blank and sampled spiked with all calibrated analytes (matrix spike) which were carried through the entire analytical scheme. In addition a laboratory reference material consisting of solvent spiked with an oil was used to check the quality control of each sample set. All internal standards (surrogates) were added to the samples prior to extraction and were used for quantification.

Aliphatic hydrocarbons (n-C_{13} to n-C_{34} including pristane and phytane) were separated by gas chromatography in the split-less mode using a flame ionization detector (FID). The output from the detector was collected by an automated HP-LAS 3357 data acquisition software package. A 30-m x 0.32-mm I.D. fused silica column with DB-5 bonded phase (J&W or equivalent) was used, with the chromatographic conditions providing baseline resolution of the n-C_{17}/pristane and n-C_{18}/phytane peak pairs. The five calibration solutions were in the range of 1.25 to 50 μg/ml. The internal standards (surrogates) for the aliphatic hydrocarbon analysis were deuterated n-alkanes with 12, 20, 24 and 30 carbons, and were added at approximate 10x the method detection limit. Analytes amounts were calculated using the surrogate standards. To monitor the recovery of the aliphatic surrogates, the chromatography internal standard deuterated n-C_{16} were added just prior to GC-FID analysis.

Aromatic hydrocarbons were separated and quantified by gas chromatography-mass spectrometry (GC-MS) (HP5890-GC and HP5970-MSD). The samples were injected in the splitless mode onto a 0.25 mm x 30 m (0.32 μm film thickness) DB-5 fused silica capillary column (J&W Scientific Inc.) at an initial temperature of 60°C and temperature programmed at 12°C/min to 300°C and held at the final temperature for 6 minutes. The mass spectral data were acquired using selected ions for each of the PAH analytes. The GC-MS was calibrated and linearity determined by injection of a standard component mixture at five concentrations ranging from 0.01 ng/μl to 1 ng/μl. Sample component concentrations were calculated from the average response factor for each analyte. Analyte identifications were based on correct retention time of the quantitation ion (molecular ion) for the specific analyte and confirmed by the ratio of quantitation to confirmation ion.

A calibration check standard was run three times during the sample runs (beginning, middle and end), with no more than 6 hours between calibration checks. The calibration check was confirmed to maintain an average response factor within 10% for all analytes, with no one analyte greater than 25% of the known concentration. With each set of samples a laboratory reference sample (oil spiked solution) was analyzed to confirm GC-MS system performance. The internal standards (surrogates) for the PAH analysis were d_8-naphthalene, d_{10}—acenaphthene, d_{10}—phenanthrene, d_{12}-chrysene, and d_{12}—perylene, and were added at a concentration similar to that expected for the analytes of interest. To monitor the recovery of the PAH surrogates, chromatography internal standards d_{10}-fluorene and d_{12}—benzo(a)pyrene were added just prior to GC-MS analysis.

The pesticides and PCBs were separated by gas chromatography in the splitless mode using an electron capture detector (ECD). The output from the detector was collected by an automated HP-LAS 3357 data acquisition software package. A 30-m x 0.32-mm I.D. fused silica column with DB-5 bonded phase (J&W or equivalent) was used. Four calibration solutions containing the pesticides and the PCBs used for quantitation were used to generate a non-linear line fit, and the calibration standards were in the range of 5 to 200 ng/ml. A sample containing only PCBs was used to confirm the identification of each PCB congener. The internal standards (surrogates) for pesticide and PCB analysis were added prior to extraction and were DBOFB (dibromooctafluorobiphenyl), PCB-103 and PCB-198. To monitor the recovery of the pesticides and PCB surrogates, the chromatography internal standard TCMX (Tetrachloro-m-xylene) was added prior to GC-ECD analysis. The chromatographic conditions for the pesticide-PCB analysis were 100°C for 1 min, then 5°C/min till 140°C, hold for 1 min, then 1.5°C/min to 250°C, hold for 1 min, and then 10°C/min to 300°C and finally held for 5 min.

Glassware was cleaned by detergent washing (Micro cleaning solution) and rinsing with tap and distilled water. The glassware was then pre-heated in a muffle furnace at 400°C for at least 4 hrs. Solvent rinses of acetone followed by methylene chloride was substituted for the heating by the muffle furnace heating when determined to be appropriate. After drying and cooling, the glassware was wrapped in pre-heated Al foil and stored in a dust free environment. Blanks, matrix spikes and standard reference materials were extracted and run with each set of samples as appropriate. In Appendix I the raw data along with the QA/QC information is presented, for the QA/QC plan see Velinsky et al. (1991).

Inorganics (Total Metals and Dilute Acid Leachable Metals). The major analytical technique used was atomic absorption spectrophotometry (AAS), in flame mode for those elements in high enough concentration and using graphite furnace (GF-AAS) or cold vapor when necessary. Samples were digested in 50 ml closed all-teflon "bombs" (Savillex Co.) (Brooks et al., 1988). Accurately weighed sediment aliquots (ca. 200 mg) were digested at 130°C in a mixture of nitric, perchloric and hydrofluoric acids. A saturated boric acid solution was then added to complete dissolution of the sediment and the digest was brought to a known volume. Various dilutions were made on the clear digest solutions to bring them into the working range for AAS. Standard reference materials and blanks were digested and analyzed with every batch of samples (See Appendix II).

Because of its relative freedom from matrix interference and its high sample throughput, flame AAS was used whenever possible. However, only Fe, Mn and Zn were consistently in high enough concentrations to be determined by flame AAS. Most of the other elements (Cd, Cu, Ni, Pb) were determined by GF-AAS. The flame AAS work was conducted on a Perkin-Elmer Model 306 instrument, essentially following the manufacturer's recommendations. Working curves were constructed from commercial standards and resulting concentrations were verified by analyzing NSIT and other standard materials (NRCC) with every sample set.

A Perkin-Elmer Zeeman 3030, equipped with an HGA-600 furnace and AS-60 autosampler, was used for GF-AAS. Matrix modifiers and analytical conditions for the furnace and spectrophotometer were based on the manufacturer's recommendations, with modifications as appropriate to maximize sensitivity and minimize interferences. Standard reference materials and spiked samples were used to evaluate instrument performance and furnace conditions were changed when necessary. Based on 10 separate analyses of the reference materials over the course of the project, the accuracy and precision of the analyses are approximately ± 10 % for all metals.

Mercury was determined by cold vapor AAS on an aliquot of the same digest used to determine other trace elements. A "head space" sampling procedure was used in contrast to the more common "stripping" procedure. One ml of sample or standard (more if needed) was put into a 25-ml Erlenmeyer flask and the flask was closed with a rubber serum stopper. The flask was injected with 0.5 ml of a 10 percent $SnCl_2$ solution and shaken for 30 seconds to reduce Hg to the metal and allow it to transfer into the head space. A syringe needle connected to the mercury analyzer by a short piece of tygon tubing was next pushed through the serum stopper. Finally, a syringe needle connected to a water reservoir by tygon tubing was pushed through the serum stopper. Water was allowed to flow into the flask at a rate that filled it in about 10 seconds. The water forced air from the flask, with its Hg, into the Hg analyzer where it was measured. A Laboratory Data Control Co. UV monitor with a 30 cm path length cell was used for Hg determinations.

Glassware, plasticware, and reaction vessels were cleaned first by soaking in Micro cleaning solution for 24 hrs and then rinsed with distilled water. Glassware and the reaction vessels were then soaked in an acid bath (50%v/v HNO_3) for 24 hrs, rinsed with distilled deionized water (DDW), and air dried in a laminar flow hood in a dust free environment. Other plasticware used in these procedures were either used only a single time or reused after washing with Micro solution, appropriate acids (i.e., either HCl or HNO_3, depending upon resistance to attack) and DDW. As stated previously, method blanks, matrix spikes, and standard reference materials were run with each set of samples. In Appendix II the raw data along with the QA/QC information is presented, for the QA/QC plan see Velinsky et al. (1991).

Acid Extractable Metals. Acid extractable metals were analyzed by atomic absorption spectrophotometry (AAS) following leaching of sediment samples with a dilute HCl.

In brief, frozen sediment samples were quickly thawed and homogenized. Aliquots (ca. 1-2 grams) were placed into pre-cleaned and tared 50 ml centrifuge tubes. Samples were accurately weighed and frozen using liquid nitrogen and stored at -20°C until extraction. While the transfer was not performed in a nitrogen purged glovebag, the entire transfer was performed within 5 minutes to minimize any oxidation effects. Wet and dry weights were determined from these samples.

For extraction, samples were placed into a N_2-purged glove bag and allowed to thaw. Deaerated 1M HCl (Baker Intra-analyzed grade) was added to a volume of 25 ml and the centrifuge tubes were capped tightly. The samples were removed from the glove bag, mixed on a Vortex mixer, and shaken for 1 hour. After centrifugation to separate the solids, samples were transferred to pre-cleaned screw cap polyethylene bottles and the metals analyzed by AAS.

To monitor precision and recovery of metals, several replicates of in-house sediment standard (HS-2, collected from the Mississippi River Delta) were included in the preparation. Two unspiked replicates were analyzed, along with four replicates that were spiked with known amounts of analytes prior to sample processing. Two blanks were included to evaluate contamination.

Acid Volatile Sulfur. Acid volatile sulfide is an operationally defined sediment phase, which depends on acid concentration, temperature, and reaction time. Metal sulfides, predominately iron sulfide (FeS), which are soluble in weak hydrochloric acid, are termed acid volatile sulfide (AVS). This sulfur phase includes amorphous and crystalline metal monosulfides (e.g., FeS, ZnS and CuS). For the analysis of acid-volatile sulfur, the method of Cutter and Oatts (1987) was used.

Briefly, 20-80 mg of frozen sediment (wet/dry weight ratio determined on a separate aliquot) and 10 ml of N_2-purged DDW were placed in a glass stripping vessel which was purged with helium for 2 min. At this point, hydrochloric acid was then added to a concentration of 0.5 M. Hydrogen sulfide (H_2S) was purged from the solution and trapped in a glass U-tube filled with Porapak QS, immersed in liquid nitrogen. After 15 min of purging and trapping, the U-tube was removed from the liquid nitrogen to volatilized the H_2S, which was separated from other volatile compounds prior to detection by a photoionization detector. Detector signals were processed by a HP-3390A digital integrator/plotter.

Calibration of the detector was accomplished using a known quantity of anhydrous sodium sulfide (Alfa Products) dissolved in a known weight of N_2-purged DDW. Standards were run at the start, middle, and at the end of each day. Samples were run in either duplicate or triplicates and precision was generally better than 10% as relative standard deviation. All tubing and fittings used in the apparatus are made of Teflon and the purging vessel, water trap and U-tube are borosilicate glass treated with dimethyldichlorosilane. All glassware or plasticware was washed with Micro then rinsed with distilled water, acetone, DDW, 0.5M HCl, and DDW.

Porewater Ammonia. Sediment samples for the separation and determination of porewater ammonia (i.e., $NH_3+NH_4^+$) were from the final sediment mixture (i.e., combination of 3 separate grabs). Therefore, these samples integrate the possible differences in porosity and concentration of ammonia in the pore fluids of the area.

Porewater was separated from the solid phase by centrifugation and filtration. For this, the 50 ml centrifuge tubes, with approximately 40 ml of wet sediment in each, were centrifuged at 2000 rpm for 15 minutes. The porewaters were decanted into a syringe filtration unit (Gelman 25 mm filter holder) using Whatman GFF (25 mm, 0.7 μm pore size) glass fiber filters. The filters were pre-rinsed with DDW. Porewaters were expressed through the filter and the first 5 ml or so was discarded and the remaining water collected in acid-soaked, DDW rinsed 50 ml plastic tubes. These samples were quick frozen using liquid nitrogen and stored frozen until analysis.

Ammonia analysis was done with the method of Solorzano (1969) modified by using the oxidizing reagent of Liddicoat et al. (1975) and a 1-h dark color development at 35°C. All glassware or plasticware was washed with Micro then rinsed with distilled water, acetone, DDW, 10%(v/v) HCl, and DDW. Blanks and standards were included with each set of samples.

The concentration of porewater NH_3 (i.e., un-ionized ammonia) was calculated using the equations given in Emerson et al. (1975), using both bottom ambient water temperatures and pHs and, as a comparison, overlying sediment toxicity test water temperature and pH.

Organic Carbon and Grains Size. Organic carbon (OC) was determined by infra-red absorption after combustion in an O_2 stream, using a LECO WR-12 Total Carbon System. Samples, 100 to 500mg, were acidified using dilute HCl in methanol and then dried overnight at 50°C. Method blanks and duplicate samples were analyzed every 20 samples. Data are reported as μg of C per gram dry weight. All glassware and utensils are pre-heated prior to use.

Sediment grain size was determined by the procedure of Folk (1974), utilizing sieving to separate gravel and sand fractions from the clay and silt fractions. The latter fractions were subsequently separated by the pipette (settling rate) method. Detailed descriptions of the methods utilized in measuring OC, $CaCO_3$ and grain size are reported in Brooks et al. (1988).

Chapter III.

Distribution and Sources of Trace Inorganic and Organic Contaminants to River Sediments of the Washington, D.C. Area.

Introduction

Geographical trends of anthropogenic chemicals may help identify source areas for major inputs to urban sedimentary environments. Certain chemicals may have a diffuse source and would yield distributions that indicate no consistent geographical trend. Other chemicals, however, may have a specific source (i.e., point source) from either an industrial or municipal facility or chemical spill that would be indicated by higher sedimentary concentrations in a specific area than adjacent areas. Different geographical trends may be reflected not just in concentration gradients but also by the molecular distribution within certain classes of compounds. Both polychlorinated biphenyls (PCBs) and polycyclic aromatic hydrocarbons (PAHs) are mixtures of many distinct compounds that could reflect possible sources. The objectives of this chapter are to present geographical trends, and to elucidate possible source areas of specific organic and inorganic chemicals. Sedimentary concentrations will be compared to concentrations found in outfalls and sewers that drain into each respective area.

Results and Discussion

Sediment Organic Carbon and Grain Size

Organic carbon (OC) concentrations ranged between 2.5 and 6.4 % on a dry weight basis (dw) for all sediment samples with an average of 4.0 ± 0.9 %OC (± standard deviation; Table 3-1). Highest concentrations were observed in Kingman Lake and in the Tidal Basin. In Kingman Lake, the highest concentrations were towards the southern entrance of the lake. In the Tidal Basin, concentrations of OC were highest in the northern embayment and decreased towards the center of the basin. This embayment includes a major storm sewer outfall that drains the Constitution Avenue area.

Outfall sediment samples exhibited a greater range in OC concentrations than river or basin sediments. Concentrations ranged from 2.0 to 11.1 %OC in the Washington Ship Channel, Tidal Basin, and Anacostia River outfalls, respectively. This wide range most likely reflects both the different possible sources of OC and the physical sorting of particles (both size and composition) during runoff events.

Grain size distributions in the study area were fairly uniform with the sediments

Table 3-1. **Bottom sediment and porewater characteristics for the various study areas*.**

Sta. ID.	TOC (%)	SAND (%)	SILT (%)	Clay (%)	AVS (μmole S/g-dw)	PW NH_3 (mg N/L)
KL-1	4.05	12.84	50.29	36.87	12.9	11.1
KL-2	4.02	3.00	68.83	28.31	11.8	13.4
KL-3	4.06	0.20	67.10	32.69	12.7	18.3
KL-4	4.95	12.89	54.32	32.79	9.2	26.5
KL-5	6.08	11.10	54.64	34.26	4.8	5.6
AR-1	3.89	13.93	53.41	32.66	10.8	25.1
AR-2	3.99	0.54	63.23	36.23	7.5	30.6
AR-3	2.98	0.53	70.91	28.56	7.5	26.5
AR-4	4.30	13.99	59.16	26.85	26.4	34.2
AR-5A	3.75	0.69	71.41	27.90	17.0	18.8
AR-6	3.57	0.86	67.73	31.41	ND	ND
OAR-1	4.89	9.70	61.57	28.72	ND	ND
OAR-2	3.44	9.04	68.15	22.81	ND	ND
OAR-3	2.62	77.68	20.16	2.17	ND	ND
OAR-4	4.68	10.71	61.34	27.95	ND	ND
OAR-6	6.08	16.84	52.85	30.31	ND	ND
OAR-R1	0.66	44.90	33.86	21.24	ND	ND
SAR-2	1.02	78.16	21.36	0.48	ND	ND
SAR-3	0.28	85.63	14.22	0.15	ND	ND
SAR-5	2.50	78.55	19.91	1.54	ND	ND
SAR-6	0.84	77.35	20.92	1.73	ND	ND
WSC-1	3.21	1.47	72.20	26.34	83.0	6.4
WSC-2	2.89	0.42	80.17	19.41	ND	ND
WSC-3	3.37	0.33	84.24	15.43	47.6	5.5
WSC-5	2.54	31.45	50.72	17.83	ND	ND
WSC-6	3.74	0.71	69.80	29.49	ND	ND
OWSC-1	3.30	15.06	72.98	11.96	ND	ND
OWSC-2	11.07	38.53	51.45	10.02	ND	ND
OWSC-3	2.87	78.60	20.35	1.05	ND	ND
OWSC-R1	8.76	39.33	23.30	37.37	ND	ND
SWSC-2	0.37	75.46	23.99	0.55	ND	ND
PR-1	3.86	21.87	45.82	32.31	ND	ND
PR-2	2.41	13.17	51.77	35.06	ND	ND
PR-3	3.92	9.59	54.99	35.41	ND	ND
PR-4A	4.14	5.77	59.97	34.26	4.2	27.4
TB-1	6.37	2.90	69.94	27.16	1.0	12.9
TB-1.5	4.13	1.34	73.60	25.06	ND	ND
TB-2	3.02	0.68	35.09	35.09	ND	ND
TB-3	4.70	21.33	46.55	32.12	20.4	5.5
TB-4	3.30	0.45	76.46	23.09	ND	ND
TB-5A	3.10	1.20	67.66	31.14	ND	ND
TB-6	3.37	0.63	73.47	25.90	ND	ND
OTB-1-1	NA	NA	NA	NA	NA	NA
OTB-1-2	3.00	19.42	71.44	9.14	ND	ND
OTB-2	1.98	80.07	18.57	1.36	ND	ND
OTB-3	1.89	86.56	12.50	0.94	ND	ND
OTB-4	1.88	81.29	16.51	2.20	ND	ND
OTB-5	2.34	77.44	21.00	1.56	ND	ND
STB-2-1	9.69	60.71	33.52	5.77	ND	ND
STB-2-2	10.98	48.62	47.80	3.58	ND	ND

*Station IDs. starting with (O) indicate samples that were taken directly in front of an outfall, while (S) indicates samples that were taken in a sewer. Stations AR-5, PR-4 and TB-5 were sampled and analyzed in triplicate and the average value is reported. AVS is acid-volatile sulfur and PW NH_3 is the concentration of porewater ammonia ($NH_3+NH_4^+$).
ND - No Data.

predominately in the clay and silt size fraction (<63 μm; Table 3-1). At a few stations, the sand fraction accounted for between 25 and 30% (e.g., WSC-5, PR-1 and TB-3) of the total sediment. These locations may be areas of stronger currents in which fine grain sediments do not settle. This is most evident in the outfall sediment samples (Table 3-1). These samples exhibited a greater range in grain size, reflecting the physical sorting of particles near the effluent of storm and combined sewers. For example, in the Anacostia River, OAR-3 contained approximately 22% fine grain material (<63 μm), while river sediment samples contained >90% fines. Tidal Basin sediment samples had generally more fine grain material than sediment taken at the outfalls, with the sand fraction comprising approximately 80% of the sediment.

Sedimentary Trace Metals (Cd, Cr, Cu, Hg, Pb, and Zn)

Distribution and Geographic Trends

Sedimentary concentrations of the different trace metals are presented in Table 3-3 and in Figures 3-1 to 3-5. For selected stations, data from ICPRB (1990) are presented in Table 3-2 to help set a baseline to assess future trends. Except for cadmium (Cd) concentrations, most data from the two studies are comparable. Cadmium concentrations in the 1991 study were approximately two to four times higher than in this study, and these differences cannot totally be accounted for by spatial or temporal variability between data sets. It is suggested from the QA/QC information and data presented in ICPRB (1990), that their method had a positive bias of a factor of 10 when standard reference material (BCSS-1) was analyzed for Cd. In comparing the sedimentary concentrations of chromium (Cr), mercury (Hg) and lead (Pb) agreement between the two data sets is reasonable (i.e., within ± 100%) considering that the studies are two years apart, the same locations were not sampled in each case, and different digestion methods were employed (i.e., total versus hot acid digestion for this study and ICPRB (1990), respectively).

Excluding Cd, the only area with a consistent trend in trace metal concentrations between ICPRB (1990) and the present study was at the Potomac River site off the mouth of Rock Creek (i.e., PR-1 and PMS-13). Here concentrations in the present study are uniformly higher. However, this site is characterized by high water velocities and suitable sediment samples were difficult to collect in both studies. The higher concentrations observed in this study may be the result of higher within site variability as well as from actual changes in loads.

In the following discussion, the trace metal sedimentary concentrations are presented on a whole sediment basis (i.e., weight of metal per weight of dry whole sediment). Concentrations are

Table 3-2. Trace metal comparison between Phase I (ICPRB, 1990) and present study*.

Sta. ID.	Cd	Cr	Cu	Fe	Hg	Pb	Zn
Anacostia River							
No.22	4.00	140.00	95.00	ND	0.40	168.00	479.00
KL-4	1.92	106.30	96.60	4.19	0.46	199.30	462.00
ANA-12	8.00	130.00	80.00	ND	0.37	136.00	415.00
KL-5	2.01	106.50	76.10	4.38	0.35	143.70	418.00
ANA-17	8.00	150.00	103.00	ND	0.27	179.00	452.00
AR-2	1.93	117.60	91.90	4.56	0.29	147.50	401.00
ANA-21	6.00	120.00	207.00	ND	1.20	351.00	587.00
AR-4	3.18	155.50	126.90	4.19	1.04	408.90	512.00
ANA-24	4.00	140.00	92.00	ND	0.33	107.00	396.00
AR-6	0.92	90.30	63.80	4.82	0.54	83.20	279.00
Tidal Basin							
No.15	6.00	190.00	121.00	ND	0.34	346.00	529.00
TB-6	0.93	92.30	59.10	4.88	0.27	91.40	285.00
Potomac River							
PMS-13	<2	68.00	31.00	ND	0.08	68.00	138.00
PR-1	0.99	96.20	59.70	4.45	0.56	127.70	365.00
Washington Ship Channel							
PWC-06	4.00	140.00	148.00	ND	0.61	178.00	475.00
WSC-2	1.03	95.50	99.90	4.99	0.58	146.60	332.00

* Concentrations in μg metal per gram dry weight, except for Fe which is in %. Station locations for the Phase I study may not exactly match the present study.

Table 3-3. Sedimentary concentrations of trace metals in the various study areas*.

Sta. ID.	Cd	Cr	Cu	Fe	Hg	Pb	Zn
KL-1	1.53	105.9	63.8	4.07	0.28	133.8	348.0
KL-2	2.21	134.0	92.3	5.04	0.43	184.3	466.0
KL-3	2.19	118.0	100.1	4.73	0.39	176.5	450.0
KL-4	1.92	106.3	96.6	4.19	0.46	199.3	462.0
KL-5	2.01	106.5	76.1	4.38	0.35	143.7	418.0
AR-1	1.72	103.4	75.6	3.91	0.34	138.9	355.0
AR-2	1.93	117.6	91.9	4.56	0.29	147.5	401.0
AR-3	1.96	123.5	102.0	4.82	0.37	156.9	406.0
AR-4	3.18	155.5	126.9	4.19	1.04	408.9	512.0
AR-5A	1.48	107.5	90.2	5.23	0.36	130.5	367.3
AR-6	0.92	90.3	63.8	4.82	0.54	83.2	279.0
OAR-1	1.72	111.0	73.4	4.01	0.30	164.0	420.0
OAR-2	1.75	116.0	145.0	4.25	1.21	185.0	450.0
OAR-3	0.90	58.0	69.9	1.54	0.72	175.0	215.0
OAR-4	1.43	109.0	86.9	4.08	0.30	151.0	382.0
OAR-6	0.50	74.0	94.7	3.73	1.16	111.0	208.0
OAR-R1	0.29	31.0	19.9	1.79	0.17	40.0	80.0
SAR-2	0.79	634.0	327.8	3.63	0.18	8137.0	512.0
SAR-3	0.37	163.0	20.5	2.38	0.01	102.0	224.0
SAR-5	1.68	133.0	97.4	1.64	2.02	207.0	271.0
SAR-6	0.45	122.0	47.9	1.43	0.22	96.0	164.0
WSC-1	1.19	94.3	103.0	5.06	0.74	183.0	356.0
WSC-2	1.03	95.5	99.9	4.99	0.58	146.6	332.0
WSC-3	1.09	90.7	92.6	5.24	0.52	125.8	339.0
WSC-5	0.45	51.1	33.4	2.92	0.23	48.3	137.0
WSC-6	0.79	86.8	52.6	4.76	0.25	61.9	247.0
OWSC-1	1.25	83.0	102.2	3.33	0.64	163.0	400.0
OWSC-2	3.31	105.0	251.3	3.56	0.63	425.0	1094.0
OWSC-3	0.95	63.0	112.3	1.51	0.20	515.0	406.0
OWSC-R1	3.05	167.0	348.0	4.11	0.87	2101.0	750.0
SWSC-2	4.07	44.0	27.6	1.16	0.05	72.0	200.0
PR-1	0.99	96.2	59.7	4.45	0.56	127.7	365.0
PR-2	0.55	66.6	34.2	3.89	0.15	32.0	168.0
PR-3	0.52	63.4	35.6	3.76	0.13	33.9	171.0
PR-4A	0.58	69.0	37.8	4.06	0.15	39.0	188.3
TB-1	1.67	97.4	120.1	4.89	0.45	204.0	385.0
TB-1.5	NA	NA	NA	NA	NA	NA	NA
TB-2	0.84	91.1	55.1	4.55	0.25	84.5	255.0
TB-3	0.74	75.9	44.5	3.89	0.24	109.5	216.0
TB-4	0.97	96.9	66.7	5.09	0.29	104.3	292.0
TB-5A	0.83	87.0	55.3	4.67	0.27	79.3	259.7
TB-6	0.93	92.3	59.1	4.88	0.27	91.4	285.0
OTB-1-1	0.24	41.0	19.7	0.89	0.07	36.0	62.0
OTB-1-2	0.83	30.0	47.9	1.67	0.15	120.0	235.0
OTB-2	0.43	28.0	13.7	1.91	0.06	320.0	112.0
OTB-3	0.89	167.0	25.9	2.50	0.09	1015.0	180.0
OTB-4	0.94	176.0	102.6	2.89	9.22	3627.0	527.0
OTB-5	0.73	149.0	39.4	2.32	0.13	465.0	197.0
STB-2-1	9.46	3063.0	1784.9	7.07	7.03	31296.0	1236.0
STB-2-2	2.81	518.0	510.8	1.89	4.96	5022.0	684.0

*Station IDs. starting with (O) indicate samples that were taken directly in front of an outfall, while (S) indicates samples that were taken in a sewer. All concentrations are in μg per gram dry weight, except for Fe which is %. Stations AR-5, PR-4 and TB-5 were sampled and analyzed in triplicate, these data are the average (See Table 3-4). NA - Not Analyzed.

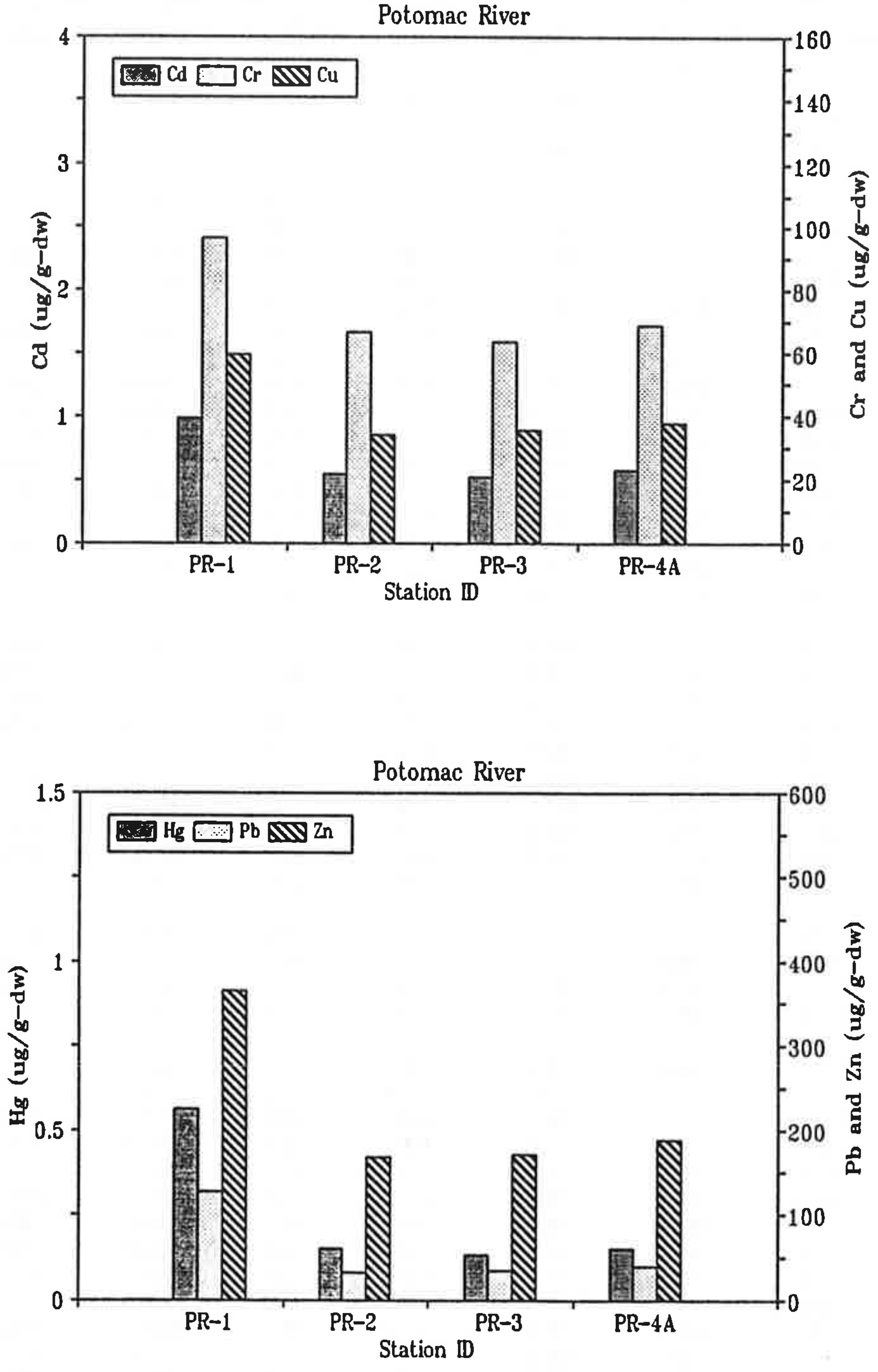
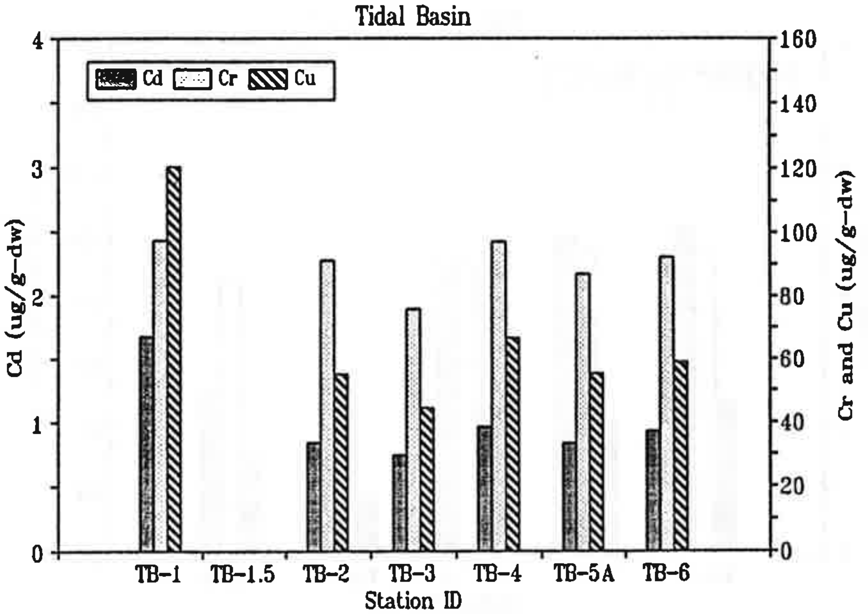


Figure 3-1. Sedimentary trace metal distribution: Potomac River.



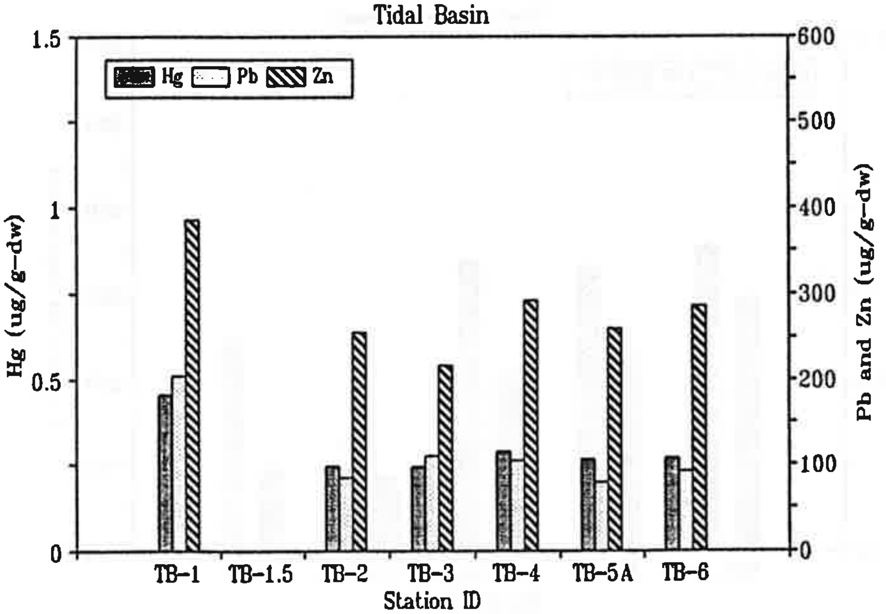
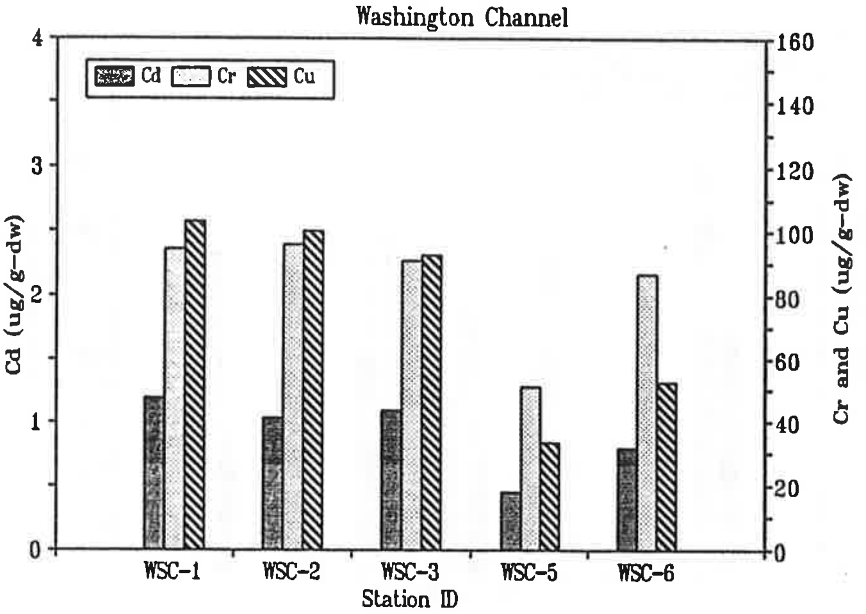


Figure 3-2. Sedimentary trace metal distribution: Tidal Basin.



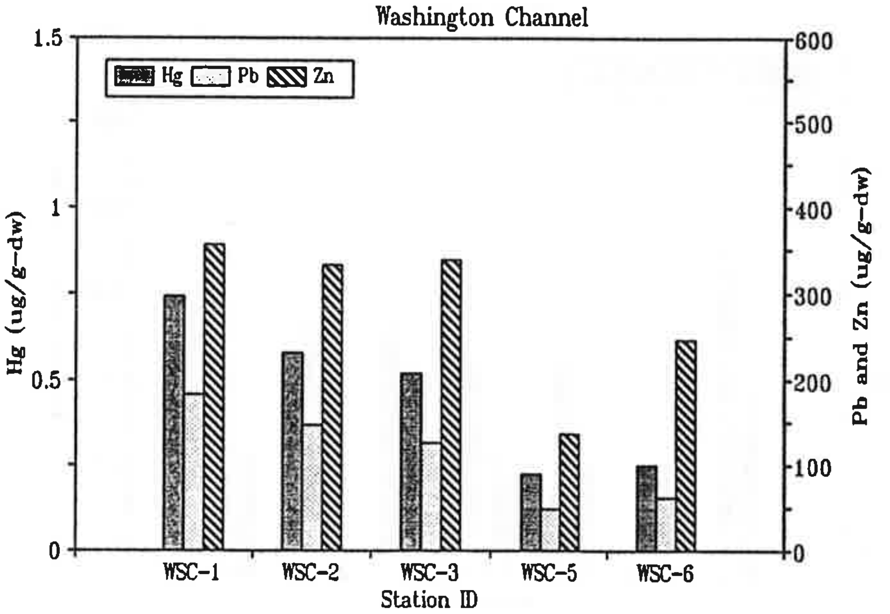
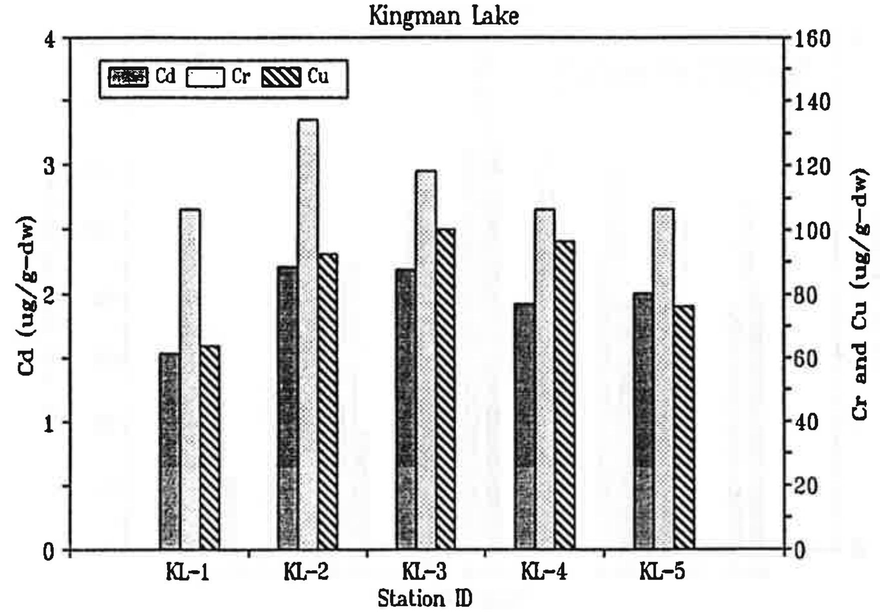


Figure 3-3. Sedimentary trace metal distribution: Washington Ship Channel.



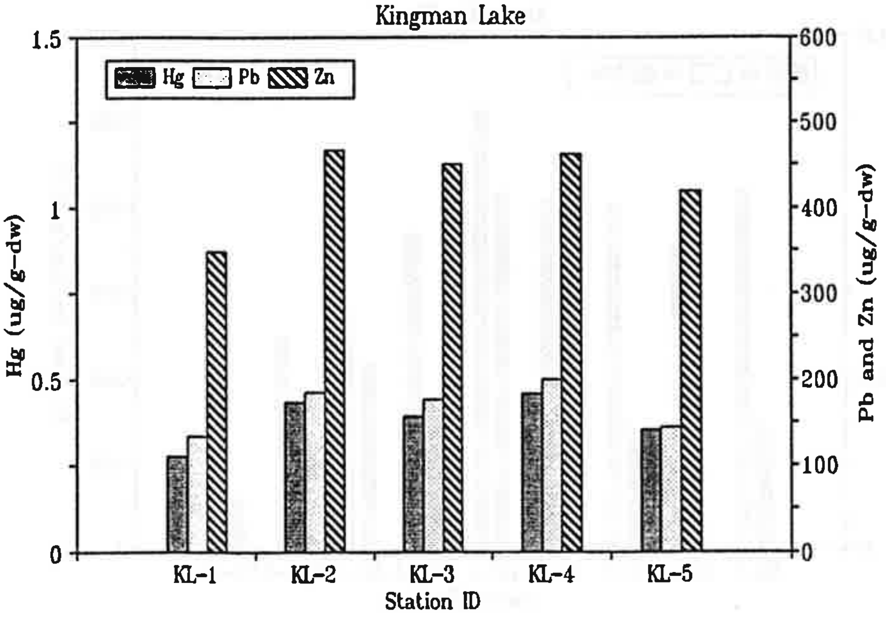
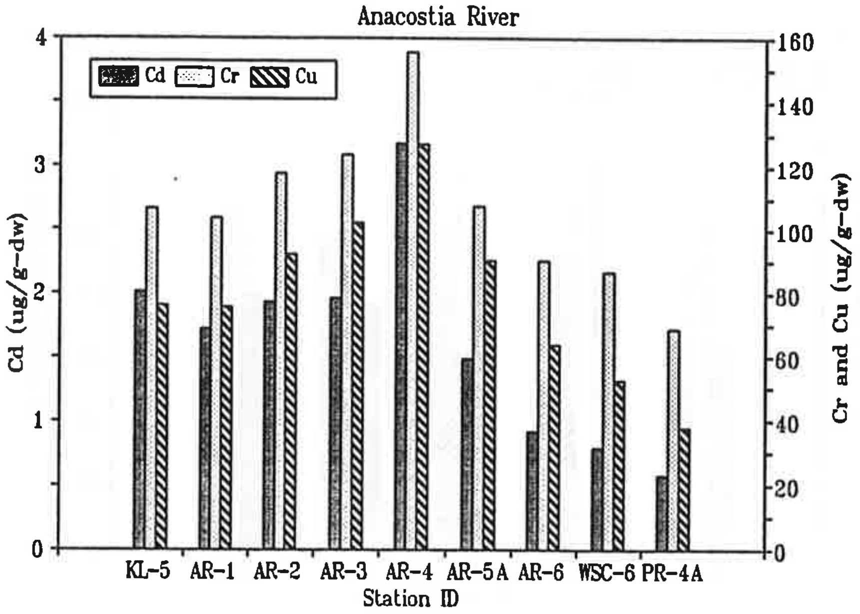


Figure 3-4. Sedimentary trace metal distribution: Kingman Lake.



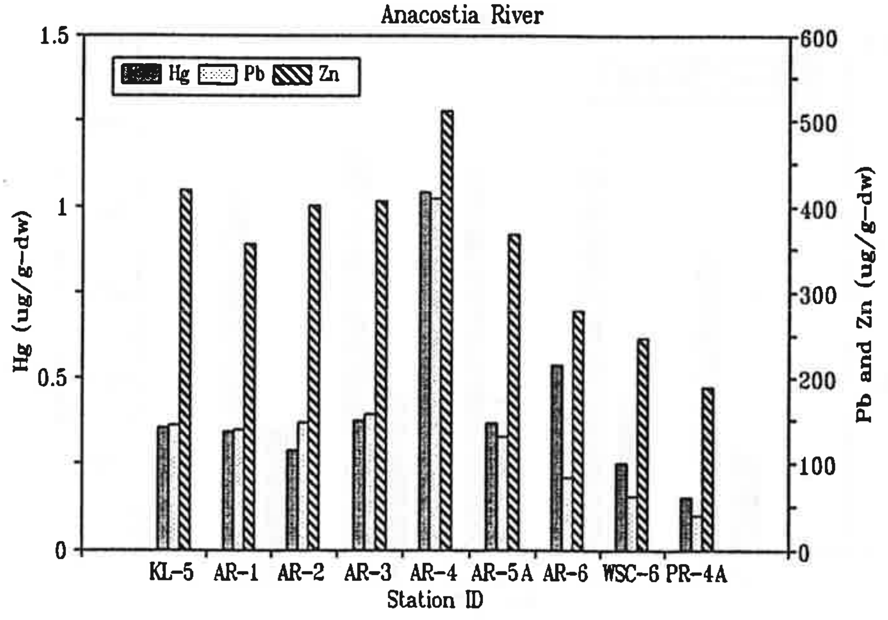


Figure 3-5. Sedimentary trace metal distribution: Anacostia River.

normalized to either grain size (NOAA, 1991) or iron (Fe) concentrations (see discussions in NOAA, 1991; Helz et al., 1985; Windom et al., 1989) only when normalization makes a substantial change in the interpretation of the data.

The distribution of individual trace metals exhibited similar geographic trends within each river or basin. The lowest concentrations of trace metals were found in the Potomac River with the exception of PR-1 (Figure 3-3). This station is located at the mouth of Rock Creek and is influenced by runoff from the central region of the District of Columbia (Figure 2-1). Concentrations of all trace metals upstream of PR-1 are lower (ICPRB, 1990) suggesting that there are no obvious sources above PR-1. Station PR-4, located at the confluence of the Anacostia and Potomac Rivers, and the Washington Ship Channel had one the lowest concentrations of any site. This station was sampled in triplicate to assess small scale spatial variability (i.e., 3 samples of 3 grabs each within 5 m of each other). Triplicate samples exhibit excellent agreement with relative standard deviations (RSD; standard deviation (SD)/mean X 100) of less than 11% for all metals (Table 3-4).

Concentrations of sedimentary trace metals in the Tidal Basin were similar at all sites except TB-1 (Table 3-3; Figure 3-2). Trace metal concentrations were up to 2 times higher at TB-1 then at other stations. For example, concentrations of copper (Cu) and Pb at TB-1 were 120.1 and 204.0 μg/g compared to 56.1 ± 8.0 and 93.8 ± 12.8 μg/g (average of the other 5 stations), respectively. Chromium concentrations, however, were similar at all stations (90.1 ± 8.0 μg Cr/g, n=6). The grain size distribution was similar among all Tidal Basin stations and would not account for the differences between TB-1 and the other stations. The sediments around TB-1 are most likely influenced by a large storm water sewer that empties into this section of the basin (see below, Figure 2-1). This sewer drains the area around Constitution Avenue including the Mall around the Smithsonian Institution. There is little industry in the area, so street runoff is the most likely source of these trace metals.

Similar to station PR-4 in the Potomac River, station TB-5 was also analyzed in triplicate to asses spatial variability. The relative standard deviation was <6% for all metals (Table 3-4). These results imply that spatial variability of the local area is small compared to overall geographic trends.

Within the Washington Ship Channel, concentrations of all metals were highest in sediments from the head of the channel (i.e., stations WSC-1,2, and 3) (Table 3-3; Figure 3-3). For example, Pb concentrations decreased from 183.0 and 125.8 μg Pb/g from WSC-1 and WSC-3, respectively, to a low of 48.3 μg Pb/g at WSC-5. Due to the higher percent of sand at WSC-5, concentrations were normalized to the percent of fines (i.e., μg metal/ g fine grain) and are therefore slightly higher,

Table 3-4. Results from triplicate analysis of 3 separate samples from the Anacostia and Potomac Rivers and Tidal Basin*.

Sta. ID.	TOC	Silt+Clay	Cd	Cr	Cu	Fe	Hg	Pb	Zn
Anacostia River									
AR-5a	3.72	0.99	1.48	107.4	89.2	5.21	0.36	131.7	371.0
AR-5b	3.89	0.99	1.52	106.5	93.3	5.23	0.39	130.0	366.0
AR-5c	3.64	0.99	1.45	108.5	88.1	5.26	0.34	129.7	365.0
Average	3.75	0.99	1.48	107.5	90.2	5.23	0.36	130.5	367.3
± SD	0.13	0.001	0.035	1.0	2.7	0.03	0.025	1.1	3.2
Potomac River									
PR-4a	4.25	0.95	0.65	70.5	39.9	4.27	0.15	42.0	198.0
PR-4b	4.11	0.94	0.56	67.7	38.1	4.06	0.16	39.0	186.0
PR-4c	4.07	0.94	0.52	68.7	35.4	3.84	0.14	36.0	181.0
Average	4.14	0.94	0.58	69.0	37.8	4.06	0.15	39.0	188.3
± SD	0.09	0.01	0.067	1.4	2.3	0.22	0.008	3.0	8.7
Tidal Basin									
TB-5a	3.05	0.99	0.85	91.6	55.3	4.71	0.26	82.8	264.0
TB-5b	3.02	0.99	0.83	85.1	54.8	4.63	0.29	81.2	257.0
TB-5c	3.23	0.99	0.82	84.2	55.9	4.68	0.25	73.9	258.0
Average	3.10	0.99	0.83	87.0	55.3	4.67	0.27	79.3	259.7
± SD	0.11	0.002	0.015	4.0	0.6	0.04	0.017	4.7	3.8

*All concentrations are in μg per gram dry weight, except for Fe and TOC which are %. Silt+Clay is the fraction of silt and clay in the sample. At each station, three samples, of three grabs each, were taken within approximately 5 m of each other. ± SD is the standard deviation (1σ).

reflecting the dilution of sediment with sand. The other stations in the Washington Ship Channel had >90% fine grain material so no substantial grain size effect was observed. Interestingly, WSC-5 is located in an active seagrass bed near Greenleaf Point (Figure 2-1). At this station, concentrations of most trace metals were among the lowest determined in this study (Table 3-3). At station WSC-6, located at the confluence of the Washington Ship Channel and the Anacostia River, all trace metals increased in concentration from those at WSC-5.

The upper end of the Washington Ship Channel is a semi-enclosed embayment in which the water is partially flushed once per tidal cycle from Tidal Basin waters. Numerous bridges and roadways, both automotive and railroad, cross the upper end of the waterbody. There are four storm sewers that drain into the upper end of the channel. Sources of the trace metals are likely to be a combination of atmospheric fallout and runoff from the bridges, as well as runoff from the storm drains. It appears that once the sediment-associated contaminants are introduced to the area, they are retained and incorporated into the sediments. Sediment transport down the channel may be limited. However, further studies would be required to accurately assess the magnitude of sediment transport down the channel.

Sedimentary concentrations of all trace metals were elevated in Kingman Lake compared to the other study areas (Table 3-3; Figure 3-4). Station KL-5, located in the Anacostia River just outside the southern entrance of the lake, also exhibited enriched concentrations. The lake is most likely affected by runoff from the numerous parking areas around R.F.K. stadium. The restricted flow of the basin and potentially high sedimentation rates could allow the accumulation of these trace metals in the sediments.

Data for the Anacostia River are presented as a transect from KL-5, located in the Anacostia River, to PR-4, located just south of Hains Point (Figure 2-1) at the confluence of the Potomac and Anacostia Rivers. This transect includes WSC-6, located at the confluence of the Anacostia River and the Washington Ship Channel. From station KL-5 to AR-3 (just upstream of the Navy Yard), concentrations of Hg, Pb, Zn, and Cd were fairly constant, while concentrations of Cr and Cu increased slightly (Table 3-3; Figure 3-5). Concentrations of all trace metals were highest in this transect at station AR-4. The increase in trace metal concentrations from KL-5 and AR-3 to AR-4 was greatest for Hg, Pb, and Cd, and indicate that a substantial source of these metals exist between AR-3 and AR-4. Between KL-5 and AR-3 the average concentrations of Hg, Pb and Cd increased 206%, 179% and 66%, respectively, compared to station AR-4. The gradual increase in concentrations of Cr, Cu, and Zn from KL-5 to AR-4 indicates diffuse sources for these metals.

Along this section of the Anacostia River, river width increases as it approaches the Potomac River. This increase in width may increase residence time of the water, enabling particulate material and associated metals to settle to the bottom and thus be incorporated into the sediments (Scatena, 1987).

Sedimentary concentrations of all trace metals decreased downstream of AR-4. The largest decrease were noted for Hg, Pb, and Cd; concentrations decreased 600%, 1000% and 450%, respectively, from AR-4 to PR-4 for Hg, Pb, and Cd. The general decrease in concentrations were not related to grain size changes. Greater than 90% of the river sediment between AR-5 and PR-4 were in the clay and silt size fractions, whereas only 85% of the sediment at station AR-4 was in these size fractions. This difference would therefore increase the relative concentration of all metals at AR-4 by approximately 15% relative to the downstream stations, and would make the decrease in total sediment trace metal concentrations even larger. The decrease in trace metal sedimentary concentrations may be due to many factors, including a decrease in sources and transport of sediment both into and out of the lower reach of the Anacostia River.

Comparison between Sediments, Outfalls and Sewers

One of the objectives of this study was to evaluate the possible sources of inorganic (and organic) contaminants to the river sediments of the Washington, D.C. area. To address this objective, samples were collected directly in front of storm and combined sewer outfalls in the Tidal Basin, Washington Ship Channel and Anacostia River. Sediment samples were also taken "in" specific combined and storm sewers in these areas. These samples were collected "up pipe" from the outfall and represent possible source material to each area (see Chapter II for details). Unfortunately, only 6 samples were collected due to an absence of sufficient material or the presence of overlying water in various sewer pipes. In this section the outfall sediment samples, denoted by the prefix (O), and sewer sediment samples, denoted by the prefix (S), are compared to sediment concentrations in each study area.

To facilitate the comparison of trace metal concentrations between river, outfall and sewer sediment samples, trace metal concentrations were divided by the fraction of fine grain sediment in each sample (i.e., $\mu g/g$ fine grain). Fine grain sediment, $< 63 \mu m$, is the sum of the silt and clay size fractions. This normalization procedure assumes that no contaminants are associated with the sand-sized material. The amount of sand material within a sample only serves to dilute the level of contamination for a given sample. Grain size data for all samples were presented in Table 3-1. Most river sediment samples consisted predominantly of silt and clay sized-material. The outfall and sewer sediment samples however, are much more variable with respect to the percent of sand, silt and clay, with higher amounts of sand-sized material. Normalization of the data to grain size, therefore, yielded only small changes in river sediment trace metal concentrations, but significant differences in trace metal concentrations from the outfall and sewer sediment samples (compare Tables 3-3 and 3-5).

Variability between duplicates aliquots of the outfall and sewer samples was relatively large (see Appendix II). These variations are most likely due to the coarse grain nature of these samples (e.g., approximately 80% sand), and the heterogenic nature of coarse grain material from these environments. In most cases, however, the variation in replicates was smaller than the variations between samples (i.e., the analytical differences between duplicates was small compared to differences between samples). It also should be pointed out that for samples with a greater proportion of clay and silt sized-material (i.e., river sediments), the analytical and small scale spatial replication was excellent (see Appendix II, Table 3-4). Also, the analysis of certified standard reference materials indicated that methods used for this study are both accurate and precise given a homogenous sample.

In the Tidal Basin six major storm sewers that drain the area (Table 2-1; Figure 3-6). Five of these sewers were sampled at the outfall, and all had elevated trace metal concentrations compared to sediments in the basin (Table 3-5). Material collected at OTB-4 and OTB-3 had the highest trace metal concentrations of any sample (Figure 3-7). For example, concentrations of Pb and Hg at OTB-4 were 1.9 % (i.e., 19400 μg Pb/g fine grain) and 50 μg Hg/g fine grain, respectively. Lead and Hg concentrations in Tidal Basin sediments ranged from 80 to 210 μg Pb/g fine grain and 0.3 to 0.5 μg Hg/g fine grain, respectively. These data reveal an extreme concentration gradient between the outfalls and sediments of the basin. Elevated concentrations of Cu, Cd, and Zn also were evident at stations OTB-4 and OTB-3, compared to sediment in the main portion of the Tidal Basin (Figure 3-7).

Sediment from one sewer was sampled in the Tidal Basin area (STB-2; Table 2-5). STB-2 is a separate (sanitary) sewer that drains the area around the BEP along 15th Street, N.W. (Figure 3-6). This sewer was sampled on two different occasions to assess temporal variability in the concentration of trace metals (Table 3-5). Unfortunately, storm sewers that empty into the basin had little or no sediment in them at the time of sampling.

The concentrations of all trace metals were extremely elevated in STB-2 compared to both the outfall and Tidal Basin sediment samples (Table 3-5). High concentrations of Pb were observed on both occasions with concentrations ranging from approximately 1 to 8 % (i.e., 10000 to 80000 μg Pb/g fine grain). Concentrations of Cd, Hg, and Cu were also elevated compare to the other samples taken in the Tidal Basin area. Because this sewer is a sanitary sewer, this material would not enter

Table 3-5. Concentrations of trace metals normalized to the fraction of fine grain sediment from the various study areas*.

Sta. ID.	Cd	Cr	Cu	Fe	Hg	Pb	Zn
KL-1	1.76	121.5	73.2	4.67	0.32	153.5	399.3
KL-2	2.28	137.9	95.0	5.19	0.44	189.7	479.7
KL-3	2.19	118.2	100.3	4.74	0.39	176.9	450.9
KL-4	2.20	122.0	110.9	4.81	0.52	228.8	530.4
KL-5	2.26	119.8	85.6	4.93	0.39	161.6	470.2
AR-1	2.00	120.1	87.8	4.54	0.40	161.4	412.5
AR-2	1.94	118.2	92.4	4.58	0.29	148.3	403.2
AR-3	1.97	124.2	102.5	4.85	0.37	157.7	408.2
AR-4	3.70	180.8	147.5	4.87	1.21	475.4	595.3
AR-5A	1.49	108.2	90.8	5.27	0.37	131.4	369.9
AR-6	0.93	91.1	64.4	4.86	0.54	83.9	281.4
OAR-1	1.90	122.9	81.3	4.44	0.33	181.6	465.2
OAR-2	1.92	127.5	159.4	4.67	1.33	203.4	494.7
OAR-3	4.03	259.7	313.0	6.90	3.24	783.7	962.8
OAR-4	1.60	122.1	97.3	4.57	0.34	169.1	427.8
OAR-6	0.60	89.0	113.9	4.49	1.39	133.5	250.1
OAR-R1	0.53	56.3	36.1	3.25	0.31	72.6	145.2
SAR-2	3.62	2902.9	1500.9	16.62	0.81	37257.3	2344.3
SAR-3	2.57	1134.3	142.7	16.56	0.07	709.8	1558.8
SAR-5	7.83	620.0	454.1	7.65	9.43	965.0	1263.4
SAR-6	1.99	538.6	211.5	6.31	0.97	423.8	724.1
WSC-1	1.21	95.7	104.5	5.13	0.75	185.7	361.3
WSC-2	1.03	95.9	100.3	5.01	0.58	147.2	333.4
WSC-3	1.09	91.0	92.9	5.26	0.52	126.2	340.1
WSC-5	0.66	74.5	48.7	4.26	0.33	70.5	199.9
WSC-6	0.80	87.4	53.0	4.79	0.25	62.3	248.8
OWSC-1	1.47	97.7	120.3	3.92	0.75	191.9	470.9
OWSC-2	5.38	170.8	408.8	5.79	1.02	691.4	1779.7
OWSC-3	4.44	294.4	524.8	7.06	0.92	2406.5	1897.2
OWSC-R1	5.03	275.3	573.4	6.77	1.43	3463.3	1236.4
SWSC-2	16.59	179.3	112.5	4.73	0.20	293.4	815.0
PR-1	1.27	123.1	76.4	5.70	0.72	163.4	467.2
PR-2	0.63	76.7	39.4	4.48	0.17	36.9	193.5
PR-3	0.58	70.1	39.4	4.16	0.15	37.5	189.2
PR-4A	0.61	73.2	40.1	4.31	0.16	41.4	199.9
TB-1	1.72	100.3	123.7	5.04	0.47	210.1	396.5
TB-1.5	NA	NA	NA	NA	NA	NA	NA
TB-2	1.20	129.8	78.5	6.48	0.35	120.4	363.4
TB-3	0.94	96.5	56.6	4.94	0.31	139.2	274.6
TB-4	0.97	97.3	67.0	5.11	0.29	104.8	293.3
TB-5a	0.84	88.0	56.0	4.73	0.27	80.3	262.8
TB-6	0.94	92.9	59.5	4.91	0.27	92.0	286.8
OTB-1-1							
OTB-1-2	1.03	37.2	59.4	2.07	0.18	148.9	291.6
OTB-2	2.16	140.5	68.7	9.58	0.32	1605.6	562.0
OTB-3	6.62	1242.6	192.7	18.60	0.68	7552.1	1339.3
OTB-4	5.02	940.7	548.4	15.45	49.26	19385.4	2816.7
OTB-5	3.24	660.5	174.6	10.28	0.56	2061.2	873.2
STB-2-1	24.08	7795.9	4542.9	17.99	17.89	79653.9	3145.8
STB-2-2	5.47	1008.2	994.2	3.68	9.65	9774.2	1331.3

*Concentrations in μg metal per gram fine grain sediment (silt+clay), except for Fe which is in %.. Stations AR-5, PR-4 and TB-5 were sampled and analyzed in triplicate, these data are the average (See Table 3-3 for raw data). \
NA - Not Analyzed.

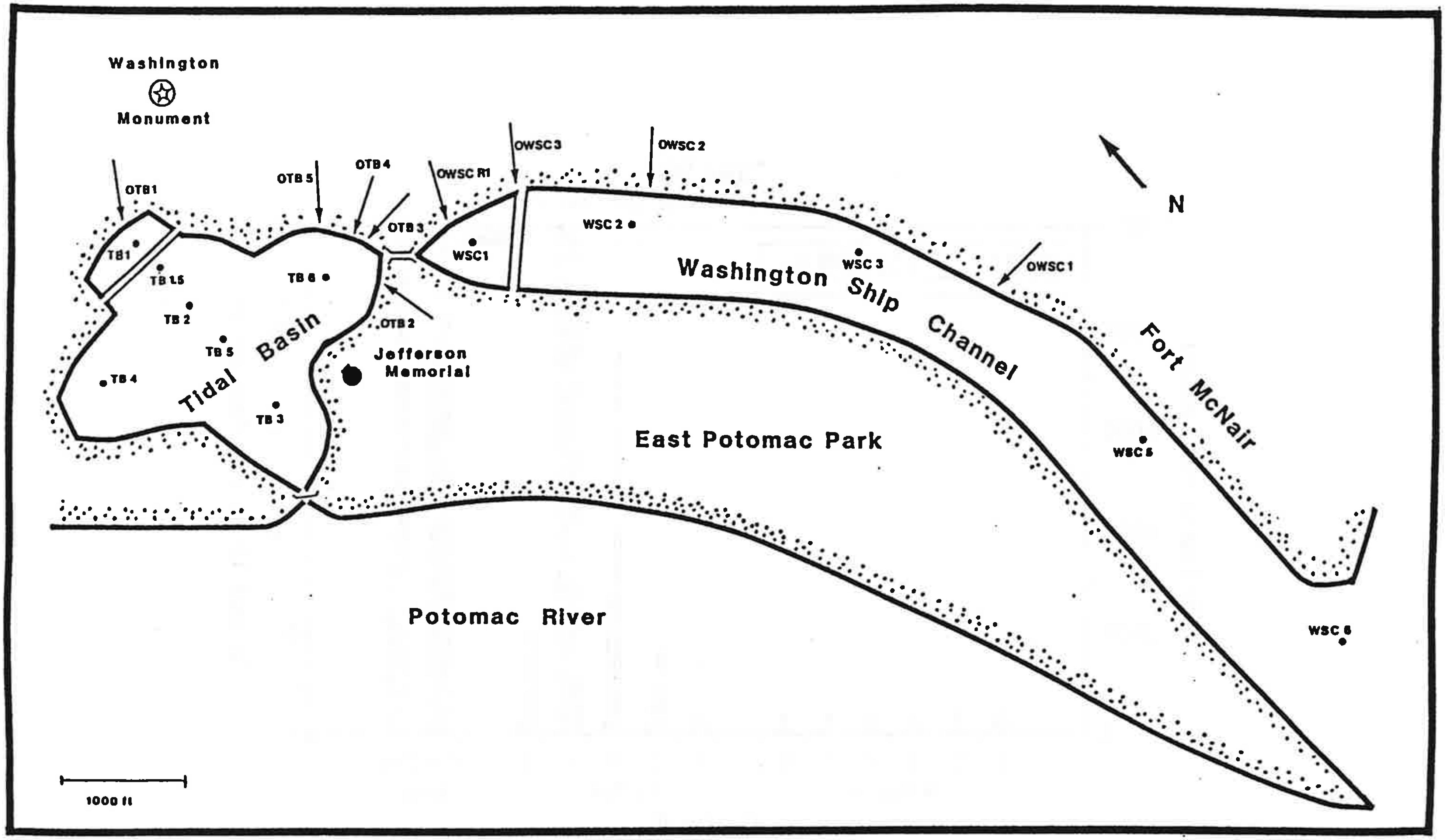


Figure 3-6. Outfall and sediment station locations in the Tidal Basin.

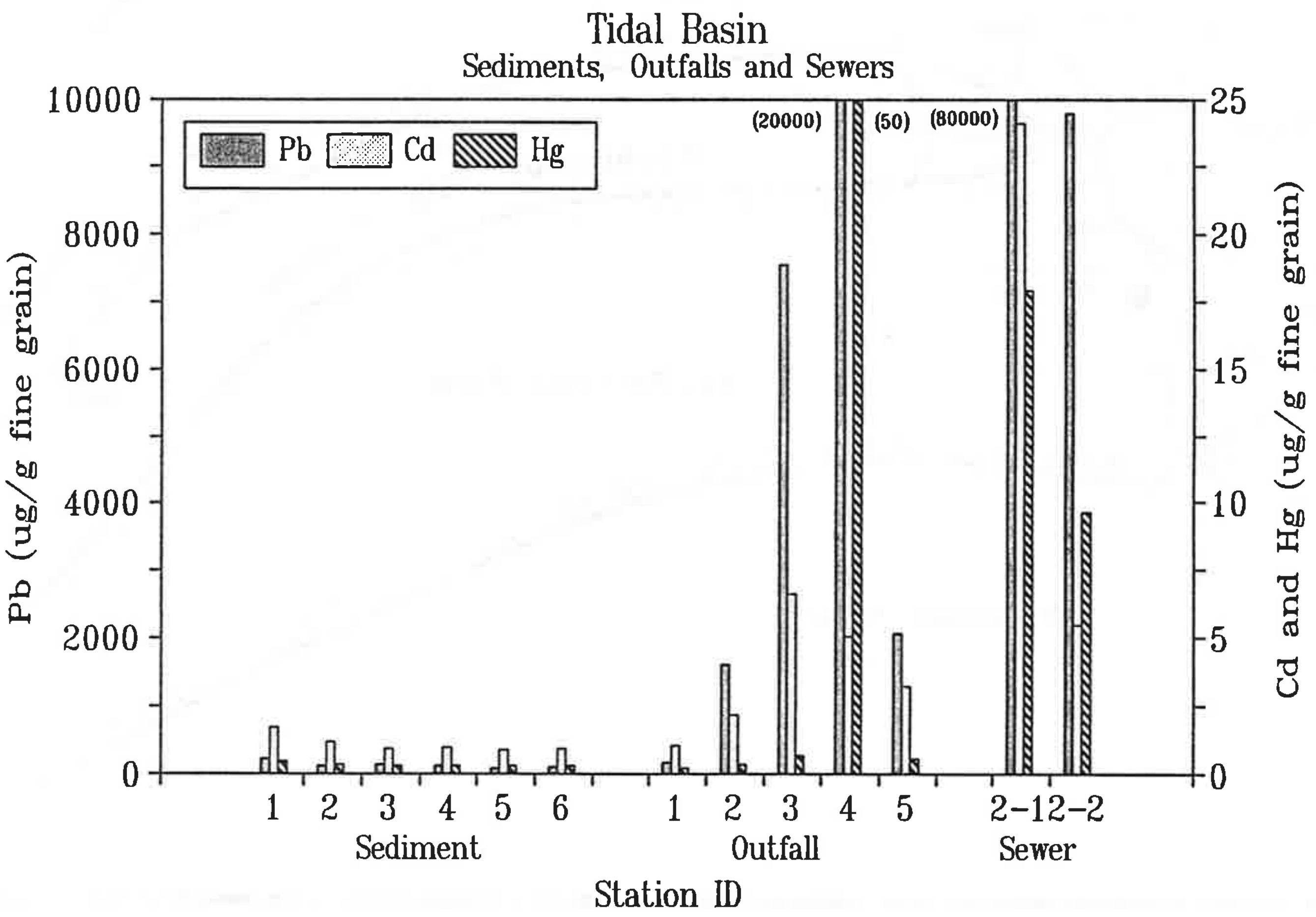


Figure 3-7a. Outfall, sewer, and sediments of the Tidal Basin: Trace Metals.

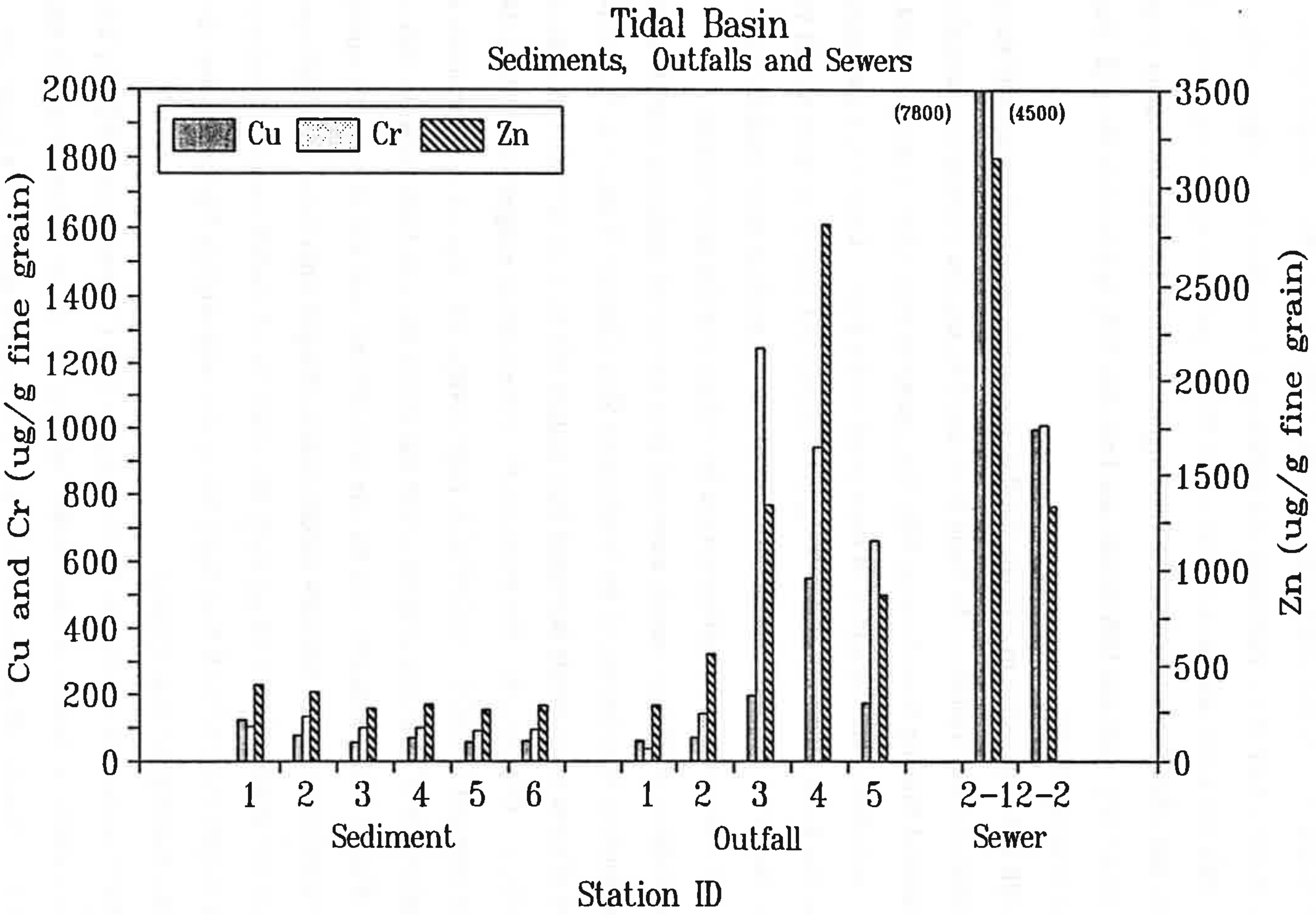


Figure 3-7b. Outfall, sewer, and sediments of the Tidal Basin: Trace Metals.

into the Tidal Basin's waters, but would be transported through the sewer system to the Blue Plains Wastewater Treatment for treatment and disposal.

These results indicate that the dominant source(s) of trace metals to the sediments of the Tidal Basin is from runoff through the storm water outfalls; OTB-3 and OTB-4. OTB-3 and OTB-4 are located on the eastern wall of the basin near the paddleboat concession area (Figure 3-7). These storm sewers drain the street area around 15th and D Street, and near the intersection of Ohio and Maine Avenues and 15th Street in southwest Washington, D.C.. This area is a major automotive thoroughfare connecting 14th and 15th Streets and Interstate 395, and borders the U.S. Bureau of Engraving and Printing (BEP).

Although it is impossible to estimate the flux (i.e., mass per time) of material through the storm and combined sewer system to the basin from this data set, the extreme concentration gradients suggest that material flowing from these outfalls (i.e., samples were taken directly in front the outfall in the river or waterbody) are the source of trace metal to the basin. Once these contaminants are introduced into the basin, dispersal of the fine grain material and associated trace metals yield the concentrations measured in the sediments. Additional sources such as other outfalls not sampled, direct runoff, and atmospheric deposition can not be evaluated at the present time.

Concentrations of all trace metals measured from the outfall sediment samples were higher than the concentrations in sediments of the Washington Ship Channel (Table 3-5; Figure 3-8). Concentrations of most trace metals increased from station OWSC-1 to OWSC-3 than decreased slightly at OWSC-R1 (Figure 3-9). For example, Pb concentrations ranged from 191 to 2400 μg Pb/g fine grain between OWSC-1 and OWSC-3, respectively, with highest concentrations at station OWSC-3. Station OWSC-3 is near a storm sewer that drains the area from between 12th and 13th Streets, S.W. (Figure 3-8). This area was the site of a railroad yard and is currently undergoing numerous construction projects. Mercury concentrations changed little between outfall samples, ranging from approximately 0.8 to 1.0 μg Hg/g fine grain for all outfall samples. Sediment concentrations ranged from 0.3 to 0.8 μg Hg/g fine grain, with slightly higher concentrations in the upper end of the Washington Ship Channel.

One storm sewer was sampled in the Washington Ship Channel area (SWSC-2; Table 2-5). This storm sewer drains a small area between 9th and 10th Streets on Maine Avenue in southwest Washington D.C.. The runoff collected from this area eventually feeds into a larger storm sewer line that flows into the Washington Ship Channel just above Seafood Wharf. Concentrations of most trace metals from this sewer were elevated compared to concentrations in sediments of the channel, but not

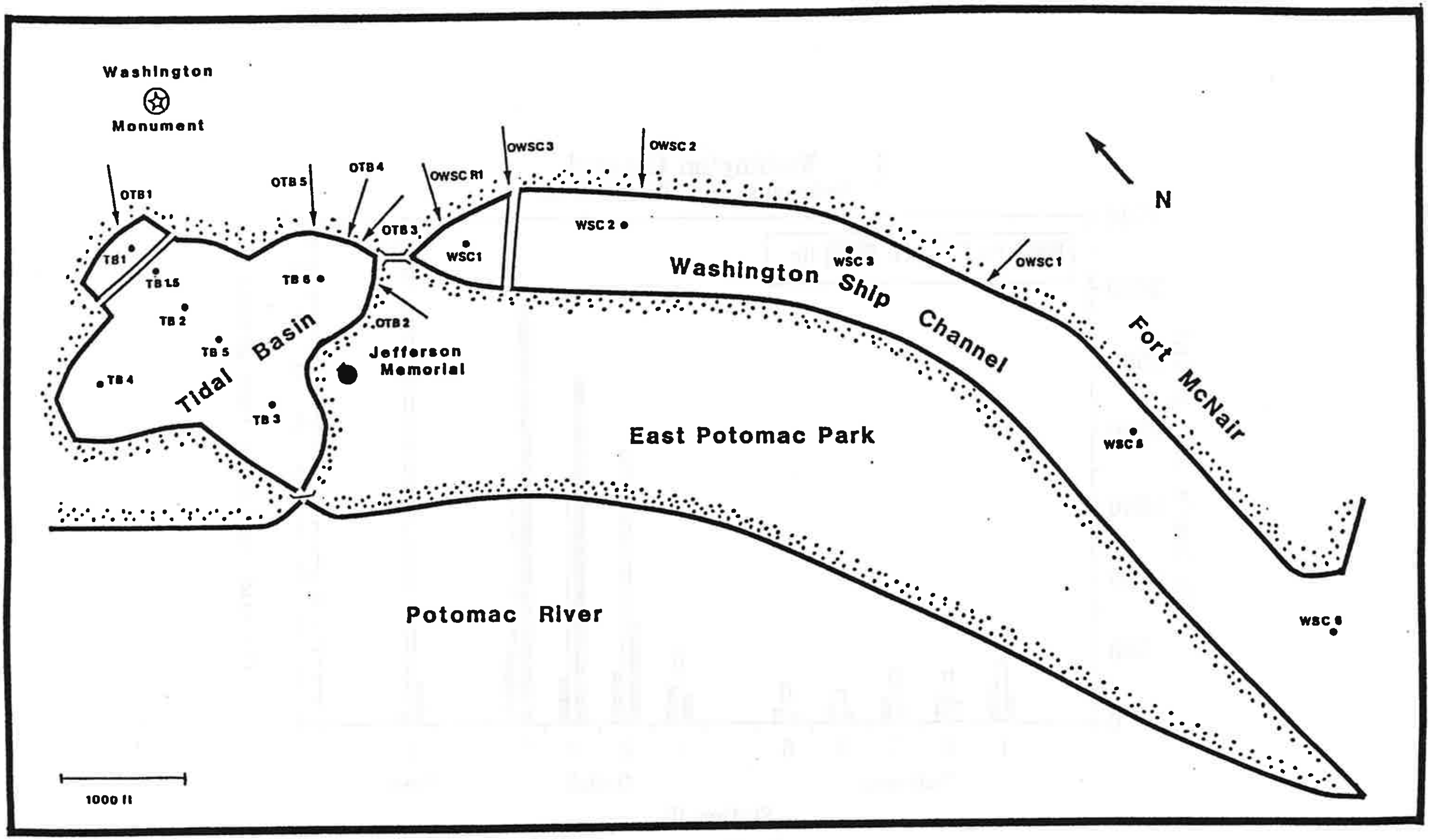


Figure 3-8. Sewer, outfall, and sediment sample locations in the Washington Ship Channel.

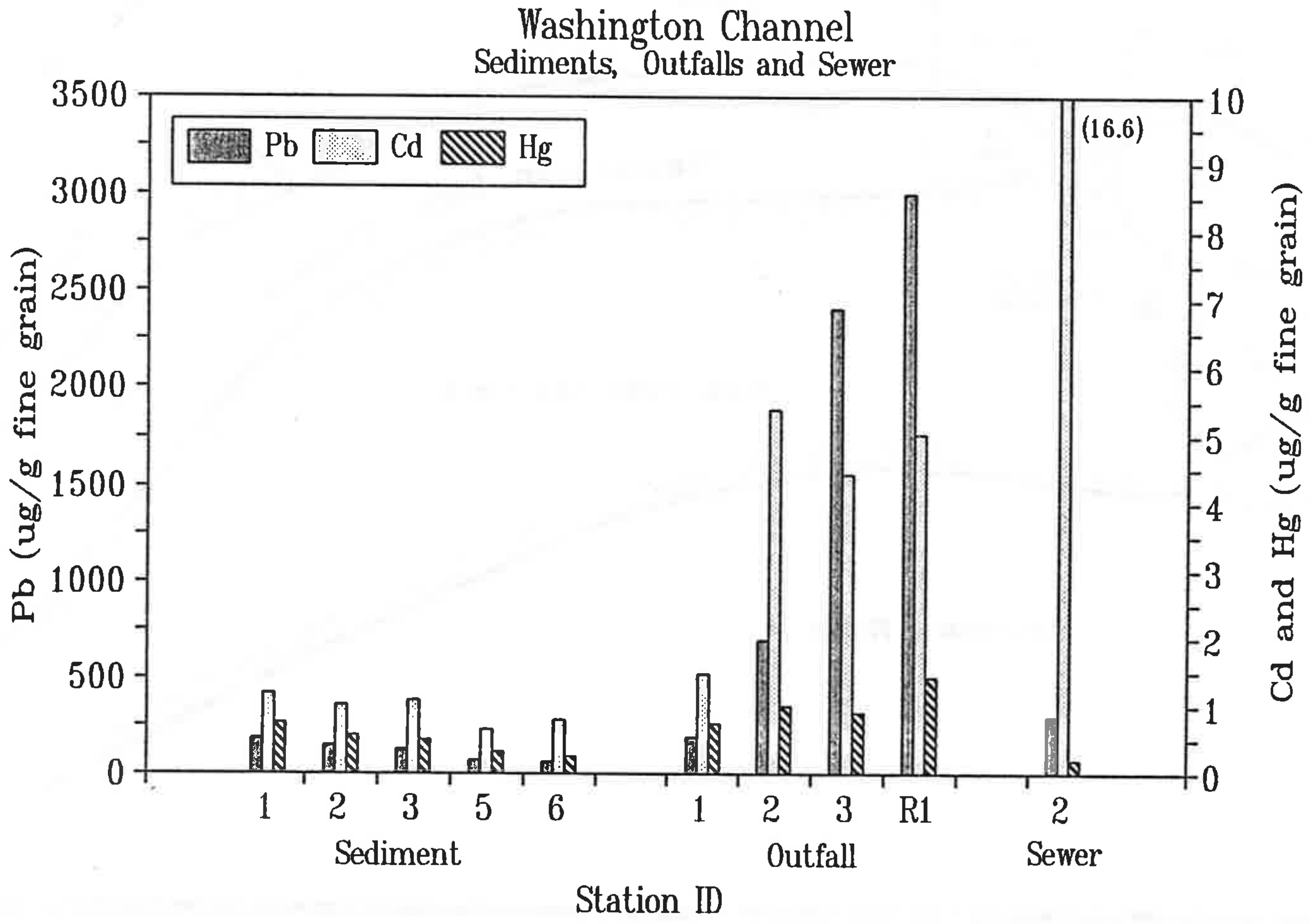


Figure 3-9a. Outfall, sewer and sediments of the Washington Ship Channel: Trace Metals.

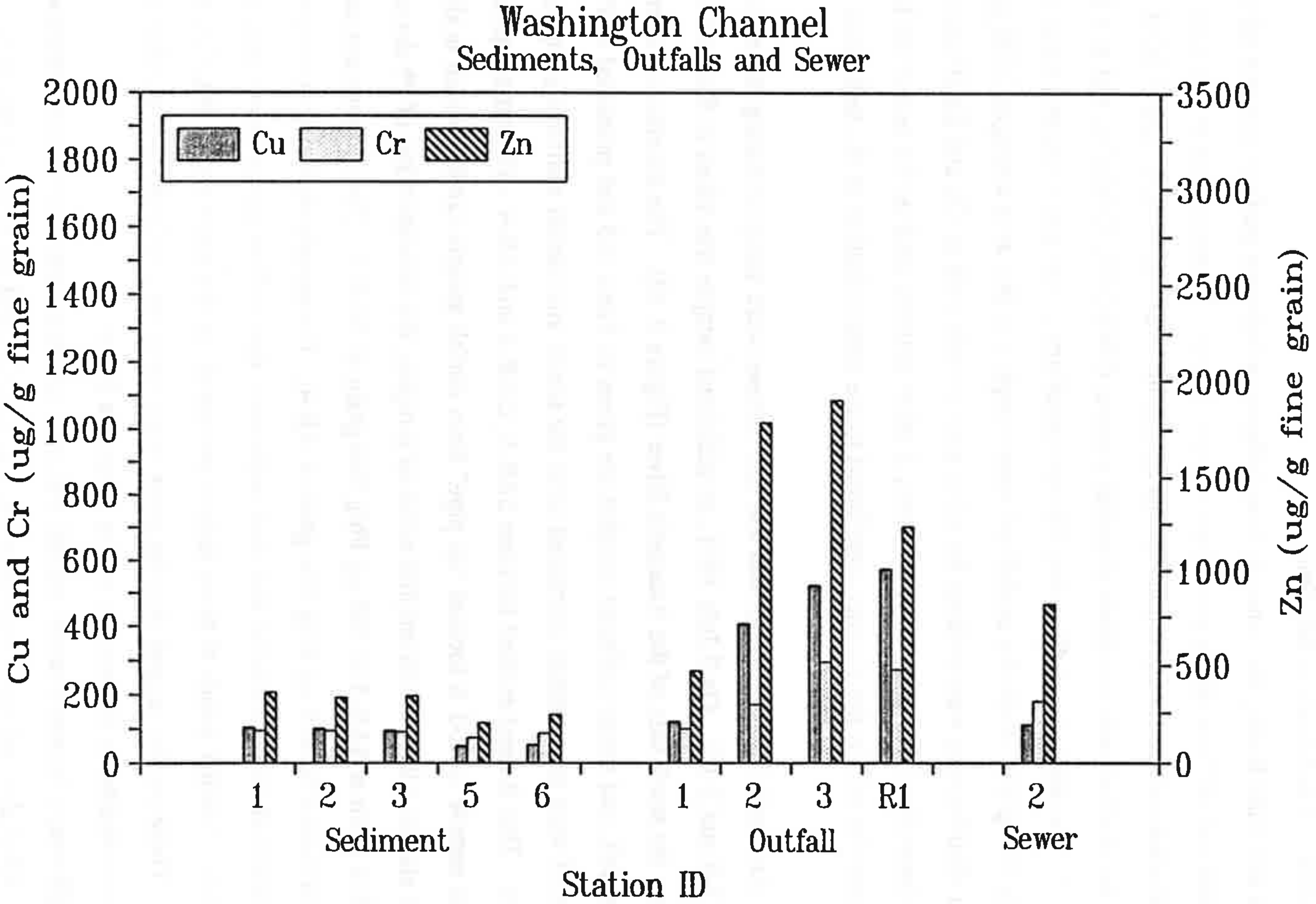


Figure 3-9b. Outfall, sewer and sediments of the Washington Ship Channel: Trace Metals.

as high as some of the outfall sediment concentrations (Table 3-5, Figure 3-9). The concentration of Cd (17 μg Cd/g fine grain) in the sewer sediment sample was substantially higher than either in the outfall or channel sediment samples (overall range = 0.7 to 5.4 μg Cd/g fine grain). The sources of the high Cd levels are unknown at this time.

As in the Tidal Basin, the concentration differences between outfalls and channel sediments samples, indicate runoff from storm sewers are a major source of trace metals to this area. The higher concentrations of sedimentary trace metals at stations WSC-1, WSC-2, and WSC-3 (Figure 3-9) correspond to elevated concentrations at outfall stations OWSC-R1, OWSC-3, and to a lesser extent OWSC-2. For example, sedimentary Pb concentrations in the upper channel ranged from 130 to 190 μg Pb/g fine grain, while the outfall sediment samples in this area averaged 2300 μg Pb/g fine grain. Similar distributions were evident for other trace metals such as Cu and Zn (Figure 3-9). It is impossible to determine from this study, however, if other sources such as the numerous boats and boat related activities within the channel contributed to the contamination of the sediments in the channel.

In the Anacostia River, five outfalls and four sewers were sampled during the course of this study (Tables 2-5 and 3-10). On 7 July 1991, an additional sample was taken in front of a storm sewer outfall on the south side of the Anacostia River (Figure 3-10). The distribution of trace metals in the river, outfall, and sewer sediment samples are given in Table 3-5 and presented in Figure 3-11. Concentrations of most trace metals decreased from the sewer and outfall sediment samples to the river sediments. This is most evident between SAR-5, OAR-3 and AR-4 sediment samples. The sewer sediment sample SAR-5 is located "up pipe" from outfall sample OAR-3 which is slightly upstream from station AR-4. Between this series of samples, the concentration of Pb decreased from 965 μg Pb/g fine grain at SAR-5 to 783 μg Pb/g fine grain at OAR-3. The sedimentary concentration of Pb decreased further to 475 μg Pb/g fine grain at AR-4. The sample collected at station OAR-3 would be a mixture of outfall material and river sediments, thus reflecting the lower concentrations found in the river. Similar trends at these stations are noted for the trace metals Hg, Cd, and Zn (Figure 3-11). These results suggest that the storm water emptying at OAR-3, is a major source of trace metal contamination to this section of the Anacostia River.

The differences between sewer, outfall and river sediment trace metal concentrations at SAR-2, OAR-2 and AR-2 also indicate a source of Pb, Cd, Cu, Cr, and Zn from the sewer system. Concentrations of Pb and Zn, for example, were 37000 and 2300 μg/g fine grain, respectively, at SAR-2. The concentrations of these metals decreased at OAR-2, the outfall of the storm sewer from

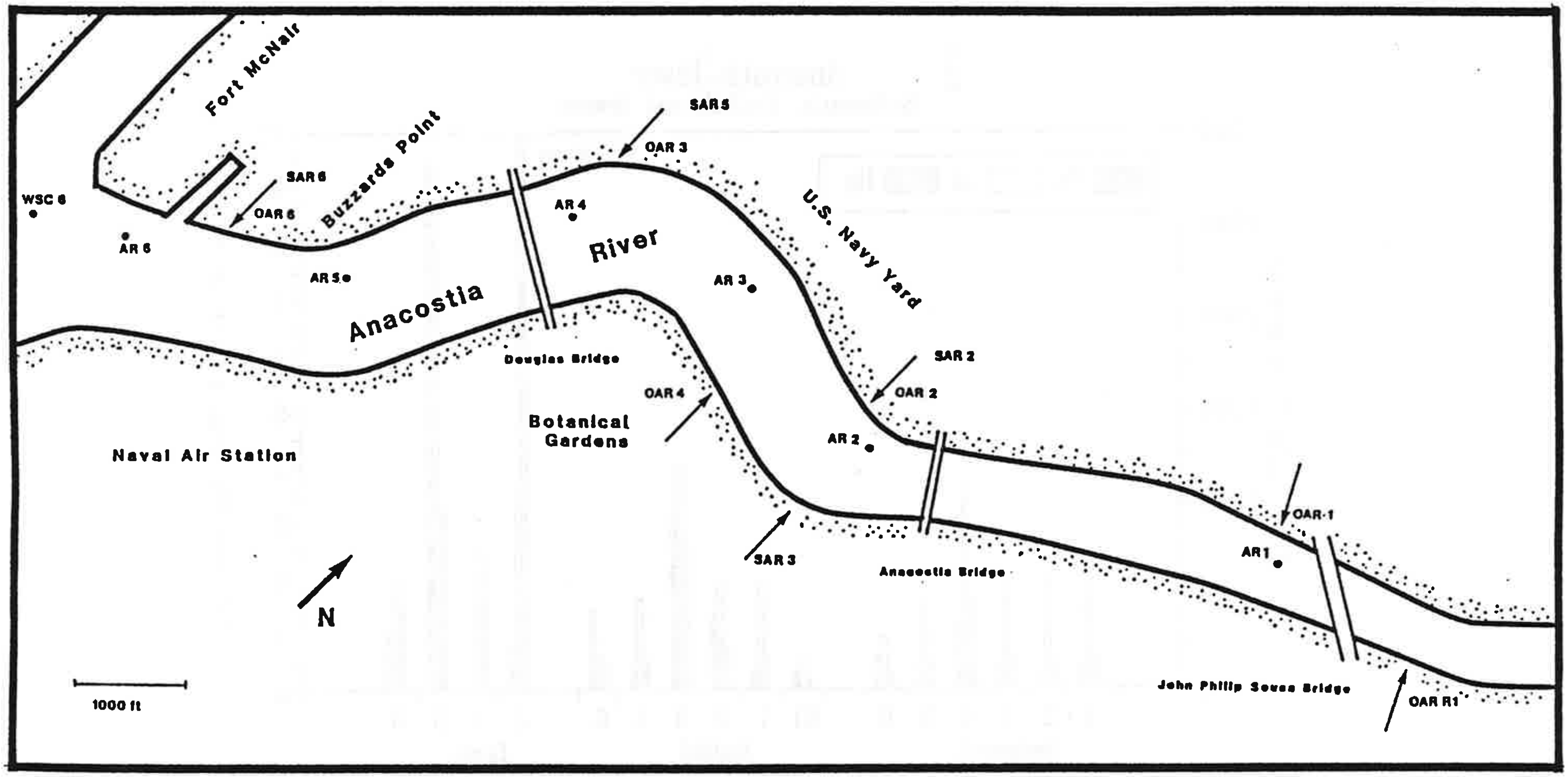


Figure 3-10. Sewer, outfall and sediment sampling locations in the Anacostia River.

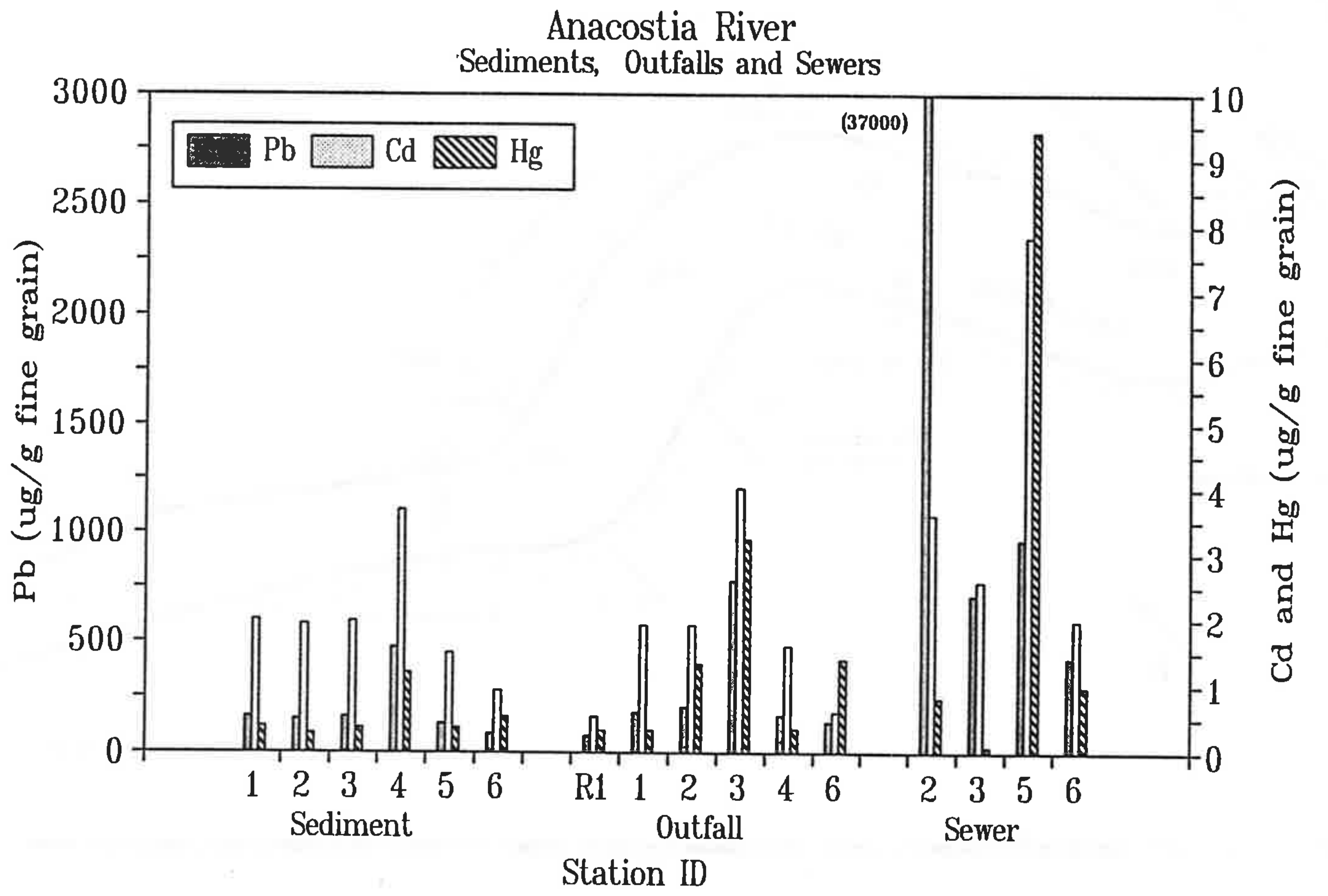


Figure 3-11a. Outfall, sewer and sediments of the Anacostia River: Trace Metals.

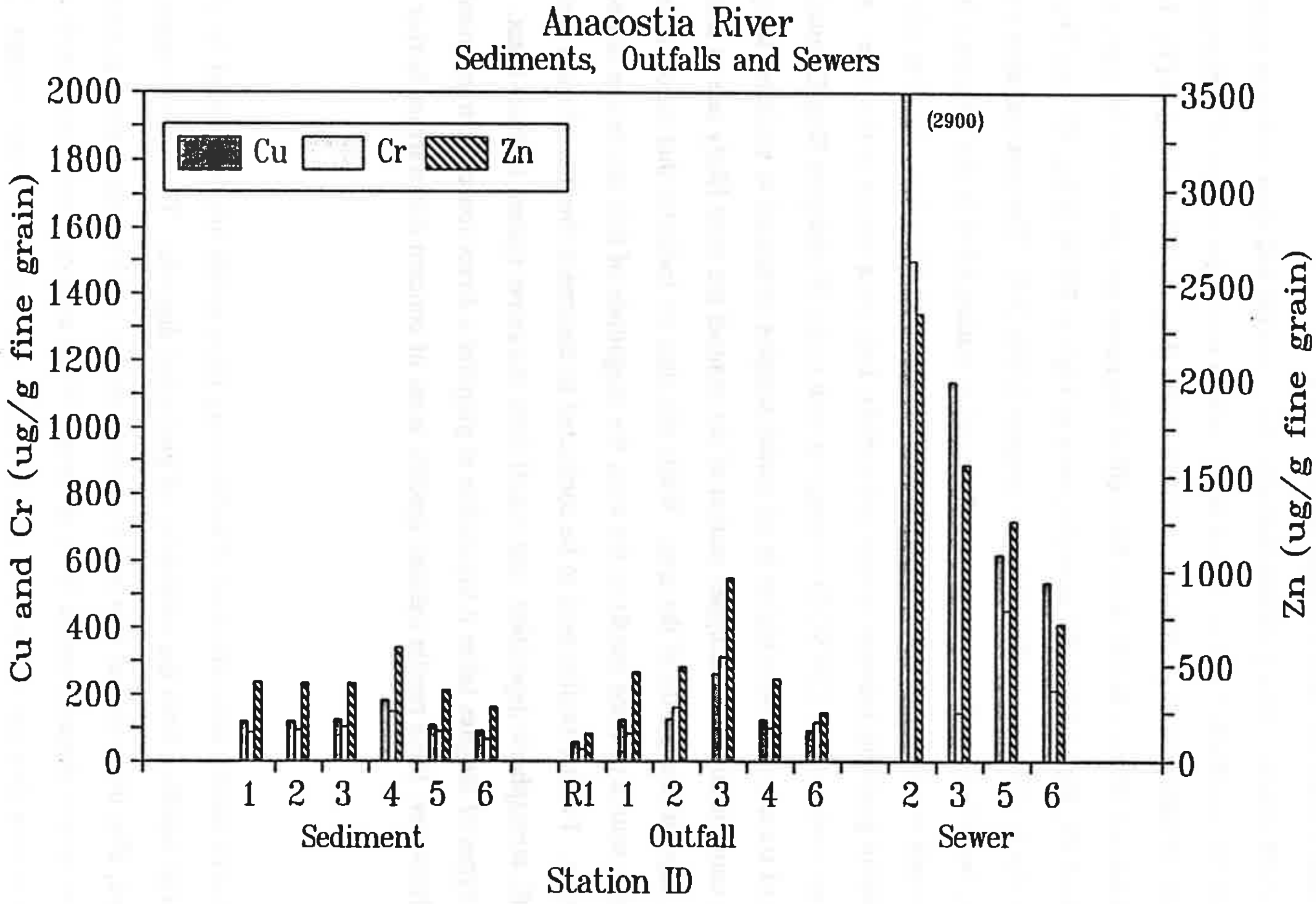


Figure 3-11b. Outfall, sewer and sediments of the Anacostia River: Trace Metals.

which SAR-6 was taken. This decrease was most likely related to the mixing of river sediments with material closer to the outfall. Station AR-2 is located slightly upstream of the outfall, and has concentrations higher than, or similar to, the outfall sediment. The distribution of Hg, however, does not indicate a source from this sewer system (Figure 3-11).

Trace metal concentration gradients between sewer, outfall and river sediment samples suggest that runoff from the stormwater and combined sewer system is a major source of contaminants to the Anacostia River, Washington Ship Channel and Tidal Basin (Figures 3-7, 3-9 and 3-11). In all areas, highest concentrations of trace metals were from either the sewer samples or outfall material. Concentrations of Pb, Hg, and Cd, for example, were as high as 80000 (8%), 50, and 24 μg/g fine grain, respectively in either the outfall or sewer samples (Table 3-5). The concentration trends between sewer, outfall and sediment are especially noted at station AR-4 in the Anacostia River. While there is trace metal contamination of sediments upstream of AR-4 (i.e., KL-5 to AR-3), trace metal concentration gradients between sewers and outfalls indicate a source to the river. Although there is only one sewer sample (SWSC-2) to compare with in the Washington Ship Channel, concentrations of trace metals were higher in all outfall samples compared to sediment samples. The slightly higher concentrations in the upper section of the channel are most likely due to storm water runoff and the depositional nature of the area. While this data set indicates that runoff from the sewer system is a major source of trace metals to the area, the magnitude of this source can not be quantified directly. Further studies need to be conducted to determine the flux of trace metals from upstream runoff, atmospheric deposition, and runoff from the sewer system in these areas. Due to the nature and types of samples taken it impossible to pinpoint a direct source of trace metals from this data set. However, these results indicate specific areas of concern that warrant further investigation.

Excess Metals

Baseline or natural concentrations of sedimentary trace metals are determined largely from inorganic material resulting from the weathering of geological deposits. These rocks consist of quartz, feldspars, clay minerals and iron and manganese oxides and have trace metal concentrations dependent on the source material eroded from the area. When anthropogenic trace metals are introduced to a system they can be adsorbed onto fine-grain material in the water column. Inorganic and organic coatings on the fine-grain suspended material are the main phase for adsorption, and once trace metals are bound to particulate matter the sediment-associated metals can settle and be incorporated into sediment.

Normalization of the sediment to a reference element, not associated with anthropogenic influences, is a convenient approach to determine the degree of sediment contamination. Elements such as aluminum (Al) (Windom et al., 1989; Schropp et al., 1990), lithium (Li) (Loring et al., 1990) and iron (Fe) (Trefrey and Presely, 1976; Sinex and Helz, 1981; Helz et al., 1985) have been used in the past. For this study Fe was chosen as a normalizing element because 1) it is the fourth most abundant metal in the earth with a crustal average of 3.5% (Wedepohl, 1971); 2) in most cases anthropogenic sources are small compared to the amount of Fe naturally present; 3) the ratio of metal to Fe is fairly constant in the Earth's crust. The major caveat in using Fe as a normalizing element, instead of Al or Li, is that Fe undergoes important diagenetic reactions in many sediments. These reactions include dissolution and precipitation of Fe oxides and Fe-sulfur minerals (i.e., pyrite). To test if Fe is as useful as Al as a normalizing agent for this study, a regression would be needed to check if their concentrations are linearly related. Unfortunately, Al was not determined as part of this program. Therefore a regression was done between Fe and Al sedimentary concentrations from other studies within Chesapeake Bay (NOAA, 1991). Chesapeake Bay sediments analyzed within the NOAA (1991) study are from a variety of depositional areas throughout the bay, and may be indicative of the relationship between Al and Fe in this study area. The result of this regression ($r = 0.93$, $n = 57$; $p < 0.01$; $Fe/Al = 0.56$) indicates that Fe is an appropriate normalizing element for Chesapeake Bay sediments and may be useful for this study.

A useful tool in expressing the degree to which a sediment is impacted from anthropogenic sources of trace metals is the enrichment factor (EF) (Trefrey and Presely, 1976; Sinex and Helz, 1981; Helz et al., 1985; Windom et al., 1989). The enrichment factor is defined as: $EF = (X/Fe)_{sediment} /(X/Fe)_{unimpacted\ sediment}$, where X/Fe is the ratio of the trace metal (X) to the amount of Fe in the sample. In using the EF, a comparison to a sediment that is unimpacted by anthropogenic sources is necessary $[(X/Fe)_{unimpacted}]$ (i.e., critical in this analysis is the choice of metal to Fe ratio for "unimpacted" sediments). Past studies have compared sediments to the distribution of trace metals in the earth's crust (Sinex and Helz, 1981; Helz et al., 1985). While this approach is useful, it may not account for natural variations in sediment types of different geological regions. One way to account for this variability is to derive a ratio from "unimpacted" sediments in the general area of interest (Windom et al., 1989; Schropp et al., 1990).

In the present study, all samples have the potential to be impacted above natural levels. Therefore, data from samples taken in the Chesapeake Bay drainage area (including the Potomac

River) were used to derived metal abundances in the general area (NOAA, 1991). Sixteen stations in Chesapeake Bay were used, some of which were sampled over multiple years. The major criterion for the selection of these stations is that they are relatively remote from anthropogenic sources (i.e, Baltimore Harbor and Elizabeth River). The ratios obtained from the regression of the NOAA (1991) data are presented in Table 3-6 along with data from other areas. The ratios derived from Helz et al. (1985) are from the average composition of coastal plain deposits from northern Chesapeake Bay, while the data from core 1314 (Goldberg et al., 1978) are from a location just south of the mouth of the Potomac River. These data, along with values from average continental crust and soils, are similar in magnitude. An average (± SD) metal to iron ratio of 0.04 ± 0.03, 17.8 ± 6.0, 6.6 ± 3.0, 0.04, 5.5 ± 2.6, and 17.7 ± 5.1 is derived for the metals Cd, Cr, Cu, Hg, Pb, and Zn, respectively (Table 3-6). These averages were used to calculate the EF for each station.

The degree to which sediments in the study area are enriched in trace metals from anthropogenic sources varies from metal to metal. These variations can be due to a number of factors including 1) choice of $(X/Fe)_{unimpacted}$; 2) biogeochemistry of the metal; and 3) sources of metals to the study area. While these calculations use the average $(X/Fe)_{unimpacted}$, these values can vary. For example, the Cd/Fe value ranges from 0.01 to 0.09, while the Pb/Fe value ranges from 4.0 to 9.4. While these values may change the magnitude of the EF, the geographic trends should not change. In light of these factors some general trends and features are obtained from the EF data (Table 3-7).

The enrichment factors (EF) are generally highest for Cd and lowest for Cr and Hg (Table 3-7). Intermediate values are evident for Pb, Zn and Cr. Except for Hg, all trace metals are enriched in Kingman Lake and the upper Anacostia River (KL-1 to AR-4). This is especially evident at station AR-4 which has the highest EF in the study area for all trace metals. The EF for all metals decrease in order of $Cd > Pb > Zn > Hg > Cu > Cr$ at station AR-4. Other stations also indicate higher enrichments (and possible sources) of trace metals. These include WSC-1, 2, and 3 in the upper end of the Washington Ship Channel; station PR-1 at the mouth of Rock Creek in the Potomac River; and TB-1 in the northern embayment of the Tidal Basin. The order of enrichment (i.e., $Cd > Pb > Zn > Hg > Cu > Cr$) for these stations are similar to AR-4 with some small variations between Hg and Cu.

The EF indicate that there are important sources of all traces metals to the sediments of the Washington, D.C. area. These source materials are enriched in Cd and Pb relative to the other metals. Areas that are impacted more by anthropogenic sources include the mouth of Rock Creek (PR-1), the northern embayment of the Tidal Basin (TB-1), the upper end of the Washington Ship

Table 3-6. Metal to Iron Ratios used for the Calculation of Enrichment Factors (EF).

Cd	Cr	Cu	Hg	Pb	Zn	Location
0.03	20.0	8.5	0.01	4.2	17.0	Continental Crust[a]
ND	18.8	9.2	ND	9.4	25.0	Soils[b]
0.01	11.8	3.6	ND	4.4	14.1	St. Mary's County Coastal Deposit[c]
0.01	24.0	2.1	ND	3.9	14.5	Ann Arundal County Deposits[c]
0.09	9.4	8.1	0.06	NS	NS	Chesapeake Bay Sediments[d]
0.05	23.0	8.1	ND	NS	NS	Core 1314[e], Mouth of Potomac River
0.04	17.8	6.6	0.04	5.5	17.7	Average
0.03	6.0	3.0		2.6	5.1	± Standard Deviation (1σ)

Values are the ratio of total metal ($\mu g/g$) to total Fe (%). [a]Wedepohl, 1971; [b]Martin and Whitfield, 1983; [c]Helz et al., 1985; [d]NOAA, 1991; [e]Goldberg et al., 1978. ND - No Data; NS - regression between metal and iron was not significant at the $p<0.05$ level, whereas other metals were significant at the $p<0.01$ level ($n > 50$).

Table 3-7. Trace metal enrichment factors (EF) for the sediments of the Washington, D.C. area*.

Sta. ID.	Cd	Cr	Cu	Hg	Pb	Zn
KL-1	9.4	1.5	2.4	1.7	6.0	4.8
KL-2	11.0	1.5	2.8	2.1	6.7	5.2
KL-3	11.6	1.4	3.2	2.1	6.8	5.3
KL-4	11.5	1.4	3.5	2.7	8.7	6.2
KL-5	11.5	1.4	2.6	2.0	6.0	5.4
AR-1	11.0	1.5	2.9	2.2	6.5	5.1
AR-2	10.6	1.4	3.1	1.6	5.9	4.9
AR-3	10.2	1.4	3.2	1.9	5.9	4.8
AR-4	19.0	2.1	4.6	6.2	17.7	6.9
AR-5A	7.1	1.2	2.6	1.7	4.5	4.0
AR-6	4.8	1.1	2.0	2.8	3.1	3.3
WSC-1	5.9	1.0	3.1	3.7	6.6	4.0
WSC-2	5.2	1.1	3.0	2.9	5.3	3.8
WSC-3	5.2	1.0	2.7	2.5	4.4	3.7
WSC-5	3.9	1.0	1.7	1.9	3.0	2.7
WSC-6	4.1	1.0	1.7	1.3	2.4	2.9
PR-1	5.6	1.2	2.0	3.2	5.2	4.6
PR-2	3.5	1.0	1.3	1.0	1.5	2.4
PR-3	3.5	0.9	1.4	0.9	1.6	2.6
PR-4A	3.6	1.0	1.4	0.9	1.8	2.6
TB-1	8.5	1.1	3.7	2.3	7.6	4.5
TB-1.5	ND	ND	ND	ND	ND	ND
TB-2	4.6	1.1	1.8	1.4	3.4	3.2
TB-3	4.8	1.1	1.7	1.6	5.1	3.1
TB-4	4.8	1.1	2.0	1.4	3.7	3.2
TB-5A	4.5	1.0	1.8	1.4	3.1	3.1
TB-6	4.8	1.1	1.8	1.4	3.4	3.3

*Enrichment factor = $(X/Fe)_{sediment}/(X/Fe)_{unimpacted}$, where X is the trace metal of interest and the $(X/Fe)_{unimpacted}$ values are taken from Table 3-6. ND - No data.

Channel (WSC-1 to WSC-3), and the upper Anacostia River and Kingman Lake (AR-4 to KL-5). The enrichment in the Tidal Basin is likely due to the large storm sewer that drains the area around the Mall of the Smithsonian and Constitution Ave. In the Anacostia River, increased levels of enrichment at AR-4, just downstream of the Washington Navy Yard, are probably due to the storm and combined sewers located just above this station. The degree to which stations above AR-4 are enriched may be due to multiple sources and a net deposition in this area. From AR-4 to KL-1 there are numerous storm and combined sewers that drain into this area (Table 2-1). In the Kingman Lake area (KL-1 to Kl-4), runoff from R.F.K. stadium and the surrounding environment could be a major source of trace metals.

Sedimentary Organics

A) Hydrocarbons

Sedimentary hydrocarbons exhibited a wide range in concentrations throughout the study area. These variations are due to transport processes, biological and chemical differences between individual compounds (i.e., water solubility, volatility, and weathering and microbial degradation rates), and the different possible sources of these compounds. Sedimentary concentrations of total hydrocarbons, and the different fractions that compose it are presented in Table 3-8. The concentrations of individual compounds are given in Appendix II.

In this study the total sedimentary hydrocarbons were broken down into three fractions: saturated hydrocarbons (SHC), polycyclic aromatic hydrocarbons (PAH), and the unresolved complex mixture (UCM). The UCM contains co-eluting compounds that are not resolved by current capillary gas chromatographic techniques, and is thought to be mainly alicyclic hydrocarbons. Saturated hydrocarbons are the sum of normal alkanes from n-C_{13} to n-C_{34} including the isoprenoids pristane and phytane, while PAHs are the sum of 44 individual aromatic hydrocarbons (Appendix I). Total hydrocarbons (THC) are the sum of the SHC, PAH, and the UCM and represent the hydrocarbons extracted under the procedures used in this study (see Chapter II). While PAHs are potentially more harmful to aquatic organisms then SHC or possibly UCM, the molecular distribution and abundance of the UCM, SHC and PAH provide a wealth of information concerning the sources and transformations of bulk hydrocarbons.

The sources and nature of hydrocarbon geochemistry can be revealed by the distribution of the individual compounds that comprise saturated (SHC) and aromatic hydrocarbons (PAH) (Farrington, 1980; Hites et al., 1980; Wakeham et al., 1980; Boehm and Farrington, 1984; Boehm,

Table 3-8. Sedimentary concentrations of hydrocarbons from the various study areas*.

Sta. ID.	Total PAH	Total SHC	UCM	THC
KL-1	16.08	17.67	910.57	944.32
KL-2	15.26	14.92	1000.60	1030.78
KL-3	14.19	15.21	2089.70	2119.10
KL-4	10.31	15.85	1267.79	1293.95
KL-5	9.76	27.94	852.24	889.94
AR-1	14.39	12.74	902.10	929.24
AR-2	15.07	22.13	1367.61	1404.80
AR-3	13.18	12.07	855.53	880.78
AR-4	28.27	31.04	1539.30	1598.61
AR-5A	9.56	10.69	783.70	803.95
AR-6	5.68	6.25	350.40	362.33
OAR-1	23.71	26.20	1457.84	1507.75
OAR-2	28.58	21.55	876.11	926.24
OAR-3	23.61	14.85	393.54	432.00
OAR-4	19.06	15.54	1191.57	1226.17
OAR-6	36.95	6.11	116.83	159.89
OAR-R1	11.52	7.50	580.50	599.52
SAR-2	32.07	9.66	468.80	510.53
SAR-3	5.76	2.24	393.10	401.10
SAR-5	39.57	25.36	901.20	966.14
SAR-6	8.74	7.52	499.90	516.16
WSC-1	7.16	8.41	384.63	400.21
WSC-2	7.18	8.83	451.20	467.21
WSC-3	6.34	6.23	430.30	442.87
WSC-5	8.73	6.12	105.80	120.65
WSC-6	5.59	17.31	280.80	303.70
OWSC-1	9.91	66.17	603.60	679.68
OWSC-2	44.16	36.06	951.89	1032.12
OWSC-3	129.95	6.59	293.00	429.54
OWSC-R1	78.27	54.46	4075.00	4207.74
SWSC-2	4.37	3.71	555.30	563.38
PR-1	29.15	5.87	132.05	167.07
PR-2	3.58	13.48	109.60	126.65
PR-3	3.74	13.36	92.68	109.78
PR-4A	3.61	12.99	109.33	125.94
TB-1	11.60	3.71	379.60	394.90
TB-1.5	9.75	14.79	595.13	619.67
TB-2	3.80	3.46	161.90	169.16
TB-3	8.69	18.27	299.70	326.66
TB-4	4.93	12.21	438.54	455.69
TB-5A	4.79	12.32	331.55	348.66
TB-6	3.82	3.82	171.20	178.84
OTB-1-1	6.88	1.19	86.10	94.17
OTB-1-2	8.01	10.66	285.10	303.77
OTB-2	10.58	2.96	143.00	156.54
OTB-3	4.96	5.92	448.83	459.71
OTB-4	11.61	22.06	629.18	662.85
OTB-5	10.65	21.98	738.76	771.39
STB-2-1	9.04	12.11	1474.64	1495.79
STB-2-2	8.60	11.25	965.28	985.13

*Concentrations in μg per gram dry weight. PAH-polycyclic aromatic hydrocarbons; SHC-saturated hydrocarbons; UCM-unresolved complex mixture; THC-total hydrocarbons. Station IDs. starting with (O) indicate samples that were taken directly in front of an outfall, while (S) indicates samples that were taken in a sewer. Stations AR-5, PR-4 and TB-5 were sampled and analyzed in triplicate and the average value is reported.

1984; Pruell and Quinn, 1985). For example, biogenic SHC from terrestrial plants are indicated by higher molecular weight alkanes with a predominance of odd over even n-alkanes. The distribution of even- and odd-numbered alkanes is approximately unity for petroleum hydrocarbons. The n-paraffins are indicative of recent inputs of hydrocarbons (i.e., they are first to be microbially degraded). Petroleum hydrocarbons are indicated by higher amounts of the UCM with a greater range in the amount and structure of compounds within the SHC and PAH fractions (Farrington and Meyers, 1975; Farrington and Tripp, 1977). In fact, the ratio of resolved saturated and aromatic peaks to the UCM has been used as an indication of petroleum inputs to sediments (Farrington and Quinn, 1973). Within the aromatic hydrocarbons, the various alkyl-substituted naphthalenes (i.e., C_1, C_2, C_3) have not been found in organisms and are thought to be derived from petroleum contamination. PAHs can also help discriminate between combustion sources of hydrocarbons and those derived by the direct discharge of oil. Oil contains a greater percentage of alkyl-substituted compounds in the naphthalene, phenanthrene-anthracene, and chrysene series. Refined petroleum products would have a greater abundance of lower than higher molecular weight compounds. The partial combustion of oil reduces the amount of alkyl-substituted compounds leaving the parent structure in greater abundance (Youngblood and Blumer, 1975). Some of the general differences between biogenic and petroleum sources of hydrocarbons are summarized in Table 3-9. These differences will be exploited in the following discussions in evaluating the source of hydrocarbon contamination to the sediments of the various study areas.

Distribution and Geographic Trends

Sedimentary concentrations of the different hydrocarbon fractions are presented in Table 3-8. Sediment concentrations of a selected group of PAHs, total DDT, total chlordane and total polychlorinated biphenyls (PCB) were compared for specific locations between this study and ICPRB (1990) (Table 3-10). This was done to appraise the results from the first study and help set a baseline to assess future trends. DDT is the sum of DDT (1,1-(2,2,2-trichloroethylidene)bis[4-chlorobenzene]) and its breakdown products, DDE (1,1-(2,2,2-trichloroethenylidene)bis[4-chlorobenzene]) and DDD (1,1-(2,2-dichloroethylidene)bis[4-chlorobenzene]), including the o+p and p+p isomers. Polychlorinated biphenyls (PCB) are the sum of the 209 possible individual PCB congeners, while total chlordane is the sum of $\Gamma+\alpha$-chlordane and cis+trans + nonachlordane. Polycyclic aromatic hydrocarbon sediment concentrations are higher in ICPRB (1990) than in the present study except for the locations corresponding to AR-6 and PR-1. The concentrations of total PCB agree fairly well

Table 3-9. General Characteristics of Biogenic and Petroleum Hydrocarbons*.

Natural Biogenic Hydrocarbons
Narrow range of molecular weight distribution of SHC and PAH (if present), UCM is either low or absent.
Odd- to even-numbered alkane ratio is > 1.
Terrestrial plant material indicated by an alkane distribution from nC_{23} to nC_{34}, centered around nC_{29} or nC_{31}.
Aquatic organisms have a predominance of nC_{13} to nC_{21} alkanes with an greater amounts of odd-numbered compounds.

Fossil Fuel or Petroleum Hydrocarbons
Wider range in molecular weight distribution of both SHC and PAH, UCM is present in large amounts compared to alkanes and PAHs.
Odd- to even-numbered alkane ratio = 1.
Several homologous series with adjacent members in approximately the same concentrations.
Natural source sources of PAH indicated by less complex distribution with compounds related to structure of precursors (i.e., perylene and retene).
Direct discharge of oil is indicated by PAHs (e.g., naphthalene, phenanthrene-anthracene, and chrysene series) contains many alkyl-substituted species (i.e., C_1, C_2 and C_3).
Combustion products have a greater abundance of un-substituted parent compounds, with homologs which decrease in abundance as the degree of alkyl substitution increases.
UCM present in greater proportion than resolved peaks.

* Taken from Youngblood and Blumer, 1975; Farrington, 1980; Hites et al., 1980; Wakeham et al., 1980; Boehm and Farrington, 1984; Boehm, 1984; Pruell and Quinn, 1985; Pierce et al., 1986.

Table 3-10. Comparison between Phase I (ICPRB, 1990) and present study for selected organics in the different study areas*.

Sta.ID.	PAH[1]	PCB[2]	DDT[3]	Chlordane[4]
Anacostia River				
No.22	16.12	0.48	37.30	86.00
KL-4	6.07	0.51	76.40	153.00
ANA-12	17.22	0.43	30.40	96.00
KL-5	6.27	0.66	78.00	139.00
ANA-17	15.54	0.38	40.40	48.00
AR-2	8.71	0.50	56.00	91.10
ANA-21	44.97	1.80	8.10	105.00
AR-4	10.10	2.20	123.80	88.50
ANA-24	11.35	0.36	30.60	22.00
AR-6	29.30	0.22	28.70	27.60
Tidal Basin				
No.15	11.27	1.20	99.00	15.30
TB-6	1.91	0.15	28.80	7.47
Potomac River				
PMS-13	4.78	0.12	22.90	16.60
PR-1	16.30	0.26	103.00	41.60
Washington Ship Channel				
PWC-06	6.66	0.65	28.10	15.40
WSC-2	3.66	0.33	35.90	18.61

*Concentrations for PAH and PCB in μg per gram dry weight, and for DDT and total chlordane in ng per gram dry weight. [1]Sum of 15 individual PAH; [2]Sum of 209 congeners; [3]Total DDT = DDD+DDE+DDT; [4]Sum of $\Gamma+\alpha$-chlordane and cis+trans + nonachlordane.

between studies except for the station in the Tidal Basin. Within a factor of 2 or 3, both DDT and chlordane are similar for both studies except at stations AR-4, TB-6, PR-1 for DDT and PR-1 for chlordane. While the trace metal results show good agreement between data sets (Table 3-2), PAH, PCB, DDT and chlordane exhibit more variation between data sets (Table 3-10). There is no discernible trend in the variations between the present data set and that of ICPRB (1990). It is impossible to determine the actual cause of the observed differences, but they could result from both temporal and spatial changes between the two studies as well as methodological differences between the two laboratories.

The concentrations of total sedimentary hydrocarbons (THC) in the Potomac River ranged from 110 to 167 μg THC/g (Table 3-8). The highest concentration was at station PR-1 which is located near the mouth of Rock Creek (Figure 2-1). For all sediment samples in the Potomac River the UCM was the dominant component of the THC with the remaining being either PAH or SHC (Table 3-8). The UCM to THC ratio averaged 0.84 ± 0.04 and is the lowest of all sediment samples in this study. Of particular interest to this study is the concentration and distribution of PAHs. Polycyclic aromatic hydrocarbons, compared to either SHC and UCM, have been shown to have a significant effect on the mortality, abundance and diversity of benthic organisms (see Chapter IV). Sediment concentrations of PAHs were highest at PR-1 (29 μg PAH/g), and due to the greater abundance of sand-sized material at PR-1 (Table 3-1), concentrations are higher on a normalized basis. The concentration of PAHs at PR-1 was the highest for all sediment samples (excluding the outfall and sewer samples) in this study. Stations PR-2, PR-3, and PR-4(a,b,c) had uniform PAH concentrations, with an average of 3.6 ± 0.4 μg PAH/g (n=5, station PR-4 was sampled in triplicate, see below). The higher concentrations of both PAHs and the UCM indicate a greater amount of anthropogenic hydrocarbons at PR-1, most likely due to runoff from Rock Creek which drains through northwest Washington.

In the Tidal Basin, total sedimentary hydrocarbons (THC) ranged from 169 to 613 μg THC/g (Table 3-8). While the highest concentrations were found at TB-1.5, which is located near the Kutz Bridge (Figure 2-1), there are no significant trends in the distribution of THC. PAHs concentrations ranged from 0.4 to 11.6 μg PAH/g within the Tidal Basin. The higher concentrations of PAH at TB-1 and TB-1.5 may be due to their proximity to the large storm sewer that empties near TB-1 and the vehicular traffic on Kutz Bridge near TB-1.5. Grain size differences among stations are small (Table 3-1), and would contribute little to the overall variability in the distribution of hydrocarbons.

Concentrations of total hydrocarbons (THC) ranged from 120 to 467 μg THC/g in the surficial sediments of the Washington Ship Channel. The highest sediment concentrations were at stations WSC-1, WSC-2, and WSC-3, located at the upper end of the channel (Table 3-8). This area also had the highest concentration of trace metals and may have similar sources. As in the other areas, THCs are dominated by the UCM (UCM/THC $\geq$ 0.95) and suggests that the hydrocarbons are composed mainly of weathered petroleum products (Table 3-9). Sediment PAH concentrations were fairly uniform throughout the channel with an overall average of 7.0 ± 1.0 μg PAH/g (n=5) for all stations.

Of all the study areas, concentrations of sedimentary THC were highest in Kingman Lake (Table 3-8). Concentrations ranged from 944 to 2120 μg THC/g within the lake and 890 μg THC/g at KL-5, which is located in the Anacostia River at the southern entrance to Kingman Lake. PAH concentrations ranged from 10 to 16 μg PAH/g in the lake with highest values at KL-1. At station KL-5, the concentration of PAHs was approximately 10 μg PAH/g (Table 3-8).

In the Anacostia River, data are presented in a similar manner as the trace metals. Stations KL-5 and PR-4A, along with those in the Anacosita River, were compared to asses geographical trends (Figure 2-1). This transect includes WSC-6, which is located at the confluence of the Anacostia River and the Washington Ship Channel. From the southern entrance to Kingman Lake (KL-5) to just below the Washington Navy Yard (AR-4), concentrations of THC ranged from 880 to 1600 μg THC/g, with highest concentrations at AR-4. Sediment concentrations of PAHs and UCM were also highest at AR-4 and indicate a possible "local" source of hydrocarbons. A substantial decrease in the concentrations of THC and PAHs occurred below the South Capitol Street Bridge (AR-4). At the most downstream station (PR-4A), concentrations of THC and PAHs were some of the lowest in this study; 126 μg THC/g and 4.4 μg PAH/g, respectively. These trends are similar to trace metals, most notably Pb, and indicate a substantial local source of sediment contamination near the Washington Navy Yard and the South Capital Street Bridge.

Several stations during this study were sampled and analyzed in triplicate to asses the small scale spatial variability of this area. For this, at 3 stations, 3 samples of three grabs each were taken within approximately 5 m of each other (Table 3-11). At the Potomac River station, PR-4, THC concentrations agreed to within ± 11% RSD (relative standard deviation) (Table 3-11). The %RSD was slightly higher, but well within reason, for the individual components of the THC with the relative standard deviation for total PAHs, SHCs, and UCM of ± 13%, ± 20%, and ± 12%, respectively. In the Tidal Basin (TB-5), PAH concentrations agreed to within ± 5% (relative standard deviation) for all three samples, however concentrations of both SHC and UCM were

Table 3-11. Results from triplicate analysis of 3 separate samples from the Anacostia and Potomac Rivers and Tidal Basin*.

Sta. ID.	Total PAH	Total SHC	UCM	THC
Anacostia River				
AR-5a	9.83	11.11	905.40	926.34
AR-5b	8.76	8.27	616.80	633.83
AR-5c	10.09	12.70	828.80	851.59
Average	9.56	10.69	783.67	803.92
± SD	0.57	1.83	122.07	124.08
Potomac River				
PR-4a	4.23	16.67	109.30	130.20
PR-4b	3.48	11.68	125.30	140.46
PR-4c	3.13	10.63	92.90	106.66
Average	3.61	12.99	109.17	125.77
± SD	0.46	2.63	13.23	14.15
Tidal Basin				
TB-5a	4.57	12.75	316.90	334.22
TB-5b	5.10	33.75[1]	2197.80[1]	2236.65[1]
TB-5c	4.71	11.88	346.20	362.79
Average	4.79	12.32	331.55	348.66
± SD	0.22	NC	NC	NC

* All concentrations are in μg per gram dry weight. At each station, three samples of three grabs each were taken within approximately 5 m of each other. ± SD is the standard deviation (1σ). [1] Data not included in average. NC - Not calculated.

significantly higher for sample TB-5b (Table 3-11). The THC, which is predominately UCM, also reflected this distribution. It is unclear why the SHC and UCM are elevated in TB-5b. The QA/QC data (see Appendix I) does not indicate significant discrepancies for yields and surrogate recoveries between this set. Also, trace metal (Table 3-3), TOC and grain size data (Table 3-1) do not reflect the differences seen in the SHC and UCM data. Due to the close agreement between TB-5a and TB-5c for both the SHC and UCM, the data for TB-5b is not included in the average and further discussions. Samples are currently being reanalyzed to investigate the variations in SHC and UCM. Concentrations of PAHs at AR-5 in the Anacostia River agreed to within ± 6% RSD, and the SHCs, UCM and THCs exhibited slightly greater variability of ± 16% RSD (Table 3-11).

These results, along with the TOC and grain size data (Table 3-4) indicate that the variability of the "local" area is smaller than some of the geographic trends seen in the data set. This may not be the case however, for other study areas in which the grain size and total organic carbon (TOC) vary significantly.

Comparison between Sediments, Outfalls and Sewers

One of the objectives of this study was to evaluate the possible sources of organic contaminants to river sediments of the Washington, D.C. area. To address this objective, sediment samples were collected directly in front of outfalls of various storm and combined sewers in the Tidal Basin, Washington Ship Channel, and Anacostia River. Sediment samples were also taken <u>in</u> specific combined and storm sewers that drain into these areas (see Chapter II for sampling details). In this section, outfall sediment samples, denoted with the prefix (O), and sewer sediment samples, denoted with the prefix (S), are compared to sediment concentrations in each respective area (i.e., basin, channel or river).

To provide a common basis for the comparison of sediment hydrocarbons between outfall, and sewer sediment samples and river, basin or channel sediments, concentrations were divided by the fraction of fine grain sediment (Table 3-1) in each sample (i.e., μg/g fine grain). This normalization procedure is similar to that used for the trace metal data (see above), and the normalized data are presented in Table 3-12.

Total (THC) and polycyclic aromatic hydrocarbon (PAHs) concentrations in the sediment, outfall and sewer samples from the Tidal Basin are given in Table 3-12 and presented in Figure 3-12. Concentrations of both THC and PAHs were substantially elevated, compared to basin sediments, at all but one outfall (OTB-1-2). Concentrations of THC ranged from 375 to 3800 μg THC/g fine grain

Table 3-12. Concentrations of hydrocarbons normalized to the fraction of fine grain sediment*.

Sta. ID.	Total PAH	Total SHC	UCM	THC
KL-1	18.45	20.27	1044.71	1083.43
KL-2	15.71	15.36	1030.06	1061.13
KL-3	14.22	15.24	2094.10	2123.56
KL-4	11.84	18.20	1455.39	1485.42
KL-5	10.97	31.42	958.65	1001.05
AR-1	16.72	14.81	1048.10	1079.63
AR-2	15.15	22.25	1375.03	1412.43
AR-3	13.25	12.13	860.09	885.47
AR-4	32.86	36.09	1789.68	1858.63
AR-5A	9.62	10.77	789.14	809.53
AR-6	5.73	6.30	353.44	365.47
OAR-1	26.26	29.02	1614.62	1669.90
OAR-2	31.43	23.69	963.18	1018.30
OAR-3	105.73	66.50	1762.37	1934.60
OAR-4	21.35	17.40	1334.49	1373.24
OAR-6	44.52	7.37	140.75	192.64
OAR-R1	20.95	13.64	1055.45	1090.04
SAR-2	146.86	44.22	2146.52	2337.59
SAR-3	40.07	15.62	2735.56	2791.25
SAR-5	184.50	118.24	4201.40	4504.13
SAR-6	38.58	33.20	2207.06	2278.84
WSC-1	7.27	8.53	390.33	406.13
WSC-2	7.21	8.87	453.10	469.18
WSC-3	6.36	6.25	431.72	444.33
WSC-5	12.65	8.87	153.33	174.85
WSC-6	5.65	17.49	283.64	306.77
OWSC-1	11.66	77.85	710.12	799.62
OWSC-2	72.40	59.12	1560.48	1692.00
OWSC-3	618.81	31.40	1395.24	2045.45
OWSC-R1	128.31	89.28	6680.32	6897.93
SWSC-2	17.48	14.84	2221.20	2253.52
PR-1	37.31	7.51	169.01	213.83
PR-2	4.12	15.52	126.22	145.86
PR-3	4.14	14.77	102.52	121.44
PR-4A	3.84	13.79	116.03	133.65
TB-1	11.94	3.82	390.94	406.70
TB-1.5	9.88	14.99	603.22	628.09
TB-2	5.41	4.93	230.69	241.04
TB-3	11.05	23.22	380.96	415.23
TB-4	4.96	12.27	440.53	457.75
TB-5A	4.85	19.69	965.20	989.75
TB-6	3.84	3.85	172.29	179.97
OTB-1-1	NC	NC	NC	NC
OTB-1-2	9.89	13.16	351.98	375.03
OTB-2	52.90	14.80	715.00	782.70
OTB-3	38.16	45.54	3452.56	3536.26
OTB-4	61.08	116.09	3311.50	3488.67
OTB-5	46.30	95.56	3212.00	3353.86
STB-2-1	23.18	31.05	3781.13	3835.36
STB-2-2	16.86	22.06	1892.70	1931.63

* Concentrations in μg per gram fine grain sediment (silt+clay). Station IDs. starting with (O) indicate samples that were taken directly in front of an outfall, while (S) indicates samples that were taken in a sewer. Stations AR-5, PR-4 and TB-5 were sampled and analyzed in triplicate and this is the average value. NC - Not Calculated (no grain size data).

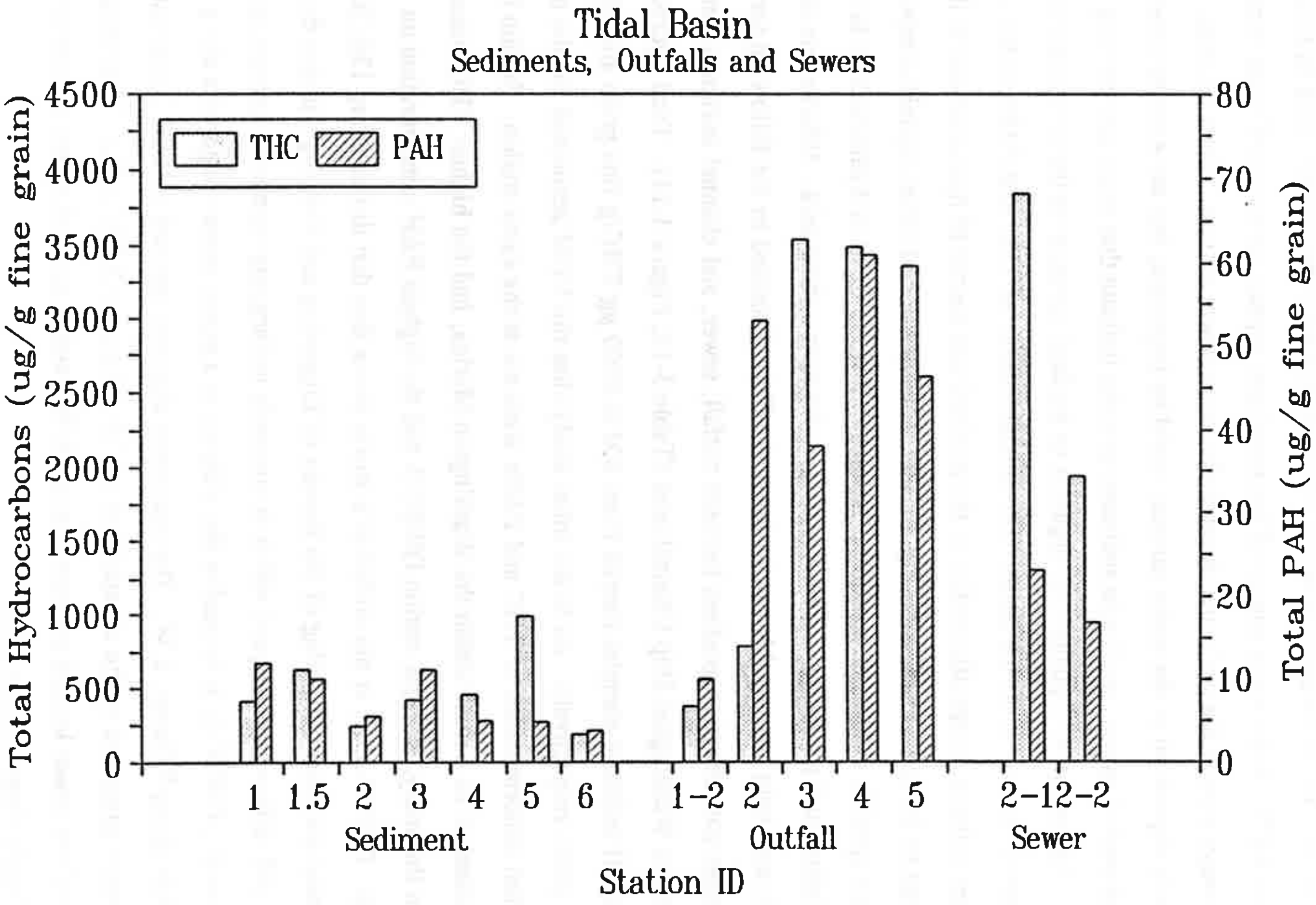


Figure 3-12. Outfall, sewers and sediment of the Tidal Basin: Hydrocarbons.

from the outfall and sewer sediment samples, compared to 180 to 1000 μg THC/g fine grain for basin sediment. For all samples, the unresolved complex mixture (UCM) accounted for the majority of the THC (ca. ≥ 95%). PAH concentrations in outfall and sewer sediment samples ranged from 10 to 60 μg PAH/g fine grain. These concentrations are substantially higher than those found in basin sediments (Table 3-12). A dominant source of hydrocarbons appears to be runoff from numerous streets and highways around the basin and through the storm sewer system. Other sources, such as direct atmospheric deposition to the water surface, could be important, but the extreme concentration gradient between outfall, sewer, and basin sediment samples indicate that these sources may be small in comparison. Atmospheric deposition of organics to the land surfaces in the area could contribute to the overall input, via runoff, to the basin. The concentrations of THC and PAHs in the outfall sediment samples indicate no specific outfall as the predominate source of hydrocarbons to the area. This is in contrast to the trace metal data (Figure 3-7), notably Pb, and other organic compounds which do indicate specific outfalls as a source. It appears that the input of hydrocarbons to the basin is much more diffuse and related to vehicular traffic in the surrounding area. Information on the individual PAHs may help support this conclusion and will be discussed in the following section.

An extreme concentration gradient between outfall, sewer, and channel sediment samples is also observed in the Washington Ship Channel area (Table 3-12; Figure 3-13). Total hydrocarbons and PAHs in outfall sediment samples ranged from 800 to 6900 μg THC/g fine grain and 12 to 620 μg PAH/g fine grain, respectively. As in the other study sites the UCM accounted for the majority of the THC. Highest concentrations of THC and PAHs were not at the same station. Station OWSC-R1, which is located at an outfall within the Washington Marina, had the highest THC concentration of all samples in the study, whereas station OWSC-3 had the highest PAH concentration on a normalized basis. OWSC-R1 is at the outfall of a storm sewer line that drains along 13th Street, S.W., starting near the Annex Building of the Bureau of Engraving and Printing. It also drains the area around the old railroad freight yard which is currently undergoing numerous construction projects. The outfall, OWSC-3, is located at the effluent of a storm sewer that drains along the north side of Ft. McNair along P Street, S.W. The one sewer that was sampled (SWSC-2) had intermediate concentrations when compared to the channel and outfall sediments (Table 3-12). This sample was taken in a small storm sewer located on Maine Ave., S.W., and would reflect the contribution of hydrocarbons directly from street runoff.

While the gradients between outfall and channel sediment samples indicate the source of hydrocarbons could be from street runoff, numerous marinas border the eastern side of the channel

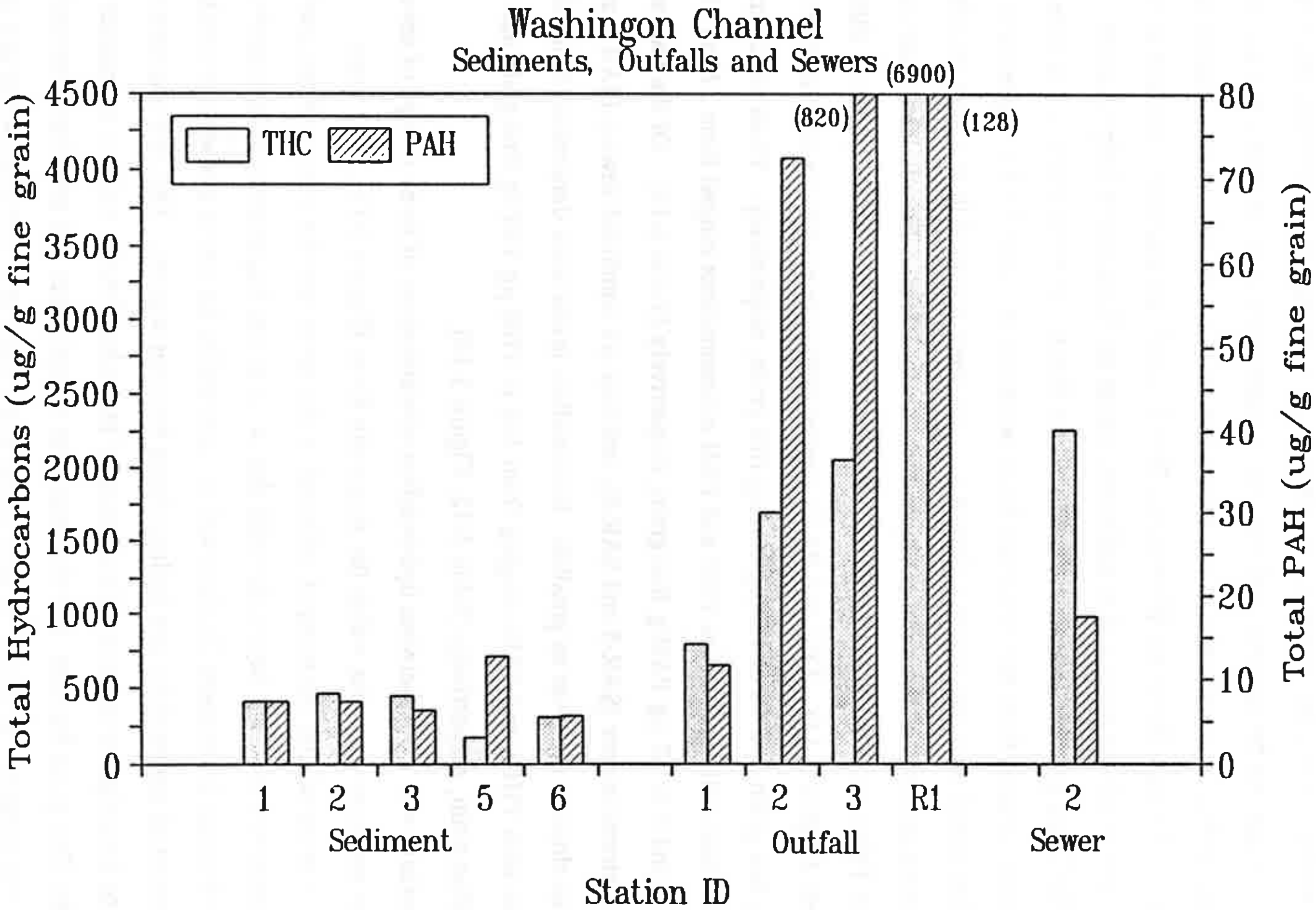


Figure 3-13. Outfall, sewers and sediments of the Washington Ship Channel: Hydrocarbons.

(Figure 3-8), and could contribute hydrocarbons to channel sediments (Vouldrias and Smith, 1986). The input of hydrocarbons would be related to activities such as boat fueling, fuel spills, engine exhaust and creosote-treated pilings used for the construction of these marinas. These additional sources of hydrocarbons could be substantial in this area, and the separation between street runoff and boat-related sources can not be accomplished with the concentration data set alone, but may be resolved using the molecular distribution of the PAHs (see below). However, these results show that sediments bordering the eastside of the Washington Ship Channel are extremely elevated in the concentration of hydrocarbons compared to sediments within the Washington Ship Channel.

Total (THC) and polycyclic aromatic hydrocarbon (PAHs) concentrations in the river, outfall, and sewer sediment samples from the Anacostia River are given in Table 3-12 and presented in Figure 3-14. Five outfall and four sewer sediment samples were obtained in this area allowing a more comprehensive analysis of the sediment hydrocarbon distribution. In most cases, sediment concentrations of THCs and PAHs were highest in sewer sediment samples compared to either outfall or river sediments (Figure 3-14). THC and PAHs concentrations in the sewers ranged from 2300 to 4500 μg THC/g fine grain and 40 to 180 μg PAH/g fine grain, respectively. These concentrations are in contrast to river sediments where THC and PAH concentrations ranged from 370 to 1860 μg THC/g fine grain and 6 to 32 μg PAH/g fine grain, respectively (Table 3-12). Of the four sewers sampled, two are storm sewers (SAR-5 and SAR-6), and two are combined sewers (SAR-2 and SAR-3); all sampled as close to the river as possible. Intermediate levels were determined from outfall sediment samples with THCs and PAHs ranging from 141 to 1760 μg THC/g fine grain and 21 to 106 μg PAH/g fine grain, respectively (Table 3-12; Figure 3-14).

A comparison was made between hydrocarbon concentrations of three groups of sewer, outfall, and river sediments samples within the Anacostia River (Figure 3-15). For these comparisons, it is assumed that the material collected in the sewer was the source of material at the outfall. This assumption may not be strictly valid due to 1) in-situ degradation of hydrocarbons during transport through the system; 2) additional sources within the sewer system not sampled; and 3) selective transport of the particles and hydrocarbons between stations. The first and second assumption can be investigated using the distribution of individual PAHs, while it is assumed that by normalizing to the fine grain fraction, selective transport of sediments and associated-contaminants would be taken into account. It should be pointed out that SAR-5 is a combined sewer and only during extreme rain events would water and material from this sewer reach the outfall and influence the sediment chemistry of the river. During this study, no significant rain events occurred that

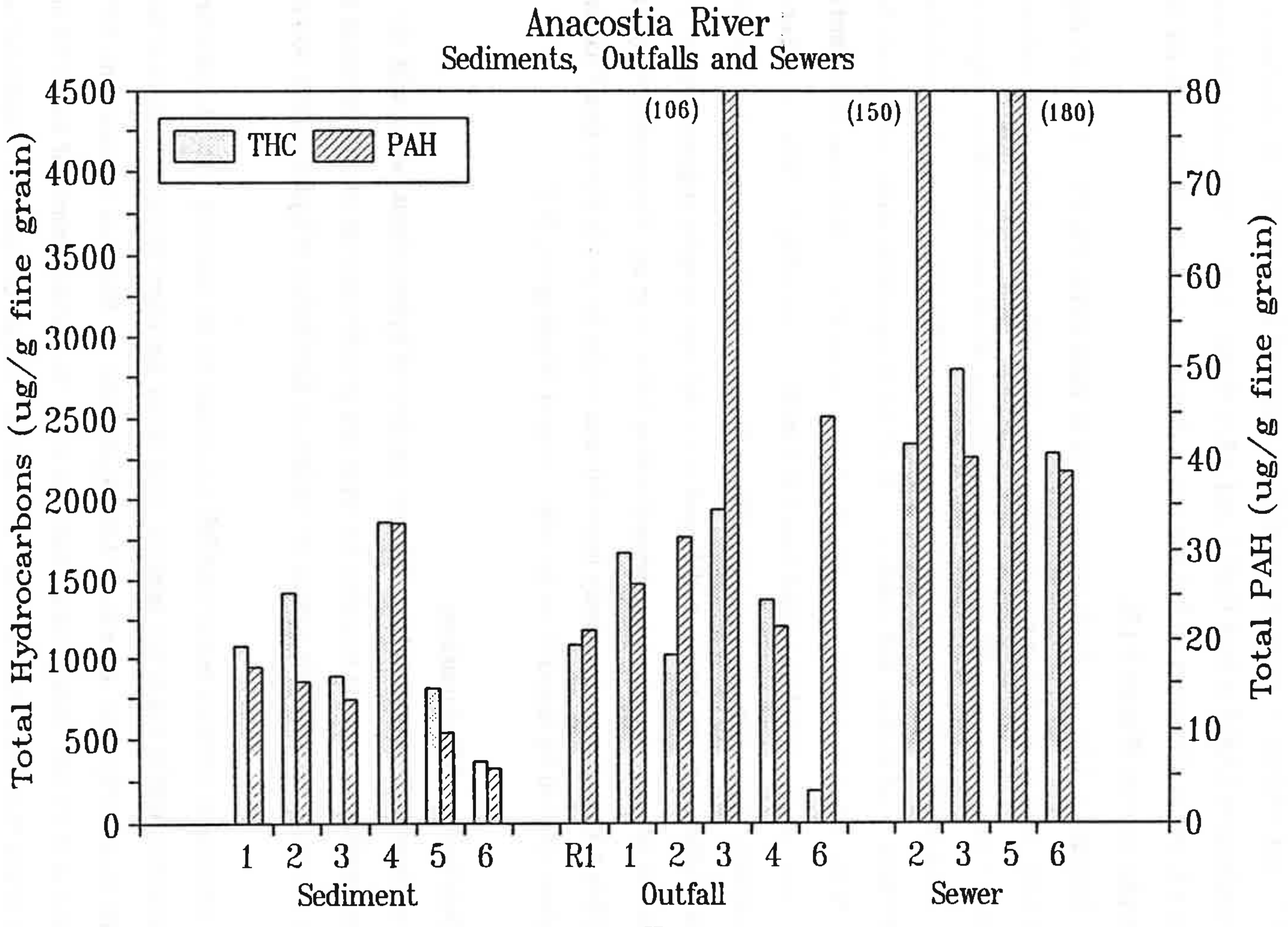


Figure 3-14. Outfall, sewers and sediments of the Anacostia River: Hydrocarbons.

may have caused a combined sewer overflow.

In the three series (Figure 3-15), THC and PAH concentrations decreased from sewer to river samples. This trend is particularly evident in the series located near the Navy Yard (Figure 3-10; AR-4, OAR-3, and SAR-5). Concentrations of THC decreased from 4500 to approximately 2000 μg THC/g fine grain from SAR-5 to both OAR-3 and AR-4 (Figure 3-15). PAH concentrations decreased by a factor of 5 between SAR-5 and AR-4. Similar decreases are evident in the other two series to varying degrees (Figure 3-15).

The decrease in THC and PAH concentrations in these series may be due to both degradation and dilution with lower hydrocarbon concentration fine grain sediment. These results indicate that a major source of hydrocarbon contamination to the sediments of the Anacostia River may be due to street runoff through the combined and storm sewer system of the area. Street dust, including material from tires, road asphalt, and crankcase oils could be a possible source of hydrocarbons in this runoff. Wakeham et al. (1980) compared the PAH content of lake sediments to various urban source materials, and concluded that street dust was a major source of hydrocarbons. Other sources, such as atmospheric deposition and direct oil spills to the river may be important, but the extreme concentration gradient between sewer, outfall, and river sediment samples suggests that urban runoff was the dominant source. Samples taken around station AR-4, near the Washington Navy Yard, indicate that this may be the most severely impacted area in the Anacostia River (see Chapter IV) and may be the most affected by runoff from the urban area of Washington, D.C..

Molecular Distribution of Hydrocarbons

The molecular distribution of the different fractions of hydrocarbons, along with the concentrations gradients, can help elucidate the types and possibly sources of contamination to sediments of the study area. In this section the molecular distribution of hydrocarbons will be discussed.

The unresolved complex mixture (UCM) accounted for the majority of total hydrocarbons (THC) in sediments, outfall and sewer samples, with minor but important contributions of both saturated (SHCs) and polycyclic aromatic (PAHs) hydrocarbons. For most sediments the UCM to THC ratio was ≥ 0.95 with little variation between sites. The predominance of the UCM throughout these sites indicates that weathered petroleum products are a major component of hydrocarbon contamination in this area. Sources of this contamination is runoff from streets and highways around the area although direct discharge of oil (i.e., small spills) can not be ruled out. It should be noted

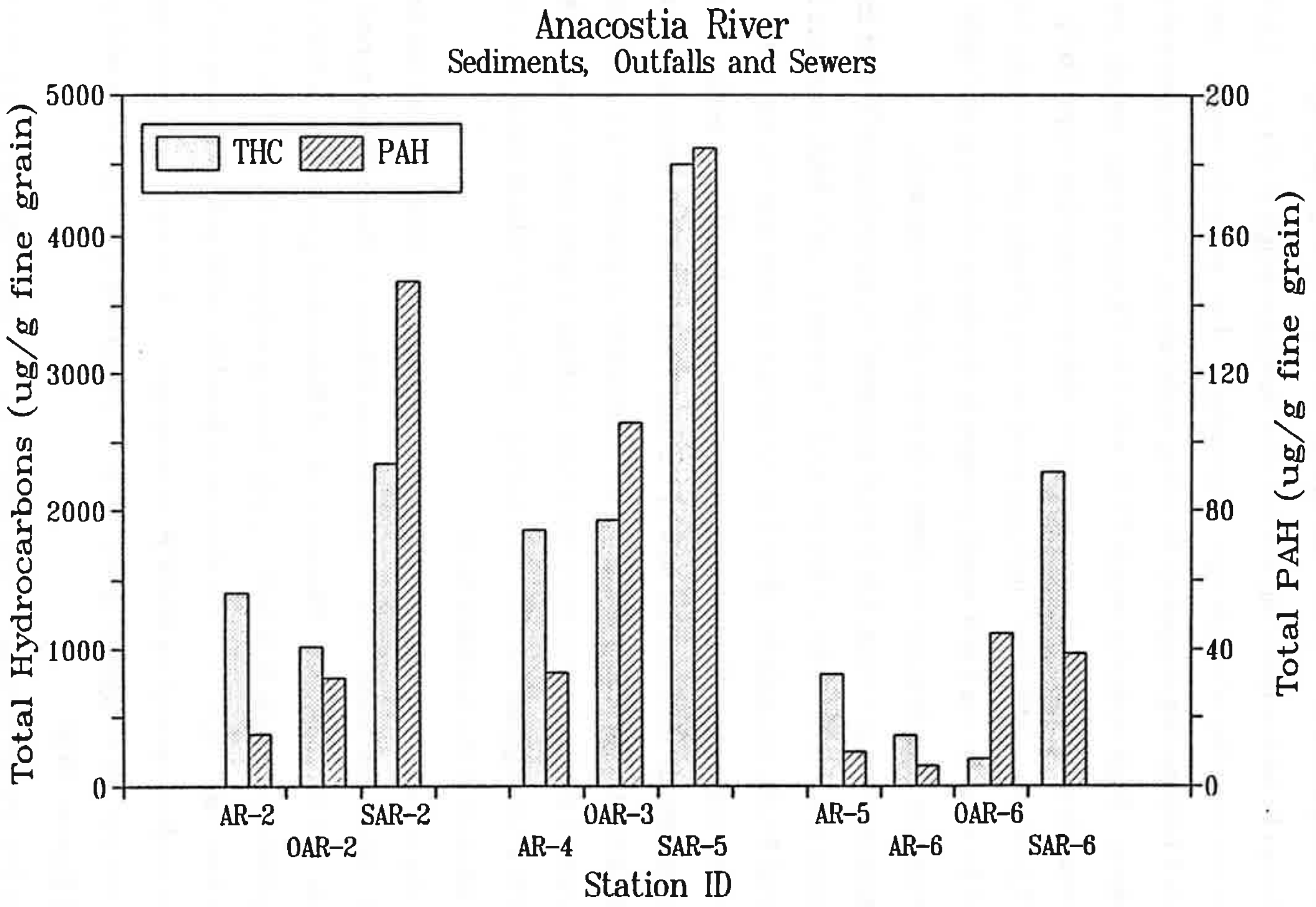


Figure 3-15. Outfall, sewer and sediment series in the Anacostia River: Hydrocarbons.

that the UCM to THC ratios in the Potomac River were slightly lower ($\leq$ 0.90) than in most of the other areas indicating less of a predominance of weathered petroleum hydrocarbons. While the concentration of the UCM indicates a petroleum hydrocarbon source, the molecular distribution of PAHs can give an indication of the type of hydrocarbons: oil versus combustion products.

The PAHs can be broken down into low and high molecular weight PAHs (i.e., LMW and HMW PAHs) that are indicative of certain types hydrocarbons. Low molecular weight hydrocarbons are defined as 2 to 3 benzene ring compounds including naphthalenes, anthracenes, phenanthrenes, and dibenzothiophenes. High molecular weight PAH, with 4 to 5 benzene rings, include compounds such as fluoranthene, chrysenes, benz[a]pyrene and dibenzo[ah]anthracene (see Appendix I). A predominance of LMW over HMW PAHs indicates an oil source of hydrocarbons (Table 3-9). Due to weathering and degradation, the LMW would decrease in abundance relative to the HMW PAHs. Combustion of petroleum also yields hydrocarbons with more HMW compounds.

In most samples from this study, LMW PAH accounted for approximately 35% of the total PAH. In the Anacostia River, at stations AR-4 and SAR-5 however, LMW PAH accounted for 60% and 90% of the total PAHs, respectively. SAR-5 is the combined sewer that can impact the river near station AR-4 and is the sewer line that empties at the outfall OAR-3 (Figure 3-10). Low molecular weight compounds accounted for 40% of the total PAHs at OAR-3 which is the outfall between AR-4 and SAR-5. These results indicate a distinct source of petroleum derived hydrocarbons to the area just south of the Washington Navy Yard near the South Capitol Street Bridge. The higher abundance of LMW PAH suggests that direct inputs (e.g., spills) of petroleum are a source of hydrocarbons to this area of the Anacostia River.

Substantial quantities of unsubstituted PAH were found in all sediment, outfall and sewer samples analyzed. Major compounds include phenanthrene-anthracene, fluoranthene, pyrene, benzo[a]anthracene, and benzopyrenes. Concentrations of fluoranthene-pyrene ranged from 0.56 to 5.3 μg/g, benzo[a]anthracene from 0.11 to 0.93 μg/g, benzo[a+e]pyrenes from 0.23 to 1.7 μg/g for all river sediment samples. Higher concentrations were found in outfall and sewer samples (see Appendix I). The predominance of the HMW PAH compounds in most samples suggests that combustion products are also a major component of the hydrocarbons in the sediments of this area (Youngblood and Blumer, 1975).

Within the low molecular weight PAHs, alkyl-substituted compounds (e.g., 1 to 4 methyl groups) dominate the distribution of the naphthalene series in most sediments. Figure 3-16 is an example of the type of distribution observed throughout this study. Again this indicates that

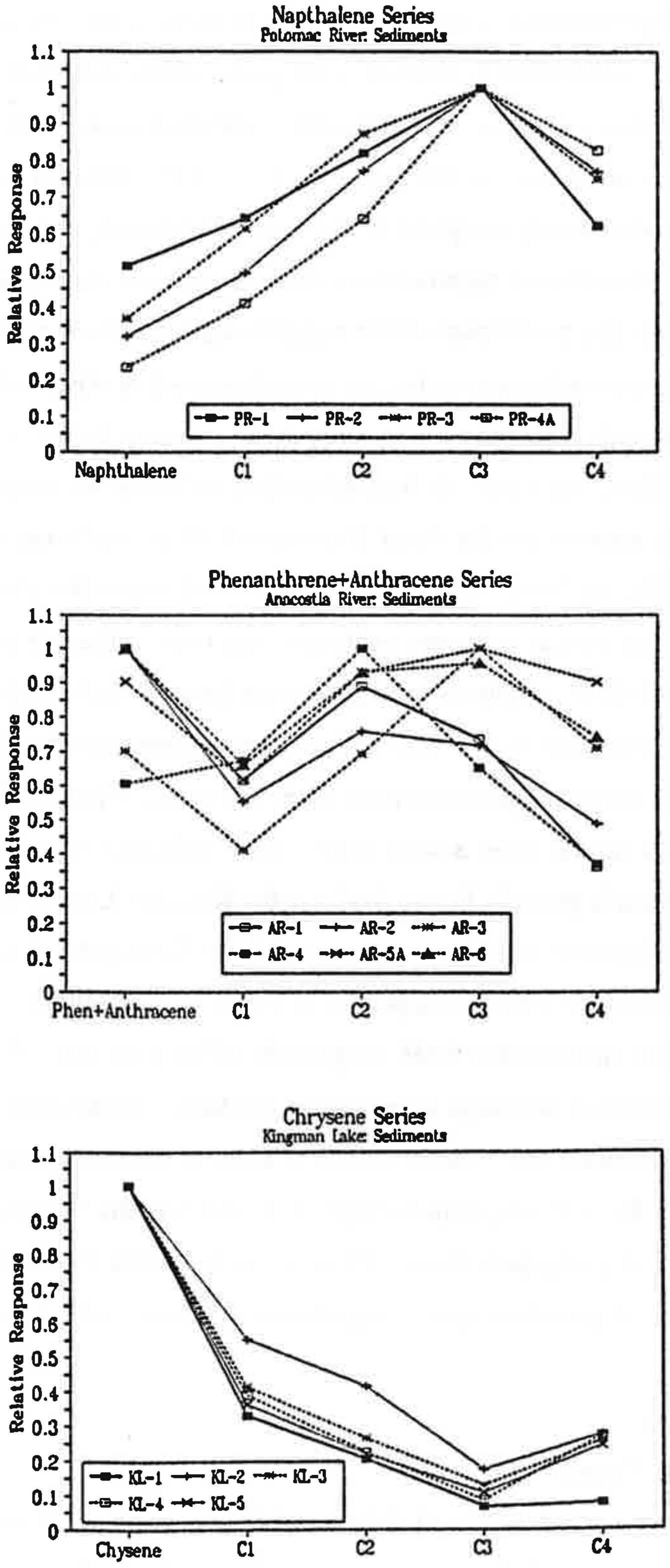


Figure 3-16. Relative abundances of naphthalenes, phenanthrene+anthracenes, and chrysenes in various locations.

petroleum is one source of hydrocarbons to the sediments in all study areas. In some outfall and sewer samples, unsubstituted naphthalene is equal to or of greater abundance than substituted forms, suggesting more of a combustion component to the sample. Naphthalene is a low molecular weight PAH which is very soluble in water (ca. 20,000 $\mu g/l$; log $K_{ow} = 3.9$). Once in the sediment, naphthalene can decrease in abundance, compared to the substituted forms, due to microbial degradation and solubility. Detection of naphthalene at the high concentration seen in this study as well as the distribution within the naphthalene series suggest recent inputs of petroleum.

Within the phenanthrene-anthracene series, no consistent trend is observed between the alkyl-substituted and parent compounds from the various study areas. In most locations, unsubstituted phenanthrene-anthracene is the major form. In Anacosita River sediment for example, this series indicates that both pyrogenic sources and the direct discharge of oil are both important components of sedimentary hydrocarbons (Figure 3-16). Differences are observed within the phenanthrene-anthracene series between most outfall and sewer sediments and river sediments in the Anacostia River. While the results at SAR-5 indicate more of petroleum input of hydrocarbons, the other outfall and sewer sediments reflect more of a combustion source. Upon entering the river, these materials are mixed yielding the distribution observed in the sediments (Figure 3-16).

For all study areas, a similar trend is seen in the higher molecular weight chrysene series. An example of this distribution is given in Figure 3-16 for the Kingman Lake area. This series is dominated by unsubstituted chrysene with lesser amounts of C_1 to C_4 substituted forms. This again indicates a combustion products are a major component of PAHs in the sediments of all areas.

Overall, the variations in individual PAH compounds reflect a mixture of combustion products (i.e., pyrogenic sources) and direct discharge of petroleum products. These distributions look similar to other urban areas. Specific areas that indicate increased areas of contamination include station PR-1 in the Potomac River near Rock Creek, stations WSC-1, 2, and 3 in the Washington Ship Channel, and the area around AR-4 in the Anacostia River. Only in the Anacostia River, near the Washington Navy Yard, are direct inputs of petroleum a more significant component of the sediments.

B) Chlorinated Hydrocarbons

Distribution and Geographic Trends

The concentrations of a selected suite of chlorinated hydrocarbon were measured in basin, river, and channel sediments, and outfall and sewer sediments samples, and the results for individual components are reported in Appendix I. The results for sediment concentrations of total chlordane (sum of $\Gamma+\alpha$-chlordane and cis+trans + nonachlordane), total DDT (sum of DDT, DDD and DDE), and total PCB (sum of 209 possible individual congeners) are presented in Table 3-13. The data in Table 3-13 are reported in ng per gram dry weight of sediment (i.e., ng/g). Concentrations were normalized to grain size for the comparison between outfall, sewer, and bottom sediment samples.

Chlordane, DDT, and PCBs were found in all sediment samples analyzed as part of this study (Table 3-13). Total chlordane, DDT, and PCB concentrations ranged from 5 to 150, 7 to 160, and 70 to 2200 ng/g, respectively. The highest sedimentary chlordane levels from the Potomac River (43 ng/g) were near Rock Creek at station PR-1, with lower concentrations downstream. This site also exhibited high levels of DDT and PCB compared to the other sampling sites in the Potomac River (Table 3-13). Evidently runoff from Rock Creek influences the chemical composition of the sediments around this area. Whereas no river sediment samples were taken farther upstream as part of this study, sediment concentrations of DDT, PCB, and chlordane above Rock Creek, reported in ICPRB (1990), are, lower indicating little upstream source of these compounds.

The distribution of chlordane, DDT, and PCB in the Tidal Basin reveal higher concentrations at stations TB-1 and TB-1.5. These sites are located near the large storm sewer outfall (Figure 3-6) that drains along Constitution Avenue and the Mall of the Smithsonian Institution. The sediment concentrations of DDT at these stations, 160 and 170 ng/g, were some of the highest determined in this study. Concentrations of chlordane, DDT and PCB in the Washington Ship Channel were intermediate compared to the other study areas with no distinct geographical distribution (Table 3-13). Concentrations of chlordane ranged from 14 to 28 ng/g, DDT from 15 to 42 ng/g, and PCB from 144 to 390 ng/g in the channel (Table 3-13).

Sediment concentration differences do exist in the spatial distribution of chlordane, DDT, and PCB in the Kingman Lake and Anacostia River. Higher concentrations of chlordane were determined in the Kingman Lake area (i.e., maximum at KL-4 of 150 ng/g) and upper Anacosita River (Table 3-13). Downstream of station AR-4, river sediment concentrations decreased to approximately 27 ng/g at PR-4A, located just south of Hains Point in the Potomac River. This distribution suggests a possible source within the Kingman Lake area (i.e., KL-4). There is a golf course in the upper section of the lake which may have used chlordane in the past. The chlordane could still be leaching off this area. The chlordane distribution indicates a source within or upstream of Kingman Lake. In contrast, concentrations of both DDT and PCB reached maximum levels farther downstream of the lake, in the Anacostia River. Sediment concentrations of DDT and PCB were 124 and 2200 ng/g, respectively, at AR-4 which is just below the Washington Navy Yard near the South Capitol Street

Table 3-13. Concentrations of chlordane, DDT, and PCB from the various study areas.*

Sta. ID.	Chlordane	DDT	PCB
KL-1	95.53	35.99	653.8
KL-2	107.59	64.96	529.8
KL-3	119.83	60.69	454.9
KL-4	153.32	76.38	514.6
KL-5	139.53	78.19	657.7
AR-1	138.66	77.87	711.9
AR-2	91.12	55.95	504.8
AR-3	111.49	76.93	770.3
AR-4	88.56	123.81	2203.4
AR-5A	57.71	55.46	485.8
AR-6	27.63	28.65	218.4
OAR-1	115.75	105.13	383.1
OAR-2	117.17	101.39	1270.7
OAR-3	33.34	43.78	841.2
OAR-4	93.31	261.22	475.0
OAR-6	37.66	324.37	344.0
OAR-R1	23.17	54.48	138.2
SAR-2	4.83	57.71	89.2
SAR-3	25.63	23.11	74.5
SAR-5	141.61	68.70	794.1
SAR-6	16.69	25.99	1449.5
WSC-1	14.27	42.05	392.5
WSC-2	18.61	35.85	328.4
WSC-3	18.18	29.66	304.8
WSC-5	27.79	36.14	295.6
WSC-6	16.51	15.14	144.0
OWSC-1	39.04	50.63	991.6
OWSC-2	64.32	58.48	3181.5
OWSC-3	128.46	448.12	878.5
OWSC-R1	30.10	146.88	2752.7
SWSC-2	5.07	7.15	261.3
PR-1	41.57	103.23	264.6
PR-2	7.08	9.71	68.4
PR-3	5.27	6.95	73.3
PR-4A	9.34	11.19	70.2
TB-1	24.76	157.62	609.7
TB-1.5	17.45	170.97	498.4
TB-2	6.36	23.25	108.3
TB-3	13.64	87.59	245.3
TB-4	7.80	76.29	241.5
TB-5A	8.03	38.66	188.6
TB-6	7.47	28.84	154.1
OTB-1-1	4.20	57.90	110.6
OTB-1-2	14.45	118.00	402.9
OTB-2	7.02	148.36	243.9
OTB-3	9.59	74.68	1252.8
OTB-4	50.07	803.38	3349.5
OTB-5	14.73	79.63	380.9
STB-2-1	9.79	43.19	727.5
STB-2-2	37.83	91.10	286.3

*Concentrations in ng per gram dry weight. Station IDs. starting with (O) indicate samples that were taken directly in front of an outfall, while (S) indicates samples taken in a sewer. Stations AR-5, PR-4, and TB-5 were sampled and analyzed in triplicate, these data are the average. Chlordane is the sum of Γ+α-chlordane and cis+trans + nonachlordane; DDT = DDD+DDE+DDT; PCB is the sum of 209 congeners.

Bridge. Numerous storm and combined sewers also drain into this area and may have an impact on the sediments (see below). This location also has elevated concentrations of trace metals, and total and aromatic hydrocarbons. Below the South Capital Street Bridge, concentrations of all sediment contaminants decreased to some of the lowest levels measured in this study (Table 3-13).

Selected stations were sampled in triplicate and analyzed for chlorinated hydrocarbons to assess small scale spatial differences. These results, presented in Table 3-14, reveal no substantial variations in the sediment distribution of total chlordane, DDT, and PCBs in the "local" area (i.e., within 5 m). Due to the fact that the grain size distribution is fairly uniform for all sediments (Table 3-1), these results suggest that spatial variations are small compared to geographical changes observed in the Potomac and Anacostia rivers, and the Tidal Basin.

Comparison between Sediments, Outfalls and Sewers

The sediment concentrations of chlordane, DDT, and PCB were normalized to grain size (i.e., ng/g fine grain sediment) so that a comparison can be made between sediment, outfall and sewer samples (Table 3-15). As with the other data, the outfall (O) and sewer (S) samples will be compared to sediment concentrations in each respective area.

Substantially higher concentrations of chlordane, DDT, and PCB were determined in outfall sediments of the Tidal Basin (Figure 3-17). Concentrations of chlordane, DDT, and PCB reached levels of 260, 4200, and 18000 ng/g fine grain, respectively, and were significantly higher than those determined in the basin sediments. Outfalls, OTB-3 and OTB-4, are located near the paddleboat concession area and drain the area around 15th St and Ohio Ave., S.W. (Figure 3-6). The separate (sanitary) sewer sample (STB-2-1 and STB-2-2), taken on two separate occasions, had concentrations of chlordane, DDT, and PCB only slightly elevated compared to basin sediments. This sewer is a separate sewer running down 15th St., S.W. and services the BEP. Although this material would most likely not impact the Tidal Basin, it would eventually reach the Blue Plains Wastewater Treatment facility for treatment and disposal.

Polychlorinated biphenyls (PCBs), which have been fully regulated since 1976 and their manufacture in the U.S. ceased since 1977, are still in use as electrical insulators in many transformers. They are also used as a fire retardant, and additives to oils and paints. Persistence of PCBs in aquatic sediments is due to their slow rate of degradation and vaporization, low water solubility, and partitioning to particles and organic carbon. Bacteria degrade PCB, with the rate dependent on the position and degree of chlorination of the biphenyl ring (Kennish, 1992). Also,

Table 3-14. Results from triplicate analysis of 3 separate samples from the Anacostia and Potomac Rivers and Tidal Basin*.

Sta. ID.	Chlordane	DDT	PCB
Anacostia River			
AR-5a	65.44	60.32	512.3
AR-5b	60.13	62.03	496.4
AR-5c	47.57	44.03	448.9
Average	57.71	55.46	485.8
± SD	7.49	8.11	26.9
Potomac River			
PR-4a	10.32	12.42	84.6
PR-4b	9.31	12.64	77.5
PR-4c	8.39	8.52	48.5
Average	9.34	11.19	70.2
± SD	0.79	1.89	15.6
Tidal Basin			
TB-5a	7.07	37.86	180.5
TB-5b	8.71	38.97	203.5
TB-5c	8.31	39.16	181.9
Average	8.03	38.66	188.6
± SD	0.70	0.57	10.6

*Concentrations in ng per gram dry weight. Chlordane is the sum of $\Gamma+\alpha$-chlordane and cis+trans + nonachlordane; DDT = DDD+DDE+DDT; PCB is the sum of 209 congeners.

Table 3-15. Concentrations of chlordane, DDT and PCB normalized to the fraction of fine grain sediment*.

Sta. ID.	Chlordane	DDT	PCB
KL-1	109.60	41.29	750.1
KL-2	110.76	66.88	545.4
KL-3	120.08	60.82	455.8
KL-4	176.01	87.68	590.8
KL-5	156.96	87.96	739.8
AR-1	161.10	90.48	827.1
AR-2	91.61	56.25	507.5
AR-3	112.08	77.34	774.4
AR-4	102.97	143.94	2561.8
AR-5A	58.11	55.84	489.2
AR-6	27.87	28.90	220.3
OAR-1	128.20	116.44	424.3
OAR-2	128.81	111.46	1397.0
OAR-3	149.33	196.08	3766.9
OAR-4	104.50	292.56	532.0
OAR-6	45.38	390.81	414.5
OAR-R1	42.13	99.05	251.3
SAR-2	22.12	264.22	408.4
SAR-3	178.37	160.80	518.6
SAR-5	660.20	320.30	3702.3
SAR-6	73.69	114.73	6399.5
WSC-1	14.49	42.68	398.3
WSC-2	18.69	36.00	329.8
WSC-3	18.24	29.76	305.8
WSC-5	40.27	52.37	428.4
WSC-6	16.67	15.29	145.5
OWSC-1	45.93	59.56	1166.6
OWSC-2	105.43	95.87	5215.6
OWSC-3	611.73	2133.88	4183.5
OWSC-R1	49.34	240.79	4512.6
SWSC-2	20.30	28.62	1045.2
PR-1	53.21	132.13	338.7
PR-2	8.15	11.19	78.7
PR-3	5.83	7.68	81.1
PR-4A	9.91	11.88	74.5
TB-1	25.50	162.33	628.0
TB-1.5	17.69	173.29	505.1
TB-2	9.06	33.13	154.3
TB-3	17.33	111.34	311.9
TB-4	7.83	76.63	242.6
TB-5A	8.13	39.13	190.9
TB-6	7.51	29.02	155.1
OTB-1-1	NC	NC	NC
OTB-1-2	17.84	145.68	497.4
OTB-2	35.10	741.82	1219.5
OTB-3	73.74	574.46	9637.0
OTB-4	263.51	4228.34	17628.8
OTB-5	64.05	346.22	1656.3
STB-2-1	25.11	110.76	1865.4
STB-2-2	74.17	178.62	561.3

*Concentrations in ng per gram fine grain sediment (silt+clay). Chlordane is the sum of Γ+α-chlordane and cis+trans + nonachlordane; DDT = DDD+DDE+DDT; PCB is the sum of 209 congeners. NC - Not Calculated (no grain size data). See Table 3-13 for raw data.

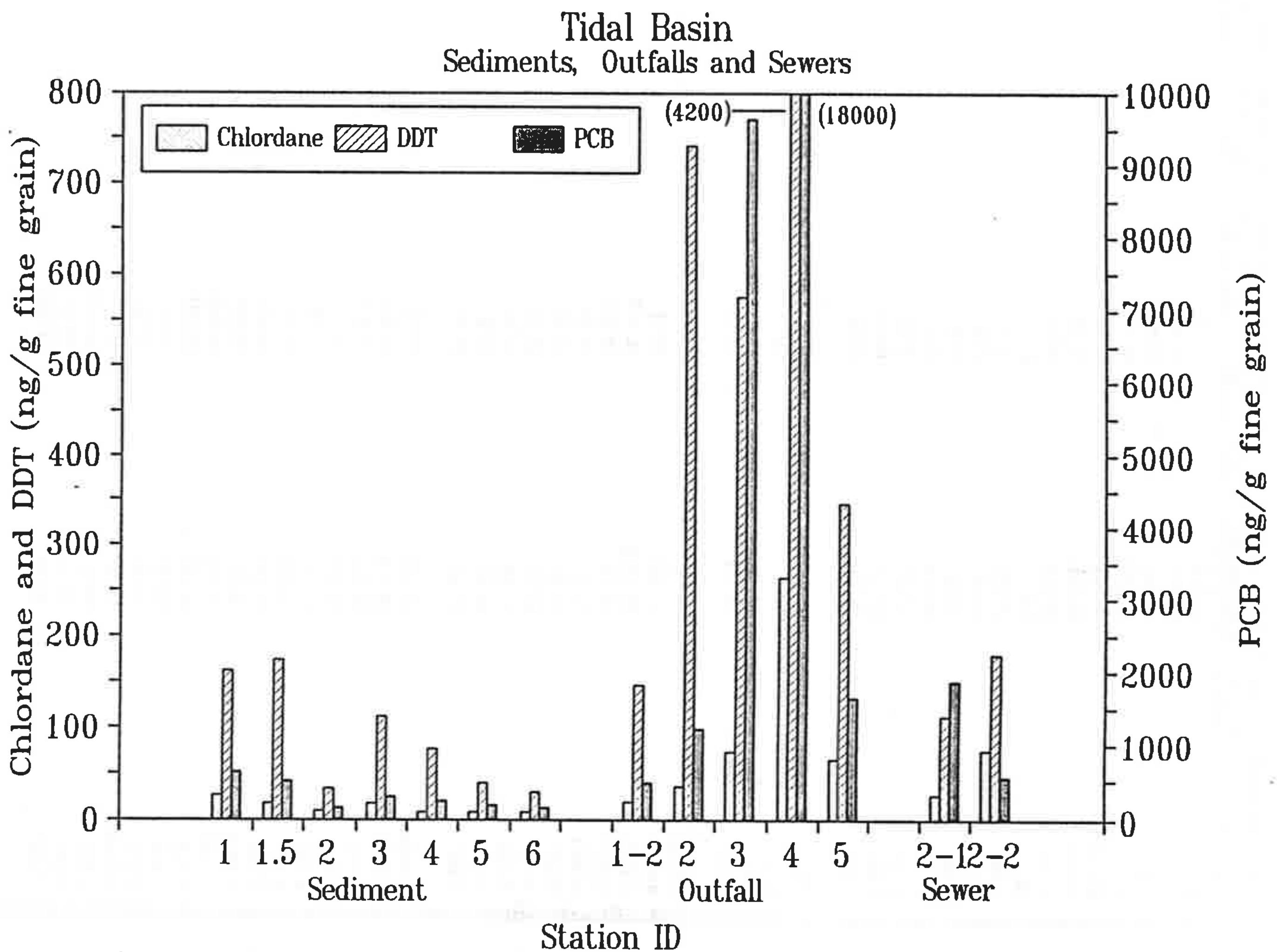


Figure 3-17. Outfall, sewers and sediments of the Tidal Basin: Chlordane, DDT and PCB.

because they are still in use in the U.S. and this area (e.g., transformer fluids), accidental spills can still occur. The only major industrial or production facility in this area is the Bureau of Engraving and Printing. While PCB are not currently thought to be used at this facility, past usage may still contribute to the input of PCB to the area.

The current sources of the pesticides chlordane and DDT are elusive. Both chlordane and DDT have been banned for use in the United States. DDT was banned in 1972 and has an approximate environmental half-life of 10 to 20 years (NOAA, 1989; Woodwell et al., 1971). Therefore its detection, along with its breakdown products (i.e., DDE+DDD) in sediments, is to be expected. Approximately 70 to 90% of the total DDT in sediment, outfall and sewer samples from this study correspond to the sum of (o-p + p-p) DDE and DDD forms, and indicates an active degradation of DDT in these areas and/or inputs of already degraded DDT. However, the presence of sedimentary DDT (and DDE and DDD) in large concentrations at the outfalls and in the sewers is interesting given the lack of any definitive recent inputs. It might be expected that DDT should have been flushed through the sewer system 20 years after its ban. It has been suggested that DDT could be a contaminant in other pesticide mixtures (Schimitt et al., 1985). However the study of Schmitt et al (1985) was conducted in farming areas in the southwest U.S. and may not be applicable to the District. Also, it is possible that re-exposed soils from construction projects could introduce DDT in the environment. If the sediment concentrations of DDT and its breakdown products are a results of inputs before 1972, concentrations of DDT must have been substantially higher in the past and could still impose a biological impact to the environment.

Chlordane is a multi-component mixture of polychloro-methanoindenes. Technical grade chlordane contains more than 140 components of which only 120 compounds can be resolved by current analytical techniques. Alpha(α)-chlordane, gamma(Γ)-chlordane, heptachlor and trans-nonachlor are the dominant constituents (Dearth and Hites, 1991), and are used to control termites and ants. Because of the toxicity, potential carcinogenicity and environmental persistence of these components and/or metabolites, e.g., heptachlor hepoxide and oxychlordane, the use of chlordane is under federal regulations. The use of chlordane was halted in 1988 after a phased reduction in use since approximately 1975. The half-life of chlordane is similar to that of DDT (i.e., approximately 10 to 20 years), and therefore its persistence is to be expected for many years.

As in the Tidal Basin, concentrations of chlordane, DDT, and PCB were substantially higher in the outfall sediments of the Washington Ship Channel (Figure 3-18). Chlordane, DDT, and PCB outfall sediment concentrations were as high as 600, 2100, and 5200 ng/g fine grain, respectively,

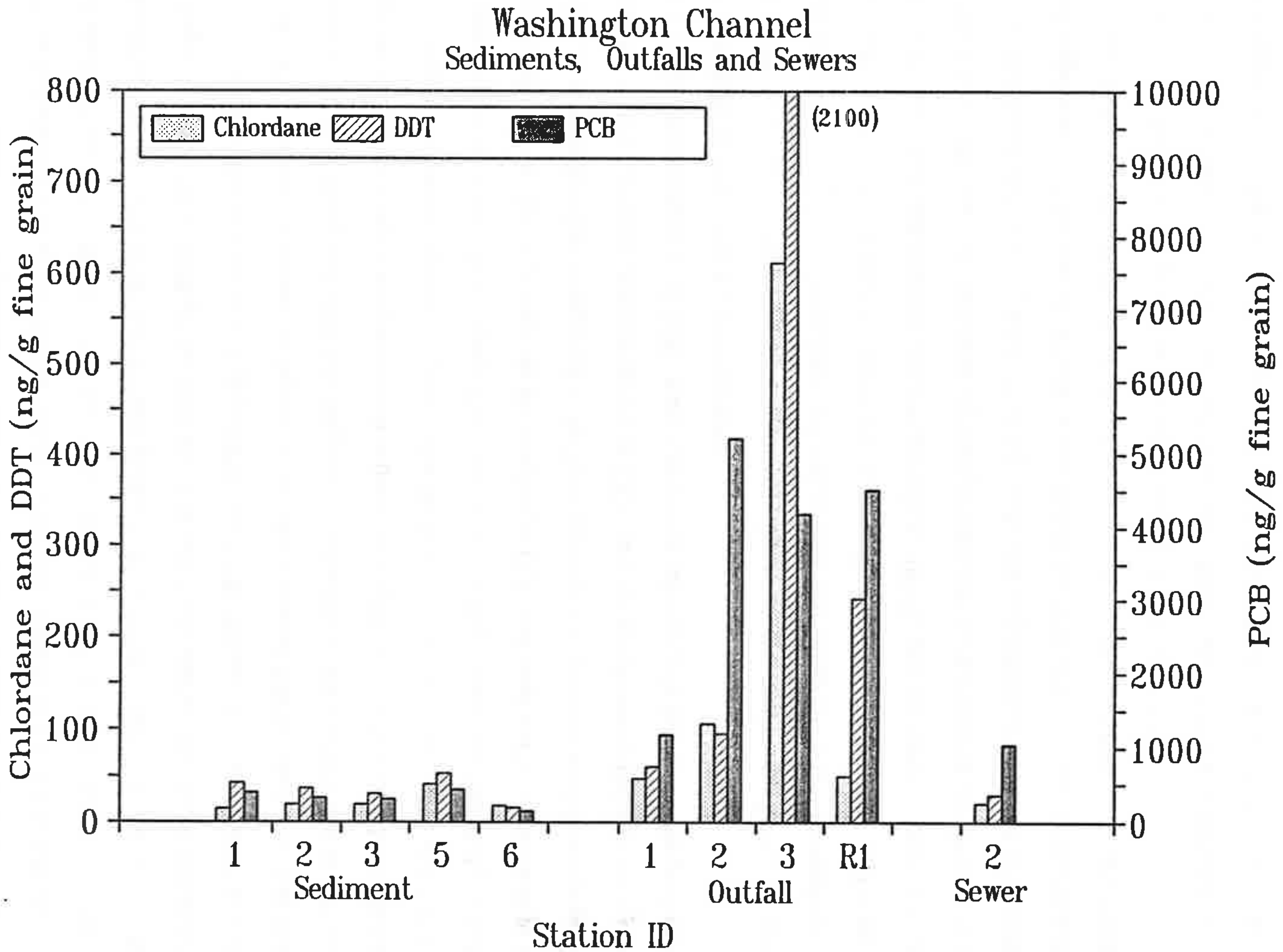


Figure 3-18. Outfall, sewer and sediments of the Washington Ship Channel: Chlordane, DDT and PCB.

(Table 3-15). Highest chlordane and DDT concentrations were found at OWSC-3, while PCB concentrations were highest at all three upstream outfalls (i.e., OWSC-2 to OWSC-R1; Figure 3-18; Figure 3-8). The storm water drainage area that influences this portion of the channel, borders the area between 10 and 15 Streets, S.W. near the Department of Agriculture, the Bureau of Engraving and Printing, and the old Lionel freight yard. The freight yard area is currently undergoing extensive construction projects. The higher PCB levels found in these outfalls may be due to sources in this area, similar to those found in the Tidal Basin.

A substantial concentration gradient between sewers, outfalls and sediments of the Anacostia River was observed for chlordane, DDT, and PCB (Figure 3-19; Table 3-15). Concentrations in this series were as high as 660, 400, and 6400 ng/g fine grain for chlordane, DDT and PCB, respectively. As with the hydrocarbons, a large decrease in concentrations were found between the sewer, outfall, and river sediments near station AR-4 (i.e., SAR-5 > > OAR-3 > > AR-4) (Figure 3-20). Similar decreases were observed in vary degrees for the other sewer, outfall, and river sediment series (Figure 3-20). These data indicate that street and land runoff, as well as possible combined sewer overflows, are sources of chlordane, DDT, and PCB to sediments of the Anacostia River. The areas around the Washington Navy Yard (e.g., AR-4) and Kingman Lake may have substantially higher sources that affect the concentration of contaminants in river sediments. In this regard, on the southern side of the Anacostia, slightly downstream of AR-4 is the U.S. Botanical Gardens. Use of the pesticides, DDT and chlordane, in the past could have impacted the sediments in this reach of the river.

Comparison of Sedimentary Concentrations to Other Studies

Trace metals and organics exhibited a wide range in concentrations throughout this study area. Concentrations were generally higher in either outfall or sewer sediment samples compared to in-place sediments from the Tidal Basin, Washington Ship Channel, and Anacostia River. In this section , a brief comparison, between the sediment concentrations of trace metals and organics from this study, is made to other studies from the Chesapeake Bay and the region.

Comparisons will be made for a select group of sediment contaminants. In making these comparisons, the variable nature (i.e., grain size, organic carbon, etc.) of the sediments are often ignored or can not be accounted for with data from the other studies that did not report bulk sediment characteristics. Also, the selection of studies can bias the interpretation between data sets. For this reason, only data from the Chesapeake Bay and Delaware Bay will be utilized. These studies include

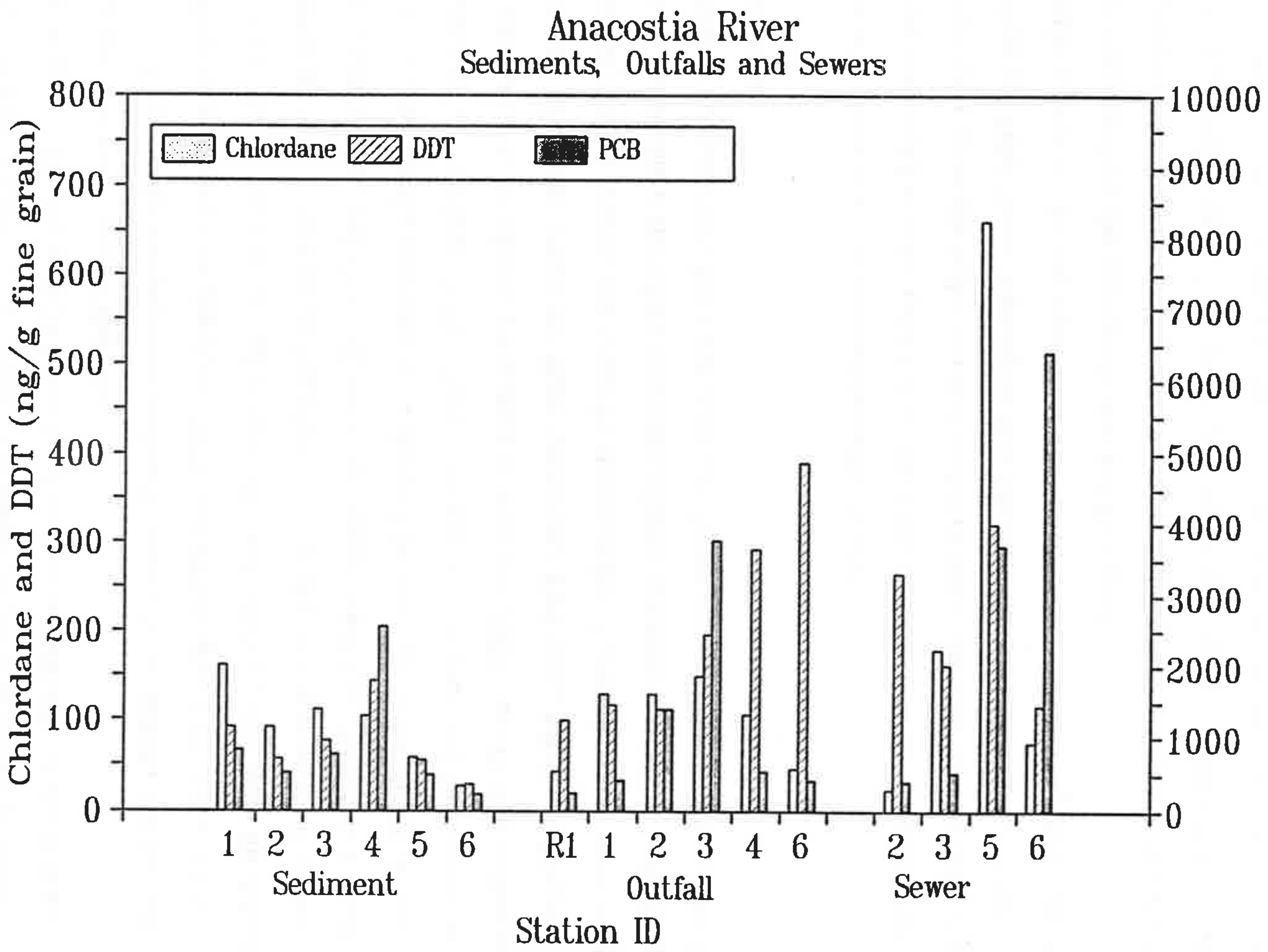


Figure 3-19. Outfall, sewers and sediments of the Anacostia River: Chlordane, DDT and PCB.

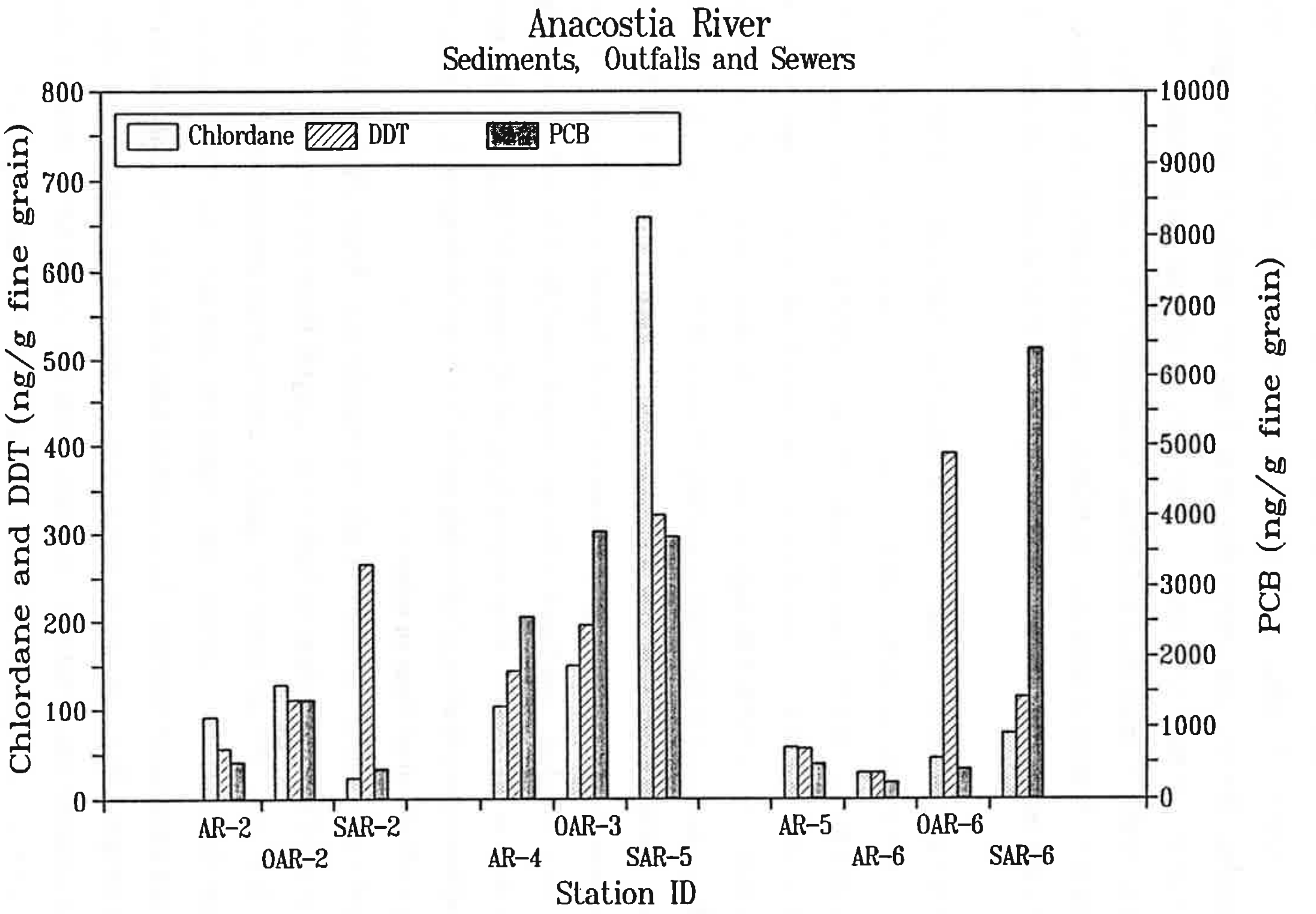


Figure 3-20. Outfall, sewer and sediment series in the Anacostia River: Chlordane, DDT and PCB.

tidal freshwater and marine areas. It should be pointed out that the extraction method for metals and organics may not be the same for all studies. Whereas the methods used in this study and those of NOAA determine total metal concentrations, those of MDE and EPA utilize methods that extract only a portion of the total metals using specific acid extractions (e.g., HNO_3-HF digestion versus hot 12N HCl, respectively). Hot acid extraction is thought to obtain only metals that are biologically available, which may or may not be correct. Total digestion of sediments provides a geochemical basis for the evaluation of trace metal enrichment above background levels (see above) and is much more reproducible. Sources of these data are NOAA's Status and Trends Studies (NOAA, 1991), EPA (1987b), and recent data from the Maryland Department of the Environment (Eskin, unpublished data).

In Table 3-16, trace metals and selected organics (i.e., PAHs, PCBs, DDTs, and chlordanes) are presented. For the present study, concentrations are presented as both μg per g dry weight and normalized to the fraction of fine grain sediment ($<63\mu$m). NOAA (1991) data are normalized to the fraction of fine grain sediment, whereas the other data sets are not. In the present study, station AR-4 in the Anacostia River exhibited the highest concentrations, while either two Potomac River stations (PR-2, PR-3) or one station in the Washington Ship Channel (WSC-5) exhibited the lowest concentrations. Sediment concentrations of Cd, Cu, Hg, and Pb at station AR-4 are higher than those found in the mainstem Chesapeake Bay by a factor of 2 to 4, dependent on the metal. Concentrations of all metals are well below those found in Baltimore Harbor and the Schuykill River. Compared to the marine portion of the Potomac River estuary (i.e., MDE stations MLE2.2, XDA11, and XEA659), sediment concentrations of all metals are higher in the Washington, D.C. area, reflecting its proximity to direct runoff from an urban area.

A similar comparison was made for selected organics (i.e., PAHs, PCBs, and DDTs). The concentrations of PCBs in the Baltimore Harbor and Schuykill River are much higher compared to the Washington, D.C. area. For all groups of organics, concentrations measured in this study are higher than those from the mainstem Chesapeake Bay. Again reflecting the effect of the urban environment to the water and sediment of the river. On a chemical basis alone, it appears that specific areas within the Washington, D.C. area are moderately contaminated with trace metals and organics and the most severely impacted area is that of the Anacostia River near station AR-4. However, the above comparisons are based on in-place sediments, outfall and sewer sediment samples were not included. The concentrations of trace metals and organics were substantially higher in most outfalls and sewers.

Summary and Conclusions

The geographic and spatial trends for both sedimentary trace metals and organics reveal specific areas are of concern within the Washington, D.C. area. These locations are indicated by an increase in the sediment concentrations of both trace metals and hydrocarbons (chlorinated and non-chlorinated) relative to adjacent locations, and within the entire study area. In many cases both trace metals and organics exhibit the same geographic trend. Substantial concentrations of Pb, Cd, and Hg as well as organics such as hydrocarbons (e.g., PAHs), PCBs and DDT are observed in many areas, such as near the Washington Navy Yard (AR-4), near Rock Creek in the Potomac River (PR-1), and upper Washington Ship Channel (WSC-1 to WSC-3). Furthermore, concentration gradients between sewer, outfall and sediment samples strongly suggest that urban runoff is a major source of these contaminants to the sediments.

For certain constituents like THC and PAH, the outfall distribution indicates a more diffuse inputs related to the ubiquitous nature of their sources (i.e., fossil fuel combustion, crankcase oils etc.) to this area. Other contaminants have distributions that suggest more of a "point" source in the area. For example, outfall and sewer sediment concentrations of PCB and to a lesser extent chlordane and total DDT are high only in specific locations. Similar trends are evident in both the Tidal Basin and Washington Ship Channel.

In the Potomac River station PR-1 has increased levels of most contaminants compared to the other river stations. This station is located near the mouth of Rock Creek which flows through the northwest section of the District of Columbia. Rock Creek has numerous storm and combined sewers draining into its waters which could be a major source of these contaminants. Similarly, the sediments at TB-1 in the Tidal Basin, also contain slightly greater concentrations of most contaminants in that area. Located near TB-1 is a large storm sewer that drains Constitution Ave. around the Mall of the Smithsonian Institution. While the outfall sample taken at this location (OTB-1) does not exhibit higher concentrations, the concentrations of most contaminants at outfalls, OTB-3, OTB-4, and OTB-5 are significantly higher than the basin sediments suggesting a source from runoff through their respective drainage areas.

In the Washington Ship Channel the increased concentrations of many contaminants in the upper end of the channel (i.e., WSC-1, WSC-2, and WSC-3) suggests that increase loading and retention of sediment contaminants in this area is occurring. While a substantial proportion of the contamination is most likely due to street runoff (i.e., there are no combined sewers in this area), the numerous boats and boat related activities could also contribute to the concentrations observed in the

Table 3-16. Comparison of trace metal data from various studies in the region*.

Cd	Cr	Cu	Hg	Pb	Zn	Location	Source
0.45 - 3.2	51 - 155	33 -126	0.2 - 1.0	32 - 409	137 - 512	Washington, D.C.	This Study
(0.58 - 3.7)	(70 - 180)	(39 - 148)	(0.2 - 1.2)	(37 - 475)	(189 - 595)		
<1 - 650	60 - 5750	60 - 2930	0.1 - 10	130 - 13890	350 - 6040	Baltimore Harbor	EPA (1987)
ND	10 - 880	10 - 3000	<0.01 - 0.9	20 - 19000	30 - 1400	Schuylkill River, PA.	EPA (1987)
0.2 - 1.3	39 - 62	29 - 43	0.07 - 0.3	15 - 73	134 - 270	Potomac Estuary	MDE (unpub)
(0.2 - 1.5)	(90 - 237)	(15 - 30)	(0.1 - 0.2)	(24 - 80)	(107 - 593)	Lower Ches. Bay	NOAA (1991)
(0.6 - 1.3)	(77 - 647)	(20 - 75)	(0.1 - 0.4)	(27 - 125)	(111 - 790)	Middle Ches. Bay	NOAA (1991)
(0.6 - 1.0)	(108 - 280)	(56 - 79)	(0.2 - 0.5)	(57 - 83)	(291 - 390)	Upper Ches. Bay	NOAA (1991)

* Concentrations are in μg per gram dry weight except for values in ( ) which are normalized to the fraction of fine grain sediment. ND - No data.

Table 3-17. Comparison of selected organic data from various studies in the region.*

PCBs	PAHs	DDT	Chlordanes	Location	Source
68 - 2203	4 - 29	7 - 160	5 - 153	Washington, D.C.	This Study
(74 - 2560)	(4 - 37)	(8 - 170)	(6 - 180)		
4 - 80000	ND	ND	ND	Baltimore Harbor	EPA (1987)
<100 - 2400	ND	<10 - 100	0 - 70	Schuylkill River, PA.	EPA (1987)
ND	ND	ND	ND	Potomac Estuary	MDE (unpub)
(8 - 1220)	(0.1 - 1.4)	(0.7 - 6.1)	(0.5 - 5.3)	Lower Ches. Bay	NOAA (1991)
(5 - 100)	(0.3 - 1.8)	(0.8 - 6.2)	(0.3 - 10)	Middle Ches. Bay	NOAA (1991)
(110 - 812)	(2.5 - 5.5)	(5 - 22)	(2.1 - 8.0)	Upper Ches. Bay	NOAA (1991)

* Concentrations of PCBs, DDTs, and chlordanes are in ng per gram, and PAHs are in μg per gram dry weight. Values in ( ) have normalized to the fraction of fine grain material. ND - No data.

sediments.

The concentration differences between sewer, outfall, and river sediment samples in the Anacostia River, along with the spatial trends in sediment contamination from station KL-5 to PR-4A, suggest that the numerous storm and combined sewers in the river are a major source of contamination. This is especially noted at station AR-4 located just downstream of the Washington Navy Yard, near the South Capital Street Bridge. While the extreme gradient between the sewer, outfall and sediment at this location indicates urban runoff is a source, past and present activities at the Navy Yard and possibly the U.S. Botanical Gardens (located slightly downstream on the southern side of the river) could also contribute to the contamination of the area. Also, while there is no heavy industry located in the area, there are other facilities that border the area (e.g., oil off-loading terminals, power plants, construction companies) that may have some impact. Interestingly, however, the net result of all these possible sources are substantially higher concentrations of all contaminants at AR-4, with a large concentration decrease downstream. This distribution suggests a higher source function at AR-4 and/or a greater retention of upstream sources (i.e., fine grain sediments) in this section of the river. The downstream gradient is most likely related to the mixing (via tides and runoff) of uncontaminated sediments with sediments at station AR-4.

Chapter IV

Biological effects of contaminated sediment in the Washington, D.C., area.

Introduction

The widespread distribution of chemical contamination in sediments from the Washington, D.C., area is well documented (ICPRB, 1991; Chapter III). However, because the bioavailability of sediment-sorbed organic and inorganic pollutants is controlled by complex partitioning factors (Landrum and Robbins, 1990), traditional chemical analyses provide little or no insight to the biological consequences of sediment contamination (Burton, 1991; Di Toro et al., 1990, 1991; Hale and Huggett, 1988; Jenne and Zacchara, 1987). Laboratory bioassays are useful in assessing toxicity of contaminated sediments to select test organisms (Chapman, 1989). However, these tests represent the "worst-case scenario" and may not accurately reflect the in situ conditions at each site. Furthermore, laboratory toxicity test organisms may not invariably be protective of sensitive benthic species. A measure of resident infaunal community structure is therefore necessary to confirm biological effects of sediment contamination.

A measure of resident benthic macroinvertebrate community structure can support and complement sediment chemical analysis and toxicity tests. Because many benthic invertebrates live in intimate contact with bottom sediments, are relatively immobile, and possess sensitive life stages which respond quickly to stress, they often serve as excellent indicators of impacts to the sedimentary environment (e.g., physical resuspension, contaminant enrichment). Additionally, benthic macroinvertebrates are an integral part of the aquatic food chain and are a primary food source for many fish (U.S. EPA, 1989).

The objective of this chapter is to assess, through the integration of sediment toxicity test results, benthic community analyses, and chemical data, the extent of pollution-induced degradation in water bodies in the Washington, D.C., area. This "burden-of-evidence" approach, known as the Sediment Quality Triad, has been successfully used to identify areas where sediment contamination causes adverse effects in San Francisco Bay (CA) and in the Gulf of Mexico (Chapman et al., 1991; Chapman et al., 1987).

Stations will also be ranked from most to least impacted by applying the numerical ranking system developed by Kreis (1988). The ranking system, which has been successfully applied and validated in the Great Lakes and Detroit River, integrates physical, chemical, and biological data to provide an objective assessment of pollution-induced degradation. In the present study, measures of benthic community structure, sediment toxicity, and sediment chemistry will be weighted equally in the ranking process to be consistent with the concept of the Sediment Quality Triad Approach (Chapman, 1985).

Results and Discussion

Sediment Toxicity

Test Acceptability

Textural properties of Corsica River sediment compare well to those of test sediments (Table 4-1, Chapter III). Thus, Corsica River sediment fulfills criteria set forth for reference and negative control sediment (ASTM, 1991). Mean survival of H. azteca exposed to Corsica River sediment was 87.5 ± 5.0% (mean ± standard deviation; Table 4-2), exceeding the recommended minimum criteria for survival in control sediment of 80% (ASTM, 1991). High survival of H. azteca in control sediment indicates no problems associated with test organism health or test conditions. Overlying water quality parameters (i.e., temperature, dissolved oxygen, pH, conductivity, alkalinity, hardness) were acceptable for all replicates of each treatment, except for one replicate within the AR-4 treatment in which air flow was temporarily interrupted and the dissolved oxygen concentration fell below the recommended 60% saturation (ASTM, 1991). Survival and length data for this replicate were subsequently excluded from statistical analyses.

Amphipod Response

Mean survival of H. azteca ranged from 25.0 to 87.5% for all test sediments (Table 4-2). Three Anacostia River stations (AR-1, AR-3, AR-4) and the sole Potomac River station (PR-4) had significantly greater mortality when compared to reference sediment (Table 4-2). From highest to lowest, the rank of mean survival of H. azteca for all stations within each waterbody is: Washington Ship Channel (82%) > Tidal Basin (80%) > Kingman Lake (71%) > Anacostia River (56%) > Potomac River (25%).

Mean length of H. azteca in KL-1 sediment from Kingman Lake was significantly lower than in control sediment (Table 4-2). In one treatment (TB-1), mean amphipod length was significantly greater compared to control mean amphipod length (Table 4-2). Inhibition of amphipod growth is an indication of conditions that place the organism near the limit of its range of physiological tolerance. The reduction in growth could potentially affect reproductive success by increasing the time to reproductive maturity due to delayed development. Alternatively, the size of females at the time of reproduction could be reduced, thereby reducing reproductive output (i.e., fecundity) (Johns et al.,

Table 4-1. Textural properties and trace element concentrations of sediment collected from Corsica River, Queen Anne's County, MD* and this study.

ID.	Sand	Silt	Clay	TOC	Fe	Cd	Cr	Cu	Hg	Pb	Zn
Corsica River	7.9	48.9	43.2	2.5	9.0	<0.5	15.0	6.4	<0.1	12.0	37.0
This Study	6.8	62.7	29.4	3.8	NA	NA	NA	NA	NA	NA	NA

* Sand, Silt, Clay, total organic carbon (TOC), and Fe are in units of %. Trace metals are in units of µg per gram dry weight. NA - Not applicable, see Chapter III. Values for this study are averages of all sediment samples.

Table 4-2. Mean survival and mean length of Hyalella azteca for 28 day. Standard deviations are presented in parentheses.

Collection Site	Survival (%)	Length (mm)
Reference/Control	87.5 ± 5.0	2.41 ± 0.43
Kingman Lake		
KL-1	61.3 ± 14.9	1.99 ± 0.41*
KL-2	82.5 ± 6.5	2.62 ± 0.52
KL-3	78.8 ± 9.5	2.61 ± 0.39
KL-4	72.5 ± 8.7	2.45 ± 0.56
KL-5	61.5 ± 15.5	2.70 ± 0.48
Anacostia River		
AR-1	38.8 ± 11.1*	1.98 ± 0.41
AR-2	77.5 ± 10.6	2.14 ± 0.39
AR-3	53.8 ± 10.3*	2.01 ± 0.32
AR-4	35.0 ± 17.8*	1.93 ± 0.39
AR-5	76.3 ± 2.5	2.69 ± 0.54
Washington Channel		
WSC-1	86.3 ± 7.5	2.57 ± 0.50
WSC-3	78.8 ± 9.5	2.64 ± 0.54
Tidal Basin		
TB-1	87.5 ± 10.4	2.97 ± 0.46
TB-3	73.8 ± 4.8	2.39 ± 0.40
Potomac River		
PR-4	25.0 ± 9.1*	2.18 ± 0.41

(*) denotes that value is significantly < reference,
while values underlined are significantly > reference.

1991).

Enhanced growth of H. azteca was caused by sediment from one site. Other researchers have also observed enhanced growth in sediment toxicity tests (Ingersoll and Nelson, 1991; Johns et al., 1991; Chapman et al., 1985). This phenomenon may be a result of hormesis, the apparent magnification of physiological processes caused by low levels of toxicant (Stebbing, 1981). Alternatively, the presence of particulate plant debris (i.e., leaves), on which H. azteca feed (Collyard et al., 1991), may have provided amphipods a supplemental food source in these test sediments. Particulate plant debris was absent in reference sediment because it was sieved prior to test initiation.

It is clear from the results of sediment toxicity test, that a major area of concern within Washington D.C. is the Anacostia River. Specifically, test results indicate the consistent presence of sediment toxicity (i.e., deleterious effects on survival or growth of H. azteca) from just downstream of the Sousa Bridge (AR-1) to just upstream of the Douglas Bridge (AR-4). For reasons to be discussed below, the cause of toxicity exhibited by sediment from PR-4 appears to be unrelated to sediment contamination in the Anacostia River.

Benthic Community Analysis

Benthic Community Characteristics

A total of 5675 organisms within 28 taxa are identified from all sites within the study area (Table 4-3). Appendix 1 contains a list of all invertebrates collected per grab. Each station is dominated by oligochaetes (i.e., worms) and chironomids (i.e., non-biting midges), which together comprise at least 93% of the total number of organisms. Crustaceans, mollusks, leeches, and other insect families are also represented (Table 4-4). Taxa richness (i.e., the number of distinct taxa) ranges from 5 at AR-4 and WSC-3 to 17 at KL-5. Abundance ranges from 783 to 6112 organisms/m^2 at AR-4 and KL-1, respectively. Both parameters are comparable to other surveys conducted within this region (Edmonson, 1988; Holland et al., 1988). Evenness, a measure of homogeneity of species distribution within a sample, ranges from 0.1 at AR-3 to 0.6 at TB-3 and KL-1.

Oligochaete worms, often considered the most pollution tolerant group of freshwater macroinvertebrates (U.S. EPA, 1990; U.S. FWS, 1988; Hart and Fuller, 1974), dominate the benthos at all stations except TB-3, KL-1, KL-2, and KL-5 (Table 4-4). These burrowing organisms feed on detritus and associated microbes. Oligochaetes can tolerate prolonged dissolved oxygen (D.O.) depletions (Pennak, 1978) and exposure to toxicants that do not inhibit growth of their bacterial food

Table 4-3. Benthic Macroinvertebrates data for the Potomac and Anacostia River Study*.

Station ID.	PR-4	TB-1	TB-3	WSC-1	WSC-3	AR-1	AR-2	AR-3	AR-4	AR-5	KL-1	KL-2	KL-3	KL-4	KL-5
ANNELIDA															
Oligochaeta	267	151	112	162	127	438	383	339	116	162	427	87	344	650	70
Hirudinea	1	0	0	0	0	0	0	0	0	3	0	0	0	1	1
MOLLUSCA															
Corbicula fluminea	4	0	3	2	0	3	1	1	1	1	0	0	0	3	4
Pisidium spp.	4	0	0	0	3	4	4	3	2	4	0	1	1	1	0
Bithynia tentaculata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Valvata sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
CRUSTACEA															
Gammaridae genus A	6	0	1	0	0	3	1	0	0	0	0	0	0	0	0
Gammarus spp.	4	5	0	0	0	10	0	0	0	0	0	0	0	0	0
Gammarus fasciatus	1	0	0	0	0	4	0	0	0	0	0	0	0	0	0
Corophium lacustre	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
CHIRONOMIDAE															
Procladius spp.	4	14	32	1	15	109	15	2	9	4	6	106	87	71	107
Coelotanypus spp.	18	19	3	15	1	10	5	9	12	17	0	3	9	4	2
Tanypus spp.	0	0	0	0	0	2	1	1	0	0	551	9	9	1	5
Larsia spp.	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1
Tanypodinae genus A	0	0	0	0	0	0	0	0	0	0	5	0	0	0	0
Chironomus spp.	4	14	170	1	3	6	0	0	0	0	109	9	0	0	11
Cryptochironomus spp.	5	2	9	5	0	1	0	0	0	1	0	0	1	0	0
Dicrotendipes spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	6
Harnishia spp.	1	0	0	0	0	1	0	0	0	0	0	0	1	0	0
Polypedilum spp.	0	0	5	0	0	0	0	0	0	1	0	0	0	0	0
Endochironomus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
Paratanytarsus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Rheotanytarsus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Orthocladius spp.	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1
Nanocladius spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
OTHER INSECTA															
Palpomyia spp.	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Chaoborus spp.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1
Caenis spp.	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Total # of Taxa	13	7	9	6	5	12	7	6	5	8	6	7	9	8	17
Total # of Organisms	320	206	337	186	149	591	410	356	140	193	1099	216	455	732	219

* Values are total organisms per station.

Table 4-4. Benthic community parameters for stations in the Potomac (PR) and Anacostia (AR) rivers, the Washington Channel (WSC), Tidal Basin (TB), and Kingman lake (KL).*

Sta. ID.	PR-4	TB-1	TB-3	WSC-1	WSC-3	AR-1	AR-2	AR-3	AR-4	AR-5	KL-1	KL-2	KL-3	KL-4	KL-5
Total Abundances (#/m^2)	1837	1169	1937	1035	902	3290	2288	2037	783	1086	6112	1202	2522	4092	1236
Taxa Richness	13	7	9	6	5	12	7	6	5	8	6	7	9	8	17
Evenness	0.3	0.5	0.6	0.3	0.4	0.5	0.2	0.1	0.4	0.3	0.6	0.5	0.4	0.2	0.5
Oligochaeta (%)	83	73	33	87	85	74	93	96	83	84	39	40	76	89	32
Chironomidae (%)	10	24	65	12	13	22	5	3	15	12	61	59	24	11	64
Mollusca (%)	3	0	1	1	2	1	1	1	2	3	0	0.5	0.2	0.5	3.2
Crustacea (%)	3	4	0.3	0	0	3	0.2	0	0	0	0	0	0	0	0
Other Insects (%)	0.3	0	0.6	0	0	0	0	0	0	0	0.1	0	0.2	0	0.5

*Rare Taxa = 1 or 2 individuals per entire survey source (Hart and Fuller, 1974). Predatory non-biting midges (Diptera: Chironomidae) are the second most abundant group, with Procladius spp. being the dominant genus. These insects either sprawl on or burrow into sediment and engulf other insects, small crustaceans, and worms. Another dominant chironomid, Chironomus spp., is a burrowing tube builder. This organism tolerates long periods of depleted D.O. via a hemoglobin oxygen transport system (Simpson and Bode, 1980). However, early life stages of Chironomus riparius are sensitive to sediment-bound toxicants, particularly metals (Burton, 1991). The absence of Chironomus spp. at AR-2 and AR-3 and to a lesser extent at AR-4 and AR-5 may be a reflection of elevated sediment metal concentrations at these stations (Table 4-3; see Chapter III).

Rare taxa (i.e., 1 or 2 individuals per entire survey) occur at 6 (i.e., PR-4, TB-3, KL-1, KL-2, KL-3, and KL-5) of 15 stations and include mayflies, chironomids, other dipterans, and mollusks (Table 4-4). Caenis spp., a mayfly (Ephemeroptera: Caenidae), and the non-biting midge, Rheotanytarsus sp. (Diptera: Chironmidae), both represent groups generally considered sensitive to certain classes of pollutants (Simpson and Bode, 1980; U.S. EPA, 1989). The greatest number of rare taxa (7) are found at KL-5, which also contains the lowest proportion of oligochaetes. Each of the four stations which are not dominated by oligochaetes contain at least one rare taxon.

Table 4-5 lists the benthic community parameters within each sampling site. The highest and lowest values for each parameter are indicated. This intersite comparison does not reveal a clear demarcation between "best" and "worst" sites. However, AR-2, AR-3, and AR-4, when averaged, contain low taxa richness, the lowest evenness, and the highest percentage of oligochaetes. These data indicate that impacts to the benthic community at these stations may be most severe relative to other sites within the survey. Additionally, within the mainstem Anacostia River, there is an upstream to downstream decrease in taxa richness from KL-5 to AR-4 and abundance from AR-1 to AR-4 (Table 4-4). Finally, the proportion of oligochaetes increases from KL-1 to AR-3. These factors demonstrate a decline in the balance of the benthic community in this reach of the Anacostia River. However, taxa richness, abundance, and number of rare taxa are higher at the confluence of the Potomac and Anacostia Rivers (i.e., PR-4) than at the upstream Anacostia River stations, indicating that the factors impacting the lower Anacostia River may not extend into the Potomac River.

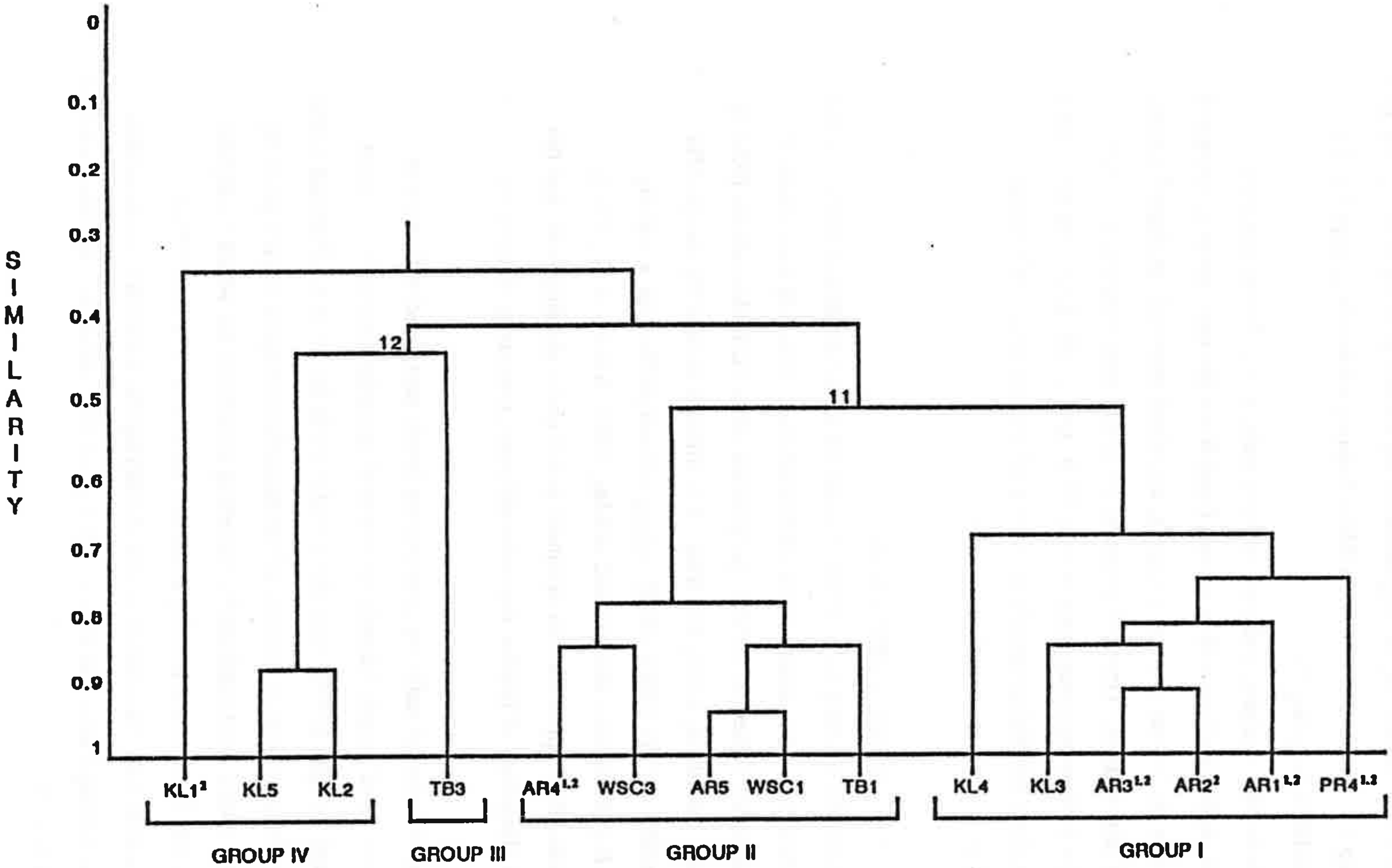
Cluster Analysis

Four clusters are separated by numerical classification (Figure 4-1), with groups I and II

Table 4-5. Ranking of benthic community parameters for the various study areas*.

	Potomac River[1]	Tidal Basin	Washington Channel	Lower Anacostia River	Lower Anacostia River	Kingman Lake
Station ID.	PR-4	TB-1, TB-3	WSC-1, WSC-3	KL-5, AR-1 - AR-5	AR-2 - AR-4	KL1 - KL4
Taxa Richness (# of Taxa)	13 (H)	8	6 (L)	10	6 (L)	7.5
Total Abundance (#/m^2)	1837	1553	935 (L)	1787	1703	3490 (H)
Evenness	0.3	0.55 (H)	0.35	0.33	0.2 (L)	0.43
Oligochaeta (%)	83	53 (L)	86	78	91 (H)	61

* (H) = Highest value within parameter, (L) = Lowest value within parameter, [1]Not an average, only one station.



[1] % Survival significantly less than reference in amphipod toxicity tests.
[2] Length significantly less than reference in amphipod toxicity tests.

Figure 4-1. Cluster analysis of benthic assemblages using the Bray-Curtis similarity coefficient and an unweighted pair group method. Group I and II and groups III and IV are significantly different (linkage 11 and 12) using the bootstrap.

(linkage 11) and groups III and IV (linkage 12) being significantly different at $p=0.05$. A list of p values for 50, 100, 200, and 500 clustering simulations appears in Appendix III. Because the benthic community parameters of KL-1 (i.e., evenness, % oligochaetes) are similar to those of KL-2 and KL-5, KL-1 was placed into group IV. All lower Anacostia River Stations are within groups I and II, with the exception of KL-5 which is in group IV.

Results of benthic community analysis, sediment toxicity tests, and sediment chemical analyses (Chapter III) all indicate that stations within groups I and II are the most severely impacted except (Table 4-6). Group I has the lowest average evenness, amphipod survival, amphipod length, and the highest proportion of oligochaetes. Group II contains the lowest taxa richness and total abundance while exhibiting the highest concentrations of total PCB, total PAH, DDT and total metal enrichment. Three of four stations exhibiting significant amphipod toxicity and 4 of 6 stations displaying significant growth effects are contained in group I.

Comparison of Biological Measures to Bulk Chemical Data

Chemical analyses revealed relatively high levels of sediment contamination at most test sites (see Chapter III). A broad variety of contaminant types were identified, including trace elements (i.e., heavy metals), polychlorinated biphenyls (PCBs), polynuclear aromatic hydrocarbons (PAHs), and chlorinated pesticides (i.e., chlordane, DDT, dieldrin). It is difficult to identify the specific sediment contaminants responsible for the toxicity to H. azteca without performing a toxicity identification evaluation (T.I.E.) (Schubauer-Berigan and Ankley, 1991; Ankley et al., 1990). However, T.I.E.s are expensive, their application to sediment is still under development, and the extension of T.I.E. results to alterations of benthic macroinvertebrate community structure is questionable.

Alternatively, the identification of sediment-contaminant levels associated with adverse biological effects provides a means of grossly identifying potential causative factors in sediment toxicity assessments. Long and Morgan (1990) have developed criteria for NOAA's National Status and Trends program that provide a qualitative estimate of the potential biological impact posed by sediment contaminants. These values were obtained by screening data bases for which biological effects (e.g., significant mortality in sediment toxicity tests) are associated with a particular contaminant concentration, ranking the concentrations, and identifying the concentration associated with the lower 10th percentile causing biological effects, ER-L, and the median concentration causing biological effects, ER-M (Table 4-7).

Table 4-6. Benthic community parameters of groups separated by numerical classification analysis*.

	GROUP I	GROUP II	GROUP III	GROUP IV
		BENTHOS		
Taxa Richness (# of Taxa)	9	6 (L)	9	10 (H)
Total Abundances (#/m^2)	160	56 (L)	116	171 (H)
Evenness	0.3 (L)	0.4	0.6 (H)	0.5
Oligochaeta (%)	85 (H)	82	33 (L)	37
		TOXICITY TESTING		
Amphipod Survival (%)	58 (L)	73	74 (H)	68
Amphipod Length (mm)	2.2 (L)	2.6 (H)	2.4	2.4
		BULK SEDIMENT CHEMISTRY		
PCB (ng/g-dw)	515	801 (H)	305 (L)	614
PAH (ng/g-dw)	5232	6082 (H)	3201 (L)	5880
DDT (ng/g-dw)	65	93 (H)	30 (L)	60
Enrichment Factor	4.3	4.8 (H)	2.8 (L)	4.5

*(H) = High value, (L) = Low value, Group III has only one station (TB-3) and as such is not an average.

Table 4-7. Effects related concentrations of sediment contaminants*.

Chemical Analyte	ER-L	ER-M
Trace Metals (µg/g)		
Cadmium (Cd)	5	9
Chromium (Cr)	80	145
Copper (Cu)	70	390
Lead (Pb)	35	110
Mercury (Hg)	0.15	1.3
Zinc (Zn)	120	270
Chlorinated Hydrocarbons (ng/g)		
Total Polychlorinated Biphenyls (PCBs)	50	400
Total DDT (DDT+DDE+DDD)	3	350
Dieldrin	0.02	8
Endrin	0.02	45
Aromatic Hydrocarbons (ng/g)		
Acenaphthene (1)	150	650
Anthracene (2)	85	960
Benzo[a]anthracence (3)	230	1600
Benzo[a]pyrene (4)	400	2500
Chrysene (5)	400	2800
Flouranthene (6)	600	3600
Fluorene (7)	35	640
Naphthalene (8)	340	2100
Phenanthrene (9)	225	1380
Pyrene (10)	350	2200
Total Polycyclic Aromatic Hydrocarbons (PAHs)	4000	35000

*Concentrations taken from Long and Morgan (1990). See text for details.

Levels of contamination at all study sites exceeded ER-L values for the contaminants listed in Table 4-8. The most common contaminants exceeding ER-L values include copper, chromium, mercury, total and individual PAHs, and DDT, whereas ER-M values were commonly exceeded by levels of lead, zinc, and PCB. Sites within the Anacostia River registered the most exceedances (Table 4-8). Sediment toxicity test results and benthic community analyses are in general agreement with bulk sediment contaminant concentrations and the number of exceedances of the Long and Morgan (1990) criteria, especially in instances where there is a higher proportion of ER-M exceedances and thus higher contamination levels. A notable exception is the sole Potomac River site. Although sediments from PR-4 caused the highest mortality in sediment toxicity tests, contaminant levels of this sediment are among the lowest.

Relationships between select biological parameters and sediment properties were examined by Pearson product-moment correlation using the SYSTAT statistical software program (Wilkinson 1989). Biological parameters included amphipod survival, amphipod length, species richness, and total abundance. The sediment characteristics included textural measures (e.g., particle size distribution, total organic carbon), bulk sediment concentrations of individual and fine grain-normalized trace metals, bulk sediment concentration of individual organic chemicals (e.g., total PAHs, PCBs, individual chlorinated pesticides), individual organic chemicals normalized to percent total organic carbon, and porewater ammonia (i.e., $NH_3 + NH_4^+$). Correlations between amphipod response and several properties appear in Table 4-9. Significant correlations exist between several pairs of biological parameters and sediment characteristics. Only porewater ammonia exhibits a significant negative correlation with both measures of sediment toxicity (Table 4-9). The other significant negative correlations observed were for organic carbon normalized concentration of total PCBs (PCB_{OC}) with amphipod length, and copper with species richness. Significant, positive correlations are observed for percent iron with amphipod survival, percent organic carbon with amphipod length, and percent clay with total abundance.

Significant, inverse relationships between the concentration of porewater ammonia with amphipod survival and amphipod length suggest that porewater ammonia (i.e., $NH_3 + NH_4^+$) contributed to the observed toxicity. Generally, it is the un-ionized form of ammonia (i.e., NH_3), rather than the ammonium ion (i.e, NH_4^+), that has been considered responsible for toxicity to aquatic organisms (U.S. EPA 1984). However, both ammonia and ammonium are reported to be equally toxic to a strain of H. azteca from St. Louis Bay, Lake Superior, MN (M. Schubauer-Berigan, personal communication). In this study, it is not possible to determine which form of ammonia is

Table 4-8. Exceedances of effects-related concentrations for contaminants in sediments collected in the Washington, D.C. area*.

Station	ER-L Exceedances	ER-M Exceedances	Total Exceedances
Tidal Basin			
TB-1	Cu, Cr, Hg, PCB, DDT, dieldrin, endrin, PAH 2-10[1]	Pb, Zn, chlordane	19
TB-3	Cu, Cr, Hg, PCB, DDT, PAH 2,3,5-10	Pb, Zn, chlordane	17
Washington Channel			
WSC-1	Cu, Cr. Hg, DDT, PAH 2,5-10, Total PAH	Pb, Zn, PCB, chlordane	16
WSC-3	Hg, Zn, PCB, DDT, dieldrin, PAH 5,7-10, Total PAH	Pb, chlordane	13
Kingman Lake			
KL-1	Cu, Cr, Hg, DDT, dieldrin, PAH 2-10, Total PAH	Pb, Zn, PCB, chlordane	19
KL-2	Cu, Cr, Hg, DDT, dieldrin, PAH 3-6,9,10, Total PAH	Pb, Zn, PCB, chlordane	18
KL-3	Cu, Cr, Hg, DDT, dieldrin, PAH 3-10, Total PAH	Pb, Zn, PCB, chlordane, PAH 7,8	18
KL-4	Cu, Cr, Hg, DDT, dieldrin, PAH 3-10, Total PAH	Pb, Zn, PCB, chlordane	18
KL-5	Cu, Cr, Hg, DDT, PAH 3-10, Total PAH	Pb, Zn, PCB, chlordane, dieldrin	18
Anacostia River			
AR-1	Cu, Cr, Hg, DDT, dieldrin, endrin, PAH 2-10, Total PAH	Pb, Zn, PCB, chlordane	19
AR-2	Cu, Cr, Hg, DDT, dieldrin, PAH 2-10, Total PAH	Pb, Zn, PCB, chlordane, PAH 7	19
AR-3	Cu, Cr, Hg, DDT, dieldrin, endrin, PAH 2-10, Total PAH	Pb, Zn, PCB, chlordane, PAH 7	19
AR-4	Cu, Hg, DDT, dieldrin, PAH 2-6,9,10, Total PAH	Cr, Pb, Zn, PCB, chlordane, PAH 7,8	19
AR-5	Cu, Cr, Hg, DDT, dieldrin, endrin, PAH 3,5-10, Total PAH	Pb, Zn, PCB, chlordane	18
Potomac River			
PR-4	Hg, Pb, Zn, PCB, DDT, dieldrin, endrin, PAH 7,9	chlordane	10

* ER-L and ER-M values are taken from Long and Morgan (1990), see text for details. [1]For PAH number see Table 4-7.

Table 4-9. Results of Pearson correlation matrix describing relationships between parameters and sediment properties*.

Parameters	Survival	Length	Richness	Abundance
Survival	1.000	*****	*****	*****
Length	0.727	1.000	*****	*****
Richness	-0.368	0.103	1.000	*****
Abundance	-0.145	-0.457	-0.010	1.000
TOC	0.374	0.619	0.262	-0.262
Sand	0.037	0.072	0.167	0.133
Silt	0.340	0.319	-0.434	-0.468
Clay	-0.246	-0.310	0.482	0.550
Cd	-0.075	-0.173	-0.189	-0.058
Cr	-0.061	-0.280	-0.350	-0.055
Cu	0.301	0.169	-0.525	-0.295
Fe	0.592	0.498	-0.430	-0.456
Hg	0.009	-0.290	-0.480	-0.389
Pb	-0.350	-0.113	-0.435	-0.224
Zn	0.202	0.058	-0.276	-0.048
PAH	-0.057	-0.329	-0.313	0.268
PCB	-0.405	-0.423	-0.259	-0.119
DDT	-0.016	0.153	-0.025	-0.259
Chlordane	-0.183	-0.274	0.275	0.439
NH_4^+	-0.568	-0.613	-0.089	0.118
PAH/TOC	-0.173	-0.517	-0.390	0.296
PCB/TOC	-0.457	-0.548	-0.336	-0.075
Chlordane/TOC	-0.228	-0.429	0.087	0.449
DDT/TOC	-0.248	-0.215	-0.172	-0.221

*Regression with data from station PR-4.

responsible for toxicity to H. azteca because the analytical procedure employed measures total ammonia (i.e., $NH_3 + NH_4^+$) (Table 4-10). Therefore, further discussion on the contribution of ammonia to the toxicity of sediments to H. azteca will be limited to porewater ammonia (i.e., $NH_3 + NH_4^+$).

Ammonia (either NH_3 or NH_4^+) has been identified as a major source of toxicity in fresh water (Ankley et al. 1990) and marine (Jones and Lee 1988) sediment contamination assessments. The primary source of ammonia to sediment is deposition of organic matter and the subsequent digenetic production of NH_4^+ (Berner 1980). Concentrations of porewater total ammonium from sediments in the present study are within the range of those attributed by Ankley et al. (1990) as causing toxicity in porewater only exposures. Porewater concentrations of total ammonium from six stations in the present study (AR-1 through AR-4, PR-4, and KL-4) are above the mean LC_{50} value of 20 mg/L reported for the St. Louis Bay strain of H. azteca (M. Schubauer-Berigan, personal communication). Four of these six stations exhibited significant mortality (Table 4-2). These comparisons support the hypothesis that the presence of total ammonium contributed to the observed toxicity. Concentrations of porewater total ammonium in PR-4 sediment are among the highest of any site in the present study (Table 4-10). Thus, porewater ammonia from PR-4 may have contributed to the significant mortality of H. azteca in this sediment.

It appears that toxicity of PR-4 sediment may be attributed in large part to porewater ammonia because the concentrations of all trace metals and of most organic compounds were the lowest of the 15 sites tested (Chapter III). The apparently strong contribution of total ammonium to toxicity of PR-4 sediment may have affected relationships between amphipod response and the degree of sediment contamination at other sites. In a graphical representation of amphipod mortality versus organic carbon normalized concentrations of total PAH and total PCB (total PAH_{OC} and total PCB_{OC}), the presence of PR-4 as an outlier is demonstrated (Figure 4-2). Because outliers may be unduly influential in correlation analysis, Pearson correlation analysis was also performed without PR-4 data.

Coefficients of correlations between amphipod mortality and total PAH, total PCB, and organic carbon-normalized concentrations of chlordane (CHL_{OC}), PAH_{OC}, and PCB_{OC} are significant without PR-4 data (Table 4-11). Additionally, the coefficients of correlations between amphipod length and PAH_{OC} is significant when PR-4 data is removed. Finally, without PR-4 data, the relationship between the concentration of porewater ammonia and amphipod survival is not significant. These results strongly suggest that amphipod toxicity at PR-4 is related to porewater ammonia. At other stations, PAHs, PCBs, and chlordane appear to contribute to amphipod mortality.

Table 4-10. Concentrations of pore water total and un-ionized ammonia in sediment toxicity experiments.*

Station ID	Temperature	pH	Total $NH_3 + NH_4^+$	Un-ionized NH_3
Kingman Lake				
KL-1	20	7.8	11.1	0.28
KL-2	20	7.9	13.4	0.44
KL-3	20	7.9	18.3	0.51
KL-4	20	8.0	26.5	0.93
KL-5	20	8.2	5.6	0.31
Anacostia River				
AR-1	20	7.9	25.1	0.83
AR-2	20	7.9	30.6	0.86
AR-3	20	7.9	26.5	0.80
AR-4A	20	7.9	34.2	1.00
AR-5	20	7.9	18.8	0.53
Washington Channel				
WSC-1	20	8.1	6.4	0.28
WSC-3	20	8.1	5.5	0.27
Potomac River				
PR-4A	20	8.2	27.4	1.51
Tidal Basin				
TB-1	20	8.1	12.9	0.63
TB-3	20	8.2	5.5	0.22

* Concentrations in mg N/L. pH and temperature are those measured in the above lying water within each chamber, while concentrations of pore water $NH_3+NH_4^+$ are from field samples. Calculations were done using the equations and pKs from Emerson et al. (1975).

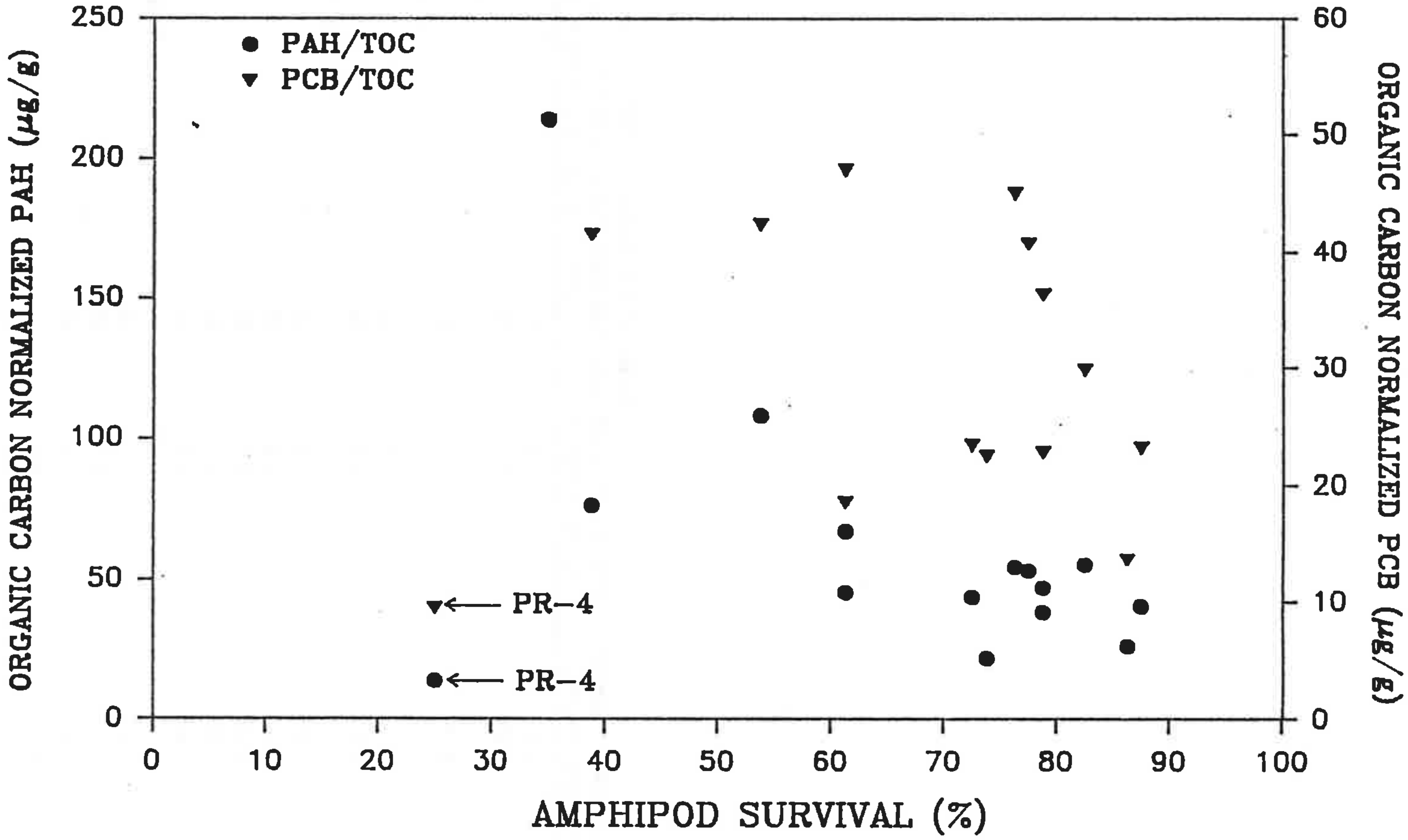


Figure 4-2. Relationship of amphipod survival and PCB and PAH normalized concentrations.

Table 4-11. Results of Pearson correlation matrix describing relationships between parameters and sediment properties without station PR-4.

Parameters	Survival	Length	Richness	Abundance
Survival	1.000	*****	*****	*****
Length	0.777	1.000	*****	*****
Richness	-0.192	0.190	1.000	*****
Abundance	-0.213	-0.474	0.011	1.000
TOC	0.381	0.613	0.333	-0.270
Sand	-0.068	0.046	0.251	0.127
Silt	0.383	0.316	-0.451	-0.471
Clay	-0.166	-0.285	0.449	0.572
Cd	-0.492	-0.299	-0.003	-0.094
Cr	-0.465	-0.420	-0.205	-0.089
Cu	-0.014	0.088	-0.407	-0.382
Fe	0.563	0.476	-0.371	-0.486
Hg	-0.254	-0.100	-0.398	-0.435
Pb	-0.403	-0.220	-0.316	-0.277
Zn	-0.221	-0.062	-0.059	-0.098
PAH	-0.554	-0.521	-0.129	0.289
PCB	-0.721	-0.500	-0.017	-0.139
DDT	-0.205	0.113	0.081	-0.281
Chlordane	-0.489	-0.360	0.466	0.448
NH_4^+	-0.527	-0.593	-0.216	0.136
PAH/TOC	-0.601	-0.683	0.259	0.307
PCB/TOC	-0.775	-0.627	-0.263	-0.092
Chlordane/TOC	-0.543	-0.525	0.247	0.458
DDT/TOC	-0.504	-0.275	-0.081	-0.243

The possibility that porewater ammonia contributed to toxicity at other stations cannot be rejected. Porewater ammonia concentrations at AR-1, AR-3, and AR-4 were above the LC_{50} reported by M. Schubauer-Berigan (personal communication), and even low concentrations can cause toxicity with other contaminants through additive, synergistic, or antagonistic mechanisms (Ankley et al. 1990). The relationship between amphipod length and porewater ammonia remains significant without PR-4 data, indicating that porewater ammonia may have broadly contributed to growth inhibition.

Numerical Ranking

Results of the numerical ranking of study sites is presented in order from most to least impacted (Figure 4-3). The most severely degraded station is AR-4, followed by AR-3, AR-1 and AR-2. These results support prior conclusions that the main area of concern is in the reach of the Anacostia River downstream of the Sousa Bridge to just upstream of the Douglas Bridge. The relative contribution of each Triad component to the final station values is indicated (Figure 4-3). At most stations, the contribution from the three measures is approximately equal, indicating good correspondence among the results of sediment chemistry, benthic community and toxicity test analyses. A notable exception is found at PR-4. The sediment chemistry component contributed minimally to the 8'th place rank of PR-4, suggesting that none of the individual chemical variables incorporated into the ranking system are the cause of toxicity or the degraded benthic community at this station. This supposition supports the hypothesis of ammonia being the cause of toxicity in laboratory exposures.

Comparison to Measures of Bioavailability

Currently, methods for estimating the bioavailability of metals and non-ionic organic chemicals from sediment chemistry data are under consideration by the U.S. Environmental Protection Agency for the establishment of sediment quality criteria. It is argued that the toxicity of certain divalent metals may depend on the concentration of acid volatile sulfide (AVS) in marine (Di Toro et al., 1990) and freshwater (Burton, 1991; Carlson et al., 1991) sediment. Acid volatile sulfides are a reactive sedimentary phase composed mainly of Fe (FeS) and Mn (MnS) sulfides (Morse et al., 1987). AVS may mediate metal toxicity by complexing divalent metals with lower solubility constants than Fe or Mn (i.e., Cd, Cr, Cu, Hg, Ni, Pb, and Zn) (Di Toro et al., 1990). Theoretically, this sequestration decreases the proportion of metals in pore water, thereby reducing toxicity (Carlson et al., 1991).

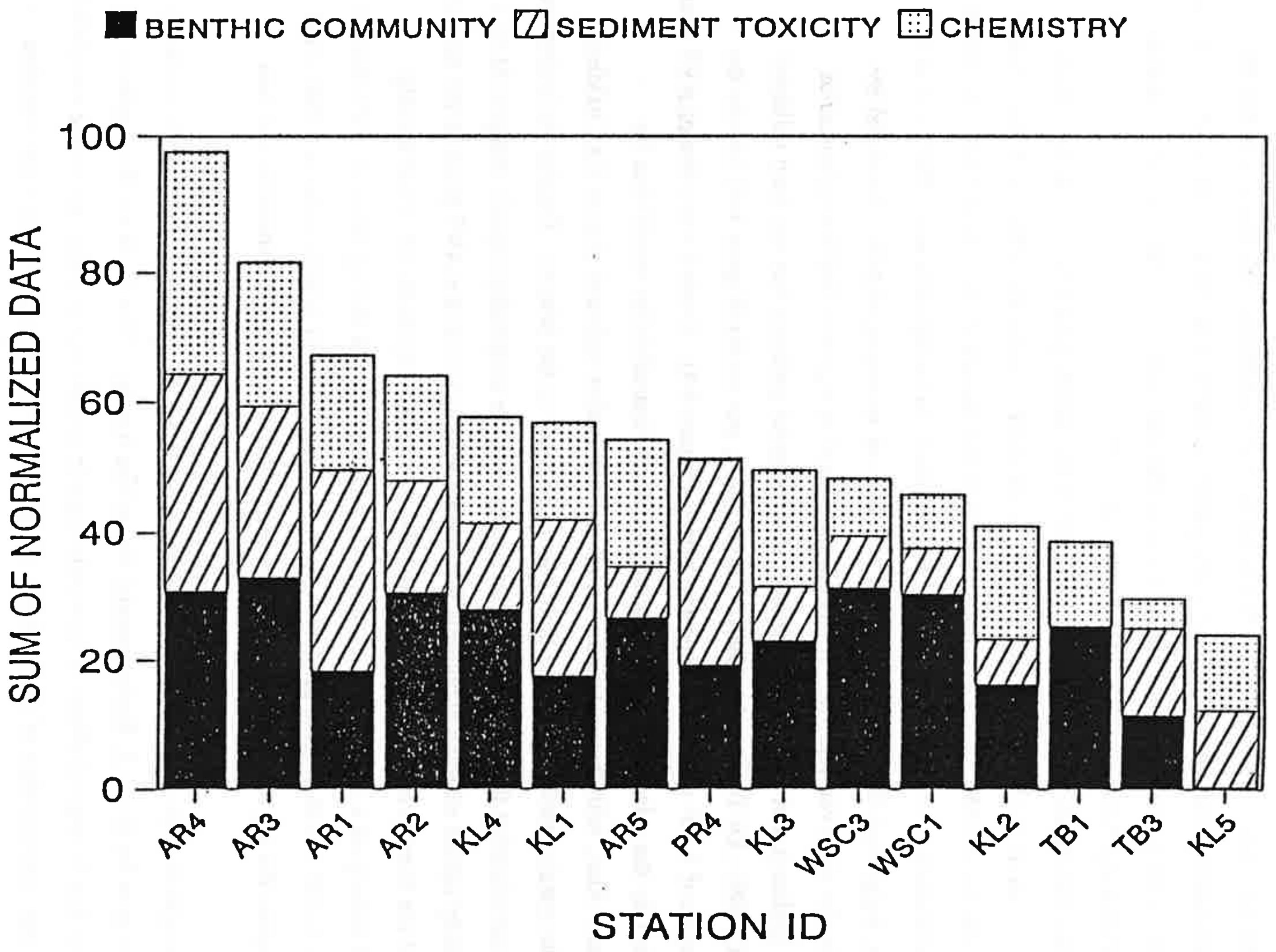


Figure 4-3. Ranking order for biological and chemical impact.

Ideally, SEM and AVS are determined from the same sediment extract. However, in the present study it was necessary to perform the analyses using different methods at different times because of analytical and logistical constraints. One normal HCl was used to extract metals, whereas the AVS extraction followed recommended procedures and used 0.5 N HCl (Di Toro et al., 1990). The molar ratio of Fe to sulfide in the 1.0 N extract is > > 1 (Appendix II), indicating that the method also extracted some amorphous iron-oxide phases in addition to the more AVS phase. Thus, the metal concentrations resulting from the acid extraction represent an overestimation of what is normally operationally defined as SEM (Di Toro et al., 1990).

Divalent metals are thought to be sequestered in the sulfide pool when the molar quantity of AVS is greater than SEM (Di Toro et al., 1990). These metal sulfides are considered biologically unavailable. Ratios of SEM:AVS are <1 for all sites in the present study (Table 4-12). According to the AVS-normalization argument, therefore, metals would be biologically unavailable and unable to cause toxicity, suggesting that other factors (i.e., pore water ammonia, organic chemicals) are responsible for the observed toxicity. The AVS-normalization argument has limitations. For example, the application of AVS-normalization to mixed-metal sediment has not been validated (Carlson et al., 1991; Di Toro et al., 1990). Furthermore, our results (Figure 4-4) indicate the gradual oxidation of AVS during the exposure period (Figure 4-4). Gradual oxidation of AVS would be accompanied by the release of metals, and the predicted bioavailability would thus be underestimated. Also, with the oxidation of AVS and SEM other sediment phases (i.e., oxides) would bind the metals therefore limiting their potential impact to the infauna. Despite the limitations of the AVS-normalization theory, however, the strong evidence supporting organic compounds as a source of toxicity agrees with the hypothesis that metals were bound to the AVS phase at the time of sampling, and are therefore unlikely to have contributed significantly to the observed toxicity. Because AVS undergoes a seasonal cycle, however, it is possible that during times of AVS-minima (i.e., winter), metals could become available and thus adversely affect benthic infauna. This could potentially explain the significant relationship between sediment copper concentration and taxa richness.

The establishment of sediment quality criteria for non-ionic organic compounds is currently under consideration by the U.S. Environmental Protection Agency. The basis for these criteria lies in the observation that biological effects of non-ionic organic compounds in sediment can be correlated to the pore water concentration of the compound, and, further, that the pore water concentration of these compounds is governed by the partitioning between sediment organic carbon and the pore water

Table 4-12. Molar ratio of sediment extractable metal (SEM) to acid volatile sulfur (AVS)*.

Station ID.	Cd	Cu	Pb	Zn	SUM
KL-1	0.0010	0.027	0.040	0.284	0.35
KL-2	0.0015	0.058	0.074	0.433	0.57
KL-3	0.0014	0.059	0.054	0.310	0.42
KL-4	0.0017	0.063	0.081	0.550	0.70
KL-5	0.0030	0.138	0.114	0.695	0.95
AR-1	0.0012	0.043	0.056	0.372	0.47
AR-2	0.0021	0.099	0.088	0.594	0.78
AR-3	0.0021	0.119	0.095	0.607	0.82
AR-4	0.0008	0.010	0.063	0.197	0.27
AR-5A	0.0006	0.038	0.030	0.189	0.26
AR-6	NA	NA	NA	NA	NA
WSC-1	0.0001	0.008	0.010	0.041	0.06
WSC-2	NA	NA	NA	NA	NA
WSC-3	0.0002	0.010	0.011	0.063	0.08
WSC-5	NA	NA	NA	NA	NA
WSC-6	NA	NA	NA	NA	NA
PR-1	NA	NA	NA	NA	NA
PR-2	NA	NA	NA	NA	NA
PR-3	NA	NA	NA	NA	NA
PR-4A	0.0009	0.062	0.031	0.347	0.44
TB-1[1]	0.0103	0.821	0.687	3.110	4.63
TB-1.5	NA	NA	NA	NA	NA
TB-2	NA	NA	NA	NA	NA
TB-3	0.0002	0.008	0.015	0.097	0.12
TB-4	NA	NA	NA	NA	NA
TB-5A	NA	NA	NA	NA	NA
TB-6	NA	NA	NA	NA	NA

* Units are μmole Metal per μmole S. SUM is the ratio of the molar sum of the 1N extractable metals (Cd, Cu, Pb, and Zn) to AVS. See Chapter 2 and Appendix I for raw data. [1]AVS was oxidized during transport. NA - Not Analyzed

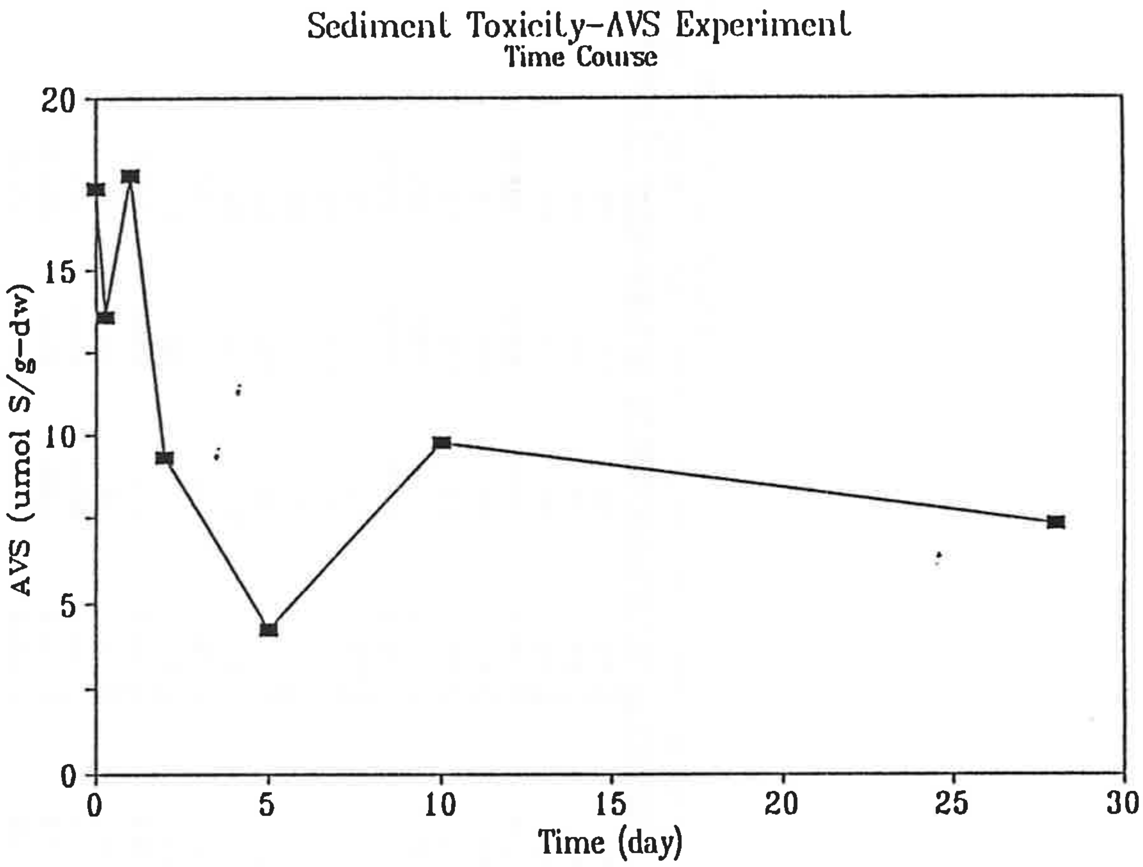


Figure 4-4. Acid volatile sulfur (AVS) time course experiment. Experimental conditions were similar as for the other toxicity test for this sample (AR-5). Sediment samples were taken at specific time intervals and the sample was immediately frozen until analysis.

phase of a sediment (Di Toro et al., 1991). Di Toro et al. (1991) suggest that sediment quality criteria (SQC) be established using the final chronic value (FCV) from water quality criteria (WQC) normalized by a coefficient that approximates the partitioning between organic carbon and pore water, which yields the organic carbon-normalized SQC concentration, or SQC_{OC}. The partitioning of a chemical between sediment and pore water is calculated using two factors, the hydrophobicity of a chemical and the sorption capacity of a sediment (i.e., sediment organic carbon concentration). For the present study, the hydrophobicity of five organic compounds, DDT, chlordane, endrin, dieldrin, flouranthene, acenaphthene, phenanthrene, and PCBs, were estimated using the most recent octanol/water partitioning coefficients available for each compound (Table 4-13). SQC_{OC} were then calculated using the most recent FCV available for each chemical (Table 4-13).

Organic carbon-normalized concentrations of chlordane, DDT, and PCBs are greater than SQC_{OC} for each chemical at all sites (Table 4-13). No exceedances are observed for dieldrin, endrin, acenaphthene, flouranthene, or phenanthrene. Interpretation of criteria exceedances by sediment chemical concentrations in the present study must be interpreted with caution because the U.S. EPA is currently reevaluating K_{OC}s and FCVs for PCB, DDT, and chlordane. It is likely that criteria issued by U.S. EPA for these compounds will differ from those estimated for the present study. Despite this, that PCB/TOC and chlordane/TOC uniformly exceed SQC_{OC} estimates and exhibit significant relationships with sediment toxicity strongly supports the hypothesis that these compounds contribute to sediment toxicity.

Summary and Conclusions

Results of sediment toxicity testing and macroinvertebrate community analysis agree that the lower Anacostia River stations (i.e., from AR-1 to AR-4) exhibit the most severe degree of biological impairment. Sediments from these stations generally elicited the highest toxicity and harbored the least diverse benthic macroinvertebrate communities. Sediment contaminant concentrations are highest at these four stations, indicating a strong relationship between sediment contamination and biological impairment. This investigation also identified Kingman Lake sediment as a potential environmental concern. Even though only one station within Kingman Lake exhibited toxicity (i.e., growth impairment at KL-1), amphipod survival was overall quite low, and chemical contaminant levels of Kingman Lake sediments are high. The two other areas, the Washington Ship Channel and the Tidal Basin, showed low sediment toxicity, moderate benthic community parameters, and levels of sediment contamination below those occurring in the Anacostia River. The sole Potomac River site is

Table 4-13. Sediment quality criteria derivation and number of exceedances for select non-ionic organic compounds.

Compound	K_{oc} (L/mg)	Final Chronic Value ($\mu g/L$)	SQC_{oc} ($\mu g/g_{oc}$)	Number of Sites Exceeding SQC_{oc}
Total PCB[1]	0.2 to 1.2 x 10^5	0.014	0.28 to 1.68	15
Total DDT[1]	1.42 x 10^5	0.001	0.142	15
Chlordane[1]	0.037 x 10^5	0.0043	0.016	15
Dieldrin[2]	2.46 to 6.92 x 10^4	0.0625	0.047 to 0.132	0
Endrin[2]	5.25 x 10^4	0.061	2.36	0
Acenaphthene[2]	6.03 x 10^3	23.0	138	0
Flouranthene[2]	1.26 x 10^5	8.12	1022	0
Phenanthrene[2]	1.95 x 10^4	6.32	123	0

[1] K_{oc}s estimated from K_{ow}s of Kadez et al (1986) and freshwater chronic values as reported in the 1980 Federal Registrar, [2] K_{oc}s and freshwater chronic values from Hansen et al (1991).

the most perplexing situation. Two triad components, sediment toxicity testing and benthic community analysis, indicate biological impairment at this station. However, sediment contaminant levels here are the lowest of any station, and sediment toxicity test results have been attributed to high concentrations of un-ionized ammonia present due to toxicity test conditions. Therefore, biological impairment suggested by benthic community analysis may instead be a result of temporal variation of the macrofaunal community, impacts related to seasonal dynamics in the proportion of un-ionized ammonia under field conditions, or physical disruption.

This study has succeeded in demonstrating the importance of employing a "burden of evidence approach", such as the sediment quality triad, in sediment contamination assessments. Had the assessment been based entirely on comparing contaminant concentrations in field collected sediment to effects-related criteria (i.e., Long and Morgan's (1990) ER-L and ER-M), it would be concluded that sediment from all stations possessed the potential for biological impairment. Similarly, sediment toxicity tests alone would have included the Potomac River station with those within the stretch of the lower Anacostia River as the most severely biologically impaired. By utilizing synoptic measures of sediment contamination, sediment toxicity, and benthic community parameters, it was possible to firmly label the lower Anacostia River as the area of greatest concern within the riverine system of Washington, D.C.

Chapter V

Recommendations for Future Studies

The present study indicates that specific sedimentary areas are impacted by chemical contaminants from runoff through the storm and combined sewer system of the District of Columbia, although inputs from spills and boat-related activities can not be excluded. These areas include the Tidal Basin, Washington Channel, Kingman Lake, and the lower Anacostia River. While certain contaminants (e.g., Pb, PCB, and DDT) appear to have specific source areas (i.e., sewer pipes), other chemical classes (e.g., PAHs) have a much more diffuse source. In addition, sediment toxicity and biodiversity measurements reveal definitive biological impact in many areas including the lower Anacostia River and the Potomac River near Hains Point. The specific chemical agent or agents that are impacting these sites are different. For instance, increase sediment concentrations of anthropogenic chemicals in the Anacostia appears to be causing the impact in this area, whereas the build-up of pore water ammonia in the sediments near Hains Point is suggested as the causative agent in this location. While this report addressed the initial objectives of this study, many questions regarding the fate, transport and biological impact of sediment contamination in the Washington, D.C. area still exist.

Below are listed additional studies that should be undertaken to help better define the source, fate, and transport of these and other possible contaminants in the area:

1) To help determine the possible source(s) of specific contaminants to the areas, a facilities survey of the area bordering the Anacostia River, Washington Channel and Tidal Basin should be completed. The specific areas would be defined by the storm and combined sewer flow system draining into each reach of the river or waterbody. This survey would determine what facilities are within each drainage area and their potential to impact the sediments and water.

2) Once a survey is completed, the impact of the major sites should be investigated by sampling the runoff during both dry and wet periods. The sampling should be done similarly to the present study by sampling sediment (and water) in the storm and combined sewers that drain around each facilities. Sampling could be done at different times during the year to help better assess the variability in runoff. The data derived from this project would help quantify the loading of chemical to the areas waterways. This project would be part of the current NPDES program for monitoring and characterizing storm water runoff.

3) A sediment-contaminant transport study would help determine if material at specific sites, such as near the Washington Navy Yard (AR-4), is being deposited and/or transported downstream. Present chemical data indicates that station AR-4 is the most impacted either due to downstream transport and sediment focusing or increase loadings to this specific area. Also, it appears that some of the contaminants are being transported downstream at an undetermined rate. This type of study would help elucidate the fate of contaminants in the river and their potential impact to other areas around the District of Columbia.

4) While the present data indicates that significant sediment toxicity occurred at the Potomac River site (PR-4), the cause of this toxicity is not clear, and may be due to the concentration of pore water ammonia (i.e., un-ionized NH_3). The shoals around PR-4, Hains Point, appear to be a depositional area that could be affected by sediment from the Washington Channel and more likely the Anacostia River. As shown in the present study, the sediments in the lower Anacostia are chemically and biologically impacted and this material could be accumulating around Hains Point. It would be useful to better determine the extent of the toxicity at Hains Point and the possible causes, either from naturally occurring ammonia (i.e., diagenesis of sedimentary organic matter) or anthropogenic chemicals.

5) In the present study the actual and specific cause of sediment toxicity can not be determined. Sediment toxicity tests, by their design, provide information on the bulk sediment characteristics, they do not however, identify the specific agent or chemical responsible for toxicity. A toxicity identification evaluation (TIE) should be performed using sediments from specific areas to help define which chemicals are the cause of biological effects. A TIE is a stepwise process that combines toxicity testing and analysis of the physical and chemical characteristics of sediments to identify potentially causative toxicants. The results from the TIE studies would better define the cause sediment toxicity which in conjunction with the other studies can help determine sources of contamination to the sediments. Once the sources, transport and fate of chemical contaminants are determined regulatory processes can be utilized to help control the input of chemicals to the waters and sediment of the District of Columbia.

Chapter VI

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Appendix I. Sedimentay Trace Metal Data and QA/QC Information

Trace Metal Raw Data: File 1
GERG DATA SHEET
Conc. in mass per sediment dry weight

Key:
NA - Not Analyzed
NR - Not Reported
RPD - relative percent difference of duplicate analyses
(Observed difference/mean X 100)

Sta ID	TAMU ID	Cd (ug/g)	Cr (ug/g)	Cu (ug/g)	Fe(%)	Hg (ng/g)	Pb (ug/g)	Zn (ug/g)
TB-1	910381	1.67	97.4	120.1	4.89	454.0	204.0	385.0
TB-1.5	NA	NA	NA	NA	NA	NA	NA	NA
TB-2	910382	0.84	91.1	55.1	4.55	246.0	84.5	255.0
TB-3	910383	0.74	75.9	44.5	3.89	242.0	109.5	216.0
TB-4	910384	0.97	96.9	66.7	5.09	286.0	104.3	292.0
TB-5A	AVERAGE	0.83	87.0	55.3	4.67	265.7	79.3	259.7
TB-6	910388	0.93	92.3	59.1	4.88	269.0	91.4	285.0
PR-1	910389	0.99	96.2	59.7	4.45	562.0	127.7	365.0
PR-2	910390	0.55	66.6	34.2	3.89	150.0	32.0	168.0
PR-3	910391	0.52	63.4	35.6	3.76	132.0	33.9	171.0
PR-4A	AVERAGE	0.58	69.0	37.8	4.06	149.7	39.0	188.3
WSC-1	910395	1.19	94.3	103.0	5.06	743.0	183.0	356.0
WSC-2	910396	1.03	95.5	99.9	4.99	581.0	146.6	332.0
WSC-3	910397	1.09	90.7	92.6	5.24	519.0	125.8	339.0
WSC-5	910398	0.45	51.1	33.4	2.92	225.0	48.3	137.0
WSC-6	910399	0.79	86.8	52.6	4.76	250.0	61.9	247.0
AR-1	910400	1.72	103.4	75.6	3.91	341.0	138.9	355.0
AR-2	910401	1.93	117.6	91.9	4.56	287.0	147.5	401.0
AR-3	910402	1.96	123.5	102.0	4.82	373.0	156.9	406.0
AR-4	910403	3.18	155.5	126.9	4.19	1040.0	408.9	512.0
AR-5A	AVERAGE	1.48	107.5	90.2	5.23	364.3	130.5	367.3
AR-6	910407	0.92	90.3	63.8	4.82	535.0	83.2	279.0
KL-1	910408	1.53	105.9	63.8	4.07	277.0	133.8	348.0
KL-2	910409	2.21	134.0	92.3	5.04	432.0	184.3	466.0
KL-3	910410	2.19	118.0	100.1	4.73	391.0	176.5	450.0
KL-4	910411	1.92	106.3	96.6	4.19	457.0	199.3	462.0
KL-5	910412	2.01	106.5	76.1	4.38	351.0	143.7	418.0
Triplicates:								
AR-5A	910404	1.48	107.4	89.2	5.21	358.0	131.7	371.0
AR-5B	910405	1.52	106.5	93.3	5.23	392.0	130.0	366.0
AR-5C	910406	1.45	108.5	88.1	5.26	343.0	129.7	365.0
AR-5ave		1.48	107.5	90.2	5.23	364.3	130.5	367.3
AR-5std		0.04	1.0	2.7	0.03	25.1	1.1	3.2
PR-4A	910392	0.65	70.5	39.9	4.27	148.0	42.0	198.0
PR-4B	910393	0.56	67.7	38.1	4.06	158.0	39.0	186.0
PR-4C	910394	0.52	68.7	35.4	3.84	143.0	36.0	181.0
PR-4ave		0.58	69.0	37.8	4.06	149.7	39.0	188.3
PR-4std		0.07	1.4	2.3	0.22	7.6	3.0	8.7
TB-5A	910385	0.85	91.6	55.3	4.71	260.0	82.8	264.0
TB-5B	910386	0.83	85.1	54.8	4.63	285.0	81.2	257.0
TB-5C	910387	0.82	84.2	55.9	4.68	252.0	73.9	258.0
TB-5ave		0.83	87.0	55.3	4.67	265.7	79.3	259.7
TB-5std		0.02	4.0	0.6	0.04	17.2	4.7	3.8

Sta ID	TAMU ID	Cd (ug/g)	Cr (ug/g)	Cu (ug/g)	Fe(%)	Hg (ng/g)	Pb (ug/g)	Zn (ug/g)
Reference Materials:								
Reported:								
	BCSS mean	0.25	123.0	18.5	3.29	NR	22.7	119.0
	BCSS std	0.04	14.0	2.7	0.11	NR	3.4	12.0
	BCSS-1	0.26	107.5	15.4	3.10	179.0	21.4	99.0
	BCSS-2	0.22	111.5	17.6	3.37	358.0	23.5	108.0
	Average Rec.%	94.23	89.0	89.3	98.30		98.9	86.8
	RPD	17.05	3.7	13.2	8.19	66.4	9.2	8.4
						0.0		
	HS-2-17	0.49	84.3	21.8	3.44	99.0	32.7	109.0
	HS-2-30	0.51	82.6	24.5	3.68	123.0	35.0	115.0
	RPD	5.12	2.1	11.9	6.64	21.5	6.9	4.7
Reported								
	MESS mean	0.59	71.0	25.1	3.05	NR	34.0	191.0
	MESS std	0.1	11.0	3.8	0.18	NR	6.1	17.0
	MESS-85	0.7	56.2	20.1	2.80	199.0	30.5	163.0
	MESS-95	0.62	58.9	24.4	3.00	204.0	33.5	178.0
	Average Rec %	112.16	81.1	88.8	94.92		94.1	89.3
	RPD	12.11	4.6	19.5	6.95	2.4	9.4	9.2
Duplicates:	910383	0.72	73.3	46.2	3.92	243.0	130.8	213.0
	910383	0.76	78.5	42.8	3.87	242.0	88.1	22.0
	RPD	4.56	6.9	7.7	1.30	0.4	39.0	3.1
	910384	0.98	96.7	66.6	5.06	298.0	101.2	293.0
	910384	0.95	97.1	66.9	5.12	273.0	107.4	291.0
	RPD	3.48	0.4	0.4	1.09	8.7	5.9	0.9
	910392	0.71	71.1	41.7	4.15	159.0	43.1	196.0
	910392	0.63	72.1	38.6	4.32	154.0	40.9	199.0
	910392	0.60	68.4	39.5	4.34	132.0	42.1	201.0
	RPD	5.31	5.3	2.5	0.60	15.8	3.0	1.1
	910403	3.22	158.0	129.2	4.23	1050.0	407.1	531.0
	910403	3.15	152.9	124.5	4.16	1030.0	410.7	493.0
	RPD	2.06	3.3	3.7	1.64	2.0	0.9	7.5
	910404	1.54	107.2	88.8	5.20	358.0	131.7	368.0
	910404	1.43	107.6	89.7	5.22	715.0	131.7	374.0
	RPD	7.79	0.3	1.0	0.41	66.4	0.0	1.5

Trace Metal Raw Data: File II
GERG DATA SHEET
Conc. in mass per sediment dry weight

Key:
NA - Not Analyzed
NR - Not Reported
RPD - relative percent difference of duplicate analyses
(Observed difference/mean X 100)

Sta. ID	TAMU ID	Cd (ug/g)	Cr (ug/g)	Cu (ug/g)	Fe(%)	Hg (ng/g)	Pb (ug/g)	Zn (ug/g)
SAR-2-	911339	0.79	634.0	327.8	3.63	176.0	8137.0	512.0
OAR-1	911434	1.72	111.0	73.4	4.01	300.0	164.0	420.0
OAR-2	911435	1.75	116.0	145.0	4.25	1212.0	185.0	450.0
OAR-3	911436	0.90	58.0	69.9	1.54	723.0	175.0	215.0
OAR-4	911437	1.43	109.0	86.9	4.08	303.0	151.0	382.0
OAR-6	911438	0.50	74.0	94.7	3.73	1159.0	111.0	208.0
OAR-R1	911343	0.29	31.0	19.9	1.79	173.0	40.0	80.0
OTB-1-1	911448	0.24	41.0	19.7	0.89	67.0	36.0	62.0
OTB-1-2	911439	0.83	30.0	47.9	1.67	148.0	120.0	235.0
OTB-2	911440	0.43	28.0	13.7	1.91	64.0	320.0	112.0
OTB-3	911441	0.89	167.0	25.9	2.50	91.0	1015.0	180.0
OTB-4	911442	0.94	176.0	102.6	2.89	9216.0	3627.0	527.0
OTB-5	911443	0.73	149.0	39.4	2.32	126.0	465.0	197.0
OWSC-1	911444	1.25	83.0	102.2	3.33	638.0	163.0	400.0
OWSC-2	911445	3.31	105.0	251.3	3.56	627.0	425.0	1094.0
OWSC-3	911446	0.95	63.0	112.3	1.51	196.0	515.0	406.0
OWSC-R1	911344	3.05	167.0	348.0	4.11	865.0	2101.0	750.0
SAR-3	911340	0.37	163.0	20.5	2.38	9.0	102.0	224.0
SAR-5	911341	1.68	133.0	97.4	1.64	2022.0	207.0	271.0
SAR-6	911342	0.45	122.0	47.9	1.43	220.0	96.0	164.0
Site 1 Spl 1	911334	0.27	46.0	20.9	2.28	62.0	35.0	122.0
Site 1 Spl 2	911335	0.12	22.0	7.2	1.10	50.0	19.0	47.0
Site 1 Spl 2	911352	0.12	23.0	10.6	1.58	55.0	36.0	57.0
Site 2 Spl 1	911336	0.10	24.0	10.6	1.90	26.0	13.0	41.0
STB-2-1	911338	9.46	3063.0	1784.9	7.07	7030.0	31296.0	1236.0
STB-2-2	911337	2.81	518.0	510.8	1.89	4957.0	5022.0	684.0
SWSC-2	911345	4.07	44.0	27.9	1.16	48.0	72.0	200.0
Matrix Spikes:								
A+spike	911335	0.32	17.0	22.4	0.73		38.0	160.0
C	911335	0.12	22.0	7.2	1.10		19.0	47.0
theo inc (%)		0.23	NR	18.2	NR		23.0	122.0
rec (%)		85.9	NR	83.5	NR		81.0	93.0
A+spike	911336	0.29	28.0	26.8	1.81		34.0	170.0
B	911336	0.1	20.0	10.3	1.86		14.0	36.0
C	911336	0.1	24.0	10.8	1.95		13.0	45.0
mean		0.1	24.0	10.6	1.90		13.0	41.0
rpd (%)		1.65	19.0	4.9	4.76		7.0	22.0
theo inc (%)		0.22	NR	18.0	NR		22.0	120.0
rec (%)		84.9	NR	90.3	NR		93.0	107.0
A+spike	911344	3.2	167.0	456.1	4.33		2930.0	908.0
B	911344	3.05	173.0	348.0	4.11		2101.0	750.0
theo inc (%)		0.23	NR	18.4	NR		23.0	122.0
rec (%)		66.03	NR	587.9	NR		3607.0	129.0
A+spike	911352	0.34	23.0	26.6	1.58		63.0	183.0
B	911352	0.12	23.0	10.6	1.58		36.0	57.0
theo inc (%)		0.23	NR	18.2	NR		23.0	121.0
rec (%)		95.9	NR	88.0	NR		122.0	104.0

Sta. ID	TAMU ID		Cd (ug/g)	Cr (ug/g)	Cu (ug/g)	Fe(%)	Hg (ng/g)	Pb (ug/g)	Zn (ug/g)
Duplicates									
		911339	0.7	192.0	312.0	3.93		13706.0	543.0
		911339	0.9	1077.0	343.7	3.34		2568.0	481.0
	mean		0.8	635.0	327.8	3.63		8137.0	512.0
	RPD(%)		17.1	139.0	9.7	16.2		137.0	12.0
		911340	0.4	281.0	21.9	3.00		168.0	182.0
		911340	0.3	45.0	19.1	1.75		35.0	266.0
	mean		0.4	163.0	20.5	2.38		102.0	224.0
	RPD(%)		31.4	144.0	13.9	53.0		131.0	38.0
		911436	0.8	66.0	70.7	1.72		189.0	222.0
		911436	1.0	49.0	69.2	1.36		161.0	208.0
	mean		0.9	58.0	69.9	1.54		175.0	215.0
	RPD(%)		27.9	31.0	2.1	23.5		16.0	6.0
		911441	0.9	197.0	21.4	2.45		1232.0	196.0
		911441	0.9	136.0	30.4	2.54		798.0	163.0
	mean		0.9	167.0	25.9	2.50		1015.0	180.0
	RPD(%)		1.2	37.0	34.9	3.48		43.0	19.0
		911442	0.8	187.0	118.4	2.86		3648.0	506.0
		911442	1.1	164.0	86.8	2.91		3606.0	548.0
	mean		0.9	176.0	102.6	2.89		3627.0	527.0
	RPD(%)		28.8	13.0	30.8	1.52		1.0	8.0
		911443	0.7	222.0	37.1	2.26		700.0	178.0
		911443	0.8	77.0	41.7	2.37		229.0	217.0
	mean		0.7	149.0	39.4	2.32		465.0	197.0
	RPD(%)		15.5	97.0	11.8	4.70		101.0	19.0
		911444	1.3	82.0	103.6	3.37		168.0	410.0
		911444	1.2	85.0	100.8	3.28		158.0	391.0
	mean		1.3	83.0	102.2	3.33		163.0	400.0
	RPD(%)		4.0	4.0	2.8	2.58		6.0	5.0
		911446	1.0	74.0	131.7	1.43		431.0	350.0
		911446	0.9	52.0	93.0	1.58		598.0	462.0
	mean		1.0	63.0	112.3	1.51		515.0	406.0
	RPD(%)		1.2	34.0	34.5	9.85		32.0	28.0
		911448	0.2	11.0	19.5	0.65		30.0	56.0
		911448	0.3	72.0	20.0	1.13		42.0	69.0
	mean		0.2	41.0	19.7	0.89		36.0	62.0
	RPD(%)		32.5	148.0	2.8	53.2		33.0	20.0

Trace Metal Raw Data: File III
GERG DATA SHEET
Sediment Extractable Metals
(1 N HCL Leach)

KEY: * Conc. are in wet weight basis.
** ml/g wet sediment for samples;
/g dry sediment for standards.
RPD – rel. % difference of duplicate analyses

Sta ID	DF**	Cd (ug/g)*	Cu (ug/g)*	Fe (ug/g)*	Pb (ug/g)*	Zn (ug/g)*	Hg (ng/g)*
AR-1	13.0	0.64	12.5	4320.0	53.3	111.0	0.7
AR-2	10.3	0.70	18.6	4290.0	54.2	115.0	< 0.6
AR-3	11.5	0.72	22.7	4870.0	59.1	119.0	< 0.6
AR-4	11.3	1.03	7.2	4950.0	151.0	149.0	< 0.6
AR-5A	14.0	0.54	18.0	5280.0	44.4	94.4	< 0.6
AR-5C	7.4	0.54	17.9	5310.0	47.9	90.7	< 0.6
KL-1	9.0	0.68	10.7	4130.0	50.6	114.0	< 0.6
KL-2	12.4	0.75	16.0	5010.0	67.2	124.0	< 0.6
KL-3	12.9	0.82	20.0	4830.0	59.9	109.0	< 0.6
KL-4	12.0	0.81	16.9	4580.0	71.4	153.0	< 0.6
KL-5	11.5	0.71	18.8	4190.0	50.8	97.3	0.9
PR-4B	14.9	0.18	6.6	3140.0	10.7	38.3	< 0.6
TB-1	13.5	0.41	18.4	4140.0	50.3	71.8	< 0.6
TB-2 MIX	12.3	0.27	7.1	5740.0	27.9	57.1	< 0.6
TB-2-1	11.6	0.25	5.1	5440.0	27.2	51.8	< 0.6
TB-3	10.0	0.25	4.7	4570.0	30.3	60.0	< 0.6
TB-1-1	13.0	0.30	6.9	6160.0	34.5	60.8	< 0.6
TB-1-2	10.9	0.27	8.1	6220.0	38.0	59.8	< 0.6
TB-1-3	12.2	0.32	7.6	6570.0	34.4	59.7	< 0.6
TB-1-MIX	13.3	0.32	6.9	7330.0	37.0	63.9	< 0.6
TB-2-2	14.7	0.27	6.5	5660.0	26.2	57.9	< 0.6
TB-2-3	13.3	0.33	7.0	5940.0	29.4	65.0	< 0.6
WSC-1	16.3	0.33	12.3	4990.0	52.9	66.2	< 0.6
WSC-3	11.6	0.25	9.3	5740.0	32.9	58.0	< 0.6
QA DATA:							
Blank A	24.22	<0.004	<0.2	<4.0	<0.1	<2.0	<0.6
Blank B	24.17	<0.004	<0.2	<4.0	<0.1	<2.0	<0.6
Reference Material:							
HS-2C	38.96	0.34	14.47	6651	23.32	39.85	18.24
HS-2D	44.91	0.33	14.75	6673	23.65	40.33	17.97
mean		0.34	14.61	6662	23.48	40.09	18.1
rpd(%)		2.99	1.95	0.33	1.39	1.21	1.48
nominal tot. conc.		0.44	30	37600	33	138	116
% Rel		76.14	48.69	17.72	71.16	29.05	15.61
Spikes:							
HS-2 SPK	57.16	0.55	32.07	7276	47.84	150.45	53.08
theo inc.		0.22	17.56	21.96	117.07	109.58	
rec(%)		97.9	99.4	110.9	94.3	31.9	
HS-2 SPK DUP	52.67	0.53	30.3	7144	45.03	139.94	50.1
theo inc.		0.20	15.67	19.6	104.47	97.79	
rec(%)		99.5	100.1	110.0	95.6	32.7	
HS-2 A	52.77	0.52	30.36	7224	43.93	140.21	48.6
theo inc.		0.20	15.71	19.65	104.76	98.05	
rec(%)		94.1	100.2	104.1	95.6	31.1	
HS-2 B	46.69	0.51	28.1	7035	40.76	128.71	46.17
theo inc.		0.18	14.06	17.58	93.72	87.72	
rec(%)		99.5	96.0	98.3	94.6	32.0	

NOTE: The low spike recovery for Hg is typical of what lab obtains for SEM procedure, Hg SEM values were not used. Method blanks give true detection limit values.

Sta. ID	TAMU ID		Cd (ug/g)	Cr (ug/g)	Cu (ug/g)	Fe(%)	Hg (ng/g)	Pb (ug/g)	Zn (ug/g)
Hg Duplicates:									
		911339					158.0		
		911339					194.0		
	mean						176.0		
	rpd(%)						20.0		
		911340					8.0		
		911340					9.0		
	mean						9.0		
	rpd(%)						11.0		
		911345					55.0		
		911345					40.0		
	mean						48.0		
	rpd(%)						31.0		
		911440					66.0		
		911440					62.0		
	mean						64.0		
	rpd(%)						5.0		
		911443					121.0		
		911443					131.0		
	mean						126.0		
	rpd(%)						8.0		
		911445					737.0		
		911445					516.0		
	mean						627.0		
	rpd(%)						35.0		
		911446					215.0		
		911446					178.0		
	mean						196.0		
	rpd(%)						19.0		
		911448					54.0		
		911448					81.0		
	mean						67.0		
	rpd(%)						41.0		
Reference Material:									
	BCSS-711		115.0		16.3	3.14	230.0	21.0	119.0
	reported		123.0		18.5	3.29	250.0	23.0	119.0
	sd		14.0		2.7	0.10	40.0	3.0	12.0
	rec(%)		94.0		87.9	95.6	92.4	90.0	100.0
	BEST-65		99.0		46.0	3.88	220.0	21.0	161.0
	MESS-180		57.0		22.6	2.78	600.0	31.0	190.0
	MESS-226		59.0		22.2	2.79	600.0	34.0	186.0
	mean		58.0		22.4	2.79	610.0	33.0	188.0
	rpd(%)		4.0		1.6	0.05	3.3	11.0	2.0
	reported		68.0		25.1	2.97	590.0	34.0	191.0
	sd		3.0		3.8	0.08	10.0	6.0	17.0
	rec(%)		85.0		89.3	93.8	103.5	96.0	99.0
Blanks			Cd (ug/g)	Cr (ug/g)	Cu (ug/g)	Fe(%)	Hg (ng/g)	Pb (ug/g)	Zn (ug/g)
RB-59			0.06	<0.03	<0.2	<0.004	<6	<0.1	3.7
RB-146			0.03	<0.03	<0.2	<0.004	<6	<0.1	<2.0
Detection Limits:			<0.005	<0.03	<0.2	<0.004	<6	<0.1	<2.0

NOTE: There is no spike for Cr and Fe, they were originally to be determined by INAA and would have been spiked then, but due to time constraints they were not completed.

Appendix II. Sedimentary Organic and QA/QC Information

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	TB-1	TB-1.5	TB-2	TB-3	TB-4
LABSAMNO:	RQ1630	RQ1642	RQ1631	RQ1640	RQ1650
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1630	>Q1642	>Q1631	>Q1640	>Q1650
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M411	M405	M411	M405	M405
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	26.36	30.16	17.34	26.76	39.74
DRYWT:	10.36	9.65	6.99	10.81	10.57
VOL:					
ACEND10:	131.5	102.3	79.3	83.0	106.1
BENAD12:					
CHRYD12:	131.9	144.3	61.4	134.1	108.7
FLUOD10:					
NAPHD8:	117.1	77.7	73.4	90.6	72.8
PERYD12:	64.2	83.4	92.3	78.8	37.5
PHEND10:	106.4	93.5	76.5	97.3	87.9
C12ALKD:	97.0	81.2	100.0	79.0	82.7
C20ALKD:	116.4	138.9 M	94.4	84.6	103.3
C24ALKD:	125.0	64.0	110.2	127.6 M	98.7
C30ALKD:	103.3	261.9 M	65.9	133.2 M	178.6 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU

DATE: 06-Mar-92

LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	TB-1	TB-1.5	TB-2	TB-3	TB-4
LABSAMNO:	RQ1630	RQ1642	RQ1631	RQ1640	RQ1650
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	45.87	57.40	43.94	47.81	49.93
C11	62.26	70.55	42.93	74.94	60.96
C12	52.19	106.98	28.19	85.61	67.44
C13	58.04	84.94	30.77	65.38	57.72
C14	62.96	230.13	30.03	111.07	111.02
C15	136.10	195.65	63.10	139.09	154.60
C16	93.85	307.60	38.41	144.87	177.17
C17	411.90	388.24	207.60	225.60	341.50
PRISTANE	252.80	139.97	76.80	132.60	191.30
C18	66.10	211.48	46.80	91.80	79.00
PHYTANE	336.30	213.56	144.00	120.50	226.30
C19	188.40	222.86	221.10	146.70	302.00
C20	87.20	76.79	71.00	61.80	70.10
C21	139.70	158.43	120.40	137.30	149.10
C22	94.50	92.20	65.60	82.00	80.60
C23	237.31	551.16	176.28	265.81	341.41
C24	89.17	172.44	75.01	151.84	100.38
C25	420.93	906.55	427.58	1236.92	566.66
C26	26.60	185.01	124.57	216.62	107.11
C27	363.34	1159.72	624.10	1720.33	825.78
C28	30.31	264.14	107.66	299.05	190.72
C29	337.33	3858.55	630.67	4204.15	2128.42
C30	2.14	326.34	7.68	556.36	272.11
C31	87.12	3437.88	22.24	5494.53	3855.39
C32	2.77	142.78	19.52	509.73	317.68
C33	20.74	1002.59	6.40	1756.49	1222.83
C34	0.63	229.78	4.32	191.70	166.83
TOT ALKANES	3706.6	14793.7	3456.7	18270.6	12214.0
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	379.6	595.1	161.9	299.7	438.5
Surrogate Recoveries					
C12ALKD:	97.0	81.2	100.0	79.0	82.7
C20ALKD:	116.4	138.9 M	94.4	84.6	103.3
C24ALKD:	125.0	64.0	110.2	127.6 M	98.7
C30ALKD:	103.3	261.9 M	65.9	133.2 M	178.6 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:															
ID:	TB-1			TB-1.5			TB-2			TB-3			TB-4		
LABSAMNO:	>Q1630			>Q1642			>Q1631			>Q1640			>Q1650		
UNIT:	ng/g			ng/g			ng/g			ng/g			ng/g		
PNA Analyte	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
NAPHTHALENE	67.39			60.79			44.93			66.80			45.88		
C1-NAPHTHALENES	100.06			103.26			76.08			98.79			83.15		
C2-NAPHTHALENES	97.44			153.34			69.06			141.89			128.99		
C3-NAPHTHALENES	113.23			196.58			66.27			178.91			162.84		
C4-NAPHTHALENES	106.23			192.66			40.55			162.45			179.98		
BIPHENYL	15.08			17.51			12.40			20.12			11.20		
ACENAPHTHYLENE	34.75			20.59			20.32			39.93			10.52		
ACENAPHTHENE	44.50			27.42			15.82			42.66			12.51		
FLUORENE	58.65			49.37			29.81			66.44			28.26		
C1-FLUORENES	44.42			53.50			24.79			60.19			37.90		
C2-FLUORENES	102.07			126.41			53.22			114.03			99.20		
C3-FLUORENES	152.46			222.18			53.90			234.00			126.29		
PHENANTHRENE	687.33			411.50			159.75			409.08			167.43		
ANTHRACENE	139.90			76.93			44.06			100.02			37.62		
C1-PHEN_ANTHR	406.58			340.58			130.26			308.47			197.18		
C2-PHEN_ANTHR	446.95			380.17			137.38			326.64			249.77		
C3-PHEN_ANTHR	402.20			307.07			105.92			221.81			203.15		
C4-PHEN_ANTHR	321.68			256.64			89.60			143.90			154.78		
DIBENZOTHIO	34.39			28.73			11.30			26.72			15.00		
C1-DIBEN	48.12			56.79			19.04			46.80			41.35		
C2-DIBEN	117.63			119.37			35.49			99.51			79.84		
C3-DIBEN	189.83			194.52			49.08			109.54			79.00		
FLUORANTHENE	1336.64			974.27			323.73			891.09			397.15		
PYRENE	1184.94			901.13			295.30			778.50			388.41		
C1-FLUORAN_PYR	673.20			554.21			193.50			500.20			261.81		
BENaANTHRACENE	371.35			314.48			152.42			346.94			137.80		
CHRYSENE	752.54			423.64			284.72			393.93			196.77		
C1-CHRYSENES	370.09			244.34			130.87			222.82			128.60		
C2-CHRYSENES	251.45			171.66			82.96			134.56			92.93		
C3-CHRYSENES	99.40			119.63			28.02			83.12			43.02		
C4-CHRYSENES	237.19			128.65			58.96			80.75			32.45		
BENbFLUORAN	524.96			452.31			249.68			337.50			183.59		
BENkFLUORAN	426.97			309.19			94.08			330.48			190.32		
BENePYRENE	417.29			319.53			166.89			268.21			159.71		
BENaPYRENE	445.75			347.23			150.63			336.40			119.21		
PERYLENE	359.20			423.85			159.96			431.78			217.94		
I123cdPYRENE	187.51			313.26			64.73			252.19			109.82		
DBahANTHRA	50.03			70.83			16.06			53.10			27.66		
BghiPERYLENE	178.56			298.35			59.76			229.93			94.43		

LABNAME: GERG/TAMU   DATE: 06-Mar-92   LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	TB-1	TB-1.5	TB-2	TB-3	TB-4
LABSAMNO:	>Q1630	>Q1642	>Q1631	>Q1640	>Q1650
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	64.47	68.39	51.04	63.83	54.74
1-METHYLNAPH	35.59	34.87	25.04	34.96	28.41
2,6-DIMETHNAPH	39.94	44.21	35.45	55.57	30.24
2,3,5-TRIMETHNAPH	31.52	23.24	18.16	33.58	20.79
1-METHYLPHEN	82.35	86.15	14.04	44.56	32.21
Surrogate Recoveries					
NAPHD8:	117.1	77.7	73.4	90.6	72.8
ACEND10:	131.5	102.3	79.3	83.0	106.1
PHEND10:	106.4	93.5	76.5	97.3	87.9
CHRYD12:	131.9	144.3	61.4	134.1	108.7
PERYD12:	64.2	83.4	92.3	78.8	37.5

LABNAME: GERG/TAMU   DATE: 06-Mar-92   LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1630P	Q1642P	Q1631P	Q1640P	Q1650P
STATION	TB-1 (ppb)	TB-1.5 (ppb)	TB-2 (ppb)	TB-3 (ppb)	TB-4 (ppb)
TOTAL BHC'S	0.00	0.00	0.06	0.00	1.76
TOTAL CHLORDANES	24.76	17.45	6.36	13.64	7.80
TOTAL DDT'S	157.62	170.97	23.25	87.59	76.29
TOTAL PCB'S	609.7	498.4	108.3	245.3	241.5
TOXAPHENE					
TOTAL CL2	1.0	1.3	1.1	1.2	2.3
TOTAL CL3	13.5	13.4	7.8	9.6	7.3
TOTAL CL4	180.0	43.8	21.3	24.4	17.5
TOTAL CL5	153.9	103.9	28.2	56.7	48.5
TOTAL CL6	155.4	137.9	34.3	65.9	76.1
TOTAL CL7	93.7	153.5	13.6	69.8	78.1
TOTAL CL8	20.2	33.2	3.6	12.0	16.0
TOTAL CL9	0.0	1.1	0.3	1.4	1.4
TOTAL CL10	0.0	22.9	0.0	10.1	2.2
ALPHA-BHC	0.00	0.00	0.01	0.00	0.00
HCB	1.86	0.00	0.35	0.00	0.00
BETA-BHC	0.00	0.00	0.00	0.00	0.00
GAMMA-BHC	0.00	0.00	0.05	0.00	1.76
DELTA-BHC	0.00	0.00	0.00	0.00	0.00
HEPTACHLOR	0.00	0.00	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.00	0.00	0.00
OXYCHLORDANE	0.00	0.00	0.00	0.00	0.00
GAMMA-CHLORDANE	8.99	5.23	2.21	4.57	2.55
ALPHA-CHLORDANE	8.20	6.21	2.20	4.61	2.35
TRANS-NONACHLOR	4.70	2.98	1.02	2.43	1.23
CIS-NONACHLOR	2.87	3.02	0.93	2.02	1.67
ALDRIN	2.53	7.52	0.28	6.61	1.32
DIELDRIN	0.95	0.67	0.25	0.00	0.37
ENDRIN	0.23	0.00	0.00	0.00	0.00
MIREX	0.00	0.00	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	2.32	0.00	0.31	0.00	0.00
4,4'DDE (P,P'DDE)	76.07	103.74	15.06	39.19	51.25
2,4'DDD (O,P'DDD)	9.28	4.59	0.82	4.97	1.71
4,4'DDD (P,P'DDD)	41.27	37.24	4.10	37.19	13.70
2,4'DDT (O,P'DDT)	5.14	4.56	0.72	1.49	1.81
4,4'DDT (P,P'DDT)	23.55	20.83	2.24	4.75	7.82

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1630P	Q1642P	Q1631P	Q1640P	Q1650P
STATION	TB-1 (ppb)	TB-1.5 (ppb)	TB-2 (ppb)	TB-3 (ppb)	TB-4 (ppb)
PCB#7 (CL2)	0.0	0.0	0.4	0.0	0.0
PCB#8 (CL2)	0.0	0.3	0.0	0.0	0.8
PCB#18 (CL3)	0.4	0.4	0.1	0.5	0.3
PCB#15 (CL2)	1.0	1.0	0.7	1.2	1.5
PCB#24 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#16/32 (CL3)	5.0	2.7	3.8	2.1	1.6
PCB#29 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#26 (CL3)	0.0	1.8	0.0	1.2	0.9
PCB#25 (CL3)	2.9	3.9	1.3	2.0	1.0
PCB#50 (CL4)	1.1	1.3	0.5	0.6	0.8
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	3.4	2.6	1.5	1.9	2.0
PCB#33 (CL3)	1.8	1.1	1.0	0.9	0.7
PCB#22 (CL3)	0.0	0.8	0.2	1.0	0.8
PCB#45 (CL4)	0.2	0.0	0.0	0.0	0.0
PCB#46 (CL4)	0.5	0.0	0.0	0.0	0.0
PCB#52 (CL4)	133.7	18.6	9.8	7.2	4.7
PCB#49 (CL4)	6.5	3.8	2.1	2.8	2.3
PCB#47/48 (CL4)	3.4	2.3	1.2	1.0	1.0
PCB#44 (CL4)	5.1	3.1	1.2	2.0	1.0
PCB#37/42 (CL4)	3.4	2.8	1.0	0.0	1.4
PCB#41/64 (CL4)	4.6	0.0	0.9	0.0	0.0
PCB#40 (CL4)	0.0	0.0	0.0	0.0	0.8
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	3.9	1.7	0.8	1.8	1.0
PCB#70 (CL4)	9.3	5.0	1.8	4.1	2.4
PCB#66 (CL4)	8.3	5.1	2.1	4.9	2.1
PCB#88 (CL5)	7.3	2.8	1.6	1.4	1.7
PCB#60/56 (CL5)	6.1	2.4	1.0	1.8	1.4
PCB#92? (CL5)	13.0	8.9	1.9	4.1	4.3
PCB#84? (CL5)	9.8	0.0	2.0	0.0	0.0
PCB#101 (CL5)	20.3	15.8	4.5	9.8	9.0
PCB#99 (CL5)	7.5	4.9	1.5	3.1	2.6
PCB#83 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#97 (CL5)	5.5	2.6	1.2	2.2	1.2
PCB#87 (CL5)	10.8	6.5	1.7	3.1	2.2
PCB#85 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#136 (CL6)	0.0	2.7	0.0	1.3	1.3
PCB#110/77 (CL5/4)	30.4	19.1	5.2	10.0	8.1
PCB#82 (CL5)	4.4	2.3	0.6	1.7	0.9
PCB#151 (CL6)	9.8	8.6	2.6	3.9	4.8
PCB#107/108/144(CL5/	8.4	7.2	1.8	2.4	4.0
PCB#149 (CL6)	24.2	19.8	5.7	10.3	11.8

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1630P	Q1642P	Q1631P	Q1640P	Q1650P
STATION	TB-1 (ppb)	TB-1.5 (ppb)	TB-2 (ppb)	TB-3 (ppb)	TB-4 (ppb)
PCB#118/108/149(CL5/	19.3	15.2	3.5	9.7	6.6
PCB#188 (CL7)	0.0	1.8	0.0	0.0	0.9
PCB#146 (CL6)	6.3	4.9	1.5	2.4	3.1
PCB#153 (CL6)	42.1	35.0	8.8	17.5	21.1
PCB#105 (CL5)	11.2	16.1	1.6	7.5	6.5
PCB#141 (CL6)	15.5	8.0	3.4	3.5	3.9
PCB#137 (CL6)	0.0	0.0	0.5	0.0	0.0
PCB#? (CL6)	0.0	0.0	0.6	0.0	1.3
PCB#138 (CL6)	46.6	39.7	8.7	20.6	21.9
PCB#158 (CL7)	1.8	2.1	0.4	0.7	1.2
PCB#129 (CL6)	0.0	7.4	0.3	0.2	2.0
PCB#126 (CL5)	1.1	1.1	0.0	0.0	0.4
PCB#178 (CL7)	0.0	2.6	0.3	1.0	1.1
PCB#187/182/159(CL7/	9.0	21.6	1.7	11.1	11.0
PCB#183 (CL7)	4.8	6.9	0.9	2.7	3.9
PCB#128 (CL6)	6.1	3.6	1.1	1.7	1.6
PCB#167 (CL6)	0.0	1.6	0.2	1.3	0.6
PCB#185 (CL7)	2.8	2.8	0.6	1.7	1.5
PCB#174 (CL7)	7.8	10.6	1.5	5.0	6.6
PCB#177 (CL7)	4.6	10.2	0.9	3.0	6.1
PCB#156/171/202(CL6/	4.8	6.6	0.9	3.4	2.6
PCB#200 (CL8)	0.7	0.0	0.2	0.0	0.0
PCB#172 (CL7)	1.2	3.1	0.1	1.6	1.6
PCB#180 (CL7)	22.9	36.5	3.6	14.6	20.3
PCB#191 (CL7)	1.0	1.1	0.2	0.4	0.9
PCB#170 (CL7)	29.9	43.5	2.0	22.8	16.1
PCB#201 (CL8)	5.0	8.0	0.9	3.1	4.5
PCB#196 (CL8)	7.0	9.3	1.2	2.9	4.8
PCB#189 (CL7)	0.0	0.2	0.0	0.0	0.5
PCB#195 (CL8)	2.1	3.2	0.5	0.8	1.9
PCB#194 (CL8)	5.4	12.7	0.8	5.1	4.8
PCB#205 (CL9)	0.0	0.2	0.0	0.1	0.1
PCB#206 (CL9)	0.0	0.9	0.3	1.3	1.3
PCB#209 (CL10)	0.0	22.9	0.0	10.1	2.2

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	TB-5A	TB-5B	TB-5C	TB-6	OTB-1-1
LABSAMNO:	RQ1643	RQ1648	RQ1646	RQ1636	RQ1632
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1643	>Q1648	>Q1646	>Q1636	>Q1632
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M405	M405	M405	M411	M410
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	30.32	29.13	30.06	27.56	15.68
DRYWT:	10.52	10.08	10.64	8.68	8.78
VOL:					
ACEND10:	109.3	123.4	102.3	94.3	96.1
BENAD12:					
CHRYD12:	135.1	150.0	139.7	81.1	89.1
FLUOD10:					
NAPHD8:	70.3	80.0	98.4	100.5	119.6
PERYD12:	55.4	66.0	85.6	70.0	144.1
PHEND10:	110.6	90.7	109.7	102.3	88.7
C12ALKD:	82.5	76.6	86.7	112.9	95.3
C20ALKD:	105.2	42.3	109.7	96.9	91.8
C24ALKD:	83.1	114.6	82.7	120.8	92.6
C30ALKD:	150.2 M	249.0 M	141.3 M	92.7	112.9
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	TB-5A	TB-5B	TB-5C	TB-6	OTB-1-1
LABSAMNO:	RQ1643	RQ1648	RQ1646	RQ1636	RQ1632
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	48.60	58.09	56.73	42.18	0.00
C11	51.52	124.72	45.70	49.21	15.32
C12	59.20	221.20	44.26	29.38	16.07
C13	43.84	346.44	43.34	35.32	25.94
C14	92.97	538.48	67.50	35.57	37.68
C15	121.97	726.52	107.56	91.65	83.45
C16	158.65	605.00	97.97	51.64	58.36
C17	234.20	1779.80	202.70	240.20	73.10
PRISTANE	121.30	1604.30	65.00	94.60	51.90
C18	89.30	650.00	59.60	80.10	52.10
PHYTANE	177.30	1292.40	93.40	162.30	51.20
C19	208.90	765.90	161.50	239.10	62.30
C20	61.80	484.20	48.20	76.60	55.30
C21	127.70	810.80	97.70	120.40	54.10
C22	64.90	522.70	59.60	67.10	38.20
C23	322.80	527.18	289.13	169.32	54.50
C24	279.33	372.96	153.72	77.67	47.22
C25	622.80	1428.74	660.57	358.66	97.86
C26	124.93	391.72	118.50	97.70	50.65
C27	1016.00	2116.19	1008.67	561.47	67.29
C28	224.40	514.57	247.63	155.35	16.54
C29	2596.13	6188.24	2511.47	794.91	113.46
C30	289.11	987.31	399.02	43.28	2.81
C31	3818.34	6881.42	3471.21	128.80	38.91
C32	215.16	812.60	261.95	13.53	17.23
C33	1473.10	2469.40	1360.77	1.05	1.18
C34	107.30	525.61	143.01	4.78	11.43
TOT ALKANES	12751.6	33746.5	11876.4	3821.9	1194.1
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	316.9	2197.8	346.2	171.2	86.1
Surrogate Recoveries					
C12ALKD:	82.5	76.6	86.7	112.9	95.3
C20ALKD:	105.2	42.3	109.7	96.9	91.8
C24ALKD:	83.1	114.6	82.7	120.8	92.6
C30ALKD:	150.2 M	249.0 M	141.3 M	92.7	112.9

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	TB-5A	TB-5B	TB-5C	TB-6	OTB-1-1
LABSAMNO:	>Q1643	>Q1648	>Q1646	>Q1636	>Q1632
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	56.52	45.13	37.80	45.70	9.35
C1-NAPHTHALENES	91.34	73.84	61.88	75.50	13.72
C2-NAPHTHALENES	144.15	111.90	91.94	73.31	21.98
C3-NAPHTHALENES	174.47	131.54	107.73	73.43	30.68
C4-NAPHTHALENES	155.03	128.63	95.46	48.27	42.11
BIPHENYL	12.61	11.06	11.58	13.98	4.64
ACENAPHTHYLENE	12.29	11.24	15.53	21.87	18.06
ACENAPHTHENE	15.25	11.31	17.52	18.88	29.74
FLUORENE	30.37	23.39	29.61	35.24	36.63
C1-FLUORENES	37.54	30.91	30.56	32.99	28.68
C2-FLUORENES	95.45	82.55	75.34	71.54	44.97
C3-FLUORENES	125.23	156.59	118.00	77.05	57.19
PHENANTHRENE	163.42	194.04	158.91	170.75	436.10
ANTHRACENE	37.61	41.51	37.54	46.92	139.18
C1-PHEN_ANTHR	171.92	220.44	144.14	139.69	328.76
C2-PHEN_ANTHR	197.59	269.74	171.20	134.00	243.20
C3-PHEN_ANTHR	146.82	189.66	140.28	115.66	130.32
C4-PHEN_ANTHR	104.10	126.23	115.64	93.33	58.47
DIBENZOTHIO	14.21	14.99	12.07	12.29	17.89
C1-DIBEN	34.89	35.42	22.60	20.81	32.14
C2-DIBEN	63.54	84.09	43.17	44.11	49.84
C3-DIBEN	61.23	68.74	52.23	57.15	50.61
FLUORANTHENE	347.88	438.26	389.94	284.22	727.94
PYRENE	345.07	414.07	367.57	276.30	659.25
C1-FLUORAN_PYR	221.78	280.18	248.92	191.10	995.56
BENaANTHRACENE	134.73	145.10	176.22	142.64	302.55
CHRYSENE	190.03	189.00	219.70	275.96	452.65
C1-CHRYSENES	99.30	118.73	116.63	112.68	235.95
C2-CHRYSENES	64.73	71.11	87.69	73.88	117.05
C3-CHRYSENES	32.39	35.22	47.20	29.72	31.55
C4-CHRYSENES	27.56	41.99	34.95	46.88	45.96
BENbFLUORAN	212.20	184.30	237.76	198.30	324.28
BENkFLUORAN	116.25	176.86	187.72	144.05	165.86
BENePYRENE	143.16	152.58	178.32	145.88	232.93
BENaPYRENE	133.43	158.34	185.60	131.77	334.21
PERYLENE	313.44	311.17	272.52	224.62	74.27
I123cdPYRENE	111.92	152.38	172.07	53.16	163.72
DBahANTHRA	25.84	31.00	40.13	14.79	46.25
BghiPERYLENE	101.09	137.73	161.11	47.13	141.61

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	TB-5A	TB-5B	TB-5C	TB-6	OTB-1-1
LABSAMNO:	>Q1643	>Q1648	>Q1646	>Q1636	>Q1632
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	60.07	49.00	39.42	50.04	8.23
1-METHYLNAPH	31.27	24.84	22.46	25.46	5.49
2,6-DIMETHNAPH	32.24	25.18	29.66	39.99	9.72
2,3,5-TRIMETHNAPH	19.27	14.44	16.42	23.90	13.53
1-METHYLPHEN	37.51	31.88	30.23	21.78	60.78
Surrogate Recoveries					
NAPHD8:	70.3	80.0	98.4	100.5	119.6
ACEND10:	109.3	123.4	102.3	94.3	96.1
PHEND10:	110.6	90.7	109.7	102.3	88.7
CHRYD12:	135.1	150.0	139.7	81.1	89.1
PERYD12:	55.4	66.0	85.6	70.0	144.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1643P	Q1648P	Q1646P	Q1636P	Q1632P
STATION	TB-5A (ppb)	TB-5B (ppb)	TB-5C (ppb)	TB-6 (ppb)	OTB-1-1 (ppb)
TOTAL BHC'S	1.38	1.19	0.62	0.11	0.04
TOTAL CHLORDANES	7.07	8.71	8.31	7.47	4.20
TOTAL DDT'S	37.86	38.97	39.16	28.84	57.90
TOTAL PCB'S	180.5	203.5	181.9	154.1	110.6
TOXAPHENE					
TOTAL CL2	1.4	0.7	0.7	1.0	0.2
TOTAL CL3	6.2	6.7	4.9	8.7	3.3
TOTAL CL4	12.9	12.0	10.6	24.6	35.5
TOTAL CL5	35.2	34.4	34.7	39.5	31.1
TOTAL CL6	57.0	55.7	51.5	50.6	30.1
TOTAL CL7	60.7	65.8	68.9	23.9	9.9
TOTAL CL8	12.0	14.1	13.8	7.1	2.1
TOTAL CL9	1.0	0.9	1.2	1.1	0.0
TOTAL CL10	0.0	18.9	2.0	0.3	0.0
ALPHA-BHC	0.00	0.00	0.00	0.03	0.00
HCB	0.00	0.00	0.00	0.21	0.29
BETA-BHC	0.00	0.00	0.00	0.00	0.00
GAMMA-BHC	1.38	1.19	0.62	0.07	0.04
DELTA-BHC	0.00	0.00	0.00	0.02	0.00
HEPTACHLOR	0.00	0.00	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.00	0.00	0.00
OXYCHLORDANE	0.00	0.00	0.00	0.00	0.00
GAMMA-CHLORDANE	2.43	2.74	2.78	2.60	1.42
ALPHA-CHLORDANE	2.21	2.93	2.66	2.51	1.49
TRANS-NONACHLOR	1.04	1.59	1.45	1.19	0.88
CIS-NONACHLOR	1.38	1.45	1.41	1.17	0.41
ALDRIN	3.34	4.02	3.94	0.22	0.14
DIELDRIN	0.32	0.46	0.49	0.40	0.32
ENDRIN	0.00	0.00	0.00	0.00	0.00
MIREX	0.00	0.00	0.00	0.08	0.00
2,4'DDE (O,P'DDE)	0.00	0.00	0.00	0.35	0.59
4,4'DDE (P,P'DDE)	24.74	22.58	24.03	16.64	24.28
2,4'DDD (O,P'DDD)	1.04	1.46	1.12	1.12	2.97
4,4'DDD (P,P'DDD)	8.29	8.90	8.87	7.35	16.04
2,4'DDT (O,P'DDT)	0.93	1.91	0.94	0.85	2.73
4,4'DDT (P,P'DDT)	2.86	4.12	4.19	2.53	11.30

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1643P	Q1648P	Q1646P	Q1636P	Q1632P
STATION	TB-5A (ppb)	TB-5B (ppb)	TB-5C (ppb)	TB-6 (ppb)	OTB-1-1 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.4	0.0	0.0	0.3	0.0
PCB#18 (CL3)	0.2	0.1	0.1	0.1	0.0
PCB#15 (CL2)	0.9	0.7	0.7	0.7	0.2
PCB#24 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#16/32 (CL3)	1.5	1.7	1.3	4.0	2.5
PCB#29 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#26 (CL3)	0.8	1.2	0.7	0.0	0.0
PCB#25 (CL3)	0.9	1.2	0.7	1.2	0.0
PCB#50 (CL4)	0.8	0.5	0.5	0.4	0.4
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	1.5	1.3	1.1	1.8	0.4
PCB#33 (CL3)	0.6	0.6	0.5	1.2	0.4
PCB#22 (CL3)	0.6	0.6	0.4	0.4	0.0
PCB#45 (CL4)	0.0	0.1	0.0	0.0	0.0
PCB#46 (CL4)	0.0	0.0	0.0	0.1	0.2
PCB#52 (CL4)	3.4	4.7	2.7	11.7	25.5
PCB#49 (CL4)	1.4	1.2	1.1	1.9	1.1
PCB#47/48 (CL4)	0.5	0.6	0.5	1.6	0.8
PCB#44 (CL4)	0.7	0.4	0.8	1.4	1.2
PCB#37/42 (CL4)	1.2	0.0	1.1	1.1	0.5
PCB#41/64 (CL4)	0.0	0.0	0.0	1.3	2.8
PCB#40 (CL4)	0.0	0.0	0.0	0.0	0.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	0.7	0.6	0.5	1.0	0.6
PCB#70 (CL4)	2.1	1.6	1.6	2.4	1.6
PCB#66 (CL4)	2.1	2.4	1.8	1.7	0.9
PCB#88 (CL5)	0.7	0.7	0.8	2.3	0.8
PCB#60/56 (CL5)	0.9	0.8	0.7	1.5	0.9
PCB#92? (CL5)	2.3	2.3	2.0	2.8	2.4
PCB#84? (CL5)	0.0	0.0	0.0	2.5	1.6
PCB#101 (CL5)	6.9	6.3	6.4	5.8	4.7
PCB#99 (CL5)	1.9	1.7	1.6	2.0	1.3
PCB#83 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#97 (CL5)	0.8	0.9	0.9	1.6	1.1
PCB#87 (CL5)	1.5	1.6	1.9	2.4	2.4
PCB#85 (CL5)	0.0	0.0	0.0	0.0	0.7
PCB#136 (CL6)	1.0	0.9	0.9	0.0	0.0
PCB#110/77 (CL5/4)	6.7	6.4	6.3	7.1	7.0
PCB#82 (CL5)	0.7	0.9	0.6	0.9	1.0
PCB#151 (CL6)	3.2	3.3	3.1	3.4	2.4
PCB#107/108/144(CL5/	2.5	2.4	2.2	2.5	1.7
PCB#149 (CL6)	8.3	7.5	7.7	7.5	5.1

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1643P	Q1648P	Q1646P	Q1636P	Q1632P
STATION	TB-5A (ppb)	TB-5B (ppb)	TB-5C (ppb)	TB-6 (ppb)	OTB-1-1 (ppb)
PCB#118/108/149(CL5/	5.0	5.1	5.0	5.1	3.5
PCB#188 (CL7)	0.8	0.7	1.2	0.0	0.0
PCB#146 (CL6)	1.8	1.9	1.8	2.1	1.4
PCB#153 (CL6)	14.7	14.1	14.2	12.5	7.7
PCB#105 (CL5)	5.3	5.4	6.3	2.8	2.1
PCB#141 (CL6)	2.7	3.0	2.8	5.1	2.9
PCB#137 (CL6)	0.0	0.0	0.0	0.7	0.3
PCB#? (CL6)	0.0	0.0	0.0	1.0	0.0
PCB#138 (CL6)	18.0	15.8	16.3	13.4	7.6
PCB#158 (CL7)	0.7	1.0	0.9	0.7	0.3
PCB#129 (CL6)	2.8	3.8	0.0	0.4	0.3
PCB#126 (CL5)	0.2	0.3	0.0	0.0	0.0
PCB#178 (CL7)	0.5	0.6	0.0	0.5	0.3
PCB#187/182/159(CL7/	8.6	8.3	9.8	2.7	1.3
PCB#183 (CL7)	2.7	3.0	3.0	1.5	0.7
PCB#128 (CL6)	1.2	1.5	1.3	2.2	1.3
PCB#167 (CL6)	0.5	1.0	0.7	0.6	0.4
PCB#185 (CL7)	1.4	1.8	1.4	1.0	0.6
PCB#174 (CL7)	4.6	4.8	4.8	2.5	1.2
PCB#177 (CL7)	3.4	4.8	4.2	1.5	0.5
PCB#156/171/202(CL6/	2.6	2.7	2.7	1.8	0.7
PCB#200 (CL8)	0.0	1.3	0.0	0.4	0.2
PCB#172 (CL7)	1.3	1.8	1.6	0.6	0.0
PCB#180 (CL7)	14.2	14.6	15.9	6.2	2.3
PCB#191 (CL7)	0.4	0.8	0.9	0.4	0.1
PCB#170 (CL7)	17.1	18.4	20.0	4.0	1.4
PCB#201 (CL8)	3.2	3.4	3.5	1.8	0.6
PCB#196 (CL8)	3.7	3.7	4.2	2.3	0.7
PCB#189 (CL7)	0.4	0.4	0.4	0.0	0.0
PCB#195 (CL8)	1.0	1.2	1.4	1.0	0.2
PCB#194 (CL8)	4.1	4.5	4.6	1.6	0.4
PCB#205 (CL9)	0.1	0.1	0.1	0.0	0.0
PCB#206 (CL9)	0.9	0.8	1.1	1.1	0.0
PCB#209 (CL10)	0.0	18.9	2.0	0.3	0.0

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	OTB-1-2	OTB-2	OTB-3	OTB-4	OTB-5
LABSAMNO:	RQ1629	RQ1635	RQ1633	RQ1634	RQ1641
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1629	>Q1635	>Q1633	>Q1634	>Q1641
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M410	M410	M409	M409	M405
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	19.82	13.76	4.68	4.12	18.43
DRYWT:	6.74	9.70	3.55	3.07	10.78
VOL:					
ACEND10:	64.9	117.1	110.5	60.3	104.9
BENAD12:					
CHRYD12:	52.0	82.7	119.2	86.4	209.3
FLUOD10:					
NAPHD8:	51.2	101.9	125.6	82.2	81.4
PERYD12:	139.6	64.4	90.1	101.6	101.3
PHEND10:	52.5	88.5	97.7	76.1	116.6
C12ALKD:	74.9	93.0	92.1	89.2	85.1
C20ALKD:	97.0	92.7	101.0	102.3	114.1
C24ALKD:	86.9	105.7	85.6	96.7	62.5
C30ALKD:	110.3	130.2 M	174.3 M	153.2 M	470.4 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	OTB-1-2	OTB-2	OTB-3	OTB-4	OTB-5
LABSAMNO:	RQ1629	RQ1635	RQ1633	RQ1634	RQ1641
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	42.96	237.27	0.00	46.34	13.80
C11	54.08	74.85	4.22	43.90	17.84
C12	60.52	15.94	11.85	67.39	24.81
C13	64.32	15.26	8.09	49.42	22.02
C14	87.31	16.33	46.61	98.53	37.77
C15	184.35	28.77	54.02	157.84	84.60
C16	149.35	24.40	74.42	191.21	95.75
C17	291.30	64.60	82.40	201.61	116.54
PRISTANE	213.70	24.80	51.70	114.52	84.13
C18	136.70	33.30	91.90	195.88	102.62
PHYTANE	239.20	34.60	72.40	99.27	99.42
C19	161.00	46.10	121.70	270.79	134.12
C20	123.00	46.80	104.00	248.79	85.15
C21	199.80	51.60	162.20	489.70	174.99
C22	127.30	33.50	117.60	538.61	132.64
C23	413.36	70.82	288.46	1035.61	646.24
C24	235.71	58.37	142.80	1190.12	392.86
C25	1273.28	171.51	369.07	1381.72	1196.87
C26	317.56	88.72	138.94	1045.53	401.71
C27	1801.21	306.34	207.86	1282.41	1385.22
C28	317.44	174.33	146.28	1106.24	363.43
C29	3826.63	1164.35	1399.51	4162.40	9418.32
C30	98.29	75.09	287.61	1200.56	682.48
C31	223.58	77.26	878.03	3218.27	3638.10
C32	15.32	15.20	279.25	1158.79	603.83
C33	1.37	2.48	469.92	1433.60	1262.96
C34	1.28	7.45	309.03	1028.38	761.02
TOT ALKANES	10659.9	2960.0	5919.9	22057.4	21979.2
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	285.1	143.0	448.8	629.2	738.8
Surrogate Recoveries					
C12ALKD:	74.9	93.0	92.1	89.2	85.1
C20ALKD:	97.0	92.7	101.0	102.3	114.1
C24ALKD:	86.9	105.7	85.6	96.7	62.5
C30ALKD:	110.3	130.2 M	174.3 M	153.2 M	470.4 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:															
ID:	OTB-1-2			OTB-2			OTB-3			OTB-4			OTB-5		
LABSAMNO:	>Q1629			>Q1635			>Q1633			>Q1634			>Q1641		
UNIT:	ng/g			ng/g			ng/g			ng/g			ng/g		
PNA Analyte	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
NAPHTHALENE	50.69			52.01			32.10			85.39			66.92		
C1-NAPHTHALENES	67.77			88.37			31.42			79.88			100.96		
C2-NAPHTHALENES	81.39			129.53			43.49			112.26			106.77		
C3-NAPHTHALENES	92.02			144.45			86.11			131.23			130.28		
C4-NAPHTHALENES	103.62			68.63			78.46			109.98			152.89		
BIPHENYL	7.72			10.62			10.66			27.99			12.62		
ACENAPHTHYLENE	29.56			42.06			8.10			35.61			35.28		
ACENAPHTHENE	26.52			59.09			9.73			167.26			32.60		
FLUORENE	41.75			99.21			15.88			197.40			69.80		
C1-FLUORENES	36.44			29.43			20.55			90.78			53.39		
C2-FLUORENES	81.63			33.04			46.92			80.41			114.48		
C3-FLUORENES	122.41			32.14			103.63			158.38			315.95		
PHENANTHRENE	440.70			1317.90			186.66			1308.58			792.82		
ANTHRACENE	89.88			166.47			26.91			266.88			161.62		
C1-PHEN_ANTHR	268.03			328.24			109.02			445.47			431.71		
C2-PHEN_ANTHR	321.13			181.29			168.14			295.01			405.49		
C3-PHEN_ANTHR	307.28			112.25			187.50			125.41			342.73		
C4-PHEN_ANTHR	233.08			77.99			143.25			71.32			332.79		
DIBENZOTHIO	24.12			51.14			13.93			56.28			39.61		
C1-DIBEN	41.82			22.53			25.02			33.27			50.50		
C2-DIBEN	105.27			33.31			69.23			39.46			114.24		
C3-DIBEN	143.30			47.69			108.96			31.34			207.53		
FLUORANTHENE	797.26			1521.11			450.70			1621.90			1164.84		
PYRENE	727.24			1122.88			452.30			1343.94			1031.53		
C1-FLUORAN_PYR	429.61			397.62			233.21			481.02			660.63		
BENaANTHRACENE	306.11			467.08			168.32			504.91			387.24		
CHRYSENE	541.96			719.81			240.50			603.56			451.48		
C1-CHRYSENES	350.82			257.07			150.14			188.27			257.21		
C2-CHRYSENES	265.32			114.19			165.09			80.79			216.07		
C3-CHRYSENES	131.91			49.16			83.93			23.54			182.19		
C4-CHRYSENES	79.58			57.34			83.57			66.79			188.86		
BENbFLUORAN	332.61			534.54			215.51			608.89			338.16		
BENkFLUORAN	130.83			400.15			197.69			333.44			352.11		
BENePYRENE	321.78			391.58			197.67			353.63			283.86		
BENaPYRENE	360.32			569.78			188.59			525.81			334.30		
PERYLENE	82.84			206.26			87.47			162.69			175.68		
I123cdPYRENE	199.42			291.95			234.56			331.86			250.92		
DBahANTHRA	46.08			85.24			49.68			102.69			56.02		
BghiPERYLENE	190.67			266.46			235.98			322.09			246.24		

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	OTB-1-2	OTB-2	OTB-3	OTB-4	OTB-5
LABSAMNO:	>Q1629	>Q1635	>Q1633	>Q1634	>Q1641
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	44.63	39.73	19.29	42.03	63.44
1-METHYLNAPH	23.14	48.64	12.13	37.85	37.52
2,6-DIMETHNAPH	24.30	38.08	8.28	46.49	24.27
2,3,5-TRIMETHNAPH	23.62	36.48	10.80	37.23	17.20
1-METHYLPHEN	90.90	65.44	24.73	66.76	49.07
Surrogate Recoveries					
NAPHD8:	51.2	101.9	125.6	82.2	81.4
ACEND10:	64.9	117.1	110.5	60.3	104.9
PHEND10:	52.5	88.5	97.7	76.1	116.6
CHRYD12:	52.0	82.7	119.2	86.4	209.3
PERYD12:	139.6	64.4	90.1	101.6	101.3

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1629P	Q1635P	Q1633P	Q1634P	Q1641P
STATION	OTB-1-2 (ppb)	OTB-2 (ppb)	OTB-3 (ppb)	OTB-4 (ppb)	OTB-5 (ppb)
TOTAL BHC'S	0.56	0.02	0.20	2.87	0.54
TOTAL CHLORDANES	14.45	7.02	9.59	50.07	14.73
TOTAL DDT'S	118.00	148.36	74.68	803.38	79.63
TOTAL PCB'S	402.9	243.9	1252.8	3349.5	380.9
TOXAPHENE					
TOTAL CL2	0.4	0.0	10.5	3.8	0.0
TOTAL CL3	9.5	5.5	12.2	43.0	10.6
TOTAL CL4	146.3	85.1	229.6	464.4	189.9
TOTAL CL5	89.5	69.6	225.5	1629.6	85.5
TOTAL CL6	100.4	57.0	457.9	975.1	71.2
TOTAL CL7	49.7	23.6	277.9	145.2	25.6
TOTAL CL8	11.1	4.6	67.1	41.9	5.8
TOTAL CL9	1.2	0.4	6.0	9.3	0.5
TOTAL CL10	0.0	0.0	0.4	0.0	0.0
ALPHA-BHC	0.24	0.00	0.00	0.34	0.00
HCB	1.20	0.38	0.23	0.32	0.38
BETA-BHC	0.17	0.00	0.00	2.03	0.00
GAMMA-BHC	0.15	0.02	0.20	0.49	0.54
DELTA-BHC	0.00	0.00	0.00	0.00	0.00
HEPTACHLOR	0.00	0.00	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.20	2.79	0.46
OXYCHLORDANE	0.00	1.09	0.34	6.80	0.38
GAMMA-CHLORDANE	4.96	1.97	2.82	13.90	4.77
ALPHA-CHLORDANE	4.93	2.03	2.59	14.87	4.56
TRANS-NONACHLOR	3.04	1.24	1.54	7.10	3.19
CIS-NONACHLOR	1.52	0.68	2.10	4.61	1.37
ALDRIN	1.66	0.23	0.00	13.08	0.00
DIELDRIN	1.05	0.48	0.53	9.29	1.71
ENDRIN	0.17	0.00	0.00	0.75	0.00
MIREX	0.00	0.00	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	1.45	2.17	0.99	8.31	1.01
4,4'DDE (P,P'DDE)	62.39	64.55	30.72	142.14	26.51
2,4'DDD (O,P'DDD)	5.85	10.42	8.34	34.90	6.13
4,4'DDD (P,P'DDD)	33.14	49.34	26.32	196.81	38.88
2,4'DDT (O,P'DDT)	2.81	3.45	4.51	86.40	1.07
4,4'DDT (P,P'DDT)	12.36	18.45	3.80	334.83	6.03

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1629P	Q1635P	Q1633P	Q1634P	Q1641P
STATION	OTB-1-2 (ppb)	OTB-2 (ppb)	OTB-3 (ppb)	OTB-4 (ppb)	OTB-5 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.0	0.0	0.0	1.8	0.0
PCB#18 (CL3)	0.3	0.0	1.3	0.3	0.0
PCB#15 (CL2)	0.4	0.0	10.5	2.0	0.0
PCB#24 (CL3)	0.0	0.0	0.4	0.0	0.0
PCB#16/32 (CL3)	3.9	3.8	2.5	25.0	7.4
PCB#29 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#26 (CL3)	0.2	0.0	1.7	0.0	0.0
PCB#25 (CL3)	1.9	0.7	2.0	8.2	1.7
PCB#50 (CL4)	1.0	0.2	3.5	4.9	5.3
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	1.9	0.4	3.3	4.0	0.9
PCB#33 (CL3)	1.0	0.6	0.5	4.5	0.7
PCB#22 (CL3)	0.4	0.0	0.5	1.0	0.0
PCB#45 (CL4)	0.1	0.0	0.1	0.0	0.0
PCB#46 (CL4)	0.4	0.8	1.2	1.8	0.0
PCB#52 (CL4)	119.6	71.9	95.5	288.4	161.6
PCB#49 (CL4)	4.9	1.3	40.1	15.0	3.3
PCB#47/48 (CL4)	2.6	1.3	66.6	4.9	1.8
PCB#44 (CL4)	3.5	1.4	5.4	28.8	2.8
PCB#37/42 (CL4)	1.5	0.6	2.9	9.0	2.8
PCB#41/64 (CL4)	1.7	3.2	0.0	0.0	0.0
PCB#40 (CL4)	0.0	0.0	0.6	17.2	0.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	1.7	0.7	2.8	15.4	6.9
PCB#70 (CL4)	5.0	2.5	6.0	65.4	3.6
PCB#66 (CL4)	4.4	1.1	5.0	13.5	1.7
PCB#88 (CL5)	4.0	1.9	24.4	23.6	2.9
PCB#60/56 (CL5)	3.3	1.2	2.5	30.8	1.9
PCB#92? (CL5)	7.9	8.0	26.0	41.5	5.6
PCB#84? (CL5)	6.9	3.7	4.7	59.0	6.7
PCB#101 (CL5)	12.4	8.5	53.6	177.6	12.2
PCB#99 (CL5)	3.7	3.2	17.6	64.4	4.9
PCB#83 (CL5)	0.0	0.0	1.1	32.1	1.4
PCB#97 (CL5)	2.9	2.7	2.8	57.0	2.5
PCB#87 (CL5)	6.9	6.5	8.8	166.3	7.6
PCB#85 (CL5)	0.0	0.0	1.4	21.8	0.9
PCB#136 (CL6)	0.0	0.0	12.6	2.7	0.0
PCB#110/77 (CL5/4)	17.4	13.4	28.3	359.6	17.5
PCB#82 (CL5)	2.2	3.6	1.1	36.9	1.8
PCB#151 (CL6)	6.2	2.4	43.3	23.2	4.5
PCB#107/108/144(CL5/	5.5	2.4	31.4	28.2	4.0
PCB#149 (CL6)	14.5	7.0	91.4	97.4	12.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1629P	Q1635P	Q1633P	Q1634P	Q1641P
STATION	OTB-1-2	OTB-2	OTB-3	OTB-4	OTB-5
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	10.7	8.7	12.2	258.4	10.6
PCB#188 (CL7)	0.0	0.0	1.2	0.0	0.0
PCB#146 (CL6)	4.1	2.0	21.0	23.4	2.5
PCB#153 (CL6)	24.7	12.7	120.6	181.1	20.1
PCB#105 (CL5)	5.7	5.7	9.7	272.4	5.1
PCB#141 (CL6)	9.8	4.5	27.7	65.6	4.8
PCB#137 (CL6)	1.3	1.4	1.3	17.8	0.7
PCB#? (CL6)	4.2	2.5	4.3	52.8	0.9
PCB#138 (CL6)	26.5	15.8	119.9	341.2	19.7
PCB#158 (CL7)	1.3	0.9	4.6	17.9	0.7
PCB#129 (CL6)	0.9	1.3	2.0	0.0	1.2
PCB#126 (CL5)	0.0	0.0	0.0	51.3	0.0
PCB#178 (CL7)	0.9	0.9	9.7	7.8	0.6
PCB#187/182/159(CL7/	5.3	1.8	42.6	11.2	3.0
PCB#183 (CL7)	3.2	1.1	16.4	6.8	1.7
PCB#128 (CL6)	4.0	3.5	6.9	97.8	3.0
PCB#167 (CL6)	1.1	1.5	1.7	25.9	0.4
PCB#185 (CL7)	1.6	0.9	5.2	7.3	0.6
PCB#174 (CL7)	4.2	1.7	29.6	9.2	2.9
PCB#177 (CL7)	2.7	1.0	18.1	4.6	1.2
PCB#156/171/202(CL6/	3.0	2.3	5.1	46.2	1.5
PCB#200 (CL8)	0.7	0.5	2.3	5.9	0.5
PCB#172 (CL7)	0.8	0.0	6.0	12.3	0.9
PCB#180 (CL7)	11.7	4.3	74.1	30.2	6.7
PCB#191 (CL7)	0.5	0.2	3.9	1.4	0.4
PCB#170 (CL7)	13.3	9.1	35.9	27.2	4.2
PCB#201 (CL8)	2.7	1.2	16.2	9.6	1.6
PCB#196 (CL8)	3.7	1.6	21.2	13.8	2.2
PCB#189 (CL7)	0.0	0.0	1.0	0.0	0.0
PCB#195 (CL8)	1.3	0.4	8.8	1.9	0.7
PCB#194 (CL8)	2.8	0.9	18.6	10.8	0.8
PCB#205 (CL9)	0.0	0.0	0.8	0.0	0.0
PCB#206 (CL9)	1.2	0.4	5.2	9.3	0.5
PCB#209 (CL10)	0.0	0.0	0.4	0.0	0.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	PR-1 CLAM	PR-1	PR-2	PR-3 CLAM	PR-3
LABSAMNO:	RQ1669	RQ1653	RQ1621	RQ1670	RQ1662
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1669	>Q1653	>Q1621	>Q1670	>Q1662
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M408	M407	M403	M408	M407
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	TISSUE	SEDIMENT	SEDIMENT	TISSUE	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	0.90	22.36	19.76	4.36	26.56
DRYWT:	0.13	10.42	8.36	0.64	10.57
VOL:					
ACEND10:	33.7	102.5	101.0	57.2	44.1
BENAD12:					
CHRYD12:	35.2	141.0	177.2	57.0	50.4
FLUOD10:					
NAPHD8:	35.4	108.4	87.3	53.1	40.1
PERYD12:	27.5	172.3	69.8	35.7	34.1
PHEND10:	39.0	114.2	97.8	56.3	46.0
C12ALKD:	82.0	21.6	81.6	86.2	93.2
C20ALKD:	74.3	50.4	79.2	96.6	118.5
C24ALKD:	82.6	47.3	237.5 M	85.9	139.2 M
C30ALKD:	84.2	79.2	87.8	89.0	116.6
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	PR-1 CLAM	PR-1	PR-2	PR-3 CLAM	PR-3
LABSAMNO:	RQ1669	RQ1653	RQ1621	RQ1670	RQ1662
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	0.00	95.30	36.96	0.00	42.91
C11	0.00	102.38	65.96	24.32	88.31
C12	0.00	72.10	78.00	62.61	88.81
C13	0.00	80.90	58.00	8.84	79.26
C14	0.00	121.85	147.46	11.52	168.06
C15	642.58	111.33	207.36	559.64	219.53
C16	221.24	151.34	237.21	39.22	193.61
C17	127.98	138.60	386.80	238.40	297.24
PRISTANE	546.07	268.58	100.00	212.60	96.71
C18	149.52	149.63	1272.10	216.10	205.99
PHYTANE	561.07	186.31	111.20	251.10	108.33
C19	99.97	122.93	222.60	241.50	203.61
C20	209.01	99.00	107.00	167.30	79.17
C21	215.32	103.08	162.40	90.80	126.81
C22	272.07	72.65	85.10	57.40	77.63
C23	395.49	142.12	213.86	117.50	253.32
C24	501.60	68.44	81.02	73.80	92.07
C25	628.60	404.40	691.64	193.43	921.83
C26	455.27	99.86	160.04	100.68	175.43
C27	623.67	661.50	1370.98	85.17	1632.89
C28	571.01	179.19	212.03	114.19	255.31
C29	1126.29	1369.81	2965.71	281.92	3228.07
C30	320.00	133.28	339.24	38.19	318.68
C31	792.67	733.47	3358.86	215.79	3378.49
C32	251.49	58.20	170.88	57.28	169.33
C33	0.00	136.20	607.59	36.46	817.27
C34	0.00	6.02	26.78	0.00	37.83
TOT ALKANES	8710.9	5868.5	13476.8	3495.8	13356.5
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	13.3	132.1	109.6	238.3	92.7
Surrogate Recoveries					
C12ALKD:	82.0	21.6	81.6	86.2	93.2
C20ALKD:	74.3	50.4	79.2	96.6	118.5
C24ALKD:	82.6	47.3	237.5 M	85.9	139.2 M
C30ALKD:	84.2	79.2	87.8	89.0	116.6

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	PR-1 CLAM	PR-1	PR-2	PR-3 CLAM	PR-3
LABSAMNO:	>Q1669	>Q1653	>Q1621	>Q1670	>Q1662
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	83.23	553.76	30.00	17.22	38.20
C1-NAPHTHALENES	158.55	695.42	46.32	25.85	63.56
C2-NAPHTHALENES	261.47	885.18	72.44	32.01	90.28
C3-NAPHTHALENES	785.22	1077.03	93.51	82.17	103.06
C4-NAPHTHALENES	827.80	674.99	72.22	129.67	77.78
BIPHENYL	85.01	82.42	10.60	7.89	14.26
ACENAPHTHYLENE	110.34	219.04	11.70	14.37	15.74
ACENAPHTHENE	108.82	219.07	10.90	4.38	10.76
FLUORENE	61.54	316.81	23.82	5.10	23.92
C1-FLUORENES	161.69	290.18	28.23	29.12	33.69
C2-FLUORENES	382.41	445.65	61.46	143.79	86.02
C3-FLUORENES	581.11	676.59	131.10	459.12	153.94
PHENANTHRENE	264.59	1959.23	184.46	17.58	186.70
ANTHRACENE	103.94	321.82	36.36	23.86	28.25
C1-PHEN_ANTHR	488.29	1329.26	137.93	93.73	159.33
C2-PHEN_ANTHR	703.51	1182.93	157.91	200.01	160.02
C3-PHEN_ANTHR	449.41	514.15	121.90	255.96	81.95
C4-PHEN_ANTHR	326.78	308.91	62.25	183.52	48.45
DIBENZOTHIO	36.84	157.14	10.82	6.20	11.92
C1-DIBEN	113.10	231.02	19.72	14.78	24.71
C2-DIBEN	205.69	340.87	46.04	38.14	43.31
C3-DIBEN	210.83	284.31	43.36	69.21	34.21
FLUORANTHENE	693.66	2781.29	376.46	263.10	371.62
PYRENE	725.83	2532.80	322.10	352.34	311.97
C1-FLUORAN_PYR	630.70	1478.87	204.59	222.42	169.76
BENaANTHRACENE	261.32	932.60	117.19	41.02	106.41
CHRYSENE	407.08	1182.79	135.33	182.07	169.60
C1-CHRYSENES	170.83	567.21	97.57	74.24	78.13
C2-CHRYSENES	115.88	325.92	42.11	48.20	39.63
C3-CHRYSENES	0.00	120.27	12.13	18.30	11.04
C4-CHRYSENES	0.00	232.16	30.63	22.11	28.66
BENbFLUORAN	105.87	955.57	161.76	38.90	181.63
BENkFLUORAN	93.91	990.56	99.45	34.43	108.88
BENePYRENE	205.54	773.67	104.56	95.18	117.10
BENaPYRENE	59.29	970.10	123.61	9.36	124.06
PERYLENE	41.15	220.91	104.95	39.62	83.79
I123cdPYRENE	41.38	1144.96	108.30	11.77	171.06
DBahANTHRA	20.45	230.08	24.45	5.01	41.74
BghiPERYLENE	50.01	941.04	99.15	22.86	135.29

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	PR-1 CLAM	PR-1	PR-2	PR-3 CLAM	PR-3
LABSAMNO:	>Q1669	>Q1653	>Q1621	>Q1670	>Q1662
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	85.71	459.80	29.97	12.58	41.39
1-METHYLNAPH	72.84	235.62	16.35	13.27	22.17
2,6-DIMETHNAPH	61.66	331.33	20.94	9.53	30.30
2,3,5-TRIMETHNAPH	125.60	206.49	13.40	16.68	17.23
1-METHYLPHEN	60.38	294.13	27.20	37.30	45.69
Surrogate Recoveries					
NAPHD8:	35.4	108.4	87.3	53.1	40.1
ACEND10:	33.7	102.5	101.0	57.2	44.1
PHEND10:	39.0	114.2	97.8	56.3	46.0
CHRYD12:	35.2	141.0	177.2	57.0	50.4
PERYD12:	27.5	172.3	69.8	35.7	34.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1669P	Q1653P	Q1621P	Q1670P	Q1662P
	CLAM			CLAM	
STATION	PR-1	PR-1	PR-2	PR-3	PR-3
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.16	0.00	0.35	0.39	1.02
TOTAL CHLORDANES	24.35	41.57	7.08	25.25	5.27
TOTAL DDT'S	30.30	103.23	9.71	23.68	6.95
TOTAL PCB'S	149.6	264.6	68.4	440.2	73.3
TOXAPHENE					
TOTAL CL2	0.0	1.1	0.9	0.0	0.7
TOTAL CL3	2.9	14.4	9.0	3.1	5.0
TOTAL CL4	41.1	15.2	16.6	58.7	4.3
TOTAL CL5	49.8	61.4	17.5	96.4	12.4
TOTAL CL6	55.6	81.0	20.1	224.0	22.8
TOTAL CL7	13.1	76.7	9.7	57.0	22.9
TOTAL CL8	3.5	15.5	1.9	6.8	7.2
TOTAL CL9	0.4	1.9	0.1	0.5	0.7
TOTAL CL10	0.7	2.5	0.0	0.0	0.0
ALPHA-BHC	0.00	0.00	0.01	0.00	0.00
HCB	0.00	0.00	0.00	0.00	0.00
BETA-BHC	0.00	0.00	0.00	0.00	0.00
GAMMA-BHC	0.16	0.00	0.34	0.39	1.02
DELTA-BHC	0.00	0.00	0.00	0.00	0.00
HEPTACHLOR	0.00	3.24	0.08	0.00	0.00
HEPTA-EPOXIDE	0.56	0.00	0.00	0.66	0.00
OXYCHLORDANE	0.60	0.00	0.00	0.81	0.00
GAMMA-CHLORDANE	7.31	12.22	2.38	6.04	1.62
ALPHA-CHLORDANE	7.97	12.40	2.62	7.61	1.68
TRANS-NONACHLOR	5.61	6.04	1.45	6.62	1.15
CIS-NONACHLOR	2.30	7.68	0.55	3.50	0.82
ALDRIN	0.00	14.81	0.97	0.00	2.71
DIELDRIN	2.50	3.98	1.17	2.75	0.41
ENDRIN	0.00	0.00	0.14	0.28	0.00
MIREX	0.00	0.00	0.10	0.00	0.00
2,4'DDE (O,P'DDE)	0.56	0.00	0.13	0.39	0.00
4,4'DDE (P,P'DDE)	10.46	24.50	4.16	13.39	3.80
2,4'DDD (O,P'DDD)	1.86	10.22	0.59	1.21	0.48
4,4'DDD (P,P'DDD)	13.04	68.51	1.84	5.39	2.17
2,4'DDT (O,P'DDT)	0.62	0.00	1.22	1.11	0.50
4,4'DDT (P,P'DDT)	3.75	0.00	1.77	2.20	0.00

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1669P	Q1653P	Q1621P	Q1670P	Q1662P
	CLAM			CLAM	
STATION	PR-1	PR-1	PR-2	PR-3	PR-3
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.0	0.0	0.3	0.0	0.0
PCB#18 (CL3)	0.0	0.6	0.1	0.3	0.2
PCB#15 (CL2)	0.0	1.1	0.6	0.0	0.7
PCB#24 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#16/32 (CL3)	0.0	4.0	4.1	0.0	1.4
PCB#29 (CL3)	0.0	0.0	0.9	0.0	0.0
PCB#26 (CL3)	0.0	3.4	0.0	0.0	1.1
PCB#25 (CL3)	2.9	3.7	1.7	1.9	0.7
PCB#50 (CL4)	17.1	0.8	4.7	3.7	0.5
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	0.0	1.9	1.0	0.8	1.1
PCB#33 (CL3)	0.0	0.8	0.9	0.0	0.5
PCB#22 (CL3)	0.0	0.0	0.2	0.0	0.0
PCB#45 (CL4)	0.0	0.0	0.0	0.0	0.0
PCB#46 (CL4)	0.0	0.0	0.2	0.0	0.0
PCB#52 (CL4)	8.7	3.9	5.0	11.9	0.9
PCB#49 (CL4)	0.0	1.9	0.5	3.6	0.6
PCB#47/48 (CL4)	0.0	2.0	0.6	11.9	0.6
PCB#44 (CL4)	3.6	0.0	1.1	6.0	0.0
PCB#37/42 (CL4)	0.0	0.0	0.3	0.0	0.0
PCB#41/64 (CL4)	0.0	0.0	0.0	0.0	0.0
PCB#40 (CL4)	0.0	0.0	0.0	0.0	0.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	0.0	1.0	1.7	1.4	0.3
PCB#70 (CL4)	10.3	2.0	1.5	18.6	0.6
PCB#66 (CL4)	1.5	3.7	1.1	1.6	0.7
PCB#88 (CL5)	0.0	0.0	0.9	5.9	0.0
PCB#60/56 (CL5)	0.0	2.3	0.8	2.9	0.0
PCB#92? (CL5)	2.6	0.0	0.5	3.7	0.0
PCB#84? (CL5)	8.1	0.0	2.0	9.3	0.0
PCB#101 (CL5)	7.4	13.8	2.1	19.1	3.3
PCB#99 (CL5)	4.2	4.0	1.1	5.4	0.4
PCB#83 (CL5)	0.0	0.0	0.4	0.0	0.0
PCB#97 (CL5)	1.8	0.9	0.3	4.8	0.3
PCB#87 (CL5)	2.7	4.3	0.8	3.0	0.5
PCB#85 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#136 (CL6)	0.0	3.2	1.0	0.0	0.5
PCB#110/77 (CL5/4)	8.4	15.6	2.8	12.1	2.3
PCB#82 (CL5)	1.0	2.9	1.1	0.6	0.5
PCB#151 (CL6)	2.5	5.5	1.1	13.4	1.5
PCB#107/108/144(CL5/	1.9	4.2	1.1	7.4	1.0
PCB#149 (CL6)	6.2	10.7	2.6	25.7	3.6

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1669P	Q1653P	Q1621P	Q1670P	Q1662P
	CLAM			CLAM	
STATION	PR-1	PR-1	PR-2	PR-3	PR-3
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	7.5	6.5	1.6	15.6	1.7
PCB#188 (CL7)	0.0	0.0	1.0	0.0	0.0
PCB#146 (CL6)	1.2	3.7	1.1	7.8	0.9
PCB#153 (CL6)	20.1	16.7	4.8	94.3	5.8
PCB#105 (CL5)	4.3	6.9	2.1	6.6	2.3
PCB#141 (CL6)	2.1	5.0	1.4	8.2	1.1
PCB#137 (CL6)	0.0	0.0	0.2	1.0	0.0
PCB#? (CL6)	0.9	0.0	0.2	1.8	0.0
PCB#138 (CL6)	20.3	25.5	6.3	60.7	6.2
PCB#158 (CL7)	0.4	2.0	0.2	2.5	0.3
PCB#129 (CL6)	0.0	0.0	0.2	0.6	0.0
PCB#126 (CL5)	0.0	1.9	0.0	0.0	0.0
PCB#178 (CL7)	0.0	1.9	0.1	2.0	0.0
PCB#187/182/159(CL7/	2.6	19.4	0.8	10.3	4.7
PCB#183 (CL7)	1.3	4.1	0.5	5.6	1.4
PCB#128 (CL6)	2.2	2.5	0.5	4.2	0.7
PCB#167 (CL6)	0.0	0.0	0.3	2.7	0.7
PCB#185 (CL7)	0.0	0.0	0.6	1.4	1.2
PCB#174 (CL7)	0.4	6.1	0.9	2.5	2.3
PCB#177 (CL7)	1.1	12.9	0.4	4.7	3.4
PCB#156/171/202(CL6/	0.0	8.1	0.5	3.5	2.0
PCB#200 (CL8)	0.0	6.9	0.1	0.6	0.0
PCB#172 (CL7)	0.0	5.2	0.2	0.2	1.2
PCB#180 (CL7)	4.9	18.2	2.8	18.2	5.9
PCB#191 (CL7)	0.2	0.8	0.1	1.3	0.3
PCB#170 (CL7)	1.8	0.0	1.2	5.9	0.0
PCB#201 (CL8)	0.0	4.4	0.5	0.9	1.4
PCB#196 (CL8)	2.7	4.2	0.6	3.5	1.8
PCB#189 (CL7)	0.0	0.0	0.0	0.0	0.0
PCB#195 (CL8)	0.9	0.0	0.3	1.4	0.5
PCB#194 (CL8)	0.0	0.0	0.5	0.4	3.6
PCB#205 (CL9)	0.0	0.0	0.0	0.2	0.1
PCB#206 (CL9)	0.4	1.9	0.1	0.3	0.6
PCB#209 (CL10)	0.7	2.5	0.0	0.0	0.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	PR-4A CLAM	PR-4A	PR-4B	PR-4C	WSC-1
LABSAMNO:	RQ1671	RQ1657	RQ1622	RQ1623	RQ1627
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1671	>Q1657	>Q1622	>Q1623	>Q1627
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M408	M407	M403	M403	M411
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	TISSUE	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	2.38	27.83	22.24	23.50	25.71
DRYWT:	0.35	10.24	8.43	9.94	8.92
VOL:					
ACEND10:	83.0	111.6	70.1	92.3	78.5
BENAD12:					
CHRYD12:	121.2	87.9	126.2	143.5	78.8
FLUOD10:					
NAPHD8:	87.7	110.6	62.6	67.7	74.2
PERYD12:	69.1	61.7	62.8	56.8	88.2
PHEND10:	86.0	82.0	85.4	94.6	59.0
C12ALKD:	81.4	86.5	80.9	46.8	86.7
C20ALKD:	85.4	137.6 M	89.6	77.7	122.2 M
C24ALKD:	89.9	128.8 M	119.1	128.4	52.5
C30ALKD:	90.5	118.7	107.0	89.3	170.5 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	PR-4A CLAM	PR-4A	PR-4B	PR-4C	WSC-1
LABSAMNO:	RQ1671	RQ1657	RQ1622	RQ1623	RQ1627
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	0.00	39.73	21.41	9.71	88.14
C11	0.00	76.91	36.11	13.11	105.60
C12	59.35	87.52	26.92	25.58	74.25
C13	0.00	69.13	26.92	53.27	85.25
C14	0.00	160.13	39.90	103.13	118.11
C15	155.95	177.58	95.47	204.81	187.41
C16	0.00	178.39	78.07	198.98	162.80
C17	907.70	318.10	238.40	241.70	494.76
PRISTANE	219.30	90.40	84.20	111.30	391.11
C18	65.90	246.70	328.70	235.50	219.63
PHYTANE	158.20	115.16	100.90	111.10	548.29
C19	104.60	229.50	173.90	179.90	338.80
C20	101.90	114.06	77.80	99.80	130.66
C21	66.40	189.87	148.30	145.50	198.61
C22	62.40	107.87	88.60	86.50	116.11
C23	107.90	347.67	237.78	163.01	543.40
C24	96.70	124.22	86.42	63.17	155.22
C25	196.20	1359.46	991.79	649.05	1123.22
C26	110.20	241.36	99.14	114.84	380.36
C27	146.20	2429.33	1611.74	1137.89	1376.22
C28	119.70	356.33	231.69	175.91	200.44
C29	254.10	4910.80	3071.66	2423.41	1133.98
C30	49.60	344.93	295.88	277.25	50.89
C31	215.90	3381.84	2799.23	3022.11	151.84
C32	50.60	181.52	150.65	157.47	10.37
C33	0.00	755.73	511.80	596.46	18.96
C34	0.00	33.17	25.72	26.23	5.73
TOT ALKANES	3248.8	16667.4	11679.1	10626.7	8410.2
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	108.1	109.8	125.3	92.9	384.6
Surrogate Recoveries					
C12ALKD:	81.4	86.5	80.9	46.8	86.7
C20ALKD:	85.4	137.6 M	89.6	77.7	122.2 M
C24ALKD:	89.9	128.8 M	119.1	128.4	52.5
C30ALKD:	90.5	118.7	107.0	89.3	170.5 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	PR-4A CLAM	PR-4A	PR-4B	PR-4C	WSC-1
LABSAMNO:	>Q1671	>Q1657	>Q1622	>Q1623	>Q1627
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	31.43	26.89	24.80	19.42	72.81
C1-NAPHTHALENES	30.21	42.77	43.66	37.85	146.79
C2-NAPHTHALENES	81.15	55.01	68.93	70.45	166.75
C3-NAPHTHALENES	172.77	71.96	84.01	146.16	192.05
C4-NAPHTHALENES	223.11	59.76	71.40	119.44	164.40
BIPHENYL	18.57	9.40	9.03	6.33	21.20
ACENAPHTHYLENE	12.08	12.93	11.97	8.54	23.55
ACENAPHTHENE	9.49	8.45	10.68	7.33	41.29
FLUORENE	9.35	17.00	20.96	15.87	58.21
C1-FLUORENES	56.89	23.50	29.31	27.19	55.38
C2-FLUORENES	233.87	61.12	71.59	67.74	109.49
C3-FLUORENES	446.84	102.43	114.11	88.41	159.37
PHENANTHRENE	24.91	189.92	152.59	145.44	446.54
ANTHRACENE	22.17	28.27	31.21	25.55	104.10
C1-PHEN_ANTHR	76.84	188.61	115.77	123.55	325.12
C2-PHEN_ANTHR	186.95	210.09	122.64	132.31	366.46
C3-PHEN_ANTHR	248.08	199.74	86.23	88.59	305.87
C4-PHEN_ANTHR	173.43	84.07	47.38	43.41	205.76
DIBENZOTHIO	5.28	12.90	8.27	7.89	29.16
C1-DIBEN	34.41	26.69	17.28	17.21	59.52
C2-DIBEN	61.10	57.23	34.39	36.04	138.23
C3-DIBEN	92.68	54.48	32.29	33.82	161.32
FLUORANTHENE	200.71	371.85	353.83	312.17	799.12
PYRENE	284.91	334.92	289.01	263.05	723.47
C1-FLUORAN_PYR	224.69	175.29	185.68	162.31	377.27
BENaANTHRACENE	45.62	135.57	115.43	92.40	185.68
CHRYSENE	178.53	216.04	185.03	146.26	333.34
C1-CHRYSENES	61.20	104.14	90.87	75.86	140.94
C2-CHRYSENES	55.12	60.79	51.79	42.16	100.43
C3-CHRYSENES	28.24	17.55	19.88	13.41	44.57
C4-CHRYSENES	0.00	42.91	41.78	26.51	12.22
BENbFLUORAN	47.80	224.63	239.56	161.75	260.03
BENkFLUORAN	19.47	140.80	78.09	83.90	190.15
BENePYRENE	83.34	152.42	127.24	98.83	209.84
BENaPYRENE	12.50	162.56	133.18	104.70	140.48
PERYLENE	25.91	78.82	85.90	74.81	82.19
I123cdPYRENE	15.06	226.72	130.57	94.18	98.73
DBahANTHRA	7.30	54.89	28.29	21.11	19.66
BghiPERYLENE	27.63	185.11	119.18	88.36	90.30

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	PR-4A CLAM	PR-4A	PR-4B	PR-4C	WSC-1
LABSAMNO:	>Q1671	>Q1657	>Q1622	>Q1623	>Q1627
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	14.19	26.70	28.12	23.95	92.28
1-METHYLNAPH	16.02	16.07	15.54	13.90	54.51
2,6-DIMETHNAPH	13.16	19.76	23.21	18.20	71.53
2,3,5-TRIMETHNAPH	25.93	10.85	14.74	17.00	53.43
1-METHYLPHEN	12.14	35.26	16.73	23.20	165.13
Surrogate Recoveries					
NAPHD8:	87.7	110.6	62.6	67.7	74.2
ACEND10:	83.0	111.6	70.1	92.3	78.5
PHEND10:	86.0	82.0	85.4	94.6	59.0
CHRYD12:	121.2	87.9	126.2	143.5	78.8
PERYD12:	69.1	61.7	62.8	56.8	88.2

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1671P	Q1657P	Q1622P	Q1623P	Q1627P
	CLAM				
STATION	PR-4A	PR-4A	PR-4B	PR-4C	WSC-1
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.61	0.52	0.13	0.24	0.36
TOTAL CHLORDANES	30.28	10.32	9.31	8.39	14.27
TOTAL DDT'S	23.89	12.42	12.64	8.52	42.05
TOTAL PCB'S	249.5	84.6	77.5	48.5	392.5
TOXAPHENE					
TOTAL CL2	0.0	0.6	0.0	0.0	1.3
TOTAL CL3	6.2	4.4	5.2	0.9	12.0
TOTAL CL4	52.1	3.9	6.9	8.6	64.8
TOTAL CL5	69.4	18.0	27.3	23.0	108.3
TOTAL CL6	101.7	20.9	19.0	12.3	122.6
TOTAL CL7	28.0	32.8	20.1	4.1	62.5
TOTAL CL8	4.1	5.8	2.2	0.9	21.9
TOTAL CL9	0.2	0.6	0.0	0.0	6.7
TOTAL CL10	0.3	0.1	0.0	0.0	0.9
ALPHA-BHC	0.00	0.00	0.00	0.00	0.02
HCB	0.00	0.00	0.00	0.00	0.26
BETA-BHC	0.00	0.00	0.13	0.00	0.00
GAMMA-BHC	0.61	0.52	0.00	0.24	0.34
DELTA-BHC	0.00	0.00	0.00	0.00	0.00
HEPTACHLOR	0.00	0.28	0.04	0.00	0.00
HEPTA-EPOXIDE	0.88	0.00	0.00	0.00	0.00
OXYCHLORDANE	0.99	0.00	0.00	0.00	0.52
GAMMA-CHLORDANE	7.96	3.38	3.31	3.03	4.80
ALPHA-CHLORDANE	9.85	3.30	3.26	2.98	4.59
TRANS-NONACHLOR	7.26	2.14	2.05	1.88	2.35
CIS-NONACHLOR	3.34	1.22	0.65	0.50	2.00
ALDRIN	0.00	2.98	1.88	0.83	0.48
DIELDRIN	7.67	0.77	1.04	0.64	0.00
ENDRIN	0.70	0.00	0.07	0.12	0.00
MIREX	0.00	0.00	0.00	0.03	0.00
2,4'DDE (O,P'DDE)	0.51	0.00	0.00	0.00	0.62
4,4'DDE (P,P'DDE)	12.71	4.98	6.41	3.71	24.13
2,4'DDD (O,P'DDD)	1.20	1.08	0.57	0.41	1.72
4,4'DDD (P,P'DDD)	7.72	3.67	3.04	2.02	10.39
2,4'DDT (O,P'DDT)	0.24	0.47	0.43	0.22	1.27
4,4'DDT (P,P'DDT)	1.51	2.23	2.20	2.17	3.92

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1671P CLAM	Q1657P	Q1622P	Q1623P	Q1627P
STATION	PR-4A	PR-4A	PR-4B	PR-4C	WSC-1
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#18 (CL3)	0.9	0.1	0.0	0.0	0.4
PCB#15 (CL2)	0.0	0.6	0.0	0.0	1.3
PCB#24 (CL3)	0.0	0.0	0.4	0.0	0.0
PCB#16/32 (CL3)	0.0	1.2	3.6	0.0	4.5
PCB#29 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#26 (CL3)	0.0	0.9	0.0	0.0	0.3
PCB#25 (CL3)	4.7	0.7	0.0	0.0	2.3
PCB#50 (CL4)	11.5	0.5	1.1	0.6	2.5
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	0.7	1.0	0.8	0.6	2.5
PCB#33 (CL3)	0.0	0.5	0.4	0.3	1.4
PCB#22 (CL3)	0.0	0.0	0.0	0.0	0.6
PCB#45 (CL4)	0.0	0.0	0.0	0.0	0.2
PCB#46 (CL4)	0.0	0.0	0.0	0.0	0.3
PCB#52 (CL4)	11.8	1.0	0.0	4.9	25.5
PCB#49 (CL4)	1.3	0.6	0.0	0.0	5.7
PCB#47/48 (CL4)	3.4	0.2	1.2	1.0	4.7
PCB#44 (CL4)	7.2	0.0	0.0	0.0	4.3
PCB#37/42 (CL4)	0.0	0.0	0.0	0.0	3.0
PCB#41/64 (CL4)	0.0	0.0	0.0	0.0	3.0
PCB#40 (CL4)	0.0	0.0	0.0	0.0	0.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	1.9	0.5	2.1	1.4	3.0
PCB#70 (CL4)	12.6	0.6	1.4	0.8	6.7
PCB#66 (CL4)	2.4	0.7	1.1	0.0	5.9
PCB#88 (CL5)	4.1	0.7	1.5	1.1	5.5
PCB#60/56 (CL5)	3.3	0.5	12.4	10.3	3.6
PCB#92? (CL5)	2.2	0.7	0.0	0.0	5.7
PCB#84? (CL5)	11.9	0.0	2.7	2.3	6.7
PCB#101 (CL5)	10.1	3.4	2.0	1.5	15.2
PCB#99 (CL5)	3.2	0.6	0.0	0.0	5.7
PCB#83 (CL5)	0.0	0.0	0.0	0.4	0.0
PCB#97 (CL5)	3.1	0.4	0.0	0.3	3.9
PCB#87 (CL5)	2.6	0.9	0.6	0.5	7.6
PCB#85 (CL5)	0.0	0.0	0.0	0.0	2.4
PCB#136 (CL6)	0.0	0.8	0.8	0.3	0.0
PCB#110/77 (CL5/4)	9.2	4.0	2.9	2.3	20.8
PCB#82 (CL5)	1.2	0.9	0.0	0.0	2.2
PCB#151 (CL6)	6.5	1.3	0.8	0.7	7.2
PCB#107/108/144(CL5/	3.7	0.8	0.6	0.5	6.2
PCB#149 (CL6)	11.7	3.4	2.4	1.9	18.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1671P	Q1657P	Q1622P	Q1623P	Q1627P
	CLAM				
STATION	PR-4A	PR-4A	PR-4B	PR-4C	WSC-1
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	11.1	2.5	1.6	1.4	13.9
PCB#188 (CL7)	0.0	0.0	1.1	0.3	0.0
PCB#146 (CL6)	3.5	0.6	0.6	0.2	5.1
PCB#153 (CL6)	38.7	5.1	4.4	2.9	30.6
PCB#105 (CL5)	3.9	2.5	2.9	2.5	9.0
PCB#141 (CL6)	4.0	1.1	1.6	1.1	12.3
PCB#137 (CL6)	0.6	0.0	0.0	0.0	0.0
PCB#? (CL6)	0.8	0.0	0.0	0.0	2.3
PCB#138 (CL6)	30.0	5.7	6.1	3.8	34.9
PCB#158 (CL7)	1.3	0.3	0.1	0.1	1.9
PCB#129 (CL6)	0.0	0.0	0.4	0.2	1.4
PCB#126 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#178 (CL7)	0.7	0.0	0.2	0.1	1.3
PCB#187/182/159(CL7/	5.1	3.5	0.8	0.4	7.6
PCB#183 (CL7)	2.7	0.8	0.4	0.3	3.8
PCB#128 (CL6)	2.7	0.8	0.4	0.4	5.5
PCB#167 (CL6)	1.4	0.0	0.3	0.2	1.2
PCB#185 (CL7)	0.7	0.0	0.5	0.0	2.0
PCB#174 (CL7)	1.1	1.9	0.9	0.5	6.1
PCB#177 (CL7)	2.3	3.3	0.4	0.2	3.2
PCB#156/171/202(CL6/	1.7	2.1	1.3	0.7	4.3
PCB#200 (CL8)	0.0	0.0	0.2	0.1	0.9
PCB#172 (CL7)	0.0	0.0	0.0	0.1	1.3
PCB#180 (CL7)	10.0	4.6	3.2	1.6	17.6
PCB#191 (CL7)	0.5	0.0	0.2	0.1	0.7
PCB#170 (CL7)	2.6	16.5	11.4	0.0	11.0
PCB#201 (CL8)	0.5	1.2	0.6	0.3	6.0
PCB#196 (CL8)	2.6	1.6	0.6	0.3	7.0
PCB#189 (CL7)	0.0	0.0	0.0	0.0	0.0
PCB#195 (CL8)	0.9	0.4	0.2	0.1	3.6
PCB#194 (CL8)	0.2	2.5	0.6	0.2	4.4
PCB#205 (CL9)	0.0	0.2	0.0	0.0	0.3
PCB#206 (CL9)	0.2	0.4	0.0	0.0	6.4
PCB#209 (CL10)	0.3	0.1	0.0	0.0	0.9

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	WSC-2	WSC-3	WSC-5 CLAM	WSC-5	WSC-5
LABSAMNO:	RQ1626	RQ1628	RQ1674	RQ1686	RQ1654
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1626	>Q1628	>Q1674	>Q1686	>Q1654
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M411	M411	M409	M409	M407
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	TISSUE	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	18.67	15.71	4.72	18.63	20.13
DRYWT:	5.88	5.20	0.70	9.80	9.56
VOL:					
ACEND10:	67.0	123.3	100.7	100.7	93.3
BENAD12:					
CHRYD12:	47.4	69.2	101.0	101.0	104.0
FLUOD10:					
NAPHD8:	62.6	114.3	100.1	100.1	105.3
PERYD12:	49.5	41.4	92.2	92.2	73.6
PHEND10:	72.4	109.5	95.1	95.1	85.5
C12ALKD:	73.9	92.4	90.1	87.3	92.1
C20ALKD:	96.2	107.6	76.0	110.3	107.0
C24ALKD:	72.2	78.6	76.3	99.4	97.6
C30ALKD:	110.9	91.4	77.9	103.7	121.0
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	WSC-2	WSC-3	WSC-5 CLAM	WSC-5	WSC-5
LABSAMNO:	RQ1626	RQ1628	RQ1674	RQ1686	RQ1654
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	105.70	79.73	0.00	49.76	29.24
C11	163.05	110.17	0.00	69.19	70.04
C12	132.98	98.02	427.85	142.44	92.82
C13	128.79	110.63	16.64	67.48	64.94
C14	137.93	122.44	18.83	428.37	159.80
C15	304.41	146.40	133.68	163.58	163.54
C16	155.19	99.38	6.31	675.84	211.93
C17	1008.20	492.00	559.10	360.70	434.20
PRISTANE	431.50	356.70	284.60	101.00	119.60
C18	202.20	192.00	70.20	401.70	121.10
PHYTANE	653.90	581.60	198.50	90.30	170.10
C19	279.00	268.20	91.00	102.50	151.70
C20	130.50	118.40	90.20	47.80	89.90
C21	217.70	192.20	64.10	93.60	136.70
C22	128.00	88.90	50.40	47.30	58.60
C23	442.09	407.82	91.52	247.58	191.88
C24	214.34	103.64	1033.87	63.36	54.99
C25	753.18	664.99	106.94	568.69	557.93
C26	267.61	281.03	90.47	80.54	76.04
C27	1399.41	1153.16	80.60	694.01	731.18
C28	170.71	162.87	98.44	68.38	151.62
C29	1193.32	355.64	217.77	1002.02	1213.30
C30	56.53	17.48	56.88	61.46	87.36
C31	142.39	2.10	196.90	1031.89	783.95
C32	5.13	16.17	56.67	81.20	40.67
C33	5.23	3.81	7.65	403.28	151.22
C34	2.42	4.07	0.00	51.43	6.42
TOT ALKANES	8831.4	6229.6	4049.1	7195.4	6120.8
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	451.2	430.3	138.2	120.8	105.8
Surrogate Recoveries					
C12ALKD:	73.9	92.4	90.1	87.3	92.1
C20ALKD:	96.2	107.6	76.0	110.3	107.0
C24ALKD:	72.2	78.6	76.3	99.4	97.6
C30ALKD:	110.9	91.4	77.9	103.7	121.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	WSC-2	WSC-3	WSC-5 CLAM	WSC-5	WSC-5
LABSAMNO:	>Q1626	>Q1628	>Q1674	>Q1686	>Q1654
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	75.47	65.13	19.82	40.07	41.01
C1-NAPHTHALENES	168.78	156.59	26.82	50.09	41.42
C2-NAPHTHALENES	184.52	174.05	33.23	75.73	76.77
C3-NAPHTHALENES	180.60	166.02	112.66	98.47	129.26
C4-NAPHTHALENES	130.75	122.64	139.12	80.91	108.54
BIPHENYL	23.78	21.88	12.68	15.00	10.77
ACENAPHTHYLENE	30.03	21.87	19.29	39.51	40.66
ACENAPHTHENE	34.92	28.43	9.66	11.65	17.43
FLUORENE	62.77	55.17	5.84	28.48	36.08
C1-FLUORENES	62.00	54.36	60.23	40.61	53.74
C2-FLUORENES	127.95	115.09	162.93	98.89	133.15
C3-FLUORENES	122.89	122.58	542.82	165.19	189.54
PHENANTHRENE	331.72	303.18	15.13	215.63	366.37
ANTHRACENE	73.16	75.05	26.42	66.38	97.44
C1-PHEN_ANTHR	219.49	214.54	80.53	238.51	404.18
C2-PHEN_ANTHR	243.81	243.81	166.57	280.52	462.66
C3-PHEN_ANTHR	235.10	22.99	200.23	135.40	203.46
C4-PHEN_ANTHR	195.39	189.41	182.63	65.35	113.43
DIBENZOTHIO	20.75	19.60	5.51	18.04	25.89
C1-DIBEN	37.43	36.34	13.76	30.40	54.25
C2-DIBEN	79.43	78.00	37.38	70.00	115.87
C3-DIBEN	117.88	115.07	49.43	54.15	96.90
FLUORANTHENE	604.32	524.39	196.40	645.24	818.82
PYRENE	474.56	609.39	274.94	612.28	714.71
C1-FLUORAN_PYR	329.40	332.04	180.15	371.33	463.63
BENaANTHRACENE	273.48	229.08	39.74	331.10	375.13
CHRYSENE	603.12	527.42	184.13	365.39	399.21
C1-CHRYSENES	244.41	197.11	51.32	193.34	210.31
C2-CHRYSENES	175.05	139.23	44.86	96.71	110.91
C3-CHRYSENES	54.77	55.58	23.82	29.56	21.25
C4-CHRYSENES	74.39	87.17	16.56	61.19	65.33
BENbFLUORAN	450.93	358.00	41.80	488.04	420.95
BENkFLUORAN	238.60	263.84	16.71	181.25	314.52
BENePYRENE	303.87	277.69	80.90	262.10	273.03
BENaPYRENE	217.44	122.50	6.59	330.46	370.10
PERYLENE	190.13	74.35	22.77	475.39	520.38
I123cdPYRENE	89.68	68.50	11.46	344.96	408.99
DBahANTHRA	20.44	16.27	3.85	87.65	109.28
BghiPERYLENE	79.59	53.60	19.78	272.55	310.28

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	WSC-2	WSC-3	WSC-5 CLAM	WSC-5	WSC-5
LABSAMNO:	>Q1626	>Q1628	>Q1674	>Q1686	>Q1654
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	104.87	96.95	15.60	32.18	24.42
1-METHYLNAPH	63.91	59.64	11.22	17.91	17.00
2,6-DIMETHNAPH	81.44	74.27	11.20	26.74	27.32
2,3,5-TRIMETHNAPH	49.36	44.77	12.58	14.38	22.63
1-METHYLPHEN	21.52	39.97	13.19	40.73	90.17
Surrogate Recoveries					
NAPHD8:	62.6	114.3	100.1	100.1	105.3
ACEND10:	67.0	123.3	100.7	100.7	93.3
PHEND10:	72.4	109.5	95.1	95.1	85.5
CHRYD12:	47.4	69.2	101.0	101.0	104.0
PERYD12:	49.5	41.4	92.2	92.2	73.6

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1626P	Q1628P	Q1674P	Q1686P	Q1654P
			CLAM		
STATION	WSC-2	WSC-3	WSC-5	WSC-5	WSC-5
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.38	0.13	0.77	0.43	0.35
TOTAL CHLORDANES	18.61	18.18	27.79	7.37	7.12
TOTAL DDT'S	35.85	29.66	36.14	16.69	18.61
TOTAL PCB'S	328.4	304.8	295.6	92.0	99.4
TOXAPHENE					
TOTAL CL2	1.4	0.9	1.4	3.2	0.7
TOTAL CL3	6.0	12.4	7.7	10.3	13.4
TOTAL CL4	64.5	42.5	64.9	24.0	19.2
TOTAL CL5	102.2	102.0	100.2	27.7	23.6
TOTAL CL6	98.2	96.2	103.8	20.7	22.8
TOTAL CL7	39.9	39.9	21.3	9.0	16.1
TOTAL CL8	15.6	12.6	3.2	2.3	2.9
TOTAL CL9	5.4	2.8	0.3	0.3	0.4
TOTAL CL10	1.4	0.5	0.2	0.4	2.4
ALPHA-BHC	0.08	0.00	0.00	0.06	0.00
HCB	0.26	0.29	0.00	0.06	0.04
BETA-BHC	0.00	0.00	0.00	0.07	0.00
GAMMA-BHC	0.19	0.13	0.61	0.29	0.35
DELTA-BHC	0.11	0.00	0.17	0.00	0.00
HEPTACHLOR	0.00	0.00	0.00	0.00	0.00
HEPTA-EPOXIDE	0.25	0.00	0.68	0.00	0.00
OXYCHLORDANE	0.36	0.00	0.86	0.00	0.56
GAMMA-CHLORDANE	6.44	6.42	7.24	2.71	2.33
ALPHA-CHLORDANE	6.13	6.20	9.11	2.52	2.32
TRANS-NONACHLOR	3.32	3.17	6.71	1.47	1.25
CIS-NONACHLOR	2.11	2.39	3.19	0.67	0.66
ALDRIN	0.81	0.38	0.00	0.00	1.70
DIELDRIN	0.91	0.79	5.54	1.01	0.58
ENDRIN	0.26	0.27	0.41	0.21	0.14
MIREX	0.00	0.00	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	0.53	0.44	0.70	0.22	0.15
4,4'DDE (P,P'DDE)	20.57	17.53	19.06	5.29	7.79
2,4'DDD (O,P'DDD)	1.80	1.37	1.87	1.29	1.28
4,4'DDD (P,P'DDD)	9.33	7.56	11.89	8.55	7.81
2,4'DDT (O,P'DDT)	0.96	0.77	0.56	0.32	0.30
4,4'DDT (P,P'DDT)	2.66	1.99	2.05	1.02	1.28

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1626P	Q1628P	Q1674P CLAM	Q1686P	Q1654P
STATION	WSC-2 (ppb)	WSC-3 (ppb)	WSC-5 (ppb)	WSC-5 (ppb)	WSC-5 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.0	0.0	0.0	2.1	0.3
PCB#18 (CL3)	0.5	0.3	1.1	0.4	0.2
PCB#15 (CL2)	1.4	0.9	1.4	1.1	0.4
PCB#24 (CL3)	0.0	0.1	0.4	0.0	0.0
PCB#16/32 (CL3)	0.0	5.0	1.2	4.2	6.0
PCB#29 (CL3)	0.0	0.0	0.0	0.6	0.0
PCB#26 (CL3)	0.0	0.2	0.0	0.1	4.0
PCB#25 (CL3)	0.0	3.2	3.9	1.6	1.1
PCB#50 (CL4)	1.8	0.8	6.4	4.5	1.0
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	3.7	2.5	1.1	2.1	1.2
PCB#33 (CL3)	1.2	0.8	0.0	1.0	0.9
PCB#22 (CL3)	0.5	0.4	0.0	0.3	0.0
PCB#45 (CL4)	0.2	0.2	0.0	0.1	0.0
PCB#46 (CL4)	0.2	0.2	0.0	0.2	0.0
PCB#52 (CL4)	29.4	11.4	14.9	8.2	4.1
PCB#49 (CL4)	4.5	3.6	2.7	1.7	2.2
PCB#47/48 (CL4)	3.5	2.9	2.9	0.8	2.2
PCB#44 (CL4)	4.9	4.4	10.8	2.2	1.3
PCB#37/42 (CL4)	2.3	2.1	1.8	1.3	1.6
PCB#41/64 (CL4)	1.8	2.3	2.2	0.0	1.6
PCB#40 (CL4)	0.0	0.0	0.0	0.7	1.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	2.5	2.6	3.3	0.9	0.6
PCB#70 (CL4)	6.8	6.3	16.6	1.9	1.5
PCB#66 (CL4)	6.6	5.9	3.1	1.6	2.0
PCB#88 (CL5)	4.4	5.6	5.4	1.8	0.0
PCB#60/56 (CL5)	3.2	3.5	4.9	1.2	1.0
PCB#92? (CL5)	3.8	3.8	3.2	2.4	1.8
PCB#84? (CL5)	6.1	7.3	13.6	2.7	2.1
PCB#101 (CL5)	13.8	13.2	14.0	3.3	3.5
PCB#99 (CL5)	4.9	5.6	5.1	1.3	1.2
PCB#83 (CL5)	0.5	0.6	0.0	0.7	0.0
PCB#97 (CL5)	4.4	4.6	4.8	1.4	0.8
PCB#87 (CL5)	8.5	8.1	4.0	1.7	1.7
PCB#85 (CL5)	3.2	2.6	1.1	0.4	0.0
PCB#136 (CL6)	0.0	0.0	0.0	0.0	0.0
PCB#110/77 (CL5/4)	20.8	19.5	15.7	4.6	5.3
PCB#82 (CL5)	2.1	2.2	1.5	1.1	0.6
PCB#151 (CL6)	6.2	5.9	7.0	1.4	1.5
PCB#107/108/144(CL5/	5.4	4.8	4.2	1.1	1.2
PCB#149 (CL6)	14.9	14.1	14.0	3.1	3.4

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1626P	Q1628P	Q1674P	Q1686P	Q1654P
			CLAM		
STATION	WSC-2	WSC-3	WSC-5	WSC-5	WSC-5
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	13.0	13.0	16.0	2.4	2.8
PCB#188 (CL7)	0.0	0.0	0.0	0.0	0.0
PCB#146 (CL6)	4.2	4.1	3.6	0.8	0.8
PCB#153 (CL6)	25.1	24.2	35.8	5.5	5.5
PCB#105 (CL5)	8.2	7.4	6.5	1.6	1.6
PCB#141 (CL6)	9.3	8.4	4.0	1.7	2.0
PCB#137 (CL6)	1.0	1.2	0.7	0.2	0.3
PCB#? (CL6)	1.5	1.8	1.0	0.2	0.4
PCB#138 (CL6)	25.7	26.2	29.2	6.2	6.5
PCB#158 (CL7)	1.3	1.4	1.3	0.2	0.3
PCB#129 (CL6)	0.9	1.0	0.4	0.4	0.3
PCB#126 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#178 (CL7)	0.7	0.7	0.5	0.0	0.3
PCB#187/182/159(CL7/	5.4	4.9	3.9	0.7	1.1
PCB#183 (CL7)	2.8	2.7	2.3	0.5	0.5
PCB#128 (CL6)	5.4	5.1	3.1	0.7	0.9
PCB#167 (CL6)	1.0	0.9	1.4	0.0	0.4
PCB#185 (CL7)	1.5	1.4	0.5	0.3	0.9
PCB#174 (CL7)	4.3	4.3	1.0	0.9	1.0
PCB#177 (CL7)	2.5	2.4	1.8	0.5	0.6
PCB#156/171/202(CL6/	2.9	3.3	3.7	0.5	0.8
PCB#200 (CL8)	0.7	0.6	0.2	0.1	0.2
PCB#172 (CL7)	0.6	0.8	0.0	0.2	0.0
PCB#180 (CL7)	10.1	10.3	6.9	2.0	2.3
PCB#191 (CL7)	0.5	0.5	0.4	0.1	0.1
PCB#170 (CL7)	6.0	6.3	1.8	2.7	8.0
PCB#201 (CL8)	4.2	3.3	0.4	0.8	0.8
PCB#196 (CL8)	4.8	4.2	1.8	0.7	0.9
PCB#189 (CL7)	0.0	0.0	0.0	0.0	0.1
PCB#195 (CL8)	3.2	1.8	0.5	0.3	0.3
PCB#194 (CL8)	2.6	2.7	0.2	0.5	0.7
PCB#205 (CL9)	0.2	0.0	0.0	0.0	0.0
PCB#206 (CL9)	5.1	2.8	0.3	0.3	0.4
PCB#209 (CL10)	1.4	0.5	0.2	0.4	2.4

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	WSC-6 CLAM	WSC-6	OWSC-1	OWSC-2	OWSC-3 CLAM
LABSAMNO:	RQ1675	RQ1685	RQ1619	RQ1663	RQ1676
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1675	>Q1685	>Q1619	>Q1663	
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M408	M409	M403	M407	M408
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	TISSUE	SEDIMENT	SEDIMENT	SEDIMENT	TISSUE
SUBMAT:					
SAMPLWT:					
WETWT:	1.47	31.14	25.11	31.05	1.40
DRYWT:	0.22	10.09	8.01	7.70	0.21
VOL:					
ACEND10:	48.2	87.7	32.0	80.1	0.0
BENAD12:					
CHRYD12:	49.9	98.9	40.7	74.4	0.0
FLUOD10:					
NAPHD8:	52.0	104.6	21.4	116.1	0.0
PERYD12:	40.1	78.4	15.4	120.6	0.0
PHEND10:	52.4	102.1	42.0	91.2	0.0
C12ALKD:	80.4	87.0	70.2	61.2	77.3
C20ALKD:	76.9	101.4	69.8	154.5 M	80.0
C24ALKD:	85.3	79.9	140.7 M	151.2 M	87.2
C30ALKD:	87.4	130.8 M	118.4	114.1	88.3
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	WSC-6 CLAM	WSC-6	OWSC-1	OWSC-2	OWSC-3 CLAM
LABSAMNO:	RQ1675	RQ1685	RQ1619	RQ1663	RQ1676
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	0.00	45.39	76.49	160.92	0.00
C11	0.00	81.47	124.58	406.61	0.00
C12	263.37	108.95	83.18	467.72	12.36
C13	223.53	96.60	72.03	296.95	0.00
C14	0.00	277.94	115.95	348.70	0.00
C15	142.16	299.24	190.79	492.61	0.00
C16	49.38	338.10	125.74	577.88	4.30
C17	679.20	467.20	547.00	529.24	40.80
PRISTANE	668.80	224.50	416.00	1373.46	55.70
C18	141.20	435.00	228.90	666.73	9.60
PHYTANE	423.10	190.50	514.00	1359.09	25.90
C19	199.80	175.20	567.20	439.33	8.80
C20	232.20	84.40	3025.50	369.20	18.00
C21	180.70	183.50	9202.40	570.33	14.50
C22	192.10	107.20	12315.40	407.05	18.20
C23	297.26	416.54	9016.85	1315.52	28.80
C24	343.05	131.85	7806.39	2326.48	36.14
C25	496.00	1021.23	7578.35	4288.73	43.97
C26	360.62	293.78	4670.58	3863.04	39.62
C27	419.33	1846.02	4051.94	4003.31	34.41
C28	334.50	403.70	1852.76	2933.48	34.12
C29	10205.66	4403.97	2110.40	3001.59	53.35
C30	205.71	430.51	467.01	1587.51	20.26
C31	518.85	3387.49	606.12	1789.76	45.02
C32	134.84	291.61	194.25	1133.86	15.94
C33	41.22	1436.19	150.01	823.50	0.00
C34	0.00	132.50	58.49	531.07	0.00
TOT ALKANES	16752.6	17310.6	66168.3	36063.7	559.8
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	172.3	280.8	603.6	951.9	3.2
Surrogate Recoveries					
C12ALKD:	80.4	87.0	70.2	61.2	77.3
C20ALKD:	76.9	101.4	69.8	154.5 M	80.0
C24ALKD:	85.3	79.9	140.7 M	151.2 M	87.2
C30ALKD:	87.4	130.8 M	118.4	114.1	88.3

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	WSC-6 CLAM	WSC-6	OWSC-1	OWSC-2	OWSC-3 CLAM
LABSAMNO:	>Q1675	>Q1685	>Q1619	>Q1663	0.00
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	43.01	41.97	190.51	410.00	
C1-NAPHTHALENES	39.82	68.68	383.60	202.00	LOST IN
C2-NAPHTHALENES	74.15	89.35	236.61	230.30	PROCESSING
C3-NAPHTHALENES	208.06	108.22	266.68	306.90	
C4-NAPHTHALENES	257.05	88.91	271.73	312.10	
BIPHENYL	46.39	15.41	21.63	207.00	
ACENAPHTHYLENE	22.23	23.78	27.86	69.80	
ACENAPHTHENE	3.89	17.88	49.69	338.30	
FLUORENE	10.04	32.35	67.56	431.30	
C1-FLUORENES	78.90	43.94	67.68	211.00	
C2-FLUORENES	275.96	151.36	114.89	312.80	
C3-FLUORENES	643.94	169.51	202.75	741.00	
PHENANTHRENE	34.94	201.46	398.94	3630.30	
ANTHRACENE	29.39	39.05	88.24	659.80	
C1-PHEN_ANTHR	90.39	166.72	226.09	1038.60	
C2-PHEN_ANTHR	226.09	192.14	238.17	1059.70	
C3-PHEN_ANTHR	323.47	115.58	156.26	708.60	
C4-PHEN_ANTHR	265.30	70.09	135.31	457.70	
DIBENZOTHIO	11.90	15.63	27.60	163.00	
C1-DIBEN	37.33	27.94	32.53	120.60	
C2-DIBEN	81.55	54.35	60.49	266.10	
C3-DIBEN	120.15	52.36	85.08	390.20	
FLUORANTHENE	209.62	434.09	942.71	5472.60	
PYRENE	362.39	414.50	858.00	4622.10	
C1-FLUORAN_PYR	303.79	232.40	444.15	1644.10	
BENaANTHRACENE	57.62	204.65	430.21	1976.00	
CHRYSENE	270.77	293.19	592.73	3075.40	
C1-CHRYSENES	106.16	142.24	250.59	797.30	
C2-CHRYSENES	86.60	87.54	139.53	494.30	
C3-CHRYSENES	48.12	32.59	51.91	208.60	
C4-CHRYSENES	76.55	60.12	102.70	334.30	
BENbFLUORAN	73.90	332.26	637.72	3261.30	
BENkFLUORAN	31.47	257.65	354.04	1580.00	
BENePYRENE	150.71	241.07	389.66	1937.40	
BENaPYRENE	23.72	245.43	422.61	2336.00	
PERYLENE	31.89	158.65	317.98	811.20	
I123cdPYRENE	20.92	321.72	298.08	1390.80	
DBahANTHRA	14.96	70.21	71.16	352.90	
BghiPERYLENE	39.19	278.27	254.88	1603.20	

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	WSC-6 CLAM	WSC-6	OWSC-1	OWSC-2	OWSC-3 CLAM
LABSAMNO:	>Q1675	>Q1685	>Q1619	>Q1663	0.00
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	20.17	45.45	296.94	128.00	
1-METHYLNAPH	19.65	23.23	86.66	74.00	
2,6-DIMETHNAPH	27.57	40.72	46.29	136.60	
2,3,5-TRIMETHNAPH	26.64	20.12	26.20	139.50	
1-METHYLPHEN	13.86	36.65	50.67	196.90	
Surrogate Recoveries					
NAPHD8:	52.0	104.6	21.4	116.1	
ACEND10:	48.2	87.7	32.0	80.1	
PHEND10:	52.4	102.1	42.0	91.2	
CHRYD12:	49.9	98.9	40.7	74.4	
PERYD12:	40.1	78.4	15.4	120.6	

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1675P	Q1685P	Q1619P	Q1663P
	CLAM			
STATION	WSC-6	WSC-6	OWSC-1	OWSC-2
	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.85	0.34	1.22	0.00
TOTAL CHLORDANES	40.37	16.51	39.04	64.32
TOTAL DDT'S	32.18	15.14	50.63	58.48
TOTAL PCB'S	331.4	144.0	991.6	3181.5
TOXAPHENE				
TOTAL CL2	0.0	1.4	11.4	0.0
TOTAL CL3	9.3	12.1	70.6	53.7
TOTAL CL4	72.3	29.2	422.2	1026.8
TOTAL CL5	101.3	38.8	286.4	1174.0
TOTAL CL6	122.5	40.8	124.5	749.7
TOTAL CL7	31.0	21.1	70.3	175.7
TOTAL CL8	5.5	5.1	10.3	28.3
TOTAL CL9	0.7	0.7	0.8	5.0
TOTAL CL10	0.6	0.7	0.0	0.0
ALPHA-BHC	0.00	0.00	0.54	0.00
HCB	0.16	0.13	0.00	2.71
BETA-BHC	0.00	0.00	0.48	0.00
GAMMA-BHC	0.65	0.34	0.20	0.00
DELTA-BHC	0.20	0.00	0.00	0.00
HEPTACHLOR	0.00	0.05	0.00	0.00
HEPTA-EPOXIDE	0.88	0.32	0.00	0.00
OXYCHLORDANE	0.89	0.00	0.00	0.00
GAMMA-CHLORDANE	11.10	6.52	17.44	22.93
ALPHA-CHLORDANE	13.34	5.15	12.54	20.96
TRANS-NONACHLOR	9.65	3.10	6.47	11.95
CIS-NONACHLOR	4.51	1.36	2.59	8.47
ALDRIN	0.00	0.00	14.61	5.48
DIELDRIN	4.22	1.42	2.38	6.68
ENDRIN	0.24	0.25	0.65	1.50
MIREX	0.00	0.00	0.73	0.00
2,4'DDE (O,P'DDE)	0.64	0.22	0.72	0.00
4,4'DDE (P,P'DDE)	16.43	7.31	16.42	29.53
2,4'DDD (O,P'DDD)	1.77	1.07	4.75	4.21
4,4'DDD (P,P'DDD)	11.19	4.53	22.60	22.17
2,4'DDT (O,P'DDT)	0.54	0.37	1.24	0.00
4,4'DDT (P,P'DDT)	1.61	1.64	4.90	2.57

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1675P	Q1685P	Q1619P	Q1663P
	CLAM			
STATION	WSC-6	WSC-6	OWSC-1	OWSC-2
	(ppb)	(ppb)	(ppb)	(ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.0	0.0	4.0	0.0
PCB#18 (CL3)	1.2	0.4	1.7	0.0
PCB#15 (CL2)	0.0	1.4	7.5	0.0
PCB#24 (CL3)	0.0	0.0	0.9	0.0
PCB#16/32 (CL3)	1.1	5.0	13.4	11.9
PCB#29 (CL3)	0.0	0.4	0.0	0.0
PCB#26 (CL3)	0.0	0.2	0.0	11.4
PCB#25 (CL3)	5.5	2.5	7.7	17.4
PCB#50 (CL4)	10.4	3.4	0.0	11.0
PCB#31 (CL3)	0.0	0.0	0.0	0.0
PCB#28 (CL3)	1.4	2.2	34.4	12.8
PCB#33 (CL3)	0.0	1.1	3.7	0.0
PCB#22 (CL3)	0.0	0.4	8.9	0.0
PCB#45 (CL4)	0.0	0.1	4.2	0.0
PCB#46 (CL4)	0.0	0.2	3.6	0.0
PCB#52 (CL4)	17.8	11.9	92.7	500.0
PCB#49 (CL4)	2.9	1.7	40.5	35.1
PCB#47/48 (CL4)	3.5	1.3	34.9	24.0
PCB#44 (CL4)	14.4	2.4	49.3	64.8
PCB#37/42 (CL4)	2.7	1.2	32.4	20.5
PCB#41/64 (CL4)	2.0	0.0	0.0	0.0
PCB#40 (CL4)	0.0	1.0	12.8	11.6
PCB#100 (CL5)	0.0	0.0	0.0	0.0
PCB#74 (CL4)	3.1	1.2	23.8	15.9
PCB#70 (CL4)	12.4	2.7	59.8	105.4
PCB#66 (CL4)	3.1	2.1	68.2	238.5
PCB#88 (CL5)	6.1	3.0	11.3	21.1
PCB#60/56 (CL5)	4.9	1.6	61.6	40.9
PCB#92? (CL5)	2.0	1.3	8.5	33.2
PCB#84? (CL5)	17.5	5.4	18.7	61.1
PCB#101 (CL5)	13.4	5.0	23.1	147.4
PCB#99 (CL5)	5.5	1.7	11.9	62.1
PCB#83 (CL5)	0.0	0.7	0.0	5.3
PCB#97 (CL5)	4.5	1.5	8.2	55.6
PCB#87 (CL5)	4.4	2.2	17.3	136.6
PCB#85 (CL5)	0.6	0.4	6.7	45.8
PCB#136 (CL6)	0.0	0.0	0.9	0.0
PCB#110/77 (CL5/4)	13.9	7.0	50.7	219.9
PCB#82 (CL5)	1.2	0.5	8.1	30.3
PCB#151 (CL6)	7.4	2.2	4.8	34.6
PCB#107/108/144(CL5/	4.0	1.6	3.6	33.3
PCB#149 (CL6)	13.6	5.6	13.2	118.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1675P CLAM	Q1685P	Q1619P	Q1663P
STATION	WSC-6 (ppb)	WSC-6 (ppb)	OWSC-1 (ppb)	OWSC-2 (ppb)
PCB#118/108/149(CL5/	16.7	4.2	29.8	167.8
PCB#188 (CL7)	0.0	0.0	0.0	0.0
PCB#146 (CL6)	4.0	1.4	3.8	22.8
PCB#153 (CL6)	44.4	10.5	28.2	184.5
PCB#105 (CL5)	6.5	2.7	27.0	113.7
PCB#141 (CL6)	4.7	3.8	10.1	72.6
PCB#137 (CL6)	0.9	0.4	1.9	15.1
PCB#? (CL6)	1.2	0.4	2.7	14.5
PCB#138 (CL6)	37.9	12.5	36.4	207.8
PCB#158 (CL7)	1.5	0.4	1.2	15.0
PCB#129 (CL6)	0.3	0.5	1.9	11.9
PCB#126 (CL5)	0.0	0.0	0.0	0.0
PCB#178 (CL7)	0.9	0.3	1.2	3.7
PCB#187/182/159(CL7/	5.3	2.1	26.8	25.5
PCB#183 (CL7)	2.8	1.2	2.1	10.8
PCB#128 (CL6)	3.8	1.7	6.8	53.6
PCB#167 (CL6)	1.7	0.5	1.7	0.0
PCB#185 (CL7)	0.7	1.1	3.3	10.0
PCB#174 (CL7)	1.3	1.9	5.0	20.8
PCB#177 (CL7)	2.4	1.1	8.3	16.3
PCB#156/171/202(CL6/	2.5	1.3	12.3	14.3
PCB#200 (CL8)	0.3	0.3	3.7	3.3
PCB#172 (CL7)	0.0	0.5	2.2	4.6
PCB#180 (CL7)	10.6	6.0	14.8	47.1
PCB#191 (CL7)	0.5	0.2	0.3	1.2
PCB#170 (CL7)	3.5	4.4	0.0	0.0
PCB#201 (CL8)	0.5	1.3	2.4	10.6
PCB#196 (CL8)	3.1	1.6	3.6	11.5
PCB#189 (CL7)	0.0	0.0	0.3	0.0
PCB#195 (CL8)	1.3	0.7	0.6	2.9
PCB#194 (CL8)	0.3	1.2	0.0	0.0
PCB#205 (CL9)	0.0	0.0	0.0	0.0
PCB#206 (CL9)	0.7	0.7	0.8	5.0
PCB#209 (CL10)	0.6	0.7	0.0	0.0

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	OWSC-3	AR-1	AR-2	AR-3	AR-4
LABSAMNO:	RQ1620	RQ1612	RQ1658	RQ1613	RQ1655
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1620	>Q1612	>Q1658	>Q1613	>Q1655
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M403	M403	M407	M403	M407
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	16.52	21.92	29.45	22.74	25.09
DRYWT:	10.97	9.03	10.22	9.39	10.69
VOL:					
ACEND10:	76.1	40.0	81.7	91.4	77.8
BENAD12:					
CHRYD12:	51.5	26.6	128.7	200.6	115.2
FLUOD10:					
NAPHD8:	87.1	36.1	84.4	91.8	85.0
PERYD12:	105.6	15.2	92.6	102.6	114.3
PHEND10:	80.8	23.9	83.8	113.5	81.8
C12ALKD:	68.6	102.4	127.0 M	75.2	109.1
C20ALKD:	99.5	88.9	402.1 M	115.3	501.1 M
C24ALKD:	73.8	114.7	352.1 M	204.2 M	585.9 M
C30ALKD:	127.6 M	81.3	140.7 M	67.1	129.6 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	OWSC-3	AR-1	AR-2	AR-3	AR-4
LABSAMNO:	RQ1620	RQ1612	RQ1658	RQ1613	RQ1655
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	237.14	43.62	99.20	74.37	363.21
C11	263.72	134.60	284.94	240.03	530.39
C12	92.62	191.35	447.30	312.61	410.14
C13	69.29	155.77	515.20	411.52	410.14
C14	142.40	317.05	915.62	478.12	806.58
C15	235.16	559.23	1231.90	834.42	1420.08
C16	292.85	430.22	1169.61	575.39	1045.62
C17	217.10	703.70	1365.39	846.31	1052.76
PRISTANE	186.80	2854.00	3909.34	2723.86	11208.55
C18	310.90	1352.80	1394.43	655.60	954.05
PHYTANE	184.10	2169.80	3209.87	2107.35	6874.75
C19	202.70	423.40	889.37	449.67	868.86
C20	175.70	294.90	1014.26	277.07	521.62
C21	243.80	393.10	585.55	334.49	483.04
C22	222.50	104.50	352.63	142.51	271.08
C23	341.50	80.87	641.51	82.19	487.63
C24	259.90	15.78	220.97	49.99	391.36
C25	774.34	935.59	1421.22	791.98	1408.70
C26	520.09	32.05	500.70	11.38	307.72
C27	672.39	572.34	814.53	135.45	646.48
C28	268.81	26.36	220.13	21.91	227.24
C29	461.41	483.01	509.40	225.50	190.42
C30	30.02	30.75	65.70	31.46	34.68
C31	138.10	323.76	206.00	139.64	62.64
C32	21.93	37.46	48.92	35.10	31.32
C33	19.41	70.66	91.06	56.20	26.85
C34	10.09	8.30	1.48	21.29	3.36
TOT ALKANES	6594.8	12745.0	22126.2	12065.4	31039.3
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	293.0	902.1	1367.6	855.5	1539.3
Surrogate Recoveries					
C12ALKD:	68.6	102.4	127.0 M	75.2	109.1
C20ALKD:	99.5	88.9	402.1 M	115.3	501.1 M
C24ALKD:	73.8	114.7	352.1 M	204.2 M	585.9 M
C30ALKD:	127.6 M	81.3	140.7 M	67.1	129.6 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:															
ID:	OWSC-3			AR-1			AR-2			AR-3			AR-4		
LABSAMNO:	>Q1620			>Q1612			>Q1658			>Q1613			>Q1655		
UNIT:	ng/g			ng/g			ng/g			ng/g			ng/g		
PNA Analyte	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
NAPHTHALENE	367.20			29.86			68.41			45.85			130.40		
C1-NAPHTHALENES	432.38			48.94			102.31			81.25			291.36		
C2-NAPHTHALENES	548.34			132.89			153.49			129.22			1127.27		
C3-NAPHTHALENES	614.74			570.06			259.89			219.90			2374.27		
C4-NAPHTHALENES	495.50			329.59			359.92			393.71			2195.01		
BIPHENYL	105.79			12.61			17.79			13.27			46.94		
ACENAPHTHYLENE	191.74			14.96			54.65			38.13			65.29		
ACENAPHTHENE	1104.37			19.86			36.99			31.74			76.60		
FLUORENE	1661.11			34.34			54.79			49.97			144.83		
C1-FLUORENES	478.67			49.36			75.36			74.52			369.94		
C2-FLUORENES	557.18			134.75			212.93			219.74			889.71		
C3-FLUORENES	1172.65			259.16			511.63			561.96			1209.30		
PHENANTHRENE	16638.63			591.95			636.40			474.98			1040.27		
ANTHRACENE	2336.08			76.26			91.57			75.29			137.87		
C1-PHEN_ANTHR	3764.85			410.26			403.11			321.91			1309.84		
C2-PHEN_ANTHR	1997.52			594.20			552.43			542.98			1945.55		
C3-PHEN_ANTHR	854.57			492.28			521.97			783.91			1267.76		
C4-PHEN_ANTHR	329.87			242.11			354.84			557.27			719.87		
DIBENZOTHIO	674.15			36.09			38.01			28.15			103.55		
C1-DIBEN	290.09			63.29			67.19			50.79			250.50		
C2-DIBEN	328.80			172.52			177.45			163.78			550.63		
C3-DIBEN	286.22			239.50			273.39			327.83			611.23		
FLUORANTHENE	19713.87			1492.93			1618.16			1230.91			1867.04		
PYRENE	14614.72			1327.70			1489.94			996.60			1810.53		
C1-FLUORAN_PYR	4763.41			707.20			801.71			816.30			1092.86		
BENaANTHRACENE	8976.68			607.11			410.07			375.03			580.88		
CHRYSENE	8840.65			817.34			704.84			589.20			799.39		
C1-CHRYSENES	2651.68			334.25			300.09			316.53			458.89		
C2-CHRYSENES	956.89			190.82			202.99			229.25			365.24		
C3-CHRYSENES	271.66			80.00			87.01			109.05			163.31		
C4-CHRYSENES	976.07			178.47			151.96			149.96			123.74		
BENbFLUORAN	6890.77			919.31			819.83			772.54			646.58		
BENkFLUORAN	5514.33			613.60			572.41			263.39			665.42		
BENePYRENE	4391.30			610.08			556.46			496.67			570.52		
BENaPYRENE	6482.92			586.26			502.43			425.28			557.58		
PERYLENE	2139.70			220.52			172.99			160.54			171.87		
I123cdPYRENE	3554.92			543.94			819.86			493.57			729.64		
DBahANTHRA	815.76			132.08			166.05			103.38			186.07		
BghiPERYLENE	3164.17			476.04			664.74			467.48			618.26		

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	OWSC-3	AR-1	AR-2	AR-3	AR-4
LABSAMNO:	>Q1620	>Q1612	>Q1658	>Q1613	>Q1655
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	222.50	31.19	67.71	54.16	193.41
1-METHYLNAPH	209.88	17.75	34.60	27.09	97.95
2,6-DIMETHNAPH	142.06	36.33	61.31	55.09	483.16
2,3,5-TRIMETHNAPH	112.69	36.69	43.81	39.54	465.69
1-METHYLPHEN	791.98	88.87	79.01	67.87	269.81
Surrogate Recoveries					
NAPHD8:	87.1	36.1	84.4	91.8	85.0
ACEND10:	76.1	40.0	81.7	91.4	77.8
PHEND10:	80.8	23.9	83.8	113.5	81.8
CHRYD12:	51.5	26.6	128.7	200.6	115.2
PERYD12:	105.6	15.2	92.6	102.6	114.3

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1620P	Q1612P	Q1658P	Q1613P	Q1655P
STATION	OWSC-3	AR-1	AR-2	AR-3	AR-4
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	1.31	0.15	0.00	11.12	0.00
TOTAL CHLORDANES	128.46	138.66	91.12	111.49	88.56
TOTAL DDT'S	448.12	77.87	55.95	76.93	123.81
TOTAL PCB'S	878.5	711.9	504.8	770.3	2203.4
TOXAPHENE					
TOTAL CL2	5.6	10.5	11.8	9.2	55.1
TOTAL CL3	32.4	64.1	47.9	24.1	153.8
TOTAL CL4	171.0	220.1	122.2	244.5	477.4
TOTAL CL5	376.1	235.7	142.0	250.8	560.0
TOTAL CL6	205.0	120.2	96.8	169.4	509.8
TOTAL CL7	68.4	56.8	71.9	64.3	401.0
TOTAL CL8	21.2	9.6	29.7	14.8	99.8
TOTAL CL9	9.6	0.0	0.2	1.8	11.1
TOTAL CL10	0.0	0.0	0.0	0.0	0.0
ALPHA-BHC	0.00	0.15	0.00	1.02	0.00
HCB	0.10	0.72	0.22	0.00	0.00
BETA-BHC	0.83	0.00	0.00	10.10	0.00
GAMMA-BHC	0.48	0.00	0.00	0.00	0.00
DELTA-BHC	0.00	0.00	0.00	0.00	0.00
HEPTACHLOR	0.14	0.86	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.00	0.00	0.00
OXYCHLORDANE	0.00	0.00	0.00	0.00	0.00
GAMMA-CHLORDANE	50.08	52.20	33.56	41.81	29.33
ALPHA-CHLORDANE	39.71	44.29	29.46	36.25	30.53
TRANS-NONACHLOR	26.08	29.49	19.37	23.94	14.41
CIS-NONACHLOR	12.44	11.81	8.73	9.48	14.29
ALDRIN	9.43	18.52	11.69	10.25	7.08
DIELDRIN	7.67	6.30	4.98	5.42	6.26
ENDRIN	0.47	3.41	0.00	2.07	0.00
MIREX	0.00	2.54	0.00	2.26	0.00
2,4'DDE (O,P'DDE)	2.54	0.60	0.00	0.00	0.00
4,4'DDE (P,P'DDE)	61.25	32.04	24.80	34.84	73.34
2,4'DDD (O,P'DDD)	41.41	5.30	4.36	5.51	8.41
4,4'DDD (P,P'DDD)	150.69	30.57	17.69	30.50	28.25
2,4'DDT (O,P'DDT)	0.93	0.91	2.80	0.00	10.01
4,4'DDT (P,P'DDT)	191.29	8.45	6.29	6.08	3.79

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1620P	Q1612P	Q1658P	Q1613P	Q1655P
STATION	OWSC-3 (ppb)	AR-1 (ppb)	AR-2 (ppb)	AR-3 (ppb)	AR-4 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	1.5	4.8	2.1	6.7	23.1
PCB#18 (CL3)	1.8	2.9	5.0	2.3	16.6
PCB#15 (CL2)	4.1	5.6	9.7	2.5	32.0
PCB#24 (CL3)	1.1	0.6	0.7	1.5	1.8
PCB#16/32 (CL3)	9.1	12.1	7.2	10.4	20.3
PCB#29 (CL3)	1.9	0.0	0.0	0.0	0.0
PCB#26 (CL3)	0.0	2.5	3.9	0.0	10.6
PCB#25 (CL3)	0.0	23.7	9.2	0.0	23.8
PCB#50 (CL4)	0.0	0.0	11.2	0.0	41.5
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	14.0	13.2	14.4	9.9	46.8
PCB#33 (CL3)	2.9	6.3	4.0	0.0	19.5
PCB#22 (CL3)	1.6	2.8	3.5	0.0	14.4
PCB#45 (CL4)	0.8	0.0	1.6	0.0	5.6
PCB#46 (CL4)	1.7	0.0	0.0	0.0	3.1
PCB#52 (CL4)	90.1	125.1	13.7	120.3	53.1
PCB#49 (CL4)	9.7	10.2	10.6	18.1	40.8
PCB#47/48 (CL4)	4.5	6.4	4.8	13.8	26.9
PCB#44 (CL4)	17.4	26.9	17.3	33.2	46.8
PCB#37/42 (CL4)	7.3	8.9	9.5	10.7	31.5
PCB#41/64 (CL4)	0.0	0.0	10.7	0.0	29.1
PCB#40 (CL4)	0.0	0.0	2.4	0.0	10.3
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	12.2	12.9	8.2	12.5	32.8
PCB#70 (CL4)	20.0	18.6	16.6	19.5	80.4
PCB#66 (CL4)	7.3	11.2	15.4	16.3	75.5
PCB#88 (CL5)	14.7	25.9	7.9	19.9	0.0
PCB#60/56 (CL5)	28.7	16.8	10.0	43.9	41.2
PCB#92? (CL5)	38.5	5.3	5.7	7.4	34.3
PCB#84? (CL5)	46.9	56.3	11.9	41.8	17.7
PCB#101 (CL5)	28.0	19.0	17.9	22.7	82.5
PCB#99 (CL5)	14.7	7.7	7.2	0.0	42.0
PCB#83 (CL5)	46.1	0.0	0.0	0.0	0.0
PCB#97 (CL5)	19.0	3.9	5.1	4.2	17.9
PCB#87 (CL5)	15.8	10.9	9.8	12.4	30.6
PCB#85 (CL5)	4.5	3.9	0.0	3.5	0.0
PCB#136 (CL6)	0.0	0.0	3.1	2.8	12.6
PCB#110/77 (CL5/4)	52.5	40.6	25.1	42.8	92.9
PCB#82 (CL5)	7.0	3.6	5.1	4.6	10.7
PCB#151 (CL6)	9.9	5.3	6.5	7.4	38.7
PCB#107/108/144(CL5/	8.0	4.2	4.6	5.5	30.8
PCB#149 (CL6)	27.8	15.2	14.1	21.7	87.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1620P	Q1612P	Q1658P	Q1613P	Q1655P
STATION	OWSC-3 (ppb)	AR-1 (ppb)	AR-2 (ppb)	AR-3 (ppb)	AR-4 (ppb)
PCB#118/108/149(CL5/	33.0	25.3	18.6	27.1	87.2
PCB#188 (CL7)	0.0	0.0	0.0	0.8	0.0
PCB#146 (CL6)	4.8	3.9	3.4	4.9	34.3
PCB#153 (CL6)	55.0	29.9	23.3	43.7	133.0
PCB#105 (CL5)	18.6	12.3	13.2	15.1	72.3
PCB#141 (CL6)	18.6	8.8	6.2	16.1	31.0
PCB#137 (CL6)	1.3	0.0	0.0	1.6	0.0
PCB#? (CL6)	1.5	0.0	2.2	1.5	5.0
PCB#138 (CL6)	63.4	40.2	26.3	54.3	137.1
PCB#158 (CL7)	1.9	1.2	2.1	1.7	10.0
PCB#129 (CL6)	3.3	2.6	0.0	1.8	2.7
PCB#126 (CL5)	0.0	0.0	0.0	0.0	14.3
PCB#178 (CL7)	1.0	1.6	0.0	1.3	0.0
PCB#187/182/159(CL7/	9.4	21.6	15.7	8.9	62.3
PCB#183 (CL7)	4.5	2.2	3.8	3.6	23.6
PCB#128 (CL6)	9.6	6.2	3.7	8.5	13.5
PCB#167 (CL6)	0.0	4.2	0.0	1.8	0.0
PCB#185 (CL7)	3.4	0.0	0.0	2.7	6.4
PCB#174 (CL7)	8.9	5.0	6.4	7.7	37.3
PCB#177 (CL7)	3.3	1.7	11.3	3.3	27.4
PCB#156/171/202(CL6/	9.8	3.8	7.9	3.4	14.8
PCB#200 (CL8)	0.4	0.0	4.5	0.0	0.0
PCB#172 (CL7)	0.0	1.6	4.4	1.1	0.0
PCB#180 (CL7)	26.1	16.5	20.4	25.0	108.6
PCB#191 (CL7)	0.7	0.3	1.3	0.5	4.7
PCB#170 (CL7)	0.0	0.0	0.0	0.0	81.5
PCB#201 (CL8)	9.7	1.6	5.0	3.4	25.0
PCB#196 (CL8)	8.8	2.8	4.3	5.3	30.6
PCB#189 (CL7)	0.4	0.1	0.0	0.0	2.0
PCB#195 (CL8)	2.2	0.4	0.0	0.0	10.9
PCB#194 (CL8)	0.0	4.7	15.9	6.1	33.3
PCB#205 (CL9)	0.0	0.0	0.2	0.0	2.3
PCB#206 (CL9)	9.6	0.0	0.0	1.8	8.8
PCB#209 (CL10)	0.0	0.0	0.0	0.0	0.0

LABNAME: GERG/TAMU　　DATE: 06-Mar-92　　LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	AR-5A	AR-5B	AR-5C	AR-6 CLAM	AR-6
LABSAMNO:	RQ1614	RQ1615	RQ1656	RQ1672	RQ1616
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1614	>Q1615	>Q1656	>Q1672	>Q1616
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M403	M403	M407	M408	M403
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	TISSUE	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	24.83	26.71	30.20	1.46	10.12
DRYWT:	10.13	9.99	10.57	0.22	10.12
VOL:					
ACEND10:	77.2	116.4	70.3	58.8	67.4
BENAD12:					
CHRYD12:	148.0	167.4	120.0	54.7	141.6
FLUOD10:					
NAPHD8:	74.3	80.4	70.7	57.4	71.8
PERYD12:	54.5	53.7	64.3	45.1	69.9
PHEND10:	80.0	91.0	81.2	56.5	94.7
C12ALKD:	131.3 M	105.2	104.0	80.5	69.3
C20ALKD:	205.5 M	145.7 M	231.1 M	77.1	77.8
C24ALKD:	272.9 M	157.5 M	344.6 M	83.2	99.0
C30ALKD:	130.9 M	98.9	178.0 M	81.7	153.5 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	AR-5A	AR-5B	AR-5C	AR-6 CLAM	AR-6
LABSAMNO:	RQ1614	RQ1615	RQ1656	RQ1672	RQ1616
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	78.37	57.00	118.16	0.00	44.83
C11	179.59	136.47	283.44	0.00	84.50
C12	193.82	138.60	310.72	246.58	69.82
C13	191.82	127.66	276.45	0.00	54.91
C14	231.71	147.13	336.65	87.86	61.27
C15	455.59	345.01	592.13	211.40	128.67
C16	332.32	203.28	380.85	110.12	121.77
C17	772.71	629.92	807.34	2163.60	334.20
PRISTANE	1987.16	1268.44	1549.74	1028.40	450.90
C18	917.35	690.54	811.50	151.30	439.00
PHYTANE	1747.80	1234.64	1390.03	685.60	454.40
C19	450.77	312.27	543.85	162.10	220.00
C20	319.28	227.31	409.33	235.10	118.00
C21	384.20	290.85	419.74	167.50	192.40
C22	128.41	165.53	202.70	175.70	106.60
C23	366.23	262.80	462.72	269.06	199.06
C24	1.08	55.22	197.99	329.17	30.70
C25	1002.50	775.10	1162.01	491.47	605.03
C26	48.53	31.97	350.13	335.22	165.97
C27	695.58	542.89	870.59	309.56	875.15
C28	27.39	18.05	369.30	306.24	219.28
C29	384.13	361.77	563.65	700.21	871.27
C30	15.82	25.99	35.60	167.10	23.83
C31	116.04	162.05	158.40	568.80	307.80
C32	27.52	19.74	28.12	230.80	20.32
C33	53.89	39.98	66.04	106.70	47.78
C34	1.61	0.82	1.55	0.00	2.09
TOT ALKANES	11111.2	8271.0	12698.8	9239.6	6249.5
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	905.4	616.8	828.8	222.0	350.4
Surrogate Recoveries					
C12ALKD:	131.3 M	105.2	104.0	80.5	69.3
C20ALKD:	205.5 M	145.7 M	231.1 M	77.1	77.8
C24ALKD:	272.9 M	157.5 M	344.6 M	83.2	99.0
C30ALKD:	130.9 M	98.9	178.0 M	81.7	153.5 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	AR-5A	AR-5B	AR-5C	AR-6 CLAM	AR-6
LABSAMNO:	>Q1614	>Q1615	>Q1656	>Q1672	>Q1616
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	38.81	37.75	78.11	38.97	31.71
C1-NAPHTHALENES	74.09	65.63	114.75	42.21	57.31
C2-NAPHTHALENES	123.88	116.19	181.42	68.75	86.76
C3-NAPHTHALENES	188.89	155.12	265.11	168.85	115.57
C4-NAPHTHALENES	207.67	178.33	272.73	312.16	130.98
BIPHENYL	13.96	9.04	21.44	7.90	12.05
ACENAPHTHYLENE	27.65	19.96	45.63	19.58	21.08
ACENAPHTHENE	20.16	13.20	26.74	10.72	14.91
FLUORENE	37.89	24.66	47.35	5.77	30.99
C1-FLUORENES	58.55	37.81	76.09	60.47	43.48
C2-FLUORENES	149.61	111.19	196.80	197.45	119.14
C3-FLUORENES	330.35	222.43	372.81	670.80	247.96
PHENANTHRENE	339.83	295.40	357.73	36.75	189.03
ANTHRACENE	65.01	61.73	60.29	34.67	34.66
C1-PHEN_ANTHR	266.75	236.11	300.87	108.77	147.65
C2-PHEN_ANTHR	421.13	368.46	424.30	373.45	207.99
C3-PHEN_ANTHR	493.01	411.61	399.93	541.72	214.79
C4-PHEN_ANTHR	466.06	415.41	297.26	515.71	166.03
DIBENZOTHIO	19.88	17.79	23.58	7.69	11.96
C1-DIBEN	42.93	39.48	46.77	28.88	23.42
C2-DIBEN	127.52	108.44	113.96	151.18	55.04
C3-DIBEN	216.09	184.29	167.85	229.25	95.39
FLUORANTHENE	896.10	830.76	852.91	252.49	482.26
PYRENE	895.78	809.09	853.88	423.77	478.27
C1-FLUORAN_PYR	606.37	539.69	485.70	449.14	302.19
BENaANTHRACENE	237.50	223.36	251.62	109.60	169.28
CHRYSENE	408.63	378.68	416.14	372.97	252.53
C1-CHRYSENES	218.67	196.29	210.13	173.45	155.51
C2-CHRYSENES	169.53	156.91	160.70	138.63	104.94
C3-CHRYSENES	95.94	85.08	64.45	62.66	49.17
C4-CHRYSENES	106.25	92.61	96.88	79.39	56.34
BENbFLUORAN	539.50	542.12	642.45	165.61	303.83
BENkFLUORAN	283.78	245.67	204.30	48.51	227.80
BENePYRENE	332.19	317.10	359.71	247.52	213.27
BENaPYRENE	304.73	278.71	301.84	43.80	212.37
PERYLENE	237.26	230.94	196.57	41.70	138.56
I123cdPYRENE	353.90	325.49	523.25	36.65	219.70
DBahANTHRA	82.75	67.37	124.92	21.32	42.27
BghiPERYLENE	328.68	310.64	448.28	59.46	214.64

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	AR-5A	AR-5B	AR-5C	AR-6 CLAM	AR-6
LABSAMNO:	>Q1614	>Q1615	>Q1656	>Q1672	>Q1616
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	49.88	43.89	76.37	25.15	38.24
1-METHYLNAPH	24.21	21.74	38.38	17.06	19.07
2,6-DIMETHNAPH	53.07	31.46	71.39	17.21	35.47
2,3,5-TRIMETHNAPH	29.92	19.79	48.49	13.12	22.00
1-METHYLPHEN	48.30	39.83	34.67	23.58	29.26
Surrogate Recoveries					
NAPHD8:	74.3	80.4	70.7	57.4	71.8
ACEND10:	77.2	116.4	70.3	58.8	67.4
PHEND10:	80.0	91.0	81.2	56.5	94.7
CHRYD12:	148.0	167.4	120.0	54.7	141.6
PERYD12:	54.5	53.7	64.3	45.1	69.9

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1614P	Q1615P	Q1656P	Q1672P	Q1616P
				CLAM	
STATION	AR-5A	AR-5B	AR-5C	AR-6	AR-6
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.28	0.00	0.68	0.34	0.36
TOTAL CHLORDANES	65.44	60.13	47.57	37.53	27.63
TOTAL DDT'S	60.32	62.03	44.03	27.01	28.65
TOTAL PCB'S	512.3	496.4	448.9	311.9	218.4
TOXAPHENE					
TOTAL CL2	3.8	4.2	3.7	0.7	2.3
TOTAL CL3	11.9	17.0	19.9	9.6	5.5
TOTAL CL4	84.6	96.7	57.7	74.1	36.2
TOTAL CL5	186.1	180.3	111.2	102.6	98.8
TOTAL CL6	158.9	139.6	109.2	102.3	51.6
TOTAL CL7	60.1	52.9	126.4	26.9	20.5
TOTAL CL8	10.6	9.3	29.3	4.8	5.5
TOTAL CL9	1.5	1.5	2.8	0.3	0.6
TOTAL CL10	0.0	0.0	0.0	0.0	0.0
ALPHA-BHC	0.00	0.00	0.00	0.00	0.05
HCB	0.00	0.00	0.00	0.00	0.00
BETA-BHC	0.00	0.00	0.00	0.00	0.00
GAMMA-BHC	0.28	0.00	0.00	0.34	0.31
DELTA-BHC	0.00	0.00	0.68	0.00	0.00
HEPTACHLOR	0.16	0.00	0.00	0.00	0.08
HEPTA-EPOXIDE	0.00	0.00	0.00	0.70	0.00
OXYCHLORDANE	0.00	0.00	0.00	0.75	0.00
GAMMA-CHLORDANE	26.07	24.50	17.35	10.67	10.92
ALPHA-CHLORDANE	21.31	19.37	15.51	12.70	9.17
TRANS-NONACHLOR	12.33	11.56	9.61	8.73	5.29
CIS-NONACHLOR	5.56	4.70	5.10	3.97	2.16
ALDRIN	5.53	5.24	5.43	0.00	3.21
DIELDRIN	5.56	5.26	2.10	3.39	1.90
ENDRIN	1.19	1.13	0.00	0.33	0.55
MIREX	0.86	0.74	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	0.86	0.72	0.00	0.00	0.41
4,4'DDE (P,P'DDE)	29.13	27.74	21.75	14.02	13.46
2,4'DDD (O,P'DDD)	3.95	3.70	2.77	1.81	1.90
4,4'DDD (P,P'DDD)	20.34	18.83	13.06	10.51	7.79
2,4'DDT (O,P'DDT)	1.01	1.33	2.04	0.00	1.29
4,4'DDT (P,P'DDT)	5.03	9.71	4.41	0.68	3.81

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1614P	Q1615P	Q1656P	Q1672P CLAM	Q1616P
STATION	AR-5A (ppb)	AR-5B (ppb)	AR-5C (ppb)	AR-6 (ppb)	AR-6 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.9	1.1	0.0	0.0	0.6
PCB#18 (CL3)	0.9	1.1	1.4	1.4	0.4
PCB#15 (CL2)	2.9	3.1	3.7	0.7	1.7
PCB#24 (CL3)	0.0	0.0	0.0	0.5	0.0
PCB#16/32 (CL3)	1.3	6.0	3.2	0.0	0.0
PCB#29 (CL3)	0.0	0.0	0.0	0.0	0.8
PCB#26 (CL3)	0.0	0.0	2.6	0.0	0.0
PCB#25 (CL3)	0.0	0.0	5.2	5.6	0.0
PCB#50 (CL4)	0.0	0.0	3.8	8.0	0.0
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	7.2	7.2	6.2	2.1	3.1
PCB#33 (CL3)	1.4	1.8	1.3	0.0	0.8
PCB#22 (CL3)	1.1	0.9	0.0	0.0	0.4
PCB#45 (CL4)	0.3	0.0	0.5	0.0	0.1
PCB#46 (CL4)	0.5	0.9	0.1	0.0	0.2
PCB#52 (CL4)	27.2	35.4	8.6	20.9	14.0
PCB#49 (CL4)	6.0	6.3	5.7	3.6	2.6
PCB#47/48 (CL4)	4.3	6.1	3.2	3.1	2.0
PCB#44 (CL4)	10.0	12.2	5.5	15.5	4.6
PCB#37/42 (CL4)	4.2	3.4	3.5	0.0	1.9
PCB#41/64 (CL4)	0.0	0.0	4.6	3.1	0.0
PCB#40 (CL4)	0.0	0.0	0.0	0.0	0.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	6.7	7.3	3.9	4.6	3.0
PCB#70 (CL4)	12.4	12.6	9.5	11.0	4.0
PCB#66 (CL4)	13.1	12.7	8.7	4.4	3.9
PCB#88 (CL5)	14.6	11.6	4.6	7.0	4.5
PCB#60/56 (CL5)	27.9	36.2	3.9	6.0	15.7
PCB#92? (CL5)	6.5	6.0	6.4	3.2	2.3
PCB#84? (CL5)	22.2	20.2	4.7	15.5	9.4
PCB#101 (CL5)	18.3	18.1	17.5	12.9	7.3
PCB#99 (CL5)	0.0	0.0	6.5	5.3	25.1
PCB#83 (CL5)	3.3	0.0	0.0	0.0	0.7
PCB#97 (CL5)	6.0	5.9	4.2	4.2	2.2
PCB#87 (CL5)	10.9	10.4	6.3	4.7	3.7
PCB#85 (CL5)	2.2	3.2	0.0	0.0	1.0
PCB#136 (CL6)	1.5	2.9	2.4	0.0	0.9
PCB#110/77 (CL5/4)	30.2	26.5	19.7	14.8	11.1
PCB#82 (CL5)	4.8	4.4	2.9	1.6	1.8
PCB#151 (CL6)	8.1	7.3	7.4	6.6	2.9
PCB#107/108/144(CL5/	6.7	6.1	4.8	3.8	2.3
PCB#149 (CL6)	21.3	18.7	17.0	12.4	7.4

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1614P	Q1615P	Q1656P	Q1672P	Q1616P
				CLAM	
STATION	AR-5A	AR-5B	AR-5C	AR-6	AR-6
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	21.0	19.4	16.7	16.8	7.1
PCB#188 (CL7)	0.3	1.0	0.0	0.0	0.3
PCB#146 (CL6)	4.9	4.8	5.0	3.6	1.6
PCB#153 (CL6)	41.1	37.7	28.1	37.4	13.6
PCB#105 (CL5)	11.5	12.2	13.1	6.7	4.6
PCB#141 (CL6)	15.0	13.0	6.7	4.4	4.5
PCB#137 (CL6)	1.6	1.0	0.0	0.7	0.6
PCB#? (CL6)	2.1	2.2	0.0	0.9	0.7
PCB#138 (CL6)	48.1	43.2	30.7	29.4	15.5
PCB#158 (CL7)	1.6	1.4	2.5	1.2	0.5
PCB#129 (CL6)	0.0	0.0	0.6	0.0	0.0
PCB#126 (CL5)	2.4	2.2	1.4	0.0	0.9
PCB#178 (CL7)	1.0	1.1	0.4	0.6	0.4
PCB#187/182/159(CL7/	8.1	7.1	15.4	3.8	2.6
PCB#183 (CL7)	4.1	3.1	5.4	2.4	1.3
PCB#128 (CL6)	6.6	5.0	3.6	3.0	2.0
PCB#167 (CL6)	1.2	1.3	2.3	1.5	0.5
PCB#185 (CL7)	2.4	2.1	0.0	0.6	1.0
PCB#174 (CL7)	7.5	6.4	8.8	1.5	2.4
PCB#177 (CL7)	3.1	2.4	10.2	2.0	1.3
PCB#156/171/202(CL6/	7.4	2.5	5.6	2.3	1.3
PCB#200 (CL8)	0.5	0.2	0.0	0.0	0.3
PCB#172 (CL7)	0.0	0.0	3.3	0.0	0.2
PCB#180 (CL7)	23.6	21.2	24.6	10.3	7.8
PCB#191 (CL7)	0.7	0.6	0.0	0.5	0.3
PCB#170 (CL7)	0.0	0.0	46.9	2.7	0.0
PCB#201 (CL8)	4.0	3.7	7.3	0.7	1.5
PCB#196 (CL8)	5.0	4.5	8.1	2.9	1.8
PCB#189 (CL7)	0.0	0.0	0.0	0.0	0.1
PCB#195 (CL8)	1.1	1.0	2.6	0.9	0.5
PCB#194 (CL8)	0.0	0.0	11.2	0.3	1.4
PCB#205 (CL9)	0.0	0.0	0.2	0.0	0.0
PCB#206 (CL9)	1.5	1.5	2.6	0.3	0.6
PCB#209 (CL10)	0.0	0.0	0.0	0.0	0.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	OAR-1	OAR-2	OAR-3	OAR-4	OAR-6 CLAM
LABSAMNO:	RQ1661	RQ1617	RQ1618	RQ1659	RQ1673
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1661	>Q1617	>Q1618	>Q1659	>Q1673
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M407	M403	M403	M407	M408
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	TISSUE
SUBMAT:					
SAMPLWT:					
WETWT:	22.67	11.79	15.02	25.83	1.34
DRYWT:	9.86	4.62	9.99	10.15	0.20
VOL:					
ACEND10:	77.5	145.1	52.8	84.0	27.6
BENAD12:					
CHRYD12:	135.5	115.2	18.0	136.2	27.7
FLUOD10:					
NAPHD8:	77.2	65.5	23.9	90.9	29.4
PERYD12:	95.0	66.5	29.8	104.2	20.1
PHEND10:	93.1	80.6	13.5	83.7	31.5
C12ALKD:	104.4	67.0	42.2	104.3	82.2
C20ALKD:	395.3 M	132.4 M	151.4 M	305.2 M	78.0
C24ALKD:	365.6 M	119.6	113.9	632.6 M	86.1
C30ALKD:	152.3 M	114.7	48.7	123.3	86.7
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:															
ID:	OAR-1			OAR-2			OAR-3			OAR-4			OAR-6 CLAM		
LABSAMNO:	RQ1661			RQ1617			RQ1618			RQ1659			RQ1673		
Alkanes and Isoprenoids	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
UNIT:	ng/g			ng/g			ng/g			ng/g			ng/g		
C10	65.56			118.89			183.91			83.08			0.00		
C11	149.24			296.35			812.32			196.82			0.00		
C12	170.84			407.91			1273.50			284.96			167.72		
C13	201.30			490.76			1468.93			310.57			0.00		
C14	376.00			1030.66			1404.23			495.18			0.00		
C15	821.80			1563.81			1584.89			840.29			0.00		
C16	871.16			1262.65			1288.86			669.97			29.20		
C17	1016.30			923.64			1039.64			857.05			1513.70		
PRISTANE	6540.14			2139.62			1498.59			3122.37			538.20		
C18	1671.30			1383.47			831.44			798.45			102.30		
PHYTANE	4511.10			1686.80			925.02			2603.20			355.90		
C19	676.35			562.44			512.40			611.05			130.60		
C20	548.27			569.20			475.45			500.56			201.60		
C21	505.58			409.26			360.07			461.18			176.30		
C22	401.22			253.55			171.86			156.27			208.30		
C23	698.41			965.88			168.81			469.09			295.05		
C24	738.24			290.92			158.48			73.05			284.45		
C25	2483.64			2273.68			461.14			1256.67			518.80		
C26	1018.35			252.28			119.38			425.19			398.62		
C27	1092.22			1955.66			29.09			757.46			411.31		
C28	509.59			170.69			23.37			12.18			282.93		
C29	722.06			1526.86			29.73			294.46			569.20		
C30	29.12			53.35			2.70			30.32			116.93		
C31	230.32			824.64			12.17			125.71			546.95		
C32	43.68			43.30			11.15			36.79			251.14		
C33	86.92			87.78			0.68			65.07			0.00		
C34	22.06			7.54			1.35			1.02			0.00		
TOT ALKANES	26200.8			21551.6			14849.2			15538.0			7099.2		
UNIT:	ug/g			ug/g			ug/g			ug/g			ug/g		
UCM	1457.8			876.1			393.5			1191.6			112.4		
Surrogate Recoveries															
C12ALKD:	104.4			67.0			42.2			104.3			82.2		
C20ALKD:	395.3	M		132.4	M		151.4	M		305.2	M		78.0		
C24ALKD:	365.6	M		119.6			113.9			632.6	M		86.1		
C30ALKD:	152.3	M		114.7			48.7			123.3			86.7		

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	OAR-1	OAR-2	OAR-3	OAR-4	OAR-6 CLAM
LABSAMNO:	>Q1661	>Q1617	>Q1618	>Q1659	>Q1673
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	82.56	87.57	82.39	76.60	50.40
C1-NAPHTHALENES	283.55	143.50	331.77	120.83	67.98
C2-NAPHTHALENES	815.18	301.68	777.11	229.10	139.79
C3-NAPHTHALENES	1388.96	615.89	1105.66	440.34	293.52
C4-NAPHTHALENES	1539.83	1232.69	803.92	229.10	457.28
BIPHENYL	25.82	10.92	15.90	26.94	26.85
ACENAPHTHYLENE	54.22	27.29	7.39	61.86	30.38
ACENAPHTHENE	63.83	48.96	42.51	58.95	15.08
FLUORENE	130.65	75.26	59.33	86.16	19.46
C1-FLUORENES	275.74	69.07	73.89	114.45	82.41
C2-FLUORENES	723.10	182.57	138.80	305.03	351.67
C3-FLUORENES	1008.23	395.30	183.40	685.24	718.14
PHENANTHRENE	953.71	1333.96	1911.09	931.75	73.10
ANTHRACENE	104.79	242.73	300.59	137.78	44.85
C1-PHEN_ANTHR	899.53	776.64	1156.91	603.77	159.88
C2-PHEN_ANTHR	1421.35	1009.24	1239.86	900.00	432.31
C3-PHEN_ANTHR	498.70	1047.26	666.21	841.46	550.50
C4-PHEN_ANTHR	133.58	688.28	362.93	523.70	402.62
DIBENZOTHIO	71.64	67.93	116.59	53.78	14.63
C1-DIBEN	162.49	110.72	162.77	97.19	41.84
C2-DIBEN	418.64	302.36	322.98	264.74	120.42
C3-DIBEN	498.54	439.28	306.93	396.05	167.99
FLUORANTHENE	2116.89	3055.52	2833.83	2056.10	450.21
PYRENE	1911.41	2371.11	2374.60	1889.20	645.96
C1-FLUORAN_PYR	1049.33	1625.16	1183.47	1038.39	515.32
BENaANTHRACENE	538.16	1202.62	965.53	500.58	128.77
CHRYSENE	900.35	1478.21	967.11	805.26	456.95
C1-CHRYSENES	356.12	776.07	437.48	387.43	159.49
C2-CHRYSENES	242.98	479.58	231.40	301.13	104.64
C3-CHRYSENES	117.46	194.65	76.92	151.64	59.25
C4-CHRYSENES	159.26	340.83	163.38	173.88	95.20
BENbFLUORAN	1082.55	1554.28	970.17	774.84	114.46
BENkFLUORAN	476.90	1287.02	640.20	697.87	51.01
BENePYRENE	628.42	1092.29	619.25	615.98	258.74
BENaPYRENE	600.29	1169.98	801.49	569.45	35.19
PERYLENE	185.68	355.60	126.47	177.67	53.46
I123cdPYRENE	858.88	1117.61	496.23	841.73	23.59
DBahANTHRA	213.44	252.45	135.15	205.85	20.30
BghiPERYLENE	714.91	1022.82	418.83	690.95	42.64

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	OAR-1	OAR-2	OAR-3	OAR-4	OAR-6 CLAM
LABSAMNO:	>Q1661	>Q1617	>Q1618	>Q1659	>Q1673
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	176.85	92.32	194.96	78.35	40.18
1-METHYLNAPH	106.70	51.18	136.81	42.48	27.80
2,6-DIMETHNAPH	288.31	47.80	124.31	97.01	32.70
2,3,5-TRIMETHNAPH	264.50	44.55	88.13	80.22	35.31
1-METHYLPHEN	128.17	158.82	254.19	123.60	42.79
Surrogate Recoveries					
NAPHD8:	77.2	65.5	23.9	90.9	29.4
ACEND10:	77.5	145.1	52.8	84.0	27.6
PHEND10:	93.1	80.6	13.5	83.7	31.5
CHRYD12:	135.5	115.2	18.0	136.2	27.7
PERYD12:	95.0	66.5	29.8	104.2	20.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1661P	Q1617P	Q1618P	Q1659P	Q1673P
					CLAM
STATION	OAR-1	OAR-2	OAR-3	OAR-4	OAR-6
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.00	14.18	0.76	0.00	0.40
TOTAL CHLORDANES	115.75	117.17	33.34	93.31	39.87
TOTAL DDT'S	105.13	101.39	43.78	261.22	57.18
TOTAL PCB'S	383.1	1270.7	841.2	475.0	521.1
TOXAPHENE					
TOTAL CL2	5.9	7.3	14.8	4.3	5.2
TOTAL CL3	37.1	47.1	58.0	27.1	27.8
TOTAL CL4	69.9	312.9	362.7	63.5	171.4
TOTAL CL5	127.2	351.6	258.9	131.9	164.4
TOTAL CL6	87.5	399.3	107.5	124.6	130.0
TOTAL CL7	57.1	142.8	34.1	96.2	32.5
TOTAL CL8	9.4	23.2	10.5	37.3	5.5
TOTAL CL9	0.0	3.1	0.8	3.5	0.4
TOTAL CL10	0.0	0.0	0.0	0.0	0.0
ALPHA-BHC	0.00	0.30	0.56	0.00	0.00
HCB	0.00	0.00	0.00	0.00	0.00
BETA-BHC	0.00	13.88	0.00	0.00	0.00
GAMMA-BHC	0.00	0.00	0.20	0.00	0.40
DELTA-BHC	0.00	0.00	0.00	0.00	0.00
HEPTACHLOR	0.00	0.00	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.00	0.00	0.63
OXYCHLORDANE	0.00	0.00	0.00	0.00	1.40
GAMMA-CHLORDANE	47.85	46.86	14.57	34.60	10.91
ALPHA-CHLORDANE	41.58	38.80	10.87	30.11	13.66
TRANS-NONACHLOR	26.31	22.21	5.68	19.41	9.42
CIS-NONACHLOR	0.00	9.29	2.22	9.19	3.86
ALDRIN	6.99	16.91	11.97	14.15	0.00
DIELDRIN	4.50	10.79	2.50	4.93	4.99
ENDRIN	0.00	2.75	0.57	0.00	0.00
MIREX	0.00	0.00	0.00	2.10	0.00
2,4'DDE (O,P'DDE)	0.00	1.13	0.73	0.00	1.05
4,4'DDE (P,P'DDE)	29.36	37.81	14.42	29.50	17.81
2,4'DDD (O,P'DDD)	5.30	10.15	4.36	11.21	6.08
4,4'DDD (P,P'DDD)	47.17	40.95	19.32	118.00	29.51
2,4'DDT (O,P'DDT)	4.41	5.04	0.99	0.00	0.60
4,4'DDT (P,P'DDT)	18.89	6.31	3.97	102.51	2.13

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1661P	Q1617P	Q1618P	Q1659P	Q1673P CLAM
STATION	OAR-1 (ppb)	OAR-2 (ppb)	OAR-3 (ppb)	OAR-4 (ppb)	OAR-6 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.0	5.7	4.3	0.0	0.0
PCB#18 (CL3)	2.5	4.8	2.5	1.9	3.8
PCB#15 (CL2)	5.9	1.6	10.5	4.3	5.2
PCB#24 (CL3)	0.0	0.0	1.4	0.0	1.2
PCB#16/32 (CL3)	6.5	11.7	5.7	4.6	6.0
PCB#29 (CL3)	0.0	0.0	2.4	0.0	0.0
PCB#26 (CL3)	4.5	0.0	0.0	2.9	0.0
PCB#25 (CL3)	12.5	16.3	5.4	9.4	6.7
PCB#50 (CL4)	5.0	0.0	0.0	3.5	14.2
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	8.5	13.4	28.8	6.8	7.1
PCB#33 (CL3)	2.5	0.0	3.3	1.5	0.0
PCB#22 (CL3)	0.0	1.0	8.6	0.0	3.0
PCB#45 (CL4)	0.0	0.0	3.7	0.0	1.2
PCB#46 (CL4)	0.0	0.0	3.6	0.0	0.0
PCB#52 (CL4)	9.4	169.6	80.6	8.9	30.5
PCB#49 (CL4)	6.3	25.1	36.0	6.1	9.8
PCB#47/48 (CL4)	2.9	15.4	27.7	3.1	8.2
PCB#44 (CL4)	11.3	58.3	48.8	8.7	36.2
PCB#37/42 (CL4)	3.9	0.0	31.4	4.3	14.0
PCB#41/64 (CL4)	5.3	0.0	0.0	5.3	9.6
PCB#40 (CL4)	1.6	0.0	13.0	0.0	2.7
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	5.0	12.3	23.4	5.0	8.8
PCB#70 (CL4)	9.5	16.9	54.2	9.0	21.0
PCB#66 (CL4)	9.7	15.3	40.5	9.6	15.3
PCB#88 (CL5)	0.0	25.7	10.6	7.9	8.2
PCB#60/56 (CL5)	5.5	16.0	53.7	4.6	15.5
PCB#92? (CL5)	5.8	26.0	7.4	8.6	3.2
PCB#84? (CL5)	18.4	43.9	16.4	14.4	19.3
PCB#101 (CL5)	15.3	50.5	20.8	17.9	20.2
PCB#99 (CL5)	5.5	25.1	10.9	6.8	8.7
PCB#83 (CL5)	0.0	0.0	4.7	0.0	0.0
PCB#97 (CL5)	4.0	6.9	8.1	0.0	8.5
PCB#87 (CL5)	8.5	14.6	16.0	7.8	8.9
PCB#85 (CL5)	0.0	4.5	5.4	0.0	2.6
PCB#136 (CL6)	2.8	1.8	1.6	3.3	0.0
PCB#110/77 (CL5/4)	25.8	61.2	43.7	24.3	25.2
PCB#82 (CL5)	5.1	6.5	7.0	3.3	2.4
PCB#151 (CL6)	5.8	27.0	4.5	9.4	8.3
PCB#107/108/144(CL5/	6.8	23.2	2.8	5.8	5.2
PCB#149 (CL6)	14.4	65.3	11.7	19.2	16.9

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1661P	Q1617P	Q1618P	Q1659P	Q1673P
					CLAM
STATION	OAR-1	OAR-2	OAR-3	OAR-4	OAR-6
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	16.5	34.3	26.6	16.0	25.4
PCB#188 (CL7)	0.0	0.0	0.0	0.0	0.0
PCB#146 (CL6)	3.7	30.3	4.4	5.9	4.7
PCB#153 (CL6)	19.9	102.3	25.1	31.1	46.5
PCB#105 (CL5)	10.0	13.0	25.0	14.6	11.1
PCB#141 (CL6)	6.4	31.6	8.4	9.0	2.7
PCB#137 (CL6)	0.0	1.7	1.5	0.0	0.0
PCB#? (CL6)	0.0	3.1	1.9	0.0	1.6
PCB#138 (CL6)	23.6	103.3	29.5	32.7	40.5
PCB#158 (CL7)	2.1	2.6	0.8	2.2	1.6
PCB#129 (CL6)	0.0	3.7	1.5	0.0	0.0
PCB#126 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#178 (CL7)	0.0	6.9	1.1	0.0	0.8
PCB#187/182/159(CL7/	13.0	26.6	3.7	22.9	4.6
PCB#183 (CL7)	3.3	7.1	2.0	5.7	2.9
PCB#128 (CL6)	3.8	9.3	6.9	4.8	4.3
PCB#167 (CL6)	0.0	4.9	2.3	2.9	1.7
PCB#185 (CL7)	0.0	5.2	2.9	0.0	0.8
PCB#174 (CL7)	5.9	16.7	3.8	9.9	1.8
PCB#177 (CL7)	10.1	11.3	1.4	12.9	2.5
PCB#156/171/202(CL6/	7.0	15.0	8.1	6.3	2.9
PCB#200 (CL8)	0.0	0.0	0.0	0.0	0.0
PCB#172 (CL7)	0.0	0.2	0.0	0.0	0.0
PCB#180 (CL7)	16.8	46.3	13.7	31.0	11.0
PCB#191 (CL7)	0.0	2.2	0.4	1.6	0.5
PCB#170 (CL7)	0.0	0.0	0.0	0.0	4.1
PCB#201 (CL8)	4.1	10.3	2.8	8.2	1.1
PCB#196 (CL8)	3.3	10.2	3.4	8.0	3.4
PCB#189 (CL7)	0.0	1.0	0.4	0.0	0.0
PCB#195 (CL8)	2.0	2.7	0.9	3.1	1.0
PCB#194 (CL8)	0.0	0.0	3.5	18.0	0.0
PCB#205 (CL9)	0.0	0.0	0.0	0.2	0.0
PCB#206 (CL9)	0.0	3.1	0.8	3.3	0.4
PCB#209 (CL10)	0.0	0.0	0.0	0.0	0.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	OAR-6	KL-1	KL-2	KL-3	KL-4
LABSAMNO:	RQ1660	RQ1637	RQ1647	RQ1645	RQ1644
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q1660	>Q1637	>Q1647	>Q1645	>Q1644
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M407	M411	M405	M405	M405
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	19.70	19.39	36.24	32.69	25.69
DRYWT:	10.48	8.53	11.96	11.44	10.66
VOL:					
ACEND10:	87.6	100.3	81.0	44.4	37.4
BENAD12:					
CHRYD12:	91.1	83.0	154.3	15.4	30.2
FLUOD10:					
NAPHD8:	106.1	70.2	69.4	24.5	48.3
PERYD12:	105.4	152.9	62.3	38.7	28.7
PHEND10:	91.9	73.4	108.1	17.9	36.5
C12ALKD:	85.9	152.7 M	65.4	53.9	103.4
C20ALKD:	136.5 M	233.9 M	75.6	50.3	191.9 M
C24ALKD:	97.1	61.7	147.4 M	243.6 M	180.7 M
C30ALKD:	132.7 M	83.9	337.5 M	345.3 M	300.5 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	OAR-6	KL-1	KL-2	KL-3	KL-4
LABSAMNO:	RQ1660	RQ1637	RQ1647	RQ1645	RQ1644
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	158.58	65.95	30.86	29.77	23.12
C11	196.79	174.11	54.99	61.66	51.22
C12	153.78	324.25	167.48	119.74	91.09
C13	151.25	465.04	451.18	146.60	89.10
C14	195.59	484.90	1108.50	256.93	173.61
C15	244.72	1072.02	1417.18	503.30	442.69
C16	252.44	508.17	1001.65	226.30	225.43
C17	324.95	1707.46	868.20	597.60	668.06
PRISTANE	164.59	3371.41	2009.20	3228.40	2173.63
C18	429.50	377.28	196.70	231.70	188.84
PHYTANE	128.29	2503.41	1190.10	2329.90	1361.83
C19	221.23	529.08	257.70	155.50	113.04
C20	139.62	415.87	187.90	128.40	103.63
C21	136.75	395.29	234.30	432.80	284.61
C22	114.37	193.20	121.80	207.30	117.84
C23	171.64	816.46	238.93	275.36	316.84
C24	99.15	303.73	336.64	151.30	192.08
C25	293.42	1636.89	401.59	668.58	938.98
C26	126.37	67.27	36.42	33.17	30.94
C27	482.12	1195.82	380.63	314.31	745.48
C28	195.00	157.24	2.79	35.61	140.32
C29	1046.04	722.11	1618.63	1733.45	2759.12
C30	107.70	1.25	53.09	141.63	477.09
C31	439.63	160.31	1824.44	2144.42	3197.22
C32	43.87	4.05	255.49	408.46	73.45
C33	92.31	16.19	455.01	645.59	868.53
C34	3.81	2.80	21.97	3.84	2.44
TOT ALKANES	6113.5	17671.5	14923.4	15211.6	15850.2
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	116.8	910.6	1000.6	2089.7	1267.8
Surrogate Recoveries					
C12ALKD:	85.9	152.7 M	65.4	53.9	103.4
C20ALKD:	136.5 M	233.9 M	75.6	50.3	191.9 M
C24ALKD:	97.1	61.7	147.4 M	243.6 M	180.7 M
C30ALKD:	132.7 M	83.9	337.5 M	345.3 M	300.5 M

LABNAME: GERG/TAMU

DATE: 06-Mar-92

LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:					
ID:	OAR-6	KL-1	KL-2	KL-3	KL-4
LABSAMNO:	>Q1660	>Q1637	>Q1647	>Q1645	>Q1644
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	308.60	55.11	83.41	25.94	21.22
C1-NAPHTHALENES	490.40	127.04	167.32	53.41	39.67
C2-NAPHTHALENES	654.60	168.25	279.13	126.34	75.81
C3-NAPHTHALENES	645.10	269.55	622.42	245.30	147.36
C4-NAPHTHALENES	468.00	377.05	1100.79	335.38	209.97
BIPHENYL	98.20	10.83	19.66	4.69	10.23
ACENAPHTHYLENE	46.70	34.10	37.94	15.26	14.56
ACENAPHTHENE	384.80	31.49	27.20	16.11	21.33
FLUORENE	563.30	44.39	47.21	16.59	31.27
C1-FLUORENES	338.10	54.97	101.61	25.39	43.01
C2-FLUORENES	505.80	162.20	396.44	89.38	118.06
C3-FLUORENES	474.80	310.42	816.60	194.52	281.43
PHENANTHRENE	3623.00	790.27	354.40	399.49	383.48
ANTHRACENE	807.00	130.61	68.66	65.05	53.55
C1-PHEN_ANTHR	1680.30	457.37	386.43	352.74	267.43
C2-PHEN_ANTHR	1144.90	633.01	728.95	627.70	390.94
C3-PHEN_ANTHR	500.20	775.96	983.89	503.42	329.20
C4-PHEN_ANTHR	298.20	463.22	633.03	315.59	184.54
DIBENZOTHIO	211.00	36.69	30.05	26.78	24.50
C1-DIBEN	164.40	62.89	74.24	67.34	55.61
C2-DIBEN	195.60	210.03	221.43	198.26	130.34
C3-DIBEN	147.60	346.37	388.24	317.86	184.35
FLUORANTHENE	4075.50	1792.70	967.26	1161.47	926.30
PYRENE	3580.70	1581.91	804.31	1107.38	830.72
C1-FLUORAN_PYR	1904.70	850.52	722.38	646.83	426.16
BENaANTHRACENE	1656.90	530.21	386.79	583.16	460.95
CHRYSENE	1940.10	1086.46	574.81	955.90	704.99
C1-CHRYSENES	727.10	360.39	317.10	395.13	274.82
C2-CHRYSENES	307.40	222.43	238.68	252.73	157.12
C3-CHRYSENES	61.90	72.51	99.66	122.34	59.03
C4-CHRYSENES	225.70	83.42	158.94	244.60	191.94
BENbFLUORAN	1513.60	1155.54	528.96	1369.08	834.69
BENkFLUORAN	1367.00	407.87	548.32	477.25	388.74
BENePYRENE	1087.40	704.20	518.19	763.41	490.84
BENaPYRENE	1595.40	686.58	453.17	694.75	529.57
PERYLENE	1127.20	108.62	239.64	74.71	152.67
I123cdPYRENE	890.50	423.72	543.44	625.20	418.88
DBahANTHRA	274.80	110.15	104.30	130.38	74.21
BghiPERYLENE	862.60	349.90	482.34	564.63	372.26

LABNAME: GERG/TAMU   DATE: 06-Mar-92   LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:					
ID:	OAR-6	KL-1	KL-2	KL-3	KL-4
LABSAMNO:	>Q1660	>Q1637	>Q1647	>Q1645	>Q1644
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	307.40	83.52	120.28	32.68	25.78
1-METHYLNAPH	183.00	43.52	47.04	20.73	13.89
2,6-DIMETHNAPH	301.10	56.14	95.88	23.27	34.85
2,3,5-TRIMETHNAPH	176.30	57.69	88.15	17.72	34.08
1-METHYLPHEN	550.60	97.73	79.76	64.58	63.02
Surrogate Recoveries					
NAPHD8:	106.1	70.2	69.4	24.5	48.3
ACEND10:	87.6	100.3	81.0	44.4	37.4
PHEND10:	91.9	73.4	108.1	17.9	36.5
CHRYD12:	91.1	83.0	154.3	15.4	30.2
PERYD12:	105.4	152.9	62.3	38.7	28.7

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1660P	Q1637P	Q1647P	Q1645P	Q1644P
STATION	OAR-6 (ppb)	KL-1 (ppb)	KL-2 (ppb)	KL-3 (ppb)	KL-4 (ppb)
TOTAL BHC'S	1.88	0.24	0.00	0.07	1.81
TOTAL CHLORDANES	37.66	95.53	107.59	119.83	153.32
TOTAL DDT'S	324.37	35.99	64.96	60.69	76.38
TOTAL PCB'S	344.0	653.8	529.8	454.9	514.6
TOXAPHENE					
TOTAL CL2	16.1	14.2	6.2	6.3	10.5
TOTAL CL3	41.7	60.2	38.7	39.9	58.0
TOTAL CL4	69.1	278.1	129.3	100.1	107.4
TOTAL CL5	90.3	171.8	150.8	129.2	155.4
TOTAL CL6	51.6	76.9	122.5	99.1	98.4
TOTAL CL7	69.4	60.1	80.0	76.1	92.5
TOTAL CL8	14.1	6.1	18.2	13.9	9.9
TOTAL CL9	0.7	1.1	1.9	1.4	0.0
TOTAL CL10	0.0	0.0	0.0	0.0	0.0
ALPHA-BHC	0.00	0.00	0.00	0.00	0.00
HCB	0.00	3.38	0.00	0.00	0.00
BETA-BHC	0.00	0.15	0.00	0.00	0.00
GAMMA-BHC	1.00	0.09	0.00	0.00	1.81
DELTA-BHC	0.88	0.00	0.00	0.07	0.00
HEPTACHLOR	0.00	0.22	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.00	0.00	0.00
OXYCHLORDANE	0.00	0.00	0.00	0.00	0.00
GAMMA-CHLORDANE	14.35	36.80	39.49	44.29	55.98
ALPHA-CHLORDANE	12.23	31.33	35.72	39.38	50.58
TRANS-NONACHLOR	7.49	19.68	20.95	23.93	33.03
CIS-NONACHLOR	3.59	7.50	11.43	12.23	13.73
ALDRIN	9.91	1.00	11.71	12.08	18.48
DIELDRIN	1.26	3.13	4.35	5.42	5.81
ENDRIN	0.00	0.00	0.00	0.00	0.00
MIREX	0.00	0.00	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	0.00	0.00	0.00	0.00	0.00
4,4'DDE (P,P'DDE)	26.05	16.89	38.28	30.74	40.67
2,4'DDD (O,P'DDD)	37.26	2.30	3.35	3.25	2.65
4,4'DDD (P,P'DDD)	171.23	13.81	23.33	21.20	27.69
2,4'DDT (O,P'DDT)	3.48	0.00	0.00	0.00	0.00
4,4'DDT (P,P'DDT)	86.35	2.99	0.00	5.50	5.37

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1660P	Q1637P	Q1647P	Q1645P	Q1644P
STATION	OAR-6 (ppb)	KL-1 (ppb)	KL-2 (ppb)	KL-3 (ppb)	KL-4 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	7.7	4.4	0.0	0.0	1.5
PCB#18 (CL3)	2.1	5.1	3.0	3.0	4.2
PCB#15 (CL2)	8.4	9.9	6.2	6.3	9.0
PCB#24 (CL3)	0.7	1.1	0.0	0.5	0.0
PCB#16/32 (CL3)	8.6	10.0	6.3	5.8	8.2
PCB#29 (CL3)	0.0	0.4	0.0	0.0	0.0
PCB#26 (CL3)	5.8	1.7	4.6	4.7	5.8
PCB#25 (CL3)	5.3	15.2	12.0	13.6	21.3
PCB#50 (CL4)	5.4	14.3	9.3	5.5	9.4
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	12.3	16.6	10.7	11.3	15.3
PCB#33 (CL3)	2.8	5.5	2.2	1.1	3.3
PCB#22 (CL3)	4.2	4.6	0.0	0.0	0.0
PCB#45 (CL4)	0.7	2.3	0.0	0.0	0.0
PCB#46 (CL4)	2.3	0.8	0.0	0.0	0.0
PCB#52 (CL4)	11.3	136.5	35.1	14.1	17.8
PCB#49 (CL4)	8.5	12.7	8.6	7.2	8.1
PCB#47/48 (CL4)	5.4	6.3	9.1	8.0	4.0
PCB#44 (CL4)	5.7	24.2	19.1	18.3	14.7
PCB#37/42 (CL4)	4.6	11.4	0.0	10.6	7.4
PCB#41/64 (CL4)	4.4	17.5	0.0	0.0	0.0
PCB#40 (CL4)	0.0	0.0	8.2	4.5	3.5
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	4.0	12.9	6.7	6.4	8.9
PCB#70 (CL4)	8.2	19.9	15.5	14.4	19.3
PCB#66 (CL4)	8.6	19.4	17.8	11.2	14.4
PCB#88 (CL5)	4.2	20.2	0.0	0.0	15.6
PCB#60/56 (CL5)	3.9	18.4	9.7	7.3	9.2
PCB#92? (CL5)	20.3	4.9	10.5	6.1	7.2
PCB#84? (CL5)	2.8	36.8	20.3	22.5	27.3
PCB#101 (CL5)	9.5	14.5	20.4	15.8	17.6
PCB#99 (CL5)	4.5	5.7	6.2	4.5	4.1
PCB#83 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#97 (CL5)	2.0	0.0	5.1	3.9	3.2
PCB#87 (CL5)	4.4	8.6	11.0	8.7	9.8
PCB#85 (CL5)	0.0	3.8	0.0	0.0	0.0
PCB#136 (CL6)	2.2	0.0	0.0	0.0	0.0
PCB#110/77 (CL5/4)	13.8	25.5	30.1	26.9	28.3
PCB#82 (CL5)	4.8	3.2	2.8	2.8	2.8
PCB#151 (CL6)	3.7	4.8	5.5	4.8	4.6
PCB#107/108/144(CL5/	3.7	3.2	4.0	3.5	2.4
PCB#149 (CL6)	7.7	10.8	15.2	12.9	13.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1660P	Q1637P	Q1647P	Q1645P	Q1644P
STATION	OAR-6 (ppb)	KL-1 (ppb)	KL-2 (ppb)	KL-3 (ppb)	KL-4 (ppb)
PCB#118/108/149(CL5/	9.4	17.7	22.0	19.2	19.5
PCB#188 (CL7)	0.0	0.0	1.0	0.9	0.2
PCB#146 (CL6)	2.1	3.0	3.6	2.8	1.6
PCB#153 (CL6)	11.4	18.3	35.8	29.1	27.1
PCB#105 (CL5)	7.1	9.3	8.6	8.1	8.4
PCB#141 (CL6)	3.9	6.9	11.1	8.9	6.9
PCB#137 (CL6)	0.0	0.0	0.0	0.0	0.0
PCB#? (CL6)	0.0	0.0	0.0	0.0	0.0
PCB#138 (CL6)	12.7	23.4	37.3	28.6	33.1
PCB#158 (CL7)	0.7	1.0	3.1	2.4	1.0
PCB#129 (CL6)	0.0	1.0	0.0	0.0	0.0
PCB#126 (CL5)	0.0	2.6	0.0	2.3	0.0
PCB#178 (CL7)	1.8	1.1	0.0	0.0	0.0
PCB#187/182/159(CL7/	11.3	2.8	19.0	18.4	29.0
PCB#183 (CL7)	2.2	1.6	4.5	3.9	3.3
PCB#128 (CL6)	2.0	4.6	4.4	3.4	2.9
PCB#167 (CL6)	0.0	1.6	2.3	2.1	1.1
PCB#185 (CL7)	0.0	1.8	0.9	0.0	0.0
PCB#174 (CL7)	3.6	2.7	7.5	7.0	7.8
PCB#177 (CL7)	9.6	1.3	8.9	9.6	13.1
PCB#156/171/202(CL6/	6.0	2.6	7.4	6.5	8.0
PCB#200 (CL8)	0.0	0.0	3.7	3.6	4.1
PCB#172 (CL7)	0.0	0.0	0.0	2.9	0.0
PCB#180 (CL7)	10.5	9.7	26.0	22.9	29.2
PCB#191 (CL7)	0.7	0.3	1.5	1.2	1.0
PCB#170 (CL7)	25.4	35.1	0.0	0.0	0.0
PCB#201 (CL8)	3.3	2.2	6.3	4.5	3.5
PCB#196 (CL8)	3.9	2.7	5.7	3.8	2.2
PCB#189 (CL7)	0.0	0.0	0.0	0.0	0.0
PCB#195 (CL8)	0.0	0.0	2.4	2.0	0.0
PCB#194 (CL8)	7.0	1.1	0.0	0.0	0.0
PCB#205 (CL9)	0.0	0.0	0.0	0.0	0.0
PCB#206 (CL9)	0.7	1.1	1.9	1.4	0.0
PCB#209 (CL10)	0.0	0.0	0.0	0.0	0.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:			
ID:	KL-5	FIELD BLANK1	FIELD BLANK2
LABSAMNO:	RQ1649	RQ1689	RQ1690
METHOD:	GCFID	GCFID	GCFID
LABSAMNO:	>Q1649	>Q1689	>Q1690
METHOD:	GCMS	GCMS	GCMS
QCBATCH:	M405	M410	M410
LAB:	GERG	GERG	GERG
MATRIX:	SEDIMENT	FBLANK	FBLANK
SUBMAT:			
SAMPLWT:			
WETWT:	33.15	10.00	10.00
DRYWT:	11.04	10.00	10.00
VOL:			
ACEND10:	76.9	55.0	56.3
BENAD12:			
CHRYD12:	19.5	46.3	47.3
FLUOD10:			
NAPHD8:	33.1	46.7	57.9
PERYD12:	14.9	62.7	27.1
PHEND10:	34.5	49.0	50.7
C12ALKD:	77.4	66.8	97.6
C20ALKD:	123.1 M	73.7	90.4
C24ALKD:	306.1 M	76.0	95.6
C30ALKD:	246.7 M	71.2	100.9
INTFLAG:			
PON:			
CATNO:	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:									
ID:	KL-5			FIELD BLANK1			FIELD BLANK2		
LABSAMNO:	RQ1649			RQ1689			RQ1690		
Alkanes and Isoprenoids	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
UNIT:	ng/g			ng/g			ng/g		
C10	52.23			1.40			3.62		
C11	115.53			2.15			0.00		
C12	206.94			0.00			0.00		
C13	323.63			1.08			0.00		
C14	502.96			2.48			1.27		
C15	672.05			3.12			1.18		
C16	568.58			7.22			3.25		
C17	704.40			5.00			3.60		
PRISTANE	640.26			0.00			1.00		
C18	262.58			3.50			2.10		
PHYTANE	509.65			2.30			0.00		
C19	306.03			4.40			2.60		
C20	190.32			5.40			4.10		
C21	350.23			12.60			18.10		
C22	207.06			28.00			164.60		
C23	501.27			55.49			511.13		
C24	304.14			87.67			864.55		
C25	1313.04			107.62			1125.77		
C26	339.67			107.11			1251.82		
C27	2001.33			106.71			1324.86		
C28	671.31			97.24			1278.91		
C29	5877.81			85.02			1167.65		
C30	926.17			64.78			945.80		
C31	6663.70			40.64			815.70		
C32	889.37			14.78			551.70		
C33	2338.99			0.00			292.90		
C34	496.04			0.00			87.50		
TOT ALKANES	27935.3			845.7			10423.7		
UNIT:	ug/g			ug/g			ug/g		
UCM	852.2			0.0			0.0		
Surrogate Recoveries									
C12ALKD:	77.4			66.8			97.6		
C20ALKD:	123.1		M	73.7			90.4		
C24ALKD:	306.1		M	76.0			95.6		
C30ALKD:	246.7		M	71.2			100.9		

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:									
ID:	KL-5			FIELD BLANK1			FIELD BLANK2		
LABSAMNO:	>Q1649			RQ1689			RQ1690		
UNIT:	ng/g			ng/g			ng/g		
PNA Analyte	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
NAPHTHALENE	24.76			1.08			1.11		
C1-NAPHTHALENES	45.91			1.72			2.01		
C2-NAPHTHALENES	100.29			0.00			0.00		
C3-NAPHTHALENES	154.98			0.00			0.00		
C4-NAPHTHALENES	188.50			0.00			0.00		
BIPHENYL	4.67			0.40			0.56		
ACENAPHTHYLENE	5.92			0.12			0.19		
ACENAPHTHENE	8.53			0.21			0.07		
FLUORENE	11.93			0.22			0.18		
C1-FLUORENES	16.26			0.00			0.00		
C2-FLUORENES	40.99			0.00			0.00		
C3-FLUORENES	87.04			0.00			0.00		
PHENANTHRENE	316.69			2.29			1.60		
ANTHRACENE	40.27			0.91			0.02		
C1-PHEN_ANTHR	174.97			0.00			0.00		
C2-PHEN_ANTHR	242.91			0.00			0.00		
C3-PHEN_ANTHR	184.29			0.00			0.00		
C4-PHEN_ANTHR	119.10			0.00			0.00		
DIBENZOTHIO	18.47			0.17			0.17		
C1-DIBEN	35.26			0.00			0.00		
C2-DIBEN	84.65			0.00			0.00		
C3-DIBEN	115.03			0.00			0.00		
FLUORANTHENE	750.32			2.35			0.36		
PYRENE	659.77			2.42			0.27		
C1-FLUORAN_PYR	322.78			0.00			0.00		
BENaANTHRACENE	491.41			0.91			0.11		
CHRYSENE	826.68			1.92			0.12		
C1-CHRYSENES	301.12			0.00			0.00		
C2-CHRYSENES	181.27			0.00			0.00		
C3-CHRYSENES	87.00			0.00			0.00		
C4-CHRYSENES	201.48			0.00			0.00		
BENbFLUORAN	1012.94			1.66			0.08		
BENkFLUORAN	461.76			0.88			0.11		
BENePYRENE	589.06			1.14			0.12		
BENaPYRENE	607.83			1.02			0.10		
PERYLENE	187.54			0.96			0.18		
I123cdPYRENE	511.79			0.88			0.10		
DBahANTHRA	87.42			0.21			0.06		
BghiPERYLENE	455.17			0.99			0.06		

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:		0	0
ID:	KL-5	FIELD BLANK1	FIELD BLANK2
LABSAMNO:	>Q1649	RQ1689	RQ1690
UNIT:	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	29.84	1.12	1.36
1-METHYLNAPH	16.07	0.60	0.65
2,6-DIMETHNAPH	12.35	0.20	0.31
2,3,5-TRIMETHNAPH	11.73	0.53	0.17
1-METHYLPHEN	37.58	0.29	0.20
Surrogate Recoveries			
NAPHD8:	33.1	46.7	57.9
ACEND10:	76.9	55.0	56.3
PHEND10:	34.5	49.0	50.7
CHRYD12:	19.5	46.3	47.3
PERYD12:	14.9	62.7	27.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	Q1649P	Q1689P	Q1690P
STATION	KL-5	FIELD BLANK1	FIELD BLANK2
	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.41	0.05	0.00
TOTAL CHLORDANES	139.53	0.48	0.00
TOTAL DDT'S	78.19	4.06	0.16
TOTAL PCB'S	657.7	13.0	7.9
TOXAPHENE			
TOTAL CL2	12.9	0.0	0.0
TOTAL CL3	61.4	0.0	0.0
TOTAL CL4	145.6	8.7	0.4
TOTAL CL5	169.1	2.0	0.5
TOTAL CL6	159.1	6.0	4.6
TOTAL CL7	100.4	1.8	0.5
TOTAL CL8	19.4	2.2	1.9
TOTAL CL9	2.1	0.2	0.0
TOTAL CL10	8.4	0.0	0.0
ALPHA-BHC	0.41	0.00	0.00
HCB	0.00	0.00	0.00
BETA-BHC	0.00	0.00	0.00
GAMMA-BHC	0.00	0.05	0.00
DELTA-BHC	0.00	0.00	0.00
HEPTACHLOR	0.00	0.00	0.00
HEPTA-EPOXIDE	0.00	0.00	0.00
OXYCHLORDANE	0.00	0.00	0.00
GAMMA-CHLORDANE	50.35	0.20	0.00
ALPHA-CHLORDANE	47.71	0.16	0.00
TRANS-NONACHLOR	28.38	0.07	0.00
CIS-NONACHLOR	13.09	0.05	0.00
ALDRIN	23.96	0.00	0.00
DIELDRIN	10.80	0.09	0.00
ENDRIN	0.00	0.00	0.00
MIREX	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	0.00	0.00	0.00
4,4'DDE (P,P'DDE)	32.20	2.29	0.04
2,4'DDD (O,P'DDD)	3.12	0.16	0.02
4,4'DDD (P,P'DDD)	27.10	1.06	0.06
2,4'DDT (O,P'DDT)	0.00	0.15	0.00
4,4'DDT (P,P'DDT)	15.78	0.40	0.04

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1649P	Q1689P	Q1690P
STATION	KL-5 (ppb)	FIELD BLANK1 (ppb)	FIELD BLANK2 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0
PCB#8 (CL2)	2.6	0.0	0.0
PCB#18 (CL3)	4.4	0.0	0.0
PCB#15 (CL2)	10.4	0.0	0.0
PCB#24 (CL3)	0.0	0.0	0.0
PCB#16/32 (CL3)	8.5	0.0	0.0
PCB#29 (CL3)	0.0	0.0	0.0
PCB#26 (CL3)	5.6	0.0	0.0
PCB#25 (CL3)	15.4	0.0	0.0
PCB#50 (CL4)	11.0	7.6	0.0
PCB#31 (CL3)	0.0	0.0	0.0
PCB#28 (CL3)	17.1	0.0	0.0
PCB#33 (CL3)	5.2	0.0	0.0
PCB#22 (CL3)	5.2	0.0	0.0
PCB#45 (CL4)	2.5	0.0	0.0
PCB#46 (CL4)	0.0	0.0	0.0
PCB#52 (CL4)	31.7	0.0	0.0
PCB#49 (CL4)	11.1	0.5	0.4
PCB#47/48 (CL4)	9.4	0.0	0.0
PCB#44 (CL4)	21.6	0.0	0.0
PCB#37/42 (CL4)	12.7	0.0	0.0
PCB#41/64 (CL4)	0.0	0.0	0.0
PCB#40 (CL4)	2.4	0.0	0.0
PCB#100 (CL5)	0.0	0.0	0.0
PCB#74 (CL4)	8.4	0.0	0.0
PCB#70 (CL4)	20.0	0.0	0.0
PCB#66 (CL4)	14.7	0.5	0.0
PCB#88 (CL5)	0.0	0.0	0.0
PCB#60/56 (CL5)	11.5	0.0	0.0
PCB#92? (CL5)	6.8	0.0	0.0
PCB#84? (CL5)	28.6	0.0	0.0
PCB#101 (CL5)	22.2	0.4	0.0
PCB#99 (CL5)	6.5	0.0	0.0
PCB#83 (CL5)	0.0	0.0	0.0
PCB#97 (CL5)	4.1	0.2	0.0
PCB#87 (CL5)	12.1	0.2	0.1
PCB#85 (CL5)	0.0	0.0	0.0
PCB#136 (CL6)	0.0	0.0	0.0
PCB#110/77 (CL5/4)	34.3	0.0	0.2
PCB#82 (CL5)	4.0	0.0	0.0
PCB#151 (CL6)	6.1	0.2	0.1
PCB#107/108/144(CL5/	4.0	0.2	0.0
PCB#149 (CL6)	14.1	0.4	0.0

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	Q1649P	Q1689P	Q1690P
		FIELD	FIELD
STATION	KL-5	BLANK1	BLANK2
	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	24.2	0.5	0.2
PCB#188 (CL7)	2.3	0.0	0.0
PCB#146 (CL6)	3.0	0.1	0.0
PCB#153 (CL6)	36.2	0.9	0.0
PCB#105 (CL5)	10.6	0.6	0.0
PCB#141 (CL6)	12.7	0.0	0.0
PCB#137 (CL6)	0.0	0.0	0.0
PCB#? (CL6)	0.0	0.0	0.0
PCB#138 (CL6)	38.9	4.2	4.4
PCB#158 (CL7)	2.9	0.0	0.0
PCB#129 (CL6)	31.7	0.0	0.0
PCB#126 (CL5)	0.0	0.0	0.0
PCB#178 (CL7)	0.0	0.0	0.0
PCB#187/182/159(CL7/	28.7	0.2	0.0
PCB#183 (CL7)	4.4	0.0	0.0
PCB#128 (CL6)	4.4	0.2	0.0
PCB#167 (CL6)	2.5	0.0	0.0
PCB#185 (CL7)	0.0	0.1	0.0
PCB#174 (CL7)	7.4	0.2	0.0
PCB#177 (CL7)	13.6	0.0	0.0
PCB#156/171/202(CL6/	9.4	0.0	0.0
PCB#200 (CL8)	6.2	0.0	0.0
PCB#172 (CL7)	4.3	0.0	0.0
PCB#180 (CL7)	27.8	1.1	0.3
PCB#191 (CL7)	1.5	0.0	0.0
PCB#170 (CL7)	0.0	0.0	0.2
PCB#201 (CL8)	6.1	0.0	0.0
PCB#196 (CL8)	4.6	1.8	1.7
PCB#189 (CL7)	0.0	0.0	0.0
PCB#195 (CL8)	2.5	0.3	0.2
PCB#194 (CL8)	0.0	0.1	0.0
PCB#205 (CL9)	0.0	0.0	0.0
PCB#206 (CL9)	2.1	0.2	0.0
PCB#209 (CL10)	8.4	0.0	0.0

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:					
ID:	SAR-3	SWSC-2	STB2-2	SAR-5	STB-2-1
LABSAMNO:	RC3197	RC3199	RC3201	RC3203	RC3205
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>C3197	>C3199	>C3201	>C3203	>C3205
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M431	M431	M431	M431	M431
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	14.08	13.55	24.62	13.82	15.61
DRYWT:	11.77	10.43	10.29	10.20	10.24
VOL:					
ACEND10:	98.1	84.1	82.4	63.5	76.0
BENAD12:					
CHRYD12:	77.0	62.8	49.7	45.0	42.1
FLUOD10:					
NAPHD8:	86.9	84.3	59.2	58.0	68.3
PERYD12:	108.1	62.7	77.5	106.8	91.7
PHEND10:	87.0	87.0	78.2	107.3	68.4
C12ALKD:	86.1	82.3	95.1	32.9	95.3
C20ALKD:	88.3	90.2	115.9	88.5	155.1 M
C24ALKD:	121.9	106.2	218.1 M	190.8 M	252.1 M
C30ALKD:	126.9	194.0 M	123.3	194.3 M	814.3 M
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:	0	0	0	0	0
ID:	SAR-3	SWSC-2	STB2-2	SAR-5	STB-2-1
LABSAMNO:	RC3197	RC3199	RC3201	RC3203	RC3205
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	10.68	10.16	647.00	367.31	980.89
C11	22.94	21.11	864.50	786.18	1459.59
C12	32.14	22.47	449.83	777.03	1290.63
C13	67.67	40.42	351.38	1583.18	1173.34
C14	100.76	47.98	306.54	2608.32	581.05
C15	131.43	58.48	353.51	4128.01	409.07
C16	121.28	76.66	323.00	3986.91	255.54
C17	102.70	91.60	379.97	1658.40	256.09
PRISTANE	90.20	115.90	367.92	2055.80	582.91
C18	80.40	90.80	409.17	1285.90	211.42
PHYTANE	99.50	125.90	337.79	1407.70	582.13
C19	95.10	134.60	375.45	1262.80	368.85
C20	122.80	130.20	267.68	1058.30	332.40
C21	121.70	144.70	447.76	1046.00	450.60
C22	60.60	94.90	260.03	642.50	217.78
C23	28.92	52.79	302.25	237.41	86.36
C24	78.79	139.42	378.52	14.50	77.51
C25	150.47	218.04	1044.96	161.82	442.10
C26	68.39	83.10	234.31	6.55	0.49
C27	78.64	213.18	142.86	275.48	373.12
C28	11.17	82.24	13.71	41.81	122.57
C29	96.23	604.56	404.10	0.37	30.97
C30	1.25	0.86	11.67	10.23	5.76
C31	189.76	158.28	1163.49	446.49	1659.52
C32	94.07	154.46	921.70	6.67	128.93
C33	106.02	554.14	492.43	159.41	21.87
C34	81.30	241.97	0.00	0.75	7.73
TOT ALKANES	2244.9	3708.9	11251.5	25362.0	8759.0
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	393.1	555.3	965.3	901.2	1474.6
Surrogate Recoveries					
C12ALKD:	86.05	82.33	95.08	32.91	95.26
C20ALKD:	88.30	90.21	115.88	88.54	155.11 M
C24ALKD:	121.94	106.19	218.09 M	190.78 M	252.13 M
C30ALKD:	126.89	194.01 M	123.32	194.33 M	814.27 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:	0			0			0			0			0		
ID:	SAR-3			SWSC-2			STB2-2			SAR-5			STB-2-1		
LABSAMNO:	>C3197			>C3199			>C3201			>C3203			>C3205		
UNIT:	ng/g			ng/g			ng/g			ng/g			ng/g		
PNA Analyte	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
NAPHTHALENE	24.60			13.79			194.83			1035.22			507.75		
C1-NAPHTHALENES	21.61			24.00			382.92			3686.75			874.83		
C2-NAPHTHALENES	25.13			22.60			350.94			4780.74			564.56		
C3-NAPHTHALENES	50.01			39.15			357.32			5952.74			408.54		
C4-NAPHTHALENES	65.92			61.86			351.88			4529.52			383.35		
BIPHENYL	3.66			2.90			38.72			350.85			57.13		
ACENAPHTHYLENE	16.89			5.89			82.74			24.90			45.76		
ACENAPHTHENE	46.46			16.31			28.86			181.50			17.45		
FLUORENE	40.19			23.55			53.73			321.69			39.20		
C1-FLUORENES	26.48			15.51			91.86			975.06			81.60		
C2-FLUORENES	66.79			41.98			151.60			2019.83			204.05		
C3-FLUORENES	138.54			93.35			210.99			2238.82			296.56		
PHENANTHRENE	439.49			301.49			388.87			820.88			397.97		
ANTHRACENE	105.30			53.23			137.18			92.37			82.88		
C1-PHEN_ANTHR	182.16			111.93			359.76			1552.72			479.48		
C2-PHEN_ANTHR	233.52			120.98			435.94			1932.95			642.54		
C3-PHEN_ANTHR	205.08			126.44			363.80			1266.22			525.01		
C4-PHEN_ANTHR	168.16			138.47			306.60			571.25			410.16		
DIBENZOTHIO	24.59			17.71			31.35			100.07			43.34		
C1-DIBEN	36.15			27.68			76.17			343.07			122.65		
C2-DIBEN	125.64			70.03			178.31			778.82			264.84		
C3-DIBEN	164.33			100.40			167.18			713.77			241.50		
FLUORANTHENE	620.39			487.50			405.47			732.00			348.08		
PYRENE	596.17			435.99			365.41			727.98			289.25		
C1-FLUORAN_PYR	333.01			219.86			293.89			498.90			228.26		
BENaANTHRACENE	293.89			190.56			307.64			454.52			180.89		
CHRYSENE	380.21			329.44			386.64			695.25			222.26		
C1-CHRYSENES	186.11			155.36			321.57			352.04			192.00		
C2-CHRYSENES	133.47			175.63			216.86			250.87			155.04		
C3-CHRYSENES	84.58			99.93			99.59			156.91			90.51		
C4-CHRYSENES	59.10			52.41			49.88			142.01			62.81		
BENbFLUORAN	217.05			212.27			284.98			341.16			132.25		
BENkFLUORAN	153.48			119.59			197.24			232.48			55.52		
BENePYRENE	138.89			130.57			194.63			201.23			72.98		
BENaPYRENE	156.88			133.26			239.45			193.99			77.59		
PERYLENE	91.12			91.04			200.39			111.64			83.66		
I123cdPYRENE	44.71			46.19			114.12			85.52			59.45		
DBahANTHRA	13.97			11.37			35.23			25.43			18.45		
BghiPERYLENE	44.19			50.71			144.47			102.94			78.88		

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:	0	0	0	0	0
ID:	SAR-3	SWSC-2	STB2-2	SAR-5	STB-2-1
LABSAMNO:	>C3197	>C3199	>C3201	>C3203	>C3205
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	12.43	14.77	252.15	2151.16	560.17
1-METHYLNAPH	9.18	9.23	130.77	1535.59	314.66
2,6-DIMETHNAPH	9.01	8.58	133.30	1836.24	271.68
2,3,5-TRIMETHNAPH	12.73	12.59	76.30	1464.52	102.55
1-METHYLPHEN	42.68	23.98	89.69	311.56	98.84
Surrogate Recoveries					
NAPHD8:	86.87	84.34	59.18	57.98	68.27
ACEND10:	98.10	84.12	82.39	63.49	75.97
PHEND10:	87.02	86.99	78.17	107.27	68.38
CHRYD12:	76.96	62.79	49.69	45.02	42.07
PERYD12:	108.14	62.66	77.45	106.82	91.72

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	C3197P	C3199P	C3201P	C3203P	C3205P
STATION	SAR-3 (ppb)	SWSC-2 (ppb)	STB2-2 (ppb)	SAR-5 (ppb)	STB2-1 (ppb)
TOTAL BHC'S	0.36	0.90	0.00	0.00	0.00
TOTAL CHLORDANES	25.63	5.07	37.83	141.61	9.79
TOTAL DDT'S	23.11	7.15	91.10	68.70	43.19
TOTAL PCB'S	74.5	261.3	286.3	794.1	727.5
TOXAPHENE	0.00	0.00	0.00	0.00	0.00
TOTAL CL2	0.7	0.8	0.0	0.0	0.5
TOTAL CL3	3.4	3.8	78.4	8.3	8.4
TOTAL CL4	18.8	50.2	87.1	163.1	22.3
TOTAL CL5	20.6	93.6	54.4	228.7	42.2
TOTAL CL6	15.7	70.4	91.9	229.6	66.1
TOTAL CL7	11.1	34.8	89.2	148.4	140.5
TOTAL CL8	3.7	6.8	20.8	37.7	372.9
TOTAL CL9	0.9	3.0	3.7	3.4	30.9
TOTAL CL10	0.0	0.0	1.9	0.0	50.1
ALPHA-BHC	0.11	0.20	0.00	0.00	0.00
HCB	0.39	0.17	2.36	19.99	0.73
BETA-BHC	0.00	0.00	0.00	0.00	0.00
GAMMA-BHC	0.16	0.60	0.00	0.00	0.00
DELTA-BHC	0.09	0.09	0.00	0.00	0.00
HEPTACHLOR	0.09	0.01	1.31	0.00	0.14
HEPTA-EPOXIDE	0.50	0.19	0.00	0.00	0.00
OXYCHLORDANE	0.52	0.36	1.40	3.39	0.00
GAMMA-CHLORDANE	9.74	1.69	14.17	55.93	3.21
ALPHA-CHLORDANE	7.67	1.26	11.85	42.35	3.55
TRANS-NONACHLOR	4.95	0.79	6.06	27.48	1.22
CIS-NONACHLOR	2.16	0.77	3.04	12.46	1.67
ALDRIN	0.00	0.00	0.00	0.00	0.00
DIELDRIN	1.65	0.76	3.20	8.94	1.40
ENDRIN	0.00	0.00	0.00	0.00	0.00
MIREX	0.00	0.00	0.00	0.00	12.11
2,4'DDE (O,P'DDE)	0.31	0.24	0.79	0.00	0.94
4,4'DDE (P,P'DDE)	7.72	1.99	27.71	21.38	23.28
2,4'DDD (O,P'DDD)	1.63	0.59	4.01	5.03	1.32
4,4'DDD (P,P'DDD)	10.89	2.16	26.73	36.40	14.37
2,4'DDT (O,P'DDT)	0.35	0.65	5.34	0.00	0.00
4,4'DDT (P,P'DDT)	2.22	1.53	26.52	5.89	3.28

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	C3197P	C3199P	C3201P	C3203P	C3205P
STATION	SAR-3 (ppb)	SWSC-2 (ppb)	STB2-2 (ppb)	SAR-5 (ppb)	STB2-1 (ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.4	0.0	0.0	0.0	0.0
PCB#18 (CL3)	0.2	0.4	0.0	1.5	0.6
PCB#15 (CL2)	0.3	0.8	0.0	0.0	0.5
PCB#24 (CL3)	0.0	0.0	0.5	0.0	0.0
PCB#16/32 (CL3)	0.3	0.0	2.7	0.0	0.0
PCB#29 (CL3)	0.0	0.7	61.8	0.0	1.7
PCB#26 (CL3)	0.0	0.6	0.0	0.0	0.0
PCB#25 (CL3)	2.0	0.0	1.4	0.0	0.0
PCB#50 (CL4)	0.5	0.8	71.5	7.4	1.5
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	0.9	1.3	7.3	4.2	3.6
PCB#33 (CL3)	0.0	0.0	1.1	2.6	1.6
PCB#22 (CL3)	0.0	0.8	3.7	0.0	0.8
PCB#45 (CL4)	0.1	0.3	0.5	0.0	0.2
PCB#46 (CL4)	0.1	0.0	0.5	0.0	0.2
PCB#52 (CL4)	9.6	25.1	4.6	76.3	5.6
PCB#49 (CL4)	0.5	1.3	1.0	5.5	1.1
PCB#47/48 (CL4)	0.8	0.9	0.0	4.3	0.9
PCB#44 (CL4)	2.5	3.0	1.4	13.9	1.6
PCB#37/42 (CL4)	0.0	1.5	0.0	0.0	1.8
PCB#41/64 (CL4)	0.4	1.7	0.0	0.0	0.0
PCB#40 (CL4)	0.3	0.5	0.0	0.0	0.0
PCB#100 (CL5)	0.0	0.0	0.0	0.0	0.0
PCB#74 (CL4)	1.5	2.7	0.0	5.3	2.4
PCB#70 (CL4)	1.5	3.8	3.5	13.9	3.2
PCB#66 (CL4)	1.2	8.8	4.0	36.5	3.9
PCB#88 (CL5)	2.3	1.6	0.0	0.0	1.2
PCB#60/56 (CL5)	1.1	2.3	2.7	5.7	3.1
PCB#92? (CL5)	0.0	2.1	1.8	16.1	2.3
PCB#84? (CL5)	0.0	3.3	5.5	33.6	1.9
PCB#101 (CL5)	3.2	11.5	6.5	36.4	5.4
PCB#99 (CL5)	1.1	4.3	0.0	10.1	1.3
PCB#83 (CL5)	0.3	0.7	0.0	0.0	0.0
PCB#97 (CL5)	0.6	3.9	1.0	5.9	0.7
PCB#87 (CL5)	1.2	7.9	3.1	13.8	2.4
PCB#85 (CL5)	0.9	2.5	2.6	6.5	6.9
PCB#136 (CL6)	0.0	1.1	0.0	0.0	0.0
PCB#110/77 (CL5/4)	4.6	21.5	16.5	43.1	7.8
PCB#82 (CL5)	0.8	2.7	2.5	5.5	1.7
PCB#151 (CL6)	0.7	2.1	7.1	15.9	2.1
PCB#107/108/144(CL5/	0.6	2.4	4.1	11.2	1.5
PCB#149 (CL6)	2.7	8.2	13.8	36.4	5.4

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	C3197P	C3199P	C3201P	C3203P	C3205P
STATION	SAR-3 (ppb)	SWSC-2 (ppb)	STB2-2 (ppb)	SAR-5 (ppb)	STB2-1 (ppb)
PCB#118/108/149(CL5/	3.0	17.2	4.7	29.7	3.9
PCB#188 (CL7)	0.0	0.0	0.0	0.0	0.0
PCB#146 (CL6)	0.6	2.0	3.1	7.1	1.3
PCB#153 (CL6)	4.3	17.0	25.1	64.2	10.7
PCB#105 (CL5)	1.1	9.5	3.5	11.1	2.1
PCB#141 (CL6)	0.9	4.2	10.0	27.3	0.0
PCB#137 (CL6)	0.3	1.9	0.0	0.0	0.0
PCB#? (CL6)	0.2	1.4	1.0	0.0	0.0
PCB#138 (CL6)	4.4	21.4	29.7	62.8	9.3
PCB#158 (CL7)	0.5	2.1	1.3	4.5	3.5
PCB#129 (CL6)	0.3	1.5	0.0	1.8	0.3
PCB#126 (CL5)	1.2	1.7	0.0	0.0	4.2
PCB#178 (CL7)	0.1	0.4	3.8	4.9	0.0
PCB#187/182/159(CL7/	1.0	2.4	10.8	22.5	35.5
PCB#183 (CL7)	0.8	1.4	5.7	11.3	0.0
PCB#128 (CL6)	0.9	5.1	2.2	6.9	0.4
PCB#167 (CL6)	0.0	1.2	0.0	2.3	0.0
PCB#185 (CL7)	0.0	4.9	5.9	8.9	7.2
PCB#174 (CL7)	1.1	2.4	7.9	17.6	7.4
PCB#177 (CL7)	1.2	2.1	4.5	10.0	6.7
PCB#156/171/202(CL6/	0.5	3.2	0.0	4.9	36.5
PCB#200 (CL8)	0.3	1.1	0.0	1.9	9.8
PCB#172 (CL7)	1.2	3.2	0.0	0.0	3.6
PCB#180 (CL7)	2.2	5.2	26.9	49.4	44.8
PCB#191 (CL7)	0.0	0.1	1.3	1.7	0.5
PCB#170 (CL7)	1.6	6.7	13.2	0.0	24.0
PCB#201 (CL8)	0.8	2.6	7.5	9.8	143.2
PCB#196 (CL8)	1.0	3.1	8.3	12.8	133.8
PCB#189 (CL7)	0.2	1.4	0.0	0.0	0.0
PCB#195 (CL8)	0.2	0.0	1.4	3.7	76.3
PCB#194 (CL8)	1.4	0.0	3.7	9.4	9.8
PCB#205 (CL9)	0.2	0.0	0.0	0.0	0.0
PCB#206 (CL9)	0.8	3.0	3.7	3.4	30.9
PCB#209 (CL10)	0.0	0.0	1.9	0.0	50.1

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:				SITE 2	SITE 1
ID:	OAR-R1	SAR-2	SAR-6	SAMPLE 1	SAMPLE 2
LABSAMNO:	RC3207	RC3209	RC3211	RC3213	RC3215
METHOD:	GCFID	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>C3207	>C3209	>C3211	>C3213	>C3215
METHOD:	GCMS	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M431	M431	M431	M431	M431
LAB:	GERG	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:					
SAMPLWT:					
WETWT:	13.15	13.01	13.76	14.97	12.74
DRYWT:	10.22	10.15	10.13	10.57	10.37
VOL:					
ACEND10:	126.4	100.9	95.1	93.2	85.2
BENAD12:					
CHRYD12:	84.8	111.8	75.5	75.3	67.5
FLUOD10:					
NAPHD8:	87.3	63.1	88.8	84.1	70.4
PERYD12:	117.4	175.9	122.0	91.0	111.7
PHEND10:	81.2	94.4	169.5	90.3	89.1
C12ALKD:	106.0	90.0	85.7	81.7	84.0
C20ALKD:	101.0	107.8	97.5	97.4	85.8
C24ALKD:	134.9 M	119.0	137.5 M	84.7	104.3
C30ALKD:	103.5	120.5	116.5	79.1	99.7
INTFLAG:					
PON:					
CATNO:	1991	1991	1991	1991	1991

LABNAME: GERG/TAMU　　DATE: 06-Mar-92　　LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:	0	0	0	SITE 2	SITE 1
ID:	OAR-R1	SAR-2	SAR-6	SAMPLE 1	SAMPLE 2
LABSAMNO:	RC3207	RC3209	RC3211	RC3213	RC3215
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
C10	486.62	51.85	32.72	12.53	11.47
C11	1349.15	83.83	72.94	7.74	16.84
C12	1303.37	79.51	64.14	4.30	8.42
C13	998.52	108.77	135.91	2.21	10.42
C14	563.61	161.98	212.24	3.56	16.95
C15	292.89	250.51	302.77	1.97	28.11
C16	114.76	281.62	355.42	9.83	31.16
C17	264.54	272.50	410.60	17.50	73.00
PRISTANE	575.13	192.20	391.40	21.00	38.80
C18	140.25	251.90	351.90	16.00	36.80
PHYTANE	470.52	181.00	317.20	35.90	58.40
C19	154.99	247.00	329.80	18.30	44.90
C20	132.17	296.70	320.60	14.50	38.30
C21	127.43	253.70	297.00	25.20	58.70
C22	60.89	185.40	212.60	16.00	36.40
C23	30.51	164.84	172.67	47.75	59.65
C24	3.20	309.40	230.99	17.86	55.57
C25	423.58	602.25	457.96	109.11	176.70
C26	111.47	465.06	315.68	20.66	98.61
C27	141.01	496.72	396.35	364.03	384.17
C28	5.33	570.96	246.34	77.16	149.74
C29	283.20	777.42	1066.23	1783.94	1658.35
C30	0.75	722.09	526.61	102.68	290.05
C31	28.05	772.93	543.99	953.12	1809.50
C32	6.21	792.94	327.05	35.14	177.53
C33	5.03	613.68	299.55	37.36	270.87
C34	0.00	470.27	183.02	1.44	49.32
TOT ALKANES	7503.9	9657.0	7519.2	3756.8	5688.7
UNIT:	ug/g	ug/g	ug/g	ug/g	ug/g
UCM	580.5	468.8	499.9	119.7	184.1
Surrogate Recoveries					
C12ALKD:	106.05	89.98	85.70	81.72	84.03
C20ALKD:	100.97	107.80	97.52	97.41	85.84
C24ALKD:	134.87 M	119.04	137.54 M	84.70	104.28
C30ALKD:	103.45	120.51	116.52	79.06	99.65

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:	0	0	0	SITE 2	SITE 1
ID:	OAR-R1	SAR-2	SAR-6	SAMPLE 1	SAMPLE 2
LABSAMNO:	>C3207	>C3209	>C3211	>C3213	>C3215
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
PNA Analyte	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
NAPHTHALENE	151.46	155.46	75.68	2.07	5.20
C1-NAPHTHALENES	317.69	147.25	252.97	2.81	5.87
C2-NAPHTHALENES	219.47	159.35	244.15	4.58	7.61
C3-NAPHTHALENES	221.20	250.94	241.07	5.26	12.33
C4-NAPHTHALENES	286.26	209.37	212.34	17.69	20.50
BIPHENYL	11.69	13.86	23.95	0.41	1.00
ACENAPHTHYLENE	21.67	474.56	77.59	0.68	5.03
ACENAPHTHENE	39.82	27.42	71.64	0.27	13.64
FLUORENE	66.36	131.76	91.64	0.46	17.43
C1-FLUORENES	50.38	109.92	79.37	4.72	11.48
C2-FLUORENES	113.33	178.13	145.99	18.76	28.80
C3-FLUORENES	172.56	225.79	219.93	26.20	55.84
PHENANTHRENE	910.75	2050.83	447.24	8.79	335.62
ANTHRACENE	178.96	738.37	118.97	0.95	39.23
C1-PHEN_ANTHR	407.31	1615.95	255.84	28.48	135.21
C2-PHEN_ANTHR	399.90	1317.09	235.40	31.09	98.24
C3-PHEN_ANTHR	335.64	774.99	145.72	13.26	57.83
C4-PHEN_ANTHR	243.51	347.98	80.65	5.59	29.68
DIBENZOTHIO	43.15	84.16	25.12	1.65	12.92
C1-DIBEN	62.12	105.06	41.15	8.55	15.61
C2-DIBEN	143.25	223.55	87.33	17.15	32.82
C3-DIBEN	160.11	200.67	87.13	10.68	32.15
FLUORANTHENE	1590.81	4404.86	683.10	7.20	453.47
PYRENE	1282.87	3682.46	619.10	9.09	399.62
C1-FLUORAN_PYR	639.80	2918.93	328.48	4.87	213.62
BENaANTHRACENE	484.81	2142.35	587.49	3.02	266.23
CHRYSENE	647.70	2142.37	656.10	5.74	344.85
C1-CHRYSENES	275.81	1230.12	342.69	2.34	120.26
C2-CHRYSENES	189.07	542.74	192.10	0.00	56.95
C3-CHRYSENES	104.12	188.35	100.42	0.00	30.22
C4-CHRYSENES	58.92	123.17	90.37	0.00	26.35
BENbFLUORAN	552.75	1596.14	438.37	3.95	263.97
BENkFLUORAN	196.76	763.32	371.09	3.32	116.88
BENePYRENE	265.74	706.86	287.84	3.38	127.02
BENaPYRENE	314.51	1142.42	363.76	1.80	156.56
PERYLENE	116.91	269.79	142.35	1.30	48.15
I123cdPYRENE	112.05	320.29	124.57	1.36	52.53
DBahANTHRA	27.03	123.10	35.39	0.50	15.68
BghiPERYLENE	104.80	233.67	113.34	1.20	46.61

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:	0	0	0	SITE 2	SITE 1
ID:	OAR-R1	SAR-2	SAR-6	SAMPLE 1	SAMPLE 2
LABSAMNO:	>C3207	>C3209	>C3211	>C3213	>C3215
UNIT:	ng/g	ng/g	ng/g	ng/g	ng/g
Analyte (Cont)	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
2-METHYLNAPH	178.09	85.83	160.50	1.49	3.35
1-METHYLNAPH	139.60	61.42	92.47	1.32	2.52
2,6-DIMETHNAPH	61.53	36.25	121.71	0.73	1.83
2,3,5-TRIMETHNAPH	46.18	42.68	65.86	1.38	3.01
1-METHYLPHEN	55.43	213.56	53.09	3.97	29.79
Surrogate Recoveries					
NAPHD8:	87.31	63.06	88.82	84.06	70.43
ACEND10:	126.42	100.86	95.08	93.24	85.24
PHEND10:	81.16	94.38	169.54	90.31	89.09
CHRYD12:	84.84	111.75	75.46	75.27	67.46
PERYD12:	117.37	175.91	122.04	90.97	111.72

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	C3207P	C3209P	C3211P	C3213P	C3215P
				SITE2	SITE1
STATION	OAR-R1	SAR-2	SAR-6	SAMPLE1	SAMPLE2
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
TOTAL BHC'S	0.31	0.00	0.00	0.00	0.11
TOTAL CHLORDANES	23.17	4.83	16.69	0.14	33.10
TOTAL DDT'S	51.48	57.71	25.99	1.29	2.69
TOTAL PCB'S	138.2	89.2	1449.5	6.3	48.7
TOXAPHENE	0.00	0.00	0.00	0.00	0.00
TOTAL CL2	0.3	0.0	111.0	0.0	11.6
TOTAL CL3	5.1	5.4	219.1	0.0	4.4
TOTAL CL4	56.5	15.7	583.6	1.4	32.6
TOTAL CL5	34.6	40.7	361.0	0.2	12.9
TOTAL CL6	19.7	17.6	166.6	4.4	6.2
TOTAL CL7	16.6	8.5	63.3	0.1	5.2
TOTAL CL8	4.0	14.9	14.8	0.3	1.3
TOTAL CL9	0.0	0.0	3.4	0.0	0.4
TOTAL CL10	0.3	1.0	1.5	0.0	0.4
ALPHA-BHC	0.20	0.00	0.00	0.00	0.00
HCB	0.41	0.00	0.00	0.00	0.08
BETA-BHC	0.00	0.00	0.00	0.00	0.00
GAMMA-BHC	0.00	0.00	0.00	0.00	0.11
DELTA-BHC	0.11	0.00	0.00	0.00	0.00
HEPTACHLOR	0.00	0.00	0.00	0.00	0.30
HEPTA-EPOXIDE	0.00	0.00	0.00	0.00	2.17
OXYCHLORDANE	0.74	0.00	2.15	0.00	0.77
GAMMA-CHLORDANE	9.52	0.00	5.25	0.00	10.84
ALPHA-CHLORDANE	7.32	4.06	4.47	0.05	10.65
TRANS-NONACHLOR	3.78	0.77	2.77	0.08	6.14
CIS-NONACHLOR	1.81	0.00	2.04	0.02	2.23
ALDRIN	0.00	0.00	0.00	0.00	0.00
DIELDRIN	1.51	0.00	2.42	0.05	1.53
ENDRIN	0.00	0.00	0.00	0.00	0.00
MIREX	0.00	0.00	0.00	0.00	0.00
2,4'DDE (O,P'DDE)	0.31	0.50	0.00	0.00	0.00
4,4'DDE (P,P'DDE)	17.56	10.52	7.12	0.99	0.81
2,4'DDD (O,P'DDD)	3.31	4.41	1.86	0.00	0.23
4,4'DDD (P,P'DDD)	29.97	27.26	13.92	0.11	0.99
2,4'DDT (O,P'DDT)	0.00	2.67	1.28	0.02	0.00
4,4'DDT (P,P'DDT)	0.33	12.34	1.81	0.17	0.66

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	C3207P	C3209P	C3211P	C3213P	C3215P
				SITE2	SITE1
STATION	OAR-R1	SAR-2	SAR-6	SAMPLE1	SAMPLE2
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#7 (CL2)	0.0	0.0	0.0	0.0	0.0
PCB#8 (CL2)	0.1	0.0	46.8	0.0	11.6
PCB#18 (CL3)	0.4	0.0	24.5	0.0	0.0
PCB#15 (CL2)	0.2	0.0	64.2	0.0	0.0
PCB#24 (CL3)	0.0	0.0	3.5	0.0	0.0
PCB#16/32 (CL3)	0.0	4.2	33.6	0.0	0.0
PCB#29 (CL3)	0.0	0.2	0.8	0.0	0.9
PCB#26 (CL3)	0.0	0.0	8.9	0.0	0.0
PCB#25 (CL3)	2.1	0.8	7.2	0.0	3.2
PCB#50 (CL4)	0.2	12.8	68.1	0.1	25.8
PCB#31 (CL3)	0.0	0.0	0.0	0.0	0.0
PCB#28 (CL3)	0.9	0.1	77.5	0.0	0.3
PCB#33 (CL3)	0.3	0.0	33.3	0.0	0.0
PCB#22 (CL3)	1.4	0.0	29.8	0.0	0.0
PCB#45 (CL4)	0.1	0.0	9.4	0.0	0.0
PCB#46 (CL4)	0.1	0.0	4.6	0.0	0.0
PCB#52 (CL4)	41.7	0.0	56.7	0.1	2.9
PCB#49 (CL4)	1.4	0.0	38.7	1.2	0.0
PCB#47/48 (CL4)	0.8	0.0	29.1	0.0	0.0
PCB#44 (CL4)	3.1	0.0	68.2	0.0	2.1
PCB#37/42 (CL4)	0.8	0.0	51.3	0.0	0.0
PCB#41/64 (CL4)	0.0	0.0	55.7	0.0	0.0
PCB#40 (CL4)	0.0	0.0	16.6	0.0	0.0
PCB#100 (CL5)	0.5	0.0	0.0	0.0	0.0
PCB#74 (CL4)	2.8	0.0	37.6	0.0	1.5
PCB#70 (CL4)	2.9	0.0	80.1	0.0	0.0
PCB#66 (CL4)	2.6	2.9	67.5	0.0	0.3
PCB#88 (CL5)	2.4	3.6	7.2	0.0	2.3
PCB#60/56 (CL5)	2.0	3.2	63.4	0.0	0.0
PCB#92? (CL5)	2.7	3.0	6.3	0.0	0.0
PCB#84? (CL5)	3.4	0.5	10.7	0.0	0.0
PCB#101 (CL5)	3.6	1.8	37.0	0.0	2.0
PCB#99 (CL5)	1.1	0.5	15.8	0.0	1.1
PCB#83 (CL5)	0.4	0.0	3.3	0.0	0.4
PCB#97 (CL5)	0.8	0.0	13.6	0.0	0.6
PCB#87 (CL5)	1.6	0.0	29.7	0.0	0.5
PCB#85 (CL5)	0.6	0.0	9.6	0.0	0.1
PCB#136 (CL6)	0.0	0.0	2.8	0.0	0.0
PCB#110/77 (CL5/4)	6.8	10.8	65.2	0.0	2.4
PCB#82 (CL5)	2.0	6.4	9.5	0.1	0.6
PCB#151 (CL6)	1.0	1.2	5.6	0.0	0.3
PCB#107/108/144(CL5/	0.6	0.7	6.3	0.0	0.4
PCB#149 (CL6)	3.4	2.9	21.1	0.0	0.9

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	C3207P	C3209P	C3211P	C3213P	C3215P
				SITE2	SITE1
STATION	OAR-R1	SAR-2	SAR-6	SAMPLE1	SAMPLE2
	(ppb)	(ppb)	(ppb)	(ppb)	(ppb)
PCB#118/108/149(CL5/	4.3	10.0	52.9	0.0	1.8
PCB#188 (CL7)	0.0	0.0	0.0	0.0	0.1
PCB#146 (CL6)	0.7	0.5	4.2	0.0	0.6
PCB#153 (CL6)	5.1	2.6	44.1	0.1	1.4
PCB#105 (CL5)	1.6	0.3	30.5	0.0	0.6
PCB#141 (CL6)	1.1	5.5	11.3	0.0	0.0
PCB#137 (CL6)	0.3	0.0	2.4	3.1	0.0
PCB#? (CL6)	0.2	0.0	2.5	0.0	0.0
PCB#138 (CL6)	6.2	5.0	52.5	0.5	2.1
PCB#158 (CL7)	0.4	0.0	4.0	0.0	0.0
PCB#129 (CL6)	0.4	0.0	2.6	0.0	0.0
PCB#126 (CL5)	3.3	0.0	0.0	0.0	0.8
PCB#178 (CL7)	0.0	0.0	1.8	0.0	0.0
PCB#187/182/159(CL7/	1.6	1.6	7.1	0.0	0.2
PCB#183 (CL7)	1.0	0.5	3.2	0.0	0.3
PCB#128 (CL6)	0.6	0.0	9.0	0.0	0.4
PCB#167 (CL6)	0.0	0.0	1.9	0.0	0.0
PCB#185 (CL7)	2.2	0.0	4.6	0.0	0.0
PCB#174 (CL7)	2.0	1.5	5.9	0.0	0.3
PCB#177 (CL7)	2.1	0.0	3.7	0.0	0.9
PCB#156/171/202(CL6/	0.7	0.0	6.5	0.6	0.5
PCB#200 (CL8)	0.5	3.4	1.5	0.0	0.3
PCB#172 (CL7)	0.0	0.0	0.0	0.0	1.4
PCB#180 (CL7)	3.4	3.4	15.1	0.1	0.5
PCB#191 (CL7)	0.0	0.0	0.4	0.0	0.0
PCB#170 (CL7)	1.9	0.0	11.4	0.0	1.0
PCB#201 (CL8)	0.9	5.5	4.0	0.0	0.1
PCB#196 (CL8)	1.2	5.2	4.8	0.2	0.7
PCB#189 (CL7)	0.0	0.0	0.4	0.0	0.2
PCB#195 (CL8)	0.3	0.8	1.4	0.1	0.2
PCB#194 (CL8)	1.1	0.0	3.1	0.0	0.0
PCB#205 (CL9)	0.0	0.0	0.7	0.0	0.0
PCB#206 (CL9)	0.0	0.0	2.6	0.0	0.4
PCB#209 (CL10)	0.3	1.0	1.5	0.0	0.4

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - GENERAL INFORMATION - 1991

INVEST#:	SITE 1	SITE 1		
ID:	SAMPLE 2 (DUP)	SAMPLE 1	OWSC-R1	OWSC-R1 (DUP)
LABSAMNO:	RQ2108	RC3217	RQ2183	RQ2184
METHOD:	GCFID	GCFID	GCFID	GCFID
LABSAMNO:	>Q2108	>C3217	>Q2183	>Q2184
METHOD:	GCMS	GCMS	GCMS	GCMS
QCBATCH:	M431	M431	M440	M440
LAB:	GERG	GERG	GERG	GERG
MATRIX:	SEDIMENT	SEDIMENT	SEDIMENT	SEDIMENT
SUBMAT:				
SAMPLWT:				
WETWT:	12.84	24.51	16.36	14.20
DRYWT:	10.45	10.10	8.18	7.10
VOL:				
ACEND10:	94.5	89.5	97.0	0.0
BENAD12:				
CHRYD12:	72.2	77.9	92.2	0.0
FLUOD10:				
NAPHD8:	74.4	71.3	92.2	0.0
PERYD12:	102.7	111.6	105.8	0.0
PHEND10:	93.7	90.7	97.1	0.0
C12ALKD:	84.4	81.9	111.6	112.1
C20ALKD:	82.9	84.0	106.9	105.7
C24ALKD:	94.5	126.4	110.5	135.0 M
C30ALKD:	92.7	66.5	149.7 M	161.6 M
INTFLAG:				
PON:				
CATNO:	1991	1991	1991	1991

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - ALIPHATIC HYDROCARBON DATA - 1991

INVEST#:	SITE 1	SITE 1	0	0
ID:	SAMPLE 2 (DUP)	SAMPLE 1	OWSC-R1	OWSC-R1 (DUP)
LABSAMNO:	RQ2108	RC3217	RQ2183	RQ2184
Alkanes and Isoprenoids	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL	Conc DB QUAL
UNIT:	ng/g	ng/g	ng/g	ng/g
C10	7.49	19.65	801.82	996.53
C11	16.90	43.32	1507.54	1941.96
C12	8.30	36.88	621.75	810.17
C13	10.63	54.31	448.30	667.34
C14	16.20	50.30	787.71	970.11
C15	26.93	32.86	1441.42	1741.60
C16	28.65	55.27	1342.24	1557.96
C17	59.50	138.80	2572.01	2934.96
PRISTANE	33.20	265.10	2636.39	2385.04
C18	33.30	47.20	780.91	937.48
PHYTANE	47.00	180.30	1596.89	1394.81
C19	36.80	134.80	972.34	1109.78
C20	32.50	113.40	919.51	1032.15
C21	46.70	313.90	1133.83	1181.33
C22	29.90	247.80	657.49	757.48
C23	50.98	487.72	818.19	993.43
C24	47.09	258.43	1513.91	1711.78
C25	153.97	943.98	2922.30	3588.00
C26	60.99	448.82	2521.23	2976.15
C27	214.50	2033.43	2352.21	2644.65
C28	41.44	688.65	1609.49	1671.72
C29	895.45	3091.22	3711.12	3785.21
C30	149.64	927.59	4364.94	3586.82
C31	560.43	3739.31	4194.63	4313.06
C32	52.25	583.65	3451.95	3719.58
C33	63.44	814.51	2448.70	3998.71
C34	17.07	222.95	3324.73	4066.82
TOT ALKANES	2741.2	15974.2	51453.6	57474.7
UNIT:	ug/g	ug/g	ug/g	ug/g
UCM	148.9	192.2	3904.76	4246.80
Surrogate Recoveries				
C12ALKD:	84.40	81.93	111.63	112.12
C20ALKD:	82.91	84.02	106.94	105.73
C24ALKD:	94.49	126.42	110.53	134.96 M
C30ALKD:	92.70	66.48	149.71 M	161.61 M

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA - 1991

INVEST#:	SITE 1			SITE 1			0			0		
ID:	SAMPLE 2 (DUP)			SAMPLE 1			OWSC-R1			OWSC-R1 (DUP)		
LABSAMNO:	>Q2108			>C3217			>Q2183			>Q2184		
UNIT:	ng/g			ng/g			ng/g			ng/g		
PNA Analyte	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
NAPHTHALENE	5.10			22.72			1324.12			SAMPLE		D
C1-NAPHTHALENES	8.08			31.03			2846.72			DILUTED		D
C2-NAPHTHALENES	10.56			32.41			2131.68			AND		D
C3-NAPHTHALENES	14.81			59.00			1959.92			SURROGATE		D
C4-NAPHTHALENES	19.12			104.99			1323.16			LOST		D
BIPHENYL	1.17			6.70			329.28					D
ACENAPHTHYLENE	1.84			1.51			138.20					D
ACENAPHTHENE	21.00			2.81			608.20					D
FLUORENE	27.17			8.27			760.90					D
C1-FLUORENES	11.47			14.88			428.50					D
C2-FLUORENES	23.40			43.29			667.00					D
C3-FLUORENES	35.59			48.41			1076.64					D
PHENANTHRENE	411.61			54.94			4677.14					D
ANTHRACENE	52.44			3.34			1103.60					D
C1-PHEN_ANTHR	146.07			53.63			2566.72					D
C2-PHEN_ANTHR	91.10			63.23			2447.36					D
C3-PHEN_ANTHR	48.42			60.74			1992.08					D
C4-PHEN_ANTHR	25.55			44.98			1273.80					D
DIBENZOTHIO	16.30			5.14			252.20					D
C1-DIBEN	14.68			15.95			272.64					D
C2-DIBEN	27.53			36.15			582.44					D
C3-DIBEN	24.98			46.56			693.38					D
FLUORANTHENE	442.41			47.81			7737.08					D
PYRENE	401.35			34.67			6824.94					D
C1-FLUORAN_PYR	217.22			32.19			4450.46					D
BENaANTHRACENE	257.21			8.17			3243.02					D
CHRYSENE	307.03			27.98			4487.22					D
C1-CHRYSENES	92.02			27.28			2657.26					D
C2-CHRYSENES	51.42			35.75			2030.42					D
C3-CHRYSENES	23.24			28.71			1010.60					D
C4-CHRYSENES	18.54			26.39			938.58					D
BENbFLUORAN	182.27			13.55			3880.18					D
BENkFLUORAN	153.90			7.26			2544.98					D
BENePYRENE	117.14			10.24			2492.28					D
BENaPYRENE	153.82			5.23			2612.82					D
PERYLENE	48.77			113.56			874.52					D
I123cdPYRENE	54.56			2.19			1344.66					D
DBahANTHRA	13.64			0.72			342.68					D
BghiPERYLENE	45.93			2.82			1347.44					D

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J Jackson

POTOMAC RIVER BASIN STUDY - AROMATIC HYDROCARBON DATA (CONT)- 1991

INVEST#:	SITE 1			SITE 1			0			0		
ID:	SAMPLE 2 (DUP)			SAMPLE 1			OWSC-R1			OWSC-R1 (DUP)		
LABSAMNO:	>Q2108			>C3217			>Q2183			>Q2184		
UNIT:	ng/g			ng/g			ng/g			ng/g		
Analyte (Cont)	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL	Conc	DB	QUAL
2-METHYLNAPH	4.59			18.24			1675.44			SAMPLE		D
1-METHYLNAPH	3.49			12.79			1171.28			DILUTED		D
										AND		
2,6-DIMETHNAPH	2.83			9.91			863.28			SURROGATE		D
										LOST		
2,3,5-TRIMETHNAPH	3.56			14.48			538.90					D
1-METHYLPHEN	32.09			12.16			555.60					D
Surrogate Recoveries												
NAPHD8:	74.38			71.32			92.22					D
ACEND10:	94.47			89.51			96.99					D
PHEND10:	93.72			90.67			97.14					D
CHRYD12:	72.21			77.86			92.20					D
PERYD12:	102.70			111.62			105.78					D

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA- 1991

RAW FILE #	C3217P	Q2183P
STATION	SITE1 SAMPLE1 (ppb)	OWSC-R1 (ppb)
TOTAL BHC'S	0.00	0.00
TOTAL CHLORDANES	47.81	30.10
TOTAL DDT'S	1.91	146.88
TOTAL PCB'S	35.9	2752.7
TOXAPHENE	0.00	0.00
TOTAL CL2	2.4	0.0
TOTAL CL3	0.7	21.0
TOTAL CL4	22.9	274.4
TOTAL CL5	9.4	667.1
TOTAL CL6	1.8	1125.2
TOTAL CL7	1.6	574.0
TOTAL CL8	0.6	144.3
TOTAL CL9	0.0	10.8
TOTAL CL10	0.0	0.0
ALPHA-BHC	0.00	0.00
HCB	0.04	2.41
BETA-BHC	0.00	0.00
GAMMA-BHC	0.00	0.00
DELTA-BHC	0.00	0.00
HEPTACHLOR	0.09	0.00
HEPTA-EPOXIDE	1.44	0.00
OXYCHLORDANE	0.73	0.00
GAMMA-CHLORDANE	22.63	2.64
ALPHA-CHLORDANE	12.75	13.33
TRANS-NONACHLOR	7.61	4.64
CIS-NONACHLOR	2.57	9.49
ALDRIN	0.00	8.77
DIELDRIN	0.67	5.23
ENDRIN	0.00	0.00
MIREX	0.00	0.00
2,4'DDE (O,P'DDE)	0.00	4.89
4,4'DDE (P,P'DDE)	0.39	40.75
2,4'DDD (O,P'DDD)	0.03	13.16
4,4'DDD (P,P'DDD)	1.25	68.74
2,4'DDT (O,P'DDT)	0.00	6.83
4,4'DDT (P,P'DDT)	0.24	12.51

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE #	C3217P	Q2183P
	SITE1	
STATION	SAMPLE1	OWSC-R1
	(ppb)	(ppb)
PCB#7 (CL2)	0.0	0.0
PCB#8 (CL2)	2.4	0.0
PCB#18 (CL3)	0.0	0.0
PCB#15 (CL2)	0.0	0.0
PCB#24 (CL3)	0.0	0.0
PCB#16/32 (CL3)	0.0	9.6
PCB#29 (CL3)	0.0	0.6
PCB#26 (CL3)	0.0	0.0
PCB#25 (CL3)	0.0	2.6
PCB#50 (CL4)	3.6	0.0
PCB#31 (CL3)	0.0	0.0
PCB#28 (CL3)	0.2	8.1
PCB#33 (CL3)	0.4	0.0
PCB#22 (CL3)	0.0	0.0
PCB#45 (CL4)	0.0	0.0
PCB#46 (CL4)	0.0	0.0
PCB#52 (CL4)	1.7	89.1
PCB#49 (CL4)	0.5	33.4
PCB#47/48 (CL4)	1.1	61.1
PCB#44 (CL4)	5.8	11.8
PCB#37/42 (CL4)	0.0	0.0
PCB#41/64 (CL4)	0.6	0.0
PCB#40 (CL4)	0.0	0.0
PCB#100 (CL5)	0.0	0.0
PCB#74 (CL4)	1.4	5.5
PCB#70 (CL4)	8.2	27.2
PCB#66 (CL4)	0.0	46.3
PCB#88 (CL5)	5.6	15.8
PCB#60/56 (CL5)	0.1	7.3
PCB#92? (CL5)	0.0	24.1
PCB#84? (CL5)	0.0	16.9
PCB#101 (CL5)	0.6	116.2
PCB#99 (CL5)	0.6	35.4
PCB#83 (CL5)	0.0	0.0
PCB#97 (CL5)	1.1	19.7
PCB#87 (CL5)	0.0	49.1
PCB#85 (CL5)	0.0	14.2
PCB#136 (CL6)	0.0	0.0
PCB#110/77 (CL5/4)	0.4	152.0
PCB#82 (CL5)	0.1	13.8
PCB#151 (CL6)	0.1	67.7
PCB#107/108/144(CL5/	0.0	46.9
PCB#149 (CL6)	0.0	158.9

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

POTOMAC RIVER BASIN STUDY - ORGANOCHLORINE DATA (CONT)- 1991

RAW FILE # STATION	C3217P SITE1 SAMPLE1 (ppb)	Q2183P OWSC-R1 (ppb)
PCB#118/108/149(CL5/	0.8	114.2
PCB#188 (CL7)	0.0	0.0
PCB#146 (CL6)	0.1	43.8
PCB#153 (CL6)	0.3	342.8
PCB#105 (CL5)	0.2	41.5
PCB#141 (CL6)	0.2	115.9
PCB#137 (CL6)	0.0	0.0
PCB#? (CL6)	0.0	0.0
PCB#138 (CL6)	0.6	321.0
PCB#158 (CL7)	0.0	20.4
PCB#129 (CL6)	0.0	6.9
PCB#126 (CL5)	0.2	0.0
PCB#178 (CL7)	0.0	18.7
PCB#187/182/159(CL7/	0.4	97.3
PCB#183 (CL7)	0.1	41.0
PCB#128 (CL6)	0.0	30.1
PCB#167 (CL6)	0.0	0.0
PCB#185 (CL7)	0.0	0.0
PCB#174 (CL7)	0.0	63.4
PCB#177 (CL7)	0.0	55.6
PCB#156/171/202(CL6/	0.4	38.1
PCB#200 (CL8)	0.0	0.0
PCB#172 (CL7)	0.4	21.6
PCB#180 (CL7)	0.5	184.4
PCB#191 (CL7)	0.0	8.3
PCB#170 (CL7)	0.0	0.0
PCB#201 (CL8)	0.1	39.8
PCB#196 (CL8)	0.0	48.8
PCB#189 (CL7)	0.0	0.0
PCB#195 (CL8)	0.5	14.4
PCB#194 (CL8)	0.0	41.4
PCB#205 (CL9)	0.0	0.0
PCB#206 (CL9)	0.0	10.8
PCB#209 (CL10)	0.0	0.0

LABNAME: GERG/TAMU DATE: 06-Mar-92 LAB APPROVAL: Thomas J. Jackson

Appendix III. Biological Data

APPENDIX ~~II~~ III: POTOMAC/ANACOSTIA RIVER STUDY, JUNE 1991

TAXON	AR1			AR2			AR3			AR4			AR5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Oligochaeta (D)	107	124	207	104	169	110	99	93	147	67	29	20	67	50	45
Hirudinea	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Mollusca															
Corbicula manilensis	1	1	1	0	1	0	0	0	1	0	1	0	1	0	0
Sphaeridae unid. gen.	0	0	0	2	0	0	0	12	0	0	0	2	0	1	0
Pisidium spp.	0	0	4	3	0	1	0	1	2	0	0	2	0	1	3
Bithynia tentaculata (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea															
Gammaridae genus A	1	0	2	0	1	0	0	0	0	0	0	0	0	0	0
Gammarus spp.	0	0	10	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus fasciatus	1	0	3	0	0	0	0	0	0	0	0	0	0	0	0
Corophium lacustre	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta															
Ceratopogonidae															
Palpomyia spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaoboridae															
Chaoborus spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroptera															
Caenis spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomidae															
Tanypodinae															
Procladius spp. (D)	28	35	46	6	2	7	0	2	0	2	2	5	2	2	0
Coelotanypus spp.	4	3	3	1	0	4	2	3	4	5	2	5	6	10	1
Tanypus spp.	0	0	2	0	1	0	0	0	1	0	0	0	0	0	0
Larsia spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Genus A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomini															
Chironomus spp.	3	1	2	0	0	0	0	0	0	0	0	0	0	0	0
Cryptochironomus spp.	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0
Dicrotendipes spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harnishia spp.	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
Endochironomus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tanytarsini															
Paratanytarsus spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orthocladiinae															
Orthocladius spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nanocladius sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS	146	164	281	116	174	122	101	111	155	74	34	34	77	66	51
NUMBER OF TAXA	8	5	11	4	5	4	2	4	5	3	4	4	5	6	4

Note: UNID indicates unidentifiable, and not counted as separate taxon.
(D) = DOMINANT TAXON, (R) = RARE TAXON
BENTHIC MACROINVERTEBRATE TAXA PER 0.06m² GRAB

APPENDIX ~~#~~ III: POTOMAC AND ANACOSTIA RIVER STUDY, JUNE 1991.

TAXON	PR4			TB1			TB3			WSC1			WSC3		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Oligochaeta (D)	120	117	30	67	49	35	6	46	60	67	32	63	36	57	34
Hirudinea	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Mollusca															
Corbicula manilensis	2	1	1	0	0	0	1	2	0	1	0	1	0	0	0
Sphaeridae unid. gen.	1	5	2	0	0	0	1	5	2	0	0	0	0	14	0
Pisidium spp.	2	1	1	0	0	0	0	0	0	0	0	0	0	1	2
Bithynia tentaculata (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Valvata sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Crustacea															
Gammaridae genus A	6	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Gammarus spp.	4	0	0	1	0	4	0	0	0	0	0	0	0	0	0
Gammarus fasciatus	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium lacustre	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0
Insecta															
Ceratopogonidae															
Palpomyia spp. (R)	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Chaoboridae															
Chaoborus sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Ephemeroptera															
Caenis spp. (R)	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0
Chironomidae															
Tanypodinae															
Procladius spp. (D)	1	3	0	1	9	4	11	12	9	0	0	1	7	8	0
Coelotanypus spp.	9	6	3	7	7	5	0	2	1	4	1	10	0	1	0
Tanypus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Larsia spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Genus A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Chironomini															
Chironomus spp.	1	2	1	3	9	2	66	69	35	1	0	0	0	3	0
Cryptochironomus spp.	1	4	0	1	1	0	1	2	6	2	0	3	0	0	0
Dicrotendipes spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Harnishia spp.	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Polypedilum spp.	0	0	0	0	0	0	0	4	1	0	0	0	0	0	0
Endochironomus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	1	1	0	0	2	0	1	0	1	0	0	1	0	0	0
Tanytarsini															
Paratanytarsus spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Rheotanytarsus sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Orthocladiinae															
Orthocladius spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nanocladius sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL ORGANISMS	149	141	40	83	78	50	87	145	115	75	33	79	43	84	36
NUMBER OF TAXA	10	8	7	7	5	5	5	9	6	5	2	5	2	5	2

Note: UNID indicates unidentifiable, and not counted as separate taxon.
(D) = DOMINANT TAXON, (R) = RARE TAXON
BENTHIC MACROINVERTEBRATE TAXA PER 0.06m² GRAB

APPENDIX ~~4~~ III: POTOMAC/ANACOSTIA RIVER STUDY, JUNE 1991

TAXON	KL1			KL2			KL3			KL4			KL5		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
Oligochaeta (D)	80	288	59	15	30	42	120	80	144	212	251	187	34	25	11
Hirudinea	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1
Mollusca															
Corbicula manilensis	0	0	0	0	0	0	0	0	0	1	1	1	1	2	1
Sphaeridae unid. gen.	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
Pisidium spp.	0	0	0	1	0	0	0	0	1	0	1	0	0	0	0
Bithynia tentaculata (R)	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Valvata sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Crustacea															
Gammaridae genus A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gammarus fasciatus	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Corophium lacustre	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Insecta															
Ceratopogonidae															
Palpomyia spp. (R)	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Chaoboridae															
Chaoborus spp. (R)	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
Ephemeroptera															
Caenis spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Chironomidae															
Tanypodinae															
Procladius spp. (D)	2	4	0	28	32	46	25	33	29	24	19	28	36	46	25
Coelotanypus spp.	0	0	0	1	0	2	5	1	3	1	1	2	1	1	0
Tanypus spp.	64	331	156	0	0	9	4	2	3	0	0	1	2	3	0
Larsia spp. (R)	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0
Genus A	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
unid. gen.	2	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Chironomini															
Chironomus spp.	19	71	19	0	5	4	0	0	0	0	0	0	2	7	2
Cryptochironomus spp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Dicrotendipes spp.	0	0	0	0	0	0	0	0	0	0	0	1	4	2	0
Harnishia spp.	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Polypedilum spp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Endochironomus spp.	0	0	0	0	0	0	0	0	0	0	0	0	3	0	0
unid. gen.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Tanytarsini															
Paratanytarsus spp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
Rheotanytarsus sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
unid. gen.	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Orthocladiinae															
Orthocladius spp.	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0
Nanocladius sp. (R)	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
unid. spp.	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0
TOTAL ORGANISMS	167	700	234	46	69	103	159	116	180	238	274	221	96	87	41
NUMBER OF TAXA	4	6	3	4	4	5	8	4	5	4	6	6	14	8	6

Note: UNID indicates unidentifiable, and not counted as separate taxon.
(D) = DOMINANT TAXON, (R) = RARE TAXON
BENTHIC MACROINVERTEBRATE TAXA PER 0.06 m^2 GRAB