SEDIMENT SURVEY OF PRIORITY POLLUTANTS IN THE DISTRICT OF COLUMBIA WATERS

- DATA REPORT -

Prepared for:

Interstate Commission on the Potomac River Basin
Rockville, Maryland

90-4

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March 5, 1990

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Executive Summary

Overview

Limno-Tech, Inc. (LTI) conducted a survey of sediment quality in the Potomac River Basin in cooperation with the Interstate Commission on the Potomac River Basin (ICPRB) and the District of Columbia (Department of Consumer and Regulatory Affairs, Water Hygiene Branch). Recent observations of polychlorinated biphenyls (PCB) and chlordane in fish collected in the vicinity of Washington D.C. raised concerns regarding the presence, diversity, and magnitude of contaminants within the basin's waterways. Accordingly, this sediment survey (which measured levels of EPA's priority pollutants) was viewed as the next logical step in evaluating the level of toxic chemical contamination in the District of Columbia portion of the Potomac River Basin. This included areas of the Potomac River ranging from near the fall line at Fletcher's Boat House to the Woodrow Wilson Bridge, the Anacostia River from the Bradenburg Marina to its confluence with the Potomac, the D.C. Shipping Channel, the Tidal Basin and selected confluent tributaries. This document is primarily a data report with minimal data analysis. A summary of pertinent results is, however, provided as a brief synopsis of toxics contamination in the Potomac River Basin sediments.

Sediments are an excellent environmental compartment to survey for defining recent and historical contamination. Many environmental toxic contaminants preferentially partition onto solids and therefore find their long-term fate within aquatic sediments. To preliminarily determine the extent and distribution of sediment contaminant levels, LTI identified 28 sampling locations in consultation with ICPRB and the District of Columbia. Station locations reflected the need to identify both "hotspots" (areas likely to be influenced by direct pollutant sources) and the more typical distribution or levels of contamination throughout these portions of the basin.

Although no formal sediment criteria exist, LTI evaluated sediment contaminant levels by comparison to a limited number of sediment guidelines for Great Lakes sediments established by the U.S. EPA and/or by "indicator" levels based on conservative assumptions. "Indicator" levels refer to conservatively calculated water column concentrations hypothetically related to corresponding sediment levels measured in this project. These indicator levels are compared to the most stringent water quality criteria provided by the U.S. EPA. If an indicator level exceeds a water quality criterion, that parameter is considered worthy of continued concern and investigation. A calculated exceedance, however, is by no means an absolute demonstration of a water quality problem.

Since funding for this project was limited, the primary focus was spent in obtaining a representative number of sediment samples to identify possible sediment contamination throughout the basin. The scope of LTI's analysis was therefore confined to a limited summary and reporting of sediment data. This report provides a:

- concise summary of conclusions and recommendations
- description of methods and station locations
- tabularized summary of analytical results
- full description of laboratory procedures and results.

The remainder of this Executive Summary offers pertinent study conclusions based on the limited data analysis authorized under the original Scope of Work and general recommendations for further study needs. Methods, station locations and a summary of results are found in the remainder of the report. All analytical results, analytical procedures and full QA/QC documentation are appended.

Conclusions

The following summary and conclusions have been made by LTI based on sediment sampling and preliminary data analyses of sediment contaminant data.

- In cooperation with the ICPRB, and with the assistance of D.C. staff from the Blue Plains Wastewater Treatment Plant, Limno-Tech collected sediment cores samples during the period of October 11-13, 1989. All chemical analyses were conducted by ECO LOGIC Laboratories of Toronto, Ontario, a specialized research group having a scientific emphasis.

- Sediment cores were obtained at 28 locations in the Potomac River Basin in the area of the District of Columbia. The top six inches of sediment in each core was analyzed for U.S. EPA priority pollutants using EPA approved analytical techniques or better.

- For nearly half of the priority pollutant analyses, advanced techniques were employed to improve precision and accuracy of measurements and ensure reliable results. These analyses were performed for specific 'target' compounds representing some of the most important organic contaminants on the priority pollutant list. Metals were also analyzed with additional precision. Other EPA accepted, yet less precise priority pollutant scans

were also conducted to determine the presence of a broader range of other priority pollutants not included in the list of target compounds.

- Of the nearly 100 ? currently listed U.S. EPA priority pollutant compounds and derivatives, over 60 (including various related isomers) were detected in sediments from the Potomac River Basin. At all stations examined, EPA sediment guidelines and/or LTI indicator levels (which assume conservative calculations--See Methods section) indicate a basis for contaminant concerns due to the presence of elevated contaminant levels of between three to thirteen priority pollutants per station. The additional EPA priority pollutant scans identified over 100 ? other contaminants not falling on the priority pollutant list. 129

- Since PCB contamination in Potomac River fish is a concern, congener specific PCB analyses were conducted. PCB congener data can provide the necessary information to identify possible toxicity of this compound. In addition, these data can also reveal important information regarding the presence of other more toxic pollutants such as dioxin or furans which typically can not be detected by EPA priority pollutant scans. The PCB congener specific data set for the Potomac River is one of only a handful for aquatic environments world-wide. PCB congener specific data are potentially valuable should additional data analysis be conducted beyond the scope of this report.

- Total PCB distribution in sediments throughout the areas examined appeared relatively low (<2 ppm dry weight) in comparison to other PCB contaminated aquatic systems. Total PCBs in sediments were generally below levels considered as "moderately polluted" by the U.S. EPA for Great Lakes sediments. However, certain specific PCB congener data indicate that dibenzodioxins and dibenzofurans may be present at toxic levels for at least five locations. In addition, LTI conservative calculations indicate that total PCBs at all stations examined are at levels of possible concern assuming EPA criteria for human health (1 in 10^6, 70 year cancer risk level for humans). The in-place PCBs found in Potomac River Basin sediments most likely represent a substantial source of PCBs to Potomac River fish.

- Chlordane levels, also detected above FDA action levels in studies of Potomac River fish, were determined to be of potential concern for at least 8 of 28 stations sampled based on LTI conservative calculations. Chlordane was detected at 26 of 28 stations. As with PCB, sediments represent a likely exposure pathway to aquatic life since the recent commercial use of this material has been banned.

- General contaminant concerns throughout the basin relate to organochlorine pesticides (e.g. DDT, DDE, chlordane....)and PCBs, polycyclic aromatic hydrocarbons (PAHs--most notably benzo (a) pyrene) and numerous heavy metals. Areas with the highest contaminant levels in general appeared in Anacostia River sediments. Certain tributaries also exhibited the presence of three or more priority pollutants above indicator levels.

- Problem areas in the Anacostia generally included portions of the river from the Benning Road Bridge to the South Capitol Street Bridge; the latter area having the highest number of potential priority pollutant concerns observed fro all locations.

- Portions of the Potomac which tended to have higher contaminant levels were depositional zones where solids would more likely settle and accumulate. Some of these areas included the Washington Ship Channel and the Tidal Basin.

- Based on EPA sediment guidelines developed for the Great Lakes, six metals from the priority pollutant list were typically at "heavily polluted" levels. These metals included cadmium, chromium, copper, lead, nickel and zinc. ECO-LOGIC conclusions say 7

- The sediment database generated from these efforts is the first comprehensive documentation of sediment contamination in the Potomac River Basin. Overall, sediments appear to be a major source of contaminants related to recent fish tissue data suggesting bioaccumulation of certain priority pollutants. Sediment data indicate that contamination is widespread.

- Although there are no formal sediment criteria to quantify contaminant concerns, limited EPA sediment guidelines and conservative LTI calculations indicate that several areas of the Potomac and Anacostia Rivers are contaminated by a variety of priority pollutants. The estimated or potential risks to aquatic and human health at numerous locations dictate that further investigations should be conducted to better quantify these concerns. Recommendations in this regard are provided as follows.

Recommendations

Regional authorities and other interested parties may want to pursue more comprehensive evaluation of the toxic contaminant issues in the Potomac River Basin to better define risks and guide regulatory activities. Based on LTI's limited data analysis and conclusions, the following recommendations are being provided to the

ICPRB as a preliminary basis to further address these concerns and to outline future study needs. Recommendations specific to analytical procedures have been provided by ECO LOGIC in the Appendix.

- The amount of valuable information which can be gleaned from the new Potomac River Basin sediment database goes well beyond the scope of the current analysis. If data had indicated no contaminant problems, no further analysis would be necessary. However, since these data reveal sediment contamination by a variety of toxic pollutants, this information should first be used for additional evaluation. This evaluation would serve as the basis for further field and laboratory studies. Additional analysis of these data might include the following aspects:

- examination of spatial or geographical trends in contamination with respect to possible source origins.

- comparisons to other sediment contaminant data from other aquatic systems.

- investigation of sediment accumulation patterns from previous studies to evaluate historical deposition rates to better define the period of record represented by the six inch subsamples.

- additional calculations for all contaminants at elevated levels using contaminant specific partition coefficients (where available) and physical characteristics of the sediments to determine possible pore water concentrations. These concentrations can be related to potential toxicity to benthic organisms and subsequent transport to other biological compartments. This would initially be done for PCB and chlordane but should be expanded to other contaminants which are bioaccumulative (e.g. metals and PAHs).

- qualitative evaluation of possible synergistic or additive effects of pollutant constituents at various stations based on information in the scientific literature.

- review of historical point and nonpoint source discharge data where available to track past or present sources.

- a more detailed evaluation at the specific PCB congener composition to better define actual toxicity potential.

- Once additional analysis of these data is complete and toxics concerns are more clearly delineated, further field and sampling studies should be considered. Depending on funding, and the necessity to proceed with additional work, LTI would recommend that an intensive survey be conducted which would include sampling for water, biota (primarily fish) and sediments for major contaminants of concern. Principal sources such as permitted outfalls and CSOs could be monitored concurrently. If funding for such broad scope sampling is not available, then specific focus on fish contaminant levels would provide a reasonable indication of human exposure concerns. The intensive, broad scope sampling would serve to: a) identify both spatial distribution of the contaminants (if generally related to a possibly source--e.g. a CSO); b) identify the vertical distribution of the contaminants within the sediments, and; c) verify original results. A variety of physical parameters of the sediments should also be analyzed. The water and fish tissue samples would better identify human exposure concerns as well as sediment toxicity to aquatic biota. Other specific sampling considerations include:

- New sediment samples should be obtained at contaminated stations with additional emphasis on highly volatile priority pollutants which were not in specifically examined within the scope of the original sampling program. Select samples were noted in the field or during sample preparation as being highly aromatic. The presence of these types of compounds may be more readily tracked to a particular point source and therefore should be quantified.

- Additional fish samples should be collected and analyzed for a variety of target compounds (i.e. those that are bioaccumulative) in addition to verifying PCB and chlordane contamination. Shellfish contaminant data should also be collected.

- A series of bioassays should be conducted using sediments from a variety of locations. This should be considered as a means to more clearly define the toxic potential of the sediments. These bioassays could use standard test organisms or indigenous species. Full pollutant data from assayed sediment samples combined with bioassay data would better define aquatic toxicity concerns. These tests could initially be run for sediments from selected locations exhibiting greatest contaminant concerns. Additional need for bioassays at other locations could then be evaluated.

- Benthic organism diversity and abundance at a variety of previously sampled locations and new stations should be evaluated. The presence

or absence of benthic life would be a simple but useful indicator of potential problems.

Overall, the detection of numerous priority pollutants above background levels and at potential levels of concern necessitates further study and evaluation. The levels of concern relate to potential risks to both aquatic and human health. The sources of these contaminants likely include historical and ongoing point and nonpoint source loads. Therefore, additional efforts need to be directed at sediment contaminant problems. The first step should be further evaluation of existing data followed by carefully planned and focused sampling and assessment programs.

Methods

This section provides a synopsis of pertinent field sampling methodologies including station selection and station descriptions. All laboratory methodologies are provided in the Appendix along with full documentation of all QA/QC procedures. A subsection below will, however, provide a brief overview of laboratory analyses.

Site Selection and Description

Site selection was critical to the project goal of defining sediment contamination. As such, the first project activity was selecting 28 sites for sediment sampling. The number of sites was based on available funding. Two objectives were used to select these locations. First, discovery of "hotspots" or beds of high contamination was important to identify the magnitude of possible contamination and identify sites posing special risks. The second objective was to characterize typical levels of contamination. Hotspot data alone can misrepresent the overall risk posed by a geographical setting. Therefore, the 28 stations presented in Table 1 represent a mix of both site location objectives. Approximately 19 of these locations correspond to previously established District of Columbia monitoring stations (i.e. those with 3 letter prefix followed by a 2 digit number). Figure 1 provides a map of the locations described in Table 1.

Sample Collection

Sampling stations in both the mainstem Potomac River, Anacostia River and Kingman Lake were accessed via boat. Tributary locations and the Tidal Basin were accessed by land. All sediment samples were collected as sediment cores in 2 inch OD Lexan (polycarbonate) tubing. Tubing was pre-washed with phosphate free detergent, tap water rinsed, acid rinsed (10% nitric acid), rinsed with deionized water and wrapped in aluminum foil until used for sampling.

For stations with depths greater than approximately 2 feet (see Table 1), a Wildco 2" KB™ Core Sampler with a Lexan core tube was gravity driven into sediments and retrieved manually via a winch. For deeper stations, an eggshell core catcher was used in the end of the core tube to retain the intact sediment core within the Lexan tube. For nearly all stations accessible by land, core tubes were driven manually into sediments.

Upon collection of 12 to 28 inches of intact sediments, core tubes were sealed with aluminum foil liner caps, overlying water above the sediment interface was carefully drained, and the core was placed upright on ice in the dark until processed at the end of the sampling day. The stainless steel coring device was scrubbed and rinsed with river water immediately following core retrieval to minimize possible

TABLE 1. STATION DESCRIPTIONS FOR POTOMAC RIVER BASIN SEDIMENT SAMPLING OCTOBER 11-13, 1989.

Station #	Station Location Description	Water Depth (ft.)
ANA-00	Anacostia R. 1500' below Brandenburg Marina	6
ANA-01	Anacostia R. at New York Ave. Bridge	6
ANA-05	Anacostia R. at Hickey Hill	6.5
ANA-08	Anacostia R. at Benning Rd Power So.	6.5
No. 22	Kingman Lake	1
ANA-12	Anacostia R. at NE Boundary Sewer	12
ANA-17	Anacostia R. at 11th Street Bridge	14
ANA-21	Anacostia R. at S. Capital St. Bridge	19
ANA-24	Anacostia R. at Buzzard Point Marina	19
PMS-01	Potomac at Fletchers Boat House	1.5
PMS-10	Potomac at Key Bridge (1000' below Bridge)	12
PMS-13	Potomac at Rock Creek (300' S near seawall)	19
No. 6	Pentagon Lagoon	5
No. 7	Cove above Natl. Airport opposite ramp	1.5
No. 8	Potomac along center of Natl. Airport	2
No. 9	Cove below Natl. Airport 60' S of runway	1
PMS-37	Potomac at Nav. Res. Lab just above pier	8
No. 12	Potomac 1000' off PEPCO Alex. discharge	10
PEC-06	Potomac E. Channel 600' below BP STP dock	5
PMS-44	Potomac at W. Wilson Bridge near VA bank	16
PMS-51	Potomac at Rosier Bluff E. side of channel	22
PWC-06	Wash. Ship Channel off Seafood Wharf	23
No. 15	Tidal Basin: S end of dock near concessions	8
TWB-01	Watts Branch Tidal: 100' below park bridge	1
THR-01	Hickey Run Tidal: 25' below trash rack	1
TLB-01	Lower Beaverdam: 600' above Anacostia	1
No. 2	Rock Creek Tidal: 30' above C&O Canal	1
No. 1	Rock Creek MD Line: at Candy Cane City	1

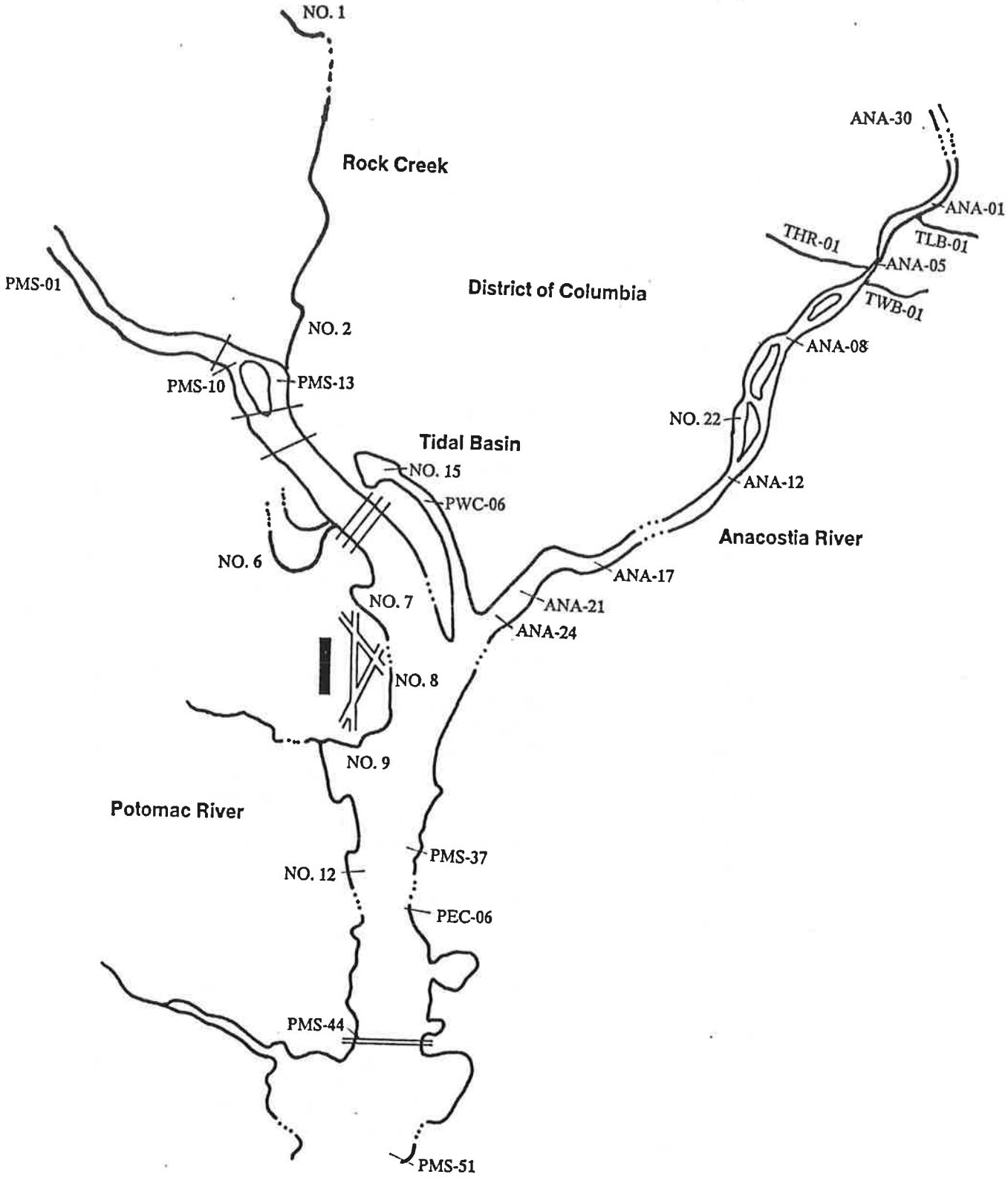

FIGURE 1. LTI SEDIMENT SAMPLING STATIONS IN THE POTOMAC RIVER BASIN, 1989.

cross contamination of subsequent cores. The sediment profile and other pertinent data were recorded before leaving each station.

At the end of each sampling day, the top six inches of each core tube were carefully extruded into stainless steel mixing containers which received similar rinse and decontamination procedures as outlined for core tubes. Extruded sediments from each core were thoroughly homogenized with decontaminated stainless steel spatulas. Before subsampling the homogenized sediment, additional notes on sediment texture, soil moisture content and aromatic nature were recorded. Approximately 100 to 150 grams of extruded and homogenized sediment were placed in pre-prepared glass sample jars and sealed with teflon lined caps. Jars were filled completely and sediments compressed to avoid air pockets where possible.

The remaining core samples were resealed and frozen in upright positions with dry ice for archiving. Analytical samples were carefully packed in coolers on ice. All sample shipment containers were sealed and embossed to ensure their intact condition through transport by overnight courier to the Ann Arbor, Michigan LTI office. Upon receipt of intact coolers in Ann Arbor, sample containers were personally relinquished to representatives of ECO LOGIC. All samples remained sealed and undisturbed through shipment and upon arrival at ECO LOGIC laboratories. Chain-of-Custody forms accompanied all sample transactions.

Sample Analysis

ECO LOGIC Laboratories conducted priority pollutant analyses of sediment samples following strict QA/QC procedures and EPA related analytical requirements. Since the EPA recommended full scan GC/MS techniques are for a broad range of parameters, they typically do not provide adequate detection limits which were deemed necessary to accurately define sediment contamination in the Potomac River Basin. Therefore, ECO LOGIC employed more sophisticated analytical procedures derived from other EPA methodologies to a host of 'target' organic compounds. These target compounds represent selected organic parameters from the priority pollutant list. They are also representative of some of the more commonly observed pollutants within each class of compounds.

In addition to the over sixty 'target' compounds, all metals on the priority pollutant list were analyzed. Full scan GC/MS analyses were also conducted to identify other compounds (including priority pollutants) which were not detected with the more precise techniques. All sediment cores have been archived by ECO LOGIC and will be stored for up to two years.

Results

Limno-Tech has conducted a preliminary analysis of sediment data to identify priority pollutants which may be present at significant levels of concern. This section will focus primarily on LTI's conservative approach to identify these possible concerns. The Executive Summary provides the most significant highlights of LTI's preliminary analysis and findings.

To identify potential contaminant concerns in Potomac River Basin sediments, LTI used two approaches. The first was based on guidelines developed by the EPA for classifying sediment contamination in the Great Lakes. The list of guidelines, however, is restricted to a limited number of pollutants including only heavy metals and total PCBs. Appendix B provides these guidelines; the Executive Summary highlighted comparisons between Potomac sediments and these guidelines.

The second approach to evaluate sediment contaminant concerns was based on very conservative assumptions regarding pollutant origin and toxicity. Water column concentrations were calculated assuming that the pollutant mass in the sediments is the origin of suspended particulate matter in the water column. The calculation is therefore:

$$\text{Water Conc. } (\mu g/l) = \text{Sediment Conc. } (ng/g) * \text{Suspended Solids Conc. } (mg/l) * 10^{-6}$$

Based on <u>approximate averages</u> for suspended solids from 1983-1987 (as determined from the District of Columbia 305 (b) Report, 1988), values of 23 mg/l and 30 mg/l were used for the Potomac and Anacostia Rivers, respectively. Tributaries were assigned similar values depending on the discharge location.

The back-calculated water column concentration or ***"indicator level"*** was compared to the most stringent EPA criteria provided for priority pollutants. Typically, these criteria levels related to human health concerns (1 in 10^6, 70 year cancer risk level) or to chronic criteria for aquatic biota if more stringent. Indicator levels are by no means, however, an absolute demonstration of risk. They are simply conservative calculations used only to indicate possible concern. Appendix B provides a list of the criteria used to determine indicator levels for 'target' organic compounds and metals.

Table 2 provides a summary analysis of priority pollutants calculated to be above "indicator levels" by station and by major class of compound. The values

presented in this table indicate that for any particular station, a number of priority pollutants within a pollutant class may be at potential levels for concern. This table illustrates that for all areas examined, anywhere from three to thirteen priority pollutants are at levels of potential concern. Organochlorine pesticides and metals appear to be of greatest concern while there are strong indications that PAHs may also be at elevated levels.

TABLE 2. NUMBER OF TARGET PRIORITY POLLUTANT COMPOUNDS AND METALS AT LEVELS OF POSSIBLE CONCERN[1] (LISTED BY MAJOR CLASS OF COMPOUND).

Number of Priority Pollutants Above Indicator Levels per Class of Compound

Station	Polycyclic Aromatics (4)[2]	Haloethers (4)	Chlorinated Hydrocarbons (6)	Organochlorine Pesticides[3] (13)	Phthalate Esters (4)	Metals (14)	# Observed/Total Possible (%) (45)
ANA-30	1	0	0	3	0	2	13.3
ANA-01	1	0	0	3	0	2	13.3
ANA-05	1	0	0	2	0	2	11.1
ANA-08	1	0	0	5	0	2	17.8
NO. 22	1	0	0	5	0	4	22.2
ANA-12	1	0	0	5	0	3	20.0
ANA-17	1	0	0	5	0	4	22.2
ANA-21	1	0	0	6	0	6	28.9
ANA-24	1	0	0	3	0	4	17.8
PMS-01	1	0	0	2	0	2	11.1
PMS-10	1	0	0	2	0	2	11.1
PMS-13	1	0	0	2	0	2	11.1
NO. 6	1	0	0	2	0	2	11.1
NO. 7	1	0	0	1	0	2	8.9
NO. 8	0	0	0	1	0	2	6.7
NO. 9	1	0	0	1	0	2	8.9
PMS-37	1	0	0	1	0	2	8.9
NO. 12	1	0	0	1	0	2	8.9
PEC-06	1	0	0	1	0	2	8.9
PMS-44	1	0	0	1	0	2	8.9
PMS-51	1	0	0	1	0	2	8.9
PWC-06	1	0	0	3	0	5	20.0
NO. 15	1	0	0	3	0	3	15.6
TWB-01	1	0	0	3	0	2	13.3
THR-01	0	0	0	1	0	2	6.7
TLB-01	1	0	0	4	0	2	15.6
NO. 2	1	0	0	2	0	2	11.1
NO. 1	1	0	0	1	0	2	8.9
Total	26	0	0	70	0	71	13.3

1 Level of concern based on conservative calculations (see Methods Section for explanations).

2 Number in parentheses indicates total number of organic and metals pollutants examined for each class of compound which can be compared to a specific EPA priority pollutant criterion. These also include those target compounds only listed in the main body of the Appended Data Report and not full scan data.

3 Includes Total PCBs.

APPENDIX A. ECO LOGIC Data Report

ECO LOGIC

F I N A L R E P O R T

Analysis of Priority Pollutants in Sediment from the Potomac River

January 23, 1990

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1. INTRODUCTION

Eco Logic was commissioned by Limno-Tech to provide the analysis of priority pollutants in sediment from the Potomac river.

Twenty eight core sediment samples were collected by Limno-Tech from various sites in the river between October 11, 1989 and October 13, 1989. These were immediately frozen and delivered to Eco Logic. The upper six inches of sediment were homogenized and subsampled for analysis of organic contaminants and metals. The remaining core samples have been archived and are available for future analysis.

A broad scan analysis was used to determine the presence of priority pollutants listed in section 307 of the Clean Water Act. A specified list of target compounds that were selectively analysed is presented below.

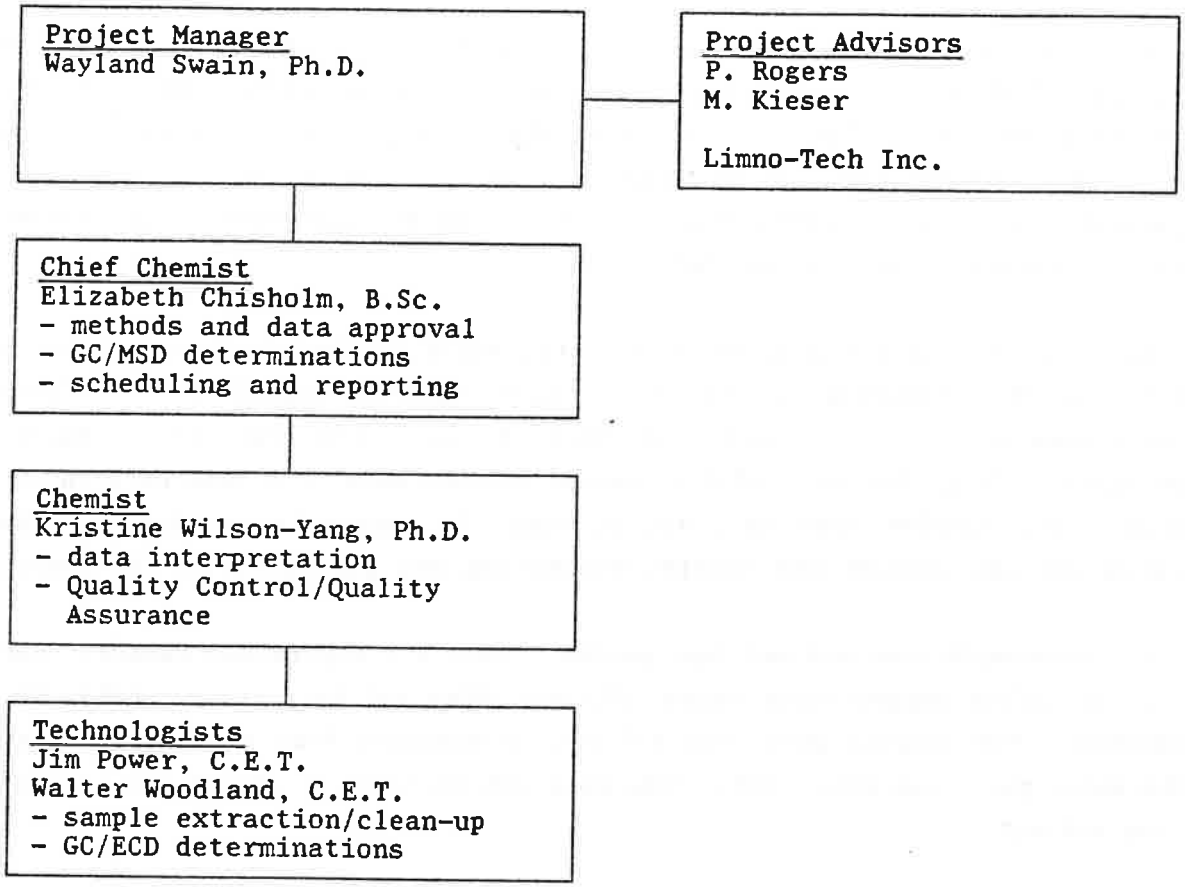
CHLOROBENZENES	1,2-Dichlorobenzene 1,3-Dichlorobenzene 1,4-Dichlorobenzene Hexachlorobenzene Hexachlorobutadiene Hexachlorocyclopentadiene Hexachloroethane 1,2,4-Trichlorobenzene
ORGANOCHLORINE PESTICIDES	DDE DDD DDT Chlordanes α-BHC Lindane Mirex Nonachlor Aldrin Dieldrin Endrin Endosulphans Methoxychlor Heptachlor Heptachlor Epoxide
CONGENER SPECIFIC PCBs	

POLYAROMATIC HYDROCARBONS	Acenaphthene Acenaphthylene Anthracene Benzo (a) anthracene Benzo (a) pyrene Benzo (b) fluoranthene Benzo (ghi) perylene Benzo (k) fluoranthene Chrysene Dibenzo (ah) anthracene Fluoranthene Fluorene Indeno (1,2,3-cd) pyrene Naphthalene Phenanthrene Pyrene
PHTHALATES	Dimethyl phthalate Diethyl Phthalate Di-n-Butyl Phthalate Benzyl Butyl Phthalate Bis (2-ethylhexyl) Phthalate Di-n-octyl Phthalate
HALOETHERS	Bis (2-chloroethyl) ether Bis (2-chloroisopropyl) ether 4-Bromophenyl phenyl ether 4-Chlorophenyl phenyl ether
METALS	Antimony Arsenic Beryllium Cadmium Chromium Copper Cyanide Lead Mercury Nickel Selenium Silver Thallium Zinc

The project team involved in all phases of the analyses is illustrated in Figure 1.1.

Figure 1.1

ECO LOGIC PROJECT TEAM



2. METHODOLOGY

2.1 Extraction Procedure

Ten grams of celite 545 were weighed into a soxhlet thimble. Three hundred millilitres of 60 percent acetone/40 percent hexane were added to a 500 mL round-bottom flask and the soxhlet apparatus assembled. This solvent system was used in place of methylene chloride to allow for the extraction of wet sediments. The solvent was cycled at least three times through the apparatus. The system was cooled and the solvent discarded.

Ten to fifteen grams of sediment was accurately weighed in the pre-cleaned soxhlet thimble containing celite 545. Three hundred millilitres of fresh acetone/hexane and 1 g of acid-cleaned copper filings were added to the round-bottom flask. The copper was added to remove sulphur which may have been in the sediment. The samples were then spiked with the surrogate standards. The apparatus was reassembled and soxhlet extraction was performed for 16 hours.

The acetone/hexane extract was poured into a 2 L separatory funnel. One litre of acidified organic-free water (OF) was added and the extract shaken for two minutes. The organic phase was allowed to separate from the water phase, and the water phase was discarded. This step was included to remove the acetone from the extract.

The combined extract was poured through a solvent-rinsed drying column containing anhydrous sodium sulphate to a depth of 10 cm, and collected in a round-bottom flask. The round-bottom flask and column were then rinsed with 20 to 30 mL of hexane to complete the quantitative transfer. The extract was concentrated to exactly 1 mL, first using a Snyder column, followed by a Kaderna Danish condenser.

2.2 Cleanup and Separation Procedure

The 1 mL sample was treated with mercury to remove any remaining traces of sulphur. A 500 mm x 10 mm i.d. chromatographic column equipped with a plug of silanized glass wool and a teflon stopcock was filled using a hexane slurry of 5 g activated silica gel. Sodium sulphate to a depth of 1 cm was then added to the top of the column, and the column rinsed with another 50 mL of hexane. The rinsings were then discarded.

The concentrated hexane sample extract was then quantitatively transferred into the column with a disposable Pasteur pipet. One hundred microlitres of the uncleaned extract was saved for analysis by full scan gas chromatography/mass spectrometry.

As the extract was just entering the sodium sulphate layer, the column was eluted with 50 mL of hexane and the eluent collected in a 250 mL round-bottom flask. This was Fraction A, and it contained chlorobenzenes, chlorinated pesticides and polychlorinated biphenyls (PCBs). The elution of the silica gel column was continued using 60 mL of 40/60 dichloromethane/hexane and the eluent collected into a second 250 mL round-bottom flask. This was Fraction B, and it contained polyaromatic hydrocarbons (PAHs) and haloethers. Finally the column was eluted with 50 mL of 10/90 Acetone/hexane and the eluent then collected into a third 250 mL round-bottom flask. This was Fraction C, and it contained the phthalate esters. Each fraction was then evaporated to exactly 1 mL using a Snyder column followed by a Kaderna Danish condenser.

2.3 Instrumental Analysis

2.3.1 Gas Chromatography

The chlorinated hydrocarbons and congener-specific PCBs in Fraction A were analysed using a Hewlett-Packard model 5890 Gas Chromatograph with dual capillary columns and electron capture detection (GC/ECD).

The GC/ECD was equipped with a 30 m DB-5 and a 30 m DB-17 capillary column of 0.25 mm inner diameter (ID) and 0.25 µm film thickness. The temperature program is given in Table 2.1. The injector temperature was set at 250°C, and the detector temperature was set at 300°C. The injection port was operated in a splitless mode with a purge delay of 1 minute. A 5 µL injection was used. The gas chromatograph was calibrated daily, using an external standard calibration technique.

2.3.2 Gas Chromatography/Mass Spectrometry

The uncleaned hexane extract was analyzed for the complete list of priority pollutants, section 307 of the Clean Water Act, using a Hewlett-Packard Model 5890 Gas Chromatograph, equipped with a Hewlett-Packard Model 5970 Mass Selective Detector (GC/MSD). A full scan technique, monitoring ions of m/z 40 to m/z 550, was employed.

The haloethers and PAHs in Fraction B and phthalate esters in Fraction C were also analyzed using a GC/MSD operated in the selected ion monitoring mode (SIM). The qualitative identification of parameters was accomplished using a primary ion, usually the base peak, and a secondary confirming ion. Tables 2.2, 2.3 and 2.4 show these ions.

The GC/MSD was equipped with a 25 m HP-5 column of 0.20 mm ID and 0.11 µm film thickness. The temperature programs used to separate all compounds in each set of parameters are shown in Table 2.1. The injector temperature was set at 280°C, and the transfer line temperature was also set at 280°C. The injection port was operated in a splitless mode with a purge delay of 0.5 minutes. A 3 µL injection volume was used.

The concentrations of the analytes were calculated using an internal standard technique. The integrated abundance of the primary ion was used for these calculations.

A schematic representation of the complete analytical procedure is illustrated in Figure 2.1.

Table 2.1 TEMPERATURE PROGRAMS FOR GAS CHROMATOGRAPHIC METHODS

PARAMETER	ANALYTICAL SYSTEM	TEMPERATURE PROGRAM							
		INITIAL TEMP (oC)	INITIAL HOLD (min)	RAMP1 (oC/min)	FINAL TEMP (oC)	FINAL HOLD (min)	RAMP2 (oC/min)	FINAL TEMP (oC)	FINAL HOLD (min)
ORGANOCHLORINE PESTICIDES CHLOROBENZENES PCBs	GC/ECD	50	2	2	260	15	-	-	-
UNCLEANED EXTRACT (PRIORITY POLLUTANTS)	GC/MSD FULL SCAN	50	2	4	280	10	-	-	-
PAHs	GC/MSD SIM	70	3	30	160	0	2.5	280	10
PHTHALATES	GC/MSD SIM	50	2	25	180	0	2	230	15
HALOETHERS	GC/MSD SIM	50	5	10	200	0	20	250	5

Table 2.2 IONS FOR POLYAROMATIC HYDROCARBONS GC/MSD ANALYSIS

	Characteristic Ions (m/z)	
	Quantitation Ion	Confirmation Ion
Naphthalene	128	129
Acenaphthylene	152	151
Acenaphthene	154	153
Fluorene	166	165
Phenanthrene	178	179
Anthracene	178	179
Fluoranthene	202	101
Pyrene	202	101
Benzo(a)anthracene	228	229
Chrysene	228	229
Benzo(b)fluoranthene	252	253
Benzo(k)fluoranthene	252	253
Benzo(a)pyrene	252	253
Indeno(123-cd)pyrene	276	138
Dibenzo(ah)anthracene	278	139
Benzo(ghi)perylene	276	138

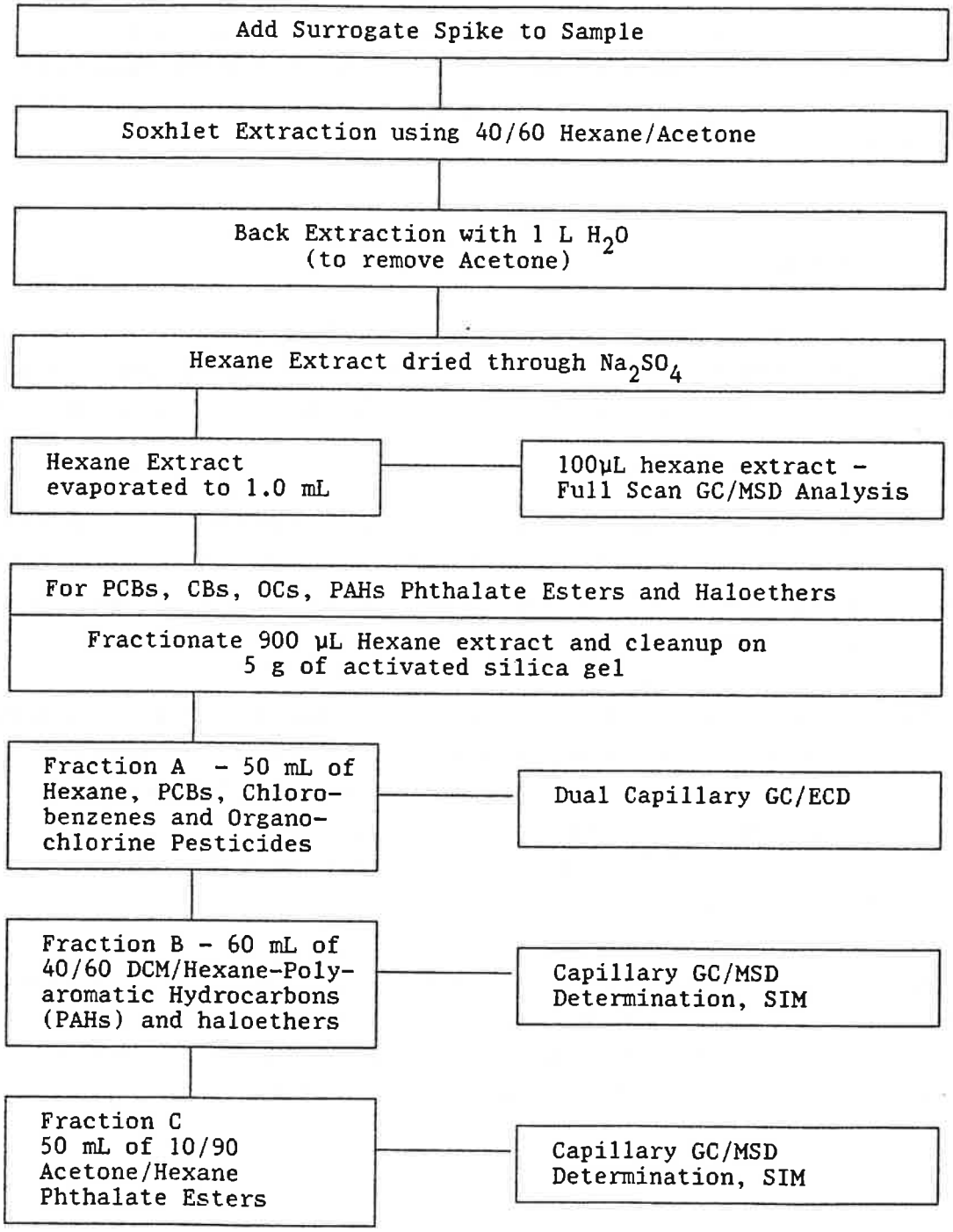
TABLE 2.3 IONS FOR HALOETHERS GC/MSD ANALYSIS

	Characteristic Ions (m/z)	
	Quantitation Ion	Confirmation Ion
Bis(2-chloroethyl)ether	93	63
Bis(2-chloroisopropyl)ether	45	77
4-bromophenyl phenyl ether	248	250
4-chlorophenyl phenyl ether	204	206

TABLE 2.4 IONS FOR PHTHALATE ESTERS GC/MSD ANALYSIS

	Characteristic Ions (m/z)	
	Quantitation Ion	Confirmation Ion
Dimethyl Phthalate	163	194
Diethyl Phthalate	149	177
Dibutyl Phthalate	149	150
Butyl Benzyl Phthalate	149	91
Bis(2-ethylhexyl)Phthalate	149	167
Di-n-octyl Phthalate	149	167

Figure 2.1 SCHEMATIC OF ANALYTICAL PROCEDURE SEDIMENT/SOIL SAMPLES



2.4 Inorganic Analysis

The analysis of metals involved air drying the sediment sample and further pulverizing using a mortar and pestle. After homogenizing, a subsample was treated by mixed acid digestion. The mercury was analysed by cold vapour atomic absorption spectroscopy (AA). Lead was determined using flame emission AA. Arsenic and antimony concentrations were determined by hydride generation AA and selenium by graphite furnace AA. All remaining metals were analysed by plasma emission AA.

3. RESULTS

Table 3.1 gives a cross reference of Limno-Tech sample identification and Eco Logic laboratory numbers. The results for all determinations are given in Tables 3.2 to 3.9. The units of concentration vary between organic and inorganic data.

All final calculations were based on a dry weight of the sediments. The moisture content of each sample is given in Table 3.9. The results have been corrected for the blank and the appropriate surrogate recoveries. Detection limits for all compounds are listed in Table 3.2

The values for chlorobenzenes, organochlorine pesticides and PCBs were determined by dual column gas chromatography with electron capture detection. Positive values were reported only when the result was confirmed on both columns. The columns employed have substantially different polarities of the stationary phase, thus, the possibility of an interference occurring for a particular compound on both columns is negligible.

All remaining target parameters were analysed using a Gas Chromatograph equipped with a mass selective detector. The presence of a compound was confirmed only when both the primary and confirming ions were detected in the correct ratios, as compared to the authentic standard.

In certain cases, compounds were positively identified as trace amounts, but since levels were below the method detection limit, these values are labelled "t" for trace, and should not be considered as precise values. Method Detection Limits (MDLs) represent the concentration which would yield a 3:1 signal to noise level. The noise is determined based on the average background level in the actual sample matrix for each type of analysis.

The mass chromatograms produced by the full scan analysis of the uncleaned extract were integrated. The mass spectra for all peaks above a specific abundance were searched against the National Bureau of Standards Library. This data base consists of 140,000 mass spectra including those for the compounds identified as priority pollutants in section 307 of the clean water act. All matches with a purity of fit greater than 60 percent are included in Appendix A of this report.

Table 3.1 SAMPLE IDENTIFICATION

ECO LABS ID	LIMNOTECH SAMPLE ID	SAMPLE MASS (g)
89-00535	ANA-17	5.14
89-00536	ANA-08	8.37
89-00537	PEPCO #2	5.41
89-00538	ANA-24	5.03
89-00539	ANA-12	6.24
89-00540	KING LAKE 22	5.51
89-00541	ANA-21	6.16
89-00542	PWC-06	3.93
89-00543	NATAP MID #8	8.01
89-00544	NATAP N #7	11.31
89-00545	PMS-13	11.55
89-00546	PMS-10	5.45
89-00547	ANA-30	10.32
89-00548	ANA-01	9.23
89-00549	ANA-05	9.71
89-00550	PMS-37	7.10
89-00551	TWB-01	11.33
89-00552	THR-01	12.16
89-00553	TLB-01	8.01
89-00554	TIDAL BASIN	6.03
89-00555	PMS-51	7.83
89-00556	PMS-44	7.11
89-00557	PEC-06	11.17
89-00558	NATAP S #9	11.74
89-00559	PENTAGON #6	7.81
89-00560	LWR ROCK CRK.	15.73
89-00561	FLETCHER B.H.	10.94
89-00562	UP ROCK CRK.	12.93

TABLE 3.2 DETECTION LIMITS

CHLOROBENZENES, ORGANOCHLORINE PESTICIDES, PCBs (GC/DUAL ECD)	METHOD DETECTION LIMIT (ng/g)
1,2-dichlorobenzene	5.5
1,3-dichlorobenzene	5.5
1,4-dichlorobenzene	5.5
Hexachlorobenzene	0.4
Hexachlorobutadiene	0.4
Hexachlorocyclopentadiene	0.4
Hexachloroethane	0.4
1,2,4-trichlorobenzene	0.6
DDT	0.08
DDD	0.08
DDE	0.08
α-BHC	0.07
Lindane	0.07
Chlordanes	0.07
Mirex	0.07
Aldrin	0.07
Dieldrin	0.07
Endrin	0.07
Endosulphanes	0.07
Methoxychlor	0.07
Heptachlor	0.07
Heptachlor Epoxide	0.07
Congener Specific PCBs	0.05
POLYAROMATIC HYDROCARBONS (GC/MSD)	**(ng/g)**
Naphthalene	0.4
Acenaphthylene	0.3
Acenaphthene	0.5
Fluorene	0.4
Phenanthrene	0.4
Anthracene	0.4
Fluoranthene	0.5
Pyrene	0.6
Benzo(a)anthracene	2
Chrysene	1
Benzo(b)fluoranthene	3
Benzo(k)fluoranthene	3
Benzo(a)pyrene	3
Indeno(123-cd)pyrene	4
Dibenzo(ah)anthracene	4
Benzo(ghi)perylene	4

TABLE 3.2 (continued) DETECTION LIMITS

PHTHALATES (GC/MSD)	(ng/g)
Dimethyl phthalate	3
Diethyl phthalate	3
Butyl benzyl phthalate	4
Bis(2-ethylhexyl)phthalate	10
Dibutyl phthalate	10
Di-n-octyl phthalate	9
HALOETHERS (GC/MSD)	**(ng/g)**
Bis(2-chloroethyl)ether	1
Bis(2-chloroisopropyl)ether	0.7
4-bromophenyl phenyl ether	4
4-chlorophenyl phenyl ether	2
METALS	**(µg/g)**
Cadmium	2
Chromium	2
Copper	2
Nickel	2
Zinc	2
Antimony	0.4
Arsenic	0.4
Beryllium	1
Lead	10
Selenium	5
Mercury	0.01
Silver	2
Titanium	5

Table 3.3 CONCENTRATIONS OF CHLOROBENZENES IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543	89-00544
1,2-Dichlorobenzene	11	21	< 5.5	16	44	25	45	12	< 5.5	4.3t
1,3-Dichlorobenzene	< 5.5	< 5.5	< 5.5	< 5.5	< 5.5	< 5.5	7.5	< 5.5	< 5.5	0.31t
1,4-Dichlorobenzene	21	13	12	48	170	71	100	43	6.1	16
Hexachlorobenzene	2.6	0.94	0.44	0.96	2.8	2.2	6.5	1.3	0.08t	0.13t
Hexachlorobutadiene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Hexachloroethane	0.11t	< 0.4	< 0.4	< 0.4	0.18t	0.10t	0.12t	< 0.4	< 0.4	< 0.4
1,3,5-Trichlorobenzene	2.6	1.2	< 0.6	1.3	3.0	2.1	3.3	0.93	< 0.6	0.36
1,2,4-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,2,3-Trichlorobenzene	0.36t	0.61	0.02t	< 0.6	1.1	0.66	2.7	< 0.6	< 0.6	0.17t
1,2,4,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	0.70	1.1	< 0.4	< 0.4
1,2,3,5-Tetrachlorobenzene	0.61	< 0.4	< 0.4	< 0.4	0.59	0.67	< 0.4	0.72	0.24t	0.31t
1,2,3,4-Tetrachlorobenzene	0.43	0.57	0.32t	0.83	0.43	0.66	1.8	1.9	< 0.4	1.4
Pentachlorobenzene	0.58	0.47	0.27t	0.35	1.4	0.88	< 0.4	0.88	< 0.4	0.50

COMPOUND	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552	89-00553	89-00554
1,2-Dichlorobenzene	22	< 5.5	< 5.5	19	12	5.7	25	4.1t	17	10
1,3-Dichlorobenzene	5.1t	0.11t	3.6t	7.4	< 5.5	4.9t	3.7t	< 5.5	2.1t	12
1,4-Dichlorobenzene	39	11	5.4	8.9	25	5.7	5.9	5.1t	20	42
Hexachlorobenzene	0.29t	0.35t	0.51	0.71	< 0.4	0.48	1.1	< 0.4	1.2	1.1
Hexachlorobutadiene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Hexachloroethane	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,3,5-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	1.6	0.47t	1.0	< 0.6	0.42t	3.1
1,2,4-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,2,3-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	0.42t	< 0.6	0.38t	< 0.6	< 0.6	0.05t
1,2,4,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	0.19t	< 0.4	0.18t	< 0.4	< 0.4	< 0.4
1,2,3,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	0.16t	< 0.4	0.59	2.3
1,2,3,4-Tetrachlorobenzene	< 0.4	0.36t	< 0.4	< 0.4	1.1	0.38t	0.71	< 0.4	0.70	1.1
Pentachlorobenzene	0.30t	0.28t	0.38t	0.50	0.29t	0.43	1.3	< 0.4	0.19t	2.0

COMPOUND	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
1,2-Dichlorobenzene	7.6	16	5.9	9.2	8.5	5.2t	9.8	4.9t
1,3-Dichlorobenzene	3.0t	< 5.5	< 5.5	1.6t	0.86t	0.73t	< 5.5	0.07t
1,4-Dichlorobenzene	25	24	8.4	8.6	23	5.0	5.8	< 5.5
Hexachlorobenzene	0.46	0.59	0.14t	0.51	0.55	0.22t	0.30t	0.08t
Hexachlorobutadiene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Hexachloroethane	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,3,5-Trichlorobenzene	0.45t	0.70	< 0.6	< 0.6	0.91	< 0.6	< 0.6	< 0.6
1,2,4-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,2,3-Trichlorobenzene	0.02t	< 0.6	< 0.6	< 0.6	0.26	< 0.6	< 0.6	< 0.6
1,2,4,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	0.90	< 0.4	< 0.4	< 0.4
1,2,3,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	0.63	< 0.4	< 0.4	< 0.4
1,2,3,4-Tetrachlorobenzene	0.50	0.56	< 0.4	0.30t	2.1	0.47	0.19t	< 0.4
Pentachlorobenzene	0.25t	0.52	0.10t	0.36t	0.36t	0.24t	0.26t	0.07t

Table 3.4 CONCENTRATIONS OF ORGANOCHLORINE PESTICIDES IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
DDT	2.7	2.6	0.67	1.1	2.7	2.3	6.1	0.88	< 0.08
DDD	2.7	0.56	0.31	0.55	1.7	< 0.08	2.0	0.20	< 0.08
DDE	35	15	6.1	29	27	35	< 0.08	27	< 0.08
a-BHC	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	4.5	1.2	< 0.07
LINDANE	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	7.7	< 0.07	< 0.07
g-CHLOR	20	17	1.3	11	28	27	41	3.1	0.38
NONACHLOR	28	20	2.5	11	32	30	32	2.8	0.11
a-CHLOR	< 0.07	14	< 0.07	< 0.07	36	28	32	9.3	< 0.07
MIREX	0.42	< 0.07	< 0.07	< 0.07	< 0.07	0.52	< 0.07	0.34	< 0.07
ALDRIN	4.0	3.9	1.0	0.60	6.2	3.4	26	5.7	0.22
DIELDRIN	5.7	3.0	< 0.07	< 0.07	6.1	5.4	31	5.4	< 0.07
ENDRIN	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
a-ENDO	< 0.07	12	0.70	1.0	13	18	58	3.4	0.14
b-ENDO	< 0.07	< 0.07	0.14	0.21	0.80	0.34	1.5	0.31	0.16
METHOXYCHLOR	< 0.07	20	6.1	6.5	4.1	< 0.07	< 0.07	< 0.07	< 0.07
HEPTACHLOR	0.82	0.92	0.36	0.50	2.0	1.0	9.9	0.88	< 0.07
HEPTACHLOR EXPOXIDE	0.20	0.24	0.56	0.33	1.1	1.4	3.1	0.20	< 0.07

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
DDT	< 0.08	9.1	1.5	5.4	1.0	9.5	0.73	3.0	< 0.08
DDD	0.25	1.8	0.74	2.2	2.1	< 0.08	0.25	1.6	< 0.08
DDE	3.8	12	7.2	10	10	< 0.08	9.6	< 0.08	< 0.08
a-BHC	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	0.45	< 0.07	< 0.07	< 0.07
LINDANE	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	0.92	< 0.07	< 0.07	< 0.07
g-CHLOR	< 0.07	4.8	0.95	9.0	20	2.6	2.3	15	< 0.07
NONACHLOR	0.42	7.0	2.0	16	13	< 0.07	3.6	< 0.07	< 0.07
a-CHLOR	< 0.07	4.8	1.1	7.4	< 0.07	2.9	< 0.07	< 0.07	< 0.07
MIREX	< 0.07	< 0.07	< 0.07	0.19	0.31	< 0.07	< 0.07	< 0.07	< 0.07
ALDRIN	0.30	0.56	0.56	1.1	1.6	0.86	0.86	3.5	0.24
DIELDRIN	1.2	1.3	0.74	1.8	1.8	< 0.07	1.1	< 0.07	< 0.07
ENDRIN	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
a-ENDO	8.9	2.6	1.6	2.9	9.7	4.2	2.7	5.6	< 0.07
b-ENDO	0.25	< 0.07	< 0.07	0.10	< 0.07	< 0.07	0.12	< 0.07	< 0.07
METHOXYCHLOR	25	8.4	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	3.3	< 0.07
HEPTACHLOR	0.37	0.30	0.40	1.4	0.54	0.26	0.53	3.8	< 0.07
HEPTACHLOR EXPOXIDE	< 0.07	0.18	< 0.07	0.16	2.0	< 0.07	0.19	< 0.07	< 0.07

COMPOUND	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
DDT	1.2	20	0.53	0.48	< 0.08	< 0.08	1.3	10	16	0.81
DDD	0.24	1.2	0.57	0.74	< 0.08	0.36	2.9	0.43	0.47	0.81
DDE	< 0.08	78	6.4	7.8	0.23	3.3	21	5.1	19	0.49
a-BHC	< 0.07	0.30	< 0.07	< 0.07	0.08	0.10	0.28	0.06	0.09	< 0.07
LINDANE	1.8	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
g-CHLOR	29	5.1	2.0	3.0	0.13	0.89	2.2	4.6	0.46	1.1
NONACHLOR	33	3.8	2.2	2.8	0.11	0.80	1.9	4.4	1.6	2.3
a-CHLOR	< 0.07	6.4	< 0.07	< 0.07	0.16	0.71	2.2	< 0.07	2.2	< 0.07
MIREX	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07
ALDRIN	6.3	0.57	0.66	0.99	0.09	1.0	0.78	0.33	0.59	0.09
DIELDRIN	< 0.07	14	< 0.07	< 0.07	< 0.07	< 0.07	2.2	< 0.07	< 0.07	< 0.07
ENDRIN	< 0.07	< 0.07	< 0.07	< 0.07	< 0.07	0.09	< 0.07	< 0.07	< 0.07	< 0.07
a-ENDO	15	40	0.29	3.2	0.15	0.18	0.97	2.1	0.98	0.19
b-ENDO	0.26	1.4	0.28	0.28	< 0.07	0.10	0.33	0.05t	0.12	0.06
METHOXYCHLOR	< 0.07	< 0.07	4.6	0.78	0.86	1.5	21	1.9	2.3	0.49
HEPTACHLOR	1.3	0.98	< 0.07	0.19	0.22	0.05	0.45	0.20	0.34	0.33
HEPTACHLOR EXPOXIDE	3.5	2.3	0.53	0.81	0.16	0.88	0.38	0.26	0.69	< 0.07

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
A. Samples 89-00535 to 89-00543

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
PCB 1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PBC 3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	110	< 0.05	< 0.05
PBC 4 & 10	< 0.05	0.34	< 0.05	0.30	1.1	< 0.05	< 0.05	< 0.05	< 0.05
PCB 7	< 0.05	< 0.05	< 0.05	< 0.05	0.34	< 0.05	< 0.05	< 0.05	< 0.05
PCB 6	< 0.05	0.41	< 0.05	0.65	1.4	0.91	2.9	0.54	< 0.05
PCB 8 & 5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	18	< 0.05	< 0.05
PCB 19	< 0.05	< 0.05	< 0.05	< 0.05	2.1	< 0.05	< 0.05	< 0.05	< 0.05
PCB 12	0.64	0.36	0.33	< 0.05	3.6	< 0.05	< 0.05	< 0.05	< 0.05
PCB 13	< 0.05	< 0.05	< 0.05	< 0.05	0.85	< 0.05	< 0.05	< 0.05	< 0.05
PCB 18	4.0	3.0	3.3	5.5	5.0	4.7	9.5	3.4	< 0.05
PCB 17	14	6.4	0.75	7.5	8.0	14	22	7.4	< 0.05
PCB 24 & 27	< 0.05	0.34	< 0.05	< 0.05	0.64	0.37	< 0.05	< 0.05	< 0.05
PCB 16 & 32	4.7	3.6	2.3	3.8	3.9	4.7	9.5	2.3	0.15
PCB 26	1.1	7.9	1.1	4.5	12	11	17	2.7	0.27
PCB 25	0.32	0.43	< 0.05	< 0.05	< 0.05	< 0.05	1.7	< 0.05	< 0.05
PCB 31 & 28	8.4	8.79	2.8	7.0	13	13	31	6.5	1.6
PCB 33	3.5	3.0	0.61	1.8	5.7	5.2	15	3.1	< 0.05
PCB 53	1.3	1.3	< 0.05	0.78	< 0.05	< 0.05	< 0.05	1.4	< 0.05
PCB 51	1.6	0.99	1.7	0.90	1.8	1.8	4.3	< 0.05	< 0.05
PCB 22	2.5	9.9	< 0.05	7.5	12	11	25	11	3.1
PCB 45	< 0.05	0.79	0.27	0.80	1.3	1.2	26	1.8	< 0.05
PCB 46	0.52	0.52	< 0.05	0.63	2.5	0.96	6.1	4.2	< 0.05
PCB 52	25	22	0.67	3.8	43	29	86	11	0.14
PCB 49	5.0	3.6	0.44	3.3	4.6	5.2	23	6.2	< 0.05
PCB 47 & 48	5.5	4.3	1.1	3.8	4.6	5.9	28	5.9	0.23
PCB 44	8.7	5.8	0.36	5.8	6.9	9.3	55	12	< 0.05
PCB 42 & 37	5.5	3.0	< 0.05	< 0.05	5.7	4.7	< 0.05	< 0.05	< 0.05
PCB 41 & 71 & 64	11	7.9	< 0.05	6.5	8.0	9.8	26	5.9	< 0.05
PCB 40	1.4	1.2	< 0.05	0.78	1.4	2.2	2.7	0.71	< 0.05
PCB 100	0.32	0.36	0.23	0.30	0.52	0.69	2.3	0.48	< 0.05
PCB 63	0.40	0.41	< 0.05	0.38	1.5	1.1	2.0	0.42	< 0.05
PCB 74	3.0	2.1	0.50	1.8	3.0	3.7	11	1.9	< 0.05
PCB 70 & 76	11	7.1	1.8	7.0	11	13	52	7.9	0.47
PCB 66 & 95	20	12	4.73	14	16	21	94	16	0.45
PCB 91	3.5	2.2	0.78	2.4	3.0	2.4	13	1.1	< 0.05
PCB 56 & 60	1.0	0.69	0.18	0.60	1.0	1.2	3.4	0.57	0.04
PCB 84	12	9.5	2.1	9.8	14	20	61	7.4	0.15
PCB 92	< 0.05	< 0.05	0.64	0.98	< 0.05	< 0.05	< 0.05	3.1	< 0.05
PCB 101	0.69	7.1	3.9	7.8	< 0.05	10	65	13	0.32
PCB 99	3.7	2.4	1.3	3.3	4.3	4.7	26	4.8	0.12
PCB 83	0.77	0.52	0.26	0.55	0.71	0.84	3.8	0.82	< 0.05
PCB 97	3.7	2.6	0.75	2.5	3.9	4.2	19	3.4	< 0.05
PCB 87	5.7	3.4	1.1	3.8	4.8	6.2	33	5.7	< 0.05
PCB 85	< 0.05	< 0.05	5.8	24	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 136	2.5	12	< 0.05	< 0.05	24	34	59	22	0.25
PCB 110	5.7	6.9	2.6	8.5	9.4	12	64	12	0.14
PCB 82	1.9	1.1	0.31	1.3	1.60	2.2	8.8	1.6	< 0.05
PCB 151	4.5	2.4	3.9	5.0	3.7	4.7	24	6.2	0.20

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
A. Samples 89-00535 to 89-00543

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
PCB 135 & 144	3.0	1.6	1.9	3.0	2.7	3.2	17	4.0	0.09
PCB 107	1.4	0.43	0.22	1.2	0.50	1.5	8.8	0.59	< 0.05
PCB 149	14	7.1	10	14	12	14	71	17	0.58
PCB 118	7.2	4.3	2.0	5.8	8.4	7.6	52	9.9	0.11
PCB 34 & 114	5.5	3.2	1.6	2.5	5.3	7.6	15	3.1	< 0.05
PCB 131	0.40	0.09	0.06	0.08	0.82	0.37	0.70	0.13	< 0.05
PCB 146	4.5	1.6	2.6	4.0	2.7	3.4	21	5.1	0.14
PCB 153 & 132 & 105	30	16	22	29	30	30	17	40	1.4
PCB 141	5.5	2.4	3.9	4.5	3.7	4.2	20	5.7	0.12
PCB 137 & 176	0.84	0.39	1.8	1.7	0.62	0.84	4.7	1.1	< 0.05
PCB 163 & 138	20	10	15	19	19	24	100	26	0.92
PCB 158	5.0	2.4	2.6	3.3	4.3	5.2	20	4.5	0.38
PCB 178	1.2	0.90	3.1	2.2	3.2	1.3	8.5	1.2	0.79
PCB 175	1.2	0.58	0.64	0.98	0.96	1.3	3.4	1.0	0.23
PCB 187 & 182	17	8.2	17	21	16	17	78	28	0.88
PCB 183	4.7	2.1	5.8	5.8	4.3	4.9	23	7.4	0.47
PCB 128	3.5	2.8	1.5	2.8	2.8	3.7	18	4.0	0.25
PCB 167	0.77	0.37	0.50	0.58	0.66	0.76	3.8	0.93	0.15
PCB 185	1.2	2.1	1.3	1.3	0.71	1.2	4.3	1.6	< 0.05
PCB 174	6.4	3.2	7.2	8.0	6.1	6.9	30	9.9	0.43
PCB 177	4.0	2.2	4.7	5.3	4.3	4.4	21	6.2	0.43
PCB 202 & 171	4.0	1.9	3.3	4.0	2.0	2.7	9.5	4.5	0.22
PCB 157 & 200	3.0	6.2	1.0	1.5	2.3	2.7	8.6	2.7	0.25
PCB 172	1.8	9.4	2.0	2.0	1.4	1.5	6.3	2.5	0.27
PCB 197	< 0.05	< 0.05	< 0.05	< 0.05	2.0	< 0.05	< 0.05	< 0.05	< 0.05
PCB 180	15	7.1	18	18	14	16	68	23	0.63
PCB 193	0.84	0.49	1.2	1.1	0.68	0.89	4.1	1.5	< 0.05
PCB 191	0.64	10	0.72	0.85	0.66	0.57	2.3	2.4	< 0.05
PCB 199	0.67	11	0.47	0.60	0.20	0.59	2.0	0.88	< 0.05
PCB 170 & 190	9.9	6.2	14	14	9.6	10	47	160	< 0.05
PCB 198	0.57	1.8	0.33	0.50	< 0.05	0.39	1.4	2.5	< 0.05
PCB 201	6.4	3.0	5.3	6.8	4.8	5.7	23	20	0.36
PCB 203 & 196	7.4	3.2	6.7	8.0	5.5	6.6	28	21	0.23
PCB 208 & 195	4.2	2.8	4.2	4.3	3.0	4.2	15	13	0.14
PCB 207	0.60	7.1	0.28	0.43	0.13	0.47	1.0	1.4	0.10
PCB 194	3.0	2.1	3.1	3.3	2.5	2.5	11	4.8	0.11
PCB 205	0.23	1.0	0.25	0.30	1.7	0.21	1.1	0.37	< 0.05
PCB 206	3.7	6.0	1.4	2.2	2.0	3.7	6.3	14	0.14

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
B. Samples 89-00544 to 89-00552

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
PCB 1	< 0.05	< 0.05	< 0.05	3.6	2.9	5.3	< 0.05	< 0.05	< 0.05
PBC 3	< 0.05	< 0.05	< 0.05	< 0.05	9.3	7.4	< 0.05	< 0.05	< 0.05
PBC 4 & 10	< 0.05	< 0.05	< 0.05	< 0.05	0.52	0.35	< 0.05	< 0.05	< 0.05
PCB 7	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.12	< 0.05	< 0.05	< 0.05
PCB 6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 8 & 5	0.96	< 0.05	< 0.05	< 0.05	2.1	2.0	1.7	7.1	< 0.05
PCB 19	0.13	0.24	< 0.05	< 0.05	< 0.05	< 0.05	0.18	1.5	< 0.05
PCB 12	< 0.05	< 0.05	0.48	< 0.05	< 0.05	6.9	1.6	< 0.05	0.08
PCB 13	< 0.05	< 0.05	< 0.05	< 0.05	0.18	< 0.05	< 0.05	< 0.05	< 0.05
PCB 18	3.1	8.5	2.5	< 0.05	2.4	< 0.05	2.3	13	1.4
PCB 17	1.0	1.4	0.42	< 0.05	2.6	1.9	1.6	4.5	< 0.05
PCB 24 & 27	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.41	< 0.05	< 0.05	< 0.05
PCB 16 & 32	2.8	2.5	2.0	1.6	2.5	< 0.05	1.4	4.2	0.39
PCB 26	0.71	3.6	0.7	0.16	0.17	0.66	0.32	3.0	0.42
PCB 25	0.12	< 0.05	< 0.05	< 0.05	< 0.05	5.5	< 0.05	< 0.05	< 0.05
PCB 31 & 28	4.0	0.80	1.5	1.2	2.4	8.9	1.9	13	0.15
PCB 33	4.2	0.85	0.69	1.1	1.2	< 0.05	1.3	5.8	< 0.05
PCB 53	< 0.05	0.48	< 0.05	< 0.05	< 0.05	1.7	< 0.05	< 0.05	< 0.05
PCB 51	5.8	0.78	< 0.05	0.74	0.93	< 0.05	0.34	1.3	< 0.05
PCB 22	2.6	3.6	4.5	1.0	1.8	< 0.05	1.2	0.69	3.1
PCB 45	0.24	2.9	0.29	< 0.05	< 0.05	< 0.05	< 0.05	6.1	0.15
PCB 46	0.28	0.95	< 0.05	< 0.05	0.16	< 0.05	< 0.05	< 0.05	< 0.05
PCB 52	4.2	8.1	2.9	11	13	< 0.05	3.4	57	0.15
PCB 49	6.2	0.46	0.29	0.83	1.3	12	0.69	3.4	< 0.05
PCB 47 & 48	15	0.59	0.58	1.2	2.2	2.0	0.92	3.8	< 0.05
PCB 44	1.6	0.69	0.45	1.6	2.5	< 0.05	1.2	5.7	< 0.05
PCB 42 & 37	1.7	< 0.05	< 0.05	1.3	1.6	2.7	0.84	< 0.05	< 0.05
PCB 41 & 71 & 64	3.7	0.66	0.74	1.3	2.9	47	1.5	5.8	< 0.05
PCB 40	0.32	0.19	< 0.05	0.70	0.38	< 0.05	0.23	1.2	< 0.05
PCB 100	3.7	< 0.05	< 0.05	< 0.05	0.11	< 0.05	< 0.05	< 0.05	< 0.05
PCB 63	0.30	0.24	< 0.05	0.21	2.8	0.69	0.25	< 0.05	< 0.05
PCB 74	2.2	0.30	0.50	0.49	0.80	0.27	0.52	2.2	< 0.05
PCB 70 & 76	2.5	1.4	1.4	2.2	2.8	< 0.05	1.4	8.7	< 0.05
PCB 66 & 95	11	3.0	2.6	3.3	4.8	3.8	4.0	9.9	< 0.05
PCB 91	4.6	0.33	0.37	0.37	1.0	1.7	0.38	2.3	< 0.05
PCB 56 & 60	0.31	0.12	0.16	0.18	0.25	0.66	0.17	0.94	< 0.05
PCB 84	9.6	2.9	1.7	1.3	1.6	3.6	1.6	7.5	< 0.05
PCB 92	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4.1	< 0.05	5.3	< 0.05
PCB 101	13	0.29	1.9	< 0.05	< 0.05	1.2	2.5	10	< 0.05
PCB 99	4.2	0.81	0.56	< 0.05	< 0.05	0.62	0.17	1.1	< 0.05
PCB 83	0.24	0.20	< 0.05	0.19	0.17	0.38	0.23	0.67	< 0.05
PCB 97	0.62	0.84	0.48	1.1	1.4	< 0.05	0.84	3.9	< 0.05
PCB 87	1.6	1.0	0.66	1.2	1.6	< 0.05	1.2	5.2	< 0.05
PCB 85	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4.8	< 0.05	15	< 0.05
PCB 136	5.2	8.1	4.8	0.47	0.77	< 0.05	0.21	< 0.05	< 0.05
PCB 110	4.8	2.1	1.4	1.4	1.8	15	1.2	11	< 0.05
PCB 82	0.47	0.29	0.19	0.34	0.94	< 0.05	0.34	1.5	< 0.05
PCB 151	12	1.4	1.6	1.1	1.4	< 0.05	1.9	2.6	< 0.05
PCB 135 & 144	6.0	0.79	0.85	0.70	0.88	0.93	1.0	2.0	< 0.05

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
B. Samples 89-00544 to 89-00552

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
PCB 107	5.0	0.23	0.17	0.19	0.16	0.82	0.32	1.0	< 0.05
PCB 149	24	3.8	4.5	2.7	0.30	< 0.05	4.6	8.6	< 0.05
PCB 118	2.4	1.2	1.3	1.5	2.9	2.2	1.8	7.3	< 0.05
PCB 34 & 114	3.7	1.3	1.2	2.1	3.0	< 0.05	0.99	4.1	< 0.05
PCB 131	< 0.05	< 0.05	0.14	< 0.05	0.30	0.30	0.04t	< 0.05	< 0.05
PCB 146	11	0.80	1.4	0.64	0.88	1.2	1.4	2.0	< 0.05
PCB 153 & 132 & 105	45	7.3	10	6.2	8.5	1.4	11	24	< 0.05
PCB 141	9.2	1.2	1.8	0.78	1.1	5.2	1.6	2.2	< 0.05
PCB 137 & 176	2.8	0.66	0.66	0.19	0.56	4.5	0.21	0.80	0.08
PCB 163 & 138	32	5.0	7.4	2.7	0.43	2.9	1.7	15	0.04t
PCB 158	4.2	1.0	2.2	5.1	7.2	16	1.3	3.1	< 0.05
PCB 178	7.7	0.24	1.9	0.30	0.43	0.67	0.40	2.3	0.09
PCB 175	2.2	0.28	0.34	0.44	0.43	0.51	0.34	< 0.05	0.05
PCB 187 & 182	51.1	5.1	7.7	3.3	4.6	11	6.9	7.9	< 0.05
PCB 183	14.6	1.4	2.4	0.89	1.3	8.7	2.1	2.0	< 0.05
PCB 128	2.2	0.99	1.0	0.74	1.4	0.88	1.0	2.9	< 0.05
PCB 167	0.79	0.16	0.29	0.16	< 0.05	1.0	0.27	0.53	< 0.05
PCB 185	3.6	0.69	0.69	0.21	0.28	0.29	0.44	< 0.05	< 0.05
PCB 174	19	2.0	2.5	1.3	1.7	< 0.05	2.7	3.0	< 0.05
PCB 177	13	1.3	2.0	0.83	1.6	1.5	1.9	1.9	< 0.05
PCB 202 & 171	7.9	0.90	1.4	0.51	0.69	1.5	1.5	2.3	< 0.05
PCB 157 & 200	3.1	1.6	0.42	0.92	0.96	4.0	0.32	1.4	< 0.05
PCB 172	6.1	2.9	0.61	0.39	0.46	< 0.05	0.90	0.80	< 0.05
PCB 197	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 180	47	4.5	6.4	2.9	< 0.05	< 0.05	0.78	6.3	0.09
PCB 193	3.7	0.29	0.45	0.18	4.2	2.9	0.44	< 0.05	< 0.05
PCB 191	1.3	0.36	0.90	< 0.05	0.17	< 0.05	0.34	< 0.05	< 0.05
PCB 199	1.3	0.11	0.14	0.74	0.42	2.9	0.21	< 0.05	0.04t
PCB 170 & 190	33	2.1	75	0.49	0.97	0.79	2.9	4.1	0.20
PCB 198	1.4	0.43	0.93	< 0.05	0.26	0.21	0.13	< 0.05	< 0.05
PCB 201	20	1.6	4.2	1.0	1.8	0.58	2.1	2.7	0.24
PCB 203 & 196	25	1.8	3.2	1.1	< 0.05	1.5	0.76	3.0	< 0.05
PCB 208 & 195	15	0.86	1.4	0.84	1.2	0.29	1.5	2.2	< 0.05
PCB 207	0.52	1.8	0.53	0.06	0.06	0.16	0.27	< 0.05	< 0.05
PCB 194	12	0.75	1.4	0.56	0.45	< 0.05	1.0	1.3	< 0.05
PCB 205	0.78	0.13	0.32	0.05	0.80	0.46	0.10	< 0.05	< 0.05
PCB 206	4.2	1.3	2.1	0.46	0.67	< 0.05	0.80	0.24	< 0.05

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
C. Samples 89-00553 to 89-0062

COMPOUND	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
PCB 1	< 0.05	8.3	5.5	6.4	2.9	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PBC 3	< 0.05	7.2	5.0	6.9	2.8	16	8.5	3.7	< 0.05	< 0.05
PBC 4 & 10	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.69	0.24	< 0.05	< 0.05	< 0.05
PCB 7	0.18	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.82	< 0.05
PCB 6	2.5	1.6	< 0.05	0.30	< 0.05	< 0.05	0.21	< 0.05	0.75	< 0.05
PCB 8 & 5	26	4.2	1.1	0.97	0.57	0.94	2.1	< 0.05	5.7	< 0.05
PCB 19	< 0.05	< 0.05	< 0.05	0.21	< 0.05	0.21	1.6	0.09	0.33	< 0.05
PCB 12	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.22	< 0.05	0.14
PCB 13	0.61	0.51	< 0.05	< 0.05	0.19	0.22	0.16	< 0.05	< 0.05	< 0.05
PCB 18	< 0.05	17	1.8	2.5	0.73	1.2	3.1	1.1	1.9	0.26
PCB 17	56	< 0.05	1.5	3.0	< 0.05	0.92	5.2	0.65	8.3	0.31
PCB 24 & 27	0.67	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.21	< 0.05	< 0.05	< 0.05
PCB 16 & 32	5.7	3.4	0.88	1.1	0.13	0.94	4.5	0.70	1.1	0.24
PCB 26	19	5.7	1.1	1.2	0.54	0.29	0.36	1.5	1.5	0.60
PCB 25	0.65	0.83	< 0.05	< 0.05	< 0.05	< 0.05	0.22	< 0.05	< 0.05	< 0.05
PCB 31 & 28	17	8.3	2.0	3.0	0.82	0.98	5.5	0.77	2.1	0.51
PCB 33	5.3	8.7	0.63	1.9	0.34	0.43	1.0	0.38	1.1	0.50
PCB 53	1.8	3.6	< 0.05	0.28	< 0.05	0.07	< 0.05	0.45	< 0.05	< 0.05
PCB 51	7.1	4.7	0.44	0.85	0.44	1.3	11	0.48	0.50	0.25
PCB 22	15	7.2	5.2	6.0	1.3	1.0	2.8	2.4	2.2	1.8
PCB 45	1.9	2.8	0.37	0.25	0.31	< 0.05	< 0.05	1.6	0.29	0.71
PCB 46	3.6	1.4	0.22	0.46	< 0.05	0.11	0.73	< 0.05	< 0.05	< 0.05
PCB 52	19	17	0.92	1.2	0.25	1.6	7.3	3.3	0.89	1.0
PCB 49	6.7	13	0.48	0.71	< 0.05	0.47	10	0.27	0.63	0.19
PCB 47 & 48	6.8	13	0.72	1.1	0.09	1.2	26	0.36	0.64	0.40
PCB 44	17	12	0.66	1.1	0.12	0.46	1.7	0.38	1.1	< 0.05
PCB 42 & 37	< 0.05	3.6	0.52	0.71	< 0.05	0.40	1.5	0.28	< 0.05	< 0.05
PCB 41 & 71 & 64	17	14	1.3	1.3	< 0.05	0.36	4.8	0.43	0.89	0.23
PCB 40	2.1	2.5	0.26	0.25	< 0.05	0.50	0.36	0.12	0.11	< 0.05
PCB 100	0.44	2.8	0.26	0.23	< 0.05	0.58	5.9	< 0.05	0.10	< 0.05
PCB 63	1.2	1.3	0.31	0.55	< 0.05	1.2	0.61	< 0.05	0.25	< 0.05
PCB 74	3.8	4.5	0.52	0.62	< 0.05	0.29	2.1	0.19	0.34	0.08
PCB 70 & 76	12	20	1.5	2.1	0.45	1.1	2.8	0.75	1.4	0.30
PCB 66 & 95	21	49	3.7	4.4	0.36	2.2	9.2	2.6	2.7	0.87
PCB 91	2.2	10	0.33	0.85	< 0.05	0.41	6.2	0.28	0.26	0.19
PCB 56 & 60	1.4	1.3	0.13	0.09	0.04	0.08	0.28	0.07	0.12	0.02
PCB 84	17	42	2.8	4.1	0.16	1.2	7.6	2.2	5.9	0.40
PCB 92	< 0.05	< 0.05	0.29	< 0.05	< 0.05	< 0.05	0.92	0.28	0.92	0.18
PCB 101	0.99	40	2.76	3.0	0.15	2.0	9.7	7.0	2.1	0.58
PCB 99	< 0.05	14	0.85	1.2	0.10	0.14	0.22	0.42	0.71	0.27
PCB 83	0.75	3.8	0.22	0.35	< 0.05	0.19	0.43	0.07	0.09	< 0.05
PCB 97	3.2	12	0.66	0.90	< 0.05	0.45	1.3	0.70	0.49	0.18
PCB 87	4.7	21	0.99	1.2	< 0.05	0.67	2.1	0.53	0.73	0.15
PCB 85	< 0.05	< 0.05	7.2	8.3	0.21	2.1	14	6.3	16	0.76
PCB 136	18	61	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 110	10	40	2.6	3.0	0.16	0.87	1.9	1.4	1.8	0.51
PCB 82	1.8	5.7	0.29	0.46	< 0.05	0.16	0.54	0.15	0.35	< 0.05
PCB 151	3.8	16	2.8	2.5	0.11	1.3	8.0	2.0	1.2	0.52
PCB 135 & 144	2.5	12	1.4	1.2	< 0.05	0.70	5.2	0.95	0.69	0.26

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
C. Samples 89-00553 to 89-00562

COMPOUND	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
PCB 107	1.0	3.0	0.18	0.25	< 0.05	0.10	4.5	0.07	0.27	< 0.05
PCB 149	11	47	7.0	5.8	0.18	3.2	21	4.6	3.3	1.3
PCB 118	5.6	28	1.7	2.2	0.10	0.70	3.6	0.54	1.4	0.21
PCB 34 & 114	2.6	11	1.1	1.4	< 0.05	0.57	3.8	1.1	0.92	0.46
PCB 131	0.09	0.51	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.07	0.46	< 0.05
PCB 146	2.8	15	1.7	1.8	< 0.05	1.0	8.8	0.81	1.3	0.25
PCB 153 & 132 & 105	24	110	16	12	0.44	7.3	43	7.7	8.1	2.3
PCB 141	3.3	15	2.6	1.8	0.08	1.1	7.8	1.5	1.3	0.38
PCB 137 & 176	0.49	4.0	1.5	1.1	0.19	0.35	2.8	0.42	0.51	0.15
PCB 163 & 138	0.60	70	16	8.3	0.30	4.6	26	5.1	5.0	1.4
PCB 158	19	14	2.0	1.7	0.68	0.66	4.7	1.0	0.53	0.30
PCB 178	0.81	5.1	2.0	2.0	0.38	1.0	5.7	0.65	0.76	0.25
PCB 175	0.76	3.8	0.50	0.44	0.18	0.23	1.6	0.25	0.33	< 0.05
PCB 187 & 182	13	59	11	8.7	0.19	4.9	43	5.9	5.6	1.4
PCB 183	3.9	18	4.0	2.5	0.39	1.6	12	1.7	2.0	0.38
PCB 128	2.6	14	1.3	1.5	1.5	1.1	2.9	0.59	0.71	0.15
PCB 167	0.63	3.0	0.39	0.32	< 0.05	0.18	0.93	0.11	0.26	0.03
PCB 185	0.79	4.2	0.88	0.69	0.27	0.47	2.8	0.45	0.46	0.07
PCB 174	5.0	21	4.6	3.2	0.23	2.0	15	2.8	2.2	0.62
PCB 177	3.3	15	3.3	2.5	0.18	1.8	11	1.7	1.5	0.37
PCB 202 & 171	1.7	8.5	2.2	1.7	0.16	0.98	7.6	0.86	1.1	0.20
PCB 157 & 200	1.5	8.3	0.66	0.62	0.23	0.37	2.8	0.28	0.54	< 0.05
PCB 172	1.3	6.6	1.2	0.90	0.22	0.55	5.0	0.46	0.57	0.12
PCB 197	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 180	11	51	12	7.6	0.21	4.6	38	4.8	5.6	1.0
PCB 193	0.70	3.4	0.66	0.48	< 0.05	0.35	3.1	0.29	0.30	0.06
PCB 191	0.32	1.1	0.29	0.19	< 0.05	0.14	1.5	0.13	0.11	< 0.05
PCB 199	0.47	1.6	0.14	0.09	0.05	0.10	1.2	0.09	0.10	< 0.05
PCB 170 & 190	8.9	38	8.6	5.8	0.38	2.8	24	4.0	4.1	0.89
PCB 198	0.25	1.6	0.28	0.23	< 0.05	0.14	1.1	0.13	0.15	< 0.05
PCB 201	3.8	23	3.9	2.8	0.29	1.6	16	1.5	2.1	0.27
PCB 203 & 196	4.4	28	4.8	3.2	0.09	2.0	21	1.7	2.5	0.31
PCB 208 & 195	2.5	18	2.6	1.8	< 0.05	0.98	12	0.86	1.4	0.15
PCB 207	0.22	1.7	0.24	0.25	< 0.05	0.15	0.64	0.05	0.09	< 0.05
PCB 194	1.7	10	1.8	1.2	0.04t	0.81	9.5	0.66	1.0	0.13
PCB 205	0.13	0.85	0.13	0.09	< 0.05	0.05	0.73	0.07	0.10	< 0.05
PCB 206	1.8	1.2	0.90	0.71	< 0.05	0.46	3.8	0.31	0.57	0.07

TABLE 3.5a TOTAL PCBS (ng/g)

Sample #	Total PCBs
89-00535	380
89-00536	320
89-00537	220
89-00538	360
89-00539	430
89-00540	480
89-00541	1800
89-00542	650
89-00543	17
89-00544	580
89-00545	120
89-00546	190
89-00547	82
89-00548	130
89-00549	220
89-00550	96
89-00551	342
89-00552	6.7
89-00553	480
89-00554	1200
89-00555	180
89-00556	160
89-00557	20
89-00558	96
89-00559	550
89-00560	98
89-00561	124
89-00562	26

Table 3.6 CONCENTRATIONS OF POLYAROMATIC HYDROCARBONS IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542
Naphthalene	52	64	46	76	140	97	430	100
Acenaphthylene	29	< 0.3	2.6	3.9	< 0.3	5.4	27	7.2
Acenaphthene	82	33	2.8	30	120	70	580	17
Fluorene	300	120	25	80	340	120	790	94
Phenanthrene	1200	550	120	340	1000	640	2700	230
Anthracene	20	45	20	30	58	62	< 0.4	78
Fluoranthene	2600	1700	370	1300	3300	1800	6000	1000
Pyrene	1300	700	270	570	1400	1300	3400	310
Benzo(a)anthracene	2800	1800	370	1600	2700	2200	7300	970
Chrysene	1700	1200	240	1200	1900	1600	4400	690
Benzo(b)+(k)fluoranthene	3000	2500	580	3200	3400	3800	9700	1600
Benzo(a)pyrene	1100	840	230	1100	1100	1400	3700	540
Indeno 123 cd Pyrene	600	570	160	760	820	1400	2700	430
Dibenz(ah)anthracene	150	130	34	160	190	330	650	120
Benzo(ghi)perylene	610	530	150	900	750	1300	2600	470

COMPOUND	89-00543	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550
Naphthalene	26	60	110	50	33	100	180	53
Acenaphthylene	< 0.3	3.9	21	2.2	6.8	4.0	14	7.0
Acenaphthene	< 0.5	16	61	3.5	14	55	150	8.1
Fluorene	10	63	150	20	< 0.4	60	320	41
Phenanthrene	28	440	390	90	530	450	980	170
Anthracene	11	100	27	10	43	< 0.4	100	17
Fluoranthene	100	1300	900	350	1300	370	1700	480
Pyrene	77	650	240	120	760	300	1500	240
Benzo(a)anthracene	92	1200	780	346	1000	750	1600	500
Chrysene	53	690	430	350	670	560	2000	320
Benzo(b)+(k)fluoranthene	93	1500	800	550	1200	2900	1100	370
Benzo(a)pyrene	46	580	350	200	470	530	900	250
Indeno 123 cd Pyrene	35	390	230	160	350	1300	710	170
Dibenz(ah)anthracene	8.6	81	61	38	86	320	160	41
Benzo(ghi)perylene	35	390	230	160	330	850	860	160

Table 3.6 CONCENTRATIONS OF POLYAROMATIC HYDROCARBONS IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g) (CONTINUED)

COMPOUND	89-00551	89-00552	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558
Naphthalene	130	43	68	140	72	97	22	59
Acenaphthylene	< 0.3	< 0.3	5.5	5.2	4.0	15	5.6	56
Acenaphthene	43	< 0.5	45	48	13	30	16	39
Fluorene	250	2.5	97	120	68	78	47	360
Phenanthrene	560	0.5	320	430	210	310	81	1500
Anthracene	38	< 0.4	97	16	9.4	6.2	78	120
Fluoranthene	1200	2.3	1300	1600	570	660	490	2600
Pyrene	350	< 0.6	410	660	330	370	390	2400
Benzo(a)anthracene	920	0.7	1200	2100	490	910	830	3400
Chrysene	620	1.7	860	1200	340	630	370	1700
Benzo(b)+(k)fluoranthene	1000	870	1300	2000	550	1200	510	1400
Benzo(a)pyrene	450	< 3.0	530	1100	270	400	430	1400
Indeno 123 cd Pyrene	400	< 4.0	360	790	210	320	260	720
Dibenz(ah)anthracene	85	0.6	84	200	52	78	55	180
Benzo(ghi)perylene	460	< 4.0	360	860	210	300	280	660

COMPOUND	89-00559	89-00560	89-00561	89-00562
Naphthalene	25	50	14	4.0
Acenaphthylene	3.0	1.3	5.1	3.2
Acenaphthene	24	25	12	2.8
Fluorene	62	45	63	14
Phenanthrene	280	310	390	110
Anthracene	21	14	48	17
Fluoranthene	880	650	1500	260
Pyrene	500	380	1000	110
Benzo(a)anthracene	1100	790	450	320
Chrysene	690	410	870	170
Benzo(b)+(k)fluoranthene	1100	570	1300	220
Benzo(a)pyrene	630	370	270	180
Indeno 123 cd Pyrene	540	280	240	130
Dibenz(ah)anthracene	130	68	58	35
Benzo(ghi)perylene	530	250	210	130

Table 3.7 CONCENTRATIONS OF PHTHALATES IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541
Dimethyl Phthalate	1.5t	3	2.8t	7.4	9.7	< 3	< 3
Diethyl Phthalate	12	26	29	44	47	17	24
Dibutyl Phthalate	< 10	< 10	157	91	250	< 10	670
Butyl Benzyl Phthalate	250	290	26	160	1400	330	1400
Bis (2-ethyl hexyl)Phthalate	6400	2300	2400	5300	14000	8900	33000
Di-N-Octyl Phthalate	280	195	190	190	2300	780	3000

COMPOUND	89-00542	89-00543	89-00544	89-00545	89-00546	89-00547	89-00548
Dimethyl Phthalate	15	< 3	< 3	< 3	0.35t	0.17t	1.5t
Diethyl Phthalate	0.56t	< 3	< 3	< 3	< 3	< 3	6
Dibutyl Phthalate	< 10	< 10	< 10	< 10	< 10	< 10	35
Butyl Benzyl Phthalate	80	< 4	33	35	99	110	330
Bis (2-ethyl hexyl)Phthalate	3900	< 10	240	560	< 10	1800	8600
Di-N-Octyl Phthalate	130	12	190	100	140	350	2300

COMPOUND	89-00549	89-00550	89-00551	89-00552	89-00553	89-00554	89-00555
Dimethyl Phthalate	1.3t	51	0.76t	1.1t	1.6t	42	< 3
Diethyl Phthalate	< 3	17	0.38t	3.4t	7.1t	16	0.86t
Dibutyl Phthalate	< 10	110	< 10	< 10	< 10	68	< 10
Butyl Benzyl Phthalate	58	61	410	35	79	190	32
Bis (2-ethyl hexyl)Phthalate	1200	1100	3100	< 10	1600	17000	680
Di-N-Octyl Phthalate	320	500	360	22	160	780	370

COMPOUND	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
Dimethyl Phthalate	< 3	1.6t	< 3	3.5	0.62t	< 3	< 3
Diethyl Phthalate	0.87t	0.52t	0.49t	0.69t	< 3	< 3	< 3
Dibutyl Phthalate	< 10	13	< 10	28	< 10	< 10	< 10
Butyl Benzyl Phthalate	36	< 4	3.4t	43	13	6.0	< 4
Bis (2-ethyl hexyl)Phthalate	860	< 10	< 10	880	370	85	< 10
Di-N-Octyl Phthalate	9.5	78	72	96	94	34	34

Table 3.8 CONCENTRATIONS OF HALOETHERS IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542
Bis(2-chloroethyl)ether	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bis(2-chloroisopropyl)ether	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
4-Bromophenyl phenyl ether	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4
4-Chlorophenyl phenyl ether	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2

COMPOUND	89-00543	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550
Bis(2-chloroethyl)ether	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bis(2-chloroisopropyl)ether	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
4-Bromophenyl phenyl ether	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4
4-Chlorophenyl phenyl ether	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2

COMPOUND	89-00551	89-00552	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558
Bis(2-chloroethyl)ether	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1
Bis(2-chloroisopropyl)ether	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7	< 0.7
4-Bromophenyl phenyl ether	< 4	< 4	< 4	< 4	< 4	< 4	< 4	< 4
4-Chlorophenyl phenyl ether	< 2	< 2	< 2	< 2	< 2	< 2	< 2	< 2

COMPOUND	89-00559	89-00560	89-00561	89-00562
Bis(2-chloroethyl)ether	< 1	< 1	< 1	< 1
Bis(2-chloroisopropyl)ether	< 0.7	< 0.7	< 0.7	< 0.7
4-Bromophenyl phenyl ether	< 4	< 4	< 4	< 4
4-Chlorophenyl phenyl ether	< 2	< 2	< 2	< 2

Table 3.9 CONCENTRATIONS OF METALS IN POTOMAC RIVER SEDIMENT SAMPLES (ug/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
ANTIMONY	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	0.6	< 0.4	< 0.4
ARSENIC	3.8	2.8	4.2	5.8	5.1	4.0	4.3	5.7	2.4
BERYLLIUM	4.2	2.8	3.4	4.9	3.7	4.6	3.1	6.3	2.8
CADMIUM	8	6	6	4	8	4	6	4	< 2
CHROMIUM	150	130	99	140	130	140	120	140	61
COPPER	103	50	103	92	80	95	207	148	34
LEAD	179	79	< 10	107	136	168	351	178	< 10
NICKEL	84	55	59	78	76	87	82	87	40
SELENIUM	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
SILVER	4	2.0	2.0	6	4	4	18	4	< 2
THALLIUM	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
ZINC	452	265	253	396	415	479	587	475	109
MERCURY	0.267	0.157	0.180	0.333	0.365	0.401	1.20	0.606	0.073
CYANIDE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
% MOISTURE	55.8	40.7	55.6	59.5	55.6	58.6	49.5	68.2	45.6

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
ANTIMONY	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
ARSENIC	2.8	1.4	5.5	1.6	1.9	3.2	3.9	2.3	2.2
BERYLLIUM	2.8	1.9	4.5	1.9	2.7	3.2	5.3	1.0	3.9
CADMIUM	< 2	< 2	6	6	4	< 2	4	4	< 2
CHROMIUM	55	68	110	85	89	100	86	47	57
COPPER	38	31	49	35	44	50	47	29	30
LEAD	< 10	68	< 10	29	29	50	< 10	68	< 10
NICKEL	36	35	65	41	50	40	57	39	30
SELENIUM	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
SILVER	< 2	< 2	< 2	< 2	< 2	2	< 2	< 2	< 2
THALLIUM	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
ZINC	148	138	231	159	180	241	222	182	61
MERCURY	0.079	0.080	0.135	0.067	0.087	0.242	0.156	0.087	0.019
CYANIDE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
% MOISTURE	30.1	25.0	58.6	30.1	36.8	38.4	51.2	19.4	20.3

COMPOUND	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
ANTIMONY	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
ARSENIC	3.3	4.2	3.5	4.4	2.8	2.7	5.3	1.0	2.3	1.6
BERYLLIUM	3.5	3.8	3.6	3.8	3.2	6.8	4.0	1.0	2.5	4.6
CADMIUM	8	6	6	6	4	6	6	4	6	2
CHROMIUM	110	190	95	99	85	58	99	69	87	170
COPPER	48	121	45	55	44	37	48	46	40	19
LEAD	96	346	20	69	< 10	< 10	40	10	29	< 10
NICKEL	60	100	59	61	52	35	61	32	44	91
SELENIUM	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
SILVER	< 2	< 2	< 2	< 2	< 2	< 2	4	< 2	< 2	< 2
THALLIUM	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5	< 5
ZINC	415	529	230	293	143	143	289	63	181	79
MERCURY	0.233	0.340	0.205	0.282	0.239	0.058	0.308	0.024	0.125	0.005
CYANIDE	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
% MOISTURE	57.9	61.2	49.7	52.1	40.6	34.8	51.4	18.3	31.3	14.3

4. QUALITY ASSURANCE/QUALITY CONTROL

Eco Logic's quality assurance/quality control (QA/QC) protocol is presented in Figure 4.1. QA/QC results specific to the Limno-Tech analyses are discussed below.

4.1 Organic Compounds

4.1.1 Method Blanks

A method blank was analysed during the analysis of the each class of compound. Blank results were below the detection limit for all compounds except the phthalates.

4.1.2 External Standards

External standards were run after every fifth sample. Results from the analyses of at least one representative standard from each compound class were used to assess system variability of the GC-ECD and the GC-MSD systems. Results are given in Table 4.1.

The system variability of the GC-ECD is approximately 5 percent and that of the GC-MSD is approximately 16 percent. These values represent the variation in results that can be expected due to the analysis system, that is, excluding sample inhomogeneity and variations due to sample preparation and clean-up.

4.1.3 Internal Standards

Internal standards were added to the final sample extracts, prior to GC-MSD analysis to assess injector variability. This compensates for the 16 percent variability observed in the external standards.

Figure 4.1

ECO LOGIC

Laboratory QA/QC Protocols

1. Surrogate isotopically labelled standards for each chemical class will be added to each sample prior to extraction to demonstrate chemical recoveries through all phases of the extraction, clean-up and determination procedure. This unique technique provides considerable confidence in the data accuracy.
2. A method blank will be carried through the entire analytical procedure.
3. A method spike of external standards will be analysed for each method and data can be adjusted for recovery if required.
4. A duplicate analysis will be conducted for each batch of ten samples.
5. A travelling blank and a travelling spiked blank sample will be run for each data set.
6. External standards will be run after every fifth sample.
7. Internal standards may be added to extracts prior to analysis to account for injector variability.
8. Mass calibration of the mass spectrometer will be conducted daily to assure correct mass assignments.

ECO LOGIC regularly participates in interlab round robin studies and performs analysis on available standard reference materials monthly.

Table 4.1 ANALYTICAL SYSTEM VARIABILITY

GC-ECD SYSTEM VARIABILITY

Standard Compound	n	R.S.D.[a]
Lindane	3	5%
DDT	5	8%
Mirex	5	6%
PCB1	5	4%
PCB47+48	5	5%
PCB110	5	4%

GC-MSD SYSTEM VARIABILITY

Standard Compound	n	R.S.D.[a]
Bis(2-chloroethyl)ether	4	16%
Acenaphthylene	4	18%
Dimethyl phthalate	4	16%

[a] Relative Standard Deviation

4.1.4 Surrogate Spikes and Their Recoveries

Each of the twenty-eight samples and the blanks were spiked with 1 mL of a known mixture of surrogate compounds.

The surrogate compound percent recoveries have been calculated and are given Table 4.2. These recoveries have been used to adjust the data accurately for sample-specific variability. Average surrogate spike recoveries are given in Table 4.3.

Low recoveries and large deviations are results of inherent losses due to extensive sample work-up necessary in these determinations. The complex sample matrix also contributes to variations in recoveries.

Table 4.2 SURROGATE SPIKE RECOVERIES (%)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
1,3-DIBROMOBENZENE	41	40	40	40	44	40	74	42	50
1,3,5-TRIBROMOBENZENE	64	47	47	49	62	62	83	47	52
1,2,4,5-TETRABROMOBENZENE	75	62	71	66	110	120	66	66	71
2,3,5,6-PCB	86	71	76	80	130	80	290	180	76
d-10 PHENANTHRENE	74	53	73	51	46	49	32	51	79

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
1,3-DIBROMOBENZENE	40	46	48	37	37	59	52	60	48
1,3,5-TRIBROMOBENZENE	46	57	52	57	66	96	53	90	52
1,2,4,5-TETRABROMOBENZENE	76	95	76	81	86	69	88	77	66
2,3,5,6-PCB	80	76	76	90	90	90	80	70	78
d-10 PHENANTHRENE	43	50	59	63	24	81	58	52	32

COMPOUND	89-00553	89-00554	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
1,3-DIBROMOBENZENE	32	34	42	34	48	43	40	38	37	45
1,3,5-TRIBROMOBENZENE	42	44	47	39	54	41	45	45	45	57
1,2,4,5-TETRABROMOBENZENE	110	63	64	55	95	96	71	70	66	69
2,3,5,6-PCB	120	89	74	65	82	91	80	77	81	80
d-10 PHENANTHRENE	43	38	33	36	38	39	41	46	71	61

Table 4.3 AVERAGE AND STANDARD DEVIATION OF SURROGATE SPIKE RECOVERIES *

COMPOUND		n
1,3-DIBROMOBENZENE	43 ± 7	27
1,3,5-DIBROMOBENZENE	50 ± 10	27
1,2,4,5-DIBROMOBENZENE	80 ± 20	27
2,3,5,6-PCB	90 ± 20	27
d-10 PHENANTHRENE	50 ± 20	27

* Average based on 27 samples; sample 89-00541 excluded from average

4.1.5 Method Spikes

Five methods spikes containing a known mixture of all classes of compounds analysed were carried through the entire analysis procedure. The method spikes were used to assess fractionation patterns and accuracy of the analysis procedure as a whole. The percent recoveries of the method spikes are given in Table 4.4.

Recoveries of the late-eluting PAHs are good to excellent. Haloether recoveries are excellent for all compounds except bis-(2-chloro ethyl)ether. Recoveries are good to excellent for all phthalates except dimethyl phthalate. Excellent recoveries are seen for the chlorobenzenes. The chlorinated pesticides show good to excellent recoveries except for a-chlordane, heptachlor epoxide and methoxychlor.

As in the case on the surrogate spikes, low recoveries and large deviations are results of inherent losses due to the multiple evaporations and sample work-up necessary in these determinations. The influence of the sample matrix is necessarily less in the method spike samples than in the surrogate spiked samples. The recoveries of the surrogate spikes were used to correct the sample data, as these values best represent the native compound recoveries from the actual matrix.

4.1.6 Duplicate Samples

Four samples (Table 4.5) were analysed in duplicate and the results for each pair of duplicates given in Table 4.6

PCB replicates show that, although many congeners vary about 20 percent between replicates, some others, for example PCB1 and PCB3 in samples 551 and 555, have greater variability. A large number of interferences can occur in the GC-EDC analysis of PCBs due to the complexity of the congener mixtures. Smaller numbers of specific congeners may be analysed more reproducibly.

Other replicates show acceptable variability.

4.1.7 System Tuning

Mass-calibration of the GC-MSD was conducted routinely throughout the analysis.

4.2 Metals

Standard reference material BCSS-1, a marine sediment, was analysed as a check for accuracy. Results are given in Table 4.7. Levels of both Pb and Cd were near the detection limit of the method employed and therefore show some inaccuracy in the analysis of the standard reference materials.

Two pairs of duplicate samples were run for trace metals analysis. Duplicates agree to within 6 percent (relative average deviation) except in the case of Pb which varies 20 percent near the detection limit and approximately 8 percent above the detection limit. The method variability based on the analysis of standard solution is about 5 percent.

Table 4.7 ACCURACY ASSESSMENT
NRC MARINE SEDIMENT SRM (OTTAWA) "BCSS-1"

	Measured	Certified
Cd	2	0.25 ± 0.04[a]
Cr	123	123 ± 14
Cu	21	22.7 ± 3.4
Pb	5	22.7 ± 3.4[a]
Be	2.3	1.3 ± 0.3
Sb	<0.2	0.59 ± 0.06
Ni	64	55.3 ± 3.6
Zn	129	119 ± 12
As	10	11.1 ± 1.4

[a] Near detection limit of method employed here

Table 4.4

RECOVERIES FOR CHLOROBENZENE METHOD SPIKES

Compound	% Recoveries ± S.D.	n
1,2-Dichlorobenzene	84 ± 7	3
1,3-Dichlorobenzene	82 ± 6	3
1,4-Dichlorobenzene	82 ± 6	3
1,3,5-Trichlorobenzene	90 ± 6	3
1,2,4-Trichlorobenzene	90 ± 6	3
1,2,3-Trichlorobenzene	90 ± 10	3
1,2,4,5-Tetrachlorobenzene	96 ± 8	3
1,2,3,5-Tetrachlorobenzene	95 ± 9	3
1,2,3,4-Tetrachlorobenzene	100 ± 20	3
HCE	85 ± 9	3
HCBD	80 ± 10	3
HCB	80 ± 10	3

RECOVERIES FOR CHLORINATED PESTICIDE METHOD SPIKES

Compound	% Recoveries ± S.D.	n
DDT	93 ± 8	4
DDD	130 ± 40	4
DDE	59 ± 2	4
α-BHC	54 ± 7	5
LINDANE	73 ± 10	4
g-CHLORDANE	83 ± 10	5
α-CHLORDANE	39 ± 30	3
NONACHLOR	72 ± 6	5
MIREX	82 ± 7	4
ALDRIN	67 ± 20	5
DIELDRIN	89 ± 10	4
ENDRIN	110 ± 30	5
α-ENDOSULPHAN	90 ± 20	4
b-ENDOSULPHAN	80 ± 30	4
METHOXYCHLOR	240 ± 70	2
HEPTACHLOR	58 ± 3	3
HEPTACHLOREPOXIDE + OCS	32 ± 6	4

Table 4.4 (Continued)

RECOVERIES FOR POLYCHLORINATED AROMATIC HYDROCARBON METHOD SPIKES

Compound	% Recoveries ± S.D.	n
Naphthalene	22 ± 2	5
Acenaphthylene	20 ± 4	4
Acenaphthene	26 ± 5	5
Fluorene	44 ± 4	5
Phenanthrene	9 ± 6	5
Anthracene	13 ± 8	5
Fluoranthene	51 ± 6	5
Pyrene	17 ± 7	5
Benzo(a)anthracene	63 ± 8	5
Chrysene	58 ± 7	5
Benzo(b)+(k)fluoranthene	60 ± 10	5
Benzo(a)pyrene	60 ± 10	5
Indeno 1,2,3, c.d. pyrene	70 ± 20	5
Dibenzo(ah)anthracene	70 ± 20	5
Benzo(ghi)perylene	70 ± 20	5

RECOVERIES FOR PHTHALATE METHOD SPIKES

Compound	% Recoveries ± S.D.	n
Dimethyl	20 ± 2	5
Diethyl	50 ± 6	5
Dibutyl	60 ± 20	5
Butyl Benzyl	60 ± 10	5
Bis(2-ethyl hexyl)	50 ± 40	4
Di-n-octyl	70 ± 40	4

RECOVERIES FOR HALOETHER METHOD SPIKES

Compound	% Recoveries ± S.D.	n
Bis-(2-chloroethyl)ether	37 ± 8	5
Bis-(2-chloroisopropyl)ether	100 ± 10	5
4-Bromophenyl phenyl ether	140 ± 20	5
4-Chlorophenyl phenyl ether	110 ± 10	5

Table 4.5 IDENTIFICATION OF DUPLICATE SAMPLES

Eco Labs ID	Limnotech ID	Sample mass (g)
89-00542	PWC-06	3.93
89-00542r	PWC-06	4.74
89-00546	PMS-10	5.45
89-00546r	PMS-10	8.72
89-00551	TWB-01	11.33
89-00551r	TWB-01	14.3
89-00555	PMS-51	7.83
89-00555r	PMS-51	9.93

Table 4.6

REPLICATES: CHLOROBENZENES (ng/g)

COMPOUND	89-00542	89-00542r	% Average Deviation	89-00546	89-00546r	% Average Deviation
1,2 Dichlorobenzene	12	16	14.3	< 5.5	9.6	27.3
1,3 Dichlorobenzene	< 5.5	< 5.5	-	0.11t	< 5.5	-
1,4 Dichlorobenzene	43	49	6.5	11	7.3	20.5
HCB	1.3	1.0	13.0	0.35	0.25	16.0
HCBD	< 0.4	< 0.4	-	< 0.4	< 0.4	-
HCE	< 0.4	< 0.4	-	< 0.4	< 0.4	-
1,3,5 Trichlorobenzene	0.93	1.1	9.3	< 0.4	0.79	-
1,2,4 Trichlorobenzene	< 0.6	< 0.6	-	< 0.6	6.5	-
1,2,3 Trichlorobenzene	< 0.6	< 0.6	-	< 0.6	0.51t	-
1,2,4,5 Tetrachlorobenzene	1.1	< 0.4	-	< 0.4	0.54	-
1,2,3,5 Tetrachlorobenzene	0.72	0.48	20.0	< 0.4	< 0.4	-
1,2,3,4 Tetrachlorobenzene	1.9	0.62	50.8	0.36t	0.64	-
Pentachlorobenzene	0.88	0.84	2.3	0.28t	0.39	-

COMPOUND	89-00551	89-00551r	% Average Deviation	89-00555	89-00555r	% Average Deviation
1,2 Dichlorobenzene	25	19	13.9	7.6	2.7t	-
1,3 Dichlorobenzene	3.7t	< 5.5	-	3.0t	< 5.5	-
1,4 Dichlorobenzene	5.9	7.1	9.2	25	17	18.8
HCB	1.1	0.74	19.6	0.46	1.3	48.3
HCBD	< 0.4	< 0.4	-	< 0.4	< 0.4	-
HCE	< 0.4	0.05t	-	< 0.4	0.25t	-
1,3,5 Trichlorobenzene	1.0	0.81	10.5	0.45	< 0.4	-
1,2,4 Trichlorobenzene	< 0.6	< 0.6	-	< 0.6	9.9	-
1,2,3 Trichlorobenzene	0.38t	0.67	-	0.02t	0.60	-
1,2,4,5 Tetrachlorobenzene	0.18t	0.22t	-	< 0.4	0.16t	-
1,2,3,5 Tetrachlorobenzene	0.16t	0.27t	-	< 0.4	< 0.4	-
1,2,3,4 Tetrachlorobenzene	0.71	0.52	15.4	0.5	0.76	20.6
Pentachlorobenzene	1.3	1.3	0.0	0.25t	0.27	-

Table 4.6 (Continued)

REPLICATES: ORGANOCHLORINES (ng/g)

COMPOUND	89-00542	89-00542r	% Average Deviation	89-00546	89-00546r	% Average Deviation
DDT	3.1	6.0	31.9	1.9	5.2	46.7
DDD	15	30	33.8	7.4	5.0	19.6
DDE	27	41	20.6	7.2	16	38.5
a-BHC	1.2	< 0.07	-	< 0.07	0.64	-
Lindane	< 0.07	< 0.07	-	< 0.07	< 0.07	-
g-Chlor	5.4	11	32.5	4.2	7.1	25.6
nonachlor	2.8	3.4	9.7	2	2.6	13.1
a-Chlor	11	1.8	71.9	4.4	3.8	7.3
Mirex	0.34	0.34	0.0	0.07	2.0	93.1
Aldrin	6.3	2.35	45.7	0.56	2.5	63.9
Dieldrin	5.9	1.3	63.9	2	2.4	9.4
Endrin	1.3	< 0.07	-	1.1	0.27	60.6
a-endo	6.8	24	55.4	4.1	3.9	2.1
b-endo	0.69	1.9	47.5	0.27	1.8	74.5
methoxychlor	3.3	16	65.1	3.2	1.7	30.6
heptachlor	0.88	4.2	65.0	0.4	1.1	46.6
heptachlor epoxide	1.4	2.4	26.3	0.57	0.63	5.0

COMPOUND	89-00551	89-00551r	% Average Deviation	89-00555	89-00555r	% Average Deviation
DDT	3.0	3.9	12.7	0.53	7.4	86.6
DDD	51	46	5.2	7.7	5.5	16.6
DDE	<0.08	<0.08	-	6.4	33	67.8
a-BHC	1.6	1.3	10.3	0.53	0.76	17.8
Lindane	0.43	0.72	25.2	<0.07	<0.07	-
g-Chlor	35	23	20.7	3.9	7.4	31.1
nonachlor	<0.07	21	-	2.2	5.0	39.2
a-Chlor	17	28	23.8	1.1	<0.07	-
Mirex	<0.07	0.96	-	<0.07	1.2	-
Aldrin	4.8	4.9	1.0	1.2	3.0	42.9
Dieldrin	7.6	13	26.9	1.5	3.1	35.1
Endrin	1.0	0.88	6.4	0.59	<0.07	-
a-endo	25	23	3.3	2.8	6.6	40.5
b-endo	1.4	1.7	10.8	0.69	0.82	8.9
methoxychlor	23	17.9	12.5	7.9	<0.07	-
heptachlor	3.8	3.2	8.6	<0.07	1.6	-
heptachlor epoxide	7.4	7.5	0.5	1.0	0.50	33.0

Table 4.6 (Continued)

REPLICATES: PCBs (ng/g)

COMPOUND	89-00542	89-00542r	% Average Deviation	89-00546	89-00546r	% Average Deviation
PCB1	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB3	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB4&10	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB7	< 0.05	< 0.05	-	< 0.05	0.18	-
PCB6	0.54	0.84	21.7	< 0.05	< 0.05	-
PCB8&5	< 0.05	3.8	-	< 0.05	< 0.05	-
PCB19	< 0.05	< 0.05	-	< 0.05	2.3	-
PCB12	< 0.05	< 0.05	-	0.48	2.5	67.4
PCB13	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB18	3.4	2.6	12.9	2.5	1.2	35.4
PCB17	7.4	11	17.9	0.42	1.6	57.6
PCB24&27	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB16&32	2.3	2.1	4.1	2	< 0.05	-
PCB26	2.7	2.3	7.2	0.7	0.62	5.7
PCB25	< 0.05	0.33	-	< 0.05	< 0.05	-
PCB31&28	6.5	5.8	5.3	1.5	1.7	5.2
PCB33	3.1	2.7	7.2	0.69	1.3	30.8
PCB53	1.4	0.92	21.0	< 0.05	< 0.05	-
PCB51	< 0.05	0.63	-	< 0.05	< 0.05	-
PCB22	11	6.6	24.7	4.5	1.9	40.5
PCB45	1.8	0.58	51.0	0.29	0.94	52.9
PCB46	4.2	0.64	73.7	< 0.05	0.37	-
PCB52	11	6.6	25.3	2.9	6.7	39.4
PCB49	5.2	4.4	8.1	0.29	1.7	71.3
PCB47&48	5.9	4.4	14.3	0.58	2.6	64.0
PCB44	12	3.9	51.0	0.45	8.2	89.6
PCB42&37	< 0.05	5.4	-	< 0.05	< 0.05	-

Table 4.6 (Continued)

REPLICATES: PCBs (ng/g)

COMPOUND	89-00542	89-00542r	% Average Deviation	89-00546	89-00546r	% Average Deviation
PCB41,71,64	5.9	7.4	10.9	0.74	< 0.05	-
PCB40	0.71	0.91	12.5	< 0.05	0.22	-
PCB100	0.48	0.69	18.2	< 0.05	< 0.05	-
PCB63	0.42	0.53	11.4	< 0.05	< 0.05	-
PCB74	1.9	2.8	18.9	0.5	0.34	18.7
PCB70&76	7.9	11	17.2	1.4	3.1	37.2
PCB66&95	16	23	17.3	2.6	< 0.05	-
PCB91	1.1	2.7	42.2	0.37	0.24	20.4
PCB56&60	0.57	0.90	22.4	0.16	0.22	15.3
PCB84	7.4	10	15.8	1.7	1.5	5.7
PCB92	3.1	4.9	22.7	< 0.05	0.95	-
PCB101	13	15	8.4	1.9	4.3	39.1
PCB99	4.8	6.6	15.7	0.56	1.3	41.1
PCB83	0.82	1.3	21.9	< 0.05	0.14	-
PCB97	3.4	5.0	19.1	0.48	0.17	48.5
PCB87	5.7	8.0	16.8	< 0.05	1.5	-
PCB85	< 0.05	41.0	-	0.66	< 0.05	-
PCB136	22	< 0.05	-	4.8	9.0	30.5
PCB110	12	17	18.4	1.4	3.3	40.8
PCB82	1.6	2.3	18.2	0.19	0.48	43.6
PCB151	6.2	9.0	18.3	1.6	2.7	25.7
PCB135&144	4	5.6	16.6	0.85	1.5	27.9
PCB107	0.59	0.83	17.1	0.17	0.51	49.8
PCB149	17	24	16.9	4.5	7.3	23.7
PCB118	9.9	14	17.7	1.3	2.9	37.6
PCB34&114	3.1	5.2	25.6	1.2	2.1	27.5
PCB131	0.13	0.36	47.4	0.14	0.2	17.6
PCB146	5.1	7.4	18.3	1.4	3.1	37.6
PCB153,132,105	40	56	16.9	10	18	29.6

Table 4.6 (Continued)

REPLICATES: PCBs (ng/g)

COMPOUND	89-00542	89-00542r	% Average Deviation	89-00546	89-00546r	% Average Deviation
PCB141	5.7	8.9	22.1	1.8	0.37	66.1
PCB137&176	1.1	1.7	20.8	0.66	0.88	14.2
PCB163&138	26	37	17.0	7.4	0.58	85.4
PCB158	4.5	6.9	20.8	2.2	17	77.0
PCB178	1.2	4.4	57.3	1.9	2.7	18.0
PCB175	1	1.6	22.6	0.34	0.50	19.0
PCB187&182	28	39	16.8	7.7	12	23.1
PCB183	7.4	11	18.2	2.4	2.1	7.5
PCb128	4	6.1	20.4	1	9.8	81.5
PCB167	0.93	1.4	21.0	0.29	1.0	55.9
PCB185	1.6	2.4	19.9	0.69	< 0.05	-
PCB174	9.9	14	16.9	2.5	0.91	46.7
PCB177	6.2	8.9	18.1	2	2.0	1.2
PCB202&171	4.5	6.3	16.4	1.4	0.97	17.9
PCB157&200	2.7	4.0	18.9	0.42	34	97.6
PCB172	2.5	3.9	22.1	0.61	50	97.6
PCB197	0.05	3.9	97.5	< 0.05	< 0.05	-
PCB180	23	32	16.1	6.4	12	30.9
PCB193	1.5	2.1	17.4	0.45	< 0.05	-
PCB191	2.4	1.6	18.8	0.9	5.4	71.5
PCB199	0.88	1.2	15.0	0.14	3.0	91.2
PCB170&190	160	24	74.1	75	44	26.6
PCB198	2.5	1.3	33.0	0.93	10	83.0
PCB201	20	23	6.4	4.2	5.1	9.9
PCB203&196	21	24	6.5	3.2	12	57.4
PCB208&195	13	16	11.0	1.4	6.1	62.9
PCB207	1.4	1.6	7.0	0.53	50	97.9
PCB194	4.8	7.3	20.4	1.4	5.7	60.5
PCB205	0.37	0.69	30.4	0.32	8.6	92.8
PCB206	14	16	6.7	2.1	38	89.4

Table 4.6 (Continued)

REPLICATES: PCBs (ng/g)

COMPOUND	89-00551	89-00551r	% Average Deviation	89-00555	89-00555r	% Average Deviation
PCB1	< 0.05	3.3	-	5.5	< 0.05	-
PCB3	< 0.05	6.4	-	5.0	< 0.05	-
PCB4&10	< 0.05	0.39	-	< 0.05	< 0.05	-
PCB7	< 0.05	0.24	-	< 0.05	< 0.05	-
PCB6	< 0.05	0.92	-	< 0.05	< 0.05	-
PCB8&5	7.1	5.8	10.5	1.1	< 0.05	-
PCB19	1.5	< 0.05	-	< 0.05	0.45	-
PCB12	< 0.05	7.3	-	< 0.05	1.4	-
PCB13	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB18	13	12	3.3	1.8	2.6	17.7
PCB17	4.5	3.9	6.6	1.5	4.4	48.7
PCB24&27	< 0.05	0.30	-	< 0.05	< 0.05	-
PCB16&32	4.2	3.7	6.8	1.1	2.0	28.3
PCB26	3	12	61.1	< 0.05	2.5	-
PCB25	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB31&28	13	10	10.9	2	4.8	40.9
PCB33	5.8	1.4	61.8	0.63	1.1	27.0
PCB53	< 0.05	4.8	-	< 0.05	< 0.05	-
PCB51	1.3	8.2	22.9	0.44	< 0.05	-
PCB22	0.69	8.0	84.1	5.2	2.4	36.8
PCB45	6.1	7.0	7.1	0.37	1.9	67.8
PCB46	< 0.05	0.39	-	0.22	0.77	55.5
PCB52	57	48	9.0	0.92	4.5	66.2
PCB49	3.4	3.0	5.7	0.48	2.9	71.5
PCB47&48	3.8	< 0.05	-	0.72	3.0	61.7
PCB44	5.7	5.3	3.5	0.66	6.9	82.5
PCB42&37	< 0.05	3.4	-	0.52	6.9	86.0

Table 4.6 (Continued)

REPLICATES: PCBs (ng/g)

COMPOUND	89-00551	89-00551r	% Average Deviation	89-00555	89-00555r	% Average Deviation
PCB41,71,64	5.8	6.0	1.9	1.3	6.6	67.1
PCB40	1.2	2.2	29.4	0.26	1.3	67.4
PCB100	< 0.05	0.16	-	0.26	0.66	43.7
PCB63	< 0.05	0.59	-	0.31	0.52	25.6
PCB74	2.2	0.20	83.2	0.52	2.1	60.7
PCB70&76	8.7	2.9	50.4	1.5	6.7	63.6
PCB66&95	9.9	6.5	20.4	3.7	< 0.05	-
PCB91	2.3	< 0.05	-	0.33	0.55	25.4
PCB56&60	0.94	< 0.05	-	0.13	0.60	64.4
PCB84	7.5	3.4	37.0	2.8	4.1	19.3
PCB92	5.3	8.0	20.3	0.29	2.0	75.1
PCB101	10	< 0.05	-	2.76	8.9	52.6
PCB99	1.1	15	86.1	0.85	3.0	55.5
PCB83	0.67	0.46	18.3	0.22	0.42	31.4
PCB97	3.9	< 0.05	-	0.66	2.0	50.7
PCB87	5.2	< 0.05	-	0.99	3.3	53.3
PCB85	15	5.8	44.2	7.2	< 0.05	-
PCB136	< 0.05	< 0.05	0.0	< 0.05	18	-
PCB110	11	14	13.5	2.6	8.2	51.6
PCB82	1.5	< 0.05	-	0.29	1.1	56.9
PCB151	2.6	1.9	15.2	2.8	7.8	47.3
PCB135&144	2	1.7	7.4	1.4	4.0	47.8
PCB107	1	0.46	36.7	0.18	0.37	33.9
PCB149	8.6	0.56	87.7	7	0.83	78.8
PCB118	7.3	6.4	6.8	1.7	14	78.6
PCB34&114	4.1	< 0.05	-	1.1	4.2	58.3
PCB131	< 0.05	0.54	-	< 0.05	0.18	-
PCB146	2	< 0.05	-	1.7	5.2	50.9
PCB153,132,105	24	2.3	82.4	16	44	46.2

Table 4.6 (Continued)

REPLICATES: PCBs (ng/g)

COMPOUND	89-00551	89-00551r	% Average Deviation	89-00555	89-00555r	% Average Deviation
PCB141	2.2	0.08	82.3	2.6	7.0	45.7
PCB137&176	0.8	< 0.05	-	1.5	2.9	32.2
PCB163&138	15	1.2	42.8	16	32	33.6
PCB158	3.1	2.7	8.9	2	6.4	52.3
PCB178	2.3	0.38	71.5	2	1.7	9.5
PCB175	< 0.05	0.60	85.9	0.5	1.6	52.0
PCB187&182	7.9	0.90	79.5	11	30	46.2
PCB183	2	3.3	23.9	4	11	48.3
PCB128	2.9	1.4	36.2	1.3	4.2	53.1
PCB167	0.53	1.8	55.4	0.39	0.13	51.1
PCB185	< 0.05	0.18	-	0.88	2.4	47.1
PCB174	3	0.14	91.3	4.6	0.41	83.7
PCB177	1.9	2.1	5.5	3.3	9.4	48.2
PCB202&171	2.3	0.95	41.6	2.2	4.4	33.2
PCB157&200	1.4	1.8	11.6	0.66	6.1	80.5
PCB172	0.8	0.62	38.3	1.2	9.1	76.6
PCB197	< 0.05	< 0.05	-	< 0.05	< 0.05	-
PCB180	6.3	0.54	84.2	12	34	47.4
PCB193	< 0.05	< 0.05	-	0.66	1.9	49.0
PCB191	< 0.05	0.24	-	0.29	0.69	40.7
PCB199	< 0.05	0.07	-	0.14	0.59	61.6
PCB170&190	4.1	< 0.05	-	8.6	15	27.9
PCB198	< 0.05	2.5	-	0.28	1.2	61.9
PCB201	2.7	0.18	87.6	3.9	10	45.4
PCB203&196	3	1.4	35.6	4.8	0.65	76.1
PCB208&195	2.2	< 0.05	-	2.6	7.4	47.8
PCB207	< 0.05	< 0.05	-	0.24	5.2	91.2
PCB194	1.3	0.09	87.6	1.8	0.36	66.8
PCB205	< 0.05	0.51	-	0.13	0.51	59.5
PCB206	0.24	0.85	56.2	0.9	10	84.0

Table 4.6 (Continued)

REPLICATES: PHTHALATES AND ETHERS (ng/g)

COMPOUND	89-00542	89-00542r	% Average Deviation	89-00546	89-00546r	% Average Deviation
Phthalates						
Dimethyl	15	100	73.9	0.35t	0.99t	-
Diethyl	0.56t	<3	-	<3	2.0t	-
Di-N-Butyl	<10	<10	-	<10	<10	-
Benzyl Butyl	80	39	34.5	99	2.6t	ERR
Bis(2-ethylhexyl)	3900	2300	25.8	<10	140	-
Di-N-octyl	130	46	47.7	140	2100	87.5
Ethers						
Bis(2-chloroethyl)	<1	<1	-	<1	<1	-
Bis(2-chloroisopropyl)	<0.7	<0.7	-	<0.7	<0.7	-
4-Bromophenyl phenyl	<4	<4	-	<4	<4	-
4-chlorophenyl phenyl	<2	<2	-	<2	<2	-

COMPOUND	89-00551	89-00551r	% Average Deviation	89-00555	89-00555r	% Average Deviation
Phthalates						
Dimethyl	0.76t	<3	-	<3	1.3t	-
Diethyl	0.38t	0.22t	-	0.86t	13	-
Di-N-Butyl	<10	<10	-	<10	<10	-
Benzyl Butyl	410	500	9.9	32	56	27.6
Bis(2-ethylhexyl)	3100	3700	8.8	680	<10	-
Di-N-octyl	360	160	38.5	370	120	51.0
Ethers						
Bis(2-chloroethyl)	<1	<1	-	<1	<1	-
Bis(2-chloroisopropyl)	<0.7	<0.7	-	<0.7	<0.7	-
4-Bromophenyl phenyl	<4	<4	-	<4	<4	-
4-chlorophenyl phenyl	<2	<2	-	<2	<2	-

4. The analytical procedure employed here can be applied only to semi-volatile compounds due to extensive heating while soxhlet extracting. It would be necessary to re-extract the samples using a different method in order to analyze for volatile compounds. As there is olfactory evidence of volatile contamination, this should be considered. like wh

5. The remaining core samples have been archived and are available for further subsampling. It may be useful to examine the cores at various depths to determine the extent of pollution.

6. Areas which exhibit high levels of the target parameters should be resampled with replicates taken. This will help to confirm the exact nature and extent of contamination.

7. The results of the method spikes, included as part of the QA/QC protocol, indicate that some target compounds have only fair recoveries, such as naphthalene, acenaphthylene, acenaphthene, phenanthrene, anthracene, pyrene, dimethylphthalate, α-chlordane and heptachlor epoxide. Consequently, the levels of these particular compounds may be higher than reported. Change Method.

APPENDIX A

The target compounds analysed and reported in the previous sections represent sixty six compounds identified as priority pollutants in section 307 of the clean water act. All other compounds on this list were analysed using a full scan gas chromatography/mass spectrometry technique, monitoring ions of m/z 40 to m/z 550.

The mass spectra for all peaks above a selected minimum abundance were searched against the National Bureau of Standards Library. This data base consists of 140,000 mass spectra including priority pollutants. All matches with a purity of fit greater than 70 percent are given on the following pages. The detection limit for this method is 0.010 µg/g. This data represents all remaining compounds as required in the contract agreement.

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00541	5.35	Decane, 4-methyl-	2847725	70	0.87
	8.04	Undecane	1120214	83	0.68
	12.30	Undecane, 2-methyl-	7045718	70	1.3
	12.93	Undecane, 2,5-dimethyl-	17301223	86	1.7
89-00542		No Library Matches			
89-00543	4.67	Undecane	1120214	78	0.076
	25.11	3-Pentanamine	616240	80	0.076
	32.90	3-Pentanamine	616240	77	0.061
	41.71	1,2-Benzenedicarboxylic acid, butyl 2-methylpropyl ester	17851535	81	0.12
	46.17	Tetratriacontane	14167590	78	0.089
	51.18	Eicosane, 7-hexyl-	55333998	78	0.18
	58.58	Benzo[e]pyrene	192972	76	0.079
	59.11	Nonadecane, 3-methyl-	6418457	79	0.066
89-00544	24.93	Eicosane	112958	78	0.055
	25.11	1-Dodecanamine, N,N-dimethyl-	112185	96	0.062
	38.68	Anthracene, 2-methyl-	613127	70	0.051
	39.77	Nonadecane	629925	78	0.053
	58.58	Benzol[e]pyrene	192972	79	0.053

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00535	12.51	Dodecane, 6-methyl-	6044719	76	0.58
	15.24	Heptane, 3-ethyl-5-methyl-	52896909	70	0.58
	19.81	Dodecane, 2,7,10-trimethyl-	74645980	86	1.1
	23.49	Heptane, 3-ethyl-5-methyl-	52896909	71	1.5
	25.65	Naphthalene, 1,4,6-trimethyl-	2131422	70	0.79
	30.96	Tridecane, 5-propyl-	55045119	78	2.0
	33.60	Phenol, 4-nonly-	104405	73	1.6
89-00536	12.60	Undecane, 3,6-dimethyl-	17301289	83	0.24
	15.21	Heptane, 3-ethyl-5-methyl-	52896909	70	0.22
	16.41	Tridecane	629505	86	0.22
	19.77	Nonane, 3-methyl-5-propyl-	31081182	78	0.41
	20.42	Naphthalene, 2,6-dimethyl-	581420	79	0.26
	20.80	Tridecane, 4-methyl-	26730121	76	0.23
	23.43	Heptadecane, 2,6,10,15-tetramethyl-	54833486	78	0.54
	24.99	Dodecane, 2,6,10-trimethyl-	3891983	78	0.30
	25.63	Naphthalene, 1,6,7-trimethyl-	2245387	75	0.33
	30.30	Azulene, 7-ethyl-1,4-dimethyl-	529055	78	0.26
	33.10	Dodecane, 2,7,10-trimethyl-	74645980	83	0.77
	34.82	9H-Fluroene, 9-methylene-	4425825	71	0.45
89-00537	46.71	Phytol	150867	83	3.3

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00538	19.74	Dodecane, 2,6,11-trimethyl-	31295564	76	0.34
	21.12	1H-Indene, octahydro-2,2,4,4,7,7-hexamethyl-, trans-	54832836	76	0.28
	23.39	Nonane, 3-methyl-5-propyl-	31081182	76	0.37
	33.52	Phenol, 4-nonyl-	104405	70	0.27
	36.71	Tetradecane, 4-methyl-	25117242	70	0.62
89-00539	12.69	Dodecane, 6-methyl-	6044719	96	0.66
	15.32	Tridecane, 7-methyl-	26730143	78	0.65
	19.95	Dodecane, 2,7,10-trimethyl-	74645980	86	1.2
	21.00	Tetradecane	629594	79	0.77
	23.68	Hexadecane	544763	70	1.6
	25.23	Undecane, 2-methyl-	7045718	70	0.92
	33.41	Hexadecane, 2,6,10-trimethyl-	55000527	79	1.9
89-00540	12.68	Dodecane, 6-methyl-	6044719	89	0.88
	15.31	Dodecane, 4,6-dimethyl-	61141728	78	0.85
	19.93	Dodecane, 2,7,10-trimethyl-	74645980	83	1.8
	21.79	Benzenamine, 2,3-dichloro-	608275	81	1.0
	23.63	Decane, 5-propyl-	17312628	78	2.4
	25.32	1-Octadecanamine, N,N-dimethyl-	124287	95	0.52
	25.77	Naphthalene, 1,4,6-trimethyl-	2131422	70	0.59

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00545	25.12	1-Tetradecanamine, N,N-dimethyl-	112754	80	0.14
	35.05	9H-Fluorene, 9-methylene-	4425825	89	0.099
	39.37	4H-Cyclopenta[def]phenanthrene	203645	76	0.10
89-00546	32.72	Tetracosane	646311	70	0.23
	32.88	1-Octadecanamine, N,N-dimethyl-	124287	75	0.23
89-00547	19.73	Heptadecane, 2,6,10,14-tetramethyl-	18344371	70	0.072
	20.76	Undecane	1120214	70	0.053
	24.96	Eicosane	112958	78	0.11
	32.78	Heptadecane	629787	83	0.25
	33.02	Pentadecane, 2,6,10,14-tetramethyl-	1921706	78	0.39
	35.05	9H-Fluorene, 9-methylene-	4425825	70	0.13
	36.73	Dodecane, 2,7,10-trimethyl-	74645980	76	0.38
	38.95	Anthracene, 1-methyl-	610480	76	0.091
89-00548	15.20	Octadecane, 2,6-dimethyl-	75163972	83	0.094
	19.75	Dodecane, 2,7,10-trimethyl-	74645980	83	0.23
	20.76	Pentadecane	629629	78	0.11
	23.41	Iron, tricarbonyl[N-(phenyl-2 pyridinylmethylene)benzenamine-N,N']-	74764117	70	0.37
	24.99	Tetradecane, 1-iodo-	19218941	78	0.20
	33.07	Pentadecane, 2,6,10,14-tetramethyl-	1921706	78	0.91
	36.77	Hexadecane, 2,6,11,15-tetramethyl-	504449	70	0.77

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00549	15.55	Dodecane, 4,6-dimethyl-	61141728	78	1.6
	20.24	Dodecane, 2,6,11-trimethyl-	31295564	76	2.4
89-00550	5.45	Cyclohexene, 1-methyl-4(1-methylethyl)-	5502885	79	0.080
	32.73	Hexadecane	544763	83	0.20
	39.80	Nonadecane	629925	70	0.17
89-00551	7.91	Undecane	1120214	93	0.22
	12.03	Nonadecane	629925	78	0.19
	12.64	Dodecane, 6-methyl-	6044719	86	0.32
	15.27	Tridecane, 7-methyl-	26730143	78	0.38
	15.73	1,4-Methanonaphthalene, 1,4-dihydro-	4453901	70	0.36
	16.40	1H-Indene, 1-ethylidene-	7471832	86	0.21
	19.56	Tetradecane, 2-methyl-	1560958	70	0.2
	19.88	Dodecane, 2,7,10-trimethyl-	74645980	86	0.6
	20.51	Naphthalene, 1,7-dimethyl-	575371	97	0.51
	23.58	Dodecane, 2-methyl-8-propyl-	55045073	78	1.2
	31.12	Undecane, 3,5-dimethyl-	17312811	78	1.7
	33.35	Undecane, 4,6-dimethyl-	17312822	70	1.6

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00552	10.63	Ethanone, 1-(1,4-dimethyl-3-cyclohexen-1-yl)-	43219687	79	0.056
	41.69	1,2-Benzenedicarboxylic acid, butyl octyl ester	84786	76	0.028
	46.14	Eicosane, 10-methyl-	54833237	78	0.028
	51.15	Nonacosane	630035	70	0.039
	58.60	Benz[e]acephenanthrylene	205992	70	0.035
89-00553	19.75	Dodecane, 2,7,10-trimethyl-	74645980	76	0.27
	23.43	Iron, tricarbonyl[N-(phenyl-2-pyridinylmethylene)benzenamine-N,N']-	74764117	70	0.45
	25.62	Naphthalene, 1,4,6-trimethyl-	2131422	88	0.22
	38.01	1-Octadecanamine, N,N-dimethyl-	124287	87	0.49
	59.15	Dotriacontane	544854	78	0.43
	64.50	Vitamin E acetate	58957	94	0.35
89-00554	5.62	Nonane, 3,7-dimethyl-	17302328	70	0.21
	32.74	Tetracosane	646311	78	0.21
	32.94	1-Octadecanamine, N,N-dimethyl-	124287	70	0.32
	36.70	Hexadecane, 2,6,10,14-tetramethyl-	638368	70	0.32
	39.98	1-Octadecanamine, N,N-dimethyl-	124287	96	0.17
89-00555	24.93	Docosane	629970	86	0.14
	32.74	Iron, tricarbonyl[N-(phenyl-2-pyridinylmethylene)benzenamine-N,N']-	74764117	76	0.17
	39.79	Tetracosane	646311	70	0.13

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00556		No Library Matches			
89-00557	38.70	Anthracene, 1-methyl-	610480	70	0.041
	38.86	Anthracene, 2-methyl-	613127	70	0.033
	39.75	Tetracosane, 11-decyl-	55429840	78	0.072
	41.34	1H-Indene, 1-(phenylmethylene)-	5394865	78	0.035
	46.16	Nonadecane	629925	70	0.055
	51.17	Heptadecane	7225641	83	0.046
89-00558	22.10	Biphenylene	259790	91	0.23
	31.96	9H-Fluorene, 2-methyl-	1430973	86	0.31
	37.30	Dibenzothiophene, 3-methyl-	16587523	89	0.16
	38.82	1H-Indene, 1-phenyl-	1961962	86	0.58
	39.01	Phenanthrene, 4-methyl-	832644	84	0.59
	39.27	Phenanthrene, 1-methyl-	832699	88	0.20
89-00559	20.42	Naphthalene, 1,8-dimethyl-	569415	76	0.094
	25.59	Naphthalene, 1,4,6-trimethyl-	2131422	73	0.059
	32.76	Heptacosane	593497	70	0.11
89-00560	38.70	Anthracene, 1-methyl-	610480	71	0.035
	38.86	Phenanthrene, 3-methyl-	832713	70	0.042
	39.31	4H-Cyclopenta[def]phenanthrene	203645	70	0.047

NBS LIBRARY SEARCH RESULTS FOR FULL SCAN DATA (Continued)

SAMPLE ID	RETENTION TIME (MIN)	NBS LIBRARY BEST MATCH	CAS #	PURITY OF FIT (%)	CONCENTRATION (ug/g)
89-00561	38.74	Anthracene, 1-methyl-	610480	74	0.11
	38.89	1H-Indene, 1-phenyl-	1961962	76	0.15
	39.33	4H-Cyclopenta[def]phenanthrene	203645	70	0.096
	39.78	Nonadecane	629925	79	0.10
	45.89	Benzo[b]naphtho[2,3-d]furan	243425	70	0.082
89-00562	20.72	Undecane, 3,9-dimethyl-	17301314	78	0.026
	24.90	Eicosane, 10-methyl-	54833237	83	0.040
	28.89	Decane, 2,4-dimethyl-	2801845	70	0.020
	36.28	Dodecane	112403	78	0.026
	38.82	Anthracene, 2-methyl-	613127	70	0.032
	39.28	4H-Cyclopenta[def]phenanthrene	203645	70	0.017
	43.00	Heptacosane	593497	70	0.026

APPENDIX B. U.S. EPA Great Lakes Sediment Guidelines and EPA Criteria Used for LTI "Indicator Levels"

GUIDELINES FOR CLASSIFICATION OF GREAT LAKES SEDIMENTS
(Concentrations in mg/kg dry weight)

	U. S. E P A		
	NONPOLLUTED	MODERATELY POLLUTED	HEAVILY POLLUTED
Ammonia	<75	75 - 200	>200
Arsenic	<3	3 - 8	>8
Barium	<20	20 - 60	>60
Cadmium	-	-	>6
Chemical Oxygen Demand	<40,000	40,000 -80,000	>80,000
Chromium	<25	25 - 75	>75
Copper	<25	25 - 50	>50
Cyanide	<0.10	0.10- 0.25	>0.25
Iron	<17,000	17,000 -25,000	>25,000
Lead	<40	40 - 60	>60
Manganese	<300	300 - 500	>500
Mercury	<1	-	>1
Nickel	<20	20 - 50	>50
Oil and Grease	<1,000	1,000 - 2,000	>2,000
Phosphorus	<420	420 - 650	>650
Polychlorinated Biphenyl	<1	1 - 10	>10
Polynuclear Aromatic Hydrocarbons (benzo(a)pyrene)	-	-	-
Selenium	-	-	-
2,3,7,8-TCDD (Dioxin)	-	-	-
Total Kjeldahl Nitrogen	<1,000	1,000 - 2,000	>2,000
Volatile Solids	<50,000	50,000 -80,000	>80,000
Zinc	<90	90 - 200	>200

Discussion of the applicability and limitations of these guidelines is found in the report of the Dredging Subcommittee, "Guidelines and Register for Evaluation of Great Lakes Dredging Projects", 1982. The U.S. EPA guidelines are from the report, "Guidelines for Pollutional Classification of Great Lakes Harbor Sediments".

*For the protection of aquatic life.

[1]Aquatic Ecosystem Objectives Committee. "1983 Annual Report of the Aquatic Ecosystem Objectives Committee", November 1983. Report to the Great Lakes Science Advisory Board, International Joint Commission.

[2]Aquatic Ecosystem Objectives Committee. "Report of the Aquatic Ecosystem Objectives Committee", November 1981. Report to the Great Lakes Science Advisory Board, International Joint Commission.

[3]Aquatic Ecosystem Objectives Committee. "Report of the Aquatic Ecosystem Objectives Committee", November 1980. Great Lakes Science Advisory Board, International Joint Commission.

EPA CRITERIA USED FOR LTI "INDICATOR LEVELS"

Compound	Source[1]	Most Stringent Water Criteria (ug/L)
CHLORINATED HYDROCARBONS		
Total Dichlorobenzenes	w&f	400
Hexachlorobenzene	w&f	0.00072
Hexachlorobutadiene	w&f	0.45
Hexachloroethane	w&f	1.9
1,2,4,5-Tetrachlorobenzene	w&f	38
Pentachlorobenzene	w&f	74
ORGANOCHLORINE PESTICIDES		
DDT	f&w	0.000024
DDE	ma	14
a-BHC	w&f	0.0092
Lindane	w&f	0.0186
Total Chlordane	w&f	0.00046
Mirex	fc	0.001
Aldrin	w&f	0.000074
Dieldrin	w&f	0.000071
Endrin	fc	0.0023
Total Endosulfan	mc	0.0087
Methoxychlor	fc	0.03
Heptachlor	w&f	0.00028
Total PCBs	w&f	0.000079
POLYCYCLIC AROMATICS		
Naphthalene	fc	620
Acenaphthene	fc	520
Fluoranthene	mc	16
Benzo(a)pyrene	wf[2]	0.0028
PHTHALATE ESTERS		
Dimethyl Phthalate	fc[3]	3
Diethyl Phthalate	fc[3]	3
Dibutyl Phthalate	fc[3]	3
Bis (2-ethyl hexyl)Phthalate	fc[3]	3
HALOETHERS		
Bis(2-chloroethyl)ether	w&f	0.03
Bis(2-chloroisopropyl)ether	w&f	34.7
4-Bromophenyl phenyl ether	fc[4]	122
4-Chlorophenyl phenyl ether	fc[4]	122

Compound	Source	Most Stringent Water Criteria (ug/L)
METALS		
Antimony	w&f	146
Arsenic	w&f	0.0022
Beryllium	w&f	0.0068
Cadmium	fc	1.1
Chromium	fc[5]	11
Copper	ma	2.9
Lead	fc	3.2
Nickel	mc	8.3
Selenium	f&w	10
Silver	fc	0.12
Thallium	f&w	13
Zinc	mc	86
Mercury	fc	0.012
Cyanide	ma	1

[1] Criterion is that from:

fc - criteria for chronic toxicity to freshwater organisms
ma - criteria for acute toxicity to saltwater organisms
mc - criteria for chronic toxicity to saltwater organisms
f&w - criteria for fish and water ingestion.

[2] Criteria is that of PAHs as a whole.

[3] Criteria are for phthalate esters as a whole.

[4] Criteria are for haloethers as a whole.

[5] Criteria for chromium (hex).

ELI ECO LOGIC INTERNATIONAL, INC.

Response to

Technical Comments on Potomac River Analysis

30 November 1990

Technical Comments on Analysis

1) the temperature, at which the extract was concentrated, was not in the report.

   RESPONSE: The temperature at which the sample extract was concentrated was dependant on the solvent system being evaporated. In each concentration step, hexane was present as the final solvent, therefore the temperature for concentration never exceeded 69°C, the boiling point of hexane.

2) the references made to the apparatus used such as the K-D column, Snyder column and micro-column was stated incorrectly. A K-D apparatus can be used with a Snyder column or a micro-column.

   RESPONSE: The concentration procedure involved the use of the modified Kuderna-Danish apparatus. The sample extract was placed in a 500 ml round bottom flask which was fitted with a 3-ball Snyder column. This apparatus was placed into a heating mantle. The solvent was concentrated to 10 ml under controlled heat (69°C). The 10 ml extract was quantitatively transferred to a 100 ml round bottom flask modified with a 1 ml conical reservoir. A Kuderna-Danish condenser was placed on top and the solvent was further concentrated to less than 1 ml using a water bath maintained at the boiling point of hexane. The extract was quantitatively transferred to a 1 ml volumetric flask and the volume accurately adjusted using hexane.

3) for the basic instrument calibration, how many standards were used and what were the concentrations of the standards?

4) for determining the concentrations of the analytes, the report does not tell how many standards were used, which internal standards were used, or the source of the standards.

8) for the external standards, the standard concentrations, how many points were analyzed, and whether or not they were working in the linear range should have been listed. The standard concentrations should bracket the sample concentration. This was not indicated in the report.

9) for the internal standards, indicate which ones were used.

   RESPONSE: Points 3, 4, 8, and 9 are addressed collectively for each instrumental system used in the study.

   The gas chromatograph/mass-selective-detector system was calibrated with a three-point calibration system based on standards

at 0.5 ppm, 1.0 ppm, and 5.0 ppm for all twenty-six target compounds. Anthracene-d10 was used as an internal standard at a concentration of 1 ppm in each standard.

A calibration standard was run after every fifth sample injection. Each level of standard was run successively.

Calibration standards were prepared from certified stock standard mixtures containing all target compounds. These standards were purchased from Ultra Scientific, North Kingstown, Rhode Island.

Samples were all within the linear range of the system calibration or were diluted to fall within this range.

The gas chromatograph/electron-capture detection system was calibrated with a three-level external calibration system based on standard concentrations provided in Table A.

The mid-range calibration standard was run after every fifth sample injection.

Mixed chlorobenzene and organochlorine pesticide standards were prepared from individual E.P.A. stock standards obtained from the US EPA. Repository for Toxic and Hazardous Materials. Polychlorinated biphenyl standards were prepared from a mixture of Aroclor 1232. Aroclor 1248, and Aroclor 1262. The Aroclor standards were obtained from the Quality Assurance Branch, EMSL - Cincinnati, US EPA, Cincinnati, Ohio.

Samples were all within the linear range of the system calibration or were diluted to fall within this range.

TABLE A
STANDARD CONCENTRATIONS GC/ECD

what are units ppm

TABLE A.1 ORGANOCHLORINE PESTICIDES

ß-BHC	25.000
Lindane	25.000
α-BHC	25.000
Heptachlor	25.000
δ-BHC	20.000
Aldrin	25.000
OCS	16.000
Heptachlor epoxide	25.000
γ-Chlordane	17.000
Nonachlor	20.000
α-Endosulphan	10.000
α-Chlordane	20.000
Dieldrin	10.000
pp'-DDE	25.000
Endrin	25.000
ß-Endosulphan	10.000
op'-DDT	20.000
pp'-DDD	25.000
pp'-DDT+Endrin aldehyde	50.000
Endosulphan Sulphate	10.000
Mirex	10.000
Methoxychlor	20.000

TABLE A.2 CHLOROBENZENES

13-DCB	500.00
14-DCB	500.00
12-DCB	500.00
HCE	20.000
135-TCB	50.000
124-TCB	50.000
123 TCB	50.000
HCBD	20.000
245-TCT	25.000
236-TCT	33.000
1235-TeCB	17.000
1245-TeCB	25.000
1234-TeCB	25.000
QCB	25.000
PCT	27.400
HCB	10.000

TABLE A.3 POLYCHLORINATED BIPHENYLS

PCB-1	195.00
PCB-3	120.00
PCB-4+10	13.000
PCB-7	10.000
PCB-6	19.500
PCB-8+5	230.00
PCB-19	4.5000
PCB-12	2.4000
PCB-13	1.8000
PCB-18	60.000
PCB-17	34.000
PCB-27	3.3000
PCB-16+32	60.500
PCB-26	10.500
PCB-25	4.5000
PCB-31+28	175.00
PCB-21	0.70000
PCB-33	65.000
PCB-51	15.600
PCB-22	50.000
PCB-45	12.500
PCB-46	6.5000
PCB-52	55.000
PCB-43	4.2000
PCB-49	41.000
PCB-47+48	41.000
PCB-44	70.000
PCB-42+37	39.000
PCB-42+71+64	117.00
PCB-40	15.000
PCB-100	2.3000
PCB-63	3.4000
PCB-74	37.000
PCB-70+76	95.000
PCB-66+95	124.00
PCB-91	6.0000
PCB-56+60	16.000
PCB-92+84	19.000
PCB-101	22.000
PCB-99	10.500
PCB-119	0.80000
PCB-83	1.6000
PCB-97	8.5000
PCB-87	13.500

TABLE A.3 (continued)

PCB-85	9.5000
PCB-136	6.5000
PCB-110	25.000
PCB-82	6.0000
PCB-151	26.000
PCB-135+144	10.000
PCB-107	1.5000
PCB-149	16.000
PCB-118	50.000
PCB-134+114	3.9000
PCB-146	7.5000
PCB-153+132+105	99.000
PCB-141	23.000
PCB-137+176	6.5000
PCB-163+138	45.000
PCB-158	5.500
PCB-178	15.000
PCB-175	2.7000
PCB-187+182	140.00
PCB-183	35.000
PCB-128	2.2000
PCB-185	10.000
PCB-174	50.000
PCB-177	26.000
PCB-202+171	16.000
PCB-173	0.60000
PCB-157+200	9.5000
PCB-172+197	7.5000
PCB-180	110.00
PCB-193	6.5000
PCB-191	2.1000
PCB-199	4.5000
PCB-170+190	55.000
PCB-198	3.3000
PCB-201	70.00
PCB-203+196	80.000
PCB-189	0.85000
PCB-208+195	37.000
PCB-207	2.2000
PCB-194	31.500
PCB-205	1.8000
PCB-206	19.500
PCB-209	0.44000

5) under surrogate spikes and recoveries, the contract lab used their recoveries to adjust the data for sample-specific variability. This is an incorrect procedure; the contract lab can not correct target compounds using surrogate recoveries. A surrogate is not representative of a whole class of compounds. Surrogate recoveries should be reported but don't correct for them.

RESPONSE: We appreciate the reviewer's comments regarding the correction of data for surrogate recoveries, specifically that surrogates are not representative of the entire class of compounds. However, we feel that correction by surrogate recoveries is a useful means to adjust for intersample variation. When data is to be interpreted as part of a scientific research project, correction is preferred to the submission of data which might be otherwise inaccurately compared.

EPA guidelines for data treatment, as stated in laboratory methods SW-846, do not require correction for surrogate recoveries; we will provide uncorrected data as an addendum to our report.

6) PCB isomers were reported as PCB 1 through 206. There should be a corresponding table of chemical equivalents for the identification numbers. Table 3.5 is useless without such information. PCBs are usually reported as PCB 1242, PCB 1260, etc.

RESPONSE: There are three fundamental errors associated with the statement above which require correction before an appropriate response to the comment may be framed:

1. The use of the term "PCB isomers" is incorrect. The correct term is "congener". Chemical "isomers" are defined as two or more substances with identical chemical formulae, but with differing molecular arrangement. "Congeners" are defined as a group of related chemical substances, all of which are derived from a single parent compound, and which differ only in the number and/or position of substituents attached to the parent molecule. Thus, all isomers are congeners of each other, but all congeners are not necessarily isomers. By analogy, the terms "isomers" and "congeners" bear the same relationship to each other that the words "chicken" and "birds" share, i.e., all chickens are birds, but all birds are not necessarily chickens.

2. The PCB congeners reported were indicated as 1 through 209, not 206. This is quite simply because there are 209 theoretically possible isomers which may result from the multiple chlorination of the ~~biphenyl~~ molecule, not 206 combinations.

3. Only in the United States were PCBs referred to by four digit designations such as 1242 and 1260. This older form of nomenclature was based upon the trade name Aroclor in the United States, as the original Aroclor mixtures were historically used as a basis of comparison for environmental samples. Because of environmental "weathering" and sorting of specific PCB congeners, this older approach was often capable only of approximating an original Aroclor mixture, e.g., the sample most closely resembled Aroclor 1242. This aspect is discussed in more detail below, but it is important to note that samples were described or reported as Aroclor 1242, Aroclor 1254, Aroclor 1260, etc., not PCB 1242, PCB 1254, PCB 1260.

PCBs have been manufactured by industrialized nations throughout the world. While there was no significant difference in fundamental chemical structures of the primary products, the trade names applied to these similar substances varied widely by country and by manufacturer. The following table contains a listing of PCB trade names utilized by various manufacturers around the world.

Trade Names of Polychlorinated Biphenyl Compounds
by Manufacturer and Country of Origin

Country of Origin	Product Trade Name	Industrial Manufacturer
United States	Aroclor	Monsanto
Japan	Kanechlor	Kanegafuchi
Japan	Aroclor;Sanotherm	Mitsubishi-Monsanto
Germany	Clophen	Bayer
France	Pyralene;Phenoclor	Pradelec
Italy	Fenochlor;Apirolio	Caffaro
Soviet Union	Solvol	Solvol
Czechoslovakia	Delor	Chemko

In the United States, PCBs were produced under the trade name Aroclor by the Monsanto Chemical Company, the sole manufacturer of these compounds in this country. Monsanto produced a wide variety of Aroclor products, and assigned each mixture with a four-digit identifying number. The numerical designation refers to the specific mixture of PCBs contained in the formulation, e.g., Aroclor 1242, Aroclor 1254. The first two digits indicate the number of

carbon atoms -- with a single exception, Aroclor 1016, which is a distillation product of Aroclor 1242. The second two digits of the Aroclor numerical designation specify the percentage of chlorine substitution by weight. Thus, the designation, Aroclor 1254, indicates two 6-carbon phenyl structures with 54 percent chlorine substitution by weight. The following table indicates the spectrum of Aroclor mixtures produced and their approximate percentage composition by chlorine substitution.

Percentage Composition of Aroclor Mixtures
by Number of Chlorine Substitutions

Number of Positions Substituted by Chlorine	AROCLOR MIXTURES						
	1221	1232	1016[a]	1242	1248	1254	1260
0	10						
1	50	26	2	1			
2	35	29	19	13	1		
3	4	24	57	45	21	1	
4	1	15	22	31	49	15	
5				10	27	53	12
6					2	26	42
7						4	38
8							7
9							1
10							

a. 1016 is a distillation product of Aroclor 1242 containing 1% or less of pentachlorinated isomers or higher.

In the older scientific literature, Aroclor formulations were commonly used as a mechanism for describing the quantities of contaminants present in environmental samples. Prior to approximately 1980, analytical methodologies utilized packed column gas chromatography to determine the amounts of PCB in a given sample. To make this determination, Aroclor formulations were used as reference standards for comparison of the contaminants observed. This technology has been rendered obsolete by contemporary high-resolution capillary column gas chromatography which is capable of separation and identification of individual PCB congeners. However, it is important to note that the Aroclor formulations reported in the older scientific literature represent complex mixtures of a number of individual substances. These complex mixtures of Aroclors frequently contain as many as 60 individual PCB congeners. While attempts to use Aroclor mixtures as the analytical basis for environmental samples produced profound difficulties, it must be remembered that the original uses of the manufactured products were as Aroclor formulations.

Since 1980, a new system of identification of individual PCB congeners has been utilized. The basis of this system is a fixed numerical designation of the individual carbons in the phenyl rings. Each time a chlorine is substituted for a hydrogen atom, the position of substitution can be easily identified by a single digit. Again, the bond between the two phenyl rings is used as a point of orientation. The carbon to which this bond is attached is identified as carbon number one, and further numerical designation is carried out in a clockwise direction until all six carbons of the ring are numbered. By convention, separation of individual sites on the two phenyl ring structures is facilitated by assignment of the primary, cardinal number to the right ring structure, and a similar cardinal number with an apostrophe to the left phenyl ring. Using this system of nomenclature, it is possible to describe each of the 209 theoretically possible PCB congeners with precision.

At the beginning of this decade, Ballschmiter and Zell (1980) proposed a system of numerical identification of PCB congeners based upon the classification and nomenclature system described above. The Ballschmiter and Zell (1980) system of PCB congener identification assigned permanent numbers to each PCB congener based upon a logical sequence in which substituents to the biphenyl ring are referred to in ascending numerical order. The Ballschmiter and Zell (1980) system was accepted by the International Union of Pure and Applied Chemistry (IUPAC) and has subsequently enjoyed general usage by this organization and most analytical chemists concerned with PCBs. With the acceptance of this classification by the International Union of Pure and Applied Chemistry, the numerical designation of PCB congeners from 1 to 209 has come to be called the IUPAC Numbering (Classification) System. The complete IUPAC numerical scheme for PCB congener assignments by chemical structure is presented in the following table.

International Union of Pure and Applied Chemistry (IUPAC) Numerical Designation of PCBs[a]

IUPAC No.	Structure
	Monochlorobiphenyls
1	2
2	3
3	4
	Dichlorobiphenyls
4	2,2'
5	2,3
6	2,3'
7	2,4
8	2,4'
9	2,5
10	2,6
11	3,3'
12	3,4
13	3,4'
14	3,5
15	4,4'
	Trichlorobiphenyls
16	2,2',3
17	2,2',4
18	2,2',5
19	2,2',6
20	2,3,3'
21	2,3,4
22	2,3,4'
23	2,3,5
24	2,3,6
25	2,3',4
26	2,3',5
27	2,3',6
28	2,4,4'
29	2,4,5
30	2,4,6
31	2,4',5
32	2,4',6
33	2',3,4
34	2',3,5
35	3,3',4
36	3,3',5
37	3,4,4'
38	3,4,5
39	3,4',5

IUPAC No.	Structure
	Tetrachlorobiphenyls
40	2,2',3,3'
41	2,2',3,4
42	2,2',3,4'
43	2,2',3,5
44	2,2',3,5'
45	2,2',3,6
46	2,2',3,6'
47	2,2',4,4'
48	2,2',4,5
49	2,2',4,5'
50	2,2',4,6
51	2,2',4,6'
52	2,2',5,5'
53	2,2',5,6'
54	2,2',6,6'
55	2,3,3',4
56	2,3,3',4'
57	2,3,3',5
58	2,3,3',5'
59	2,3,3',6
60	2,3,4,4'
61	2,3,4,5
62	2,3,4,6
63	2,3,4',5
64	2,3,4',6
65	2,3,5,6
66	2,3',4,4'
67	2,3',4,5
68	2,3',4,5'
69	2,3',4,6
70	2,3',4',5
71	2,3',4',6
72	2,3',5,5'
73	2,3',5',6
74	2,4,4',5
75	2,4,4',6
76	2',3,4,5
77	3,3',4,4'
78	3,3',4,5
79	3,3',4,5'
80	3,3',5,5'
81	3,4,4',5

IUPAC No.	Structure
	Pentachlorobiphenyls
82	2,2',3,3',4
83	2,2',3,3',5
84	2,2',3,3',6
85	2,2',3,4,4'
86	2,2',3,4,5
87	2,2',3,4,5'
88	2,2',3,4,6
89	2,2',3,4,6'
90	2,2',3,4',5
91	2,2',3,4',6'
92	2,2',3,5,5'
93	2,2',3,5,6
94	2,2',3,5,6'
95	2,2',3,5',6
96	2,2',3,6,6'
97	2,2',3',4,5
98	2,2',3',4,6
99	2,2',4,4',5
100	2,2',4,4',6
101	2,2',4,5,5'
102	2,2',4,5,6'
103	2,2',4,5',6
104	2,2',4,6,6'
105	2,3,3',4,4'
106	2,3,3',4,5
107	2,3,3',4',5
108	2,3,3',4,5'
109	2,3,3',4,6
110	2,3,3',4',6
111	2,3,3',5,5'
112	2,3,3',5,6
113	2,3,3',5',6
114	2,3,4,4',5
115	2,3,4,4',6
116	2,3,4,5,6
117	2,3,4',5,6
118	2,3',4,4',5
119	2,3',4,4',6
120	2,3',4,5,5'
121	2,3',4,5',6
122	2',3,3',4,5
123	2',3,4,4',5
124	2',3,4,5,5'
125	2',3,4,5,6'
126	3,3',4,4',5
127	3,3',4,5,5'

UPAC No.	Structure
	Hexachlorobiphenyls
128	2,2',3,3',4,4'
129	2,2',3,3',4,5
130	2,2',3,3',4,5'
131	2,2',3,3',4,6
132	2,2',3,3',4,6'
133	2,2',3,3',5,5'
134	2,2',3,3',5,6
135	2,2',3,3',5,6'
136	2,2',3,3',6,6'
137	2,2',3,4,4',5
138	2,2',3,4,4',5'
139	2,2',3,4,4',6
140	2,2',3,4,4',6'
141	2,2',3,4,5,5'
142	2,2',3,4,5,6
143	2,2',3,4,5,6'
144	2,2',3,4,5',6
145	2,2',3,4,6,6'
146	2,2',3,4',5,5'
147	2,2',3,4',5,6
148	2,2',3,4',5,6'
149	2,2',3,4',5',6
150	2,2',3,4',6,6'
151	2,2',3,5,5',6
152	2,2',3,5,6,6'
153	2,2',4,4',5,5'
154	2,2',4,4',5,6'
155	2,2',4,4',6,6'
156	2,3,3',4,4',5
157	2,3,3',4,4',5'
158	2,3,3',4,4',6
159	2,3,3',4,5,5'
160	2,3,3',4,5,6
161	2,3,3',4,5',6
162	2,3,3',4',5,5'
163	2,3,3',4',5,6
164	2,3,3',4',5',6
165	2,3,3',5,5',6
166	2,3,4,4',5,6
167	2,3',4,4',5,5'
168	2,3',4,4',5',6
169	3,3',4,4',5,5'

IUPAC No.	Structure
	Heptachlorobiphenyls
170	2,2',3,3',4,4',5
171	2,2',3,3',4,4',6
172	2,2',3,3',4,5,5'
173	2,2',3,3',4,5,6
174	2,2',3,3',4,5,6'
175	2,2',3,3',4,5',6
176	2,2',3,3',4,6,6'
177	2,2',3,3',4',5,6
178	2,2',3,3',5,5',6
179	2,2',3,3',5,6,6'
180	2,2',3,4,4',5,5'
181	2,2',3,4,4',5,6
182	2,2',3,4,4',5,6'
183	2,2',3,4,4',5',6
184	2,2',3,4,4',6,6'
185	2,2',3,4,5,5',6
186	2,2',3,4,5,6,6'
187	2,2',3,4',5,5',6
188	2,2',3,4',5,6,6'
189	2,3,3',4,4',5,5'
190	2,3,3',4,4',5,6
191	2,3,3',4,4',5',6
192	2,3,3',4,5,5',6
193	2,3,3',4',5,5',6
	Octachlorobiphenyls
194	2,2',3,3',4,4',5,5'
195	2,2',3,3',4,4',5,6
196	2,2',3,3',4,4',5,6'
197	2,2',3,3',4,4',6,6'
198	2,2',3,3',4,5,5',6
199	2,2',3,3',4,5,6,6'
200	2,2',3,3',4,5',6,6'
201	2,2',3,3',4,5,5',6'
202	2,2',3,3',5,5',6,6'
203	2,2',3,4,4',5,5',6
204	2,2',3,4,4',5,6,6'
205	2,3,3',4,4',5,5',6
	Nonachlorobiphenyls
206	2,2',3,3',4,4',5,5',6
207	2,2',3,3',4,4',5,6,6'
208	2,2',3,3',4,5,5',6,6'
	Decachlorobiphenyl
209	2,2',3,3',4,4',5,5',6,6'

a. Adapted from Ballschmiter and Zell (1980).

7) a method blank should be analyzed with each sample set from the same site, or every 20 samples, whichever is less. The method blank results should be reported.

RESPONSE: Samples were submitted to us blind so that knowledge of site differences was not available. However, the reviewer is correct in the statement that a method blank should have been analyzed one in twenty samples. However, the reagent or solvent lots were not changed throughout the analyses performed here so that one method blank was used for twenty-eight samples.

Results from the blank analyses are given in Table B.

TABLE B
BLANK RESULTS LIMNOTECH STUDY

TABLE B.1 CHLOROBENZENES, ORGANOCHLORINE PESTICIDES	BASED ON 8g SAMPLE; ng/g
1,2–Dichlorobenzene	ND
1,3–Dichlorobenzene	ND
1,4–Dichlorobenzene	ND
Hexachlorobenzene	ND
Hexachlorobutadiene	ND
Hexachloroethane	ND
1,3,5–Trichlorobenzene	ND
1,2,4–Trichlorobenzene	3.52
1,2,3–Trichlorobenzene	0.18
1,2,3,5–Tetrachlorobenzene	ND
1,2,4,5–Tetrachlorobenzene	ND
1,2,4,5–Tetrachlorobenzene	ND
1,2,3,5–Tetrachlorobenzene	ND
Pentachlorobenzene	ND
DDT	ND
DDD	ND
DDE	ND
ß–BHC	ND
α–BHC	ND
δ–BHC	ND
Lindane	ND
α–Chlordane	ND
γ–Chlordane	ND
Nonachlor	ND
Mirex	ND
Aldrin	ND
Dieldrin	ND
Endrin	ND
α–Endosulphan	ND
ß–Endosulphan	ND
Methoxychlor	1.60
Heptachlor	ND
OCS+Heptachlorepoxide	ND

TABLE B (continued)

PCBs	BASED ON 8g SAMPLE; ng/g
PCB 51	0.42
PCB 135+144	0.06
PCB 149	0.18
PCB 118	0.066
PCB 34+114	0.57
PCB 131	0.13
PCB 146	0.36
PCB 153+132+105	0.72
PCB 163+138	0.095
PCB 178	0.30
PCB 157+200	0.13
PCB 172	0.24
PCB 170+190	0.40

POLYAROMATIC HYDROCARBONS	
Napthanlene	0.00188
Acenaphthylene	ND
Acenaphthene	ND
Fluorene	ND
Phenanthrene	ND
Anthracene	ND
Fluoranthene	ND
Pyrene	ND
Benzo (A) anthracene	ND
Chrysene	ND
Benzo (B) fluoranthene	ND
Benzo (A) Pyrene	ND
Indeno 1,2,3-(c,d)pyrene	ND
Debenz(ah)anthracene	ND
Benzo(ghi)perylene	ND

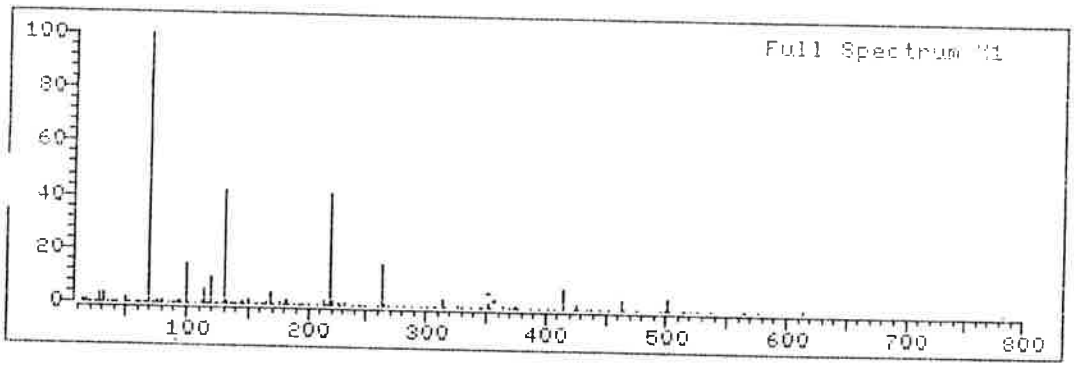
TABLE B (continued)

PHTHALATES	BASED ON 8g SAMPLE; ng/g
Dimethylphthatate	0.00162
Diethylphtahalate	0.01225
Dibutylphthalate	0.100
Butylbenzylphthalate	0.0108
Bis(2-ethylhexyl)phthalate	0.184
Di-n-octylphthatate	0.00788

Haloethers – all ND

10) under Laboratory QA/QC Protocols, the following information was not provided, a) the name of the compound used to calibrate the mass spectrometer, b) the spectra from the mass calibration, c) the corrective actions followed if the mass spec does not calibrate.

RESPONSE: The mass spectrometer was tuned daily to meet pentafluoratributylamine (PFTBA) tuning criteria using a computer controlled autotune procedure. An example spectrum from the mass calibration is shown below. The autotune results were examined by the analyst prior to analyzing each batch of samples. The system was vented and the source cleaned if it was not possible to achieve an autotune which met all tuning criteria for PFTBA.



Mass	Abs. Abund	Rel. Ratio	Trgt. Ratio	Iso. Mass	Iso. Abund	Iso. Ratio	Trgt. Ratio
69.00	101176	100.00%	100.00%	70.00	1233	1.22%	1.08%
219.00	41368	40.89%	35.00%	220.00	1911	4.62%	4.32%
501.90	4052	4.00%	2.00%	502.90	379	9.35%	10.11%

11) Table 4.3, page 31, incorrectly identifies the surrogate compounds and shows that surrogate compound recoveries were very low for three compounds. This could mean that some of the pollutants were lost during the clean-up procedure.

RESPONSE: Table 4.3 is appended with typological errors corrected; we thank the reviewer for detecting these.

TABLE 4.3

Average and Standard Deviation of Surrogate Spike Recoveries*

COMPOUND		n
1,3-Dibromobenzene	43 ± 7	27
1,3,5-Tribromobenzene	50 ± 10	27
1,2,4,5-Tetrabromobenzene	80 ± 20	27
2,3,4,5-PCB	90 ± 20	27
d-10 Phenanthrene	50 ± 20	27

* Average based on 27 samples; sample 89-00541 excluded from average.

In Table C below, we have compared the 3-s based ranges of surrogate compounds used in this study with surrogate ranges given in Table 8 of method 8270 for soils and sediments and with 3-s based ranges derived from compounds in Table 7 of the same method. Although we appreciate that these comparisons are not strictly 'protocol', they do permit an assessment of surrogate recoveries which may be acceptable to the reviewer.

TABLE C

COMPARISON OF RANGES OF PERCENTAGE RECOVERIES		COMPARISON COMPOUND; 3S RANGE
d10–phenanthrene; Average ± S 3s–range	1 ppm 50 ± 20 D to 110	p–terphenyl (TABLE 8) 18 to 137
1,3 Dibromobenzene; Average ± S 3s–range	51.4 ppb 43 ± 7 22 to 64	1,3–Dichlorobenzene (TABLE 7) 17 to 152
1,3,5–Tribromobenzene; Average ± S 3s–range	20.4 ppm 50 ± 10 20 to 80	1,3,4–Trichlorobenzene (TABLE 7) 37 to 143
1,2,4,5–Tetrabromobenzene; Average ± S 3s–range	22.1 ppb 80 ± 10 50 to 110	1,3,4–Trichlorobenzene (TABLE 7) 37 to 143
PCB 65; Average ± S 3s–range	22.3 ppb 90 ± 20 30 to 150	2–fluorobiphenyl 30 to 115

We find that the surrogate recoveries for 1,3–dibromobenzene, 1,2,4,5–tetrabromobenzene, and PCB 65 are acceptable. Some low recoveries of d10–phenanthrene and 1,3,5–tribromobenzene did occur for some samples.

It is recognized that, in this study, recovery of phenanthrene was problematic. Recovery of the trichlorobenzenes may also have problems, although method spike recoveries were excellent.

Thus, the reviewer's statement regarding loss of pollutants must be weighed carefully before rejecting the entire data set presented in this study as unreliable.

standard deviation. Two phthalates showed excellent recoveries, however, the standard deviations were slightly higher than the upper limits for s. Bromophenyl phenyl ether which had a % recovery slightly higher than the acceptable upper range value. Only two organochlorines showed low recoveries and DDD showed excellent recovery, but the standard deviation was beyond the upper limit.

In summary, only twelve compounds out of a total of 57 compounds analyzed did not meet the QC acceptance criteria. The reviewer has made an unfair and unwarranted global statement that all organochlorine pesticide recoveries are poor and that serious problems exist for all PNA (PAH) recoveries. After careful examination of the appropriate data, it appears that this statement is false for approximately 80% of the compounds in question. We have presented the data clearly in order that those interpreting the results may do so with complete knowledge of the associated accuracy.

TABLE D

Comparison of Experimental Method Spike Data and SW-846 QC Accptance Criteria

SW-846 ACCEPTABLE PARAMETER	EXPERIMENTAL% RECOVERY ± S.D.	% RECOVERY RANGE AND LIMIT FOR S.D.
Acenaphthylene	20 ± 4	(33-145) ± 40.2
Acenaphthene	26 ± 5	(47-145) ± 27.6
Fluorene	44 ± 4	(59-121) ± 20.7
Phenanthrene	9 ± 6	(54-120) ± 20.6
Anthracene	13 ± 8	(27-133) ± 32
Pyrene	17 ± 7	(52-115) ± 25.2
Dibutylphthalate	60 ± 20	(1-118) ± 16.7
Di-n-octylphthalate	70 ± 40	(4-146) ± 31.4
Bromophenyl phenyl ether	140 ± 20	(53-127) ± 23
DDD	130 ± 40	(31-141) ± 28
α-Chlordane	39 ± 30	(45-119) ± 20
Heptachlor epoxide	32 ± 6	(37-142) ± 21

16) replicates shouldn't vary more than 30% for the average deviation. The tables on pgs. 38–46 showed the lab was unable to duplicate their work with regard to a high number of compounds. When poor recoveries were found the method should have been changed and the clean–up techniques checked to verify no loss of the compound in the clean–up.

RESPONSE: We cannot dispute the fact that duplicate sample results presented in our report vary more than 30% for some compounds. However, we question whether this 30% variation also includes contributions from sample inhomogeneity in sediment samples.

The statement with regard to poor recoveries seems out of place and has been addressed in the response to point #5.

17) the tentatively identified compounds list does not tell how the concentrations were calculated.

RESPONSE: Results for the full scan analysis of unknown compounds were calculated by comparing the response of the tentatively identified compound to the response of the known amount of anthracene–d10 internal standard. It should be noted that the reported concentrations are strictly estimated values.

APPENDIX A

TABULATION OF UNCORRECTED DATA

Table 3.7 CONCENTRATIONS OF PHTHALATES IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541
Dimethyl Phthalate	1.5t	1.59	2.8t	3.774	4.462	< 3	< 3
Diethyl Phthalate	8.88	13.78	21.17	22.44	21.62	8.33	7.68
Dibutyl Phthalate	< 10	< 10	114.61	46.41	115	< 10	214.4
Butyl Benzyl Phthalate	185	153.7	18.98	81.6	644	161.7	448
Bis (2-ethyl hexyl)Phthalate	4736	1219	1752	2703	6440	4361	10560
Di-N-Octyl Phthalate	207.2	103.35	138.7	96.9	1058	382.2	960

COMPOUND	89-00542	89-00543	89-00544	89-00545	89-00546	89-00547	89-00548
Dimethyl Phthalate	7.65	< 3	< 3	< 3	0.35t	0.17t	1.5t
Diethyl Phthalate	0.56t	< 3	< 3	< 3	< 3	< 3	1.44
Dibutyl Phthalate	< 10	< 10	< 10	< 10	< 10	< 10	8.4
Butyl Benzyl Phthalate	40.8	< 4	14.19	17.5	58.41	69.3	79.2
Bis (2-ethyl hexyl)Phthalate	1989	< 10	103.2	280	< 10	1134	2064
Di-N-Octyl Phthalate	66.3	9.31568	81.7	50	82.6	220.5	552

COMPOUND	89-00549	89-00550	89-00551	89-00552	89-00553	89-00554	89-00555
Dimethyl Phthalate	1.3t	29.39266	0.76t	1.1t	1.6t	15.96	< 3
Diethyl Phthalate	< 3	9.74516	0.38t	3.4t	7.1t	6.08	0.86t
Dibutyl Phthalate	< 10	63.8	< 10	< 10	< 10	25.84	< 10
Butyl Benzyl Phthalate	46.98	35.20832	213.2	11.2	33.97	72.2	10.5006
Bis (2-ethyl hexyl)Phthalate	972	638	1612	< 10	688	6460	224.4
Di-N-Octyl Phthalate	259.2	290	187.2	7.04	68.8	296.4	122.1

COMPOUND	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
Dimethyl Phthalate	< 3	1.6t	< 3	1.435	0.62t	< 3	< 3
Diethyl Phthalate	0.87t	0.52t	0.49t	0.69t	< 3	< 3	< 3
Dibutyl Phthalate	< 10	4.978	< 10	11.48	< 10	< 10	< 10
Butyl Benzyl Phthalate	12.96	< 4	3.4t	17.63	5.98	4.26	< 4
Bis (2-ethyl hexyl)Phthalate	309.6	< 10	< 10	360.8	170.2	60.35	< 10
Di-N-Octyl Phthalate	3.42	29.56932	28.08	39.36	43.24	24.14	20.74

Table 3.3 CONCENTRATIONS OF CHLOROBENZENES IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543	89-00544
1,2-Dichlorobenzene	4.56	8.34	< 5.5	6.32	19.23	10.16	33.29	4.95	< 5.5	1.89
1,3-Dichlorobenzene	< 5.5	< 5.5	< 5.5	< 5.5	< 5.5	< 5.5	5.53	< 5.5	< 5.5	0.14
1,4-Dichlorobenzene	8.74	5.33	12	19.15	74.81	28.34	74.00	18.18	3.04	7.24
Hexachlorobenzene	2.19	0.67	0.44	0.77	2.82	1.73	6.50	1.34	0.08	0.10
Hexachlorobutadiene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Hexachloroethane	0.09	< 0.4	< 0.4	< 0.4	0.18	0.08	0.12	< 0.4	< 0.4	< 0.4
1,3,5-Trichlorobenzene	1.67	0.56	< 0.6	0.64	1.86	1.29	2.70	0.44	< 0.6	0.17
1,2,4-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,2,3-Trichlorobenzene	0.23	0.29	0.02	< 0.6	0.69	0.41	2.23	< 0.6	< 0.6	0.08
1,2,4,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	0.46	0.70	< 0.4	< 0.4
1,2,3,5-Tetrachlorobenzene	0.45	< 0.4	< 0.4	< 0.4	0.59	0.67	< 0.4	0.48	0.17	0.24
1,2,3,4-Tetrachlorobenzene	0.32	0.35	0.32	0.55	0.43	0.66	1.21	1.25	< 0.4	1.04
Pentachlorobenzene	0.43	0.29	0.27	0.23	1.36	0.88	< 0.4	0.58	< 0.4	0.38

COMPOUND	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552	89-00553	89-00554
1,2-Dichlorobenzene	10.00	< 5.5	< 5.5	7.02	7.19	2.94	14.96	1.97	5.32	3.51
1,3-Dichlorobenzene	2.35	0.05	1.33	2.73	< 5.5	2.55	2.22	< 5.5	0.67	4.15
1,4-Dichlorobenzene	18.00	5.34	1.99	3.31	14.95	2.94	3.55	2.45	6.25	14.28
Hexachlorobenzene	0.22	0.27	0.46	0.64	< 0.4	0.38	0.75	< 0.4	1.18	0.98
Hexachlorobutadiene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Hexachloroethane	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,3,5-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	1.51	0.25	0.93	< 0.6	0.18	1.37
1,2,4-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,2,3-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	0.40	< 0.6	0.34	< 0.6	< 0.6	0.02
1,2,4,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	0.13	< 0.4	0.14	< 0.4	< 0.4	< 0.4
1,2,3,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	0.12	< 0.4	0.59	1.48
1,2,3,4-Tetrachlorobenzene	< 0.4	0.27	< 0.4	< 0.4	0.76	0.33	0.55	< 0.4	0.70	0.72
Pentachlorobenzene	0.29	0.21	0.31	0.43	0.20	0.38	0.99	< 0.4	0.19	1.25

COMPOUND	89-00555	89-00556	89-00557	89-00558	89-00559	89-00560	89-00561	89-00562
1,2-Dichlorobenzene	3.18	5.33	2.82	3.95	3.42	1.98	3.61	2.21
1,3-Dichlorobenzene	1.26	< 5.5	< 5.5	0.69	0.34	0.28	< 5.5	0.03
1,4-Dichlorobenzene	10.51	8.16	4.04	3.72	9.18	1.88	2.15	< 5.5
Hexachlorobenzene	0.34	0.38	0.11	0.46	0.44	0.17	0.24	0.06
Hexachlorobutadiene	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
Hexachloroethane	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4	< 0.4
1,3,5-Trichlorobenzene	0.21	0.27	< 0.6	< 0.6	0.41	< 0.6	< 0.6	< 0.6
1,2,4-Trichlorobenzene	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6
1,2,3-Trichlorobenzene	0.01	< 0.6	< 0.6	< 0.6	0.12	< 0.6	< 0.6	< 0.6
1,2,4,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	0.64	< 0.4	< 0.4	< 0.4
1,2,3,5-Tetrachlorobenzene	< 0.4	< 0.4	< 0.4	< 0.4	0.45	< 0.4	< 0.4	< 0.4
1,2,3,4-Tetrachlorobenzene	0.32	0.31	< 0.4	0.29	1.47	0.33	0.13	< 0.4
Pentachlorobenzene	0.16	0.29	0.10	0.35	0.26	0.17	0.17	0.05

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
A. Samples 89-00535 to 89-00543

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
PCB 1	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PBC 3	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	110.00	< 0.05	< 0.05
PBC 4 & 10	< 0.05	0.24	< 0.05	0.24	1.09	< 0.05	< 0.05	< 0.05	< 0.05
PCB 7	< 0.05	< 0.05	< 0.05	< 0.05	0.34	< 0.05	< 0.05	< 0.05	< 0.05
PCB 6	< 0.05	0.29	< 0.05	0.52	1.44	0.73	2.88	0.54	< 0.05
PCB 8 & 5	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	18.00	< 0.05	< 0.05
PCB 19	< 0.05	< 0.05	< 0.05	< 0.05	2.14	< 0.05	< 0.05	< 0.05	< 0.05
PCB 12	0.55	0.25	0.25	< 0.05	3.56	< 0.05	< 0.05	< 0.05	< 0.05
PCB 13	< 0.05	< 0.05	< 0.05	< 0.05	0.85	< 0.05	< 0.05	< 0.05	< 0.05
PCB 18	3.41	2.12	2.54	4.40	4.98	3.74	9.54	3.40	< 0.05
PCB 17	12.37	4.51	0.57	6.00	8.01	11.22	21.78	7.36	< 0.05
PCB 24 & 27	< 0.05	0.24	< 0.05	< 0.05	0.64	0.30	< 0.05	< 0.05	< 0.05
PCB 16 & 32	4.05	2.52	1.77	3.00	3.92	3.74	9.54	2.32	0.11
PCB 26	0.92	5.58	0.87	3.60	11.57	8.86	16.92	2.66	0.21
PCB 25	0.28	0.31	< 0.05	< 0.05	< 0.05	< 0.05	1.69	< 0.05	< 0.05
PCB 31 & 28	7.25	6.24	2.11	5.60	12.99	10.04	30.78	6.51	1.24
PCB 33	2.99	2.12	0.46	1.44	5.70	4.13	14.94	3.11	< 0.05
PCB 53	1.09	0.89	< 0.05	0.62	< 0.05	< 0.05	< 0.05	1.36	< 0.05
PCB 51	1.41	0.70	1.27	0.72	1.78	1.48	4.32	< 0.05	< 0.05
PCB 22	2.13	7.04	< 0.05	6.00	11.75	8.86	24.84	11.32	2.33
PCB 45	< 0.05	0.56	0.20	0.64	1.34	0.96	25.74	1.78	< 0.05
PCB 46	0.45	0.37	< 0.05	0.50	2.49	0.77	6.12	4.24	< 0.05
PCB 52	21.33	15.80	0.51	3.00	42.90	23.22	86.40	11.04	0.11
PCB 49	4.27	2.52	0.34	2.60	4.63	4.13	22.86	6.23	< 0.05
PCB 47 & 48	4.69	3.05	0.82	3.00	4.63	4.72	28.44	5.94	0.18
PCB 44	7.46	4.12	0.27	4.60	6.94	7.48	55.08	12.45	< 0.05
PCB 42 & 37	4.69	2.12	< 0.05	< 0.05	5.70	3.74	< 0.05	< 0.05	< 0.05
PCB 41 & 71 & 64	9.38	5.58	< 0.05	5.20	8.01	7.87	25.92	5.94	< 0.05
PCB 40	1.24	0.88	< 0.05	0.62	1.41	1.79	2.70	0.71	< 0.05
PCB 100	0.28	0.25	0.18	0.24	0.52	0.55	2.34	0.48	< 0.05
PCB 63	0.34	0.29	< 0.05	0.30	1.46	0.85	1.98	0.42	< 0.05
PCB 74	2.56	1.46	0.38	1.44	3.03	2.95	11.34	1.87	< 0.05
PCB 70 & 76	9.38	5.05	1.35	5.60	10.68	10.04	52.20	7.92	0.36
PCB 66 & 95	17.06	8.23	3.59	10.80	16.20	16.92	93.78	15.57	0.34
PCB 91	2.99	1.59	0.59	1.90	3.03	1.93	12.96	1.10	< 0.05
PCB 56 & 60	0.87	0.49	0.14	0.48	1.00	0.94	3.42	0.57	0.03
PCB 84	10.66	6.77	1.61	7.80	14.24	15.94	61.38	7.36	0.11
PCB 92	< 0.05	< 0.05	0.49	0.78	< 0.05	< 0.05	< 0.05	3.11	< 0.05
PCB 101	0.60	5.05	2.96	6.20	< 0.05	8.07	64.98	12.74	0.25
PCB 99	3.20	1.73	0.95	2.60	4.27	3.74	25.56	4.81	0.09
PCB 83	0.66	0.37	0.19	0.44	0.71	0.67	3.78	0.82	< 0.05
PCB 97	3.20	1.86	0.57	2.00	3.92	3.35	19.44	3.40	< 0.05
PCB 87	4.91	2.39	0.82	3.00	4.81	4.92	32.58	5.66	< 0.05
PCB 85	< 0.05	< 0.05	4.44	18.80	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 136	2.13	8.63	< 0.05	< 0.05	23.67	27.55	59.40	21.79	0.19
PCB 110	4.91	4.91	1.94	6.80	9.43	9.84	64.08	12.17	0.11
PCB 82	1.62	0.78	0.23	1.02	1.60	1.73	8.82	1.61	< 0.05
PCB 151	3.84	1.73	2.96	4.00	3.74	3.74	23.58	6.23	0.15

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
A. Samples 89-00535 to 89-00543

COMPOUND	89-00535	89-00536	89-00537	89-00538	89-00539	89-00540	89-00541	89-00542	89-00543
PCB 135 & 144	2.56	1.14	1.46	2.40	2.67	2.56	17.10	3.96	0.07
PCB 107	1.17	0.31	0.17	0.98	0.50	1.16	8.82	0.59	< 0.05
PCB 149	12.16	5.05	7.82	11.00	11.93	11.22	71.10	16.70	0.44
PCB 118	6.19	3.05	1.54	4.60	8.37	6.10	52.02	9.91	0.08
PCB 34 & 114	4.69	2.26	1.20	2.00	5.34	6.10	15.30	3.11	< 0.05
PCB 131	0.34	0.06	0.04	0.06	0.82	0.30	0.70	0.13	< 0.05
PCB 146	3.84	1.14	2.01	3.20	2.67	2.76	20.70	5.09	0.11
PCB 153 & 132 & 105	25.59	11.02	16.69	23.20	29.90	23.62	16.74	39.62	1.05
PCB 141	4.69	1.73	2.96	3.60	3.74	3.35	19.98	5.66	0.09
PCB 137 & 176	0.73	0.28	1.37	1.34	0.62	0.67	4.68	1.10	< 0.05
PCB 163 & 138	16.85	7.17	11.41	15.40	19.05	19.48	100.00	25.75	0.70
PCB 158	4.27	1.73	1.96	2.60	4.27	4.13	19.62	4.53	0.29
PCB 178	1.07	0.64	2.32	1.78	3.20	1.02	8.46	1.25	0.60
PCB 175	1.07	0.41	0.49	0.78	0.96	1.06	3.42	1.02	0.18
PCB 187 & 182	14.29	5.84	13.10	16.40	15.84	13.78	78.48	27.73	0.67
PCB 183	4.05	1.46	4.44	4.60	4.27	3.94	22.68	7.36	0.36
PCB 128	2.99	1.99	1.14	2.20	2.85	2.95	17.64	3.96	0.19
PCB 167	0.66	0.27	0.38	0.46	0.66	0.61	3.78	0.93	0.12
PCB 185	1.02	1.46	0.97	1.00	0.71	0.96	4.32	1.61	< 0.05
PCB 174	5.55	2.26	5.49	6.40	6.05	5.51	29.88	9.91	0.33
PCB 177	3.41	1.59	3.59	4.20	4.27	3.54	21.06	6.23	0.33
PCB 202 & 171	3.41	1.33	2.54	3.20	1.96	2.16	9.54	4.53	0.16
PCB 157 & 200	2.56	4.38	0.78	1.16	2.31	2.16	8.64	2.66	0.19
PCB 172	1.54	6.64	1.50	1.58	1.42	1.22	6.30	2.49	0.21
PCB 197	< 0.05	< 0.05	< 0.05	< 0.05	1.96	< 0.05	< 0.05	< 0.05	< 0.05
PCB 180	12.58	5.05	13.94	14.40	14.42	12.79	68.22	22.64	0.48
PCB 193	0.73	0.35	0.89	0.90	0.68	0.71	4.14	1.50	< 0.05
PCB 191	0.55	7.30	0.55	0.68	0.66	0.45	2.34	2.38	< 0.05
PCB 199	0.58	7.57	0.36	0.48	0.20	0.47	1.98	0.88	< 0.05
PCB 170 & 190	8.53	4.38	10.56	11.00	9.61	8.27	46.80	160.00	< 0.05
PCB 198	0.49	1.25	0.25	0.40	< 0.05	0.31	1.35	2.55	< 0.05
PCB 201	5.55	2.12	4.01	5.40	4.81	4.53	23.22	19.81	0.27
PCB 203 & 196	6.40	2.26	5.07	6.40	5.52	5.31	27.90	20.94	0.18
PCB 208 & 195	3.63	1.99	3.17	3.40	3.03	3.35	15.30	13.30	0.11
PCB 207	0.51	5.05	0.21	0.34	0.13	0.37	1.04	1.39	0.08
PCB 194	2.56	1.46	2.32	2.60	2.49	1.97	11.16	4.81	0.08
PCB 205	0.20	0.73	0.19	0.24	1.71	0.17	1.08	0.37	< 0.05
PCB 206	3.20	4.25	1.06	1.76	1.96	2.95	6.30	13.58	0.11

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
B. Samples 89-00544 to 89-00552

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
PCB 1	< 0.05	< 0.05	< 0.05	3.26	2.59	4.80	< 0.05	< 0.05	< 0.05
PBC 3	< 0.05	< 0.05	< 0.05	< 0.05	8.37	6.70	< 0.05	< 0.05	< 0.05
PBC 4 & 10	< 0.05	< 0.05	< 0.05	< 0.05	0.47	0.31	< 0.05	< 0.05	< 0.05
PCB 7	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.11	< 0.05	< 0.05	< 0.05
PCB 6	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 8 & 5	0.77	< 0.05	< 0.05	< 0.05	1.89	1.79	1.34	4.95	< 0.05
PCB 19	0.11	0.18	< 0.05	< 0.05	< 0.05	< 0.05	0.14	1.05	< 0.05
PCB 12	< 0.05	< 0.05	0.36	< 0.05	< 0.05	6.25	1.30	< 0.05	0.06
PCB 13	< 0.05	< 0.05	< 0.05	< 0.05	0.17	< 0.05	< 0.05	< 0.05	< 0.05
PCB 18	2.50	6.46	1.89	< 0.05	2.12	< 0.05	1.83	9.23	1.11
PCB 17	0.83	1.05	0.32	< 0.05	2.36	1.67	1.31	3.14	< 0.05
PCB 24 & 27	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	0.37	< 0.05	< 0.05	< 0.05
PCB 16 & 32	2.21	1.90	1.55	1.47	2.24	< 0.05	1.13	2.95	0.31
PCB 26	0.57	2.76	0.54	0.15	0.15	0.59	0.26	2.09	0.32
PCB 25	0.09	< 0.05	< 0.05	< 0.05	< 0.05	4.91	< 0.05	< 0.05	< 0.05
PCB 31 & 28	3.17	0.61	1.11	1.05	2.12	8.04	1.53	9.23	0.12
PCB 33	3.36	0.65	0.52	0.97	1.10	< 0.05	1.04	4.09	< 0.05
PCB 53	< 0.05	0.36	< 0.05	< 0.05	< 0.05	1.52	< 0.05	< 0.05	< 0.05
PCB 51	4.61	0.59	< 0.05	0.66	0.84	< 0.05	0.28	0.90	< 0.05
PCB 22	2.11	2.76	3.42	0.91	1.65	< 0.05	0.99	0.49	2.41
PCB 45	0.19	2.19	0.22	< 0.05	< 0.05	< 0.05	< 0.05	4.28	0.12
PCB 46	0.22	0.72	< 0.05	< 0.05	0.14	< 0.05	< 0.05	< 0.05	< 0.05
PCB 52	3.36	6.18	2.22	9.48	11.79	< 0.05	2.75	39.98	0.12
PCB 49	4.99	0.35	0.22	0.75	1.13	11.16	0.55	2.38	< 0.05
PCB 47 & 48	12.00	0.45	0.44	1.05	2.00	1.79	0.73	2.67	< 0.05
PCB 44	1.25	0.52	0.34	1.47	2.24	< 0.05	0.93	4.00	< 0.05
PCB 42 & 37	1.34	< 0.05	< 0.05	1.16	1.41	2.46	0.67	< 0.05	< 0.05
PCB 41 & 71 & 64	2.98	0.50	0.56	1.16	2.59	42.41	1.24	4.09	< 0.05
PCB 40	0.26	0.14	< 0.05	0.63	0.34	< 0.05	0.18	0.82	< 0.05
PCB 100	2.98	< 0.05	< 0.05	< 0.05	0.10	< 0.05	< 0.05	< 0.05	< 0.05
PCB 63	0.24	0.18	< 0.05	0.19	2.48	0.62	0.20	< 0.05	< 0.05
PCB 74	1.73	0.23	0.38	0.44	0.72	0.25	0.41	1.52	< 0.05
PCB 70 & 76	2.02	1.05	1.03	2.00	2.48	< 0.05	1.10	6.09	< 0.05
PCB 66 & 95	8.93	2.28	1.95	2.95	4.36	3.46	3.21	6.95	< 0.05
PCB 91	3.65	0.25	0.28	0.34	0.94	1.56	0.31	1.62	< 0.05
PCB 56 & 60	0.25	0.09	0.12	0.16	0.22	0.59	0.14	0.66	< 0.05
PCB 84	7.68	2.19	1.31	1.16	1.41	3.24	1.31	5.24	< 0.05
PCB 92	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	3.68	< 0.05	3.71	< 0.05
PCB 101	10.46	0.22	1.43	< 0.05	< 0.05	1.12	1.99	7.33	< 0.05
PCB 99	3.36	0.62	0.42	< 0.05	< 0.05	0.56	0.14	0.76	< 0.05
PCB 83	0.19	0.15	< 0.05	0.17	0.15	0.35	0.18	0.47	< 0.05
PCB 97	0.50	0.64	0.36	0.98	1.30	< 0.05	0.67	2.76	< 0.05
PCB 87	1.25	0.79	0.50	1.04	1.41	< 0.05	0.96	3.62	< 0.05
PCB 85	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	4.35	< 0.05	10.47	< 0.05
PCB 136	4.13	6.18	3.63	0.42	0.70	< 0.05	0.17	< 0.05	< 0.05
PCB 110	3.84	1.62	1.05	1.26	1.65	13.39	0.96	7.90	< 0.05
PCB 82	0.37	0.22	0.15	0.31	0.85	< 0.05	0.28	1.05	< 0.05
PCB 151	9.60	1.05	1.23	0.97	1.30	< 0.05	1.51	1.81	< 0.05
PCB 135 & 144	4.80	0.60	0.64	0.63	0.79	0.84	0.83	1.43	< 0.05

TABLE 3.5 CONCENTRATIONS OF PCBs IN POTOMAC RIVER SEDIMENT SAMPLES (ng/g)
B. Samples 89-00544 to 89-00552

COMPOUND	89-00544	89-00545	89-00546	89-00547	89-00548	89-00549	89-00550	89-00551	89-00552
PCB 107	4.03	0.17	0.13	0.17	0.14	0.74	0.26	0.72	< 0.05
PCB 149	19.58	2.85	3.42	2.42	0.27	< 0.05	3.67	6.00	< 0.05
PCB 118	1.92	0.93	1.01	1.37	2.59	2.01	1.47	5.14	< 0.05
PCB 34 & 114	2.98	0.95	0.91	1.90	2.71	< 0.05	0.79	2.86	< 0.05
PCB 131	< 0.05	< 0.05	0.11	< 0.05	0.27	0.27	0.04t	< 0.05	< 0.05
PCB 146	8.83	0.61	1.03	0.58	0.79	1.12	1.13	1.43	< 0.05
PCB 153 & 132 & 105	36.10	5.51	7.85	5.58	7.66	1.23	9.17	17.14	< 0.05
PCB 141	7.39	0.88	1.37	0.71	1.01	4.69	1.30	1.52	< 0.05
PCB 137 & 176	2.21	0.50	0.50	0.17	0.51	4.02	0.17	0.56	0.07
PCB 163 & 138	25.63	3.80	5.64	2.42	0.39	2.57	1.33	10.47	0.04t
PCB 158	3.36	0.79	1.65	4.63	6.48	14.51	1.05	2.19	< 0.05
PCB 178	6.14	0.18	1.41	0.27	0.39	0.60	0.32	1.62	0.07
PCB 175	1.73	0.21	0.26	0.40	0.39	0.46	0.28	< 0.05	0.04
PCB 187 & 182	40.90	3.90	5.84	2.95	4.13	9.60	5.50	5.52	< 0.05
PCB 183	11.71	1.05	1.85	0.80	1.18	7.81	1.68	1.43	< 0.05
PCB 128	1.73	0.75	0.79	0.66	1.30	0.79	0.81	2.00	< 0.05
PCB 167	0.63	0.12	0.22	0.15	< 0.05	0.92	0.21	0.37	< 0.05
PCB 185	2.88	0.52	0.52	0.19	0.25	0.26	0.35	< 0.05	< 0.05
PCB 174	14.88	1.52	1.93	1.16	1.53	< 0.05	2.14	2.09	< 0.05
PCB 177	10.46	0.95	1.53	0.75	1.41	1.34	1.51	1.33	< 0.05
PCB 202 & 171	6.34	0.68	1.07	0.46	0.62	1.34	1.19	1.62	< 0.05
PCB 157 & 200	2.50	1.24	0.32	0.83	0.86	3.57	0.26	0.95	< 0.05
PCB 172	4.90	2.19	0.46	0.35	0.41	< 0.05	0.72	0.56	< 0.05
PCB 197	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
PCB 180	37.34	3.42	4.83	2.63	< 0.05	< 0.05	0.63	4.38	0.07
PCB 193	2.98	0.22	0.34	0.16	3.77	2.57	0.35	< 0.05	< 0.05
PCB 191	1.06	0.28	0.68	< 0.05	0.15	< 0.05	0.28	< 0.05	< 0.05
PCB 199	1.06	0.08	0.11	0.66	0.38	2.57	0.17	< 0.05	0.04t
PCB 170 & 190	26.02	1.62	57.00	0.44	0.87	0.71	2.29	2.86	0.16
PCB 198	1.15	0.32	0.70	< 0.05	0.24	0.19	0.10	< 0.05	< 0.05
PCB 201	16.03	1.24	3.22	0.92	1.65	0.52	1.68	1.90	0.19
PCB 203 & 196	20.26	1.33	2.42	0.95	< 0.05	1.34	0.61	2.09	< 0.05
PCB 208 & 195	11.81	0.66	1.07	0.76	1.06	0.26	1.21	1.52	< 0.05
PCB 207	0.41	1.33	0.40	0.06	0.06	0.15	0.21	< 0.05	< 0.05
PCB 194	9.50	0.57	1.07	0.51	0.40	< 0.05	0.81	0.88	< 0.05
PCB 205	0.62	0.10	0.24	0.04	0.72	0.41	0.08	< 0.05	< 0.05
PCB 206	3.36	0.95	1.57	0.41	0.60	< 0.05	0.64	0.17	< 0.05