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**Evaluation of Dredged Material
Proposed for Ocean Disposal
from Bronx River Project Area,
New York**

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Battelle Marine Sciences Laboratory
Sequim, Washington

December 1996

Prepared for the
U.S. Army Corps of Engineers - New York District
under a Related Services Agreement
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**EVALUATION OF DREDGED MATERIAL
PROPOSED FOR OCEAN DISPOSAL
FROM BRONX RIVER PROJECT AREA,
NEW YORK**

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Summary

The objective of the Bronx River project was to evaluate proposed dredged material from the Bronx River project area in Bronx, New York, to determine its suitability for unconfined ocean disposal at the Mud Dump Site. Bronx River was one of five waterways that the U. S. Army Corps of Engineers-New York District (USACE-NYD) requested the Battelle Marine Sciences Laboratory (MSL) to sample and to evaluate for dredging and disposal in May 1995. Sediment samples were collected from the Bronx River Project area, as well as from Shark River, New Jersey; Shoal Harbor/Compton Creek, New Jersey; Cheesequake Creek, New Jersey; and Westchester Creek, New York. Combining sample collection and concurrent evaluation of multiple dredged material projects was more cost-effective for the USACE-NYD because the expenses of sediment sampling, reference site testing, and quality control analyses could be shared among projects.

Tests and analyses were conducted according to the manual developed by the USACE and the U.S. Environmental Protection Agency (EPA), *Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual)*, commonly referred to as the "Green Book," and the regional manual developed by the USACE-NYD and EPA Region II, *Guidance for Performing Tests on Dredged Material to be Disposed of in Ocean Waters*.

The evaluation of proposed dredged material from the Bronx River project area consisted of bulk sediment physical and chemical analyses, chemical analyses of dredging site water and elutriate, benthic and water-column acute toxicity tests, and bioaccumulation studies. Fifteen individual sediment core samples collected from the Bronx River project area were analyzed for grain size, moisture content, and total organic carbon (TOC). One composite sediment sample, representing the entire reach of the area proposed for dredging, was analyzed for bulk density, specific gravity, metals, chlorinated pesticides, polychlorinated biphenyl (PCB) congeners, polynuclear aromatic hydrocarbons (PAH), and 1,4-dichlorobenzene. Dredging site water and elutriate water, which was prepared from the suspended-particulate phase (SPP) of the Bronx River sediment composite, were analyzed for metals, pesticides, and PCBs. Benthic acute toxicity tests were performed with the amphipod *Ampelisca abdita* and the mysid *Mysidopsis bahia*. The amphipod and mysid benthic toxicity

test procedures followed EPA guidance for reduction of total ammonia concentrations in test systems prior to test initiation. Water-column or SPP toxicity tests were performed with three species, the mysid *Mysidopsis bahia*, the juvenile silverside *Menidia beryllina*, and larvae of the mussel *Mytilus galloprovincialis*. Bioaccumulation tests were conducted with the burrowing, deposit-feeding polychaete worm *Nereis virens* and the surface-detrital-feeding, bent-nose clam, *Macoma nasuta*.

Bronx River sediment core samples were generally black, silty-clay material. Two of the 15 stations were predominantly sand and gravel. The Bronx River sediment composite sample contained eminent levels of metals, pesticides (particularly the DDD/DDE/DDT group of compounds), PCBs, PAHs, and 1,4-dichlorobenzene.

Statistically significant acute toxicity was found in the Bronx River composite in the *A. abdita* test, but not in the *M. bahia* test. Statistically significant acute toxicity and a greater than 20% increase in mortality over the reference sediment was found in the static-renewal tests with *A. abdita*, but greater than 10% increase in mortality over reference sediment was not found in the static tests with *M. bahia*. In water-column toxicity tests, acute toxicity was demonstrated with the Bronx River composite by *M. beryllina*, *M. bahia*, and *M. galloprovincialis*, which exhibited median lethal concentrations (LC_{50}) of 21.5% SPP, 71.6% SPP, and >100% SPP, respectively. The median effective concentration (EC_{50}) for *M. galloprovincialis* normal development, a more sensitive measure than survival, was 23.6% SPP for the composite.

Following 28-day bioaccumulation tests, concentrations of some contaminants were elevated in *M. nasuta* and *N. virens* tissues relative to levels in organisms exposed to the Mud Dump Reference Site. Concentrations of all metals were higher in *M. nasuta* than in *N. virens*. Pesticide and PCB concentrations were generally higher in *N. virens* than in *M. nasuta*. Concentrations of PAHs were higher in *M. nasuta* than in *N. virens*, many compounds by factors of 2 to 10 times. Many tissue burdens of organisms exposed to Bronx River sediment were statistically significantly higher for pesticides, PCBs, and PAHs, relative to those of the Mud Dump Reference Site.

Tissues of both species exposed to the Bronx River sediment composite had wet weight tissue body burdens that were lower than the U.S. Food and Drug Administration (FDA) action levels for poisonous or deleterious substances in fish and shellfish for human consumption for selected pesticides. Tissue concentrations were also below the FDA levels of concern for

chronic shellfish consumption for metals, except for *M. nasuta*, which had levels of lead slightly higher than the FDA levels of concern. Tissue concentrations were below all the designated USACE-NYD bioaccumulation matrix values.

Contents

Summary	iii
1.0 Introduction	1.1
1.1 Project Objectives	1.1
1.2 Project Background	1.2
1.3 Organization of this Report	1.2
2.0 Materials and Methods	2.1
2.1 Sediment and Water Collection	2.1
2.1.1 Test Sediment and Site Water Sampling	2.1
2.1.2 Reference and Control Sediment Sampling	2.3
2.2 Test Organism Collection	2.3
2.3 Sediment Sample Preparation	2.4
2.3.1 Laboratory Preparation and Safety Considerations	2.5
2.3.2 Preparation of Sediment for Benthic Testing and Bulk Sediment Analyses	2.6
2.3.3 Preparation of Suspended-Particulate Phase and Elutriate	2.7
2.4 Physical and Chemical Analytical Procedures	2.8
2.4.1 Grain Size and Percentage of Moisture	2.9
2.4.2 Bulk Density and Specific Gravity	2.9
2.4.3 TOC	2.9
2.4.4 Metals	2.10
2.4.5 Chlorinated Pesticides and PCBs	2.14
2.4.6 PAHs and 1,4-Dichlorobenzene	2.15
2.5 Biological Testing Procedures	2.15
2.5.1 Benthic Acute Toxicity Tests	2.15
2.5.2 Water-Column Toxicity Tests	2.20
2.5.3 Bioaccumulation Testing	2.24
2.6 Data Analysis and Interpretation Procedures	2.26
2.6.1 Randomization	2.26
2.6.2 Statistical Analysis of Water-Column Tests	2.26
2.6.3 Statistical Analysis of Benthic Toxicity Tests	2.27
2.6.4 Statistical Analysis of Bioaccumulation	2.27
2.7 Quality Assurance/Quality Control Procedures	2.28
3.0 Results	3.1
3.1 Sample Collection and Processing	3.1
3.2 Physical and Chemical Analyses	3.1
3.2.1 Sediment Core Sample Description	3.1
3.2.2 Grain Size, Percentage of Moisture, Bulk Density, Specific Gravity, and Total Organic Carbon	3.1
3.2.3 Metals	3.4
3.2.4 Chlorinated Pesticides	3.4
3.2.5 PCBs	3.5
3.2.6 PAHs and 1,4-Dichlorobenzene	3.5

Contents (contd)

3.3 Site Water and Elutriate Analyses	3.7
3.3.1 Metals	3.8
3.3.2 Chlorinated Pesticides and PCBs	3.8
3.4 Water-Column and Benthic Toxicity Testing	3.8
3.4.1 <i>Ampelisca abdita</i> Benthic Acute Toxicity Test	3.10
3.4.2 <i>Mysidopsis bahia</i> Benthic Acute Toxicity Test	3.10
3.4.3 <i>Menidia beryllina</i> Water-Column Toxicity Test	3.11
3.4.4 <i>Mysidopsis bahia</i> Water-Column Toxicity Test	3.12
3.4.5 <i>Mytilus galloprovincialis</i> Water-Column Toxicity Test	3.13
3.5 Bioaccumulation Tests with <i>Macoma nasuta</i> and <i>Nereis virens</i>	3.13
3.5.1 Bioaccumulation of Metals in <i>Macoma nasuta</i>	3.14
3.5.2 Bioaccumulation of Chlorinated Pesticides in <i>Macoma nasuta</i>	3.14
3.5.3 Bioaccumulation of PCBs in <i>Macoma nasuta</i>	3.14
3.5.4 Bioaccumulation of PAHs and 1,4-Dichlorobenzene in <i>Macoma nasuta</i> ..	3.17
3.5.5 Bioaccumulation of Metals in <i>Nereis virens</i>	3.17
3.5.6 Bioaccumulation of Chlorinated Pesticides in <i>Nereis virens</i>	3.17
3.5.7 Bioaccumulation of PCBs in <i>Nereis virens</i>	3.20
3.5.8 Bioaccumulation of PAHs and 1,4-Dichlorobenzene in <i>Nereis virens</i> ...	3.20
3.5.9 Magnification factors of compounds in <i>Macoma nasuta</i> and <i>Nereis virens</i>	3.23
4.0 Discussion and Conclusions	4.1
4.1 Sediment Physical and Chemical Characterization	4.2
4.2 Site Water and Elutriate Chemical Characterization	4.2
4.3 Toxicity	4.2
4.4 Bioaccumulation	4.3
5.0 References	5.1
Appendix A. Sediment Physical/Chemical Analyses and Quality Assurance/Quality Control Data for the Bronx River Project	A.1
Appendix B. Site Water and Elutriate Chemical Analyses and Quality Assurance/Quality Control Data, Bronx River Project	B.1
Appendix C. Benthic Acute Toxicity Test Data, Bronx River Project	C.1
Appendix D. Water-Column Toxicity Test Data, Bronx River Project	D.1
Appendix E. Bioaccumulation Test Data, Bronx River Project	E.1
Appendix F. <i>Macoma nasuta</i> Tissues Chemical Analyses and Quality Assurance/Quality Control Data, Bronx River Project	F.1
Appendix G. <i>Nereis virens</i> Tissues Chemical Analyses and Quality Assurance/Quality Control Data for Bronx River Project	G.1

Contents (contd)

Figures

FIGURE 1.1	Location of Bronx River Project Area and Sample Collection Stations	1.3
FIGURE 2.1.	Testing Containers for Benthic Static Renewal Toxicity Tests	2.17
FIGURE 4.1.	Summary Matrix of Bronx River Sediment Toxicity and Bioaccumulation in Comparison with the Mud Dump Reference Site	4.6

Tables

TABLE 2.1.	List of Analytes, Methods, and Target Detection Limits	2.11
TABLE 3.1	Summary of Sediment Sample Data for Bronx River Project Area	3.2
TABLE 3.2	Bronx River Sediment Core Descriptions	3.3
TABLE 3.3	Results of Analysis of Bronx River Sediment Samples for Grain Size, Percentage of Moisture, and Total Organic Carbon	3.4
TABLE 3.4	Results of Analysis of Bronx River Sediment Samples for Metals	3.5
TABLE 3.5	Results of Analysis of Bronx River Sediment for Chlorinated Pesticides and Polychlorinated Biphenyls	3.6
TABLE 3.6	Results of Analysis of Bronx River Sediment for PAHs and 1,4 Dichlorobenzene	3.7
TABLE 3.7	Results of Analysis of Bronx River Site Water and Elutriate for Metals	3.8
TABLE 3.8	Results of Analysis of Bronx River Site Water and Elutriate for Chlorinated Pesticides and PCBs	3.9
TABLE 3.9	Summary of Benthic Tests Performed with Bronx River Sediment Composites	3.11
TABLE 3.10	Summary of Water-Column Toxicity Tests Performed with Bronx River Sediment Composites	3.12
TABLE 3.11	Mean Concentrations of Metals in <i>Macoma nasuta</i> Tissues Exposed to Bronx River Composites and the Mud Dump Reference Site Sediment	3.15

Contents (contd)

TABLE 3.12	Mean Concentrations of Pesticides in <i>Macoma nasuta</i> Tissue Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.15
TABLE 3.13	Mean Concentrations of PCBs in <i>Macoma nasuta</i> Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.16
TABLE 3.14	Mean Concentrations of PAHs and 1,4-Dichlorobenzene in <i>Macoma nasuta</i> Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.18
TABLE 3.15	Mean Concentrations of Metals in <i>Nereis virens</i> Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.19
TABLE 3.16	Mean Concentrations of Pesticides in <i>Nereis virens</i> Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.19
TABLE 3.17	Mean Concentrations of PCBs in <i>Nereis virens</i> Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.21
TABLE 3.18	Mean Concentrations of PAHs and 1,4-Dichlorobenzene in <i>Nereis virens</i> Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment	3.22
TABLE 3.19	Magnification Factors of All Analyzed Compounds in Tissues Exposed to Bronx River Composites Compared with Mud Dump Reference Site Sediment	3.23
TABLE 4.1	Comparison of Contaminant Concentrations in <i>M. nasuta</i> and <i>Nereis virens</i> Tissues Exposed to Proposed Dredged Material from Bronx River Project Area with FDA Action Levels and Levels of Concern	4.5

1.0 Introduction

1.1 Project Objectives

The objective of the Bronx River project was to evaluate proposed dredged material from the Bronx River project area to determine its suitability for unconfined ocean disposal at the Mud Dump Site. Tests and analyses for Mud Dump disposal were conducted on Bronx River sediment core samples according to the manual developed by the U.S. Army Corps of Engineers (USACE) and the U.S. Environmental Protection Agency (EPA), *Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual)* (EPA/USACE 1991), commonly referred to as the "Green Book," and the regional manual developed by the USACE-New York District (USACE-NYD) and EPA Region II, *Guidance for Performing Tests on Dredged Material to be Disposed of in Ocean Waters* (USACE-NYD/EPA Region II 1992), hereinafter referred to as the "Regional Guidance Manual." The Regional Guidance Manual provides specifications for the use of local or appropriate test species in biological tests and identifies chemical contaminants of concern.

As required by the Regional Guidance Manual, the evaluation of proposed dredged material from the Bronx River area consisted of bulk sediment chemical analyses, chemical analyses of dredging site water and elutriate, benthic and water-column acute toxicity tests, and benthic bioaccumulation studies. Individual sediment core samples collected from the Bronx River project area were analyzed for grain size, moisture content, and total organic carbon (TOC). One composite sediment sample representing the entire reach proposed for dredging, was analyzed for bulk density, specific gravity, metals, chlorinated pesticides, polychlorinated biphenyl (PCB) congeners, polynuclear aromatic hydrocarbons (PAHs), and 1,4-dichlorobenzene. Site water and elutriate water that was prepared from the suspended-particulate phase (SPP) of the Bronx River sediment composite were analyzed for metals, pesticides, and PCBs. Benthic acute toxicity tests were performed using the amphipod *Ampelisca abdita* and the mysid *Mysidopsis bahia*. Water-column (SPP) toxicity tests were performed using three species, the mysid *M. bahia*, the juvenile silverside *Menidia beryllina*, and larvae of the mussel *Mytilus galloprovincialis*. Bioaccumulation tests were conducted on the burrowing, deposit-feeding worm *Nereis virens* and the surface-detrital-feeding clam *Macoma nasuta*.

1.2 Project Background

The proposed Bronx River project area was located in Bronx, New York (Figure 1.1). The project requires dredging and disposal of an estimated 1.35 million cu yd of sediment. Project depth of the channel is 41 ft plus 2 ft overdepth (43 ft). Bronx River was one of four waterways that the USACE-NYD requested the Battelle Marine Sciences Laboratory (MSL) to evaluate in a series of dredged material projects that became known as the New York/New Jersey Federal Projects 5 program. The projects evaluated under the Federal Projects 5 program were the Bronx River, Westchester Creek, Shark River, and Cheesecake Creek. Sediment samples from four reaches in these waterways were collected during a survey that took place from May 9 through 12, 1995. Combining sample collection and evaluation of multiple dredged material projects was more cost-effective for the USACE-NYD because the expense of sediment sampling, reference site testing, and quality control analyses could be shared among projects.

1.3 Organization of this Report

Following this introduction, Section 2 presents the materials and methods used for sample collection, sample processing, sediment sample analysis of physical and chemical parameters, toxicity testing, bioaccumulation testing, statistical data analysis, and quality assurance. Results of all physical/chemical analyses, bioassays, and bioaccumulations are presented in Section 3. A discussion of the results and conclusions is provided in Section 4. Section 5 lists the literature cited in this report. Appendix A contains tabulated results of physical and chemical sediment analyses and quality control data. Appendix B contains results of replicate sample analyses and quality control data for site water and elutriate chemical parameters. Appendix C contains raw data associated with benthic acute toxicity tests: water quality measurements, test animal survival data, and reference toxicant test results. Similar data for water-column toxicity tests are provided in Appendix D. Appendix E contains water quality measurements, test animal survival data, and reference toxicant test results for the bioaccumulation tests. Appendix F contains replicate sample results and quality control data for chemical analyses of *M. nasuta* tissue samples generated from the bioaccumulation tests, and Appendix G contains replicate sample results and quality control data for chemical analyses of *N. virens* tissue samples.

FIGURE 1.1. Location of Bronx River Project Area and Sample Collection Stations

2.0 Materials and Methods

2.1 Sediment and Water Collection

Sediment samples were collected from 15 stations within Bronx River project area. Sampling locations were selected by the USACE-NYD based on recent bathymetric surveys. The locations, their coordinates, and water and core sampling depths are presented with the sampling results in Section 3.0. Water samples were collected at a representative location in Bronx River project area and in the Mud Dump Site. Reference sediment was collected from the Mud Dump Reference Site. All samples were collected aboard the *M/V Gelberman*, which is owned and operated by USACE-NYD and located at Caven Point, New Jersey.

2.1.1 Test Sediment and Site Water Sampling

The approximate core sampling locations were first determined with the aid of reference to landmarks, such as shoreline features or buoys, as well as by water depth. Then, the vessel's onboard differential-Global Positioning System (dGPS) was used to identify and record (within 5 m) each sampling station. The vessel's LORAN was available as a backup system. Water depth at the time of sampling was measured by lead line and confirmed with a fathometer on the boat. The actual water depth was converted to mean lower water (MLW) depth by correcting to the tide height at the time the depth was recorded. The difference between the MLW depth and the project depth, plus 2 ft overdepth, yields the length of core required.

Core samples were collected aboard the *M/V Gelberman* using a submersible vibracore sampler owned and operated by Ocean Surveys, Inc. The vibracore sampler consisted of a 4-in. outer diameter, steel core barrel attached to an pneumatic vibratory hammer. The vibratory hammer could be fitted to steel core barrels of various lengths, depending on the length of core needed. To collect a core sample, the core barrel was fitted with a 3.125-in. interior diameter, steam-cleaned, Lexan polycarbonate tube. The vibracore was then suspended by the ship's crane. Once the coring apparatus was directly above the sampling station, the core was lowered through the water to the sediment surface. At this point, the station coordinates were

recorded from the vessel's dGPS, and water depth from a lead line was recorded. The vibratory hammer was switched on until the corer penetrated through the sediment to the desired project depth. Adequate penetration was determined relative to marks on the outside of the core barrel and on the cable suspending the vibracore from the crane. The vibracore apparatus was then pulled out of the sediment and lowered onto the ship's deck. A cutter-head and core-catcher assembly prevented loss of the sediment through the bottom of the core liner. After each core was brought on board, the liner was pulled from the barrel and the length of cored sediment was measured from the mudline to determine whether the project depth plus 2 ft overdepth had been reached. If not, the liner was replaced and a second core sample was attempted. If the sediment core length was at least project depth plus 2 ft overdepth, it was capped, sealed with tape, and labeled. If the sediment core length was not to project depth, the sediment sample was discarded and a second core sample was attempted at the same location (within ~20 ft), until project depth was reached or it was determined that the substrate prevented further penetration of the coring device. While on board the sampling vessel, cores were kept cool (~4°C) in a freezer on the deck of the boat.

Surface-water samples for dredging site water chemical analysis and SPP preparation were collected at one representative station in the Bronx River project area. Site water was also collected from the Mud Dump Site for chemical analysis and SPP preparation. Water samples were collected using a peristaltic pump, which collected water from several feet below the surface. Water was then transferred to precleaned, 20-L polypropylene carboys, which were previously rinsed with site water three times before filling. Water samples were labeled and kept cool (~4°C) in a freezer on the deck while on board the boat. Prior to the sampling survey, carboys were washed with hot water and detergent, acid-rinsed with dilute hydrochloric acid, then rinsed with distilled water, followed by acetone.

A log book was maintained containing records of each sample collected, consisting of station designation, coordinates, replicate number, date, sampling time, water depth, and core length. At the end of each sampling day, when the M/V *Gelberman* returned to Caven Point, all sediment cores and water samples were loaded into a locked refrigerated van, thermostatically controlled to maintain temperature at ~4°C. Sample identification numbers were logged on chain-of-custody forms daily.

At the conclusion of the sample collection survey, sediment cores and water samples were shipped by refrigerated van from Caven Point, New Jersey, to the MSL in Sequim, Washington. The shipment departed from Caven Point on May 14, 1995, and arrived at the MSL on May 19, 1995.

2.1.2 Reference and Control Sediment Sampling

Reference sediments for toxicity and bioaccumulation tests were collected from the Mud Dump Reference Site. Six 5-gal containers of surficial sediment were collected using a van Veen sampler. After recovery, water was drained from the sampler, and the sediments were transferred to epoxy-coated steel buckets. The buckets were covered, labeled, and kept cool (~4°C) in a freezer on deck while aboard the boat. Records for collected reference sediment included coordinates, replicate number, date, sampling time, and water depth. Reference sediment samples were loaded into the refrigerated van at the staging area upon return to port, and sample identification numbers were logged on chain-of-custody forms.

Control sediments were used in each toxicity and bioaccumulation test to validate test procedures. Control sediment used in *M. nasuta* and *M. bahia* tests was collected from Sequim Bay, Washington, using a van Veen sampler deployed from an MSL research vessel. Native control sediment for *A. abdita* and *N. virens* were supplied with the test organisms by their respective suppliers.

2.2 Test Organism Collection

Six species of test organisms were used to evaluate sediment samples from the Bronx River project area:

- *Ampelisca abdita*, a tube-dwelling, surface detrital-feeding amphipod
- *Mysidopsis bahia*, a juvenile mysid shrimp
- *Menidia beryllina*, a juvenile silverside fish
- *Mytilus galloprovincialis*, the larval zooplankton stage of the mussel
- *Macoma nasuta*, the bent-nose clam, a burrowing, surface detrital-feeder
- *Nereis virens*, a burrowing, deposit-feeding polychaete.

All test organisms except mysids and silversides were wild-captured animals, collected by a commercial supplier. The amphipod *A. abdita* was supplied by East Coast Amphipod,

Kingston, Rhode Island. *A. abdita* and its native sediment were collected from Narragansett Bay, Rhode Island, by dragging a large dipnet along the sediment surface. Test organisms were carefully removed from their tubes for counting, and then placed in clean, native sediment for overnight transport to the MSL. Mysids were purchased from Aquatic Biosystems, Fort Collins, Colorado. Mysids that were less than 24-h old were shipped via overnight delivery in plastic bags containing oxygen-supersaturated seawater maintained at approximately 15°C with gel refrigerant packs. Silversides were supplied by Aquatic Research Organisms in Hampton, New Hampshire, and were shipped via overnight delivery in plastic bags containing oxygen-supersaturated seawater and packed with gel refrigerant packs to maintain an ambient temperature of approximately 22°C. Mussels used for obtaining *M. galloprovincialis* larvae were purchased from the commercial supplier Marinus Inc., Long Beach, California. Mussels were wrapped in moist paper towels and transported in a Styrofoam cooler packed with gel refrigerant packs to maintain an ambient temperature of approximately 15°C. Clams (*M. nasuta*) were collected from intertidal zones in Discovery Bay, Washington, by Johnston and Gunstone. The clams were kept in large containers filled with sediment and seawater obtained from the collection site and transported to the MSL. Worms (*N. virens*) were purchased through EnviroSystems, Inc., and were collected from an intertidal region in Newcastle, Maine. The worms were packed in insulated boxes with mats of moist seaweed and shipped at ambient temperature to the MSL via overnight delivery.

All organisms were shipped or transported either in native sediment or under other conditions designed to ensure their viability. After their arrival at the MSL, the test organisms were gradually acclimated to test conditions. Animals with abnormal behavior or appearance were not used in toxicological tests. All acclimation and animal care records are part of the raw data files for these projects.

2.3 Sediment Sample Preparation

Sediment sample preparation consists of all steps performed in the laboratory between receipt of the samples at the MSL and the preparation of samples for biological testing and physical/chemical analyses. Sediment samples for physical, chemical, and biological analysis

were prepared from individual core samples, composites of a number of core samples, reference sediment, and control sediment. All sediment samples were assigned random, unique code numbers to ensure that samples are handled without bias by staff in the biology or chemistry laboratories.

Sediment for biological testing was used within the 6-week holding period specified in the Green Book. During this holding time, the sediment samples were received at the MSL; inventoried against chain-of-custody forms; processed and used for benthic and water-column toxicity tests, elutriate analysis, and bioaccumulation tests; and subsampled for sediment physical/chemical analyses. This section describes procedures followed for equipment preparation, compositing strategy, and preparation of sediments for biological testing and chemical analyses.

2.3.1 Laboratory Preparation and Safety Considerations

All glassware, stainless-steel or titanium utensils, Nalgene, Teflon, and other laboratory containers and equipment underwent stringent cleaning procedures to avoid contamination of samples. Glassware (e.g., test containers, aquaria, sediment transfer dishes) was washed with hot water and detergent, rinsed with deionized water, then soaked in a 10% solution of reagent grade nitric acid for a minimum of 4 h and rinsed again with deionized water before it was allowed to air dry. Polyvinyl chloride (PVC), Nalgene, and Teflon tools were then rinsed with methylene chloride and allowed to dry under a fume hood. Stainless-steel bowls, spoons, spatulas, and other utensils were washed with hot water and detergent, rinsed with deionized water, and allowed to air dry. They were then solvent-rinsed with methylene chloride and allowed to dry under a fume hood.

Neoprene stoppers and polyethylene sheets or other porous materials were washed with hot water and detergent and rinsed with deionized water. These items were then "seasoned" by continuous soaking in 0.45- μ m filtered seawater for at least 2 days prior to use. Large pieces of laboratory equipment, such as the epoxy-coated sediment mixer, were washed with a dilute solution of detergent, and thoroughly rinsed with tap water followed by deionized water or filtered seawater.

Equipment used for determining water quality, including the meters for pH, dissolved oxygen (DO), temperature, ammonia and salinity, were calibrated according to the manufacturers' specifications and internal MSL standard operating procedures (SOPs).

Because the potential toxicity of the Bronx River sediment was unknown, sediment processing and testing were segregated from other laboratory activities. Specific areas at the MSL were established for sample storage and for core-cutting, sediment mixing, and sediment sieving. Work areas were covered with plastic sheeting to contain any waste sediment. Wastewater generated during all operations was retained in 55-gal barrels and periodically pumped through activated charcoal filters and into the MSL's wastewater treatment system. These procedures minimized any potential for cross-contamination of sediment samples and any potential accidental release to the environment.

Laboratory staff members were protected by personal safety equipment such as eyewear, Tyvek suits, plastic aprons, and rubber gloves. Those who were likely to have the most exposure to the potential volatile compounds in the bulk sediment (i.e., those responsible for opening, homogenizing, and compositing core samples) used half-mask respirators.

2.3.2 Preparation of Sediment for Benthic Testing and Bulk Sediment Analyses

Each Lexan core liner was opened by scoring the core longitudinally with a circular saw, then finishing the cut and opening the core with a clean, solvent-rinsed linoleum knife to expose the sediment. As each sediment core sample was opened, it was examined for physical characteristics (e.g., sediment type and consistency, color, odor). In particular, the presence of any strata in the cores was noted. All core observations were recorded in the sediment preparation log book. The sediment between the mudline and project depth was then transferred from the core liner to a clean, stainless-steel bowl by scooping the sediment from the core liner with a spoon or spatula. The sediment was mixed by hand with stainless-steel utensils until the color and consistency appeared homogenous, creating a sample representative of the individual sampling station. Sieving was not necessary because organisms that may interfere with test results were not observed in the sediment samples.

Aliquots of the homogenized sediment were then transferred to the appropriate sample jar(s) for physical or chemical analyses required on individual core samples. A portion of each homogenized core sample was also retained as an archive sample. The remainder of the sediment from the individual core stations was combined in an epoxy coated cement mixer to create a composite sample representing the Bronx River project area, designated COMP BX. The composite contained sediments from Stations BX-1 through BX-15. The composited reach sediment was used for chemical analysis, solid-phase toxicity, and bioaccumulation testing, as required for USACE-NYD. The compositing scheme for these samples is provided in Section 3. Aliquots of homogenized composite sediment were transferred to the appropriate sample jar(s) for physical or chemical analyses required on the composite sample. A portion of the homogenized composited sediment was also retained as an archive sample. The remainder was stored in labeled epoxy-coated pails, tightly covered, at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ until use for SPP/elutriate preparation or benthic toxicity and bioaccumulation tests.

The Mud Dump Reference Site sediment, *M. nasuta* native control sediment, and *N. virens* native control sediment were also homogenized in the large, stainless-steel bowls, but prior to mixing, these sediments were pressed through a 1-mm mesh sieve to remove live organisms that might affect the outcome of toxicity tests. After mixing, aliquots for physical and chemical analyses were removed. Native control sediment for *A. abdita* was passed through a 0.5-mm mesh sieve to remove live organisms and mixed in stainless-steel bowls after sieving. All reference and control sediments were stored at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ until use in benthic toxicity and bioaccumulation tests.

2.3.3 Preparation of Suspended-Particulate Phase and Elutriate

Toxicological effects of dredged sediments dissolved and suspended in the water-column at an open-water disposal site were simulated in the laboratory by preparation and testing of the SPP. To prepare the SPP, a sediment-water slurry was created and centrifuged at low speed. The centrifugation procedure replaced the 1-h settling procedure described in the Green Book. Low speed centrifugation provided a more efficient method of SPP preparation and maintained consistency between projects. The SPP was decanted and reserved for testing with water-column organisms. The elutriate phase was prepared by centrifuging the supernatant at a higher speed and collecting the decanted SPP. This liquid was analyzed for

chemical constituents to identify potential water-soluble contaminants that could remain in the water-column after dredge and disposal operations.

The SPP was prepared by creating a 4:1 (volume:volume) water-to-sediment slurry in 1-L glass jars with Teflon-lined lids. The jars were marked at 200 mL and 400 mL and filled to the 200-mL mark with site water. Homogenized sediment was added until the water was displaced to the 400-mL mark. Each jar was then filled to 1 L with site water, placed on a shaker table, and agitated for 30 min at 120 to 150 cycles/min. The slurry was then transferred to 500-mL Teflon jars, tightly sealed, and centrifuged at approximately 1750 rpm for 10 min, at a relative centrifugal force of approximately 1000 g. Following centrifugation, the supernatant was poured into 4-L glass jars. The Teflon jars were rinsed after each use and the above process continued until an adequate amount of SPP was produced from each composite. Between SPP preparations, all glass and Teflon containers were cleaned according to procedures described in Section 2.3.1. When all SPP for a treatment was prepared, portions were taken for elutriate preparation. The remaining SPP was either used immediately for biological tests or stored at $4^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and used within 24 h for testing. The 100% SPP was mixed with Mud Dump Site water to yield three dilutions: 0%, 10%, and 50% SPP, for a total of four concentrations for each sediment composite.

To prepare SPP for elutriate chemistry analyses, a 1-L aliquot of the SPP was collected in an acid-washed Teflon bottle for trace metals analysis, and three 1-L aliquots were collected in EPA-certified amber glass bottles for analysis of organic compounds. The elutriate for metals analysis was prepared by transferring SPP to acid-washed polycarbonate centrifuge jars, and the elutriate for analysis of organic compounds was prepared by transferring SPP to Teflon centrifuge jars; then both were centrifuged at 2000 rpm for 30 min at a relative centrifugal force of approximately 1200 g. The decanted supernatant liquid was the elutriate phase. One liter of elutriate was submitted for triplicate trace metals analysis and three 1-L portions were submitted for analysis of organic compounds.

2.4 Physical and Chemical Analytical Procedures

Individual sediment cores, composited bulk sediment, water, elutriate, and tissue samples were analyzed for selected physical and chemical parameters. Table 2.1 lists the

parameters measured in each sample type, the method used for each analysis, and the target analytical detection limits. The following sections briefly describe the procedures used for physical and chemical analyses. Procedures followed those required by the Regional Guidance Manual unless otherwise noted.

2.4.1 Grain Size and Percentage of Moisture

Grain size was measured following two methods described by Plumb (1981). The wet sieve method was used to determine the size distribution of sand or coarser-grained particles larger than a U.S. No. 230 standard sieve (62.5 μm mesh). The size distribution of particles smaller than a U.S. No. 230 sieve was determined using the pipet method. Grain size was reported as percentages within four general size classes:

gravel	>2000 μm diameter
sand	$\leq 2000 \mu\text{m}$ and $\geq 62.5 \mu\text{m}$ diameter
silt	< 62.5 μm diameter and $\geq 3.9 \mu\text{m}$ diameter
clay	< 3.9 μm diameter.

Percentage of moisture was obtained using the Plumb (1981) method for determining total solids. The procedure involves drying a sediment sample at 100°C until a constant weight is obtained. Percentage of moisture was calculated by subtracting the percentage of total solids from 100%.

2.4.2 Bulk Density and Specific Gravity

Bulk density, or unit weight, was determined according to EM 111-2-1906 (USACE 1970). Specific gravity, the ratio of the mass of a given volume of material to an equal volume of water at the same temperature, was measured according to ASTM D-854.

2.4.3 TOC

Samples were analyzed according to the EPA Edison, New Jersey, laboratory procedure (EPA 1986). Inorganic carbon was removed from the sample by acidification. The sample was combusted, and the evolved carbon dioxide was quantitated using a carbon-hydrogen-nitrogen (CHN) analyzer. TOC was reported as a percentage of the dry weight of the unacidified sample.

2.4.4 Metals

Preparation and analysis of water samples for Cd, Cr, Cu, Pb, Ni, Ag, and Zn were conducted according to MSL SOPs equivalent to EPA Methods 200.8 (EPA 1991). Aqueous samples were chelated with 2% ammonium pyrrolidinedithiocarbamate (APDC), precipitated out of solution, and filtered. The filter was digested in concentrated nitric acid, and the digestate was analyzed by graphite furnace atomic absorption (GFAA) spectroscopy for Cr and Zn and by inductively coupled plasma/mass spectrometry (ICP/MS) for Cd, Cu, Pb, Ni, and Ag. Water samples were analyzed for Hg directly by cold vapor atomic fluorescence (CVAF) according to the method of Bloom and Crecelius (1983). This CVAF technique is based on emission of 254-nm radiation by excited elemental Hg atoms in an inert gas stream. Mercuric ions in an oxidized sample were reduced to elemental Hg with tin chloride (SnCl_2), then purged onto gold-coated sand traps to preconcentrate the Hg and remove interferences. Mercury vapor was thermally desorbed to a second "analytical" gold trap, and from that into the fluorescence cell. Fluorescence (indicated by peak area) is proportional to the quantity of Hg collected, and was quantified using a standard curve as a function of the quantity of the sample purged.

Sediment samples for analysis of As, Cd, Cr, Cu, Pb, Ni, and Zn were prepared according to an MSL SOP equivalent to EPA Method 200.2 (EPA 1991). Solid samples were first freeze-dried and blended in a Spex mixer mill. A 0.2- to 0.5-g aliquot of dried homogeneous sample was then digested using and nitric acid. Samples were heated in sealed Teflon bombs overnight at approximately 130°C. Sediment samples were analyzed for Ag, As, Cd, Cr, Cu, Pb, Ni, and Zn using ICP/MS, following an MSL SOP based on EPA Method 200.8 (EPA 1991). Sediments were analyzed for Hg by CVAA according to an MSL procedure for total Hg determination equivalent to EPA Method 245.5 (EPA 1991).

Tissue samples were prepared for analysis of metals according to an MSL SOP based on EPA Method 200.3 (EPA 1991). Solid samples were first freeze-dried and blended, and a 0.2- to 0.5-g aliquot of dried homogeneous sample was then digested in a microwave using nitric acid and hydrogen peroxide. Tissue samples were analyzed for As, Cd, Cr, Cu, Pb, Ni, Ag, and Zn using the ICP/MS method (EPA Method 200.8 [EPA 1991]). Tissue samples were analyzed for Hg by CVAA following an MSL procedure equivalent to EPA Method 245.6 (EPA 1991).

TABLE 2.1. List of Analytes, Methods, and Target Detection Limits

Analyte	Methods	Sediment Detection Limit ^(a)	Tissue Detection Limit ^(b)	Water Detection Limit
PHYSICAL PARAMETERS				
Grain Size	Plumb (1981)	1.0%	---	---
Specific Gravity	ASTM D-854		---	---
Bulk Density	EM 1110-2-1906 (USACE 1970)		---	---
Percent Moisture	Sediment: Plumb (1981)	1.0%		---
	Tissue: Freeze-dry		1.0%	
Total Organic Carbon	EPA (1986)	0.1%	---	---
METALS				
Arsenic	EPA 200.2, -.3, -.8 ^(c)	0.1 µg/g	1.0 µg/g	---
Cadmium	EPA 200.2, -.3, -.8 ^(c)	0.01 µg/g	0.1 µg/g	0.025 µg/L
Chromium	EPA 200.2, -.3, -.8, -.9 ^(c)	0.02 µg/g	0.2 µg/g	1.0 µg/L
Copper	EPA 200.2, -.3, -.8 ^(c)	0.1 µg/g	1.0 µg/g	0.35 µg/L
Lead	EPA 200.2, -.3, -.8 ^(c)	0.1 µg/g	0.1 µg/g	0.35 µg/L
Mercury	EPA 245.5 (sed.); 245.6 (tiss.) ^(c)	0.02 µg/g	0.02 µg/g	
	Bloom and Crecelius (1983) (water)			0.002 µg/L
Nickel	EPA 200.2, -.3, -.8 ^(c)	0.1 µg/g	0.1 µg/g	0.30 µg/L
Silver	EPA 200.2, -.3, -.8, -.9 ^(c)	0.1 µg/g	0.1 µg/g	0.25 µg/L
Zinc	EPA 200.2, -.3, -.8, -.9 ^(c)	0.1 µg/g	1.0 µg/g	0.15 µg/L
ORGANIC COMPOUNDS				
Pesticides				
Aldrin	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.004 µg/L
α-Chlordane	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.014 µg/L
trans-Nonachlor	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.014 µg/L
Dieldrin	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.002 µg/L
4,4'-DDT	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.012 µg/L
2,4'-DDT	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.020 µg/L
4,4'-DDD	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.011 µg/L
2,4'-DDD	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.020 µg/L
4,4'-DDE	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.004 µg/L
2,4'-DDE	EPA 8080 (sediment, tissue)	1.0 ng/g	0.4 ng/g	
	EPA 608 (water) ^(c)			0.020 µg/L

TABLE 2.1. (contd)

Analyte	Methods	Sediment Detection Limit ^(a)	Tissue Detection Limit ^(b)	Water Detection Limit
Endosulfan I	EPA 8080 (sediment, tissue) EPA 608 (water) ^(c)	1.0 ng/g	0.4 ng/g	0.014 µg/L
Endosulfan II	EPA 8080 (sediment, tissue) EPA 608 (water) ^(c)	1.0 ng/g	0.4 ng/g	0.004 µg/L
Endosulfan sulfate	EPA 8080 (sediment, tissue) EPA 608 (water) ^(c)	1.0 ng/g	0.4 ng/g	0.010 µg/L
Heptachlor	EPA 8080 (sediment, tissue) EPA 608 (water) ^(c)	1.0 ng/g	0.4 ng/g	0.003 µg/L
Heptachlor epoxide	EPA 8080 (sediment, tissue) EPA 608 (water) ^(c)	1.0 ng/g	0.4 ng/g	0.100 µg/L
<u>PCBs</u>				
8 (2,4')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
18 (2,2',5)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
28 (2,4,4')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
44 (2,2',3,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
49 (2,2',4,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
52 (2,2',5,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
66 (2,3',4,4')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
87 (2,2',3,4,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
101 (2,2',3,5,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
105 (2,3,3',4,4')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
118 (2,3',4,4',5)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
128 (2,2',3,3',4,4')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
138 (2,2',4,4',5,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
153 (2,2',4,4',5,5')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
170 (2,2',3,3',4,4',5)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
180 (2,2',3,4',5,5',6)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
183 (2,2',3,4,4',5,6)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
184 (2,2',3,4,4',6,6')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
187 (2,2',3,4',5,5',6)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
195 (2,2',3,3',4,4',5,6)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
206 (2,2',3,3',4,4',5,5',6)	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L
209 (2,2',3,3',4,4',5,5',6,6')	NYSDEC (1992) ^(c)	1.0 ng/g	0.4 ng/g	0.0005 µg/L

TABLE 2.1. (contd)

Analyte	Methods	Sediment Detection Limit ^(a)	Tissue Detection Limit ^(b)	Water Detection Limit
<u>PAHs</u>				
Acenaphthene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Acenaphthylene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Anthracene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Fluorene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Naphthalene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Phenanthrene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Benz[a]anthracene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Benzo[a]pyrene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Benzo[b]fluoranthene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Benzo[ghi]perylene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Benzo[k]fluoranthene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Chrysene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Dibenz[a,h]anthracene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Fluoranthene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Indeno[1,2,3-cd]pyrene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
Pyrene	NOAA (1993) ^(c)	10 ng/g	4 ng/g	---
1,4-Dichlorobenzene	NOAA (1993) ^(c)	1.0 ng/g	0.4 ng/g	---

(a) Detection limits are in dry weight for all sediment parameters except Hg.

(b) Detection limits are in wet weight for all organic and inorganic tissue parameters.

(c) Equivalent Battelle Ocean Sciences or MSL standard operating procedures were substituted for the methods cited.

2.4.5 Chlorinated Pesticides and PCBs

Water samples were prepared and analyzed for chlorinated pesticides and PCBs according to an MSL procedure equivalent to EPA Method 8080 (EPA 1990), and incorporating techniques developed by the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends "Mussel Watch" Program (NOAA 1993). Samples were extracted with methylene chloride. Extract volumes were reduced and solvent-exchanged to hexane. The sample extracts underwent cleanup by alumina and silica column chromatography; further interferences were removed by an additional cleanup treatment using high-performance liquid chromatography (HPLC). Sample extracts were concentrated and analyzed using gas chromatography with electron capture detection (GC-ECD) by the internal standard technique.

Sediment and tissue samples for pesticide and PCB analysis were extracted and analyzed according to an MSL procedure similar to EPA Method 8080 for pesticides and the New York State Department of Environmental Conservation (NYSDEC) Congener-Specific Method 91-11 (NYSDEC 1992). The method also uses techniques from the NOAA Mussel Watch procedure. A 20-g to 50-g sample of homogenized sediment or macerated tissue was first combined with sodium sulfate in a sample jar to remove water. Samples were extracted by adding successive portions of methylene chloride and agitating sample jars at ambient temperature using a roller technique. Extract volumes were reduced and solvent-exchanged to hexane, followed by Florisil column chromatography cleanup. Interferences were removed using HPLC cleanup; tissue sample extracts underwent an additional cleanup by gel permeation chromatography (GPC). Sample extracts were concentrated and analyzed using GC-ECD by the internal standard technique.

The concentration of total PCB in each matrix was estimated by taking the sum of the 22 congeners and multiplying by 2. This procedure for calculation of total PCB was established in 1996 (Mario Del Vicario, Chief of the Marine and Wetlands Protection Branch, U.S. Environmental Protection Agency, Region 2, February 14, 1996, letter to John F. Tavoraro, Chief of Operations Support Branch, U.S. Army Corps of Engineers, New York District). One-half of the detection limit was used in summation when an analyte was undetected.

2.4.6 PAHs and 1,4-Dichlorobenzene

Sediment samples were prepared for the analysis of 16 PAHs and 1,4-dichlorobenzene (see Table 2.1) according to an MSL method based on the NOAA Mussel Watch procedure (NOAA 1993). A 20- to 50-g sample of homogenized sediment or macerated tissue was first combined with sodium sulfate in a sample jar to remove water. Samples were extracted by adding successive portions of methylene chloride and agitating sample jars at ambient temperature using an ambient shaker technique. Extract volumes were reduced and solvent-exchanged to hexane, followed by column chromatography cleanup. Interferences were removed using HPLC cleanup; tissue sample extracts underwent an additional cleanup by GPC. Sample extracts were concentrated and analyzed using gas chromatography with mass spectrometry (GC/MS) in the selective ion monitoring (SIM) mode.

2.5 Biological Testing Procedures

2.5.1 Benthic Acute Toxicity Tests

Deposited sediment effects of open-water dredged material disposal were evaluated by benthic acute toxicity tests with the marine amphipod *A. abdita* and the mysid *M. bahia*.

2.5.1.1 Static Renewal Test with *Ampelisca abdita*

Upon receipt, *A. abdita* were placed in a tub of clean sediment from their collection area and gradually acclimated to laboratory conditions with unfiltered flowing Sequim Bay seawater. *A. abdita* were received at approximately 15°C and acclimated to 20°C±2°C over 2 days. The *A. abdita* were not fed prior to testing.

All amphipod static renewal tests were performed in 1-L glass jars modified for use as flow-through test chambers. The test chambers were fitted with funneled lids and screened overflow ports (Figure 2.1). To prepare each test container, 200 mL of clean seawater was placed in each jar. Sediment was added until water was displaced to a volume of 400 mL, then seawater was added to a total volume of 750 mL. Five replicates of each Bronx River composite sediment, Mud Dump Reference Site sediment, and native test animal control treatments were tested.

Concentrations of ammonia have been encountered in the pore water of sediment core samples from New York/New Jersey waterways at concentrations high enough to affect survival of amphipods in benthic toxicity tests (Barrows et al. 1996). Therefore, the *A. abdita* tests were conducted according to ammonia reduction methods recommended in a correction (errata) to the EPA standard methods document for conduct of benthic acute toxicity tests (EPA 1994a). This guidance recommends postponing test initiation (exposure of test animals) until pore water total ammonia concentrations are below levels at which a toxic effect can be observed. During this "purging" period, test chambers were set up and maintained under test conditions, and the overlying water was exchanged twice daily until the pore water ammonia concentrations reached the appropriate level. The water-supply system was turned on daily to deliver a volume of seawater equivalent to two chamber exchanges per day (approximately 10 min for two times per day). Pore water ammonia measurements were made on "dummy" containers that were set up and maintained in the same manner as the actual test containers but without animals added to them. The pore water was obtained by siphoning off the overlying water in the dummy jar and centrifuging the sediment in a Teflon jar for at least 20 min at an approximate relative centrifugal force of 780 x gravity. Salinity, temperature, and pH were also determined in the pore water samples. Once the test was initiated, overlying water was renewed at a rate of two chamber exchanges per day throughout the 10-day tests (approximately 10 min of renewal water flow for two times per day).

The *A. abdita* benthic toxicity tests were initiated by the addition of 20 organisms to each test chamber for a test population of 100 amphipods per sediment treatment. *A. abdita* were gently sieved from their native sediment in holding tanks and transferred to shallow baking dishes. For each test chamber, five animals were counted and transferred by pipet into each of four small, plastic cups. The animals in each transfer cup were recounted by a second analyst. The animals were placed in the test chamber by dipping the cup below the surface of the water to release the amphipods.

Salinity, temperature, DO, and pH were measured in all replicates prior to test initiation, in at least one replicate per treatment daily, and in all replicates at test termination. Measurements of total ammonia levels in the overlying water and pore water also continued during testing. Overlying water ammonia was measured in all replicates prior to test initiation (Day 0), in at least one replicate per treatment daily, and in all replicates at test termination

FIGURE 2.1. Testing Containers for Static Renewal Benthic Toxicity Tests

(Day 10). Pore water ammonia was measured in "dummy" containers on Day 0 and Day 10. The following were the acceptable ranges for water quality parameters during the *A. abdita* test:

Temperature	20°C±2°C
DO	>60% saturation (>4.6 mg/L at 20°C, 30‰)
pH	7.8±0.5
Salinity	30‰±2‰
Ammonia	≤20 mg/L in pore water at test initiation
Renewal Rate	2 exchanges/day.

The ammonia pore water maximum limit was based on a directive from the USACE-NYD (personal communication, M. Greges, USACE-NYD, April 1995).

Gentle aeration was provided throughout the test, and *A. abdita* were not fed during testing. At the end of the 10-day period, the contents of each chamber were gently sieved through 0.5-mm mesh, and the number of live, dead, and missing *A. abdita* was recorded on termination forms. An animal was considered dead if it did not respond to gentle probing. As a quality control check, a second observer confirmed surviving test organisms on at least 10% of the termination counts.

Reference toxicant tests with cadmium chloride were performed concurrently with each species. The reference toxicant tests were 96-h, water-only exposures that were otherwise conducted following the same procedures as for the static tests with sediment. *A. abdita* were exposed to nominal concentrations of 0.0, 0.19, 0.38, 0.75, and 1.5 mg/L Cd.

2.5.1.2 Static Test with *Mysidopsis bahia*

Upon receipt at the laboratory, *M. bahia* were placed in 10-gal aquaria and gradually acclimated from 26‰ seawater to 30‰ with Sequim Bay seawater over a 48-h period. *M. bahia* were received and held for 4 days at 20°C±2°C until testing and were fed concentrated brine shrimp nauplii twice daily prior to testing. Mortality of *M. bahia* during holding was less than 1%.

The 10-day static benthic acute toxicity test with *M. bahia* was performed in 1-L glass jars. To prepare each test container, 200 mL of clean seawater was placed in each jar.

Sediment was added until water was displaced up to the 400-mL mark, then seawater was added up to the 750-mL mark. Five replicates of the Bronx River sediment composite and Mud Dump Reference Site sediment were tested. Sequim Bay control sediment was used as a native control sediment for the *M. bahia* test. Exchanges of overlying water were conducted in this test to effect a reduction in pore water ammonia.

The *M. bahia* benthic toxicity test was initiated by the addition of 20 organisms to each test chamber for a test population of 100 mysids per sediment treatment. *M. bahia* were transferred from holding tanks to shallow glass dishes. For each test chamber, five animals were counted and transferred by pipet into each of four small, plastic cups. The animals in each transfer cup were recounted by a second analyst. The animals were placed in the test chamber by dipping the cup below the surface of the water to release the animals.

Salinity, temperature, DO, pH, and total ammonia in overlying water were measured in all replicates prior to test initiation, in at least one replicate per treatment daily, and in all replicates at test termination. The following were the acceptable ranges for water quality parameters during the mysid benthic test:

Temperature	20°C±2°C
DO	>40% saturation (>3.0 mg/L at 20°C, 30‰)
pH	7.8±0.5
Salinity	30‰±2‰
Ammonia	≤15 mg/L in overlying water at test initiation.

The ammonia overlying water maximum limit was based on EPA guidance (EPA 1994b) that provides criteria of 0.6 mg/L unionized ammonia at pH of 7.9-8.0 and 0.3 mg/L unionized ammonia at pH of 7.5 (at 26°C and 31‰ salinity). When converted to test temperature, pH, and salinity used at the MSL, these values equal approximately 15 mg/L total ammonia.

Gentle aeration was provided to all test chambers during the test to maintain consistency in DO concentration among test containers. At the end of the 10-day period, the contents of each chamber were gently sieved through 0.5-mm mesh, and the number of live and dead or missing *M. bahia* was recorded on termination forms. An animal was considered dead if it did not respond to gentle prodding. As a quality control check, a second observer confirmed surviving test organisms on at least 10% of the termination counts.

Reference toxicant tests with cadmium chloride were performed concurrently with each species. The reference toxicant tests were 96-h, water-only exposures that were otherwise conducted following the same procedures as for the static tests with sediment. *M. bahia* were exposed to nominal concentrations of 0, 150, 200, 300, and 400 µg/L Cu.

2.5.2 Water-Column Toxicity Tests

Water-column effects of open-water dredged-material disposal were evaluated by exposing three species of water-column organisms to the SPP of the Bronx River sediment composites. The three test species were juvenile *M. beryllina* (silverside) and *M. bahia* (mysid), and larval *M. galloprovincialis* (mussel).

2.5.2.1 Water-Column Toxicity Test with *Menidia beryllina*

Upon receipt, the *M. beryllina* were placed in a 10-gal glass aquarium and gradually acclimated from 22.0‰ seawater to 30.0‰ Sequim Bay seawater over a 3-day period. *M. beryllina* were received and held at 20°C±2°C prior to testing and were fed concentrated brine shrimp nauplii daily.

Test containers for the water-column toxicity test with silversides were 500-mL glass jars, labeled with sediment treatment code, concentration, position number, and replicate number. Five replicates of each concentration (0%, 10%, 50%, and 100% SPP) were tested, with a 300-mL test volume per replicate. Each test chamber was then placed in a randomly assigned position on a water table at 20°C±2°C and allowed to equilibrate to test temperature for several hours. After the SPP concentrations reached test temperature, water quality parameters were measured and recorded for all replicates of all concentrations for each sediment treatment.

To initiate the test, *M. beryllina* were transferred from the holding tank to test chambers with a wide-bore pipet via small transfer cups. Ten individuals were introduced to each test chamber, creating a test population of 50 silversides per concentration for each treatment. Ten animals per test chamber were used, rather than the 20 animals per chamber as described in the Regional Guidance Manual, because it is not possible to make accurate daily observations of *M. beryllina* behavior when using 20 animals. Test initiation time and date were recorded. Following test initiation, water quality parameters were recorded in one replicate of each

concentration daily. Because several treatments had DO levels lower than 40% saturation prior to test initiation, all test chambers were aerated to maintain consistency in DO concentration among test containers. Acceptable parameters for this test were as follows:

Temperature	20°C±2°C
DO	>40% saturation
pH	7.8±0.5
Salinity	30.0‰±2.0‰

The test was run under a 16-h light/8-h dark photoperiod, and silversides were fed brine shrimp nauplii daily during the test. Observations of the animals were performed at 2 h, 24 h, 48 h, and 72 h, and the number of live, dead, and missing was recorded. At the end of the 96-h test period, water quality parameters were measured for all test chambers, and the number of live, dead, and missing silversides was recorded on termination forms. As a quality control check, a second observer confirmed surviving organisms on 10% of the termination counts.

A 96-h, water-only, reference toxicant test was performed concurrently with the toxicity test with each population of *M. beryllina* to establish the health and expected response of the test organisms. The reference toxicant test was conducted in the same manner as the water-column toxicity test. *M. beryllina* were exposed to a seawater control plus four concentrations of copper sulfate: 16, 64, 160, and 400 µg/L Cu, using three replicates of each concentration.

2.5.2.2 Water-Column Toxicity Test with *Mysidopsis bahia*

Upon receipt, the *M. bahia* were placed in a 10-gal aquarium and gradually acclimated from 22‰ seawater to 30‰ Sequim Bay seawater over a 3-day period. Mysids were received and held at 20°C±2°C until testing and were fed concentrated brine shrimp nauplii twice daily prior to testing. Mortality of the *M. bahia* during holding was less than 1%.

The water-column toxicity test with the mysid was performed in 200 mL of test solution in 400-mL jars, labeled with sediment treatment code, concentration, position number, and replicate number. Five replicates of each concentration were tested. Each of the test chambers received 200 mL of test solution, then was placed randomly in a recirculating water bath and allowed to equilibrate to test temperature for several hours. Prior to test initiation,

water quality parameters were measured in each replicate of each sediment treatment concentration. Acceptable water quality parameters for this test were as follows:

Temperature	20°C±2°C
DO	>40% saturation (>3.04 mg/L at 20°C, 30‰)
pH	7.8±0.5
Salinity	30.0‰±2.0‰.

To initiate the test, *M. bahia* were transferred from the holding tank to test chambers with a wide-bore pipet via small transfer cups. Ten individuals were introduced to each test chamber, creating a test population of 50 mysids per concentration (200 mysids per treatment). Ten animals per test chamber were used, rather than the 20 animals per chamber as described in the Regional Guidance Manual, because it is not possible to make accurate daily observations of *M. bahia* behavior when using 20 animals. Test initiation time and date were documented on data forms. Observations of test organisms were performed at 4 h, 24 h, 48 h, and 72 h, using a fluorescent light table to enhance visibility of the *M. bahia*. After test initiation, water quality parameters were measured daily in one replicate concentration of all concentrations for each sediment treatment. During the 96-h exposure, *M. bahia* were fed <24-h-old brine shrimp daily. Excess food was removed daily with a small pipet, taking care not to disturb test animals. Molted exoskeletons and any particulates from the SPP solutions were also removed.

Prior to test termination, water quality parameters were measured in all replicates. At 96 h, the number of live versus dead animals was recorded for each test container. An animal was considered dead if it did not respond to gentle probing. As a quality control check, a second observer confirmed surviving test organisms on at least 10% of the termination counts.

A 96-h, water-only, reference toxicant test was performed concurrently with the toxicity test with each batch of *M. bahia* to establish the health and expected response of the test organisms. The reference toxicant test was conducted in the same manner as the water-column toxicity test. *M. bahia* were exposed to a seawater control plus four concentrations of copper sulfate: 150, 200, 300, and 400 µg/L Cu, using three replicates of each concentration.

2.5.2.3 Water-Column Toxicity Test with *Mytilus galloprovincialis* Larvae

Prior to testing, adult *M. galloprovincialis* were held in flowing, unfiltered Sequim Bay seawater at ambient temperatures for approximately 1 year.

Chambers for the bivalve larvae test were 500-mL glass jars labeled with sediment treatment code, concentration, position number, and replicate number. Dilutions of SPP from sediment composites (0%, 10%, 50%, and 100%) were prepared with 0.45- μ m-filtered Sequim Bay water in a 2000-mL graduated cylinder, then 300 mL of test solution was transferred into each test chamber. Test chambers were placed in random positions on a water table and allowed to equilibrate to test temperature for several hours. Initial water quality parameters were measured in all replicates once test chambers reached testing temperatures ($16^{\circ}\text{C} \pm 2^{\circ}\text{C}$).

Spawning was induced by placing *M. galloprovincialis* into 15°C , filtered Sequim Bay seawater and rapidly raising the holding water temperature to 20°C . Spawning occurred within 1 h of temperature elevation. When spawning began, males and females were identified and isolated in individual jars containing filtered Sequim Bay seawater and allowed to shed gametes for approximately 45 min. Eggs from each female were filtered through a 75- μ m Nytex screen into separate jars to remove feces, detritus, and byssal fibers. Sperm from at least three males were pooled and 10 mL of sperm solution was then added to each of the egg stocks. Egg-sperm solutions were gently mixed every 10 min with a perforated plunger. Fertilization proceeded for 1 h, then fertilization rate (percentage of fertilized eggs) was determined by removing a subsample and observing the number of multicell-stage embryos. Fertilization was considered successful if greater than 90% of the embryos were in the multicell stage. Egg stocks with greater than 90% fertilization were combined and rinsed on a 20- μ m Nytex screen to remove excess sperm. Stock embryo solution density was estimated by removing a 0.1-mL subsample and counting all multicell embryos, then multiplying by 10 to yield embryo density (embryos/mL). Stock solution was diluted or concentrated to yield 7500 to 9000 embryos/mL. The test was initiated by introducing 1 mL of stock solution into each test chamber, to produce embryo densities of 25 to 30 embryos/mL. Test initiation date and time were recorded on data sheets. Following initiation, 10 mL stocking-density subsamples were removed from each container and preserved in 5% formaldehyde to determine actual stocking density later.

Water quality parameters were measured in one replicate of each concentration per treatment daily throughout the test. Acceptable ranges for water quality parameters were as follows:

Temperature	16°C±2°C
DO	>60% saturation (>4.9 mg/L at 16°C, 30‰)
pH	7.8±0.5
Salinity	30.0‰±2.0‰.

Because several treatments had DO levels below the acceptable level of 40% saturation, each chamber was provided with gentle aeration to maintain consistency in DO concentration among test containers. The bivalve test was terminated after 72 h when greater than 80% of the larvae in the controls had reached the D-cell stage. Final water quality parameters were recorded for all replicates. The contents of each chamber were then homogenized with a perforated plunger, and a 10-mL subsample was removed and placed into a 20-mL scintillation vial. The subsample was then fixed with 1 mL of 50% solution of formaldehyde in seawater. Samples were scored for the appearance of normal and abnormal D-shaped larvae, blastula larvae, and total number of larvae. At least 10% of the counts were confirmed by a second observer.

A 72-h reference toxicant test was conducted to verify the health and expected response of the test organisms. The reference toxicant test was setup and conducted in the same manner as the liquid-phase tests. *M. galloprovincialis* larvae were exposed to a filtered Sequim Bay seawater control plus copper sulfate concentrations of 4, 8, 16, and 32 µg/L Cu, with three replicates per concentration.

2.5.3 Bioaccumulation Testing

The polychaete *N. virens* and the bivalve *M. nasuta* were used to evaluate the potential bioaccumulation of contaminants from dredged material. The bioaccumulation tests were 28-day flow-through exposures to sediment, followed by a 24-h depuration period that allowed the organisms to void their digestive tracts of sediment. *N. virens* and *M. nasuta* were tested in separate 10-gal flow-through aquaria. Animals were exposed to five replicates of each Bronx River sediment composite, Mud Dump Reference Site sediment, and native control sediment. Each chamber contained 25 *M. nasuta* or 20 *N. virens*. Water quality parameters (temperature,

DO, pH, and salinity) were measured in all replicates at test initiation, in at least one replicate per treatment daily, and in all replicates at test termination. Flow rates were measured daily in all chambers.

Upon receipt at the laboratory, *N. virens* were received damp in a mat of seagrass then placed in holding trays of control sediment and sunk in a holding table with heated Sequim Bay seawater flowing into the table. *N. virens* were held at $20^{\circ}\text{C}\pm 2^{\circ}\text{C}$ over a 6-day period. *N. virens* were not fed prior to testing. *M. nasuta* were received damp and held in control sediment with flowing Sequim Bay seawater for 4 days at $15^{\circ}\text{C}\pm 2^{\circ}\text{C}$ until testing and were not fed. Mortality of the *N. virens* and *M. nasuta* during holding was less than 1%.

The Regional Guidance Manual provides an acceptable temperature range of $13^{\circ}\text{C}\pm 1^{\circ}\text{C}$ for *M. nasuta*; however, to maintain consistency with previous New York Federal Project testing, a flow-through filtered seawater temperature of 15°C was used. This alteration of test temperature was not expected to affect the outcome of the test; bioaccumulation tests with *M. nasuta* have been conducted at $15^{\circ}\text{C}\pm 2^{\circ}\text{C}$ successfully. After discussion with the USACE-NYD project manager, the following ranges for water quality parameters were established as acceptable for the *M. nasuta* and *N. virens* tests:

	<u><i>M. nasuta</i></u>	<u><i>N. virens</i></u>
Temperature	$15^{\circ}\text{C}\pm 2^{\circ}\text{C}$	$20^{\circ}\text{C}\pm 2^{\circ}\text{C}$
DO	> 60% saturation	> 60% saturation
pH	7.8 ± 0.5	7.8 ± 0.5
Salinity	$30\text{‰}\pm 2\text{‰}$	$30\text{‰}\pm 2\text{‰}$
Flow Rate	$125\pm 10\text{ mL/min}$	$125\pm 10\text{ mL/min}$

Aeration was provided to all test chambers to maintain consistency in DO concentrations among test chambers. Water quality, organism behavior (e.g., burrowing activity, feeding) and organism mortality were recorded daily. Dead organisms were removed daily. At the end of the 28-day testing period, *M. nasuta* and *N. virens* were placed in clean, flowing seawater for 24 h, after which the tissues were transferred into the appropriate chemistry jars for metals, pesticide/PCB, and PAH analyses. All tissue samples were frozen immediately and stored at $<20^{\circ}\text{C}$ until analysis.

Water-only reference toxicant tests (96-h) were also performed using copper sulfate in six geometrically increasing concentrations. The exposures were conducted using a test

volume of 5 L in static 9.5-L (2.5-gal) aquaria. Three replicates of each concentration were tested, each containing 10 organisms. Water quality parameters were monitored at the same frequency and maintained within the same limits as the 28-day test, except that there were no flow rates. The *M. nasuta* reference toxicant test was conducted with treatments of 0, 0.31, 0.63, 1.25, 2.5 and 5.0 mg/L Cu; the *N. virens* test was conducted with treatments of 0, 0.05, 0.075, 0.10, 0.20, 0.30, and 0.40 mg/L Cu.

2.6 Data Analysis and Interpretation Procedures

Statistical analyses were conducted to determine the magnitude and significance of toxicity and bioaccumulation in test treatments relative to the reference treatment. Each statistical test was based on a completely random design that allowed unbiased comparison between treatments.

2.6.1 Randomization

All water-column and benthic toxicity tests were designed as completely random tests. Organisms were randomly allocated to treatments, and treatments were randomly positioned on water tables. To determine randomization, a random-number table was generated for each test using the discrete random-number generator in Microsoft's *Excel* spreadsheet software.

2.6.2 Statistical Analysis of Water-Column Tests

Two statistical analyses are presented in the Green Book for the interpretation of SPP (water-column) tests. The first is a one-sided t-test between survival in control test replicates and survival in the 100% SPP test replicates. This analysis is to be performed only when survival in the 100% SPP is less than the control (0% SPP) survival, and when control survival is >90% for nonlarval tests and >70% for larval tests (indicating test validity). Prior to conducting the t-test, angular transformation (arcsin of the square root) of the proportion surviving in test replicates was performed to reduce possible heterogeneity of variance between mean survival of test organisms in the control and in the 100% SPP. The second analysis required by the Green Book is estimation of the medium lethal concentration (LC_{50}) or median effective concentration (EC_{50}). The LC_{50} or EC_{50} values for these tests were estimated using the trimmed Spearman-Kärber method (Finney 1971) and are expressed in percentage of SPP.

The Spearman-Kärber estimator is appropriate only if there was increasing mortality (or effect) with increasing concentration, and if $\geq 50\%$ mortality (or effect) was observed in at least one test concentration when normalized to control survival. If 50% mortality (or effect) did not occur in the 100% SPP concentrations for any treatments, then LC_{50} or EC_{50} values were reported as $>100\%$ SPP.

2.6.3 Statistical Analysis of Benthic Toxicity Tests

Benthic toxicity of all sediment treatments was compared with a single reference treatment using Dunnett's test (Dunnett 1964). The arcsin square root of the proportion of organisms surviving the test was used to stabilize the within-class variances. As recommended by the Green Book, an experiment-wise error $\alpha=0.05$ was used.

2.6.4 Statistical Analysis of Bioaccumulation

Results of the chemical analyses of test organism tissue exposed to the sediment treatments were statistically compared with those tissues similarly exposed to the Mud Dump Reference Site treatment using Dunnett's test with an experiment-wise error of $\alpha=0.05$. The Dunnett's test determined whether or not contaminant body burdens in organisms exposed to the test sediments statistically exceeded those of organisms exposed to the reference sediment.

Statistical analyses were performed on the dry weight concentrations. When a compound (metals, pesticides, PCBs, and PAHs) was undetected (indicated by a "U" flag in appendix tables), one-half of the detection limit was used in numerical calculations. If the compound was undetected in all five replicate samples of the COMP BX treatment or the mean concentration of that compound was greater in reference tissue samples than in the COMP BX tissue samples, no further analysis was necessary. If the compound was undetected in all five replicates of the reference treatment, a Mann-Whitney nonparametric t-test ($\alpha=0.05$) was performed. Results of unexposed or background tissues and control tissue were not statistically compared with the reference.

2.7 Quality Assurance/Quality Control Procedures

The quality assurance/quality control (QA/QC) procedures for the Bronx River project were consistent with the Regional Guidance Manual and the Green Book, and were documented in the Work/Quality Assurance Project Plan, *Evaluation of Dredged Material Proposed for Ocean Disposal from Federal Projects in New York (Parts 4, 5, and 6)*, prepared by the MSL and submitted to the USACE-NYD for this program. This document describes all QA/QC procedures that were followed for sample collection, sample tracking and storage, and physical/chemical analyses. A member of Pacific Northwest National Laboratory's quality engineering staff was present throughout all phases of this program to observe procedures, review and audit data, and ensure that accepted protocols were followed. Laboratory notebooks or data accumulation notebooks were assigned to each portion of these studies and served as records of day-to-day project activities. Bronx River project samples were analyzed along with samples from the New York/New Jersey Federal Projects 5 Program projects. Because QC samples were associated with a batch of samples, QC analyses may have been conducted on samples from another project analyzed in the same batch as the Bronx River samples.

3.0 Results

This section presents results of sample collection and processing, and physical and chemical analyses conducted on sediment samples collected from the proposed Bronx River dredging area.

3.1 Sample Collection and Processing

Sediment core samples were collected from the Bronx River project area on May 11, 1995 (Figure 1.1). Table 3.1 lists each sampling station within the Bronx River project area, sampling coordinates, collection date, length of core required for testing (including 2 ft of overdepth), and length of core actually collected. All samples were collected aboard the M/V *Gelberman*. Fifteen core samples were collected from the Bronx River channel, and all were collected to project depth (-10 ft MLW) plus 2 ft of overdepth.

Upon delivery of the sediment core samples to the MSL on May 19, 1995, samples were prepared for the physical and chemical analyses according to the procedures described in Section 2. Individual sediment core samples were analyzed for grain size, moisture content, and TOC. One composited sediment core sample representing the Bronx River project area (COMP BX) was analyzed for bulk density, specific gravity, metals, chlorinated pesticides, PCBs, PAHs, and 1,4-dichlorobenzene. COMP BX consisted of stations BX-1 through BX-15.

3.2 Physical and Chemical Analyses

3.2.1 Sediment Core Sample Description

Table 3.2 lists physical characteristics of each sediment core sample that was examined. Bronx River sediment samples were generally black, silty-clayey material.

3.2.2 Grain Size, Percentage of Moisture, Bulk Density, Specific Gravity, and Total Organic Carbon

Table 3.3 shows the results of the analysis of individual Bronx River core samples for grain size, percentage of moisture, and TOC. A quality control sample summary and associated quality control data for these measurements are provided in Appendix A.

TABLE 3.1. Summary of Sediment Sample Data for Bronx River Project Area

Station	Collection Date	dGPS Station Coordinates		Core Length Required (ft)	Core Length Collected (ft)	Depth (ft)
		Latitude N	Longitude W			
BX-1	5/11/95	40°48.13'	73°51.91'	3.4	5.0	8.6
BX-2	5/11/95	40°48.16'	73°51.91'	3.0	4.8	9.0
BX-3	5/11/95	40°48.26'	73°51.96'	3.0	4.0	9.0
BX-4	5/11/95	40°48.39'	73°52.03'	3.1	4.5	8.9
BX-5	5/11/95	40°48.89'	73°52.50'	3.1	4.5	8.9
BX-6	5/11/95	40°49.00'	73°52.70'	3.2	4.5	8.8
BX-7	5/11/95	40°49.18'	73°52.94'	2.9	4.0	9.1
BX-8	5/11/95	40°49.18'	73°52.94'	5.4	5.9	6.6
BX-9	5/11/95	40°49.19'	73°52.96'	4.0	4.8	8.0
BX-10	5/11/95	40°49.31'	73°53.04'	2.0	3.0	10.0
BX-11	5/11/95	40°49.35'	73°53.06'	3.7	4.7	8.3
BX-12	5/11/95	40°48.95'	73°52.66'	2.6	5.5	9.4
BX-13	5/11/95	40°48.21'	73°51.90'	3.2	4.0	8.8
BX-14 ^(a)	5/11/95	40°49.07'	73°52.87'	3.0	4.0	9.0
BX-15	5/11/95	40°49.12'	73°52.87'	3.4	4.0	8.6
Grab Samples						
MDRS ^(b)	5/13/95	40°13.91'	74°52.13'	--- ^(c)	---	ND ^(d)

(a) Site water sample collected at this station.

(b) MDRS Mud Dump Reference Site.

(c) --- Not applicable.

(d) ND No data collected.

The physical characteristics of Bronx River sediments were predominantly fine grained. Two stations were predominantly sand and gravel (BX-11 and BX-15), whereas the remaining 13 stations were predominantly silt and clay. Percentages of gravel ranged from 0% to 30%; sand ranged from 6% to 46%; silt ranged from 17% to 58%; and clay ranged from 7% to 45%. Each sediment sample (station) was well represented (at least 10 %) by two or more grain-size fractions. The Mud Dump Reference Site sediment was composed of 97% sand. Bulk density and specific gravity were also measured on the Bronx River composite. The bulk density values for COMP BX, reported in both wet and dry weight, were 85 lb/cu ft and 35 lb/cu ft, respectively. The specific gravity value for COMP BX was 2.57.

With one exception (BX-15), TOC was above 4.0% in Bronx River sediment. The moisture content ranged from 20% to 72% in Bronx River sediment. TOC content in the Mud Dump Reference sediment (0.07% TOC) (20% moisture) was lower than those in all Bronx

TABLE 3.2. Bronx River Sediment Core Descriptions

Station	Mudline (-ft MLW)		Project Depth ^(a)	Description of Observations
	Core Top	Core Bottom		
BX-1	8.6	13.6	12.0	Uniform black silty/clay to -11.2 ft MLW. Remaining core was gray clay/silt.
BX-2	9.0	13.8	12.0	Uniform black silty/clay with oily sheen.
BX-3	9.0	13.0	12.0	Uniform black silty/clay.
BX-4	8.9	13.4	12.0	Uniform black silty/clay to -10 ft MLW; remaining core was gray silty/clay.
BX-5	8.9	13.4	12.0	Uniform black silty/clay to -11 ft MLW, remaining core was gray sand and clay with some shell hash.
BX-6	8.8	13.3	12.0	Uniform black silt and black silty/clay to -12 ft MLW, remaining core was gray clay.
BX-7	9.1	13.1	12.0	Uniform black silty/clay.
BX-8	6.6	12.5	12.0	Uniform black silty/clay.
BX-9	8.0	12.8	12.0	Uniform black sandy/silt.
BX-10	10.0	13.0	12.0	Uniform black silt.
BX-11	8.3	13.0	12.0	Uniform black silty/clay with a band of gray silty/clay at -10.3 ft MLW to -10.8 ft MLW.
BX-12	9.4	14.9	12.0	Uniform black silty/clay, with gray clay from -14.5 ft MLW to the bottom of the core.
BX-13	8.8	12.8	12.0	Uniform black-gray silt.
BX-14	9.0	13.0	12.0	Uniform black silty/clay with oily sheen. Dense dry brown clay plug.
BX-15	8.6	12.6	12.0	Uniform black silty/clay to -9.6 ft MLW. Remaining core was gray silty/sand with some cobble.

(a) Project depth plus 2 ft overdepth.

River core samples. Mud Dump Reference sediment moisture content (20% moisture) was equal to that of BX-15, which was the lowest moisture content of all Bronx River core samples.

TABLE 3.3. Results of Analysis of Shoal Harbor/Compton Creek Sediment Samples for Grain Size, Total Organic Carbon, and Percentage of Moisture

Station	Total Percent (dry weight)				Percentage Moisture	TOC
	Gravel >2000 μm	Sand 62.5-2000 μm	Silt 3.9-62.5 μm	Clay <3.9 μm		
BX-1	2	19	43	36	51	5.31
BX-2	0	14	41	45	68	5.82
BX-3	0	13	45	42	68	5.53
BX-4	0	6	49	45	53	4.97
BX-5	5	19	43	33	64	8.71
BX-6	1	11	47	41	61	6.13
BX-7	3	36	40	21	59	6.14
BX-8	5	25	40	30	59	6.69
BX-9	9	27	42	22	55	5.72
BX-10	0	14	58	28	72	7.77
BX-11	27	37	25	11	45	4.46
BX-12	0	9	48	43	70	5.91
BX-13	0	12	43	45	67	5.43 ^(a)
BX-14	0	14	48	38	69	6.49
BX-15	30	46	17	7	20	0.66
MDRS ^(b)	0	97	1	2	20	0.07
Ampelisca Control	0	9	67	24	62	3.35
Mysid/Macoma Control	0	23	45	32	68	2.43
Nereis Control	0	72	15	13	51	5.38 ^(a)

(a) Mean of triplicate analysis.

(b) MDRS Mud Dump Reference Site.

3.2.3 Metals

Table 3.4 shows the results of the metals analysis of sediment samples from COMP BX. Quality control data associated with the metals analysis are provided in Appendix A. Dry weight levels of metals in Bronx River sediment ranged from 1.46 $\mu\text{g/g}$ (Hg) to 535 $\mu\text{g/g}$ (Pb).

3.2.4 Chlorinated Pesticides

Table 3.5 shows the results of the analysis of Bronx River sediment for chlorinated pesticides. A quality control sample summary and associated quality control data are provided in Appendix A.

The dominant pesticides found in COMP BX were the DDT group of compounds (158 $\mu\text{g/kg}$ total DDT), followed by α -chlordane, *trans*-nonachlor, aldrin, and endosulfan sulfate.

TABLE 3.4. Results of Analysis of Bronx River Sediment Samples for Metals

<u>Sediment Treatment</u>	<u>Metals ($\mu\text{g/g dry wt}$)^(a)</u>								
	<u>Ag</u>	<u>As</u>	<u>Cd</u>	<u>Cr</u>	<u>Cu</u>	<u>Hg</u>	<u>Ni</u>	<u>Pb</u>	<u>Zn</u>
COMP BX	6.90	10.7	3.80	112	186	1.46	38.4	535	408

(a) Concentrations shown are mean of triplicate analyses.

3.2.5 PCBs

Table 3.5 shows the results of the analysis of the Bronx River sediment for PCBs. A quality control sample summary and associated quality control data are provided in Appendix A.

Eighteen of the 22 PCB congeners were detected in COMP BX sediment. The congeners PCB 8, PCB 28, PCB 184, and PCB 209 were found at a concentration below the detection limit. Total PCB concentrations were calculated as 1660 $\mu\text{g/kg}$ for COMP BX.

3.2.6 PAHs and 1,4-Dichlorobenzene

Table 3.6 shows the results of the analysis of the Bronx River sediment for PAHs and 1,4-dichlorobenzene. A quality control sample summary and associated quality control data are provided in Appendix A.

All 16 PAHs analyzed were detected in COMP BX sediment. In COMP BX, low-molecular-weight PAH (LPAH) made up approximately 16% of the total PAH concentration, whereas high-molecular-weight PAH (HPAH) made up 84% of the total. The compound 1,4-dichlorobenzene was found at a concentration of 249 $\mu\text{g/kg dry weight}$ in COMP BX.

TABLE 3.5. Results of Analysis of Bronx River Sediment for Chlorinated Pesticides and Polychlorinated Biphenyls

Analyte	COMP BX ($\mu\text{g/kg}$ dry weight)
2,4'-DDD	24.1
2,4'-DDE	1.05 U ^(a)
2,4'-DDT	0.37 U
4,4'-DDD	51.7
4,4'-DDE	47.7
4,4'-DDT	33.7
α -Chlordane	30.6
Aldrin	14.6
Dieldrin	0.32 U
Endosulfan I	0.55 U
Endosulfan II	0.55 U
Endosulfan Sulfate	4.45
Heptachlor	0.10 U
Heptachlor Epoxide	0.48 U
<i>trans</i> -Nonachlor	16.3
Total DDT ^(b)	158
Total Detected DDT	157
PCB 8	0.87 U
PCB 18	151
PCB 28	0.27 U
PCB 44	44.6
PCB 49	31.1
PCB 52	57.4
PCB 66	65.5
PCB 87	16.6
PCB 101	46.0
PCB 105	24.1
PCB 118	48.8
PCB 128	9.57
PCB 138	86.7
PCB 153	77.6
PCB 170	26.1
PCB 180	57.1
PCB 183	24.3
PCB 184	0.45 U
PCB 187	44.6
PCB 195	6.39
PCB 206	10.5
PCB 209	0.48 U
Total Estimated PCB ^(c)	1660
Total Detected PCB	828

(a) U Undetected at or above the given concentration.

(b) Sum of 2,4-DDD, 2,4-DDE, 2,4-DDT, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT; one-half of the detection limit used in summation when analyte was undetected.

(c) Total PCB = 2(x), where x = sum of all PCB congeners detected; one-half of the detection limit used in summation when analyte was undetected.

TABLE 3.6. Results of Analysis of Bronx River Sediment for PAHs and 1,4-Dichlorobenzene

<u>Analyte</u>	<u>COMP BX</u> <u>(µg/kg dry weight)^(a)</u>
Naphthalene	991
Acenaphthylene	548
Acenaphthene	594
Fluorene	658
Phenanthrene	3120
Anthracene	1490
Total LPAH	7410
Fluoranthene	6550
Pyrene	7300
Benz[a]anthracene	3860
Chrysene	4630
Benzo[b+k]fluoranthene	6010 ^(b)
Benzo[a]pyrene	3990
Indeno[123-cd]pyrene	2690
Dibenz[a,h]anthracene	684
Benzo[g,h,i]perylene	2690
Total HPAH	38400
Total PAH	45800
1,4-Dichlorobenzene	249

(a) Mean of triplicate analyses.

(b) Benzo[b]fluoranthene and benzo[k]fluoranthene coeluted during analysis, therefore data are sum of both analytes.

3.3 Site Water and Elutriate Analyses

Metals, chlorinated pesticides, and PCBs were analyzed in dredging site water collected from Bronx River Project area, and in elutriate samples prepared with Bronx River site water and the Bronx River sediment composite. Sequim Bay control water was also analyzed. All water and elutriate samples were analyzed in triplicate. Mean results of the triplicate analyses are presented and discussed in the following sections. Complete results of all site water and elutriate samples, as well as a quality control summary and associated quality control data are provided in Appendix B.

TABLE 3.7. Results of Analysis of Bronx River Site Water and Elutriate for Metals

Analyte	Concentration in µg/L ^(a)		
	Sequim Bay Control Water	Bronx River Site Water	Bronx River Elutriate
Ag	0.0090 Q ^(b)	0.0770	0.0862
Cd	0.0666	0.0734	0.0525
Cr	0.69	1.16	1.21
Cu	0.607	5.42	4.54
Hg	— ^(c)	0.0153	0.0147
Ni	0.455	1.64	1.14
Pb	0.0055 Q	2.95	2.23
Zn	1.61	20.2	8.13

(a) Results shown are the mean of triplicate analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) Q Undetected at or above twice the given concentration.

(c) — Not Analyzed.

3.3.1 Metals

Results of analysis of Bronx River site water and elutriate are shown in Table 3.7. Sequim Bay seawater was also analyzed as a control. All metals analyzed were detected in both site water and elutriate.

3.3.2 Chlorinated Pesticides and PCBs

Results of analysis of Bronx River site water and elutriate and Sequim Bay control water for chlorinated pesticides and PCBs are shown in Table 3.8. Low concentrations of 4,4'-DDD, -DDE, and -DDT, dieldrin, and heptachlor epoxide, as well as PCBs 18 and 153 were detected in the site water samples. More pesticides and PCBs were detected in the elutriate than in the site water samples, and concentrations were slightly higher.

3.4 Water-Column and Benthic Toxicity Testing

Both benthic and water-column toxicity tests were performed on the Bronx River sediment composite. Benthic acute toxicity tests were performed using the infaunal amphipod *A. abdita* and the mysid *M. bahia*. SPP tests (water-column tests) were conducted using the

TABLE 3.8. Results of Analysis of Bronx River Site Water and Elutriate for Chlorinated Pesticides and PCBs

Analyte	Concentration in ng/L ^(a)		
	Sequim Bay Control Water	Bronx River Site Water	Bronx River Elutriate
2,4'-DDD	0.50 Q ^(b)	0.47 Q	0.48 Q
2,4'-DDE	0.12 Q	0.12 Q	0.12 Q
2,4'-DDT	0.23 Q	0.22 Q	0.22 Q
4,4'-DDD	0.24 Q	1.72	8.44
4,4'-DDE	0.15 Q	2.82	9.21
4,4'-DDT	0.22 Q	1.73	10.3
Total Estimated DDT ^(c)	1.46	7.08	28.8
Total Detected DDT	0.00	6.27	28.0
α -Chlordane	0.44 Q	0.41 Q	1.78
Aldrin	0.21 Q	0.19 Q	0.20 Q
Dieldrin	0.07 Q	3.40	5.51
Endosulfan I	0.25 Q	0.23 Q	0.24 Q
Endosulfan II	0.25 Q	0.23 Q	0.83
Endosulfan Sulfate	0.25 Q	0.23 Q	0.38
Heptachlor	0.25 Q	0.23 Q	0.45
Heptachlor Epoxide	0.06 Q	0.54	0.06 Q
<i>trans</i> -Nonachlor	0.59 Q	0.55 Q	0.80
PCB 8	0.53 Q	0.49 Q	0.51 Q
PCB 18	0.56 Q	0.86	21.5
PCB 28	0.38 Q	0.35 Q	9.12
PCB 44	0.17 Q	0.15 Q	0.16 Q
PCB 49	0.29 Q	0.27 Q	3.78
PCB 52	0.19 Q	0.18 Q	0.18 Q
PCB 66	0.21 Q	0.19 Q	0.20 Q
PCB 87	0.19 Q	0.18 Q	1.29
PCB 101	0.26 Q	0.24 Q	4.70
PCB 105	0.16 Q	0.15 Q	0.15 Q
PCB 118	0.25 Q	0.23 Q	3.66
PCB 128	0.13 Q	0.12 Q	0.12 Q
PCB 138	0.18 Q	0.17 Q	5.14
PCB 153	0.21 Q	0.43	7.51
PCB 170	0.11 Q	0.10 Q	0.46
PCB 180	0.15 Q	0.14 Q	5.33
PCB 183	0.29 Q	0.27 Q	0.94
PCB 184	0.29 Q	0.27 Q	0.27 Q
PCB 187	0.21 Q	0.19 Q	2.47
PCB 195	0.15 Q	0.14 Q	0.14 Q
PCB 206	0.21 Q	0.20 Q	0.20 Q
PCB 209	0.15 Q	0.14 Q	0.52
Total Estimated PCB ^(d)	10.5	10.9	137
Total Detected PCB	0.00	1.29	66.4

(a) Results shown are the mean of triplicate analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) Q Undetected at or above twice the given concentration.

(c) Total estimated DDT is the sum of 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, 2,4'-DDT, 2,4'-DDE, and 2,4'-DDD. One-half of the detection limit was used in summation when constituent was not detected.

(d) Total PCB = 2(x), where x = sum of all 22 PCB congeners; one-half of the detection limit used in summation when analyte was undetected.

juvenile silverside *M. beryllina*, the mysid *M. bahia*, and larvae of the bivalve *M. galloprovincialis*. This section discusses the results of all sediment and reference-toxicant testing. Complete test results, water quality measurements, and the results of the reference-toxicant tests are presented in Appendix C for benthic tests, and Appendix D for water-column test results. Throughout this section, the term "significant difference" is used to express *statistically* significant differences at $\alpha=0.05$ only. Tests for statistical significance between test treatments and control or reference treatments were performed following methods outlined in Section 2.6.

3.4.1 *Ampelisca abdita* Benthic Acute Toxicity Test

Results of the static renewal, benthic acute toxicity test with *A. abdita* are summarized in Table 3.9. Complete test results and water quality data are presented in Appendix C, Tables C.1 through C.4. Survival in the *A. abdita* control sediment was 98%, validating this test. Amphipod survival was 65% for COMP BX, and 95% in the Mud Dump Reference. *A. abdita* survival in COMP BX was significantly different than in the Mud Dump Reference, and $\geq 20\%$ different than the survival in the Mud Dump Reference.

Water quality parameters were within acceptable ranges throughout the test, except for minor deviations in pH measurements rising to 8.42 in COMP BX. The Cd reference toxicant test produced an LC_{50} of 0.64 mg/L Cd, within the control range (mean ± 2 standard deviations) established other at the MSL (0.4 mg/L to 0.9 mg/L Cd). After addition of sediment to test chambers, overlying water was renewed twice daily for ammonia reduction for 11 days before test initiation. Prior to ammonia reduction procedures total ammonia in COMP BX pore water was measured at 102 mg/L. Test chambers were renewed twice daily during the 10-day test. At test termination, total ammonia concentrations were less than 1.0 mg/L in the overlying water and less than 23 mg/L in the COMP BX pore water.

3.4.2 *Mysidopsis bahia* Benthic Acute Toxicity Test

Results of the static, benthic acute toxicity test with *M. bahia* are summarized in Table 3.9. Complete test results and water quality data are presented in Appendix C, Tables C.5 through C.8. Survival was 96% in COMP BX and 91% in the Mud Dump Reference Site. The control

TABLE 3.9. Summary of Benthic Tests Performed with Bronx River Sediment Composites

<u>Test Organism and Composite</u>	<u>Mean % Survival</u>	<u>Significantly Different Than MDRS^(a)</u>	<u>≥20% Difference from MDRS</u>	<u>≥10% Difference from MDRS</u>
<i>A. abdita</i> (COMP BX)	65%	Yes	Yes	-- ^(b)
<i>A. abdita</i> (MDRS)	95%	--	--	--
<i>A. abdita</i> (Control)	98%	--	--	--
<i>M. bahia</i> (COMP BX)	96%	No	--	No
<i>M. bahia</i> (MDRS)	91%	--	--	--
<i>M. bahia</i> (Control)	92%	--	--	--

(a) MDRS Mud Dump Reference Site.

(b) -- Not Applicable.

sediment was 92%, validating the test. *M. bahia* survival in COMP BX was not significantly different than in the Mud Dump Reference Site treatment.

All water quality parameters were within acceptable ranges throughout the test, except for minor deviations in pH measurements rising to 8.51 in COMP BX and to 8.63 in the control. The Cu reference toxicant test produced an LC₅₀ of 263 µg/L Cu, which was within the control range established at the MSL (154 µg/L to 303 µg/L Cu). After addition of sediment to test chambers, overlying water was renewed twice daily for ammonia reduction for 5 days before test initiation. Prior to ammonia reduction procedures total ammonia in COMP BX porewater was measured at 102 mg/L. During the test, the ammonia concentrations were less than 14.0 mg/L in the COMP BX overlying water and less than 24 mg/L in the pore water. Test chambers were not renewed during the 10-day exposure.

3.4.3 *Menidia beryllina* Water-Column Toxicity Test

Results of the *M. beryllina* water-column toxicity test are summarized in Table 3.10. Complete test results and water quality data, are presented in Appendix D, Tables D.1 through D.4. Control survival was 90%, therefore validating the test. Survival in the 100% SPP was 0% for COMP BX. A significant reduction in survival was observed in the 100% SPP, relative to the control treatment. The *M. beryllina* LC₅₀ was 21.5% SPP for COMP BX.

TABLE 3.10. Summary of Water-Column Toxicity Tests Performed with Bronx River Sediment Composites

<u>Composite</u>	<u>Test Organism</u>	0% and 100%		Significantly <u>Different</u>	<u>LC₅₀ (%SPP)</u>
		Survival in <u>0% SPP</u>	Survival in <u>100% SPP</u>		
COMP BX	<i>M. beryllina</i>	90%	0%	Yes	21.5
COMP BX	<i>M. bahia</i>	100%	8%	Yes	71.6
COMP BX	<i>M. galloprovincialis</i>	83%	50%	Yes	>100 (survival)
COMP BX	<i>M. galloprovincialis</i>	72%	1%	Yes	23.6 ^(a) (normal)

(a) Percent normal development to the D-cell, prodissococonch I stage used to calculate the median-effective concentration (EC₅₀).

All water quality parameters were within acceptable ranges throughout the test except for a minor elevation in pH (8.41) in COMP BX, 100% SPP. The copper reference toxicant test produced an LC₅₀ of 160 µg/L Cu, which was outside the control range established at the MSL (79 µg/L to 123 µg/L Cu). This indicated that the test organisms were slightly less sensitive than those previously used and may have underestimated toxicity for this SPP.

3.4.4 *Mysidopsis bahia* Water-Column Toxicity Test

Results of the *M. bahia* water-column toxicity test are summarized in Table 3.10. Complete test results, as well as water quality data, are presented in Appendix D, Tables D.5 through D.8. This test was validated by a control survival of 100% for BX. Survival in the 100% SPP preparation was 8% in COMP BX. COMP BX 100% SPP survival was significantly lower than the control. The *M. bahia* LC₅₀ for the BX composite was 71.6% SPP.

All water quality parameters were within acceptable ranges throughout the test, with the exception of pH. The pH measurements rose to 8.52 in COMP BX 100% treatment. The copper reference toxicant test produced an LC₅₀ of 283 µg/L Cu, which was within the control range established at the MSL (154 µg/L to 303 µg/L Cu).

3.4.5 *Mytilus galloprovincialis* Water-Column Toxicity Test

Results of the *M. galloprovincialis* water-column toxicity test are summarized in Table 3.10. Complete test results and water quality data are presented in Appendix D, Tables D.9 through D.12. COMP BX showed 72% normal development and 83% survival in the controls, thus validating the test. Survival in the 100% SPP preparation was 50% for COMP BX. Significantly reduced survival, relative to the controls, was observed in the 100% SPP treatment of COMP BX. The LC_{50} was $\geq 100\%$ SPP for COMP BX. Normal development, which is considered a more sensitive indicator of toxicity, was significantly reduced only in COMP BX 100% SPP, with 1% normal prodissoconch I. The EC_{50} was 23.6% SPP for COMP BX.

All water quality parameters were within acceptable ranges throughout the test, with the exception of pH, which rose to 8.55 in the COMP BX 100%. The Cu reference toxicant test produced an EC_{50} of 12.2 $\mu\text{g/L}$ Cu, which is above the control range established for Cu at MSL (EC_{50} : 4.6 $\mu\text{g/L}$ to 9.2 $\mu\text{g/L}$ Cu).

3.5 Bioaccumulation Tests with *Macoma nasuta* and *Nereis virens*

Bioaccumulation tests with *M. nasuta* and *N. virens* were conducted using the Bronx River composite, the Mud Dump Reference Site sediments, and control sediments for each species. Both *M. nasuta* and *N. virens* were exposed for 28 days under flow-through conditions. Survival was 90% in the *M. nasuta* control exposure, and was 76% in the *N. virens* control exposure. The mean lipid content measured in the background tissue samples were 0.86% for *M. nasuta* and 1.13% for *N. virens*. No statistically significant differences in *M. nasuta* survival were observed between the Bronx River composite and the reference sediment. A statistically significant difference in *N. virens* survival was found between the Bronx River composite and the reference sediment.

The tissues of organisms exposed to COMP BX were analyzed for metals and selected organic contaminants (pesticides, PCBs, and PAHs), the results of which are summarized in this section. Magnification factors (number of times the test concentration dry weight is elevated above the reference concentration dry weight) are listed and further discussed in

Section 3.5.9. Complete test results and water quality data are tabulated in Appendix E for both species. Analytical results, including a quality control summary and associated quality control data, are presented in Appendix F for *M. nasuta* and in Appendix G for *N. virens*.

3.5.1 Bioaccumulation of Metals in *Macoma nasuta*

Results of analysis of *M. nasuta* tissues exposed to Bronx River composites and to Mud Dump Reference Site sediment for metals are shown in Table 3.11. All nine metals analyzed were detected in tissues exposed to COMP BX and in the Mud Dump Reference Site. The BX composite produced significantly elevated concentrations of Cd, Cr, Ni, and Pb, relative to the Mud Dump Reference Site treatment. The magnification factor, the magnitude by which a contaminant concentration in the test composite tissues exceeds that from the reference composite tissues, was less than five for Cd, Cr, Ni and Pb.

3.5.2 Bioaccumulation of Chlorinated Pesticides in *Macoma nasuta*

Results of analysis of *M. nasuta* tissues exposed to the COMP BX and Mud Dump Reference Site sediment for chlorinated pesticides are shown in Table 3.12. In comparison with tissues exposed to the Mud Dump Reference Site sediment, the BX composite tissues had statistically significantly elevated concentration of 4,4'-DDD, 4,4'-DDE, α -chlordane, aldrin, dieldrin, trans-nonachlor, and total DDT. Tissues exposed to COMP BX contained concentrations of all the statistically significantly elevated pesticides at levels that exceeded reference concentrations by a factor of less than 5 times, except α -chlordane, which exceeded reference concentrations by a factor of greater than 10 times.

3.5.3 Bioaccumulation of PCBs in *Macoma nasuta*

Results of analysis of *M. nasuta* tissues exposed to COMP BX and Mud Dump Reference Site sediment for PCBs are shown in Table 3.13. Of the 22 PCBs analyzed, 17 were detected in *M. nasuta* tissues exposed to the Bronx River composite. Eleven PCBs were observed at concentrations that were significantly elevated in Bronx River-exposed tissues relative to those in tissues exposed to the Mud Dump Reference Site sediment. In tissues exposed to COMP BX, the concentrations of PCB 18 exceeded those of the Mud Dump Reference tissues by more than 10 times. COMP BX tissue concentrations of PCBs 8 and 44

TABLE 3.11 Mean Concentrations of Metals in *Macoma nasuta* Tissues Exposed to Bronx River Composite and the Mud Dump Reference Site Sediment

Analyte	Concentration (mg/kg wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
Silver	0.0770	0.0836	No
Arsenic	4.40	4.20	No
Cadmium	0.0248	0.0456	Yes
Chromium	0.288	0.551	Yes
Copper	2.50	3.50	No
Mercury	0.0149	0.0153	No
Nickel	0.360	0.546	Yes
Lead	0.712	2.20	Yes
Zinc	11.7	16.9	No

(a) Results shown are a mean of five replicate tissue analyses.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

TABLE 3.12. Mean Concentrations of Pesticides in *Macoma nasuta* Tissues Exposed to Bronx River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
2,4'-DDD	0.16 Q ^(d)	0.50	No
2,4'-DDE	0.17 Q	0.20 Q	No
2,4'-DDT	0.12 Q	0.14 Q	No
4,4'-DDD	1.00	3.27	Yes
4,4'-DDE	1.92	3.33	Yes
4,4'-DDT	0.62	1.33	No
α-Chlordane	0.12	2.40	Yes
Aldrin	1.10	1.91	Yes
Dieldrin	0.34 Q	1.75	Yes
Endosulfan I	0.12 Q	0.14 Q	No
Endosulfan II	0.12 Q	0.14 Q	No
Endosulfan Sulfate	0.16 Q	0.19 Q	No
Heptachlor	0.25	0.25	No
Heptachlor Epoxide	0.09 Q	0.10 Q	No
trans-Nonachlor	0.10 Q	0.63	Yes
Total Estimated DDT ^(e)	3.99	8.77	Yes
Total Detected DDT	3.54	8.43	

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

(e) Total estimated DDT is the sum of 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, 2,4'-DDT, 2,4'-DDE, and 2,4'-DDD. One-half of the detection limit was used in summation when constituent was not detected.

TABLE 3.13. Mean Concentrations of PCBs in *Macoma nasuta* Tissues Exposed to Bronx River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration ($\mu\text{g/kg}$ wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
PCB 8	0.23 Q ^(d)	3.95	Yes
PCB 18	0.07 Q	7.88	Yes
PCB 28	2.31	8.67	Yes
PCB 44	0.05 Q	0.64	No
PCB 49	1.35	4.20	Yes
PCB 52	1.74	6.60	Yes
PCB 66	1.77	4.73	Yes
PCB 87	0.20	0.92	Yes
PCB 101	1.44	3.94	Yes
PCB 105	0.26	0.57	No
PCB 118	1.00	2.28	Yes
PCB 128	0.07 Q	0.18	No
PCB 138	0.62	2.15	Yes
PCB 153	0.78	2.75	Yes
PCB 170	0.12 Q	0.18	No
PCB 180	0.25 Q	0.72	No
PCB 183	0.12 Q	0.14 Q	No
PCB 184	0.12 Q	0.14 Q	No
PCB 187	0.14 Q	0.33	No
PCB 195	0.08 Q	0.10 Q	No
PCB 206	0.14 Q	0.16 Q	No
PCB 209	0.13 Q	0.15 Q	No
Total Estimated PCB ^(e)	26.0	103	
Total Detected PCB	11.5	50.7	

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

(e) Total estimated PCB = 2(x), where x = sum of all 22 PCB congeners; one-half of the detection limit used in summation when analyte was undetected.

exceeded the reference tissue concentrations by greater than 5 times but less than 10 times. The remaining 19 PCB congeners showed less than 5 times greater concentrations in COMP BX tissue compared with reference tissue.

3.5.4 Bioaccumulation of PAHs and 1,4-Dichlorobenzene in *Macoma nasuta*

Results of analysis of *M. nasuta* tissues exposed to COMP BX and Mud Dump Reference Site sediments for PAHs and 1,4-dichlorobenzene are shown in Table 3.14. Fifteen of the 16 PAHs analyzed were detected in *M. nasuta* tissues exposed to COMP BX at significantly elevated concentrations, relative to tissues exposed to the Mud Dump Reference Site sediment; only naphthalene was not significantly elevated. Five of the 16 PAHs analyzed were found at concentrations over 10 times higher in *M. nasuta* exposed to the BX composite than in the Mud Dump Reference Site sediment. Four of the 16 PAHs analyzed were found at concentrations between 5 and 10 times higher in *M. nasuta* exposed to the COMP BX than in the Mud Dump Reference Site. The remaining 7 PAHs analyzed were found at concentrations less than 5 times higher in *M. nasuta* exposed to COMP BX than in the *M. nasuta* exposed to Mud Dump Reference Site sediment. The compound 1,4-dichlorobenzene was detected in the tissues exposed to the Bronx River at a concentration of 1.88 $\mu\text{g/kg}$ wet weight.

3.5.5 Bioaccumulation of Metals in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Bronx River composites and Mud Dump Reference sediment for metals are shown in Table 3.15. All metals analyzed except Ag and Cr were detected in *N. virens* tissues exposed to COMP BX. None of the metals analyzed was significantly higher in COMP BX-exposed tissues than in Mud Dump Reference Site.

3.5.6 Bioaccumulation of Chlorinated Pesticides in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Bronx River composites and Mud Dump Reference Site sediments for chlorinated pesticides are shown in Table 3.16. In comparison with the Mud Dump Reference Site exposed tissues, the BX composite-exposed tissues had statistically significant elevation of 8 of the 15 analyzed pesticides and in total DDT. The compounds 4,4'-DDE and α -chlordane exceeded reference tissue concentrations by greater than 10 times in tissues exposed to COMP BX. Four pesticide compounds found in tissues exposed to COMP BX exceeded levels in reference tissues by greater than 5 times, but less than

TABLE 3.14. Mean Concentrations of PAHs and 1,4-Dichlorobenzene in *Macoma nasuta* Tissues Exposed to Bronx River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
Naphthalene	3.45	4.53	No
Acenaphthylene	0.56	1.88	Yes
Acenaphthene	0.89 Q ^(d)	4.78	Yes
Fluorene	1.13	4.91	Yes
Phenanthrene	2.10	42.2	Yes
Anthracene	1.86	23.4	Yes
Total Estimated LPAH ^(e)	9.99	81.7	
Total Detected LPAH	9.10	81.7	
Fluoranthene	9.11	230	Yes
Pyrene	23.6	289	Yes
Benz[a]anthracene	8.48	115	Yes
Chrysene	6.23	127	Yes
Benzo[b]fluoranthene	15.7	110	Yes
Benzo[k]fluoranthene	3.07	19.7	Yes
Benzo[a]pyrene	7.43	60.0	Yes
Indeno[123-cd]pyrene	1.58	11.1	Yes
Dibenz[a,h]anthracene	0.80 Q	3.15	Yes
Benzo[g,h,i]perylene	2.06	11.5	Yes
Total Estimated HPAH ^(e)	78.1	976	
Total Detected HPAH	77.3	976	
Total Estimated PAH ^(e)	88.1	1060	
Total Detected PAH	86.4	1060	
1,4-Dichlorobenzene	1.28 Q	1.88	No

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

(e) Total estimated values include one-half the detection limit for undetected constituents.

TABLE 3.15. Mean Concentrations of Metals in *Nereis virens* Tissues Exposed to Bronx River Composite and the Mud Dump Reference Site Sediment

Analyte	Concentration (mg/kg wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
Silver	0.0171 Q ^(d)	0.0164 Q	No
Arsenic	3.28	2.31	No
Cadmium	0.0728	0.0536	No
Chromium	0.0379	0.0063 Q	No
Copper	1.63	1.19	No
Mercury	0.0257	0.0341	No
Nickel	0.0497	0.0683	No
Lead	0.210	0.182	No
Zinc	8.55	7.26	No

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

TABLE 3.16. Mean Concentrations of Pesticides in *Nereis virens* Tissues Exposed to Bronx River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
2,4'-DDD	0.18	1.73	Yes
2,4'-DDE	0.15 Q ^(d)	0.15 Q	No
2,4'-DDT	0.10 Q	0.10 Q	No
4,4'-DDD	1.04	5.79	Yes
4,4'-DDE	0.22	3.08	Yes
4,4'-DDT	0.78	1.88	Yes
α-Chlordane	0.18	3.91	Yes
Aldrin	0.77	2.68	Yes
Dieldrin	0.29 Q	2.88	Yes
Endosulfan I	0.10 Q	0.10 Q	No
Endosulfan II	0.10 Q	0.10 Q	No
Endosulfan Sulfate	0.14 Q	0.14 Q	No
Heptachlor	0.29	0.26	No
Heptachlor Epoxide	0.07 Q	0.33	No
trans-Nonachlor	0.47	2.47	Yes
Total Estimated DDT ^(e)	2.47	12.73	Yes
Total Detected DDT	2.22	12.48	

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

(e) Total estimated DDT is the sum of 4,4'-DDT, 4,4'-DDE, 4,4'-DDD, 2,4'-DDT, 2,4'-DDE, and 2,4'-DDD. One-half of the detection limit was used in summation when constituent was not detected.

10 times. The remaining nine pesticide compounds analyzed for in tissues exposed to COMP BX exceeded levels in reference tissues by less than 5 times.

3.5.7 Bioaccumulation of PCBs in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Bronx River composites and Mud Dump Reference sediment for PCBs are shown in Table 3.17. There were 16 of the 19 PCBs detected in *N. virens* tissues exposed to COMP BX at concentrations that were significantly elevated relative to those in tissues exposed to the Mud Dump Reference sediment. In COMP BX tissues, 6 PCBs (PCB 18, 28, 44, 49, 66, and 118) were observed at concentrations greater than 10 times those of the tissues exposed to the Mud Dump Reference sediment; 4 PCBs (PCB 52, 101, 105, and 170) were observed at concentrations between 5 and 10 times those exposed to the Mud Dump Reference sediment; and 12 PCBs were observed at less than 5 times those concentrations found in tissues exposed to the Mud Dump Reference sediment.

3.5.8 Bioaccumulation of PAHs and 1,4-Dichlorobenzene in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Bronx River composites and Mud Dump Reference Site sediment for PAHs and 1,4-dichlorobenzene are shown in Table 3.18. All PAHs analyzed were detected in tissues exposed to the COMP BX composite, except for dibenz[a,h]anthracene. Nine PAHs in tissues exposed to BX were significantly elevated above PAHs in tissues exposed to the Mud Dump Reference Site. Concentrations of fluoranthene, pyrene, and chrysene were elevated in tissues exposed to BX over concentrations in tissues exposed to the reference sediments by more than 10 times. Benz[a]anthracene and benzo[b]fluoranthene in tissues exposed to COMP BX were observed at concentrations between 5 and 10 times those in tissues exposed to the Mud Dump Reference sediment. The remaining 11 PAHs in tissues exposed to COMP BX were observed to be less than 5 times those found in tissues exposed to the Mud Dump Reference sediment. The compound 1,4-dichlorobenzene was not detected in COMP BX-exposed tissues.

TABLE 3.17. Mean Concentrations of PCBs in *Nereis virens* Tissues Exposed to Bronx River Composites and Mud Dump Reference Site Sediment

Analyte	Concentration ($\mu\text{g/kg}$ wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
PCB 8	0.20 Q ^(d)	0.19 Q	No
PCB 18	0.31	10.9	Yes
PCB 28	0.06 Q	6.94	Yes
PCB 44	0.04 Q	5.97	Yes
PCB 49	0.36	5.80	Yes
PCB 52	1.12	9.83	Yes
PCB 66	0.08 Q	2.90	No
PCB 87	0.14 Q	0.70	Yes
PCB 101	0.96	5.55	Yes
PCB 105	0.20	1.63	Yes
PCB 118	0.23	3.30	Yes
PCB 128	0.19	0.67	Yes
PCB 138	1.21	4.70	Yes
PCB 153	1.72	6.33	Yes
PCB 170	0.24	1.40	Yes
PCB 180	0.56	2.74	Yes
PCB 183	0.12	0.79	Yes
PCB 184	0.10 Q	0.10 Q	No
PCB 187	0.40	2.01	Yes
PCB 195	0.07 Q	0.16	No
PCB 206	0.12 Q	0.23	No
PCB 209	0.11 Q	0.11 Q	No
Total Estimated PCB ^(e)	17.1	146	
Total Detected PCB	7.62	72.6	

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

(e) Total estimated PCB = $2(x)$, where x = sum of all 22 PCB congeners; one-half of the detection limit used in summation when analyte was undetected.

TABLE 3.18. Mean Concentrations of PAHs and 1,4-Dichlorobenzene in *Nereis virens* Exposed to Bronx River Composites and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight) ^(a)		
	MDRS ^(b)	BX	SD ^(c)
Naphthalene	3.47	3.53	No
Acenaphthylene	0.33 Q ^(d)	0.95	No
Acenaphthene	0.90	4.51	Yes
Fluorene	0.87	1.51	No
Phenanthrene	1.48 Q	5.23	No
Anthracene	1.25 Q	1.49	No
Total Estimated LPAHs ^(e)	8.30	17.2	
Total Detected LPAHs	5.24	17.2	
Fluoranthene	1.95 Q	93.7	Yes
Pyrene	3.75	122	Yes
Benzo(a)anthracene	0.75	8.40	Yes
Chrysene	1.22	42.1	Yes
Benzo(b)fluoranthene	0.69 Q	9.33	Yes
Benzo(k)fluoranthene	0.85 Q	4.54	Yes
Benzo(a)pyrene	0.74 Q	5.03	Yes
Indeno(123-cd)pyrene	0.88 Q	1.47	No
Dibenz(a,h)anthracene	0.68 Q	0.68 Q	No
Benzo(g,h,i)perylene	0.63 Q	2.89	Yes
Total Estimated HPAHs ^(e)	12.1	290	
Total Detected HPAHs	5.72	289	
Total Estimated PAHs ^(e)	20.4	307	
Total Detected PAHs	11.0	306	
1,4-Dichlorobenzene	1.10 Q	1.09 Q	No

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.

(b) MDRS Mud Dump Reference Site.

(c) SD Dry weight concentrations significantly different.

(d) Q One-half the achieved detection limit.

(e) Total estimated values include one-half the detection limit for undetected constituents.

3.5.9 Magnification Factors of Compounds in *Macoma nasuta* and *Nereis virens*

Table 3.19 shows the calculated magnification factors of all compounds analyzed, respective to the organisms *M. nasuta* and *N. virens*. Magnification factors were calculated with the dry weight concentrations of the compounds in the tissues of the bioaccumulation organism. These factors show the magnification of the COMP BX-exposed tissues over the Mud Dump Reference Site-exposed tissues. When all replicate analysis of a compound showed that the compound was undetected, the magnification factor displays the magnification of the COMP-BX exposed tissues above the detection limit of the Mud Dump Reference-Site exposed tissues.

In Table 3.19, magnification factors greater than or equal to 5 but less than 10 appear as underlined values, and magnification factors greater than or equal to 10 appear in bold type.

TABLE 3.19. Magnification Factors of All Analyzed Compounds in Tissues Exposed to Bronx River Composites Compared with Mud Dump Reference Site Sediment

Compound	Magnification Factors ^(a)	
	<i>Macoma nasuta</i>	<i>Nereis virens</i>
Ag (silver)	1.00	1.00
As (arsenic)	0.88	0.73
Cd (cadmium)	1.68	0.77
Cr (chromium)	1.74	0.32
Cu (copper)	1.29	0.76
Hg (mercury)	0.94	1.37
Ni (nickel)	1.39	1.21
Pb (lead)	2.82	0.91
Zn (zinc)	1.31	0.88
2,4'-DDD	1.67	<u>6.11</u>
2,4'-DDE	1.06	1.05
2,4'-DDT	1.05	1.04
4,4'-DDD	2.71	<u>5.70</u>
4,4'-DDE	1.54	12.27
4,4'-DDT	1.94	2.46
α-Chlordane	15.66	22.64
Aldrin	1.58	3.60
Dieldrin	2.34	<u>5.18</u>
Endosulfan I	1.04	1.04
Endosulfan II	1.04	1.04
Endosulfan Sulfate	1.05	1.05
Heptachlor	1.02	0.89
Heptachlor Epoxide	1.05	2.52
trans- Nonachlor	3.06	<u>5.24</u>

TABLE 3.19. (contd)

Compound	Magnification Factors ^(a)	
	<i>Macoma nasuta</i>	<i>Nereis virens</i>
PCB 8	7.77	1.05
PCB 18	53.16	30.49
PCB 28	3.31	58.39
PCB 44	6.12	79.61
PCB 49	2.84	15.47
PCB 52	3.46	8.99
PCB 66	2.42	17.74
PCB 87	2.47	2.68
PCB 101	2.47	5.91
PCB 105	1.78	5.99
PCB 118	2.08	11.33
PCB 128	1.41	3.31
PCB 138	2.86	3.92
PCB 153	2.79	3.71
PCB 170	1.13	5.03
PCB 180	1.46	4.53
PCB 183	1.04	4.02
PCB 184	1.04	1.07
PCB 187	1.56	4.72
PCB 195	1.06	1.40
PCB 206	1.04	1.26
PCB 209	1.05	1.03
Naphthalene	1.29	1.08
Acenaphthylene	2.17	1.63
Acenaphthene	2.56	3.09
Fluorene	2.71	1.28
Phenanthrene	10.85	2.06
Anthracene	7.13	1.06
Fluoranthene	22.95	24.38
Pyrene	11.01	28.41
Benzo(a)anthracene	12.36	7.97
Chrysene	18.42	20.82
Benzo(b)fluoranthene	6.23	6.98
Benzo(k)fluoranthene	5.39	2.85
Benzo(a)pyrene	7.31	3.61
Indeno(123-cd)pyrene	4.44	1.23
Dibenzo(a,h)anthracene	1.82	1.05
Benzo(g,h,i)perylene	4.93	2.46
1,4-Dichlorobenzene	1.04	1.05

- (a) Magnification factors are the number of times the test treatment concentration is greater than the reference treatment concentration. When the compound is undetected the achieved detection limit value is used in the calculation. Calculations are with dry weight concentration values.

4.0 Discussion and Conclusions

In this section, physical and chemical analyses, and bioassays performed on the Bronx River sediment composite are evaluated relative to the Mud Dump Reference Site sediment by the guidelines of the Green Book Tier III. Tier III evaluations include water-column toxicity tests, benthic toxicity tests, and whole-sediment bioaccumulation studies. Tier III evaluations assess the impact of contaminants in the dredged material on marine organisms to determine whether there is potential for the material to have an unacceptable environmental effect during ocean disposal. The Green Book provides the following guidance for determining whether the proposed dredged material is unacceptable for ocean disposal based on the Tier III benthic acute toxicity test:

- Benthic Acute Toxicity. The proposed dredged material does not meet the limiting permissible concentration (LPC) for benthic toxicity when organism survival in the test sediment and the reference site sediment is statistically significantly different, and the decrease in survival exceeds 20% for *A. abdita*, or 10% for *M. bahia*.
- Water-Column Toxicity. The LPC of dissolved plus suspended contaminants cannot exceed 0.01 of the acutely toxic concentration at the boundaries of the disposal site within the first 4 h after disposal, or at any point in the marine environment after the first 4 h. The acutely toxic concentration in this case is taken to be the median lethal concentration (LC_{50}); therefore, at least 50% mortality in an SPP treatment would be required before acute toxicity could be demonstrated according to the Green Book. A numerical mixing model should be used to predict whether concentrations greater than 0.01 of the acutely toxic SPP concentrations are likely to occur beyond the boundaries of the disposal site within the first 4 h after disposal.
- Bioaccumulation. The proposed dredged material does not meet the LPC for bioaccumulation if tissue concentrations of one or more contaminants of concern are greater than the applicable FDA levels. Regional guidance (USACE 1981) for interpretation of bioaccumulation was also considered. When the bioaccumulation of contaminants in the dredged material exceeds that in the reference material exposures, further case-specific evaluation criteria listed in the Green Book should be consulted to determine LPC and benthic effects compliance.

Sections 4.1 through 4.4 discuss the proposed Bronx River dredged material in terms of sediment characterization and Tier III evaluations. The matrix in Figure 4.1 summarizes the contribution of the Bronx River sediment composite to water-column or benthic acute toxicity

and potential for bioaccumulation relative to the Mud Dump Reference Site. This matrix shows bioaccumulation potential as the number of contaminants that were elevated in the tissues of *M. nasuta* and *N. virens* at a range of magnitudes (i.e., 2, 5, or 10 times) above tissues of each species exposed to the reference sediment. This format clearly indicates where similar classes of contaminants were accumulated by both *M. nasuta* and *N. virens*.

4.1 Sediment Physical and Chemical Characterization

Bronx River sediment core samples were generally black, silty-clayey material. The grain-size distributions of core samples were variable. Two stations were predominantly sand and gravel (BX-11 and BX-15), whereas the remaining 13 stations were predominantly silt and clay. Sediment moisture contents ranged from 20% to 72% in individual cores. All nine metals analyzed in COMP BX sediments were detected. The dominant pesticides found in COMP BX were the DDT family of compounds (158 µg/kg total DDT), followed by α-chlordane, *trans*-nonachlor, aldrin, and endosulfan sulfate. Eighteen of the 22 PCB congeners analyzed were detected in COMP BX sediment, with a total estimated PCB concentration was calculated as 1660 µg/kg. All 16 PAHs analyzed were detected in COMP BX sediment. In COMP BX, LPAH (7410 µg/kg) made up approximately 16% of the total PAH concentration (45,800 µg/kg dry weight). The concentration of 1,4-dichlorobenzene was 249 µg/kg (dry weight) in COMP BX.

4.2 Site Water and Elutriate Chemical Characterization

Concentrations of metals in Bronx River elutriate were similar to, but generally less than Bronx River site water concentrations. Most pesticides and PCBs were not detected in the site water. The majority of pesticides and PCB congeners detected were in the elutriate samples.

4.3 Toxicity

In comparison with the Mud Dump Reference Site, statistically significant acute toxicity and greater than 20% increase in mortality was found with the Bronx River composite in the static-renewal test with *A. abdita*. In comparison with the Mud Dump Reference Site, no statistically significant acute toxicity or greater than 10% increase in mortality was found with the Bronx River composite in the static test with *M. bahia*. Therefore, the Bronx River sediment

composite did not meet the LPC for benthic toxicity to the test organism *A. abdita*, but the LPC was met for the test organism *M. bahia*, if the observed effects were due to persistent contaminants.

The 100% SPP treatments from COMP BX were acutely toxic to all three species tested. For COMP BX, the LC_{50} s ranged from 21.5% SPP for *M. beryllina* to >100% SPP for *M. galloprovincialis*. The EC_{50} for *M. galloprovincialis* normal development, a more sensitive measure than survival, was 23.6% SPP for COMP BX. Based on acute mortality results (LC_{50} s), the LPC for water-column effects outside of the disposal site boundaries after 4 h is 0.22% SPP for COMP BX. A projection of SPP concentrations exceeding this value after 4 h at the Mud Dump Site boundary would be unacceptable.

4.4 Bioaccumulation

Results of *N. virens* and *M. nasuta* tissue analyses from test sediment bioaccumulation studies were compared with action levels for poisonous or deleterious substances in fish and shellfish for human consumption published by the U.S. Food and Drug Administration (FDA). Concentrations of As, Cd, Cr, Ni, and Pb were also compared with the FDA level of concern for chronic shellfish consumption (FDA 1993a,b,c,d,e) for each of these metals. Results of tissue analyses from test sediment bioaccumulation studies were also compared with contaminant concentrations in tissues of organisms similarly exposed to Mud Dump Reference Site sediment.

When *M. nasuta* and *N. virens* were exposed to COMP BX sediment composite in 28-day bioaccumulation tests, concentrations of some contaminants were elevated in tissues of both species relative to levels in organisms exposed to the Mud Dump Reference Site. Concentrations of all metals were higher in *M. nasuta* than in *N. virens* tissues. Pesticide and PCB concentrations were generally higher in *N. virens* than in *M. nasuta* tissues. Concentrations of PAHs were higher in *M. nasuta*, many compounds by factors of 2 to 10 times, than in *N. virens* tissues. Table 4.1 compares the FDA action levels for poisonous or deleterious substances in fish and shellfish for human consumption for selected pesticides and FDA levels of concern for chronic shellfish consumption for selected metals with the mean

concentration of these contaminants found in tissues of each test species. The *M. nasuta* and *N. virens* tissues exposed to COMP BX sediment had tissue body burdens that were lower than the FDA levels for each of these selected contaminants, except lead in *M. nasuta* tissues which, was slightly higher than the FDA level of concern.

When tissue burdens of *M. nasuta* exposed to COMP BX sediment were compared with those of *M. nasuta* exposed to Mud Dump Reference Site sediment, the tissue burdens were statistically significantly higher for 4 metals, 6 pesticides, 11 PCBs, and 15 PAHs. Comparison of tissue burdens of *N. virens* exposed to COMP BX sediment with those exposed to Mud Dump Reference Site sediment revealed that the tissue burdens were statistically significantly higher for no metals, 8 pesticides, 16 PCBs, and 9 PAHs. Therefore, COMP BX-A sediment requires further evaluation to determine LPC and benthic effects compliance. Figure 4.1 indicates the number of compounds in each contaminant group that was statistically significantly elevated, and whether the bioaccumulation was greater than a twofold, but less than fivefold increase over the reference; greater than fivefold, but less than tenfold increase over the reference; or a greater than tenfold increase over the reference site treatment.

TABLE 4.1. Comparison of Contaminant Concentrations in *Macoma nasuta* and *Nereis virens* Tissues Exposed to Proposed Dredged Material from Bronx River Project Area with FDA Action Levels and Levels of Concern

<u>Substance</u>	<u>FDA Level (mg/kg wet wt)</u>	<u>Concentrations^(a) in <i>M. nasuta</i> Tissues (mg/kg wet wt)</u>	<u>Concentrations^(a) in <i>N. virens</i> Tissues (mg/kg wet wt)</u>
		<u>COMP BX</u>	<u>COMP BX</u>
Chlordane	0.3 ^(b)	0.0024 ^(c)	0.0039 ^(c)
DDT + DDE ^(d)	5.0 ^(b)	0.009	0.013
Dieldrin + Aldrin	0.3 ^(b)	0.004	0.006
Heptachlor+			
Heptachlor epoxide	0.3 ^(b)	0.0004	0.0006
Total PCBs ^(e)	2.0 ^(b)	0.051	0.073
Arsenic	86 ^(f)	4.20	2.31
Cadmium	3.7 ^(f)	0.0456	0.0536
Chromium	13 ^(f)	0.551	0.0063 Q ^(g)
Lead	1.7 ^(f)	2.20	0.182
Nickel	80 ^(f)	0.546	0.0683
Methyl Mercury	1.0 ^(b)	0.0153 ^(h)	0.0341 ^(h)
Total DDT ^(d)	0.04 ^(f)	0.009	0.013
Total PCB ^(e)	0.40 ^(f)	NA	0.073
Total PCB ^(e)	0.10 ^(f)	0.051	NA
Mercury (total)	0.20 ^(f)	0.0153	0.0341
Cadmium	0.30 ^(f)	0.0456	0.0536

- (a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected, one-half of the detection limit was used in calculation of the mean concentration.
- (b) FDA Action Levels for Poisonous and Deleterious Substances in Fish and Shellfish for Human Food.
- (c) Sum of mean values for 2,4'-DDT, 4,4'-DDT, 2,4'-DDE, and 4,4'-DDE. One-half of the detection limit was used in the summation when mean values were undetected.
- (d) Sum of mean values for 2,4'-DDT, 4,4'-DDT, 2,4'-DDE, 4,4'-DDE, 2,4'-DDD, 4,4'-DDD. One-half of the detection limit was used in the summation when mean values were undetected.
- (e) Total PCBs estimated as 2.0x sum of 22 congeners. One-half of the detection limit was used in the summation when mean values were undetected in a replicate.
- (f) FDA Level of concern for chronic shellfish consumption.
- (g) Neither compound detected; value presented is 1/2 detection limit.
- (h) Value reported here is for total mercury.
- (i) USACE-NYD bioaccumulation matrix value designated in 1981 (USACE-NYD 1981).

		Sediment Treatment:	Bronx River vs. MDRS
Acute Toxicity	<i>A. abdita</i> Benthic Static-Renewal Test		S ^(a)
	<i>M. bahia</i> Benthic Static Test		- ^(b)
	<i>M. beryllina</i> SPP Test		S
	<i>M. bahia</i> SPP Test		S
	<i>M. galloprovincialis</i> SPP Test		S

		Test Species ^(c) :	<i>M.nasuta</i>	<i>N. virens</i>
Any Significant Bioaccumulation	# of Metals (9 total)		4	-
	# of Pesticide compounds (15 total)		6	8
	# of PCB congeners (22 total)		11	16
	# of PAH compounds (16 total)		15	9
	1,4-dichlorobenzene		-	-

Bioaccumulation < 2 times Ref.	# of Metals (9 total)	3	-
	# of Pesticide compounds (15 total)	2	-
	# of PCB congeners (22 total)	-	-
	# of PAH compounds (16 total)	1	-
	1,4-dichlorobenzene	-	-

Bioaccumulation >2<5 times Ref.	# of Metals (9 total)	1	-
	# of Pesticide compounds (15 total)	3	2
	# of PCB congeners (22 total)	9	7
	# of PAH compounds (16 total)	5	4
	1,4-dichlorobenzene	-	-

Bioaccumulation >5<10 times Ref.	# of Metals (9 total)	-	-
	# of Pesticide compounds (15 total)	-	4
	# of PCB congeners (22 total)	1	4
	# of PAH compounds (16 total)	4	2
	1,4-dichlorobenzene	-	-

Bioaccumulation >10 times Ref.	# of Metals (9 total)	-	-
	# of Pesticide compounds (15 total)	1	2
	# of PCB congeners (22 total)	1	5
	# of PAH compounds (16 total)	5	3
	1,4-dichlorobenzene	-	-

- (a) S Significantly different survival from reference; for amphipods mortality >20% greater than reference; for mysids mortality >10% greater than reference.
(b) - No significant difference/no significant bioaccumulation at this level.
(c) Number of compounds bioaccumulating in tissues of test species.

FIGURE 4.1. Summary Matrix of Bronx River Sediment Toxicity and Bioaccumulation in Comparison with the Mud Dump Reference Site

5.0 References

Barrows, E.S., M.R. Pinza, W.W. Gardiner, N.P. Kohn, B.D. Gruendell, H.L. Mayhew, J.Q. Word, and L.B. Rosman. 1996. *Evaluation of Dredged Material Proposed for Ocean Disposal from Federal Projects in New York and New Jersey and the Military Ocean Terminal (MOTBY)*. Prepared for Department of the Army, U.S. Army Corps of Engineers, New York District, Water Quality Branch by Battelle Marine Sciences Laboratory, Pacific Northwest National Laboratory, Richland Washington.

Bloom, N.S., and E.A. Crecelius. 1983. "Determination of Mercury in Seawater at Sub-Nanogram per Liter Levels." *Mar. Chem.* 14:49-59.

Dunnett, C.W. 1964. "New Tables for Multiple Comparisons with a Control." *Biometrics* 20:482-491.

EPA (U.S. Environmental Protection Agency). 1986. *Determination of Total Organic Carbon in Sediment*. U.S. Environmental Protection Agency, Region II, Environmental Services Division, Monitoring Management Branch, Edison, New Jersey.

EPA (U.S. Environmental Protection Agency). 1990. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846*. 3rd Ed. U.S. Environmental Protection Agency, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1991. *Methods for the Determination of Metals in Environmental Samples*. EPA/600/4-91-010. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.

EPA (U.S. Environmental Protection Agency). 1994a. *Methods for Assessing the Toxicity of Sediment-associated Contaminants with Estuarine and Marine Amphipods*. EPA/600/R-94-025. U.S. Environmental Protection Agency, Office of Research and Development, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1994b. Memorandum: Recommendations for Conducting Sediment Toxicity Test with *Mysidopsis bahia* when Ammonia may be Present at Toxic Levels. June 14, 1994. U.S. Environmental Protection Agency, Office of Science and Technology, Washington, D.C.

EPA/USACE (U.S. Environmental Protection Agency/U.S. Army Corps of Engineers). 1991. *Evaluation of Dredged Material Proposed for Ocean Disposal (Testing Manual)*. EPA-503/8-91/001. U.S. Environmental Protection Agency, Office of Marine and Estuarine Protection, Washington, D.C.

FDA (U.S. Food and Drug Administration). 1993a. Guidance Document for Arsenic in Shellfish. U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Washington, D.C.

FDA (U.S. Food and Drug Administration). 1993b. Guidance Document for Cadmium in Shellfish. U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Washington, D.C.

FDA (U.S. Food and Drug Administration). 1993c. Guidance Document for Chromium in Shellfish. U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Washington, D.C.

FDA (U.S. Food and Drug Administration). 1993d. Guidance Document for Nickel in Shellfish. U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Washington, D.C.

FDA (U.S. Food and Drug Administration). 1993e. Guidance Document for Lead in Shellfish. U.S. Food and Drug Administration, Center for Food Safety and Applied Nutrition, Washington, D.C.

Finney, D. J. 1971. *Probit Analysis*. 3rd Ed. Cambridge University Press, Boston, Massachusetts.

NOAA (National Oceanic and Atmospheric Administration). 1993. *Sampling and Analytical Methods of the National Status and Trends Program National Benthic Surveillance and Mussel Watch Projects 1984-1992. Volume IV. Comprehensive Descriptions of Trace Organic Analytical Methods*. G. G. Lauenstein and A.Y. Cantillo, eds. NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Coastal Monitoring and Bioeffects Assessment Division, Office of Ocean Resources Conservation and Assessment, Silver Spring, Maryland.

NYSDEC (New York State Department of Environmental Conservation). 1992. *Analytical Method for the Determination of PCB congeners by Fused Silica Capillary Column Gas Chromatography with Electron Capture Detector*. NYSDEC Method 91-11. New York State Department of Environmental Conservation, Albany, New York.

Plumb, R. H., Jr. 1981. *Procedure for Handling and Chemical Analysis of Sediment and Water Samples*. Tech. Rep. EPA/USACE-81-1. Prepared by Great Lakes Laboratory, State University College at Buffalo, New York, for the U.S. Environmental Protection Agency/U.S. Army Corps of Engineers Technical Committee on Criteria for Dredged and Fill Material. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

USACE (U.S. Army Corps of Engineers). 1970 (Revised 1980). *Engineer Manual, Engineering and Design, Laboratory Soils Testing*. EM 110-2-1906. Headquarters, Department of the Army, Office of the Chief of Engineers, Washington, D.C.

USACE-NYD (U.S. Army Corps of Engineers, New York District) 1981. Memorandum: Final Interpretive Guidance for Bioaccumulation of Petroleum Hydrocarbons, DDT, Cadmium, and Mercury in the New York Bight. April 7, 1981. U.S. Army Corps of Engineers, Office of the Chief of Engineers, New York, New York.

USACE-NYD/EPA Region II (U.S. Army Corps of Engineers, New York District/U.S. Environmental Protection Agency, Region II). 1992. *Guidance for Performing Tests on Dredged Material Proposed for Ocean Disposal*. 18 December 1992 Draft. U.S. Army Corps of Engineers, New York District and U.S. Environmental Protection Agency, Region II. New York, New York.

Appendix A

Sediment Physical/Chemical Analyses and
Quality Assurance/Quality Control Data for
Bronx River Project

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Grain Size, Bulk Density, Specific Gravity, and Total Solids

LABORATORY: Soil Technology, Bainbridge Island, Washington

MATRIX: Sediment

QA/QC DATA QUALITY OBJECTIVES

	<u>Reference Method</u>	<u>Target Relative Precision</u>	<u>Detection Limit</u>
Grain Size	ASTM D-2217 & D-422	≤20%	1.0%
Bulk Density	ASTM-D854	≤20%	NA
Specific Gravity	EM-1110-2-1906	≤20%	NA
Total Solids	Plumb 1981	NA	1.0%

METHOD Grain size was measured for four fractions using a combination of sieve and pipet techniques, following ASTM method D-2217 and D-422 for wet sieving. Bulk density was measured in accordance with ASTM method D-854. Specific gravity was measured in accordance with Method EM 1110-2-1906 (USACE 1970). Total solids was measured gravimetrically following Plumb (1981).

HOLDING TIMES Samples were analyzed within the 6-month holding time.

DETECTION LIMITS Target detection limits of 1.0% were met for each sample.

METHOD BLANKS Not applicable.

MATRIX SPIKES Not applicable.

REPLICATES Four samples were analyzed in triplicate for grain size and total solids. Precision was measured by calculating the relative standard deviation (RSD) among triplicate results. The RSDs ranged from 0% to 10% for grain size and was 0% for total solids, indicating acceptable precision.

QA/QC SUMMARY GRAIN SIZE (contd)

One sample was analyzed in triplicate for bulk density and specific gravity. The RSDs for the bulk density triplicates was 0% for wet weight determination and 2% for dry weight determination. The RSD for the specific gravity determination was 0%. Precision for both of these analyses was acceptable.

SRM

Not applicable.

REFERENCES

ASTM D-2217. Standard Method for Wet Preparation of Soil Samples for Particle-size Analysis and Determination of Soil Constants.

ASTM D-422. Standard Method for Particle-size Analysis of Soils

ASTM D-854. Standard Method for Specific Gravity

USACE (U.S. Army Corps of Engineers). 1970. *Engineering and Design Laboratory Soils Testing*. EM-1110-2-1906, Vicksburg, Mississippi.

Plumb, R. H., Jr. 1981. *Procedure for Handling and Chemical Analysis of Sediment and Water Samples*. Tech. Rep. EPA/USACE-81-1. Prepared by Great Lakes Laboratory, State University College at Buffalo, New York, for the U.S. Environmental Protection Agency/U.S. Army Corps of Engineers Technical Committee on Criteria for Dredged and Fill Material. U.S. Army Engineer Waterways Experiment Station, Vicksburg, Mississippi.

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5
PARAMETER: Total Organic Carbon
LABORATORY: Applied Marine Sciences, Inc., College Station, Texas
MATRIX: Sediment

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Target Relative Precision</u>	<u>Detection Limit (%)</u>
EPA 1986	≤20%	≤10%	0.1

METHOD Total organic carbon is the amount of non-volatile, partially volatile, volatile, and particulate organic carbon compounds in a sample. Each sample was dried and ball milled to a fine powder. Before combustion, inorganic carbon in the sample was removed by acidification. The TOC was then determined by measuring the carbon dioxide released during combustion of the sample.

HOLDING TIMES The holding time of 6 months was met for all TOC analyses.

DETECTION LIMITS Target detection limits of 0.1% were met for all samples.

METHOD BLANKS Not applicable.

MATRIX SPIKES Not applicable.

REPLICATES Three samples were analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) among the triplicate results. RSDs were 0% and 2%, indicating acceptable precision.

SRMs The standard reference material 1941a was analyzed with each batch of analytical samples. The non-certified value for this SRM is 4.8 ± 1.2 . The SRM values obtained in each analytical batch were within this range.

REFERENCES

U.S. Environmental Protection Agency (EPA). 1986. *Determination of Total Organic Carbon in Sediment*. U.S. EPA Region II, Environmental Services Division, Monitoring Management Branch, Edison, New Jersey.

QA/QC SUMMARY

PROGRAM: New York/Federal Projects 5

PARAMETER: Metals

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Sediment

QA/QC DATA QUALITY OBJECTIVES

	<u>Reference Method</u>	<u>Range of Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Target Detection Limit (dry wt)</u>
Arsenic	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Cadmium	ICP/MS	75-125%	≤20%	≤20%	0.01mg/kg
Chromium	ICP/MS	75-125%	≤20%	≤20%	0.02 mg/kg
Copper	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Lead	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Mercury	CVAA	75-125%	≤20%	≤20%	0.02 mg/kg
Nickel	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Silver	GFAA	75-125%	≤20%	≤20%	0.1 mg/kg
Zinc	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg

METHOD

Nine metals were analyzed: silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). Hg was analyzed using cold-vapor atomic absorption spectroscopy (CVAA) according to the method of Bloom and Crecelius (1983). Ag was analyzed using graphite furnace atomic absorption (GFAA) following a modified EPA Method 200.9 (EPA 1991). The remaining metals were analyzed by inductively coupled plasma mass spectrometry (ICP/MS) following EPA Method 200.8 (EPA 1991).

To prepare sediment samples for analysis, samples were freeze-dried and blended in a Spex mixer-mill. Approximately 5 g of mixed sample was ground in a ceramic ball mill. For ICP/MS and CVAA analyses, 0.2- to 0.5-g aliquots of dried homogenous sample were digested using hot nitric acid following a modified version of EPA Method 200.2 (EPA 1991). The modification involved precluding the addition of hydrochloric acid during digestion to avoid interferences caused by the formation of argon chloride in the ICP/MS. ArCl interferes with the quantitation of As, which has the same mass.

QA/QC SUMMARY/METALS (continued)

HOLDING TIMES

Samples were received on 5/30/95 and entered into Battelle's log-in system. Samples were subsequently freeze dried (frozen to -80°C). Samples were all analyzed within 180 days of collection. The following list summarizes all analysis dates:

<u>Task</u>	<u>Date Performed</u>
Nitric Digestion	6/21/95
ICP-MS	8/31/95
CVAA-Hg	6/23/95
GFAA-Ag	7/10/95

DETECTION LIMITS

Target detection limits were exceeded for some metals; however, metals were detected above the method detection limits (MDLs) in all samples. MDLs were determined by multiplying the standard deviation of the results of a minimum of seven replicate, low-level sediment spikes by the student's t-value at the 99th percentile ($t=3.142$).

METHOD BLANKS

One method blank was included in the analysis. Ag, Cd, Cr, and Hg were detected above the MDL in the blank. Because all blank values were less than three times the MDL and all sample values were detected at greater than five times the blank concentration, no data were flagged. Data were blank corrected.

MATRIX SPIKES

One sample was spiked with all nine metals. Recoveries of all metals were within the QC limits of 75%-125% with the exception of Pb, which was recovered at 130% of the spiked concentration. This high spike recovery for Pb was most likely due to one of five replicate values which was 23% higher than the other four replicates. Thus, reported values for Pb were considered accurate.

REPLICATES

One sample was digested and analyzed in triplicate. Precision for triplicate analyses is reported by calculating the relative standard deviation (RSD) between the replicate results. RSD values ranged from 1% to 10%, within the QC limits of $\pm 20\%$, with the exception of Pb which had an RSD of 26%. Two of the three replicate values for this sample were similar with the third replicate low. No apparent analytical cause was evident.

Five replicate analyses were performed for the SRM. The Pb RSD was 10% for these five replicates. Thus, the analytical precision was considered acceptable for Pb.

QA/QC SUMMARY/METALS (continued)

SRM

SRM 1646, an estuarine sediment obtained from the National Institute of Standards and Technology (NIST), was analyzed for all metals. Results for Cd, Cu, Pb and Hg were within ± 20 % of the certified value (Ag is not certified). Values for the remaining metals were low because the digestion method used is not as strong as the method (perchloric and hydrofluoric acids) used to certify the SRM. Thus, the results for this analysis should not be expected to match the SRM certified values and no corrective actions were taken.

REFERENCES

Bloom, N. S., and E.A. Crecelius. 1983. "Determination of Mercury in Seawater at Sub-Nanogram per Liter Levels". *Mar. Chem.* 14:49-59.

EPA (U.S. Environmental Protection Agency). 1991. *Methods for the Determination of Metals in Environmental Samples*. EPA-600/4-91-010. U.S. Environmental Protection Agency, Environmental Services Division, Monitoring Management Branch, Edison New Jersey.

QA/QC SUMMARY

PROGRAM: New York/Federal Projects 5

PARAMETER: PCB Congeners/Chlorinated Pesticides

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Sediment

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>Surrogate Recovery</u>	<u>Spike Recovery</u>	<u>Relative Precision</u>	<u>Target Detection Limit (dry wt)</u>
GC/ECD	30-150%	50-120%	≤30%	1.0 µg/kg

METHOD

A 20 gram (wet wt) aliquot of sediment samples were extracted and analyzed according to a procedure similar to EPA Method 8080 for pesticides and the New York State Department of Environmental Conservation (NYSDEC) Congener-Specific Method 91-11 (NYSDEC 1992) for PCB analysis. Sediment was first combined with sodium sulfate in a sample jar to remove water. Samples were extracted by adding successive portions of methylene chloride and agitating sample jars at ambient temperature using a roller technique. Extract volumes were reduced and solvent-exchanged to hexane, followed by Florisil-column chromatography cleanup. Interferences were removed using HPLC cleanup. Sample extracts were concentrated and analyzed using GC-ECD by the internal standard technique. The column used was a J&W DB-17 and the confirmatory column was a DB-1701, both capillary columns (30m x 0.25mm I.D.).

HOLDING TIMES

Samples were received on 5/30/95 and entered into Battelle's log-in system. Samples were stored frozen at approximately -20°C until extraction. Samples were extracted on 6/22/95. Extracts were analyzed by GC/ECD from 7/13-14/95, within the established holding time of 40 days.

DETECTION LIMITS

Target detection limits were met for all PCBs and pesticides. Method detection limits (MDLs) were determined by multiplying the standard deviation of seven spiked replicates of a representative clean marine sediment by the student's t-value ($t=3.142$).

METHOD BLANKS

One method blank was extracted. No PCB congeners or pesticides were detected above the MDL in the method blank.

QA/QC SUMMARY/PCB CONGENERS/PESTICIDES (continued)

SURROGATES

Two compounds, PCB congeners 103 and 198, were added to all samples prior to extraction to assess the efficiency of the analysis. Sample surrogate recoveries were all within the QC guidelines of 30%-150%. Sample results were calculated based on surrogate recoveries.

MATRIX SPIKES

Five of the 22 congeners and 11 of the 15 pesticides were spiked into one sample. Matrix spike recoveries ranged from 84%-124%. One pesticide (4,4'-DDE at 124%) and one congener (PCB 28 at 121%) exceeded the control limit range of 50%-120%.

REPLICATES

One sample was analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. RSDs for all detectable pesticide values were below the target precision goal of $\leq 30\%$. RSDs for all detectable congeners, except PCB 28, exceeded the control limit. Two of the three replicates were similar; however, the second replicate was high. No apparent reason for this was observed and it may be due to sample nonhomogeneity.

SRMs

SRM 1941a, a marine sediment obtained from the National Institute for Science and Technology (NIST), was analyzed with the test samples. 1941a is certified for 13 of the 22 PCB congeners and 4 of the 15 pesticide compounds analyzed. All four pesticides and all but three PCB congeners were detected within 30% of the certified mean.

MISCELLANEOUS

All congener and pesticide results were confirmed using a second dissimilar column. Results for each column were required to be within a factor of two to be considered a confirmed value.

REFERENCES

NYSDEC (New York Department of Environmental Conservation). 1992. *Analytical Method for the Determination of PCB Congeners by Fused Silica Capillary Column Gas Chromatography with Electron Capture Detector*. NYSDEC Method 91-11. New York State Department of Environmental Conservation, Albany, New York.

EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D. C.

QA/QC SUMMARY

PROGRAM: New York/Federal Projects 5

PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH) and 1,4-Dichlorobenzene

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Sediment

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>MS Recovery</u>	<u>Surrogate Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Target Detection Limit (dry wt)</u>
GC/MS/SIM	50-120%	30-150%	≤30%	≤30%	10 ng/g

METHOD

Sediment samples were extracted with methylene chloride using a roller under ambient conditions, following a procedure based on methods used by the National Oceanic and Atmospheric Administration for its Status and Trends Program (NOAA 1993). Samples were then cleaned using silica/alumina (5% deactivated) chromatography followed by high performance liquid chromatography (HPLC) cleanup.

Extracts were quantified using gas chromatography/mass spectrometry (GC/MS) in the selected ion mode (SIM) following a procedure based on NOAA (1993).

HOLDING TIMES

Samples were received on 5/30/95 and were entered into Battelle's log-in system. Samples were stored frozen at approximately -20°C until extraction. Samples were extracted on 6/22/95. All extracts were analyzed by GC/MS/SIM on 7/24-25/95, within the 180-day holding time.

DETECTION LIMITS

Target detection limits of 10 ng/g dry wt were met for all PAH compounds. Method detection limits (MDLs) were determined by multiplying the standard deviation of seven spiked replicates of a background clam sample by the student's t-value ($t=3.142$).

QA/QC SUMMARY/PAHs (continued)

METHOD BLANKS

One method blank was extracted with the extraction batch. Naphthalene and benz[a]anthracene were detected in the blank. All blank levels were less than the target MDL of 10 ng/g dry weight and all sample concentrations were well above five times the blank concentration. Therefore, no data were flagged and data were not blank corrected.

SURROGATES

Five isotopically labeled compounds were added prior to extraction to assess the efficiency of the extraction method. These were d8-naphthalene, d10-acenaphthene, d12-chrysene, d14-dibenzo[a,h]anthracene and d4-1,4 dichlorobenzene. All surrogate recoveries were within the quality control limits of 30%-150% with the exception of dibenzo[a,h]anthracene in one sample (161%). All sample results are surrogate corrected.

MATRIX SPIKES

One sample was spiked with all PAH compounds. Matrix spike recoveries were within the QC limits of 50%-120%, except for a small deviation for two PAH compounds (Recoveries of chrysene and benzo[b]fluoranthene were 123% and 124%, respectively.) All recoveries were below 130% and were considered accurate.

REPLICATES

One sample was extracted and analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. RSDs ranged from 1% to 18% and were within $\pm 30\%$, indicating acceptable precision.

SRMs

SRM 1941a, a marine sediment obtained from the National Institute for Science and Technology (NIST), was analyzed with the test samples. SRM 1941a is certified for 14 of the 16 PAH compounds analyzed. Eleven of the 14 PAHs were detected within 30% of the certified mean. Three compounds, chrysene, benzo[b]fluoranthene and dibenzo[a,h]anthracene, were recovered above the certified range at recoveries ranging from 32% to 62%. These three compounds coelute with other compounds that are specific to the SRM and should not affect test sample data.

MISCELLANEOUS

For several compounds, the ion-ratio was outside of the QC range, due to low levels in the native sediment. When the native levels are low, the error associated with the concentration measurement of the confirmation ion, which is present at a fraction of the parent ion concentration, increases. Because the confirmation ion is quantified solely from the parent ion, this will not affect the quality of the data.

QA/QC SUMMARY/PAHs (continued)

REFERENCES

NOAA (National Oceanic and Atmospheric Administration). 1993. *Sampling and Analytical Methods for the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992. Volume IV. Comprehensive Descriptions of Trace Organic Analytical Methods*. G.G. Lauenstein and A. Y. Cantillo, eds. NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Coastal Monitoring and Bioeffects Assessment Division, Office of Ocean Resources Conservation and Assessment, Silver Spring, Maryland.

EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D.C.

Table A.1. Grain Size of Sediment Samples, Bronx River

Sediment Treatment	Replicate	Batch	Total Percent (dry wt)			
			Gravel >2000 μm	Sand 62.5- 2000 μm	Silt 3.9- 62.5 μm	Clay <3.9 μm
BX-1	1	1	2	19	43	36
BX-2	1	1	0	14	41	45
BX-3	1	1	0	13	45	42
BX-4	1	1	0	6	49	45
BX-5	1	1	5	19	43	33
BX-6	1	1	1	11	47	41
BX-7	1	1	3	36	40	21
BX-8	1	1	5	25	40	30
BX-9	1	1	9	27	42	22
BX-10	1	1	0	14	58	28
BX-11	1	1	27	37	25	11
BX-12	1	1	0	9	48	43
BX-13	1	1	0	12	43	45
BX-14	1	1	0	14	48	38
BX-15	1	1	30	46	17	7
MDRS ^(a)	1	1	0	97	1	2
<i>Ampelisca</i> Control	1	1	0	9	67	24
<i>Mysidopsis/Macoma</i> Control	1	1	0	23	45	32
<i>Nereis</i> Control	1	1	0	72	15	13

(a) MDRS Mud Dump Reference Site.

Table A.2. Quality Control Data for Sediment Grain Size Analysis

Sediment Treatment	Replicate	Batch	Total Percent (dry wt)			
			Gravel >2000 μm	Sand 62.4- 2000 μm	Silt 3.9- 62.4 μm	Clay <3.9 μm
SH-5 ^(a)	1	1	0	31	41	28
SH-5	2	1	0	30	38	32
SH-5	3	1	1	31	37	31
RSD (%)			NA ^(b)	2	5	7
SR-11 ^(a)	1	1	0	33	41	26
SR-11	2	1	0	31	42	27
SR-11	3	1	0	33	40	27
RSD (%)			NA	4	2	2
WC-11 ^(a)	1	1	1	12	40	47
WC-11	2	1	1	10	43	46
WC-11	3	1	1	12	42	45
RSD (%)			NA	10	4	2

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) NA Not applicable, fraction less than five percent of total.

Table A.3. Specific Gravity and Bulk Density of Sediment Samples and Quality Control Data, Bronx River

Sediment Treatment	Replicate	Batch	Bulk Density		Specific Gravity
			Wet lbs/ft ³	Dry lbs/ft ³	
BX COMP	1	1	85	35	2.57
<u>Quality Control Data</u>					
<u>Analytical Replicates</u>					
WC COMP ^(a)	1	1	81	30	2.52
WC COMP	2	1	81	31	2.51
WC COMP	3	1	81	30	2.53
RSD (%)			0	2	0

(a) Sample randomly selected for use as a quality control sample in analytical batch.

Table A.4. Total Organic Carbon (TOC) and Percentage of Moisture in Sediment Samples, Bronx River

Sediment Treatment	Replicate	Batch	TOC (% dry wt.)	Solids (%)	Moisture (%)
BX-1	1	2	5.31	49	51
BX-2	1	2	5.82	32	68
BX-3	1	2	5.53	32	68
BX-4	1	2	4.97	47	53
BX-5	1	2	8.71	36	64
BX-6	1	2	6.13	39	61
BX-7	1	2	6.14	41	59
BX-8	1	2	6.69	41	59
BX-9	1	2	5.72	45	55
BX-10	1	2	7.77	28	72
BX-11	1	2	4.46	55	45
BX-12	1	2	5.91	30	70
BX-13	1	2	5.45	33	67
BX-13	2	2	5.41	NA ^(a)	NA
BX-13	3	2	5.44	NA	NA
BX-14	1	3	6.49	31	69
BX-15	1	3	0.66	80	20
MDRS ^(b)	1	3	0.07	80	20
<i>Ampelisca</i> Control	1	3	3.35	38	62
<i>Macoma/Mysidopsis</i> Control	1	3	2.43	32	68
<i>Nereis</i> Control	1	3	5.45	49	51
<i>Nereis</i> Control	2	3	5.27	NA	NA
<i>Nereis</i> Control	3	3	5.41	NA	NA

(a) NA Not applicable.

(b) MDRS Mud Dump Reference Site.

Table A.5. Quality Control Data for Total Organic Carbon (TOC) Analysis of Sediment Samples

Sediment Treatment	Replicate	Batch	TOC (% dry wt.)
<u>Standard Reference Material</u>			
NIST 1941a	1	1	4.88
NIST 1941a	1	2	4.85
NIST 1941a	1	3	4.79
Non-Certified Value			4.80
Range			±1.2
Percent Difference		1	2
		2	1
		3	0
<u>Analytical Replicates for TOC</u>			
SR-9 ^(a)	1	1	1.46
SR-9	2	1	1.40
SR-9	3	1	1.46
RSD (%)			2
BX-13 ^(a)	1	2	5.45
BX-13	2	2	5.41
BX-13	3	2	5.44
RSD (%)			0
Nereis Control	1	3	5.45
Nereis Control	2	3	5.27
Nereis Control	3	3	5.41
RSD (%)			2

(a) Sample randomly selected for use as a quality control sample in analytical batch.

Table A.6. Quality Control Data for Percentage Moisture Analysis of Sediment Samples

Sediment Treatment	Replicate	Batch	Solids (%)	Moisture (%)
<u>Analytical Replicates for % Moisture</u>				
SH-5 ^(a)	1	1	38	62
SH-5	2	1	38	62
SH-5	3	1	38	62
RSD (%)			0	0
SR-11 ^(a)	1	1	54	46
SR-11	2	1	54	46
SR-11	3	1	54	46
RSD (%)			0	0
WC-11 ^(a)	1	1	30	70
WC-11	2	1	30	70
WC-11	3	1	30	70
RSD (%)			0	0

(a) Sample randomly selected for use as a quality control sample in analytical batch.

Table A.7. Metals in Sediment Samples, Bronx River

Sediment Treatment	Analytical Replicate Batch		(Concentration mg/kg dry wt)								
			Ag GFAA	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
Target Detection Limit:			0.1	0.1	0.01	0.02	0.1	0.02	0.1	0.1	0.1
Method Detection Limit:			0.007	0.426	0.025	0.235	0.485	0.0017	0.217	0.238	1.25
BX COMP	1	1	7.04	10.9	3.96	115	191	1.45	38.6	602	422
BX COMP	2	1	7.38	10.6	3.89	112	189	1.50	38.8	373	442
BX COMP	3	1	6.27	10.7	3.56	108	179	1.43	37.9	629	361

Table A.8. Quality Control Data for Metals Analysis of Sediment Samples

		(Concentration µg/g dry wt)									
Sediment Treatment	Analytical Replicate	Batch	Ag GFAA	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
Method Blank	1		0.019	0.426 U ^(a)	0.0281	0.398	0.485 U	0.0305	0.217 U	0.238 U	1.25 U
	2		NA ^(b)	0.426 U	0.0664	0.391	0.485 U	NA	0.217 U	0.238 U	1.25 U
	mean		NA	0.426 U	0.0473	0.395	0.485 U	NA	0.217 U	0.238 U	1.25 U
<u>Matrix Spike Results</u>											
CQ COMP ^(c)	mean		0.061	8.56	0.0547	22.4	13.7	0.0138	4.71	44.8	32.9
CQ COMP (MS)	1		5.69	13.4	5.10	70.4	59.2	4.62	10.8	110	74.3
Concentration Spiked			5.00	5.00	5.00	50.0	50.0	5.00	5.00	50.0	50.0
Concentration Recovered			5.63	4.84	5.04	48.0	45.5	4.61	6.09	65.2	41.4
Percent Recovery			113	97	101	96	91	92	122	130	83
<u>Standard Reference Material</u>											
SRM 1646	1		0.089	7.82	0.335	40.3	14.0	0.0684	22.2	20.5	88.9
	2		NA	7.57	0.416	41.8	14.6	NA	22.8	20.7	92.4
	3		NA	7.89	0.367	41.1	13.8	NA	22.2	20.3	91.8
Certified Value Range			NC ^(e)	11.6	0.36	76	18	0.063	32	28.2	138
			NC	±1.3	±0.07	±3	±3	±0.012	±3	±1.8	±6
Percent Difference	1		NA	33 ^(f)	7	47 ^(f)	22 ^(f)	9	31 ^(f)	27 ^(f)	36 ^(f)
	2		NA	35 ^(f)	15	45 ^(f)	19	NA	29 ^(f)	27 ^(f)	33 ^(f)
	3		NA	32 ^(f)	2	46 ^(f)	23 ^(f)	NA	31 ^(f)	28 ^(f)	33 ^(f)

Table A.8 (contd)

Sediment Treatment	Analytical Replicate Batch		(Concentration µg/g dry wt)								
			Ag GFAA	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
<u>Analytical Replicates</u>											
BX COMP ^(c)	1		7.04	10.9	3.96	115	191	1.48	38.6	602	422
BX COMP	2		7.38	10.6	3.89	112	189	1.54	38.8	373	442
BX COMP	3		6.27	10.7	3.56	108	179	1.46	37.9	629	361
RSD (%)			8	1	6	3	3	3	1	26 ^(g)	10

(a) U Undetected at or above given concentration.

(b) NA Not applicable.

(c) Sample randomly selected for use as a quality control sample in analytical batch.

(d) Outside quality control criteria (75-125%) for spike recovery.

(e) NC Not certified.

(f) Outside SRM quality control criteria ($\leq 20\%$).

(g) Outside quality control criteria ($\leq 20\%$) replicate analysis.

Table A.9. Pesticides and Polychlorinated Biphenyls (PCBs) in Sediment Samples, Bronx River

Sediment Treatment Analytical Replicate	Concentration ($\mu\text{g/kg}$ dry wt)
	BX COMP 1
2,4'-DDD ^(a)	24.1
2,4'-DDE	1.05 U ^(b)
2,4'-DDT	0.37 U
4,4'-DDD	51.7
4,4'-DDE	47.7
4,4'-DDT	33.7
α -Chlordane	30.6
Aldrin	14.6
Dieldrin	0.32 U
Endosulfan I	0.55 U
Endosulfan II	0.55 U
Endosulfan Sulfate	4.45
Heptachlor	0.10 U
Heptachlor Epoxide	0.48 U
Trans Nonachlor	16.3
PCB 8	0.87 U
PCB 18	151
PCB 28	0.27 U
PCB 44	44.6
PCB 49	31.1
PCB 52	57.4
PCB 66	65.5
PCB 87	16.6
PCB 101	46.0
PCB 105	24.1
PCB 118	48.8
PCB 128	9.57
PCB 138	86.7
PCB 153	77.6
PCB 170	26.1
PCB 180	57.1
PCB 183	24.3
PCB 184	0.45 U
PCB 187	44.6
PCB 195	6.39
PCB 206	10.5
PCB 209	0.48 U
<u>Surrogate Recoveries (%)</u>	
PCB 103 (SIS)	58
PCB 198 (SIS)	64

(a) Target detection limits are 1.0 $\mu\text{g/kg}$ for all analytes.

(b) U Undetected at or above given concentration.

**Table A.10. Quality Control Data for Pesticides and Polychlorinated Byphenyl (PCB)
Analysis of Sediment Samples**

Matrix Spike Results						
Sediment Treatment Analytical Replicate Batch	Method Blank	Concentration (µg/kg dry wt)				Percent Recovery
		CQ COMP ^(a)	CQ COMP (MS)	Concentration		
				Spiked	Recovered	
1	1	1				
1	1	1				
2,4'-DDD	0.26 U	0.14 U ^(b)	0.61	NS ^(c)	NA ^(d)	NA
2,4'-DDE	0.85 U	0.48 U	0.50 U	NS	NA	NA
2,4'-DDT	0.30 U	0.17 U	0.17 U	NS	NA	NA
4,4'-DDD	0.33 U	0.19 U	3.22	2.90	3.22	111
4,4'-DDE	0.18 U	0.10 U	3.59	2.90	3.59	124 ^(e)
4,4'-DDT	0.94 U	0.53 U	3.06	2.90	3.06	106
α-Chlordane	0.64 U	0.36 U	2.99	2.90	2.99	103
Aldrin	0.27 U	0.15 U	2.57	2.90	2.57	89
Dieldrin	0.26 U	0.15 U	2.58	2.90	2.58	89
Endosulfan I	0.45 U	0.25 U	2.45	2.90	2.45	84
Endosulfan II	0.45 U	0.25 U	2.46	2.90	2.46	85
Endosulfan Sulfate	0.45 U	0.25 U	2.59	2.90	2.59	89
Heptachlor	0.08 U	0.05 U	2.90	2.90	2.90	100
Heptachlor Epoxide	0.39 U	0.22 U	2.55	2.90	2.55	88
Trans Nonachlor	0.29 U	0.16 U	0.17 U	NS	NA	NA
PCB 8	0.70 U	0.39 U	0.41 U	NS	NA	NA
PCB 18	0.20 U	0.11 U	0.12 U	NS	NA	NA
PCB 28	0.22 U	0.12 U	5.09	4.21	5.09	121 ^(e)
PCB 44	0.14 U	0.08 U	0.08 U	NS	NA	NA
PCB 49	0.37 U	0.21 U	0.21 U	NS	NA	NA
PCB 52	0.65 U	0.36 U	9.38	8.78	9.38	107
PCB 66	0.30 U	0.17 U	0.21 U	NS	NA	NA
PCB 87	0.50 U	0.28 U	0.29 U	NS	NA	NA
PCB 101	0.27 U	0.15 U	6.22	5.96	6.22	104
PCB 105	0.33 U	0.19 U	0.19 U	NS	NA	NA
PCB 118	0.38 U	0.21 U	0.22 U	NS	NA	NA
PCB 128	0.21 U	0.12 U	0.12 U	NS	NA	NA
PCB 138	0.53 U	0.30 U	2.75	2.69	2.75	102
PCB 153	0.88 U	0.49 U	3.70	3.48	3.70	106
PCB 170	0.35 U	0.20 U	0.20 U	NS	NA	NA
PCB 180	0.75 U	0.42 U	0.44 U	NS	NA	NA
PCB 183	0.37 U	0.21 U	0.21 U	NS	NA	NA
PCB 184	0.37 U	0.21 U	0.21 U	NS	NA	NA
PCB 187	0.41 U	0.23 U	0.24 U	NS	NA	NA
PCB 195	0.25 U	0.14 U	0.15 U	NS	NA	NA
PCB 206	0.43 U	0.24 U	0.58	NS	NA	NA
PCB 209	0.39 U	0.22 U	2.67	NS	NA	NA
<u>Surrogate Recoveries (%)</u>						
PCB 103 (SIS)	94	47	89	NA	NA	NA
PCB 198 (SIS)	87	42	100	NA	NA	NA

Table A.10. (contd)

Sediment Treatment Analytical Replicate Batch	Standard Reference Material			Analytical Replicates			
	Concentration (µg/kg dry wt)			Concentration (µg/kg dry wt)			
	SRM	Certified	Percent	SR COMP ^(a)	SR COMP	SR COMP	RSD
	1941a	Value	Difference	1	2	3	(%)
	1			1	1	1	
2,4'-DDD	NA	NA	NA	0.66	0.17 U	0.65	NA
2,4'-DDE	0.57 U	0.73	NA	0.57 U	0.57 U	0.56 U	NA
2,4'-DDT	NA	NA	NA	0.20 U	0.20 U	0.19 U	NA
4,4'-DDD	5.41	5.06	7	0.22 U	0.22 U	0.22 U	NA
4,4'-DDE	8.38	6.59	27	2.20	1.38	2.27	25
4,4'-DDT	7.75 ^(f)	1.25 ^(g)	520	2.38	3.14	2.14	20
α-Chlordane	2.94	2.33	26	0.56	0.43 U	0.69	NA
Aldrin	NA	NA	NA	0.18 U	0.82	0.17 U	NA
Dieldrin	0.18 U	1.26 ^(g)	NA	0.18 U	0.18 U	0.17 U	NA
Endosulfan I	NA	NA	NA	0.30 U	0.30 U	0.29 U	NA
Endosulfan II	NA	NA	NA	0.30 U	0.30 U	0.29 U	NA
Endosulfan Sulfate	NA	NA	NA	0.30 U	0.30 U	0.29 U	NA
Heptachlor	NA	NA	NA	0.18	0.06 U	0.05 U	NA
Heptachlor Epoxide	NA	NA	NA	0.26 U	0.26 U	0.25 U	NA
Trans Nonachlor	1.26	1.26	0	0.20 U	0.20 U	0.19 U	NA
PCB 8	0.47 U	1.39 ^(g)	NA	0.47 U	0.47 U	0.46 U	NA
PCB 18	8.60 ^(f)	1.15 ^(g)	648	0.14 U	0.14 U	0.13 U	NA
PCB 28	0.15 U	9.80 ^(g)	NA	3.07	2.89	2.68	7
PCB 44	7.11	4.80	48 ^(h)	0.09 U	0.09 U	0.09 U	NA
PCB 49	5.91	9.50	38 ^(h)	0.27	0.83	0.24 U	NA
PCB 52	9.46	6.89	37 ^(h)	0.43 U	3.92	0.42 U	NA
PCB 66	8.74	6.80	29	2.44	0.20 U	0.20 U	NA
PCB 87	7.59	6.70	13	0.34 U	1.79	0.33 U	NA
PCB 101	12.4	11.0	13	1.25	6.76	1.37	101 ⁽ⁱ⁾
PCB 105	4.54	3.65	24	0.98	2.28	0.22 U	NA
PCB 118	9.23	10.0	8	2.04	6.31	1.96	72 ⁽ⁱ⁾
PCB 128	1.40	1.87	25	0.33	1.10	0.14 U	NA
PCB 138	11.4	13.4	15	2.36	7.77	2.44	74 ⁽ⁱ⁾
PCB 153	13.6	17.6	23	1.80	4.70	1.97	58
PCB 170	3.38	3.00	13	0.26 U	0.77	0.30	NA
PCB 180	6.89	5.83	18	0.67	1.54	0.67	52 ⁽ⁱ⁾
PCB 183	2.42	1.63 ^(g)	48	0.56	0.99	0.47	41 ⁽ⁱ⁾
PCB 184	NA	NA	NA	0.25 U	0.25 U	0.24 U	NA
PCB 187	0.28 U	7.00 ^(g)	NA	0.28 U	0.28 U	0.27 U	NA
PCB 195	NA	NA	NA	0.17 U	0.17 U	0.16 U	NA
PCB 206	3.13	3.67	15	0.29 U	0.42	0.28 U	NA
PCB 209	10.5	8.34	26	0.26 U	0.26 U	0.72	NA
Surrogate Recoveries (%)							
PCB 103 (SIS)	84	NA	NA	87	85	77	NA
PCB 198 (SIS)	81	NA	NA	99	93	84	NA

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) U Undetected at or above given concentration.

(c) NS Not spiked.

(d) NA Not applicable.

(e) Outside quality control criteria (50-120%) for spike recovery.

(f) Elevated due to interference.

(g) Non-certified value.

(h) Outside SRM quality control criteria ($\leq 30\%$).(i) Outside quality control criteria ($\leq 30\%$) for replicate analysis.

Table A.11. Polynuclear Aromatic Hydrocarbons (PAHs) in Sediment Samples, Bronx River

Sediment Treatment Analytical Replicate Batch	Concentration ($\mu\text{g/kg dry wt}$)		
	BX COMP	BX COMP	BX COMP
	1	2	3
	1	1	1
1,4-Dichlorobenzene ^(a)	248	246	254
Naphthalene	987	1020	966
Acenaphthylene	527	609	507
Acenaphthene	585	623	575
Fluorene	664	670	639
Phenanthrene	3190	3160	3020
Anthracene	1500	1560	1420
Fluoranthene	6680	6510	6460
Pyrene	7360	7330	7230
Benzo[a]anthracene	3850	3950	3780
Chrysene	4690	4640	4570
Benzo[b]fluoranthene	6040	6090	5910
Benzo[k]fluoranthene	-- ^(b)	-- ^(b)	-- ^(b)
Benzo[a]pyrene	4020	4080	3870
Indeno[123-cd]pyrene	2300	2540	3240
Dibenzo[a,h]anthracene	597	669	788
Benzo[g,h,i]perylene	2400	2620	3050
<u>Surrogate Recoveries (%)</u>			
d4 1,4-Dichlorobenzene	50	52	49
d8 Naphthalene	55	55	53
d10 Acenaphthene	61	59	57
d12 Chrysene	61	58	57
d14 Dibenzo[a,h]anthracene	161 ^(c)	69	90

(a) Target detection limit is 10 $\mu\text{g/kg}$ for all analytes (except for 1,4-Dichlorobenzene which is 1 $\mu\text{g/kg}$).

(b) Benzo(b)fluoranthene is the sum of benzo(b)fluoranthene and benzo(k)fluoranthene. Benzo(k)fluoranthene is present but could not be quantified due to co-eluting peak.

(c) Outside quality control criteria (30-150%) for surrogate recovery.

**Table A.12. Quality Control Data for Polynuclear Aromatic Hydrocarbon (PAH)
Analysis of Sediment Samples**

Sediment Treatment Analytical Replicate Batch	Matrix Spike Results					
	Blank	Concentration (µg/kg dry wt)				Percent Recovery
		CQ COMP ^(a)	CQ COMP (MS)	Concentration		
				Spiked	Recovered	
	1	1	1			
	1	1	1			
1,4-Dichlorobenzene	2.83 U	1.53 U ^(b)	1.38 ^(c)	NS ^(d)	NA ^(e)	NA
Naphthalene	8.97	5.89	30.3	23.0	24.4	106
Acenaphthylene	3.00 U	1.62 U	26.5	23.0	26.5	115
Acenaphthene	2.69 U	1.69	25.6	23.0	23.9	104
Fluorene	5.36 U	2.89 U	27.2	23.0	27.2	118
Phenanthrene	6.33 U	7.68	33.3	23.0	25.6	111
Anthracene	7.69 U	4.15 U	24.3	23.0	24.3	106
Fluoranthene	2.91 U	14.7	38.4	23.0	23.8	NA
Pyrene	2.16 U	14.8	40.3	23.0	25.5	NA
Benzo[a]anthracene	2.17 ^(c)	6.27	33.1	23.0	26.8	116
Chrysene	1.17 U	7.51	35.7	23.0	28.2	123 ^(f)
Benzo[b]fluoranthene	2.22 U	11.1	39.6	23.0	28.6	124 ^(f)
Benzo[k]fluoranthene	3.76 U	4.48	30.6	23.0	26.1	113
Benzo[a]pyrene	2.93 U	6.69	32.2	23.0	25.5	111
Indeno[123-cd]pyrene	1.34 U	5.55	25.6	23.0	20.0	87
Dibenzo[a,h]anthracene	1.70 U	2.17 ^(c)	19.9	23.0	17.8	77
Benzo[g,h,i]perylene	1.23 U	5.64	25.4	23.0	19.7	86
<u>Surrogate Recoveries (%)</u>						
d4 1,4-Dichlorobenzene	70	61	67	NA	NA	NA
d8 Naphthalene	71	61	67	NA	NA	NA
d10 Acenaphthene	68	62	67	NA	NA	NA
d12 Chrysene	76	71	77	NA	NA	NA
d14 Dibenzo[a,h]anthracene	60	41	47	NA	NA	NA

Table A.12. (contd)

Sediment Treatment Analytical Replicate Batch	Standard Reference Material			
	Concentration ($\mu\text{g/kg dry wt}$)			Percent Difference
	SRM 1941a	Certified Value	Range	
	1			
	1			
1,4-Dichlorobenzene	108	NA	NA	NA
Naphthalene	1100	1010	140	9
Acenaphthylene	63.5	37 ^(g)	14	72
Acenaphthene	45.2	41 ^(g)	10	10
Fluorene	90.9	97.3	8.6	7
Phenanthrene	503	489	23	3
Anthracene	190	184	14	3
Fluoranthene	917	981	78	7
Pyrene	756	811	24	7
Benzo[a]anthracene	438	427	25	3
Chrysene	615	380	24	62 ^(h)
Benzo[b]fluoranthene	1130	740	110	53 ^(h)
Benzo[k]fluoranthene	385	361	18	7
Benzo[a]pyrene	547	628	52	13
Indeno[123-cd]pyrene	400	501	72	20
Dibenzo[a,h]anthracene	97.9	73.9	9.7	32 ^(h)
Benzo[g,h,i]perylene	383	525	67	27
<u>Surrogate Recoveries (%)</u>				
d4 1,4-Dichlorobenzene	46	NA	NA	NA
d8 Naphthalene	52	NA	NA	NA
d10 Acenaphthene	59	NA	NA	NA
d12 Chrysene	66	NA	NA	NA
d14 Dibenzo[a,h]anthracene	37	NA	NA	NA

Table A.12. (contd)

Sediment Treatment Analytical Replicate Batch	Analytical Replicates			RSD (%)
	Concentration (µg/kg dry wt)			
	BX COMP ^(a)	BX COMP	BX COMP	
	1	2	3	
	1	1	1	
1,4-Dichlorobenzene	248	246	254	2
Naphthalene	987	1020	966	3
Acenaphthylene	527	609	507	10
Acenaphthene	585	623	575	4
Fluorene	664	670	639	3
Phenanthrene	3190	3160	3020	3
Anthracene	1500	1560	1420	5
Fluoranthene	6680	6510	6460	2
Pyrene	7360	7330	7230	1
Benzo[a]anthracene	3850	3950	3780	2
Chrysene	4690	4640	4570	1
Benzo[b]fluoranthene	6040 ⁽ⁱ⁾	6090 ⁽ⁱ⁾	5910 ⁽ⁱ⁾	2
Benzo[k]fluoranthene	-- ⁽ⁱ⁾	-- ⁽ⁱ⁾	-- ⁽ⁱ⁾	NA
Benzo[a]pyrene	4020	4080	3870	3
Indeno[123-cd]pyrene	2300	2540	3240	18
Dibenzo[a,h]anthracene	597	669	788	14
Benzo[g,h,i]perylene	2400	2620	3050	12
<u>Surrogate Recoveries (%)</u>				
d4 1,4-Dichlorobenzene	50	52	49	NA
d8 Naphthalene	55	55	53	NA
d10 Acenaphthene	61	59	57	NA
d12 Chrysene	61	58	57	NA
d14 Dibenzo[a,h]anthracene	161 ⁽ⁱ⁾	69	90	NA

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) U Undetected at or above given concentration.

(c) Ion ratio out or confirmation ion not detected.

(d) NS Not spiked.

(e) NA Not applicable.

(f) Outside quality control criteria (50-120%) for spike recovery.

(g) Non-certified value.

(h) Outside SRM quality control criteria ($\leq 30\%$).

(i) Benzo(b)fluoranthene is the sum of benzo(b)fluoranthene and benzo(k)fluoranthene.
Benzo(k)fluoranthene is present but could not be quantified due to co-eluting peak.

(j) Outside quality control criteria (30-150%) for surrogate recovery.

Appendix B

**Site Water and Elutriate Chemical Analyses and
Quality Control/Quality Assurance Data,
Bronx River Project**

QA/QC SUMMARY

PROGRAM: New York 5

PARAMETER: Metals

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Site Water/Elutriate

QA/QC DATA QUALITY OBJECTIVES

	<u>Reference Method</u>	<u>Range of Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Target Detection Limit</u>
Cadmium	ICP/MS	75-125%	≤20%	≤20%	0.025 µg/L
Chromium	GFAA	75-125%	≤20%	≤20%	1.0 µg/L
Copper	ICP/MS	75-125%	≤20%	≤20%	0.35 µg/L
Lead	ICP/MS	75-125%	≤20%	≤20%	0.35 µg/L
Mercury	CVAF	75-125%	≤20%	≤20%	0.002 µg/L
Nickel	ICP/MS	75-125%	≤20%	≤20%	0.30 µg/L
Silver	ICP/MS	75-125%	≤20%	≤20%	0.25 µg/L
Zinc	GFAA	75-125%	≤20%	≤20%	0.15 µg/L

METHOD

Eight metals were analyzed in water samples: silver (Ag), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). Hg was analyzed using cold-vapor atomic fluorescence (CVAF) according to the method of Bloom and Crecelius (1983). Cr and Zn were analyzed by graphite furnace atomic absorption (GFAA) spectrometry following the EPA Method 200.9 (EPA 1991). The remaining metals were analyzed by inductively coupled plasma mass spectrometry (ICP/MS) following a procedure based on EPA Method 200.8 (EPA 1991).

All water and elutriate samples were acidified to pH <2 upon receipt in the laboratory. Five metals, Cd, Cu, Pb, Ni and Ag, were preconcentrated by addition of a chelating agent, which resulted in precipitation of metals from the solution. The solution was then filtered and the filter digested in concentrated acid. The digestates were then analyzed by ICP/MS as described above.

QA/QC SUMMARY/METALS (continued)

HOLDING TIMES

Water samples were received on 5/12/95 and 5/17/95 in good condition. Samples were entered into Battelle's log-in system, acidified to pH<2 and held at ambient temperature until analysis. Mercury in water has a holding time of 28 days from collection to analysis. All samples were analyzed within this holding time. Samples were all analyzed for the remaining metals within 180 days of collection. The following table summarizes all analysis:

<u>Task</u>	<u>Date</u>
APDC Extraction	7/10/95
ICP-MS	7/21/95
CVAA-Hg	5/16 and 5/31/95
GFAA-Cr	5/22/95
GFAA-Zn	5/23/95

DETECTION LIMITS

Target detection limits were met for all metals, except Zn. Detection limits for Zn exceeded the target limits; however, all sample values were well above the detection limits achieved. Method detection limits (MDLs) for Ag, Cd, Cu, Hg, Ni and Pb were determined by spiking eight replicates of laboratory deionized water and multiplying the standard deviation of the resulting analysis by the student's t-value at the 99th percentile ($t=2.998$). MDLs reported for Cr and Zn were determined by taking the standard deviation of three replicate analyses of the method blank and multiplying the standard deviation by 3.

METHOD BLANKS

Procedural blanks were only generated during the APDC extraction step and only analyzed for the metals that were preconcentrated (Ag, Cd, Cu, Ni and Pb.). The reagent blank consists of the APDC reagents only. Two reagent blanks were analyzed. Pb was detected in one of the reagent blanks, and Ni was detected in both of the reagent blanks. Both Pb and Ni were detected at concentrations ≥ 10 times that of reagent contamination.

The blanks reported for Hg, Cr and Zn (the metals analyzed on waters directly) consisted of solutions, including modifiers for the Zn-GFAA analyses, which were used to dilute all samples for analysis. Zn and Cr were detected in the blank. Both were present at less than three times the MDL. All data are corrected for the blank concentrations (or the mean of multiple blanks).

QA/QC SUMMARY/METALS (continued)

MATRIX SPIKES

Selected samples were spiked with metals at different concentrations. The APDC metals were spiked prior to sample processing, and the metals analyzed by GFAA and CVAF were spiked just prior to analysis. All recoveries were within the QC limits of 75%-125% with the exception of Cd (73%) and Pb (69%) in both APDC spikes.

REPLICATES

Each site water sample was analyzed in triplicate. Precision for triplicate analyses is reported by calculating the relative standard deviation (RSD) between the replicate results. RSD values were all within the QC limits of $\pm 20\%$ with the exception of Cd in three samples and Ag and Ni in one sample. Cd RSD exceedances ranged from 37% to 64% and Ag and Ni RSD exceedances were both at 21%. These were primarily due to one replicate that was comparatively high, and should not affect sample precision.

SRM

SRM SLRS-3, a certified riverine water sample from the National Research Council of Canada (NRCC), was analyzed for all metals, with the exception of Ag and Hg, which are not certified in this SRM. Cr, Cu and Zn were recovered within $\pm 20\%$ of mean certified value. Ni and Pb recoveries were 23% and 42%, respectively. Cd was detected at over 10 times the certified value, most likely a result of SRM contamination. However, no Cd was detected in the APDC reagent blank; therefore, sample analyses should not be compromised.

A second SRM, 1643c, a freshwater sample from NIST, was analyzed for Cr and Zn, which were recovered within the control limits of $\pm 20\%$ of mean certified value.

In addition, 1641b, a freshwater sample from NIST, was analyzed twice for Hg. Results were within $\pm 20\%$ of mean certified value.

REFERENCES

Bloom, N. S., and E.A. Crecelius. 1983. Determination of Mercury in Seawater at Sub-Nanogram per Liter Levels. Mar. Chem. 14:49-59.

EPA (U.S. Environmental Protection Agency). 1991. Methods for the Determination of Metals in Environmental Samples. EPA-600/4-91-010. U.S. Environmental Protection Agency, Environmental Services Division, Monitoring Management Branch.

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5
PARAMETER: PCB Congeners/Chlorinated Pesticides
LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington
MATRIX: Site Water/Elutriate

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>Surrogate Recovery</u>	<u>Spike Recovery</u>	<u>Relative Precision</u>	<u>Target Detection Limit</u>
GC/ECD	30-150%	50-120%	≤30%	1.0 ng/L

METHOD One liter of water was extracted with methylene chloride in a separatory funnel following a procedure based on methods used by the National Oceanic and Atmospheric Administration for its Status and Trends Program (NOAA 1993). Sample extracts were then cleaned using silica/alumina (5% deactivated) chromatography followed by high performance liquid chromatography (HPLC) cleanup. Extracts were analyzed for 15 chlorinated pesticides and 22 individual PCB congeners using gas chromatography/electron capture detection (GC/ECD) following a procedure based on EPA Method 8080 (EPA 1986). The column used was a J&W DB-17 and the confirmatory column was a DB-1701, both capillary columns (30m x 0.25mm I.D.).

HOLDING TIMES Water samples were received on 5/12/95 and 5/17/95 in good condition. Samples were entered into Battelle's log-in system and stored cold (4°C) until extraction. Samples were extracted on 5/16/95. Extracts were analyzed by GC/ECD from 5/28 through 5/29/95, within the established holding time of 40 days.

DETECTION LIMITS Target detection limits were met for all PCBs and pesticides. Method detection limits (MDLs) were determined by multiplying the standard deviation of seven spiked replicates of a representative clean Sequim Bay water sample by the student's t-value ($t=3.142$).

QA/QC SUMMARY/PCB CONGENERS/PESTICIDES (continued)

- METHOD BLANKS** One method blank was extracted. No PCB congeners or pesticides were detected above the MDL in the method blank.
- SURROGATES** Two compounds, PCB congeners 103 and 198, were added to all samples prior to extraction to assess the efficiency of the analysis. Sample surrogate recoveries were all within the QC guidelines of 30%-150%. Note that all sample values are calculated based on the recovery of the surrogate compounds.
- MATRIX SPIKES** Five out of the 22 congeners and 11 of the 15 pesticides were spiked into one sample. Matrix spike recoveries ranged from 61%-110%, all within the control limit range of 50%-120%.
- REPLICATES** All samples were analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. Only one PCB congener and only 4,4'-DDE and dieldrin were detected above the MDL. RSDs for all detectable values were below the target precision goal of $\leq 30\%$ indicating acceptable precision with the exception of 4,4'-DDE (91%) in one replicate and dieldrin (31%) in one replicate. The high RSD value for 4,4'-DDE was due to matrix interference in one replicate. The elevated value reported is flagged and should be considered an estimate.
- SRMs** An SRM is not available for organics in water.
- MISCELLANEOUS** All congener and pesticide results are confirmed using a second dissimilar column. Results for each column must be within a factor of two of the other to be considered a confirmed value. All values were within a factor of two.

REFERENCES

- NOAA (National Oceanic and Atmospheric Administration). 1993. *Sampling and Analytical Methods for the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992. Volume IV. Comprehensive Descriptions of Trace Organic Analytical Methods*. G.G. Lauenstein and A. Y. Cantillo, eds. NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Coastal Monitoring and Bioeffects Assessment Division, Office of Ocean Resources Conservation and Assessment, Silver Spring, Maryland.
- EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D. C.

Table B.1. Metals in Site Water Samples, Bronx River

Sediment Treatment	Analytical Replicate	Batch	Concentration (µg/L)							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAf	Ni ICP/MS	Pb ICP/MS	Zn GFAA
Target Detection Limit:			0.25	0.025	1.0	0.35	0.002	0.30	0.35	0.15
Method Detection Limit:			0.018	0.003	0.063	0.021	0.00007	0.028	0.011	0.269
BX-14	1	1	0.0732	0.0754	1.12	5.60	0.0162	1.70	2.88	19.9
BX-14	2	1	0.0830	0.0797	1.16	5.82	0.0162	1.73	3.19	20.6
BX-14	3	1	0.0747	0.0652	1.19	4.85	0.0136	1.49	2.77	20.2
Sequim Bay Water		1	0.018 U ^(a)	0.0666	0.69	0.607	NA ^(b)	0.455	0.011 U	1.61

(a) U Undetected at or above given concentration.

(b) NA Not analyzed.

Table B.2. Quality Control Data for Metals Analysis of Site Water Samples

Sediment Treatment	Analytical Replicate	Batch	Concentration (µg/L) Blank Corrected							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA
Reagent Blank	1	1	0.018 U ^(a)	0.003 U	NA ^(b)	0.021 U	NA	0.0432	0.0261	NA
	2	1	0.018 U	0.003 U	NA	0.021 U	NA	0.0301	0.011 U	NA
	Mean		0.018 U	0.003 U	NA	0.021 U	NA	0.0367	0.0131	NA
Direct Blank	1	1	NA	NA	0.108	NA	0.000384	NA	NA	0.63
	2	1	NA	NA	NA	NA	0.000355	NA	NA	NA
<u>Matrix Spike Results</u>										
SH-8 ^(c)	Mean	1	NS ^(d)	NS	3.72	NS	NS	NS	NS	NS
SH-8 (MS)		1	NS	NS	4.81	NS	NS	NS	NS	NS
Concentration Spiked			NS	NS	0.97	NS	NS	NS	NS	NS
Concentration Recovered			NS	NS	1.09	NS	NS	NS	NS	NS
Percent Recovery			NS	NS	112	NS	NS	NS	NS	NS
B2 SR-4 ^(c)		1	NS	NS	NS	NS	0.0101	NS	NS	8.40
		1	NS	NS	NS	NS	0.0342	NS	NS	16.8
			NS	NS	NS	NS	0.0207	NS	NS	8.91
			NS	NS	NS	NS	0.0241	NS	NS	8.38
			NS	NS	NS	NS	116	NS	NS	94
Sequim Bay SW		1	0.018 U	0.0666	NS	0.607	NS	0.455	0.011 U	NS
Sequim Bay SW (MS)	1	1	0.880	0.793	NS	1.52	NS	1.31	0.694	NS
Concentration Spiked			1.00	1.00	NS	1.00	NS	1.00	1.00	NS
Concentration Recovered			0.880	0.726	NS	0.913	NS	0.858	0.694	NS
Percent Recovery			88	73	NS	91	NS	86	69 ^(e)	NS
Sequim Bay SW		1	0.018 U	0.0666	NS	0.607	NS	0.455	0.011 U	NS
Sequim Bay SW (MS)	2	1	0.821	0.89	NS	1.53	NS	1.24	0.691	NS
Concentration Spiked			1.00	1.00	NS	1.00	NS	1.00	1.00	NS
Concentration Recovered			0.821	0.823	NS	0.923	NS	0.788	0.691	NS
Percent Recovery			82	82	NS	92	NS	79	69 ^(e)	NS

Table B.2. (contd)

Sediment Treatment	Analytical Replicate	Batch	Concentration (µg/L) Blank Corrected							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA
BR-14 ^(c)		1	NS	NS	NS	NS	0.0153	NS	NS	NS
BR-14 (MS)	1	1	NS	NS	NS	NS	0.0354	NS	NS	NS
Concentration Spiked			NS	NS	NS	NS	0.0213	NS	NS	NS
Concentration Recovered			NS	NS	NS	NS	0.0201	NS	NS	NS
Percent Recovery			NS	NS	NS	NS	94	NS	NS	NS
<u>Standard Reference Material</u>										
SLRS-3	1	1	0.013	0.221	0.27	1.28	NA	0.638	0.0394	1.09
Certified Value			NC ^(f)	0.013	0.30	1.35		0.83	0.068	1.04
Range				±0.002	±0.04	±0.07		±0.08	±0.007	±0.09
Percent Difference			NA	1600 ^(g)	10	5	NA	23 ^(g)	42 ^(g)	5
1643c	1	1	NA	NA	18.7	NA	NA	NA	NA	82.9
Certified Value					19.0					73.9
Range					±0.6					±0.9
Percent Difference			NA	NA	2	NA	NA	NA	NA	12
1641b	1	1	NA	NA	NA	NA	1600	NA	NA	NA
Certified Value							1520			
Range							±40			
Percent Difference			NA	NA	NA	NA	5	NA	NA	NA
<u>Analytical Replicates</u>										
SH-8 ^(c)	1	1	0.147	0.108	3.65	8.75	0.0720	2.85	4.72	25.5
SH-8	2	1	0.150	0.0946	3.87	8.14	0.0744	2.61	4.77	23.2
SH-8	3	1	0.153	0.272	3.65	7.95	0.0699	2.40	4.49	23.6
RSD (%)			2	62 ^(h)	3	5	3	9	3	5

B.3

Table B.2. (contd)

Sediment Treatment	Analytical Replicate	Batch	Concentration (µg/L) Blank Corrected							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA
SR-4 ^(c)	1	1	0.025	0.0500	1.48	1.97	0.00917	1.03	1.12	8.52
SR-4	2	1	0.028	0.0529	1.45	1.98	0.0103	1.05	1.09	8.97
SR-4	3	1	0.0232	0.0466	1.41	2.02	0.0110	1.01	1.05	7.71
RSD (%)			9	6	2	1	9	2	3	8
CR-5 ^(c)	1	1	0.036	0.0698	1.52	4.55	0.0131	1.91	2.12	10.3
CR-5	2	1	0.037	0.164	1.34	4.21	0.0141	1.80	2.08	11.9
CR-5	3	1	0.0245	0.0511	1.45	3.17	0.0152	1.27	1.52	11.1
RSD (%)			21 ^(h)	64 ^(h)	6	18	7	21 ^(h)	18	7
WC-8 ^(c)	1	1	0.166	0.374	2.50	6.42	0.0375	1.66	3.59	22.8
WC-8	2	1	0.189	0.168	2.50	5.89	0.0377	1.61	3.47	23.1
WC-8	3	1	0.168	0.299	2.42	6.04	0.0368	1.69	3.69	23.0
RSD (%)			7	37 ^(h)	2	4	1	2	3	1
BR-14 ^(c)	1	1	0.073	0.0754	1.12	5.60	0.0162	1.70	2.88	19.9
BR-14	2	1	0.0830	0.0797	1.16	5.82	0.0162	1.73	3.19	20.6
BR-14	3	1	0.075	0.0652	1.19	4.85	0.0136	1.49	2.77	20.2
RSD (%)			7	10	3	9	10	8	7	2

(a) U Undetected at or above given concentration.

(b) NA Not applicable.

(c) Sample randomly selected for use as a quality control sample in analytical batch.

(d) NS Not spiked.

(e) Outside quality control criteria (75-125%) for spike recovery.

(f) NC Not certified.

(g) Outside SRM quality control criteria ($\leq 20\%$).(h) Outside quality control criteria ($\leq 20\%$) for replicate analysis.

Table B.3. Metals in Elutriate Samples, Bronx River

Sediment Treatment	Analytical Replicate	Batch	Concentration (µg/L)							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA

Table B.4. Quality Control Data for Metals Analysis of Elutriate Samples

Sediment Treatment	Analytical Replicate	Batch	Concentration (µg/L)							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA
Reagent Blank	1	1	0.018 U ^(a)	0.003 U	NA ^(b)	0.0380	NA	0.0511	0.0170	NA
	2	1	0.018 U	0.003 U	NA	0.0235	NA	0.0610	0.011 U	NA
	Mean		0.018 U	0.003 U	NA	0.0308	NA	0.0561	0.0085	NA
Direct Blank		1	NA	NA	0.082 U	NA	0.00036	NA	NA	0.63
<u>Matrix Spike Results</u>										
SH COMP ^(c)	Mean	1	NS ^(d)	NS	0.58	NS	NS	NS	NS	2.33
SH COMP (MS)		1	NS	NS	3.02	NS	NS	NS	NS	11.4
Concentration Spiked			NS	NS	2.39	NS	NS	NS	NS	8.91
Concentration Recovered			NS	NS	2.44	NS	NS	NS	NS	9.07
Percent Recovery			NS	NS	102	NS	NS	NS	NS	102
WC COMP ^(c)	Mean	1	0.0592	0.0327	NS	3.53	NS	1.34	1.61	NS
WC COMP (MS)		1	1.03	0.547	NS	5.84	NS	2.01	2.41	NS
Concentration Spiked			1.00	1.00	NS	1.00	NS	1.00	1.00	NS
Concentration Recovered			0.971	0.514	NS	2.31	NS	0.670	0.800	NS
Percent Recovery			97	51 ^(e)	NS	231 ^(e)	NS	67 ^(e)	80	NS
SR COMP ^(c)	Mean	1	NS	NS	NS	NS	0.00246	NS	NS	NS
SR COMP (MS)		1	NS	NS	NS	NS	0.0276	NS	NS	NS
Concentration Spiked			NS	NS	NS	NS	0.0230	NS	NS	NS
Concentration Recovered			NS	NS	NS	NS	0.0251	NS	NS	NS
Percent Recovery			NS	NS	NS	NS	109	NS	NS	NS

Table B.4. (contd)

Sediment Treatment	Replicate	Batch	Concentration (µg/L)							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA
<u>Standard Reference Material</u>										
CASS-3	1	1	0.0033	0.034	NA	0.520	NA	0.362	0.00440	NA
Certified Value			NC ⁽ⁿ⁾	0.030	NA	0.517	NA	0.386	0.012	NA
Range				±0.005		±0.062		±0.062	±0.004	
Percent Difference			NA	13	NA	1	NA	6	63 ^(g)	NA
SLEW2	1	1	0.0017	0.018	NA	1.42	NA	0.617	0.0138	NA
Certified Value			NC	0.019	NA	1.62	NA	0.709	0.027	NA
Range				±0.002		±0.11		±0.054	±0.005	
Percent Difference			NA	5	NA	12	NA	13	49 ^(g)	NA
1643c	1	1	2.27	12.4	21.7	23.2	NA	64.1	33.6	72.6
	2	1	2.13	12.3	NA	23.1	NA	64.3	40.6	NA
Certified Value			2.21	12.2	19.0	22.3	NA	60.6	35.3	73.9
Range			±0.30	±1.0	±0.6	±2.8		±7.3	±0.9	±0.9
Percent Difference	1		3	2	14	4	NA	6	5	2
	2		4	1	NA	3	NA	6	15	NA
1641c	1	1	NA	NA	NA	NA	1510	NA	NA	NA
Certified Value			NA	NA	NA	NA	1470	NA	NA	NA
Range							±40			
Percent Difference			NA	NA	NA	NA	3	NA	NA	NA

Table B.4. (contd)

Sediment Treatment	Replicate Batch		Concentration (µg/L)							
			Ag ICP/MS	Cd ICP/MS	Cr GFAA	Cu ICP/MS	Hg CVAF	Ni ICP/MS	Pb ICP/MS	Zn GFAA
<u>Analytical Replicates</u>										
SH COMP ^(c)	1	1	0.018 U	0.027	0.58	0.999	0.00905	1.85	0.255	1.99
SH COMP	2	1	0.018 U	0.024	0.60	1.04	0.00884	1.97	0.304	2.72
SH COMP	3	1	0.018 U	0.026	0.55	1.11	0.00867	1.94	0.329	2.27
RSD (%)			NA	7	4	5	2	3	13	16
WC COMP ^(c)	1	1	0.060	0.024	1.44	3.54	0.0109	1.32	1.62	3.53
WC COMP	2	1	0.063	0.049	1.29	3.65	0.0108	1.36	1.65	3.63
WC COMP	3	1	0.055	0.026	1.42	3.41	0.00958	1.34	1.56	2.72
RSD (%)			7	43 ^(h)	6	3	7	1	3	15
SR COMP ^(c)	1	1	0.018 U	0.037	0.16	0.398	0.00251	0.559	0.222	1.36
SR COMP	2	1	0.018 U	0.043	0.24	0.376	0.00250	0.553	0.273	1.36
SR COMP	3	1	0.018 U	0.034	0.22	0.385	0.00238	0.535	0.258	1.00
RSD (%)			NA	13	20	3	3	2	10	17
BX COMP ^(c)	1	1	0.060	0.057	1.24	4.47	0.0159	1.22	2.33	8.25
BX COMP	2	1	0.132	0.054	1.26	4.54	0.0138	1.20	2.48	9.15
BX COMP	3	1	0.067	0.046	1.13	4.62	0.0143	1.00	1.88	6.98
RSD (%)			46 ^(h)	11	6	2	7	11	14	13

(a) U Undetected at or above given concentration.

(b) NA Not applicable.

(c) Sample randomly selected for use as a quality control sample in analytical batch.

(d) NS Not spiked.

(e) Outside quality control criteria (75-125%) for spike recovery.

(f) NC Not certified.

(g) Outside SRM quality control criteria (<20%).

(h) Outside quality control criteria (±20%) for replicate analysis.

**Table B.5. Pesticides and Polychlorinated Biphenyls (PCBs)
in Site Water Samples, Bronx River**

Sediment Treatment Replicate	Concentration (ng/L)			Sequim Bay Water
	BX-14	BX-14	BX-14	
Sample Size (L)	1	2	3	1
Batch	1.07	1.07	1.07	1.00
	1	1	1	1
2,4'-DDD ^(a)	0.93 U ^(b)	0.93 U	0.93 U	1.00 U
2,4'-DDE	0.23 U	0.23 U	0.23 U	0.24 U
2,4'-DDT	0.43 U	0.43 U	0.43 U	0.46 U
4,4'-DDD	0.44 U	0.44 U	4.71	0.48 U
4,4'-DDE	2.63	2.35	3.48	0.29 U
4,4'-DDT	0.40 U	0.40 U	4.79	0.43 U
α-Chlordane	0.82 U	0.82 U	0.82 U	0.88 U
Aldrin	0.38 U	0.38 U	0.38 U	0.41 U
Dieldrin	2.77	2.82	4.62	0.13 U
Endosulfan I	0.46 U	0.46 U	0.46 U	0.49 U
Endosulfan II	0.46 U	0.46 U	0.46 U	0.49 U
Endosulfan Sulfate	0.46 U	0.46 U	0.46 U	0.49 U
Heptachlor	0.46 U	0.46 U	0.46 U	0.50 U
Heptachlor Epoxide	0.11 U	0.11 U	1.52	0.12 U
Trans Nonachlor	1.10 U	1.10 U	1.10 U	1.18 U
PCB 8	0.98 U	0.98 U	0.98 U	1.06 U
PCB 18	1.54	1.04 U	1.04 U	1.12 U
PCB 28	0.70 U	0.70 U	0.70 U	0.75 U
PCB 44	0.30 U	0.30 U	0.30 U	0.33 U
PCB 49	0.53 U	0.53 U	0.53 U	0.57 U
PCB 52	0.35 U	0.35 U	0.35 U	0.38 U
PCB 66	0.38 U	0.38 U	0.38 U	0.41 U
PCB 87	0.35 U	0.35 U	0.35 U	0.38 U
PCB 101	0.48 U	0.48 U	0.48 U	0.52 U
PCB 105	0.29 U	0.29 U	0.29 U	0.32 U
PCB 118	0.46 U	0.46 U	0.46 U	0.50 U
PCB 128	0.24 U	0.24 U	0.24 U	0.26 U
PCB 138	0.34 U	0.34 U	0.34 U	0.36 U
PCB 153	0.44	0.41	0.44	0.42 U
PCB 170	0.20 U	0.20 U	0.20 U	0.21 U
PCB 180	0.27 U	0.27 U	0.27 U	0.29 U
PCB 183	0.53 U	0.53 U	0.53 U	0.57 U
PCB 184	0.53 U	0.53 U	0.53 U	0.57 U
PCB 187	0.38 U	0.38 U	0.38 U	0.41 U
PCB 195	0.27 U	0.27 U	0.27 U	0.29 U
PCB 206	0.39 U	0.39 U	0.39 U	0.42 U
PCB 209	0.27 U	0.27 U	0.27 U	0.29 U
Surrogate Recoveries (%)				
PCB 103 (SIS)	81	82	86	75
PCB 198 (SIS)	127	121	126	85

(a) Target detection limits range from 0.5 ng/L to 100 ng/L for all analytes.

(b) U Undetected at or above given concentration.

Table B.6. Quality Control Data for Pesticide and Polychlorinated Biphenyl (PCB) Analysis
in Site Water

		Matrix Spike Results				
		Concentration (ng/L)				
Sediment Treatment	Method Blank	Sequim Bay Water	Sequim Bay Water	Concentration		Percent
Replicate	1	1	(MS)	Spiked	Recovered	Recovery
Sample Size (L)	1.00	1.00	1.00			
Batch	1	1	1			
2,4'-DDD	1.00 U ^(a)	1.00 U	NS ^(b)	NS	NA ^(c)	NA
2,4'-DDE	0.24 U	0.24 U	NS	NS	NA	NA
2,4'-DDT	0.46 U	0.46 U	NS	NS	NA	NA
4,4'-DDD	0.48 U	0.48 U	12.3	12.5	12.3	98
4,4'-DDE	0.29 U	0.29 U	10.4	12.5	10.4	83
4,4'-DDT	0.43 U	0.43 U	13.0	12.5	13.0	104
α-Chlordane	0.88 U	0.88 U	8.83	12.5	8.83	71
Aldrin	0.41 U	0.41 U	7.68	12.5	7.68	61
Dieldrin	0.13 U	0.13 U	11.6	12.5	11.6	93
Endosulfan I	0.49 U	0.49 U	11.3	12.5	11.3	91
Endosulfan II	0.49 U	0.49 U	11.7	12.5	11.7	93
Endosulfan Sulfate	0.49 U	0.49 U	13.3	12.5	13.3	106
Heptachlor	0.50 U	0.50 U	8.44	12.5	8.44	68
Heptachlor Epoxide	0.12 U	0.12 U	11.6	12.5	11.6	93
Trans Nonachlor	1.18 U	1.18 U	NS	NS	NA	NA
PCB 8	1.06 U	1.06 U	NS	NS	NA	NA
PCB 18	1.12 U	1.12 U	NS	NS	NA	NA
PCB 28	0.75 U	0.75 U	17.5	15.9	17.5	110
PCB 44	0.33 U	0.33 U	NS	NS	NA	NA
PCB 49	0.57 U	0.57 U	NS	NS	NA	NA
PCB 52	0.38 U	0.38 U	32.4	32.3	32.4	101
PCB 66	0.41 U	0.41 U	NS	NS	NA	NA
PCB 87	0.38 U	0.38 U	NS	NS	NA	NA
PCB 101	0.52 U	0.52 U	24.9	22.6	24.9	110
PCB 105	0.32 U	0.32 U	NS	NS	NA	NA
PCB 118	0.50 U	0.50 U	NS	NS	NA	NA
PCB 128	0.26 U	0.26 U	NS	NS	NA	NA
PCB 138	0.36 U	0.36 U	10.6	10.2	10.6	104
PCB 153	0.42 U	0.42 U	13.8	13.2	13.8	105
PCB 170	0.21 U	0.21 U	NS	NS	NA	NA
PCB 180	0.29 U	0.29 U	NS	NS	NA	NA
PCB 183	0.57 U	0.57 U	NS	NS	NA	NA
PCB 184	0.57 U	0.57 U	NS	NS	NA	NA
PCB 187	0.41 U	0.41 U	NS	NS	NA	NA
PCB 195	0.29 U	0.29 U	NS	NS	NA	NA
PCB 206	0.42 U	0.42 U	NS	NS	NA	NA
PCB 209	0.29 U	0.29 U	NS	NS	NA	NA
<u>Surrogate Recoveries (%)</u>						
PCB 103 (SIS)	77	75	92	NA	NA	NA
PCB 198 (SIS)	92	85	92	NA	NA	NA

Table B.6. (contd)

Sediment Treatment Replicate Sample Size (L) Batch	Analytical Replicates							
	Concentration (ng/L)			RSD (%)	Concentration (ng/L)			RSD (%)
	SH-8 ^(a)	SH-8	SH-8		SR-4 ^(a)	SR-4	SR-4	
	1	2	3		1	2	3	
	1.04	1.07	1.07		1.07	1.07	1.07	
	1	1	1		1	1	1	
2,4'-DDD	0.96 U	0.93 U	0.93 U	NA	0.93 U	0.93 U	0.94 U	NA
2,4'-DDE	0.24 U	0.23 U	0.23 U	NA	0.23 U	0.23 U	0.23 U	NA
2,4'-DDT	0.44 U	0.43 U	0.43 U	NA	0.43 U	0.43 U	0.44 U	NA
4,4'-DDD	0.46 U	0.44 U	0.44 U	NA	0.44 U	0.44 U	0.45 U	NA
4,4'-DDE	2.99	3.17	13.3 ^(e)	91 ^(f)	2.50	3.45	2.72	17
4,4'-DDT	0.41 U	0.40 U	0.40 U	NA	0.40 U	0.40 U	0.40 U	NA
α -Chlordane	0.84 U	0.82 U	0.82 U	NA	0.82 U	0.82 U	0.83 U	NA
Aldrin	0.40 U	0.38 U	0.38 U	NA	0.38 U	0.38 U	0.39 U	NA
Dieldrin	0.13 U	0.12 U	0.12 U	NA	0.12 U	0.12 U	0.12 U	NA
Endosulfan I	0.47 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.46 U	NA
Endosulfan II	0.47 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.46 U	NA
Endosulfan Sulfate	0.47 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.46 U	NA
Heptachlor	0.48 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.47 U	NA
Heptachlor Epoxide	0.11 U	0.11 U	0.11 U	NA	0.11 U	0.11 U	0.11 U	NA
Trans Nonachlor	1.13 U	1.10 U	1.10 U	NA	1.10 U	1.10 U	1.11 U	NA
PCB 8	1.02 U	0.98 U	0.98 U	NA	0.98 U	0.98 U	1.00 U	NA
PCB 18	1.08 U	1.04 U	1.04 U	NA	1.04 U	1.04 U	1.05 U	NA
PCB 28	0.72 U	0.70 U	0.70 U	NA	0.70 U	0.70 U	0.71 U	NA
PCB 44	0.31 U	0.30 U	0.30 U	NA	0.30 U	0.30 U	0.31 U	NA
PCB 49	0.55 U	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U	NA
PCB 52	0.36 U	0.35 U	0.35 U	NA	0.35 U	0.35 U	0.35 U	NA
PCB 66	0.39 U	0.38 U	0.38 U	NA	0.38 U	0.38 U	0.38 U	NA
PCB 87	0.36 U	0.35 U	0.35 U	NA	0.35 U	0.35 U	0.35 U	NA
PCB 101	0.50 U	0.48 U	0.48 U	NA	0.48 U	0.48 U	0.48 U	NA
PCB 105	0.30 U	0.29 U	0.29 U	NA	0.29 U	0.29 U	0.30 U	NA
PCB 118	0.48 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.47 U	NA
PCB 128	0.25 U	0.24 U	0.24 U	NA	0.24 U	0.24 U	0.24 U	NA
PCB 138	0.35 U	0.34 U	0.34 U	NA	0.34 U	0.34 U	0.34 U	NA
PCB 153	0.40 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.39 U	NA
PCB 170	0.20 U	0.20 U	0.20 U	NA	0.20 U	0.20 U	0.20 U	NA
PCB 180	0.28 U	0.27 U	0.27 U	NA	0.27 U	0.27 U	0.27 U	NA
PCB 183	0.55 U	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U	NA
PCB 184	0.55 U	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U	NA
PCB 187	0.39 U	0.38 U	0.38 U	NA	0.38 U	0.38 U	0.39 U	NA
PCB 195	0.28 U	0.27 U	0.27 U	NA	0.27 U	0.27 U	0.27 U	NA
PCB 206	0.40 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.39 U	NA
PCB 209	0.28 U	0.27 U	0.27 U	NA	0.27 U	0.27 U	0.27 U	NA
<u>Surrogate Recoveries (%)</u>								
PCB 103 (SIS)	84	82	84	NA	81	82	69	NA
PCB 198 (SIS)	102	113	112	NA	102	95	82	NA

Table B.6. (contd)

Sediment Treatment Replicate Sample Size (L) Batch	Analytical Replicates							
	Concentration (ng/L)				Concentration (ng/L)			
	WC-8 ^(a)	WC-8	WC-8	RSD (%)	BX-14 ^(a)	BX-14	BX-14	RSD (%)
	1	2	3		1	2	3	
	1.06	1.07	1.06		1.07	1.07	1.07	
	1	1	1		1	1	1	
2,4'-DDD	0.94 U	0.93 U	0.94 U	NA	0.93 U	0.93 U	0.93 U	NA
2,4'-DDE	0.23 U	0.23 U	0.23 U	NA	0.23 U	0.23 U	0.23 U	NA
2,4'-DDT	0.44 U	0.43 U	0.44 U	NA	0.43 U	0.43 U	0.43 U	NA
4,4'-DDD	0.45 U	0.44 U	0.45 U	NA	0.44 U	0.44 U	4.71	NA
4,4'-DDE	2.98	2.45	3.49	17	2.63	2.35	3.48	21
4,4'-DDT	0.40 U	0.40 U	0.40 U	NA	0.40 U	0.40 U	4.79	NA
α -Chlordane	0.83 U	0.82 U	0.83 U	NA	0.82 U	0.82 U	0.82 U	NA
Aldrin	0.39 U	0.38 U	0.39 U	NA	0.38 U	0.38 U	0.38 U	NA
Dieldrin	0.12 U	0.12 U	0.12 U	NA	2.77	2.82	4.62	31 ^(f)
Endosulfan I	0.46 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.46 U	NA
Endosulfan II	0.46 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.46 U	NA
Endosulfan Sulfate	0.46 U	0.46 U	0.46 U	NA	0.46 U	0.46 U	0.46 U	NA
Heptachlor	0.47 U	0.46 U	0.47 U	NA	0.46 U	0.46 U	0.46 U	NA
Heptachlor Epoxide	0.11 U	0.11 U	0.11 U	NA	0.11 U	0.11 U	1.52	NA
Trans Nonachlor	1.11 U	1.10 U	1.11 U	NA	1.10 U	1.10 U	1.10 U	NA
PCB 8	1.00 U	0.98 U	1.00 U	NA	0.98 U	0.98 U	0.98 U	NA
PCB 18	1.05 U	1.04 U	1.05 U	NA	1.54	1.04 U	1.04 U	NA
PCB 28	0.71 U	0.70 U	0.71 U	NA	0.70 U	0.70 U	0.70 U	NA
PCB 44	0.31 U	0.30 U	0.31 U	NA	0.30 U	0.30 U	0.30 U	NA
PCB 49	0.53 U	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U	NA
PCB 52	0.35 U	0.35 U	0.35 U	NA	0.35 U	0.35 U	0.35 U	NA
PCB 66	0.38 U	0.38 U	0.38 U	NA	0.38 U	0.38 U	0.38 U	NA
PCB 87	0.35 U	0.35 U	0.35 U	NA	0.35 U	0.35 U	0.35 U	NA
PCB 101	0.48 U	0.48 U	0.48 U	NA	0.48 U	0.48 U	0.48 U	NA
PCB 105	0.30 U	0.29 U	0.30 U	NA	0.29 U	0.29 U	0.29 U	NA
PCB 118	0.47 U	0.46 U	0.47 U	NA	0.46 U	0.46 U	0.46 U	NA
PCB 128	0.24 U	0.24 U	0.24 U	NA	0.24 U	0.24 U	0.24 U	NA
PCB 138	0.34 U	0.34 U	0.34 U	NA	0.34 U	0.34 U	0.34 U	NA
PCB 153	0.39 U	0.39 U	0.39 U	NA	0.44	0.41	0.44	4
PCB 170	0.20 U	0.20 U	0.20 U	NA	0.20 U	0.20 U	0.20 U	NA
PCB 180	0.27 U	0.27 U	0.27 U	NA	0.27 U	0.27 U	0.27 U	NA
PCB 183	0.53 U	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U	NA
PCB 184	0.53 U	0.53 U	0.53 U	NA	0.53 U	0.53 U	0.53 U	NA
PCB 187	0.39 U	0.38 U	0.39 U	NA	0.38 U	0.38 U	0.38 U	NA
PCB 195	0.27 U	0.27 U	0.27 U	NA	0.27 U	0.27 U	0.27 U	NA
PCB 206	0.39 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.39 U	NA
PCB 209	0.27 U	0.27 U	0.27 U	NA	0.27 U	0.27 U	0.27 U	NA
<u>Surrogate Recoveries (%)</u>								
PCB 103 (SIS)	79	75	96	NA	81	82	86	NA
PCB 198 (SIS)	119	145	149	NA	127	121	126	NA

(a) U Undetected at or above given concentration.

(b) NS Not spiked.

(c) NA Not applicable.

(d) Sample randomly selected for use as a quality control sample in analytical batch.

(e) Matrix interference; value estimated.

(f) Outside quality control criteria (<30%) for replicate analysis.

**Table B.7. Pesticides and Polychlorinated Biphenyls (PCBs) in Elutriate Samples,
Bronx River**

Sediment Treatment Replicate	Concentration (ng/L)			
	Sequim Bay Water	BX COMP	BX COMP	BX COMP
Sample Size (L)	1.00	1.05	1.05	1.05
Batch	1	1	1	1
2,4'-DDD ^(a)	1.00 U ^(b)	0.95 U	0.95 U	0.95 U
2,4'-DDE	0.24 U	0.23 U	0.23 U	0.23 U
2,4'-DDT	0.46 U	0.44 U	0.44 U	0.44 U
4,4'-DDD	0.48 U	9.76	7.64	7.92
4,4'-DDE	0.29 U	9.55	9.55	8.54
4,4'-DDT	0.43 U	12.6	8.69	9.71
α -Chlordane	0.88 U	4.50	0.83 U	0.83 U
Aldrin	0.41 U	0.39 U	0.39 U	0.39 U
Dieldrin	0.13 U	5.97	5.61	4.96
Endosulfan I	0.49 U	0.47 U	0.47 U	0.47 U
Endosulfan II	0.49 U	0.470 U	1.04	1.20
Endosulfan Sulfate	0.49 U	0.47 U	0.47 U	0.66
Heptachlor	0.50 U	0.47 U	0.47 U	0.88
Heptachlor Epoxide	0.12 U	0.11 U	0.11 U	0.11 U
Trans Nonachlor	1.18 U	1.27	1.12 U	1.12 U
PCB 8	1.06 U	1.01 U	1.01 U	1.01 U
PCB 18	1.12 U	29.3	18.2	16.9
PCB 28	0.75 U	11.8	6.77	8.84
PCB 44	0.33 U	0.31 U	0.31 U	0.31 U
PCB 49	0.57 U	6.46	2.58	2.30
PCB 52	0.38 U	0.36 U	0.36 U	0.36 U
PCB 66	0.41 U	0.39 U	0.39 U	0.39 U
PCB 87	0.38 U	1.88	0.97	1.03
PCB 101	0.52 U	8.43	3.14	2.54
PCB 105	0.32 U	0.30 U	0.30 U	0.30 U
PCB 118	0.50 U	6.07	2.58	2.32
PCB 128	0.26 U	0.24 U	0.24 U	0.24 U
PCB 138	0.36 U	8.0	3.92	3.49
PCB 153	0.42 U	12.5	5.33	4.74
PCB 170	0.21 U	0.20 U	1.17	0.20 U
PCB 180	0.29 U	8.55	3.84	3.61
PCB 183	0.57 U	1.56	0.98	0.54 U
PCB 184	0.57 U	0.54 U	0.54 U	0.54 U
PCB 187	0.41 U	7.02	0.39 U	0.39 U
PCB 195	0.29 U	0.28 U	0.28 U	0.28 U
PCB 206	0.42 U	0.39 U	0.39 U	0.39 U
PCB 209	0.29 U	1.29	0.28 U	0.28 U
<u>Surrogate Recoveries (%)</u>				
PCB 103 (SIS)	78	72	77	71
PCB 198 (SIS)	76	69	73	69

(a) Target detection limits range from 0.5 ng/L to 100 ng/L for all analytes.

(b) U Undetected at or above given concentration.

Table B.8. Quality Control Data for Pesticide and Polychlorinated Biphenyl (PCB) Analysis of Elutriate Samples

Matrix Spike Results						
Sediment Treatment Analytical Replicate Sample Size (L) Batch	Concentration (ng/L)					
	Blank	Sequim Bay Water	Sequim Bay Water (MS)	Concentration		Percent Recovery
				Spiked	Recovered	
1.00	1.00	1.00				
1	1	1				
2,4'-DDD	1.00 U ^(a)	1.00 U	1.00 U	NS ^(b)	NA ^(c)	NS
2,4'-DDE	0.24 U	0.24 U	0.24 U	NS	NA	NA
2,4'-DDT	0.46 U	0.46 U	0.46 U	NS	NA	NS
4,4'-DDD	0.48 U	0.48 U	25.4	25.0	25.4	102
4,4'-DDE	0.29 U	0.29 U	23.3	25.0	23.3	93
4,4'-DDT	0.43 U	0.43 U	27.1	25.0	27.1	108
α-Chlordane	0.88 U	0.88 U	20.9	25.0	20.9	84
Aldrin	0.41 U	0.41 U	20.8	25.0	20.8	83
Dieldrin	0.13 U	0.13 U	22.6	25.0	22.6	91
Endosulfan I	0.49 U	0.49 U	22.0	25.0	22.0	88
Endosulfan II	0.49 U	0.49 U	24.3	25.0	24.3	97
Endosulfan Sulfate	0.49 U	0.49 U	28.3	25.0	28.3	113
Heptachlor	0.50 U	0.50 U	22.1	25.0	22.1	88
Heptachlor Epoxide	0.12 U	0.12 U	22.5	25.0	22.5	90
Trans Nonachlor	1.18 U	1.18 U	1.18 U	NS	NA	NA
PCB 8	1.06 U	1.06 U	1.06 U	NS	NA	NS
PCB 18	1.12 U	1.12 U	1.12 U	NS	NA	NS
PCB 28	0.75 U	0.75 U	35.4	31.9	35.4	111
PCB 44	0.33 U	0.33 U	0.33 U	NS	NA	NS
PCB 49	0.57 U	0.57 U	0.57 U	NS	NA	NS
PCB 52	0.38 U	0.38 U	72.7	66.5	72.7	109
PCB 66	0.41 U	0.41 U	0.41 U	NS	NA	NS
PCB 87	0.38 U	0.38 U	0.38 U	NS	NA	NS
PCB 101	0.52 U	0.52 U	53.4	45.1	53.4	118
PCB 105	0.32 U	0.32 U	0.32 U	NS	NA	NS
PCB 118	0.50 U	0.50 U	0.50 U	NS	NA	NS
PCB 128	0.26 U	0.26 U	0.26 U	NS	NA	NS
PCB 138	0.36 U	0.36 U	23.2	20.4	23.2	114
PCB 153	0.42 U	0.42 U	31.1	26.4	31.1	118
PCB 170	0.21 U	0.21 U	0.21 U	NS	NA	NS
PCB 180	0.29 U	0.29 U	0.29 U	NS	NA	NS
PCB 183	0.57 U	0.57 U	0.57 U	NS	NA	NS
PCB 184	0.57 U	0.57 U	0.57 U	NS	NA	NS
PCB 187	0.41 U	0.41 U	0.41 U	NS	NA	NS
PCB 195	0.29 U	0.29 U	0.29 U	NS	NA	NS
PCB 206	0.42 U	0.42 U	0.42 U	NS	NA	NS
PCB 209	0.29 U	0.29 U	0.29 U	NS	NA	NS
<u>Surrogate Recoveries (%)</u>						
PCB 103 (SIS)	48	78	79	NA	NA	NA
PCB 198 (SIS)	45	76	77	NA	NA	NA

Table B.8. (contd)

Sediment Treatment Analytical Replicate Sample Size (L) Batch	Analytical Replicates							
	Concentration (ng/L)			RSD (%)	Concentration (ng/L)			RSD (%)
	SH COMP ^(a)	SH COMP	SH COMP		WC COMP ^(a)	WC COMP	WC COMP	
	1.07 1	1.08 1	1.07 1		1.06 1	1.06 1	1.01 1	
2,4'-DDD	0.93 U	0.93 U	0.93 U	NA	0.95 U	0.95 U	0.99 U	NA
2,4'-DDE	0.23 U	0.23 U	0.23 U	NA	0.23 U	0.23 U	0.24 U	NA
2,4'-DDT	0.43 U	0.43 U	0.43 U	NA	0.44 U	0.44 U	0.46 U	NA
4,4'-DDD	0.44 U	0.44 U	0.44 U	NA	0.45 U	3.49	3.85	72 ^(e)
4,4'-DDE	0.27 U	0.27 U	0.27 U	NA	0.28 U	0.28 U	0.29 U	NA
4,4'-DDT	0.40 U	0.40 U	0.40 U	NA	8.42	3.88	4.37	45 ^(e)
α-Chlordane	0.82 U	0.82 U	0.82 U	NA	0.83 U	0.83 U	0.87 U	NA
Aldrin	0.38 U	0.38 U	0.38 U	NA	0.39 U	0.39 U	0.41 U	NA
Dieldrin	0.12 U	0.12 U	0.12 U	NA	6.84	3.06	3.25	49 ^(e)
Endosulfan I	0.46 U	0.46 U	0.46 U	NA	0.47 U	0.47 U	0.49 U	NA
Endosulfan II	0.46 U	0.46 U	0.46 U	NA	0.47 U	0.47 U	0.49 U	NA
Endosulfan Sulfate	0.46 U	0.46 U	0.46 U	NA	0.47 U	0.46 U	0.49 U	NA
Heptachlor	0.46 U	0.46 U	0.46 U	NA	0.47 U	0.47 U	0.49 U	NA
Heptachlor Epoxide	0.11 U	0.11 U	0.11 U	NA	0.11 U	0.11 U	0.12 U	NA
Trans Nonachlor	1.10 U	1.10 U	1.10 U	NA	1.12 U	1.12 U	1.17 U	NA
PCB 8	0.98 U	0.98 U	0.98 U	NA	1.01 U	1.00 U	1.05 U	NA
PCB 18	1.04 U	1.04 U	1.04 U	NA	1.06 U	1.05 U	1.11 U	NA
PCB 28	0.70 U	0.70 U	0.70 U	NA	0.71 U	1.01	0.74 U	NA
PCB 44	0.30 U	0.30 U	0.30 U	NA	0.31 U	0.31 U	0.32 U	NA
PCB 49	0.53 U	0.53 U	0.53 U	NA	0.54 U	0.53 U	0.56 U	NA
PCB 52	0.35 U	0.35 U	0.35 U	NA	0.36 U	0.35 U	0.37 U	NA
PCB 66	0.38 U	0.38 U	0.38 U	NA	0.39 U	0.38 U	0.40 U	NA
PCB 87	0.35 U	0.35 U	0.35 U	NA	0.36 U	0.35 U	0.37 U	NA
PCB 101	0.48 U	0.48 U	0.48 U	NA	1.62	0.48 U	0.51 U	NA
PCB 105	0.29 U	0.29 U	0.29 U	NA	0.30 U	0.30 U	0.31 U	NA
PCB 118	0.46 U	0.46 U	0.46 U	NA	1.84	0.47 U	0.49 U	NA
PCB 128	0.24 U	0.24 U	0.24 U	NA	0.24 U	0.24 U	0.25 U	NA
PCB 138	0.34 U	0.34 U	0.34 U	NA	2.00	0.34 U	0.64	NA
PCB 153	0.39 U	0.39 U	0.39 U	NA	1.55	0.39 U	0.47	NA
PCB 170	0.20 U	0.20 U	0.20 U	NA	0.20 U	0.20 U	0.21 U	NA
PCB 180	0.27 U	0.27 U	0.27 U	NA	0.28 U	0.27 U	0.29 U	NA
PCB 183	0.53 U	0.53 U	0.53 U	NA	0.54 U	0.53 U	0.56 U	NA
PCB 184	0.53 U	0.53 U	0.53 U	NA	0.54 U	0.53 U	0.56 U	NA
PCB 187	0.38 U	0.38 U	0.38 U	NA	0.39 U	0.39 U	0.41 U	NA
PCB 195	0.27 U	0.27 U	0.27 U	NA	0.28 U	0.27 U	0.29 U	NA
PCB 206	0.39 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.41 U	NA
PCB 209	0.27 U	0.27 U	0.27 U	NA	0.28 U	0.27 U	0.29 U	NA
<u>Surrogate Recoveries (%)</u>								
PCB 103 (SIS)	66	65	66	NA	64	5 ^(f)	0 ^(f)	NA
PCB 198 (SIS)	66	68	67	NA	60	0 ^(f)	0 ^(f)	NA

Table B.8. (contd)

Sediment Treatment Analytical Replicate Sample Size (L) Batch	Analytical Replicates							
	Concentration (ng/L)			RSD (%)	Concentration (ng/L)			RSD (%)
	SR COMP ^(a)	SR COMP	SR COMP		BX COMP ^(a)	BX COMP	BX COMP	
	1.06 1	1.06 1	1.05 1		1.05 1	1.05 1	1.05 1	
2,4'-DDD	0.95 U	0.95 U	0.95 U	NA	0.95 U	0.95 U	0.95 U	NA
2,4'-DDE	0.23 U	0.23 U	0.23 U	NA	0.23 U	0.23 U	0.23 U	NA
2,4'-DDT	0.44 U	0.44 U	0.44 U	NA	0.44 U	0.44 U	0.44 U	NA
4,4'-DDD	0.45 U	0.45 U	0.45 U	NA	9.76	7.64	7.92	14
4,4'-DDE	0.28 U	0.28 U	0.28 U	NA	9.55	9.55	8.54	6
4,4'-DDT	0.41 U	0.41 U	0.41 U	NA	12.6	8.69	9.71	19
α-Chlordane	0.83 U	0.83 U	0.83 U	NA	4.50	0.83 U	0.83 U	NA
Aldrin	0.39 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.39 U	NA
Dieldrin	0.13 U	0.13 U	0.13 U	NA	5.97	5.61	4.96	9
Endosulfan I	0.47 U	0.47 U	0.47 U	NA	0.47 U	0.47 U	0.47 U	NA
Endosulfan II	0.47 U	0.47 U	0.47 U	NA	0.47 U	1.04	1.20	NA
Endosulfan Sulfate	0.47 U	0.47 U	0.47 U	NA	0.47 U	0.47 U	0.66	NA
Heptachlor	0.47 U	0.47 U	0.47 U	NA	0.47 U	0.47 U	0.88	NA
Heptachlor Epoxide	0.11 U	0.11 U	0.11 U	NA	0.11 U	0.11 U	0.11 U	NA
Trans Nonachlor	1.12 U	1.12 U	1.12 U	NA	1.27	1.12 U	1.12 U	NA
PCB 8	1.01 U	1.01 U	1.01 U	NA	1.01 U	1.01 U	1.01 U	NA
PCB 18	1.06 U	1.06 U	1.06 U	NA	29.3	18.2	16.9	32 ^(e)
PCB 28	0.71 U	0.71 U	0.71 U	NA	11.8	6.77	8.84	27
PCB 44	0.31 U	0.31 U	0.31 U	NA	0.31 U	0.31 U	0.31 U	NA
PCB 49	0.54 U	0.54 U	0.54 U	NA	6.46	2.58	2.30	62 ^(e)
PCB 52	0.36 U	0.36 U	0.36 U	NA	0.36 U	0.36 U	0.36 U	NA
PCB 66	0.39 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.39 U	NA
PCB 87	0.36 U	0.36 U	0.36 U	NA	1.88	0.97	1.03	39 ^(e)
PCB 101	0.49 U	0.49 U	0.49 U	NA	8.43	3.14	2.54	69 ^(e)
PCB 105	0.30 U	0.30 U	0.30 U	NA	0.30 U	0.30 U	0.30 U	NA
PCB 118	0.47 U	0.47 U	0.47 U	NA	6.07	2.58	2.32	57 ^(e)
PCB 128	0.24 U	0.24 U	0.24 U	NA	0.24 U	0.24 U	0.24 U	NA
PCB 138	0.35 U	0.35 U	0.35 U	NA	8.00	3.92	3.49	48 ^(e)
PCB 153	0.40 U	0.40 U	0.40 U	NA	12.5	5.33	4.74	57 ^(e)
PCB 170	0.20 U	0.20 U	0.20 U	NA	0.20 U	1.17	0.20 U	NA
PCB 180	0.28 U	0.28 U	0.28 U	NA	8.55	3.84	3.61	52 ^(e)
PCB 183	0.54 U	0.54 U	0.54 U	NA	1.56	0.98	0.54 U	NA
PCB 184	0.54 U	0.54 U	0.54 U	NA	0.54 U	0.54 U	0.54 U	NA
PCB 187	0.39 U	0.39 U	0.39 U	NA	7.02	0.39 U	0.39 U	NA
PCB 195	0.28 U	0.28 U	0.28 U	NA	0.28 U	0.28 U	0.28 U	NA
PCB 206	0.39 U	0.39 U	0.39 U	NA	0.39 U	0.39 U	0.39 U	NA
PCB 209	0.28 U	0.28 U	0.28 U	NA	1.29	0.28 U	0.28 U	NA
<u>Surrogate Recoveries (%)</u>								
PCB 103 (SIS)	0 ^(f)	0 ^(f)	65	NA	72	77	71	NA
PCB 198 (SIS)	0 ^(f)	0 ^(f)	67	NA	69	73	69	NA

(a) U Undetected at or above given concentration.

(b) NS Not spiked.

(c) NA Not applicable.

(d) Sample randomly selected for use as a quality control sample in analytical batch.

(e) Outside quality control criteria ($\leq 30\%$) for replicate analysis.

(f) Surrogate not added. Sample quantified using RIS (Recovery Internal Standards).

Appendix C

Benthic Acute Toxicity Test Data, Bronx River Project

Table C.1 Results of 10-Day, Static-Renewal, Benthic Acute Toxicity Test
with *A. abdita*, Bronx River

Sediment Treatment	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
BX COMP	1	14	6	0.70		
BX COMP	2	15	5	0.75		
BX COMP	3	11	9	0.55		
BX COMP	4	11	9	0.55		
BX COMP	5	14	6	0.70	0.65	0.09
MDRS ^(b)	1	17	3	0.85		
MDRS	2	20	0	1.00		
MDRS	3	20	0	1.00		
MDRS	4	19	1	0.95		
MDRS	5	19	1	0.95	0.95	0.06
<i>Ampelisca</i> Control	1	19	1	0.95		
<i>Ampelisca</i> Control	2	20	0	1.00		
<i>Ampelisca</i> Control	3	20	0	1.00		
<i>Ampelisca</i> Control	4	19	1	0.95		
<i>Ampelisca</i> Control	5	20	0	1.00	0.98	0.03

(a) Survival based on initial exposure of 20 organisms per replicate.

(b) MDRS Mud Dump Reference Site.

Table C.2. Water Quality Data for 10-Day, Static-Renewal, Benthic Acute Toxicity Test with *A. abdita*, Bronx River

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)		Total Ammonia ^(a) (mg/L)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	4.6	NA ^(b)	28.0	32.0	NA	30.0
BX COMP	19.8	20.2	8.10	8.42 ^(c)	6.2	7.2	30.0	30.5	0.034	0.339
MDRS ^(d)	19.9	20.2	7.93	8.12	6.7	7.1	30.0	30.5	0.033	0.136
<i>Ampelisca</i> Control	19.6	20.1	8.11	8.36 ^(c)	6.1	7.0	30.0	30.5	0.011	0.086

(a) Total ammonia measured in overlying water.

(b) NA Not applicable.

(c) Data point out of range.

(d) MDRS Mud Dump Reference Site.

Table C.3. Results of 96-Hour, Cadmium Reference Toxicant Test
with *A. abdita*

Cadmium Concentration (mg/L)	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
0.00	1	20	0	1.00		
0.00	2	19	1	0.95		
0.00	3	19	1	0.95	0.97	0.03
0.19	1	17	3	0.85		
0.19	2	15	5	0.75		
0.19	3	17	3	0.85	0.82	0.06
0.38	1	14	6	0.70		
0.38	2	13	7	0.65		
0.38	3	14	6	0.70	0.68	0.03
0.75	1	10	10	0.50		
0.75	2	11	9	0.55		
0.75	3	8	12	0.40	0.48	0.08
1.50	1	2	18	0.10		
1.50	2	2	18	0.10		
1.50	3	0	20	0.00	0.07	0.06

(a) Survival based on initial exposure of 20 organisms per replicate.

Table C.4. Water Quality Data for 96-Hour, Cadmium Reference Toxicant Test
with *A. abdita*

Cadmium Concentration (mg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	4.6	NA ^(a)	28.0	32.0
0.00	19.9	20.2	8.03	8.17	6.8	7.2	30.0	30.5
0.19	19.9	20.1	7.94	8.18	6.9	7.2	30.0	30.5
0.38	19.7	20.3	7.98	8.14	6.9	7.2	30.0	30.5
0.75	19.9	20.2	7.91	8.14	6.9	7.3	30.0	31.0
1.50	19.9	20.2	7.96	8.11	6.9	7.3	30.0	30.5

(a) NA Not applicable.

Table C.5. Results of 10-day, Static-Renewal, Benthic Acute Toxicity Test with *M. bahia*, Bronx River

Sediment Treatment	Replicate	Live ^(a)	Dead or Missing	Proportion Survival	Mean Proportion Survival	Standard Deviation
BX COMP	1	19	1	0.95		
BX COMP	2	19	1	0.95		
BX COMP	3	19	1	0.95		
BX COMP	4	20	0	1.00		
BX COMP	5	19	1	0.95	0.96	0.02
MDRS ^(b)	1	17	3	0.85		
MDRS	2	20	0	1.00		
MDRS	3	19	1	0.95		
MDRS	4	17	3	0.85		
MDRS	5	18	2	0.90	0.91	0.07
Sequim Bay Control	1	18	2	0.90		
Sequim Bay Control	2	18	2	0.90		
Sequim Bay Control	3	17	3	0.85		
Sequim Bay Control	4	20	0	1.00		
Sequim Bay Control	5	19	1	0.95	0.92	0.06

(a) Survival based on initial exposure of 20 organisms per replicate.

(b) MDRS Mud Dump Reference Site.

Table C.6. Water Quality Data for 10-Day, Static-Renewal, Benthic Acute Toxicity Test with *M. bahia*, Bronx River

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)		Total Ammonia ^(a) (mg/L)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	3.0	NA ^(a)	28.0	32.0	NA	15.0
BX COMP	19.3	20.1	8.03	8.51 ^(c)	6.0	7.0	30.0	31.0	0.079	11.5
MDRS ^(d)	19.4	20.3	7.84	8.41 ^(c)	6.1	7.1	30.0	31.0	0.265	2.49
<i>Mysid</i> Control	19.3	20.1	7.96	8.63 ^(c)	6.3	7.0	30.0	31.0	0.094	1.51

(a) Total ammonia measured in overlying water.

(b) NA Not applicable.

(c) Data point out of range.

(d) MDRS Mud Dump Reference Site.

Table C.7. Results of 96-Hour, Copper Reference Toxicant Test with *M. bahia*

Copper Concentration (µg/L)	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
0	1	10	0	1.00		
0	2	10	0	1.00		
0	3	10	0	1.00	1.00	0.00
150	1	10	0	1.00		
150	2	10	0	1.00		
150	3	10	0	1.00	1.00	0.00
200	1	8	2	0.80		
200	2	8	2	0.80		
200	3	9	1	0.90	0.83	0.06
300	1	3	7	0.30		
300	2	4	6	0.40		
300	3	4	6	0.40	0.37	0.06
400	1	0	10	0.00		
400	2	0	10	0.00		
400	3	0	10	0.00	0.00	0.00

(a) Survival based on initial exposure of 10 organisms per replicate

Table C.8 Water Quality Data for 96-hour, Copper Reference Toxicant Test
with *M. bahia*

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	3.0	NA ^(a)	28.0	32.0
0	20.0	20.2	8.00	8.15	6.5	7.1	30.5	31.5
150	20.1	20.2	8.06	8.14	6.6	7.2	30.5	32.0
200	20.1	20.3	8.04	8.13	6.7	7.2	30.5	31.5
300	20.0	20.3	8.03	8.17	6.7	7.2	30.5	32.0
400	19.9	20.2	7.97	8.18	6.7	7.2	30.5	32.0

(a) NA Not applicable.

Appendix D

Water-Column Toxicity Test Data, Bronx River Project

Table D.1. Results of 96-Hour, Water-Column Toxicity Test with *M. beryllina*,
Bronx River

Sediment Treatment	Concentration (% SPP)	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
BX	0	1	8	2	0.80		
BX	0	2	9	1	0.90		
BX	0	3	9	1	0.90		
BX	0	4	10	0	1.00		
BX	0	5	9	1	0.90	0.90	0.07
BX	10	1	8	2	0.80		
BX	10	2	9	1	0.90		
BX	10	3	8	2	0.80		
BX	10	4	8	2	0.80		
BX	10	5	9	1	0.90	0.84	0.05
BX	50	1	0	10	0.00		
BX	50	2	0	10	0.00		
BX	50	3	0	10	0.00		
BX	50	4	0	10	0.00		
BX	50	5	1	9	0.10	0.02	0.04
BX	100	1	0	10	0.00		
BX	100	2	0	10	0.00		
BX	100	3	0	10	0.00		
BX	100	4	0	10	0.00		
BX	100	5	0	10	0.00	0.00	0.00
Brine Control		1	7	3	0.70		
Brine Control		2	10	0	1.00		
Brine Control		3	9	1	0.90		
Brine Control		4	10	0	1.00		
Brine Control		5	9	1	0.90	0.90	0.12

(a) Survival based on initial exposure of 10 organisms per replicate.

Table D.2. Water Quality Data for 96-Hour, Water-Column Toxicity Test with *M. beryllina*, Bronx River

Sediment Treatment	Concentration (% SPP)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
		Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:		18.0	22.0	7.30	8.30	3.0	NA ^(a)	28.0	32.0
BX	0	19.0	21.3	8.04	8.12	6.6	7.8	30.0	30.5
BX	10	18.9	21.2	8.03	8.31 ^(b)	5.9	7.7	30.0	30.5
BX	50	19.0	21.4	7.93	8.36 ^(b)	6.3	7.2	29.5	30.0
BX	100	19.1	21.4	7.86	8.41 ^(b)	4.6	7.0	29.5	30.0
Brine Control		18.7	21.2	7.99	8.26	6.2	7.2	29.0	30.0

(a) NA Not applicable.

(b) Data point out of range.

Table D.3. Results of 96-Hour, Copper Reference Toxicant Test with *M. beryllina*

Copper Concentration ($\mu\text{g/L}$)	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
0	1	10	0	1.00		
0	2	7	3	0.70		
0	3	10	0	1.00	0.90	0.17
16	1	9	1	0.90		
16	2	5	5	0.50		
16	3	8	2	0.80	0.73	0.21
64	1	10	0	1.00		
64	2	7	3	0.70		
64	3	7	3	0.70	0.80	0.17
160	1	4	6	0.40		
160	2	4	6	0.40		
160	3	7	3	0.70	0.50	0.17
400	1	0	10	0.00		
400	2	0	10	0.00		
400	3	0	10	0.00	0.00	0.00

(a) Survival based on initial exposure of 10 organisms per replicate.

Table D.4. Water Quality Data for 96-Hour Copper Reference Toxicant Test
with *M. beryllina*

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	3.0	NA ^(a)	28.0	32.0
0	18.9	21.2	8.06	8.17	6.2	7.5	30.0	31.0
16	18.8	21.4	8.06	8.17	6.4	7.4	30.5	31.5
64	18.8	21.5	7.98	8.15	6.3	7.5	30.0	31.0
160	18.8	21.5	8.02	8.12	6.4	7.4	30.0	31.0
400	19.0	21.4	7.94	8.05	6.4	7.5	30.5	31.0

(a) NA Not applicable.

Table D.5. Results of 96-Hour, Water-Column Toxicity Test with *M. bahia*,
Bronx River

Sediment Treatment	Concentration (% SPP)	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
BX	0	1	10	0	1.00		
BX	0	2	10	0	1.00		
BX	0	3	10	0	1.00		
BX	0	4	10	0	1.00		
BX	0	5	10	0	1.00	1.00	0.00
BX	10	1	9	1	0.90		
BX	10	2	9	1	0.90		
BX	10	3	9	1	0.90		
BX	10	4	10	0	1.00		
BX	10	5	10	0	1.00	0.94	0.05
BX	50	1	9	1	0.90		
BX	50	2	10	0	1.00		
BX	50	3	10	0	1.00		
BX	50	4	9	1	0.90		
BX	50	5	10	0	1.00	0.96	0.05
BX	100	1	2	8	0.20		
BX	100	2	0	10	0.00		
BX	100	3	0	10	0.00		
BX	100	4	0	10	0.00		
BX	100	5	2	8	0.20	0.08	0.11
Brine Control		1	10	0	1.00		
Brine Control		2	10	0	1.00		
Brine Control		3	10	0	1.00		
Brine Control		4	10	0	1.00		
Brine Control		5	9	1	0.90	0.98	0.04

(a) Survival based on initial exposure of 10 replicates

Table D.6. Water Quality Data for 96-Hour, Water-Column Toxicity Test with *M. bahia*, Bronx River

Sediment Treatment	Concentration (% SPP)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
		Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:		18.0	22.0	7.30	8.30	3.0	NA ^(a)	28.0	32.0
BX COMP	0	19.7	20.7	7.89	8.08	6.1	7.7	30.5	31.0
BX COMP	10	19.7	20.6	8.01	8.27	6.1	7.6	30.0	31.0
BX COMP	50	19.7	20.7	7.93	8.27	5.3	6.8	30.0	30.5
BX COMP	100	19.7	20.7	7.90	8.52 ^(b)	4.8	7.0	29.5	30.0
Brine Control		19.5	20.0	7.98	8.27	6.0	7.1	29.0	30.5

(a) NA Not applicable.

(b) Data point out of range.

Table D.7. Results of 96-Hour Copper Reference Toxicant Test with *M. bahia* for Water-Column Toxicity Tests

Copper Concentration (µg/L)	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
0	1	10	0	1.00		
0	2	10	0	1.00		
0	3	10	0	1.00	1.00	0.00
150	1	10	0	1.00		
150	2	10	0	1.00		
150	3	8	2	0.80	0.93	0.12
200	1	7	3	0.70		
200	2	8	2	0.80		
200	3	8	2	0.80	0.77	0.06
300	1	5	5	0.50		
300	2	6	4	0.60		
300	3	4	6	0.40	0.50	0.10
400	1	2	8	0.20		
400	2	2	8	0.20		
400	3	0	10	0.00	0.13	0.12

(a) Survival based on initial exposure of 10 organisms per replicate

Table D.8. Water Quality Data for 96-Hour Copper Reference Toxicant Test with *M. bahia*

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	3.0	NA ^(a)	28.0	32.0
0	19.6	20.2	7.91	8.18	5.9	7.8	30.5	31.5
150	19.6	20.2	7.97	8.11	6.3	7.8	30.5	31.5
200	19.8	20.3	7.89	8.10	6.4	7.4	30.5	31.5
300	19.7	20.2	8.01	8.12	6.6	7.4	30.0	31.5
400	19.7	20.2	8.03	8.12	6.8	7.5	30.0	31.5

(a) NA Not applicable.

Table D.9. Results of 72-Hour, Water-Column Toxicity Test with *M. galloprovincialis*, Bronx River

Sediment Treatment	Conc. (% SPP)	Replicate	Mean					Proportion Normal ^(a)	Mean		Standard Deviation ^(c)
			Stocking Density	Number Normal	Number Abnormal	Number Other	Number Surviving		Proportion Normal	Proportion Surviving ^(b)	
BX COMP	0	1	233	152	25	0	177	0.65		0.76	
BX COMP	0	2	233	104	18	0	122	0.45		0.52	
BX COMP	0	3	233	211	15	2	228	0.91		0.98	
BX COMP	0	4	233	171	28	6	205	0.73		0.88	
BX COMP	0	5	233	200	48	1	249	0.86	0.72	1.00 ^(d)	0.83
BX COMP	10	1	233	185	38	0	223	0.79		0.96	0.20
BX COMP	10	2	233	167	45	0	212	0.72		0.91	
BX COMP	10	3	233	222	18	4	244	0.95		1.00 ^(d)	
BX COMP	10	4	233	138	38	0	176	0.59		0.76	
BX COMP	10	5	233	174	29	2	205	0.75	0.76	0.88	0.90
BX COMP	50	1	233	2	186	0	188	0.01		0.81	
BX COMP	50	2	233	2	196	0	198	0.01		0.85	
BX COMP	50	3	233	1	152	0	153	0.00		0.66	
BX COMP	50	4	233	2	106	41	149	0.01		0.64	
BX COMP	50	5	233	8	217	1	226	0.03	0.01	0.97	0.79
BX COMP	100	1	233	4	134	3	141	0.02		0.61	0.14
BX COMP	100	2	233	2	67	0	69	0.01		0.30	
BX COMP	100	3	233	1	121	0	122	0.00		0.52	
BX COMP	100	4	233	4	114	0	118	0.02		0.51	
BX COMP	100	5	233	0	124	9	133	0.00	0.01	0.57	0.50
18.5 ppt Brine Control		1	241	239	18	2	259	0.99		1.00 ^(d)	
18.5 ppt Brine Control		2	241	281	26	6	313	1.00 ^(d)		1.00 ^(d)	
18.5 ppt Brine Control		3	241	228	6	1	235	0.95		0.98	
18.5 ppt Brine Control		4	241	236	0	3	239	0.98		0.99	
18.5 ppt Brine Control		5	241	211	3	31	245	0.88	0.96	1.00 ^(d)	0.99

(a) Proportion normal = number normal / mean stocking density.

(b) Proportion surviving = number surviving / mean stocking density.

(c) Standard deviation is based on proportion surviving.

(d) When number normal or number surviving exceeded the mean stocking density, a proportion normal and/or proportion surviving of 1.00 was used for mean calculations and statistical analysis.

Table D.10. Water Quality Data for 72-Hour, Water-Column Toxicity Test
with *M. galloprovincialis*, Bronx River

Sediment Treatment	Concentration (% SPP)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
		Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:		14.0	18.0	7.30	8.30	4.9	NA ^(a)	28.0	32.0
BX COMP	0	16.1	16.6	8.05	8.15	7.6	8.0	30.0	30.5
BX COMP	10	16.2	16.7	7.99	8.22	7.5	7.9	30.0	30.5
BX COMP	50	16.2	16.6	7.93	8.42 ^(b)	6.4	8.0	30.0	30.5
BX COMP	100	16.1	16.5	7.92	8.55 ^(b)	5.6	8.1	29.5	30.0
18.5 ppt Brine Control		16.1	16.8	7.91	8.27	6.1	8.0	30.0	30.0

(a) NA Not applicable.

(b) Data point out of range.

Table D.11. Results of 72-Hour, Copper Reference Toxicant Test with *M. galloprovincialis*

Copper Concentration (µg/L)	Replicate	Mean Stocking Density	Number Normal	Number Abnormal	Number Other	Number Surviving	Proportion Normal ^(a)	Mean Proportion Normal	Proportion Surviving ^(b)	Mean Proportion Surviving	Standard Deviation ^(c)
0	1	258	194	38	0	232	0.75		0.90		
0	2	258	225	27	0	252	0.87		0.98		
0	3	258	182	49	3	234	0.71	0.78	0.91	0.93	0.04
4	1	258	221	37	2	260	0.86		1.00 ^(d)		
4	2	258	228	31	4	263	0.88		1.00 ^(d)		
4	3	258	220	43	2	265	0.85	0.86	1.00 ^(d)	1.00	0.00
8	1	258	219	41	1	261	0.85		1.00 ^(d)		
8	2	258	170	49	0	219	0.66		0.85		
8	3	258	206	43	2	251	0.80	0.77	0.97	0.94	0.08
16	1	258	21	212	1	234	0.08		0.91		
16	2	258	71	209	0	280	0.28		1.00 ^(d)		
16	3	258	5	196	8	209	0.02	0.13	0.81	0.91	0.10
32	1	258	4	33	21	58	0.02		0.22		
32	2	258	2	14	41	57	0.01		0.22		
32	3	258	0	10	78	88	0.00	0.01	0.34	0.26	0.07

(a) Proportion normal = number normal / mean stocking density.

(b) Proportion surviving = number surviving / mean stocking density.

(c) Standard deviation is based on proportion surviving.

(d) When number normal or number surviving exceeded the mean stocking density, a proportion normal and/or proportion surviving of 1.00 was used for mean calculations and statistical analysis.

Table D.12 Water Quality Data for 72-Hour, Copper Reference Toxicant Test
with *M. galloprovincialis*

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	14.0	18.0	7.30	8.30	4.9	NA ^(a)	28.0	32.0
0	16.3	16.8	7.91	8.10	7.4	7.9	30.0	31.0
4	16.3	16.7	7.92	8.09	7.5	7.8	30.0	31.0
8	16.4	16.7	7.92	8.11	7.4	7.7	30.0	31.0
16	16.3	16.6	7.91	8.10	7.5	7.8	30.0	30.5
32	16.4	16.8	7.89	8.10	7.4	7.7	30.0	31.0

(a) NA Not applicable.

Appendix E

Bioaccumulation Test Data, Bronx River Project

Table E.1. Results of 28-Day Bioaccumulation Test with *M. nasuta*, Bronx River

Sediment Treatment	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
BX COMP	1	24	1	0.96		
BX COMP	2	24	1	0.96		
BX COMP	3	24	1	0.96		
BX COMP	4	24	1	0.96		
BX COMP	5	25	0	1.00	0.97	0.02
MDRS ^(b)	1	23	2	0.92		
MDRS	2	24	1	0.96		
MDRS	3	24	1	0.96		
MDRS	4	23	2	0.92		
MDRS	5	25	0	1.00	0.95	0.03
<i>Macoma</i> Control	1	23	2	0.92		
<i>Macoma</i> Control	2	23	2	0.92		
<i>Macoma</i> Control	3	23	2	0.92		
<i>Macoma</i> Control	4	24	1	0.96		
<i>Macoma</i> Control	5	20	5	0.80	0.90	0.06

(a) Survival based on initial exposure of 25 organisms per replicate.

(b) MDRS Mud Dump Reference Site.

Table E.2. Water Quality Summary for 28-Day Bioaccumulation Test with *M. nasuta*, Bronx River

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	13.0	17.0	7.30	8.30	5.0	NA ^(a)	28.0	32.0
BX COMP	15.4	16.5	7.87	8.12	6.9	7.8	30.0	31.0
MDRS ^(b)	15.3	16.6	7.88	8.11	7.1	7.9	30.0	31.0
<i>Macoma</i> Control	15.4	16.6	7.90	8.10	7.2	7.8	30.0	31.0

(a) NA Not applicable.

(b) MDRS Mud Dump Reference Site.

Table E.3. Results of 96-Hour, Copper Reference Toxicant Test
with *M. nasuta*

Copper Concentration ($\mu\text{g/L}$)	Live ^(a)	Dead or Missing	Proportion Surviving
0	10	0	1.00
312	9	1	0.90
625	6	4	0.60
1250	3	7	0.30
2500	0	10	0.00
5000	1	9	0.10
10000	0	10	0.00

(a) Survival based on initial exposure of 10 organisms per replicate

Table E.4. Water Quality Summary for 96-Hour *M. nasuta* Copper Reference Toxicant Test

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	13.0	17.0	7.30	8.30	5.0	NA ^(a)	28.0	32.0
0	15.5	16.1	8.03	8.10	7.6	7.8	30.5	31.5
312	15.5	16.1	7.57	8.05	5.4	7.9	30.5	31.5
625	15.5	16.1	7.87	8.07	6.7	7.9	30.5	31.5
1250	15.6	16.1	7.58	8.05	4.3 ^(b)	8.0	30.5	31.0
2500	15.7	16.2	7.30	7.96	1.2 ^(b)	8.0	30.5	31.5
5000	15.6	16.2	7.31	7.82	1.4 ^(b)	7.9	30.5	31.5
10000	15.7	16.2	7.57	7.65	5.9	8.0	30.5	31.0

(a) NA Not applicable.

(b) Data point out of range.

**Table E.5. Results of 28-Day Bioaccumulation Test with *N.virens*,
Bronx River**

Sediment Treatment	Replicate	Live ^(a)	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
BX COMP	1	11	9	0.55		
BX COMP	2	13	7	0.65		
BX COMP	3	18	2	0.90		
BX COMP	4	14	6	0.70		
BX COMP	5	19	1	0.95	0.75	0.17
MDRS ^(b)	1	17	3	0.85		
MDRS	2	18	2	0.90		
MDRS	3	19	1	0.95		
MDRS	4	20	0	1.00		
MDRS	5	18	2	0.90	0.92	0.06
<i>Nereis</i> Control	1	16	4	0.80		
<i>Nereis</i> Control	2	14	6	0.70		
<i>Nereis</i> Control	3	13	7	0.65		
<i>Nereis</i> Control	4	18	2	0.90		
<i>Nereis</i> Control	5	15	5	0.75	0.76	0.10

(a) Survival based on initial exposure of 20 organisms per replicate.

(b) MDRS Mud Dump Reference Site.

Table E.6 Water Quality Data for 28-Day Bioaccumulation Test with *N. virens*,
Bronx River

Sediment Treatment	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	4.6	NA ^(a)	28.0	32.0
BX COMP	19.0	20.3	7.78	8.09	5.6	7.0	30.0	30.5
MDRS ^(b)	19.0	20.3	7.81	8.08	5.8	7.3	30.0	30.5
<i>Nereis</i> Control	19.1	20.3	7.70	8.17	5.2	7.2	30.0	31.0

(a) NA Not applicable.

(b) MDRS Mud Dump Reference Site.

Table E.7. Results for 96-Hour, Copper Reference Toxicant Test
with *N. virens*

Copper Concentration (µg/L)	Live ^(a)	Dead or Missing	Proportion Surviving
0	10	0	1.00
50	10	0	1.00
75	10	0	1.00
100	9	1	0.90
200	5	5	0.50
300	3	7	0.30
400	0	10	0.00

(a) Survival based on initial exposure of 10 organisms per replicate

Table E.8. Water Quality Data for 96-Hour, Copper Reference Toxicant Test with *N. virens*

Copper Concentration (µg/L)	Temperature (°C)		pH		Dissolved Oxygen (mg/L)		Salinity (‰)	
	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range:	18.0	22.0	7.30	8.30	4.6	NA ^(a)	28.0	32.0
0	18.6	18.9	7.94	8.12	6.9	7.4	30.5	31.5
50	18.6	18.9	7.86	8.09	6.7	7.3	30.5	31.5
75	18.7	18.9	7.82	8.07	6.5	7.4	30.5	31.5
100	18.7	18.9	7.66	8.07	5.5	7.3	30.5	31.5
200	18.6	18.8	7.45	8.07	3.1 ^(b)	7.4	30.5	31.5
300	18.7	18.9	7.32	8.01	2.2 ^(b)	7.2	30.5	31.5
400	18.7	18.9	7.23	7.97	1.6 ^(b)	7.4	30.5	31.5

(a) NA Not applicable.

(b) Data point out of range.

Appendix F

Macoma nasuta Tissue Chemical Analyses and
Quality Assurance/Quality Control Data,
Bronx River Project

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Metals

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Clam Tissue

QA/QC DATA QUALITY OBJECTIVES

	<u>Reference Method</u>	<u>Range of Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Target Detection Limit(dry wt)</u>
Arsenic	ICP/MS	75-125%	≤20%	≤20%	1.0 mg/kg
Cadmium	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Chromium	ICP/MS	75-125%	≤20%	≤20%	0.2 mg/kg
Copper	ICP/MS	75-125%	≤20%	≤20%	1.0 mg/kg
Lead	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Mercury	CVAA	75-125%	≤20%	≤20%	0.02 mg/kg
Nickel	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Silver	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Zinc	ICP/MS	75-125%	≤20%	≤20%	1.0 mg/kg

METHOD

Nine metals were analyzed for the New York 5 Program: silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). Hg was analyzed using cold-vapor atomic absorption spectroscopy (CVAA) according to the method of Bloom and Crecelius (1983). The remaining metals were analyzed by inductively coupled plasma mass spectrometry (ICP/MS) following a procedure based on EPA Method 200.8 (EPA 1991).

To prepare tissue for analysis, samples were freeze-dried and blended in a Spex mixer-mill. Approximately 5 g of mixed sample was ground in a ceramic ball mill. For ICP/MS and CVAA analyses, 0.2- to 0.5-g aliquots of dried homogenous sample were digested using a mixture of nitric acid and hydrogen peroxide following a modified version of EPA Method 200.3 (EPA 1991).

HOLDING TIMES

Tissue samples were received on 7/13/95 in good condition. Samples were entered into Battelle's log-in system, frozen to -80°C, and subsequently freeze dried within approximately 7 days of sample receipt. Samples were analyzed within 180 days of collection.

QA/QC SUMMARY METALS (continued)

The following table summarizes the analysis dates:

<u>Task</u>	<u>Date Performed</u>
Sample Digestion	8/15/95
ICP-MS	8/29/95
CVAA-Hg	8/23/95

DETECTION LIMITS	Target detection limits were met for all metals except Ag, Cu, Ni and Zn; however, all sample values for these metals were above the achieved method detection limit (MDL). MDLs were determined by spiking seven replicates of the reagent blank and multiplying the standard deviation of the resulting analyses by the student's t-value at the 99th percentile ($t=3.142$).
METHOD BLANKS	One procedural blank was analyzed per 20 samples. No metals were detected in the blanks above the MDLs with the exception of Hg, which was detected at a concentration less than three times the target detection limit. All data were blank corrected.
MATRIX SPIKES	One sample was spiked with all metals at a frequency of 1 per 20 samples. All recoveries were within the QC limits of 75-125%.
REPLICATES	Two samples were analyzed in triplicate at a frequency of 1 per 20 samples. Background clam tissue samples were also analyzed in triplicate. Precision for triplicate analyses was reported by calculating the relative standard deviation (RSD) between the replicate results. RSDs were within the QC limits of $\pm 20\%$ for all metals with the exception of Pb in one set of triplicates (41% RSD) and Cr (26% RSD), Cu (88% RSD), and Pb (41% RSD) in the set of background tissue triplicates. In all cases, only one of the three replicates was variable, with the other two replicates in good agreement. Therefore, no data were flagged or qualified.
SRMs	SRM 1566a, oyster tissue from the National Institute of Standards and Technology (NIST), was analyzed in duplicate at a frequency of 1 per 20 samples. Results for all metals were within $\pm 20\%$ of mean certified value with the exception of Ni in one replicate and Cr in both. Cr was not detected above the MDL in either SRM sample, and the Ni values were variable. The digestion used on these samples may not be rigorous enough to completely digest the form of Cr present in this SRM.

QA/QC SUMMARY METALS (continued)

REFERENCES

Bloom, N. S., and E.A. Crecelius. 1983. Determination of Mercury in Seawater at Sub-Nanogram per Liter Levels. *Mar. Chem.* 14:49-59.

EPA (U.S. Environmental Protection Agency). 1991. Methods for the Determination of Metals in Environmental Samples. EPA-600/4-91-010. U.S. Environmental Protection Agency, Environmental Services Division, Monitoring Management Branch, Washington D.C.

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Chlorinated Pesticides/PCB Congeners

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Clam Tissue

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>Surrogate Recovery</u>	<u>Spike Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit (wet wt)</u>
GC/ECD	30-150%	50-120%	≤30%	0.4 µg/kg

METHOD

Tissues were homogenized wet using a stainless steel blade. An aliquot of tissue sample was extracted with methylene chloride using the roller technique under ambient conditions following a procedure based on methods used by the National Oceanic and Atmospheric Administration for its Status and Trends Program (NOAA 1993). Samples were then cleaned using silica/alumina (5% deactivated) chromatography followed by high performance liquid chromatography (HPLC) cleanup. Extracts were analyzed for 15 chlorinated pesticides and 22 PCB congeners using gas chromatography/electron capture detection (GC/ECD) following a procedure based on EPA Method 8080 (EPA 1986). The column used was a J&W DB-17 and the confirmatory column was a DB-1701, both capillary columns (30m x 0.25mm I.D.). All detections were quantitatively confirmed on the second column.

HOLDING TIMES

Tissue samples were received on 7/13/95 in good condition. Samples were entered into Battelle's log-in system and stored frozen until extraction. Samples were extracted in two batches. The following summarizes the extraction and analysis dates:

<u>Batch</u>	<u>Species</u>	<u>Extraction</u>	<u>Analysis</u>
1	<i>N. virens</i>	9/28/95	10/19-20/95
2	<i>M. nasuta/N. virens</i>	10/16/95	10/20-21/95

One sample, MDRS Replicate 5, was broken during processing. No additional tissue was available for reextraction, so no results are reported for this sample.

QA/QC SUMMARY/PCBs and PESTICIDES (continued)

DETECTION LIMITS	Target detection limits of 0.4 µg/kg wet weight were met for most pesticides and PCB congeners. Three samples that were reextracted due to low initial surrogate recoveries had high detection limits for all compounds. Detection limits were higher for these samples because a smaller sample size was used for the reextraction, due to limited availability of remaining tissue. Method detection limits (MDLs) reported were determined by multiplying the standard deviation of seven spiked replicates of worm tissue by the student's t-value at the 99th percentile ($t=3.142$). The reported MDLs were corrected for individual sample wet weight.
METHOD BLANKS	One method blank was extracted with each extraction batch. No pesticides or PCBs were detected in any of the method blanks, with the exception of aldrin in the blank from batch 1. The amount in the blank was less than three times the MDL; therefore, no further action was taken.
SURROGATES	Two compounds, PCB congeners 103 and 198, were added to all samples prior to extraction to assess the efficiency of the analysis. Sample surrogate recoveries were all within the QC guidelines of 30%-120%. Sample results were quantified based on surrogate recoveries.
MATRIX SPIKES	Eleven out of the 15 pesticides and 5 of the 22 PCB congeners analyzed were spiked into one sample per extraction batch. Matrix spike recoveries were within the control limit range of 50%-120% for all pesticides and PCBs, with the exception of PCB 28 (146%) in batch 2.
REPLICATES	One sample from each extraction batch was analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. RSDs for all detectable values were below the target precision goal of $\leq 30\%$.
SRMs	An appropriate SRM for chlorinated organics in tissues was not available from NIST at the time of these analyses.
MISCELLANEOUS	All pesticide and PCB congener results are confirmed using a second dissimilar column. RSDs between the primary and confirmation values must be less than 75% to be considered a confirmed value.

QA/QC SUMMARY/PCBs and PESTICIDES (continued)

REFERENCES

NYSDEC (New York Department of Environmental Conservation). 1992. *Analytical Method for the Determination of PCB congeners by Fused Silica Capillary Column Gas Chromatography with Electron Capture Detector*. NYSDEC Method 91-11. New York State Department of Environmental Conservation, Albany, New York.

EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D. C.

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH) and 1,4-Dichlorobenzene

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Clam Tissue

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>MS Recovery</u>	<u>Surrogate Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Detection Limit (wet wt)</u>
GC/MS/SIM	50-120%	30-150%	≤30%	≤30%	4 ng/g

METHOD

Tissue samples were extracted with methylene chloride following a procedure based on methods used by the National Oceanic and Atmospheric Administration for its Status and Trends Program (NOAA 1993). Samples were then cleaned using silica/alumina (5% deactivated) chromatography followed by high performance liquid chromatography (HPLC) cleanup.

Extracts were quantified using gas chromatography/mass spectrometry (GC/MS) in the selected ion mode (SIM) following a procedure based on EPA Method 8270 (NOAA 1993).

HOLDING TIMES

Tissue samples were received on 7/13/95 in good condition. Samples were entered into Battelle's log-in system and stored frozen until extraction. The following summarizes the extraction and analysis dates:

<u>Batch</u>	<u>Species</u>	<u>Extraction</u>	<u>Analysis</u>
1	<i>N. virens</i>	9/28/95	10/19-20/95
2	<i>M. nasuta/N. virens</i>	10/16/95	10/20-21/95

One sample, MDRS Replicate 5, was broken during processing. No additional tissue was available for reextraction, so no results are reported for this sample.

QA/QC SUMMARY/PAHs (continued)

DETECTION LIMITS

Target detection limits of 4 µg/kg wet weight were met for all PAH compounds except for fluoranthene and pyrene, which had method detection limits (MDL) between 4 and 6 µg/kg wet weight. MDLs were determined by multiplying the standard deviation of seven spiked replicates of a background clam sample by the student's t-value at the 99th percentile ($t=3.142$). These MDLs were based on a wet weight of 20 grams of tissue sample. Aliquots of samples that were analyzed in triplicate, used for spiking, or were reextracted, were generally less than 20 grams due to limited quantities of tissue available. Because MDLs reported are corrected for sample weight, the MDLs reported for these samples appear elevated and in some cases may exceed the target detection limit.

METHOD BLANKS

One method blank was extracted with each extraction batch. A number the high molecular weight PAHs were detected in the blank analyzed with batch 1, however, all values were less than three times the MDL. Only one PAH analyzed with batch 2, benz[a]anthracene, was detected at less than three times the MDL. Sample values that were less than five times the blank concentration were reported and flagged with a "B" to indicate that those values could be biased high due to blank contamination. Sample values greater than five times the blank concentration were considered unaffected by the blank contamination and were therefore not flagged.

SURROGATES

Five isotopically labeled compounds were added prior to extraction to assess the efficiency of the method. These were d8-naphthalene, d10-acenaphthene, d12-chrysene, d14-dibenz[a,h]anthracene and d4-1,4 dichlorobenzene. Recoveries of all surrogates were within the quality control limits of 30%-150% with the exception of d14-dibenz[a,h]anthracene in three samples from batch 1, d14-dibenz[a,h]anthracene in two samples from batch 2, and d8-naphthalene in one sample from batch 2. Of these low recoveries, all but two were above 20%. Results were quantified using the surrogate internal standard method.

MATRIX SPIKES

One sample from each batch was spiked with all PAH compounds. Matrix spike recoveries were within QC limits of 50%-120%, with the exception of benzo[b]fluoranthene (248%) and naphthalene (121%) in one sample.

REPLICATES

One sample from each batch was extracted and analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. All RSDs for detectable compounds were within $\pm 30\%$.

QA/QC SUMMARY/PAHs (continued)

SRMs

An appropriate SRM for PAHs in tissues was not available from NIST at the time of these analyses.

MISCELLANEOUS

For several compounds the ion-ratio was outside of the QC range, due to low levels in the native sediment. When the native levels are low, the error associated with the concentration measurement of the confirmation ion, which is present at a fraction of the parent ion concentration, increases. Because the confirmation ion is quantified solely from the parent ion, this will not affect the quality of the data.

REFERENCES

NOAA (National Oceanic and Atmospheric Administration). 1993. *Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992. Volume IV. Comprehensive Descriptions of Trace Organic Analytical Methods.* G.G. Lauenstein and A.Y. Cantillo, eds. NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Coastal Monitoring and Bioeffects Assessment Division, Office of Resources Conservation and Assessment, Silver Spring, Maryland.

EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D.C.

Table F.1. Metals in *M. nasuta* Tissue (Wet Weight), Bronx River

Sediment Treatment				Concentration (mg/kg wet wt)									
	Analytical Replicate	Replicate	Batch	Percent Dry Weigh	Ag ICP/MS	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
BX COMP	1		1	13.3	0.0744	4.13	0.0490	0.610	3.29	0.0155	0.590	2.08	13.4
BX COMP	2		1	14.1	0.0736	4.62	0.0490	0.530	3.19	0.0152	0.568	1.78	18.7
BX COMP	3	1	1	13.8	0.0954	3.66	0.0479	0.531	3.55	0.0149	0.479	3.95	16.6
BX COMP	3	2	1	13.8	0.0930	3.64	0.0485	0.529	3.71	0.0147	0.498	2.01	17.1
BX COMP	3	3	1	13.8	0.104	3.86	0.0459	0.584	3.74	0.0149	0.514	2.08	17.1
BX COMP	4		1	15.1	0.0380	3.77	0.0383	0.539	3.12	0.0164	0.469	1.97	20.0
BX COMP	5		1	13.6	0.135	4.77	0.0444	0.530	4.22	0.0148	0.607	2.51	15.3
MDRS ^(a)	1		1	11.7	0.0862	4.07	0.0262	0.384	2.60	0.0150	0.439	0.798	11.0
MDRS	2		1	14.9	0.0994	6.71	0.0320	0.353	3.71	0.0210	0.463	0.907	14.0
MDRS	3		1	11.9	0.0688	3.89	0.0255	0.224	1.75	0.0121	0.318	0.614	10.5
MDRS	4		1	12.2	0.0813	3.68	0.0193	0.262	2.67	0.0147	0.286	0.728	10.8
MDRS	5		1	12.7	0.0493	3.67	0.0209	0.219	1.80	0.0117	0.292	0.515	12.1
Macoma Bkgd. Tissue	1	1	1	14.0	0.0217	4.05	0.0304	0.220	7.96	0.0118	0.673	0.365	14.4
Macoma Bkgd. Tissue	1	2	1	13.8	0.0241	4.05	0.0204	0.345	2.00	0.00891	0.656	0.157	13.6
Macoma Bkgd. Tissue	1	3	1	13.4	0.0164	3.73	0.0240	0.358	1.74	0.0102	0.650	0.220	15.0

(a) MDRS Mud Dump Reference Site.

Table F.2. Metals in *M. nasuta* Tissue (Dry Weight), Bronx River

Sediment Treatment	Analytical Replicat Replicate Batch Dry Weight			Concentration (mg/kg dry wt)									
				Ag ICP/MS	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS	
	Target Detection Limit:			0.1	1.0	0.1	0.2	1.0	0.02	0.1	0.1	1.0	
	Method Detection Limit:			0.22	0.830	0.081	0.0845	1.20	0.0011	0.25	0.08	1.37	
BX COMP	1		1	13.3	0.560	31.1	0.369	4.59	24.8	0.117	4.44	15.7	101
BX COMP	2		1	14.1	0.524	32.9	0.349	3.77	22.7	0.108	4.04	12.7	133
BX COMP	3	1	1	13.8	0.694	26.6	0.348	3.86	25.8	0.108	3.48	28.7	121
BX COMP	3	2	1	13.8	0.676	26.5	0.353	3.85	27.0	0.107	3.62	14.6	124
BX COMP	3	3	1	13.8	0.753	28.1	0.334	4.25	27.2	0.108	3.74	15.1	124
BX COMP	4		1	15.1	0.251	24.9	0.253	3.56	20.6	0.108	3.10	13.0	132
BX COMP	5		1	13.6	0.990	35.0	0.326	3.89	31.0	0.109	4.46	18.4	112
MDRS ^(a)	1		1	11.7	0.737	34.8	0.224	3.28	22.2	0.128	3.75	6.82	93.6
MDRS	2		1	14.9	0.667	45.0	0.215	2.37	24.9	0.141	3.11	6.09	94.0
MDRS	3		1	11.9	0.581	32.8	0.215	1.89	14.8	0.102	2.68	5.18	89.0
MDRS	4		1	12.2	0.665	30.1	0.158	2.14	21.8	0.120	2.34	5.95	88.1
MDRS	5		1	12.7	0.390	29.0	0.165	1.73	14.2	0.0927	2.31	4.07	95.9
Macoma Bkgd. Tissue	1	1	1	14.0	0.155	28.9	0.217	1.57	56.8	0.0842	4.80	2.60	103
Macoma Bkgd. Tissue	1	2	1	13.8	0.175	29.4	0.148	2.50	14.5	0.0646	4.76	1.14	98.4
Macoma Bkgd. Tissue	1	3	1	13.4	0.122	27.8	0.179	2.67	13.0	0.0764	4.85	1.64	112

(a) MDRS Mud Dump Reference Site.

Table F.3. Quality Control Data for Metals Analysis of *M. nasuta* Tissue (Dry Weight)

Sediment Treatment	Analytical			Concentration (mg/kg dry wt)								
	Replicate	Replicate	Batch	Ag ICP/MS	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
Blank		1	1	0.22 U ^(a)	0.830 U	0.0810 U	0.0845 U	1.20 U	0.0427	0.25 U	0.08 U	1.37 U
Blank		2	1	0.22 U	0.830 U	0.0810 U	0.0845 U	1.20 U	0.0399	0.25 U	0.08 U	1.37 U
Matrix Spike Results												
MDRS ^(b)	3	1	1	0.581	32.8	0.215	1.89	14.8	0.102	2.68	5.18	89.0
MDRS (MS)				1.39	57.9	1.06	29.8	39.5	1.07	3.79	29.5	111
Concentration Spiked				1.00	25.0	1.00	25.0	25.0	1.00	1.00	25.0	25.0
Concentration Recovered				0.809	25.1	0.845	27.9	24.7	0.968	1.11	24.3	22.0
Percent Recovered				81	100	85	112	99	97	111	97	88
BX COMP ^(c)	1	1	1	0.560	31.1	0.369	4.59	24.8	NA ^(d)	4.44	15.7	101
BX COMP (MS)				1.48	55.2	1.33	32.3	50.3	NA	30.8	39.3	123
Concentration Spiked				1.00	25.0	1.00	25.0	25.0	NA	25.0	25.0	25.0
Concentration Recovered				0.920	24.1	0.961	27.7	25.5	NA	26.4	23.6	22.0
Percent Recovered				92	96	96	111	102	NA	105	94	88
Standard Reference Material												
1566a		1	1	1.52	14.2	3.94	0.0845 U	69.9	0.0598	3.20	0.330	813
1566a		2	1	1.56	14.5	3.94	0.0845 U	69.3	0.0584	1.41	0.352	814
Certified Value				1.68	14.0	4.15	1.43	66.3	0.0642	2.25	0.371	830
Range				±0.15	±1.2	±0.38	±0.46	±4.3	±0.067	±0.44	±0.014	±57
Percent Difference		1		10	1	5	NA	5	7	42 ^(e)	11	2
		2		7	4	5	NA	5	9	37 ^(e)	5	2
Analytical Replicates												
BX COMP ^(c)	3	1	1	0.694	26.6	0.348	3.86	25.8	0.108	3.48	28.7	121
BX COMP	3	2	1	0.676	26.5	0.353	3.85	27.0	0.107	3.62	14.6	124
BX COMP	3	3	1	0.753	28.1	0.334	4.25	27.2	0.108	3.74	15.1	124
RSD (%)				6	3	3	6	3	1	4	41 ^(f)	1

Table F.3. (contd)

Sediment Treatment	Analytical			Concentration (mg/kg dry wt)								
				Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
	Replicate	Replicate	Batch	ICP/MS	ICP/MS	ICP/MS	ICP/MS	ICP/MS	CVAA	ICP/MS	ICP/MS	ICP/MS
WC COMP ^(c)	3	1	1	0.711	24.5	0.291	3.63	22.5	0.338	2.98	10.1	135
WC COMP	3	2	1	0.792	24.7	0.286	3.46	23.0	0.359	3.11	10.0	137
WC COMP	3	3	1	0.770	24.5	0.305	3.45	23.2	0.368	3.42	10.3	138
RSD (%)				6	0	3	3	2	4	7	2	1
<i>Macoma</i> Bkgd. Tissue	1	1	1	0.155	28.9	0.217	1.57	56.8	0.0842	4.80	2.60	103
<i>Macoma</i> Bkgd. Tissue	1	2	1	0.175	29.4	0.148	2.50	14.5	0.0646	4.76	1.14	98.4
<i>Macoma</i> Bkgd. Tissue	1	3	1	0.122	27.8	0.179	2.67	13.0	0.0764	4.85	1.64	112
RSD (%)				18	3	19	26 ^(f)	88 ^(f)	13	1	41 ^(f)	7

(a) U Undetected at or above given concentration.

(b) MDRS Mud dump reference site.

(c) Sample randomly selected for use as a quality control sample in analytical batch.

(d) NA Not applicable.

(e) Outside SRM quality control criteria ($\leq 20\%$).(f) Outside quality control criteria ($\leq 20\%$) for replicate analysis.

Table F.4. Pesticides and Polychlorinated Biphenyls (PCBs) in Tissue of *M. nasuta* (Wet Weight), Bronx River

Sediment Treatment	Concentration (µg/kg wet wt)				
	BX COMP	BX COMP	BX COMP	BX COMP	BX COMP
Replicate	1	2	3	3	3
Analytical Replicate			1	2	3
Wet Weight (g)	20.2	20.1	9.57	9.79	10.3
Percent Dry Weight	13.3	14.1	13.8	13.8	13.8
Batch	2	2	1	1	1
2,4'-DDD ^(a)	0.64	0.76	0.53 U ^(b)	0.52 U	0.49 U
2,4'-DDE	0.26 U	0.26 U	0.54 U	0.53 U	0.51 U
2,4'-DDT	0.18 U	0.18 U	0.37 U	0.37 U	0.35 U
4,4'-DDD	2.83	3.52	3.11	2.77	2.82
4,4'-DDE	2.71	3.26	3.57	3.12	3.13
4,4'-DDT	1.57	1.61	1.36	0.94	0.94
α-Chlordane	2.34	3.06	2.09	1.85	2.01
Aldrin	1.76	1.92	2.01	1.88	1.86
Dieldrin	1.69	1.88	1.74	1.53	1.68
Endosulfan I	0.18 U	0.18 U	0.37 U	0.37 U	0.35 U
Endosulfan II	0.18 U	0.18 U	0.37 U	0.37 U	0.35 U
Endosulfan Sulfate	0.25 U	0.25 U	0.53 U	0.52 U	0.49 U
Heptachlor	0.51	0.21	0.38 U	0.38 U	0.36 U
Heptachlor Epoxide	0.13 U	0.13 U	0.28 U	0.27 U	0.26 U
Trans Nonachlor	0.63	0.89	0.30 U	0.30 U	0.28 U
PCB 8	5.14	4.73	3.16	2.61	2.57
PCB 18	9.52	9.26	6.77	5.71	5.79
PCB 28	8.00	7.72	8.97	8.38	7.96
PCB 44	0.07 U	0.07 U	0.15 U	0.14 U	0.14 U
PCB 49	4.63	4.99	3.45	3.10	3.11
PCB 52	6.92	7.17	5.89	5.27	5.32
PCB 66	4.58	4.90	4.39	3.75	3.86
PCB 87	0.92	1.04	0.79	0.53	0.60
PCB 101	3.94	4.21	3.43	2.90	3.05
PCB 105	0.87	0.96	0.35 U	0.34 U	0.32 U
PCB 118	2.42	2.59	1.94	1.56	1.61
PCB 128	0.21	0.23	0.22 U	0.21 U	0.20 U
PCB 138	2.04	3.34	1.64	1.32	1.40
PCB 153	2.65	3.03	2.56	2.01	2.03
PCB 170	0.18 U	0.18 U	0.37 U	0.36 U	0.34 U
PCB 180	0.69	0.69	0.78 U	0.77 U	0.73 U
PCB 183	0.18 U	0.18 U	0.38 U	0.37 U	0.36 U
PCB 184	0.18 U	0.18 U	0.38 U	0.37 U	0.36 U
PCB 187	0.96	0.21 U	0.43 U	0.42 U	0.40 U
PCB 195	0.13 U	0.13 U	0.26 U	0.26 U	0.25 U
PCB 206	0.21 U	0.21 U	0.45 U	0.44 U	0.42 U
PCB 209	0.20 U	0.20 U	0.41 U	0.40 U	0.38 U
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	51	64	80	82	83
PCB 198 (SIS)	37	50	74	73	76

Table F.4. (contd)

Sediment Treatment Replicate	Concentration ($\mu\text{g/kg wet wt}$)				
	BX COMP 4	BX COMP 5	MDRS ^(c) 1	MDRS 2	MDRS 3
Analytical Replicate					
Wet Weight (g)	13.3	10.0	20.1	15.2	10.4
Percent Dry Weight	15.1	13.6	11.7	14.9	11.9
Batch	1	1	1	2	1
2,4'-DDD	0.61	0.51 U	0.25 U	0.33 U	0.49 U
2,4'-DDE	0.39 U	0.52 U	0.26 U	0.34 U	0.50 U
2,4'-DDT	0.27 U	0.36 U	0.18 U	0.24 U	0.34 U
4,4'-DDD	3.88	3.22	1.11	0.34 U	1.58
4,4'-DDE	4.02	3.38	1.81	1.61	2.26
4,4'-DDT	1.27	1.14	0.15 U	0.91	0.89
α -Chlordane	2.80	1.83	0.11	0.14	0.18 U
Aldrin	2.12	1.84	0.89	1.21	1.35
Dieldrin	1.90	1.65	0.52 U	0.68 U	0.99 U
Endosulfan I	0.27 U	0.36 U	0.18 U	0.24 U	0.35 U
Endosulfan II	0.27 U	0.36 U	0.18 U	0.24 U	0.35 U
Endosulfan Sulfate	0.38 U	0.51 U	0.25 U	0.33 U	0.49 U
Heptachlor	0.28 U	0.37 U	0.26	0.24 U	0.53
Heptachlor Epoxide	0.20 U	0.27 U	0.13 U	0.18 U	0.25 U
Trans Nonachlor	0.97	0.52	0.15 U	0.19 U	0.28 U
PCB 8	3.99	3.11	0.35 U	0.46 U	0.68 U
PCB 18	8.98	5.53	0.10 U	0.13 U	0.20 U
PCB 28	10.6	8.59	2.16	1.51	3.03
PCB 44	3.01	0.14 U	0.07 U	0.09 U	0.14 U
PCB 49	4.78	3.36	1.26	1.72	1.07
PCB 52	7.58	5.86	1.66	2.12	1.56
PCB 66	5.86	4.33	2.01	2.61	0.29 U
PCB 87	1.24	0.76	0.25 U	0.33 U	0.48 U
PCB 101	4.76	3.64	1.30	1.58	1.24
PCB 105	0.67	0.33 U	0.17 U	0.71	0.32 U
PCB 118	2.74	1.93	0.91	1.32	0.64
PCB 128	0.23	0.21 U	0.11 U	0.14 U	0.20 U
PCB 138	2.23	1.70	0.68	0.83	0.51 U
PCB 153	3.30	2.55	0.79	0.95	0.84 U
PCB 170	0.37	0.35 U	0.18 U	0.23 U	0.34 U
PCB 180	1.08	0.77	0.38 U	0.50 U	0.72 U
PCB 183	0.28 U	0.37 U	0.18 U	0.24 U	0.35 U
PCB 184	0.28 U	0.37 U	0.18 U	0.24 U	0.35 U
PCB 187	0.31 U	0.41 U	0.21 U	0.27 U	0.40 U
PCB 195	0.19 U	0.25 U	0.13 U	0.17 U	0.24 U
PCB 206	0.32 U	0.43 U	0.21 U	0.28 U	0.41 U
PCB 209	0.29 U	0.39 U	0.20 U	0.26 U	0.37 U
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	87	84	92	89	81
PCB 198 (SIS)	80	82	88	73	78

Table F.4. (contd)

Sediment Treatment Replicate	Concentration ($\mu\text{g/kg}$ wet wt)				
	MDRS 4	MDRS 5	Macoma Bkgd. Tissue 1	Macoma Bkgd. Tissue 2	Macoma Bkgd. Tissue 3
Analytical Replicate					
Wet Weight (g)	20.7	20.2	14.3	10.2	10.5
Percent Dry Weight	12.2	12.7	13.7	13.7	13.7
Batch	1	2	2	2	2
2,4'-DDD	0.24 U	NA ^(d)	0.35 U	0.50 U	0.49 U
2,4'-DDE	0.25 U	NA	0.37 U	0.51 U	0.50 U
2,4'-DDT	0.17 U	NA	0.25 U	0.35 U	0.34 U
4,4'-DDD	1.15	NA	0.36 U	0.51 U	0.50 U
4,4'-DDE	2.00	NA	0.26 U	0.37 U	0.36 U
4,4'-DDT	0.59	NA	0.21 U	0.30 U	0.29 U
α -Chlordane	0.12	NA	0.13 U	0.19 U	0.18 U
Aldrin	0.93	NA	0.18 U	0.25 U	0.24 U
Dieldrin	0.49 U	NA	0.72 U	1.01 U	0.99 U
Endosulfan I	0.17 U	NA	0.25 U	0.35 U	0.35 U
Endosulfan II	0.17 U	NA	0.25 U	0.35 U	0.35 U
Endosulfan Sulfate	0.24 U	NA	0.35 U	0.50 U	0.49 U
Heptachlor	0.18 U	NA	0.26 U	0.36 U	0.36 U
Heptachlor Epoxide	0.13 U	NA	0.19 U	0.26 U	0.25 U
Trans Nonachlor	0.14 U	NA	0.20 U	0.28 U	0.28 U
PCB 8	0.34 U	NA	0.49 U	0.69 U	0.68 U
PCB 18	0.10 U	NA	0.14 U	0.20 U	0.20 U
PCB 28	2.54	NA	0.15 U	0.22 U	0.21 U
PCB 44	0.07 U	NA	0.10 U	0.14 U	0.14 U
PCB 49	1.34	NA	0.26 U	0.36 U	0.35 U
PCB 52	1.60	NA	0.45 U	0.64 U	0.62 U
PCB 66	2.31	NA	0.21 U	0.30 U	0.29 U
PCB 87	0.27	NA	0.35 U	0.49 U	0.48 U
PCB 101	1.64	NA	0.19 U	0.26 U	0.26 U
PCB 105	0.16 U	NA	0.23 U	0.33 U	0.32 U
PCB 118	1.12	NA	0.27 U	0.37 U	0.37 U
PCB 128	0.10 U	NA	0.15 U	0.21 U	0.20 U
PCB 138	0.71	NA	0.37 U	0.52 U	0.51 U
PCB 153	0.97	NA	0.61 U	0.86 U	0.84 U
PCB 170	0.17 U	NA	0.25 U	0.34 U	0.34 U
PCB 180	0.36 U	NA	0.53 U	0.74 U	0.72 U
PCB 183	0.18 U	NA	0.26 U	0.36 U	0.35 U
PCB 184	0.18 U	NA	0.26 U	0.36 U	0.35 U
PCB 187	0.20 U	NA	0.29 U	0.40 U	0.40 U
PCB 195	0.12 U	NA	0.18 U	0.25 U	0.24 U
PCB 206	0.21 U	NA	0.30 U	0.42 U	0.41 U
PCB 209	0.19 U	NA	0.27 U	0.38 U	0.37 U
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	83	NA	105	103	104
PCB 198 (SIS)	78	NA	94	84	88

(a) Target detection limits are 0.4 ng/g for all analytes.

(b) U Undetected at or above given concentration.

(c) MDRS Mud Dump Reference Site.

(d) NA Not available; sample dropped during processing.

Table F.5. Pesticides and Polychlorinated Biphenyls (PCBs) in Tissue of *M. nasuta* (Dry Weight), Bronx River

Sediment Treatment Replicate	Concentration (µg/kg dry wt)				
	BX COMP 1	BX COMP 2	BX COMP 3	BX COMP 3	BX COMP 3
Analytical Replicate			1	2	3
Wet Weight (g)	20.2	20.1	9.57	9.79	10.3
Percent Dry Weight	13.3	14.1	13.8	13.8	13.8
Batch	2	2	1	1	1
2,4'-DDD	4.8	5.4	3.9 U ^(a)	3.8 U	3.6 U
2,4'-DDE	2.0 U	1.9 U	3.9 U	3.9 U	3.7 U
2,4'-DDT	1.4 U	1.3 U	2.7 U	2.7 U	2.5 U
4,4'-DDD	21.3	25.1	22.6	20.1	20.5
4,4'-DDE	20.4	23.2	26.0	22.7	22.8
4,4'-DDT	11.8	11.5	9.89	6.8	6.8
α-Chlordane	17.6	21.8	15.2	13.5	14.6
Aldrin	13.3	13.7	14.6	13.7	13.5
Dieldrin	12.7	13.4	12.7	11.1	12.2
Endosulfan I	1.4 U	1.3 U	2.7 U	2.7 U	2.5 U
Endosulfan II	1.4 U	1.3 U	2.7 U	2.7 U	2.5 U
Endosulfan Sulfate	1.9 U	1.8 U	3.9 U	3.8 U	3.6 U
Heptachlor	3.8	1.5	2.8 U	2.8 U	2.6 U
Heptachlor Epoxide	1.0 U	0.93 U	2.0 U	2.0 U	1.9 U
Trans Nonachlor	4.7	6.3	2.2 U	2.2 U	2.0 U
PCB 8	38.7	33.7	23.0	19.0	18.7
PCB 18	71.7	65.9	49.2	41.5	42.1
PCB 28	60.2	54.9	65.2	60.9	57.9
PCB 44	0.5 U	0.5 U	1.1 U	1.0 U	1.0 U
PCB 49	34.9	35.5	25.1	22.5	22.6
PCB 52	52.1	51.0	42.8	38.3	38.7
PCB 66	34.5	34.9	31.9	27.3	28.1
PCB 87	6.9	7.40	5.7	3.9	4.4
PCB 101	29.7	30.0	24.9	21.1	22.2
PCB 105	6.6	6.8	2.5 U	2.5 U	2.3 U
PCB 118	18.2	18.4	14.1	11.3	11.7
PCB 128	1.6	1.6	1.6 U	1.5 U	1.5 U
PCB 138	15.4	23.8	11.9	9.60	10.2
PCB 153	20.0	21.6	18.6	14.6	14.8
PCB 170	1.4 U	1.3 U	2.7 U	2.6 U	2.5 U
PCB 180	5.2	4.9	5.7 U	5.6 U	5.3 U
PCB 183	1.4 U	1.3 U	2.8 U	2.7 U	2.6 U
PCB 184	1.4 U	1.3 U	2.8 U	2.7 U	2.6 U
PCB 187	7.2	1.5 U	3.1 U	3.1 U	2.9 U
PCB 195	1.0 U	0.93 U	1.9 U	1.9 U	1.8 U
PCB 206	1.6 U	1.5 U	3.3 U	3.2 U	3.1 U
PCB 209	1.5 U	1.4 U	3.0 U	2.9 U	2.8 U

Table F.5. (contd)

Sediment Treatment Replicate	Concentration ($\mu\text{g/kg dry wt}$)				
	BX COMP 4	BX COMP 5	MDRS ^(b) 1	MDRS 2	MDRS 3
Analytical Replicate					
Wet Weight (g)	13.3	10.0	20.1	15.2	10.4
Percent Dry Weight	15.1	13.6	11.7	14.9	11.9
Batch	1	1	1	2	1
2,4'-DDD	4.0	3.7 U	2.1 U	2.2 U	4.1 U
2,4'-DDE	2.6 U	3.8 U	2.2 U	2.3 U	4.2 U
2,4'-DDT	1.8 U	2.6 U	1.5 U	1.6 U	2.9 U
4,4'-DDD	25.6	23.6	9.45	2.3 U	13.3
4,4'-DDE	26.6	24.8	15.4	10.8	19.1
4,4'-DDT	8.39	8.37	1.3 U	6.1	7.5
α -Chlordane	18.5	13.4	0.94	0.94	1.5 U
Aldrin	14.0	13.5	7.6	8.12	11.4
Dieldrin	12.5	12.1	4.4 U	4.6 U	8.4 U
Endosulfan I	1.8 U	2.6 U	1.5 U	1.6 U	3.0 U
Endosulfan II	1.8 U	2.6 U	1.5 U	1.6 U	3.0 U
Endosulfan Sulfate	2.5 U	3.7 U	2.1 U	2.2 U	4.1 U
Heptachlor	1.8 U	2.7 U	2.2	1.6 U	4.5
Heptachlor Epoxide	1.3 U	2.0 U	1.1 U	1.2 U	2.1 U
Trans Nonachlor	6.4	3.8	1.3 U	1.3 U	2.4 U
PCB 8	26.4	22.8	3.0 U	3.1 U	5.7 U
PCB 18	59.3	40.6	0.85 U	0.87 U	1.7 U
PCB 28	69.9	63.1	18.4	10.1	25.6
PCB 44	19.9	1.0 U	0.6 U	0.6 U	1.2 U
PCB 49	31.6	24.7	10.7	11.5	9.03
PCB 52	50.1	43.0	14.1	14.2	13.2
PCB 66	38.7	31.8	17.1	17.5	2.4 U
PCB 87	8.19	5.6	2.1 U	2.2 U	4.1 U
PCB 101	31.4	26.7	11.1	10.6	10.5
PCB 105	4.4	2.4 U	1.4 U	4.8	2.7 U
PCB 118	18.1	14.2	7.8	8.86	5.4
PCB 128	1.5	1.5 U	0.94 U	0.94 U	1.7 U
PCB 138	14.7	12.5	5.8	5.6	4.3 U
PCB 153	21.8	18.7	6.7	6.4	7.1 U
PCB 170	2.4	2.6 U	1.5 U	1.5 U	2.9 U
PCB 180	7.13	5.7	3.2 U	3.4 U	6.1 U
PCB 183	1.8 U	2.7 U	1.5 U	1.6 U	3.0 U
PCB 184	1.8 U	2.7 U	1.5 U	1.6 U	3.0 U
PCB 187	2.0 U	3.0 U	1.8 U	1.8 U	3.4 U
PCB 195	1.3 U	1.8 U	1.1 U	1.1 U	2.0 U
PCB 206	2.1 U	3.2 U	1.8 U	1.9 U	3.5 U
PCB 209	1.9 U	2.9 U	1.7 U	1.7 U	3.1 U

Table F.5. (contd)

Sediment Treatment Replicate	Concentration (µg/kg dry wt)				
	MDRS 4	MDRS 5	Macoma Bkgd. Tissue 1	Macoma Bkgd. Tissue 2	Macoma Bkgd. Tissue 3
Analytical Replicate					
Wet Weight (g)	20.7	20.2	14.3	10.2	10.5
Percent Dry Weight	12.2	12.7	13.7	13.7	13.7
Batch	1	2	2	2	2
2,4'-DDD	2.0 U	NA ^(c)	2.5 U	3.6 U	3.6 U
2,4'-DDE	2.0 U	NA	2.7 U	3.7 U	3.6 U
2,4'-DDT	1.4 U	NA	1.8 U	2.5 U	2.5 U
4,4'-DDD	9.40	NA	2.6 U	3.7 U	3.6 U
4,4'-DDE	16.4	NA	1.9 U	2.7 U	2.6 U
4,4'-DDT	4.8	NA	1.5 U	2.2 U	2.1 U
α-Chlordane	1.0	NA	0.95 U	1.4 U	1.3 U
Aldrin	7.6	NA	1.3 U	1.8 U	1.7 U
Dieldrin	4.0 U	NA	5.2 U	7.35 U	7.2 U
Endosulfan I	1.4 U	NA	1.8 U	2.5 U	2.5 U
Endosulfan II	1.4 U	NA	1.8 U	2.5 U	2.5 U
Endosulfan Sulfate	2.0 U	NA	2.5 U	3.6 U	3.6 U
Heptachlor	1.5 U	NA	1.9 U	2.6 U	2.6 U
Heptachlor Epoxide	1.1 U	NA	1.4 U	1.9 U	1.8 U
Trans Nonachlor	1.1 U	NA	1.5 U	2.0 U	2.0 U
PCB 8	2.8 U	NA	3.6 U	5.0 U	4.9 U
PCB 18	0.82 U	NA	1.0 U	1.5 U	1.5 U
PCB 28	20.8	NA	1.1 U	1.6 U	1.5 U
PCB 44	0.6 U	NA	0.73 U	1.0 U	1.0 U
PCB 49	11.0	NA	1.9 U	2.6 U	2.5 U
PCB 52	13.1	NA	3.3 U	4.7 U	4.5 U
PCB 66	18.9	NA	1.5 U	2.2 U	2.1 U
PCB 87	2.2	NA	2.5 U	3.6 U	3.5 U
PCB 101	13.4	NA	1.4 U	1.9 U	1.9 U
PCB 105	1.3 U	NA	1.7 U	2.4 U	2.3 U
PCB 118	9.16	NA	2.0 U	2.7 U	2.7 U
PCB 128	0.82 U	NA	1.1 U	1.5 U	1.5 U
PCB 138	5.8	NA	2.7 U	3.8 U	3.7 U
PCB 153	7.9	NA	4.4 U	6.3 U	6.1 U
PCB 170	1.4 U	NA	1.8 U	2.5 U	2.5 U
PCB 180	2.9 U	NA	3.9 U	5.4 U	5.2 U
PCB 183	1.5 U	NA	1.9 U	2.6 U	2.5 U
PCB 184	1.5 U	NA	1.9 U	2.6 U	2.5 U
PCB 187	1.6 U	NA	2.1 U	2.9 U	2.9 U
PCB 195	1.0 U	NA	1.3 U	1.8 U	1.7 U
PCB 206	1.7 U	NA	2.2 U	3.1 U	3.0 U
PCB 209	1.6 U	NA	2.0 U	2.8 U	2.7 U

(a) U Undetected at or above given concentration.

(b) MDRS Mud Dump Reference Site.

(c) NA Not available; sample dropped during processing.

Table F.6. Quality Control Data for Pesticide and Polychlorinated Biphenyl (PCB) Analysis of *M. nasuta* Tissue (Wet Weight)

Sediment Treatment	Matrix Spike Results						
			Concentration (µg/kg wet wt)				Percent Recovery
	Blank	Blank	BX COMP ^(a)	BX COMP	Concentration		
	1	1	5	(MS)	Spiked	Recovered	
Replicate	1	1	5	(MS)			
Analytical Replicate	1	1	1				
Wet Weight (g)	20.0		10.0	NA	NA		
Percent Dry Weight	NA	NA	13.6	NA	NA		
Batch	1	2	1	1			
2,4'-DDD	0.25 U ^(b)	0.32 U	0.51 U	0.47 U	NS ^(c)	NA ^(d)	NA
2,4'-DDE	0.26 U	0.33 U	0.52 U	0.49 U	NS	NA	NA
2,4'-DDT	0.18 U	0.23 U	0.36 U	0.33 U	NS	NA	NA
4,4'-DDD	0.26 U	0.33 U	3.22	7.48	4.65	4.26	92
4,4'-DDE	0.19 U	0.24 U	3.38	6.61	4.65	3.23	69
4,4'-DDT	0.15 U	0.19 U	1.14	5.03	4.65	3.89	84
α-Chlordane	0.10 U	0.12 U	1.83	5.59	4.65	NA	NA
Aldrin	0.13 U	0.16 U	1.84	5.43	4.65	3.59	77
Dieldrin	0.52 U	0.65 U	1.65	5.22	4.65	3.57	77
Endosulfan I	0.18 U	0.23 U	0.36 U	3.54	4.65	3.54	76
Endosulfan II	0.18 U	0.23 U	0.36 U	4.47	4.65	4.47	96
Endosulfan Sulfate	0.25 U	0.32 U	0.51 U	4.10	4.65	4.10	88
Heptachlor	0.19 U	0.23 U	0.37 U	4.03	4.65	4.03	87
Heptachlor Epoxide	0.13 U	0.17 U	0.27 U	3.50	4.65	3.50	75
Trans Nonachlor	0.15 U	0.18 U	0.29 U	0.27 U	NS	NA	NA
PCB 8	0.35 U	0.44 U	3.11	0.65 U	NS	NA	NA
PCB 18	0.10 U	0.22	5.53	0.19 U	NS	NA	NA
PCB 28	0.11 U	0.14 U	8.59	13.5	5.92	4.92	83
PCB 44	0.07 U	0.09 U	0.14 U	0.13 U	NS	NA	NA
PCB 49	0.18 U	0.23 U	3.36	3.11	NS	NA	NA
PCB 52	0.32 U	0.41 U	5.86	17.4	12.4	11.6	93
PCB 66	0.15 U	0.19 U	4.33	3.65	NS	NA	NA
PCB 87	0.25 U	0.32 U	0.76	0.76	NS	NA	NA
PCB 101	0.13 U	0.17 U	3.64	12.8	8.39	9.16	109
PCB 105	0.17 U	0.21 U	0.33 U	0.31 U	NS	NA	NA
PCB 118	0.19 U	0.24 U	1.93	0.36 U	NS	NA	NA
PCB 128	0.11 U	0.13 U	0.21 U	0.20 U	NS	NA	NA
PCB 138	0.27 U	0.34 U	1.70	5.83	3.79	4.13	109
PCB 153	0.44 U	0.55 U	2.55	8.10	4.91	5.55	113
PCB 170	0.18 U	0.22 U	0.35 U	0.33 U	NS	NA	NA
PCB 180	0.38 U	0.47 U	0.77	0.70 U	NS	NA	NA
PCB 183	0.18 U	0.23 U	0.37 U	0.34 U	NS	NA	NA
PCB 184	0.18 U	0.23 U	0.37 U	0.34 U	NS	NA	NA
PCB 187	0.21 U	0.26 U	0.41 U	0.38 U	NS	NA	NA
PCB 195	0.13 U	0.16 U	0.25 U	0.24 U	NS	NA	NA
PCB 206	0.21 U	0.27 U	0.43 U	0.40 U	NS	NA	NA
PCB 209	0.20 U	0.25 U	0.39 U	0.36 U	NS	NA	NA
<u>Surrogate Recoveries (%)</u>							
PCB 103 (SIS)	104	113	84	87	NA	NA	NA
PCB 198 (SIS)	108	107	82	81	NA	NA	NA

Table F.6. (contd)

Sediment Treatment Replicate	Matrix Spike Results				Percent Recovery
	Concentration (µg/kg wet wt)				
	MDRS ^(e)	MDRS (MS)	Concentration		
			Spiked	Recovered	
Analytical Replicate	1				
Wet Weight (g)	15.2	NA	NA		
Percent Dry Weight	14.9	NA	NA		
Batch	2	2			
2,4'-DDD	0.33 U	0.30 U	NS	NA	NA
2,4'-DDE	0.34 U	0.31 U	NS	NA	NA
2,4'-DDT	0.24 U	0.21 U	NS	NA	NA
4,4'-DDD	0.34 U	3.84	3.00	3.84	128 ^(f)
4,4'-DDE	1.61	4.38	3.00	2.77	92
4,4'-DDT	0.91	2.84	3.00	1.93	64
α-Chlordane	0.14	2.57	3.00	2.43	81
Aldrin	1.21	3.49	3.00	2.28	76
Dieldrin	0.68 U	3.06	3.00	3.06	102
Endosulfan I	0.24 U	2.37	3.00	2.37	79
Endosulfan II	0.24 U	2.31	3.00	2.31	77
Endosulfan Sulfate	0.33 U	2.52	3.00	2.52	84
Heptachlor	0.24 U	3.02	3.00	3.02	101
Heptachlor Epoxide	0.18 U	2.82	3.00	2.82	94
Trans Nonachlor	0.19 U	0.17 U	NS	NA	NA
PCB 8	0.46 U	0.42 U	NS	NA	NA
PCB 18	0.13 U	0.12 U	NS	NA	NA
PCB 28	0.15 U	5.61	3.83	5.61	146 ^(f)
PCB 44	0.09 U	0.08 U	NS	NA	NA
PCB 49	1.72	1.58	NS	NA	NA
PCB 52	2.12	10.1	7.98	8.00	100
PCB 66	2.61	2.47	NS	NA	NA
PCB 87	0.33 U	0.30 U	NS	NA	NA
PCB 101	1.58	7.46	5.42	5.88	108
PCB 105	0.71	0.20 U	NS	NA	NA
PCB 118	1.32	1.15	NS	NA	NA
PCB 128	0.14 U	0.13 U	NS	NA	NA
PCB 138	0.83	3.30	2.44	2.47	101
PCB 153	0.95	4.13	3.17	3.18	100
PCB 170	0.23 U	0.21 U	NS	NA	NA
PCB 180	0.50 U	0.45 U	NS	NA	NA
PCB 183	0.24 U	0.22 U	NS	NA	NA
PCB 184	0.24 U	0.22 U	NS	NA	NA
PCB 187	0.27 U	0.25 U	NS	NA	NA
PCB 195	0.17 U	0.15 U	NS	NA	NA
PCB 206	0.28 U	0.26 U	NS	NA	NA
PCB 209	0.26 U	0.23 U	NS	NA	NA
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	89	97	NA	NA	NA
PCB 198 (SIS)	73	85	NA	NA	NA

Table F.6. (contd)

Sediment Treatment	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet wt)			
	BX COMP ^(a)	BX COMP	BX COMP	
Replicate	3	3	3	
Analytical Replicate	1	2	3	
Wet Weight (g)	9.57	9.79	10.3	
Percent Dry Weight	86.3	NA	NA	
Batch	1	1	1	
2,4'-DDD	0.53 U	0.52 U	0.49 U	NA
2,4'-DDE	0.54 U	0.53 U	0.51 U	NA
2,4'-DDT	0.37 U	0.37 U	0.35 U	NA
4,4'-DDD	3.11	2.77	2.82	6
4,4'-DDE	3.57	3.12	3.13	8
4,4'-DDT	1.36	0.94	0.94	22
α-Chlordane	2.09	1.85	2.01	6
Aldrin	2.01	1.88	1.86	4
Dieldrin	1.74	1.53	1.68	7
Endosulfan I	0.37 U	0.37 U	0.35 U	NA
Endosulfan II	0.37 U	0.37 U	0.35 U	NA
Endosulfan Sulfate	0.53 U	0.52 U	0.49 U	NA
Heptachlor	0.38 U	0.38 U	0.36 U	NA
Heptachlor Epoxide	0.28 U	0.27 U	0.26 U	NA
Trans Nonachlor	0.30 U	0.30 U	0.28 U	NA
PCB 8	3.16	2.61	2.57	12
PCB 18	6.77	5.71	5.79	10
PCB 28	8.97	8.38	7.96	6
PCB 44	0.15 U	0.14 U	0.14 U	NA
PCB 49	3.45	3.10	3.11	6
PCB 52	5.89	5.27	5.32	6
PCB 66	4.39	3.75	3.86	9
PCB 87	0.79	0.53	0.60	21
PCB 101	3.43	2.90	3.05	9
PCB 105	0.35 U	0.34 U	0.32 U	NA
PCB 118	1.94	1.56	1.61	12
PCB 128	0.22 U	0.21 U	0.20 U	NA
PCB 138	1.64	1.32	1.40	11
PCB 153	2.56	2.01	2.03	14
PCB 170	0.37 U	0.36 U	0.34 U	NA
PCB 180	0.78 U	0.77 U	0.73 U	NA
PCB 183	0.38 U	0.37 U	0.36 U	NA
PCB 184	0.38 U	0.37 U	0.36 U	NA
PCB 187	0.43 U	0.42 U	0.40 U	NA
PCB 195	0.26 U	0.26 U	0.25 U	NA
PCB 206	0.45 U	0.44 U	0.42 U	NA
PCB 209	0.41 U	0.40 U	0.38 U	NA
<u>Surrogate Recoveries (%)</u>				
PCB 103 (SIS)	80	82	83	NA
PCB 198 (SIS)	74	73	76	NA

Table F.6. (contd)

Sediment Treatment Replicate	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet wt)			
	Macoma Bkgd.	Macoma Bkgd.	Macoma Bkgd.	
	Tissue	Tissue	Tissue	
Analytical Replicate	1	2	3	
Wet Weight (g)	14.3	10.2	10.5	
Percent Dry Weight	14.0	13.8	13.4	
Batch	2	2	2	
2,4'-DDD	0.35 U	0.50 U	0.49 U	NA
2,4'-DDE	0.37 U	0.51 U	0.50 U	NA
2,4'-DDT	0.25 U	0.35 U	0.34 U	NA
4,4'-DDD	0.36 U	0.51 U	0.50 U	NA
4,4'-DDE	0.26 U	0.37 U	0.36 U	NA
4,4'-DDT	1.07	0.30 U	0.29 U	NA
α-Chlordane	0.13 U	0.19 U	0.18 U	NA
Aldrin	0.18 U	0.25 U	0.24 U	NA
Dieldrin	0.72 U	1.01 U	0.99 U	NA
Endosulfan I	0.25 U	0.35 U	0.35 U	NA
Endosulfan II	0.25 U	0.35 U	0.35 U	NA
Endosulfan Sulfate	0.35 U	0.50 U	0.49 U	NA
Heptachlor	0.26 U	0.36 U	0.36 U	NA
Heptachlor Epoxide	0.19 U	0.26 U	0.25 U	NA
Trans Nonachlor	0.20 U	0.28 U	0.28 U	NA
PCB 8	0.49 U	0.69 U	0.68 U	NA
PCB 18	0.14 U	0.20 U	0.20 U	NA
PCB 28	0.15 U	0.22 U	0.21 U	NA
PCB 44	0.10 U	0.14 U	0.14 U	NA
PCB 49	0.26 U	0.36 U	0.35 U	NA
PCB 52	0.45 U	0.64 U	0.62 U	NA
PCB 66	0.21 U	0.30 U	0.29 U	NA
PCB 87	0.35 U	0.49 U	0.48 U	NA
PCB 101	0.19 U	0.26 U	0.26 U	NA
PCB 105	0.23 U	0.33 U	0.32 U	NA
PCB 118	0.27 U	0.37 U	0.37 U	NA
PCB 128	0.15 U	0.21 U	0.20 U	NA
PCB 138	0.37 U	0.52 U	0.51 U	NA
PCB 153	0.61 U	0.86 U	0.84 U	NA
PCB 170	0.25 U	0.34 U	0.34 U	NA
PCB 180	0.53 U	0.74 U	0.72 U	NA
PCB 183	0.26 U	0.36 U	0.35 U	NA
PCB 184	0.26 U	0.36 U	0.35 U	NA
PCB 187	0.29 U	0.40 U	0.40 U	NA
PCB 195	0.18 U	0.25 U	0.24 U	NA
PCB 206	0.30 U	0.42 U	0.41 U	NA
PCB 209	0.27 U	0.38 U	0.37 U	NA
<u>Surrogate Recoveries (%)</u>				
PCB 103 (SIS)	105	103	104	NA
PCB 198 (SIS)	94	84	88	NA

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) U Undetected at or above given concentration.

(c) NS Not spiked.

(d) NA Not applicable.

(e) MDRS Mud Dump Reference Site.

(f) Outside quality control criteria (50-120%) for spike recovery.

Table F.7. Polynuclear Aromatic Hydrocarbons (PAHs) in *M. nasuta* Tissue
(Wet Weight), Bronx River

Sediment Treatment	Concentration (µg/kg wet wt)				
	BX COMP	BX COMP	BX COMP	BX COMP	BX COMP
Replicate	1	2	3	3	3
Analytical Replicate			1	2	3
Wet Weight (g)	20.2	20.1	9.6	9.8	10.3
Percent Dry Weight	13.3	14.1	13.8	NA	NA
Batch	2	2	1	1	1
1,4-Dichlorobenzene ^(a)	1.86 U ^(b)	1.86 U	4.18 U	4.09 U	3.88 U
Naphthalene	3.64 ^(c)	4.11	6.46	5.85	6.13
Acenaphthylene	2.69 ^(c)	2.45 ^(c)	1.65	1.12 U	1.07 U
Acenaphthene	8.18	5.65	4.63	3.24	2.90
Fluorene	8.73	6.56	4.78	4.35	3.70
Phenanthrene	53.9	41.0	40.5	33.9	36.5
Anthracene	27.5	25.1	24.0	19.3	19.9
Fluoranthene	269	256	233	182	191
Pyrene	330	309	312	265	263
Benzo[a]anthracene	114	122	118	99.9	103
Chrysene	144	150	113	92.2	97.6
Benzo[b]fluoranthene	92.2	102	128	97.1	101
Benzo[k]fluoranthene	25.5	28.4	15.8	12.1	12.3
Benzo[a]pyrene	57.5	65.7	61.4	47.3	49.2
Indeno[123-cd]pyrene	10.9	13.8	9.92	7.25 B ^(d)	8.11
Dibenzo[a,h]anthracene	3.37	4.22	3.16 B	2.49 U	2.53 B
Benzo[g,h,i]perylene	13.6	16.3	10.6	7.40	8.44
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	20 ^(e)	29 ^(e)	48	41	45
d8 Naphthalene	27 ^(e)	37	53	47	50
d10 Acenaphthene	34	44	49	50	57
d12 Chrysene	34	47	52	48	51
d14 Dibenzo[a,h]anthracene	42	58	33	31	31

Table F.7. (contd)

Sediment Treatment Replicate	Concentration ($\mu\text{g/kg wet wt}$)				
	BX COMP 4	BX COMP 5	MDRS ^(f) 1	MDRS 2	MDRS 3
Analytical Replicate					
Wet Weight (g)	13.3	9.97	20.1	15.2	10.4
Percent Dry Weight	15.1	13.6	11.7	14.9	11.9
Batch	1	1	1	2	1
1,4-Dichlorobenzene	3.01 U	4.01	1.99 U	2.46 U	3.85 U
Naphthalene	6.29	4.91 U	2.22	2.62	5.96
Acenaphthylene	2.23	1.10	0.55 U	1.16 ^(c)	1.06 U
Acenaphthene	5.08	2.79 U	1.38 U	1.72 U	2.68 U
Fluorene	3.62	2.75 U	1.27 U	2.04	2.46 U
Phenanthrene	46.2	32.7	2.66 U	3.38 U	5.14 U
Anthracene	25.9	17.5	2.24 U	3.07 ^(c)	4.33 U
Fluoranthene	241	184	8.44	10.5	9.18
Pyrene	302	226	24.4	23.5	25.2
Benzo[a]anthracene	131	104	7.50	10.0	8.03
Chrysene	135	103	5.25	6.97	6.25
Benzo[b]fluoranthene	138	107	14.6	15.1	16.7
Benzo[k]fluoranthene	17.9	13.1	2.31	6.12	2.89 U
Benzo[a]pyrene	71.3	52.9	6.32	8.53	7.51
Indeno[123-cd]pyrene	13.7	8.60	1.94 B	2.33 U	2.95 U
Dibenzo[a,h]anthracene	3.42 B	2.45 B	1.21 U	1.66 U	2.35 U
Benzo[g,h,i]perylene	14.7	8.64 U	1.91 B	3.47	2.06 U
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	48	40	49	48	39
d8 Naphthalene	55	48	55	59	44
d10 Acenaphthene	66	63	67	69	62
d12 Chrysene	72	62	52	68	41
d14 Dibenzo[a,h]anthracene	71	49	36	85	16 ^(e)

Table F.7. (contd)

Sediment Treatment	Concentration ($\mu\text{g/kg wet wt}$)				
	MDRS	MDRS	Macoma Bkgd.	Macoma Bkgd.	Macoma Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate			1	2	3
Wet Weight (g)	20.7	20.2	14.3	10.2	10.5
Percent Dry Weight	12.2	12.7	13.7	13.7	13.7
Batch	1	2	2	2	2
1,4-Dichlorobenzene	1.94 U	NA ^(g)	2.61 U	3.65 U	3.58 U
Naphthalene	2.99	NA	2.64 ^(c)	3.65 U	3.58 U
Acenaphthylene	0.53 U	NA	1.02 U	1.42 U	1.39 U
Acenaphthene	1.34 U	NA	1.83 U	2.56 U	2.50 U
Fluorene	1.24 U	NA	1.73 U	2.42 U	2.37 U
Phenanthrene	2.79	NA	3.58 U	5.02 U	4.91 U
Anthracene	2.18 U	NA	3.13 U	4.39 U	4.30 U
Fluoranthene	8.31	NA	7.51 U	10.5 U	10.3 U
Pyrene	21.3	NA	6.40 U	8.95 U	8.77 U
Benzo[a]anthracene	8.40	NA	2.52 B	3.06 B	3.11 ^(c)
Chrysene	6.43	NA	3.18 U	4.45 U	4.35 U
Benzo[b]fluoranthene	16.5	NA	2.30 U	3.22 U	3.15 U
Benzo[k]fluoranthene	2.40	NA	2.34 U	3.27 U	3.21 U
Benzo[a]pyrene	7.35	NA	2.09 U	2.93 U	2.87 U
Indeno[123-cd]pyrene	1.75 B	NA	2.47 U	3.45 U	3.38 U
Dibenzo[a,h]anthracene	1.18 U	NA	1.76 U	2.47 U	2.42 U
Benzo[g,h,i]perylene	1.81 B	NA	1.96 U	2.75 U	2.69 U
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	42	NA	42	63	48
d8 Naphthalene	48	NA	52	73	61
d10 Acenaphthene	61	NA	67	80	71
d12 Chrysene	55	NA	87	79	82
d14 Dibenzo[a,h]anthracene	35	NA	108	96	101

- (a) Target detection limits are 4.0 $\mu\text{g/kg}$ for all analytes (except 1,4-Dichlorobenzene which is 0.4 $\mu\text{g/kg}$).
- (b) U Undetected at or above given concentration.
- (c) Ion ratio out or confirmation ion not detected.
- (d) B Analyte detected in sample is < 5 times blank value.
- (e) Outside quality control criteria (30-105%) for surrogate recovery.
- (f) MDRS Mud Dump Reference Site.
- (g) NA Not available; sample dropped during processing.

Table F.8. Polynuclear Aromatic Hydrocarbons (PAHs) in *M. nasuta* Tissue (Dry Weight), Bronx River

Sediment Treatment	Concentration (µg/kg dry wt)				
	BX COMP	BX COMP	BX COMP	BX COMP	BX COMP
Replicate	1	2	3	3	3
Analytical Replicate			1	2	3
Wet Weight (g)	20.2	20.1	9.6	9.8	10.3
Percent Dry Weight	13.3	14.1	13.8	NA	NA
Batch	2	2	1	1	1
1,4-Dichlorobenzene	14.0 U ^(a)	13.2 U	30.4 U	29.7 U	28.2 U
Naphthalene	27.4 ^(b)	29.3	47.0	42.5	44.6
Acenaphthylene	20.3 ^(b)	17.4 ^(b)	12.0	8.1 U	7.8 U
Acenaphthene	61.6	40.2	33.7	23.6	21.1
Fluorene	65.7	46.7	34.8	31.6	26.9
Phenanthrene	406	292	295	247	265
Anthracene	207	179	174	140	145
Fluoranthene	2030	1820	1690	1320	1390
Pyrene	2480	2200	2270	1930	1910
Benzo[a]anthracene	858	868	857	727	749
Chrysene	1080	1070	821	671	710
Benzo[b]fluoranthene	694	726	928	706	735
Benzo[k]fluoranthene	192	202	115	88.0	89.5
Benzo[a]pyrene	433	468	446	344	358
Indeno[123-cd]pyrene	82.1	98.2	72.2	52.7 B ^(c)	59.0
Dibenzo[a,h]anthracene	25.4	30.0	23.0 B	18.1 U	18.4 B
Benzo[g,h,i]perylene	102	116	77.4	53.8	61.4

Table F.8. (contd)

Sediment Treatment Replicate	Concentration (µg/kg dry wt)				
	BX COMP 4	BX COMP 5	MDRS ^(d) 1	MDRS 2	MDRS 3
Analytical Replicate					
Wet Weight (g)	13.3	9.97	20.1	15.2	10.4
Percent Dry Weight	15.1	13.6	11.7	14.9	11.9
Batch	1	1	1	2	1
1,4-Dichlorobenzene	19.9 U	29.5	17.0 U	16.5 U	32.5 U
Naphthalene	41.5	36.1 U	18.9	17.6	50.3
Acenaphthylene	14.7	8.09	4.7 U	7.79 ^(b)	8.95 U
Acenaphthene	33.6	20.5 U	11.8 U	11.5 U	22.6 U
Fluorene	23.9	20.2 U	10.8 U	13.7	20.8 U
Phenanthrene	305	241	22.7 U	22.7 U	43.4 U
Anthracene	171	128	19.1 U	20.6 ^(b)	36.5 U
Fluoranthene	1590	1350	71.9	70.5	77.5
Pyrene	1990	1660	208	158	213
Benzo[a]anthracene	863	765	63.9	67.1	67.8
Chrysene	891	757	44.7	46.8	52.7
Benzo[b]fluoranthene	910	787	125	101	141
Benzo[k]fluoranthene	118	96.3	19.7	41.1	24.4 U
Benzo[a]pyrene	471	389	53.8	57.2	63.4
Indeno[123-cd]pyrene	90.6	63.2	16.5 B	15.6 U	24.9 U
Dibenzo[a,h]anthracene	22.6 B	18.0 B	10.3 U	11.1 U	19.8 U
Benzo[g,h,i]perylene	96.8	63.5 U	16.3 B	23.3	17.4 U

Table F.8. (contd)

Sediment Treatment Replicate	Concentration (µg/kg dry wt)				
	MDRS 4	MDRS 5	Macoma Bkgd. Tissue 1	Macoma Bkgd. Tissue 2	Macoma Bkgd. Tissue 3
Analytical Replicate					
Wet Weight (g)	20.7	20.2	14.3	10.2	10.5
Percent Dry Weight	12.2	12.7	13.7	13.7	13.7
Batch	1	2	2	2	2
1,4-Dichlorobenzene	15.9 U	NA ^(e)	19.0 U	26.6 U	26.1 U
Naphthalene	24.4	NA	19.2 ^(b)	26.6 U	26.1 U
Acenaphthylene	4.3 U	NA	7.42 U	10.3 U	10.1 U
Acenaphthene	11.0 U	NA	13.3 U	18.6 U	18.2 U
Fluorene	10.1 U	NA	12.6 U	17.6 U	17.2 U
Phenanthrene	22.8	NA	26.1 U	36.5 U	35.7 U
Anthracene	17.8 U	NA	22.8 U	32.0 U	31.3 U
Fluoranthene	67.9	NA	54.7 U	76.4 U	75.0 U
Pyrene	174	NA	46.6 U	65.1 U	63.8 U
Benzo[a]anthracene	68.7	NA	18.3 B	22.3 B	22.6 ^(c)
Chrysene	52.6	NA	23.1 U	32.4 U	31.7 U
Benzo[b]fluoranthene	135	NA	16.7 U	23.4 U	22.9 U
Benzo[k]fluoranthene	19.6	NA	17.0 U	23.8 U	23.4 U
Benzo[a]pyrene	60.1	NA	15.2 U	21.3 U	20.9 U
Indeno[123-cd]pyrene	14.3 B	NA	18.0 U	25.1 U	24.6 U
Dibenzo[a,h]anthracene	9.65 U	NA	12.8 U	18.0 U	17.6 U
Benzo[g,h,i]perylene	14.8 B	NA	14.3 U	20.0 U	19.6 U

(a) U Undetected at or above given concentration.

(b) Ion ratio out or confirmation ion not detected.

(c) B Analyte detected in sample is < 5 times blank value.

(d) MDRS Mud Dump Reference Site.

(e) NA Not available; sample dropped during processing.

Table F.9. Quality Control Summary for Polynuclear Aromatic Hydrocarbon (PAH) Analysis of *M. nasuta* Tissue (Wet Weight)

Sediment Treatment Replicate	Matrix Spike Results						
			Concentration (µg/kg wet wt)				
	Blank	Blank	BX COMP ^(a)	BX COMP			Percent
	1	NA	5	(MS)	Concentration	Percent	Recovery
Analytical Replicate	1	1	1	1	Spiked	Recovered	
Wet Weight (g)	20.0	20.0	9.97	10.8			
Percent Dry Weight	NA	NA	13.6	NA			
Batch	1	2	1	1	1		
1,4-Dichlorobenzene	2.00 U ^(b)	2.35 U	4.01 U	3.70 U	NS ^(c)	NA ^(d)	NA
Naphthalene	1.85 U	2.35 U	4.91	53.7	46.3	48.8	105
Acenaphthylene	0.55 U	0.91 U	1.10 U	38.0	46.3	38.0	82
Acenaphthene	1.39 U	1.64 U	2.79 U	41.4	46.3	41.4	90
Fluorene	1.28 U	1.56 U	2.75	48.5	46.3	45.8	99
Phenanthrene	2.67 U	3.22 U	32.7	77.6	46.3	44.9	97
Anthracene	2.25 U	2.82 U	17.5	63.4	46.3	45.9	99
Fluoranthene	3.10 U	6.76 U	184	210	46.3	26.0	56
Pyrene	2.79 U	5.76 U	226	266	46.3	40.0	86
Benzo[a]anthracene	1.05	1.82 ^(e)	104	147	46.3	43.0	93
Chrysene	1.74 U	2.86 U	103	144	46.3	41.0	89
Benzo[b]fluoranthene	1.49	2.07 U	107	222	46.3	115	248 ^(f)
Benzo[k]fluoranthene	1.50 U	2.10 U	13.1	61.6	46.3	48.5	105
Benzo[a]pyrene	1.28 U	1.88 U	52.9	95.9	46.3	43.0	93
Indeno[123-cd]pyrene	1.53	2.22 U	8.60	45.1	46.3	36.5	79
Dibenzo[a,h]anthracene	1.30	1.59 U	2.45 U	38.3	46.3	38.3	83
Benzo[g,h,i]perylene	1.25	1.77 U	8.64	38.0	46.3	29.4	63
Surrogate Recoveries (%)							
d4 1,4-Dichlorobenzene	64	78	40	36		NA	NA
d8 Naphthalene	69	85	48	44		NA	NA
d10 Acenaphthene	64	88	63	54		NA	NA
d12 Chrysene	61	92	62	60		NA	NA
d14 Dibenzo[a,h]anthracene	27 ^(g)	113	49	45		NA	NA

Table F.9. (contd)

Sediment Treatment	Matrix Spike Results				
	Concentration ($\mu\text{g/kg}$ wet wt)				
	MDRS ^(h)	MDRS (MS)	Concentration		Percent
Replicate	2		Spiked	Recovered	Recovery
Analytical Replicate	1	1			
Wet Weight (g)	15.2	16.7			
Percent Dry Weight	14.9	NA			
Batch	2	2			
1,4-Dichlorobenzene	2.46 U	2.24 U	NS	NA	NA
Naphthalene	2.62	38.9	30.0	36.3	121 ^(f)
Acenaphthylene	1.16 ^(e)	30.4	30.0	29.2	97
Acenaphthene	1.72 U	29.9	30.0	29.9	100
Fluorene	2.04	30.6	30.0	28.6	95
Phenanthrene	3.38 U	28.8	30.0	28.8	96
Anthracene	3.07 ^(e)	34.1	30.0	31.0	103
Fluoranthene	10.5	40.7	30.0	30.2	101
Pyrene	23.5	50.3	30.0	26.8	89
Benzo[a]anthracene	10.0	42.7	30.0	32.7	109
Chrysene	6.97	41.3	30.0	34.4	115
Benzo[b]fluoranthene	15.1	50.9	30.0	35.8	119
Benzo[k]fluoranthene	6.12	41.2	30.0	35.1	117
Benzo[a]pyrene	8.53	40.0	30.0	31.5	105
Indeno[123-cd]pyrene	2.33 U	30.6	30.0	30.6	102
Dibenzo[a,h]anthracene	1.66 U	27.7	30.0	27.7	92
Benzo[g,h,i]perylene	3.47	26.6	30.0	23.1	77
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	48	66		NA	NA
d8 Naphthalene	59	74		NA	NA
d10 Acenaphthene	69	81		NA	NA
d12 Chrysene	68	80		NA	NA
d14 Dibenzo[a,h]anthracene	85	99		NA	NA

Table F.9. (contd)

Sediment Treatment	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet wt)			
	BX COMP ^(a)	BX COMP	BX COMP	
Replicate	3	3	3	
Analytical Replicate	1	2	3	
Wet Weight (g)	9.6	9.8	10.3	
Percent Dry Weight	7.7	14.9	19.8	
Batch	1	1	1	
1,4-Dichlorobenzene	4.18 U	4.09 U	3.88 U	NA
Naphthalene	6.46	5.85	6.13	5
Acenaphthylene	1.65	1.12 U	1.07 U	NA
Acenaphthene	4.63	3.24	2.90	26
Fluorene	4.78	4.35	3.70	13
Phenanthrene	40.5	33.9	36.5	9
Anthracene	24.0	19.3	19.9	12
Fluoranthene	233	182	191	13
Pyrene	312	265	263	10
Benzo[a]anthracene	118	99.9	103	9
Chrysene	113	92.2	97.6	11
Benzo[b]fluoranthene	128	97.1	101	15
Benzo[k]fluoranthene	15.8	12.1	12.3	15
Benzo[a]pyrene	61.4	47.3	49.2	14
Indeno[123-cd]pyrene	9.92	7.25 B ⁽ⁱ⁾	8.11	16
Dibenzo[a,h]anthracene	3.16 B	2.49 U	2.53 B	NA
Benzo[g,h,i]perylene	10.6	7.40	8.44	19
<u>Surrogate Recoveries (%)</u>				
d4 1,4-Dichlorobenzene	48	41	45	NA
d8 Naphthalene	53	47	50	NA
d10 Acenaphthene	49	50	57	NA
d12 Chrysene	52	48	51	NA
d14 Dibenzo[a,h]anthracene	33	31	31	NA

Table F.9. (contd)

Sediment Treatment Replicate	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet wt)			
	Macoma Bkgd.	Macoma Bkgd.	Macoma Bkgd.	
	Tissue	Tissue	Tissue	
Analytical Replicate	1	2	3	
Wet Weight (g)	14.3	10.2	10.5	
Percent Dry Weight	14.0	13.8	13.4	
Batch	2	2	2	
1,4-Dichlorobenzene	2.61 U	3.65 U	3.58 U	NA
Naphthalene	2.64 ^(e)	3.65 U	3.58 U	NA
Acenaphthylene	1.02 U	1.42 U	1.39 U	NA
Acenaphthene	1.83 U	2.56 U	2.50 U	NA
Fluorene	1.73 U	2.42 U	2.37 U	NA
Phenanthrene	3.58 U	5.02 U	4.91 U	NA
Anthracene	3.13 U	4.39 U	4.30 U	NA
Fluoranthene	7.51 U	10.5 U	10.3 U	NA
Pyrene	6.40 U	8.95 U	8.77 U	NA
Benzo[a]anthracene	2.52 ^(e)	3.06 ^(e)	3.11 ^(e)	11
Chrysene	3.18 U	4.45 U	4.35 U	NA
Benzo[b]fluoranthene	2.30 U	3.22 U	3.15 U	NA
Benzo[k]fluoranthene	2.34 U	3.27 U	3.21 U	NA
Benzo[a]pyrene	2.09 U	2.93 U	2.87 U	NA
Indeno[123-cd]pyrene	2.47 U	3.45 U	3.38 U	NA
Dibenzo[a,h]anthracene	1.76 U	2.47 U	2.42 U	NA
Benzo[g,h,i]perylene	1.96 U	2.75 U	2.69 U	NA
<u>Surrogate Recoveries (%)</u>				
d4 1,4-Dichlorobenzene	42	63	48	NA
d8 Naphthalene	52	73	61	NA
d10 Acenaphthene	67	80	71	NA
d12 Chrysene	87	79	82	NA
d14 Dibenzo[a,h]anthracene	108	96	101	NA

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) U Undetected at or above given concentration.

(c) NS Not spiked.

(d) NA Not applicable.

(e) Ion ratio out or confirmation ion not detected.

(f) Outside quality control criteria (50-120%) for spike recovery.

(g) Outside quality control criteria (30-150%) for surrogate recovery.

(h) MDRS Mud Dump Reference Site.

(i) B Analyte detected in sample is < 5 times blank value.

Table F.10. Lipids in Tissue of *M. nasuta*

Sample ID	% Dry Weight	% Lipid (wet wt)	% Lipid (dry wt)
<i>Macoma</i> Bkgd. Tissue	13.73	0.80	5.83
<i>Macoma</i> Bkgd. Tissue	13.73	0.98	7.14
<i>Macoma</i> Bkgd. Tissue	13.73	0.80	5.83

 

Appendix G

Nereis virens Tissue Chemical Analyses and
Quality Assurance/Quality Control Data,
Bronx River Project

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Metals

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Worm Tissue

QA/QC DATA QUALITY OBJECTIVES

	<u>Reference Method</u>	<u>Range of Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Target Detection Limit(dry wt)</u>
Arsenic	ICP/MS	75-125%	≤20%	≤20%	1.0 mg/kg
Cadmium	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Chromium	ICP/MS	75-125%	≤20%	≤20%	0.2 mg/kg
Copper	ICP/MS	75-125%	≤20%	≤20%	1.0 mg/kg
Lead	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Mercury	CVAA	75-125%	≤20%	≤20%	0.02 mg/kg
Nickel	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Silver	ICP/MS	75-125%	≤20%	≤20%	0.1 mg/kg
Zinc	ICP/MS	75-125%	≤20%	≤20%	1.0 mg/kg

METHOD

Nine metals were analyzed for the New York 5 Program: silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb) and zinc (Zn). Hg was analyzed using cold-vapor atomic absorption spectroscopy (CVAA) according to the method of Bloom and Crecelius (1983). The remaining metals were analyzed by inductively coupled plasma mass spectrometry (ICP/MS) following a procedure based on EPA Method 200.8 (EPA 1991).

To prepare tissue for analysis, samples were freeze-dried and blended in a Spex mixer-mill. Approximately 5 g of mixed sample was ground in a ceramic ball mill. For ICP/MS and CVAA analyses, 0.2- to 0.5-g aliquots of dried homogenous sample were digested using a mixture of nitric acid and hydrogen peroxide following a modified version of EPA Method 200.3 (EPA 1991).

HOLDING TIMES

Tissue samples were received on 7/13/95 in good condition. Samples were entered into Battelle's log-in system, frozen to -80°C, and subsequently freeze dried within approximately 7 days of sample receipt. Samples were analyzed within 180 days of collection.

QA/QC SUMMARY METALS (continued)

The following table summarizes the analysis dates:

<u>Task</u>	<u>Date Performed</u>
Sample Digestion	8/15/95
ICP-MS	8/29/95
CVAA-Hg	8/25/95

DETECTION LIMITS	Target detection limits were met for all metals except Ag, Cu, Ni and Zn; however, all sample values for Cu, Ni, and Zn were above the achieved method detection limit (MDL). MDLs were determined by spiking seven replicates of the reagent blank and multiplying the standard deviation of the resulting analyses by the student's t-value at the 99th percentile ($t=3.142$).
METHOD BLANKS	One procedural blank was analyzed per 20 samples. No metals were detected in the blanks above the MDLs.
MATRIX SPIKES	One sample was spiked with all metals at a frequency of 1 per 20 samples. All recoveries were within the QC limits of 75-125% with the exception of Pb and Zn in one matrix spike. Both Pb and Zn were spiked at or below levels found in the native samples. These comparatively low spiking concentrations decrease the analytical ability to discern the matrix spike from the native metals. Data were considered accurate.
REPLICATES	Two samples was analyzed in triplicate at a frequency of 1 per 20 samples. Precision for triplicate analyses was reported by calculating the relative standard deviation (RSD) between the replicate results. RSDs were within the QC limits of $\pm 20\%$ for all metals with the exception of Hg (26%) in the background tissue.
SRMs	SRM 1566a, oyster tissue from the National Institute of Standards and Technology (NIST), was analyzed in duplicate with each matrix for all metals. Results for all metals were within $\pm 20\%$ of mean certified value with the exception of Ni in one replicate and Cr in both. The digestion used on these samples may not be rigorous enough to completely digest the form of Cr present in this SRM.

REFERENCES

Bloom, N. S., and E.A. Crecelius. 1983. Determination of Mercury in Seawater at Sub-Nanogram per Liter Levels. *Mar. Chem.* 14:49-59.

EPA (U.S. Environmental Protection Agency). 1991. Methods for the Determination of Metals in Environmental Samples. EPA-600/4-91-010. U.S. Environmental Protection Agency, Environmental Services Division, Monitoring Management Branch, Washington D.C.

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Chlorinated Pesticides/PCB Congeners

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Worm Tissue

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>Surrogate Recovery</u>	<u>Spike Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit (wet wt)</u>
GC/ECD	30-150%	50-120%	≤30%	0.4 µg/kg

METHOD

Tissues were homogenized wet using a stainless steel blade. An aliquot of tissue sample was extracted with methylene chloride using the roller technique under ambient conditions following a procedure based on methods used by the National Oceanic and Atmospheric Administration for its Status and Trends Program (NOAA 1993). Samples were then cleaned using silica/alumina (5% deactivated) chromatography followed by high performance liquid chromatography (HPLC) cleanup. Extracts were analyzed for 15 chlorinated pesticides and 22 PCB congeners using gas chromatography/electron capture detection (GC/ECD) following a procedure based on EPA Method 8080 (EPA 1986). The column used was a J&W DB-17 and the confirmatory column was a DB-1701, both capillary columns (30m x 0.25mm I.D.). All detections were quantitatively confirmed on the second column.

HOLDING TIMES

Samples of worm tissue were received on 7/13/95 in good condition. Samples were entered into Battelle's log-in system and stored frozen until extraction. Samples were extracted in two batches. The following summarizes the extraction and analysis dates:

<u>Batch</u>	<u>Species</u>	<u>Extraction</u>	<u>Analysis</u>
1	<i>N. virens</i>	9/28/95	10/19-20/95
2	<i>M. nasuta/N. virens</i>	10/16/95	10/20-21/95

QA/QC SUMMARY/PCBs and PESTICIDES (continued)

DETECTION LIMITS	Target detection limits of 0.4 µg/kg wet weight were met for most pesticides and PCB congeners. Method detection limits (MDLs) reported were determined by multiplying the standard deviation of seven spiked replicates of worm tissue by the student's t-value at the 99th percentile ($t=3.142$). MDLs were reported corrected for individual sample wet weight extracted.
METHOD BLANKS	One method blank was extracted with each extraction batch. No pesticides or PCBs were detected in any of the method blanks, with the exception of aldrin in the blank from batch 1. The amount in the blank was less than three times the MDL; therefore, no further action was taken.
SURROGATES	Two compounds, PCB congeners 103 and 198, were added to all samples prior to extraction to assess the efficiency of the analysis. Sample surrogate recoveries were all within the QC guidelines of 30%-120%. Sample results were quantified based on surrogate recoveries.
MATRIX SPIKES	Eleven out of the 15 pesticides and 5 of the 22 PCB congeners analyzed were spiked into one sample per extraction batch. Matrix spike recoveries were within the control limit range of 50%-120% for all pesticides and PCBs, with the exception of heptachlor (126%) and PCB 101 (123%) in batch 1.
REPLICATES	One sample from each extraction batch was analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. RSDs for all detectable values were below the target precision goal of $\leq 30\%$.
SRMs	An appropriate SRM for chlorinated organics in tissues was not available from National Institute of Standards and Technology at the time of these analyses.
MISCELLANEOUS	All pesticide and PCB congener results are confirmed using a second dissimilar column. RSDs between the primary and confirmation values must be less than 75% to be considered a confirmed value.

QA/QC SUMMARY/PCBs and PESTICIDES (continued)

REFERENCES

NYSDEC (New York Department of Environmental Conservation). 1992. *Analytical Method for the Determination of PCB congeners by Fused Silica Capillary Column Gas Chromatography with Electron Capture Detector*. NYSDEC Method 91-11. New York State Department of Environmental Conservation, Albany, New York.

EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods*. SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D. C.

QA/QC SUMMARY

PROGRAM: New York Federal Projects 5

PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH) and 1,4-Dichlorobenzene

LABORATORY: Battelle/Marine Sciences Laboratory, Sequim, Washington

MATRIX: Worm Tissue

QA/QC DATA QUALITY OBJECTIVES

<u>Reference Method</u>	<u>MS Recovery</u>	<u>Surrogate Recovery</u>	<u>SRM Accuracy</u>	<u>Relative Precision</u>	<u>Detection Limit (wet wt)</u>
GC/MS/SIM	50-120%	30-150%	≤30%	≤30%	4 ng/g

METHOD

Tissue samples were extracted with methylene chloride following a procedure based on methods used by the National Oceanic and Atmospheric Administration for its Status and Trends Program (NOAA 1993). Samples were then cleaned using silica/alumina (5% deactivated) chromatography followed by high performance liquid chromatography (HPLC) cleanup.

Extracts were quantified using gas chromatography/mass spectrometry (GC/MS) in the selected ion mode (SIM) following a procedure based on EPA Method 8270 (NOAA 1993).

HOLDING TIMES

Samples of worm tissue were received on 7/13/95 in good condition. Samples were entered into Battelle's log-in system and stored frozen until extraction. The following summarizes the extraction and analysis dates:

<u>Batch</u>	<u>Species</u>	<u>Extraction</u>	<u>Analysis</u>
1	<i>N. virens</i>	9/28/95	10/19-20/95
2	<i>M. nasuta/N. virens</i>	10/16/95	10/20-21/95

QA/QC SUMMARY/PAHs (continued)

DETECTION LIMITS

Target detection limits of 4 µg/kg wet weight were met for all PAH compounds except for fluoranthene and pyrene, which had method detection limits (MDL) between 4 and 6 µg/kg wet weight. MDLs were determined by multiplying the standard deviation of seven spiked replicates of a background clam sample by the student's t-value at the 99th percentile ($t=3.142$). These MDLs were based on a wet weight of 20 grams of tissue sample. Aliquots of samples that were analyzed in triplicate, used for spiking, or were reextracted, were generally less than 20 grams due to limited quantities of tissue available. Because MDLs reported are corrected for sample weight, the MDLs reported for these samples appear elevated and in some cases may exceed the target detection limit.

METHOD BLANKS

One method blank was extracted with each extraction batch. No PAHs were detected in the blanks, with the exception of naphthalene in batch 1 and fluorene and benz[a]anthracene in batch 2. All levels were less than three times the MDL. A number of sample values, however, that were less than five times the blank concentration were reported and flagged with a "B" to indicate that these values could be biased high due to blank contamination. Sample values greater than five times the blank concentration are not significantly affected by the blank contamination and were therefore not flagged.

SURROGATES

Five isotopically labeled compounds were added prior to extraction to assess the efficiency of the method. These were d8-naphthalene, d10-acenaphthene, d12-chrysene, d14-dibenz[a,h]anthracene and d4-1,4-dichlorobenzene. Recoveries of all surrogates were within the quality control limits of 30%-150%. Results were quantified using the surrogate internal standard method.

MATRIX SPIKES

One sample from each batch was spiked with all PAH compounds. Matrix spike recoveries were generally within QC limits of 50%-120%, with some exceptions. Spike recoveries for four PAH compounds in batch 1 were high; however, no recovery exceeded 144%. Naphthalene was recovered slightly above the upper control limit in batch 2.

QA/QC SUMMARY/PAHs (continued)

REPLICATES

One sample from each batch was extracted and analyzed in triplicate. Precision was measured by calculating the relative standard deviation (RSD) between the replicate results. Two compounds were detected in all three replicates in batch 1, and one compound was detected in all three replicates in batch 2. All RSDs were within $\pm 30\%$.

SRMs

An appropriate SRM for PAHs in tissues was not available from NIST at the time of these analyses.

MISCELLANEOUS

For several compounds the ion-ratio was outside of the QC range, due to low levels in the native sediment. When the native levels are low, the error associated with the concentration measurement of the confirmation ion, which is present at a fraction of the parent ion concentration, increases. Because the confirmation ion is quantified solely from the parent ion, this will not affect the quality of the data.

REFERENCES

NOAA (National Oceanic and Atmospheric Administration). 1993. *Sampling and Analytical Methods of the National Status and Trends Program, National Benthic Surveillance and Mussel Watch Projects 1984-1992. Volume IV. Comprehensive Descriptions of Trace Organic Analytical Methods.* G.G. Lauenstein and A.Y. Cantillo, eds. NOAA Technical Memorandum NOS ORCA 71. National Oceanic and Atmospheric Administration, Coastal Monitoring and Bioeffects Assessment Division, Office of Resources Conservation and Assessment, Silver Spring, Maryland.

EPA (U.S. Environmental Protection Agency). 1986. *Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.* SW-846. U.S. Document No. 955-001-00000, U.S. Environmental Protection Agency, Washington D.C.

Table G.1. Metals in *N. virens* Tissue (Wet Weight), Bronx River

Sediment Treatment	Analytical			Percent Dry Weight	Concentration (mg/kg wet wt)								
					Ag ICP/MS	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
BX COMP	1	1	1	14.0	0.031 U ^(a)	1.86	0.0592	0.0118 U	1.06	0.0304	0.0597	0.190	7.06
BX COMP	1	2	1	14.0	0.031 U	1.76	0.0540	0.0118 U	1.00	0.0292	0.0448	0.183	6.79
BX COMP	1	3	1	14.0	0.031 U	1.90	0.0590	0.0118 U	1.06	0.0311	0.0579	0.201	7.16
BX COMP	2		1	15.2	0.034 U	2.70	0.0472	0.0129 U	0.973	0.0510	0.0436	0.164	7.05
BX COMP	3		1	15.3	0.034 U	2.58	0.0473	0.0129 U	1.18	0.0148	0.0891	0.179	7.26
BX COMP	4		1	14.2	0.031 U	2.02	0.0550	0.0120 U	1.31	0.0459	0.0879	0.144	6.24
BX COMP	5		1	16.0	0.035 U	2.43	0.0608	0.0135 U	1.43	0.0286	0.0670	0.230	8.73
MDRS ^(b)	1		1	16.2	0.036 U	3.74	0.0797	0.0137 U	1.70	0.0181	0.0543	0.181	7.87
MDRS	2		1	13.9	0.031 U	3.19	0.0591	0.0528	1.42	0.0208	0.0822	0.164	9.99
MDRS	3		1	13.8	0.030 U	2.89	0.0626	0.0116 U	1.30	0.0267	0.0345 U	0.168	6.75
MDRS	4		1	18.9	0.042 U	4.19	0.0893	0.0363	2.30	0.0234	0.0472 U	0.323	10.5
MDRS	5		1	15.0	0.033 U	2.40	0.0734	0.0879	1.43	0.0392	0.0710	0.211	7.63
<i>Nereis</i> Bkgd. Tissue	1	1	1	7.7	0.017 U	1.58	0.0353	0.00933	0.69	0.0105	0.0487	0.067	4.22
<i>Nereis</i> Bkgd. Tissue	1	2	1	14.9	0.033 U	2.40	0.0651	0.0201	1.20	0.0335	0.0733	0.150	8.14
<i>Nereis</i> Bkgd. Tissue	1	3	1	19.8	0.043 U	3.48	0.105	0.0271	1.55	0.0451	0.0998	0.172	10.8

(a) U Undetected at or above given concentration.

(b) MDRS Mud Dump Reference Site.

Table G.2. Metals in *N. virens* Tissue (Dry Weight), Bronx River

Sediment Treatment	Analytical			Percent Dry Weight	Concentration (mg/kg dry wt)								
	Replicate	Replicate	Batch		Ag ICP/MS	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
	Target Detection Limit:				0.1	1.0	0.1	0.2	1.0	0.02	0.1	0.1	1.0
	Method Detection Limit:				0.22	0.830	0.0810	0.0845	1.20	0.0011	0.25	0.08	1.37
BX COMP	1	1	1	14.0	0.22 U ^(a)	13.3	0.423	0.0845 U	7.55	0.217	0.427	1.36	50.5
BX COMP	1	2	1	14.0	0.22 U	12.6	0.386	0.0845 U	7.15	0.209	0.320	1.31	48.5
BX COMP	1	3	1	14.0	0.22 U	13.6	0.422	0.0845 U	7.57	0.222	0.414	1.44	51.2
BX COMP	2		1	15.2	0.22 U	17.7	0.310	0.0845 U	6.39	0.335	0.286	1.08	46.3
BX COMP	3		1	15.3	0.22 U	16.9	0.310	0.0845 U	7.73	0.0968	0.584	1.17	47.6
BX COMP	4		1	14.2	0.22 U	14.2	0.387	0.0845 U	9.19	0.323	0.618	1.01	43.9
BX COMP	5		1	16.0	0.22 U	15.2	0.381	0.0845 U	8.95	0.179	0.420	1.44	54.7
MDRS ^(b)	1		1	16.2	0.22 U	23.1	0.492	0.0845 U	10.5	0.112	0.335	1.12	48.6
MDRS	2		1	13.9	0.22 U	22.9	0.424	0.379	10.2	0.149	0.590	1.18	71.7
MDRS	3		1	13.8	0.22 U	21.0	0.454	0.0845 U	9.45	0.194	0.25 U	1.22	49.0
MDRS	4		1	18.9	0.22 U	22.2	0.473	0.192	12.2	0.124	0.25 U	1.71	55.7
MDRS	5		1	15.0	0.22 U	16.0	0.490	0.587	9.56	0.262	0.474	1.41	51.0
<i>Nereis</i> Bkgd. Tissue	1	1	1	7.7	0.22 U	20.6	0.462	0.122	9.05	0.137	0.637	0.873	55.1
<i>Nereis</i> Bkgd. Tissue	1	2	1	14.9	0.22 U	16.1	0.437	0.135	8.08	0.225	0.492	1.01	54.7
<i>Nereis</i> Bkgd. Tissue	1	3	1	19.8	0.22 U	17.6	0.530	0.137	7.82	0.228	0.505	0.870	54.7

(a) U Undetected at or above given concentration.

(b) MDRS Mud Dump Reference Site.

Table G.3. Quality Control Data for Metals Analysis of *N. virens* Tissue (Dry Weight)

Sediment Treatment				Concentration (mg/kg dry wt)								
	Analytical Replicate	Replicate	Batch	Ag ICP/MS	As ICP/MS	Cd ICP/MS	Cr ICP/MS	Cu ICP/MS	Hg CVAA	Ni ICP/MS	Pb ICP/MS	Zn ICP/MS
Blank		1	1	0.22 U ^(a)	0.830 U	0.0810 U	0.0845 U	1.20 U	0.0427	0.25 U	0.08 U	1.37 U
Blank		2	1	0.22 U	0.830 U	0.0810 U	0.0845 U	1.20 U	0.0399	0.25 U	0.08 U	1.37 U
<u>Matrix Spike Results</u>												
SH COMP ^(b)	5		1	0.22 U	17.5	0.324	0.0845 U	6.51	0.0920	0.674	0.752	46.4
SH COMP (MS)		1		0.942	44.1	1.22	1.09	31.7	1.12	1.69	1.57	69.1
Concentration Spiked				1.00	25.0	1.00	1.00	25.0	1.00	1.00	1.00	25.0
Concentration Recovered				0.942	26.6	0.896	1.09	25.2	1.03	1.02	0.818	22.7
Percent Recovered				94	106	90	109	101	103	102	82	91
BX COMP ^(b)	2		1	0.22 U	14.5	0.273	0.0845 U	7.00	0.0905	0.478	0.905	52.1
BX COMP (MS)		1		0.978	42.0	1.22	1.17	33.1	1.03	1.65	2.46	70.7
Concentration Spiked				1.00	25.0	1.00	1.00	25.0	1.00	1.00	1.00	25.0
Concentration Recovered				0.978	27.5	0.947	1.17	26.1	0.940	1.17	1.56	18.6
Percent Recovered				98	110	95	117	104	94	117	156 ^(c)	74 ^(c)
<u>Standard Reference Material</u>												
1566a		1	1	1.58	14.3	4.08	0.0845 U	70.7	0.0738	1.71	0.351	838
1566a		2	1	1.59	14.7	3.92	0.113	70.7	0.0620	2.50	0.314	837
Certified Value				1.68	14.0	4.15	1.43	66.3	0.0642	2.25	0.371	830
Range				±0.15	±1.2	±0.38	±0.46	±4.3	±0.067	±0.44	±0.014	±57
Percent Difference		1		6	2	2	NA ^(d)	7	15	24 ^(e)	5	1
		2		5	5	6	92 ^(e)	7	3	11	15	1
<u>Analytical Replicates</u>												
SR COMP ^(b)	5	1	1	0.22 U	14.3	0.307	0.0845 U	8.63	0.264	0.434	1.08	51.9
SR COMP	5	2	1	0.22 U	14.6	0.306	0.0845 U	8.27	0.237	0.356	1.02	52.7
SR COMP	5	3	1	0.22 U	14.2	0.294	0.142	7.96	0.232	0.295	1.23	51.6
RSD (%)				NA	1	2	NA	4	7	19	10	1

Table G.3. (contd)

Sediment Treatment	Concentration (mg/kg dry wt) Blank Corrected											
	Analytical			Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
	Replicate	Replicate	Batch	ICP/MS	ICP/MS	ICP/MS	ICP/MS	ICP/MS	CVAA	ICP/MS	ICP/MS	ICP/MS
BX COMP ^(b)	1	1	1	0.22 U	13.3	0.423	0.0845 U	7.55	0.217	0.427	1.36	50.5
BX COMP	1	2	1	0.22 U	12.6	0.386	0.0845 U	7.15	0.209	0.320	1.31	48.5
BX COMP	1	3	1	0.22 U	13.6	0.422	0.0845 U	7.57	0.222	0.414	1.44	51.2
RSD (%)				NA	4	5	NA	3	3	15	5	3
<i>Nereis</i> Bkgd. Tissue	1	1	1	0.22 U	20.6	0.462	0.122	9.05	0.137	0.637	0.873	55.1
<i>Nereis</i> Bkgd. Tissue	1	2	1	0.22 U	16.1	0.437	0.135	8.08	0.225	0.492	1.01	54.7
<i>Nereis</i> Bkgd. Tissue	1	3	1	0.22 U	17.6	0.530	0.137	7.82	0.228	0.505	0.87	54.7
RSD (%)				NA	13	10	6	8	26 ^(f)	15	9	0

(a) U Undetected at or above given concentration.

(b) Sample randomly selected for use as a quality control sample in analytical batch.

(c) Outside quality control criteria (75-125%) for spike recovery.

(d) NA Not applicable.

(e) Outside SRM quality control criteria ($\leq 20\%$).

(f) Outside quality control criteria ($\leq 20\%$) for replicate analysis.

Table G.4. Pesticides and Polychlorinated Biphenyls (PCBs) in *N. virens* Tissue (Wet Weight), Bronx River

Sediment Treatment Replicate	Concentration (µg/kg wet wt)				
	BX COMP 1	BX COMP 2	BX COMP 3	BX COMP 4	BX COMP 5
Analytical Replicate					
Wet Weight (g)	14.4	18.4	20.3	18.6	20.2
Percent Dry Wt.	14.0	15.2	15.3	14.2	16.0
Batch	2	1	1	1	1
2,4'-DDD ^(a)	1.55	2.28	2.07	0.87	1.87
2,4'-DDE	0.37 U ^(b)	0.28 U	0.26 U	0.28 U	0.26 U
2,4'-DDT	0.25 U	0.19 U	0.18 U	0.19 U	0.18 U
4,4'-DDD	5.49	7.88	5.72	2.93	6.92
4,4'-DDE	2.65	4.07	3.46	1.76	3.47
4,4'-DDT	2.08	1.90	1.95	1.15	2.31
α-Chlordane	3.98	5.71	4.79	0.87	4.18
Aldrin	2.52	3.36	3.01	1.42	3.07
Dieldrin	2.92	3.75	3.06	1.39	3.28
Endosulfan I	0.25 U	0.19 U	0.18 U	0.19 U	0.18 U
Endosulfan II	0.25 U	0.19 U	0.18 U	0.19 U	0.18 U
Endosulfan Sulfate	0.35 U	0.27 U	0.25 U	0.27 U	0.25 U
Heptachlor	0.26 U	0.60	0.18 U	0.20 U	0.37
Heptachlor Epoxide	0.19 U	0.57	0.39	0.14 U	0.50
Trans Nonachlor	2.55	2.73	2.43	1.28	3.34
PCB 8	0.49 U	0.38 U	0.34 U	0.38 U	0.34 U
PCB 18	10.8	15.9	13.7	2.08	12.0
PCB 28	7.04	9.72	8.68	1.19	8.06
PCB 44	9.05	7.84	7.03	0.08 U	5.91
PCB 49	6.44	7.36	6.33	2.40	6.46
PCB 52	11.0	12.1	11.0	4.48	10.6
PCB 66	0.21 U	7.40	0.15 U	0.16 U	6.86
PCB 87	0.68	1.01	0.77	0.27 U	0.89
PCB 101	6.24	6.22	5.99	3.06	6.25
PCB 105	1.91	1.69	1.72	1.07	1.78
PCB 118	3.86	3.63	3.46	1.81	3.74
PCB 128	0.71	0.69	0.74	0.45	0.77
PCB 138	6.01	4.72	5.02	2.53	5.20
PCB 153	7.40	6.55	7.30	3.40	7.01
PCB 170	1.51	1.60	1.65	0.57	1.66
PCB 180	3.12	3.02	3.12	1.07	3.35
PCB 183	0.83	0.86	0.99	0.26	1.01
PCB 184	0.26 U	0.20 U	0.18 U	0.20 U	0.18 U
PCB 187	2.17	2.18	2.49	0.85	2.37
PCB 195	0.18 U	0.22	0.23	0.14 U	0.19
PCB 206	0.30 U	0.27	0.33	0.23 U	0.29
PCB 209	0.27 U	0.21 U	0.19 U	0.21 U	0.19 U
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	85	102	67	99	114
PCB 198 (SIS)	71	77	48	78	95

Table G.4. (contd)

Sediment Treatment	Concentration ($\mu\text{g/kg wet wt}$)				
	MDRS ^(a)	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate				1	2
Wet Weight (g)	20.2	20.4	20.0	12.9	12.1
Percent Dry Wt.	16.2	13.9	13.8	18.9	NA
Batch	1	1	2	1	1
2,4'-DDD	0.32	0.25 U	0.25 U	0.39 U	0.42 U
2,4'-DDE	0.26 U	0.26 U	0.26 U	0.40 U	0.43 U
2,4'-DDT	0.18 U	0.18 U	0.18 U	0.28 U	0.29 U
4,4'-DDD	1.15	1.19	0.78	1.00	1.26
4,4'-DDE	0.34	0.26	0.19 U	0.30	0.31 U
4,4'-DDT	1.03	0.76	0.67	0.40	0.73
α -Chlordane	0.28	0.16	0.10	0.19	0.19
Aldrin	0.77	0.75	0.65	0.93	1.01
Dieldrin	0.52 U	0.51 U	0.52 U	0.79 U	0.85 U
Endosulfan I	0.18 U	0.18 U	0.18 U	0.28 U	0.30 U
Endosulfan II	0.18 U	0.18 U	0.18 U	0.28 U	0.30 U
Endosulfan Sulfate	0.25 U	0.25 U	0.25 U	0.39 U	0.41 U
Heptachlor	0.19 U	0.18 U	0.19 U	0.28 U	0.30 U
Heptachlor Epoxide	0.13 U	0.13 U	0.13 U	0.20 U	0.22 U
Trans Nonachlor	0.69	0.35	0.47	0.31	0.32
PCB 8	0.35 U	0.34 U	0.35 U	0.54 U	0.58 U
PCB 18	0.10 U	0.10 U	0.10 U	0.16 U	0.17 U
PCB 28	0.11 U	0.11 U	0.11 U	0.17 U	0.18 U
PCB 44	0.07 U	0.07 U	0.07 U	0.11 U	0.12 U
PCB 49	0.65	0.44	0.18 U	0.57	0.54
PCB 52	1.45	1.24	0.97	1.07	1.01
PCB 66	0.15 U	0.15 U	0.15 U	0.23 U	0.25 U
PCB 87	0.25 U	0.25 U	0.25 U	0.39 U	0.41 U
PCB 101	1.33	1.11	0.75	0.79	0.70
PCB 105	0.17 U	0.60	0.17 U	0.26 U	0.27 U
PCB 118	0.65	0.19 U	0.19 U	0.29 U	0.37
PCB 128	0.25	0.23	0.17	0.16 U	0.17 U
PCB 138	1.50	1.55	0.98	0.65	0.67
PCB 153	2.10	2.21	1.47	0.86	0.92
PCB 170	0.41	0.17 U	0.23	0.27 U	0.29 U
PCB 180	0.75	0.65	0.44	0.58 U	0.62 U
PCB 183	0.19	0.18 U	0.18 U	0.28 U	0.30 U
PCB 184	0.18 U	0.18 U	0.18 U	0.28 U	0.30 U
PCB 187	0.52	0.58	0.24	0.32 U	0.34 U
PCB 195	0.13 U	0.12 U	0.13 U	0.20 U	0.21 U
PCB 206	0.21 U	0.21 U	0.21 U	0.33 U	0.35 U
PCB 209	0.20 U	0.19 U	0.20 U	0.30 U	0.32 U
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	105	59	123	107	109
PCB 198 (SIS)	91	47	103	95	96

Table G.4. (contd)

Sediment Treatment	Concentration ($\mu\text{g/kg}$ wet wt)				
	MDRS	MDRS	Nereis Bkgd.	Nereis Bkgd.	Nereis Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3		1	2	3
Wet Weight (g)	12.3	20.1	20.4	20.0	20.5
Percent Dry Wt.	NA	15.0	17.4	17.4	17.4
Batch	1	1	2	2	2
2,4'-DDD	0.41 U	0.25 U	0.25 U	0.25 U	0.25 U
2,4'-DDE	0.42 U	0.26 U	0.26 U	0.26 U	0.26 U
2,4'-DDT	0.29 U	0.18 U	0.18 U	0.18 U	0.18 U
4,4'-DDD	1.04	0.99	0.26 U	0.26 U	0.26 U
4,4'-DDE	0.30 U	0.21	0.18 U	0.19 U	0.18 U
4,4'-DDT	0.63	0.85	0.68	0.48	0.53
α -Chlordane	0.18	0.17	0.09 U	0.10 U	0.09 U
Aldrin	0.99	0.70	0.46	0.47	0.47
Dieldrin	0.84 U	0.52 U	0.51 U	0.52 U	0.51 U
Endosulfan I	0.29 U	0.18 U	0.18 U	0.18 U	0.18 U
Endosulfan II	0.29 U	0.18 U	0.18 U	0.18 U	0.18 U
Endosulfan Sulfate	0.41 U	0.25 U	0.25 U	0.25 U	0.25 U
Heptachlor	0.30 U	1.00	0.18 U	0.19 U	0.18 U
Heptachlor Epoxide	0.22 U	0.13 U	0.13 U	0.13 U	0.13 U
Trans Nonachlor	0.24 U	0.59	0.35	0.15 U	0.32
PCB 8	0.57 U	0.35 U	0.34 U	0.35 U	0.34 U
PCB 18	0.17 U	1.33	0.10 U	0.10 U	0.10 U
PCB 28	0.18 U	0.11 U	0.11 U	0.11 U	0.11 U
PCB 44	0.11 U	0.07 U	0.07 U	0.07 U	0.07 U
PCB 49	0.48	0.18 U	0.18 U	0.18 U	0.18 U
PCB 52	0.97	0.93	0.32 U	0.32 U	0.32 U
PCB 66	0.24 U	0.15 U	0.15 U	0.15 U	0.15 U
PCB 87	0.41 U	0.25 U	0.25 U	0.25 U	0.25 U
PCB 101	0.64	0.90	0.19	0.18	0.19
PCB 105	0.27 U	0.17 U	0.16 U	0.17 U	0.16 U
PCB 118	0.31 U	0.19 U	0.19 U	0.19 U	0.19 U
PCB 128	0.17 U	0.22	0.11	0.11	0.11
PCB 138	0.65	1.36	0.67	0.65	0.68
PCB 153	0.85	1.92	0.98	0.94	0.96
PCB 170	0.28 U	0.35	0.17 U	0.18 U	0.17 U
PCB 180	0.61 U	0.66	0.37 U	0.38 U	0.37 U
PCB 183	0.30 U	0.18 U	0.18 U	0.18 U	0.18 U
PCB 184	0.30 U	0.18 U	0.18 U	0.18 U	0.18 U
PCB 187	0.33 U	0.50	0.20 U	0.21 U	0.20 U
PCB 195	0.21 U	0.13 U	0.12 U	0.13 U	0.12 U
PCB 206	0.35 U	0.21 U	0.21 U	0.21 U	0.21 U
PCB 209	0.32 U	0.20 U	0.19 U	0.20 U	0.19 U
Surrogate Recoveries (%)					
PCB 103 (SIS)	109	110	124	103	130
PCB 198 (SIS)	91	89	98	82	100

(a) Target detection limits are 0.4 $\mu\text{g/kg}$ for all analytes.

(b) U Undetected at or above given concentration.

(c) MDRS Mud dump reference site.

Table G.5. Pesticides and Polychlorinated Biphenyls (PCBs) in *N. virens* Tissue (Dry Weight), Bronx River

Sediment Treatment	Concentration (µg/kg dry wt)				
	BX COMP	BX COMP	BX COMP	BX COMP	BX COMP
Replicate	1	2	3	4	5
Analytical Replicate	1	1	1	1	1
Wet Weight (g)	14.4	18.4	20.3	18.6	20.2
Percent Dry Wt.	14.0	15.2	15.3	14.2	16.0
Batch	2	1	1	1	1
2,4'-DDD	11.1	15.0	13.6	6.1	11.7
2,4'-DDE	2.6 U ^(a)	1.8 U	1.7 U	2.0 U	1.6 U
2,4'-DDT	1.8 U	1.2 U	1.2 U	1.3 U	1.1 U
4,4'-DDD	39.2	51.7	37.5	20.6	43.4
4,4'-DDE	18.9	26.7	22.7	12.4	21.7
4,4'-DDT	14.9	12.5	12.8	8.09	14.5
α-Chlordane	28.4	37.5	31.4	6.1	26.2
Aldrin	18.0	22.1	19.7	10.0	19.2
Dieldrin	20.9	24.6	20.1	9.8 U	20.6
Endosulfan I	1.8 U	1.2 U	1.2 U	1.3 U	1.1 U
Endosulfan II	1.8 U	1.2 U	1.2 U	1.3 U	1.1 U
Endosulfan Sulfate	2.5 U	1.8 U	1.6 U	1.9 U	1.6 U
Heptachlor	1.9 U	3.9	1.2 U	1.4 U	2.3
Heptachlor Epoxide	1.4 U	3.7	2.6	1.0 U	3.1
Trans Nonachlor	18.2	17.9	15.9	9.00	20.9
PCB 8	3.5 U	2.5 U	2.2 U	2.7 U	2.1 U
PCB 18	77.1	104	89.8	14.6	75.0
PCB 28	50.3	63.8	56.9	8.37 U	50.5
PCB 44	64.7	51.5	46.1	0.6 U	37.0
PCB 49	46.0	48.3	41.5	16.9	40.5
PCB 52	78.7	79.3	71.8	31.5	66.7
PCB 66	1.5 U	48.6	1.0 U	1.1 U	43.0
PCB 87	4.9	6.63	5.0	1.9 U	5.6
PCB 101	44.6	40.8	39.3	21.5	39.2
PCB 105	13.7	11.1	11.3	7.52	11.2
PCB 118	27.6	23.8	22.7	12.7	23.4
PCB 128	5.1	4.5	4.8	3.2	4.8
PCB 138	43.0	31.0	32.9	17.8	32.6
PCB 153	52.9	43.0	47.8	23.9	43.9
PCB 170	10.8	10.5	10.8	4.0	10.4
PCB 180	22.3	19.8	20.4	7.52	21.0
PCB 183	5.9	5.6	6.5	1.8	6.33
PCB 184	1.9 U	1.3 U	1.2 U	1.4 U	1.1 U
PCB 187	15.5	14.3	16.3	6.0	14.8
PCB 195	1.3 U	1.4	1.5	1.0 U	1.2
PCB 206	2.1 U	1.8	2.2	1.6 U	1.8
PCB 209	1.9 U	1.4 U	1.2 U	1.5 U	1.2 U

Table G.5. (contd)

Sediment Treatment	Concentration ($\mu\text{g/kg dry wt}$)				
	MDRS ^(b)	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate	1	1	1	1	2
Wet Weight (g)	20.2	20.4	20.0	12.9	12.1
Percent Dry Wt.	16.2	13.9	13.8	18.9	18.9
Batch	1	1	2	1	1
2,4'-DDD	2.0	1.8 U	1.8 U	2.1 U	2.2 U
2,4'-DDE	1.6 U	1.9 U	1.9 U	2.1 U	2.3 U
2,4'-DDT	1.1 U	1.3 U	1.3 U	1.5 U	1.5 U
4,4'-DDD	7.10	8.54	5.7 U	5.29	6.67
4,4'-DDE	2.1	1.9	1.4 U	1.6	1.6 U
4,4'-DDT	6.36	5.5	4.9	2.1	3.9
α -Chlordane	1.7	1.1	0.73	1.0	1.0
Aldrin	4.8	5.4	4.7	4.9	5.3
Dieldrin	3.2 U	3.7 U	3.8 U	4.2 U	4.5 U
Endosulfan I	1.1 U	1.3 U	1.3 U	1.5 U	1.6 U
Endosulfan II	1.1 U	1.3 U	1.3 U	1.5 U	1.6 U
Endosulfan Sulfate	1.5 U	1.8 U	1.8 U	2.1 U	2.2 U
Heptachlor	1.2 U	1.3 U	1.4 U	1.5 U	1.6 U
Heptachlor Epoxide	0.80 U	0.93 U	0.94 U	1.1 U	1.2 U
Trans Nonachlor	4.3	2.5	3.4	1.6	1.7
PCB 8	2.2 U	2.4 U	2.5 U	2.9 U	3.1 U
PCB 18	0.62 U	0.72 U	0.73 U	0.85 U	0.90 U
PCB 28	0.68 U	0.79 U	0.80 U	0.90 U	1.0 U
PCB 44	0.4 U	0.5 U	0.5 U	0.58 U	0.64 U
PCB 49	4.0	3.2	1.3 U	3.0	2.9
PCB 52	8.95	8.90	7.0	5.66	5.35
PCB 66	0.93 U	1.1 U	1.1 U	1.2 U	1.3 U
PCB 87	1.5 U	1.8 U	1.8 U	2.1 U	2.2 U
PCB 101	8.21	7.97	5.4	4.2	3.7
PCB 105	1.0 U	4.3	1.2 U	1.4 U	1.4 U
PCB 118	4.0	1.4 U	1.4 U	1.5 U	2.0
PCB 128	1.5	1.7	1.2	0.85 U	0.90 U
PCB 138	9.26	11.1	7.1	3.4	3.5
PCB 153	13.0	15.9	10.7	4.6	4.9
PCB 170	2.5	1.2 U	1.7	1.4 U	1.5 U
PCB 180	4.6	4.7	3.2	3.1 U	3.3 U
PCB 183	1.2	1.3 U	1.3 U	1.5 U	1.6 U
PCB 184	1.1 U	1.3 U	1.3 U	1.5 U	1.6 U
PCB 187	3.2	4.2	1.7	1.7 U	1.8 U
PCB 195	0.80 U	0.86 U	0.94 U	1.1 U	1.1 U
PCB 206	1.3 U	1.5 U	1.5 U	1.7 U	1.9 U
PCB 209	1.2 U	1.4 U	1.5 U	1.6 U	1.7 U

Table G.5. (contd)

Sediment Treatment	Concentration (µg/kg dry wt)				
	MDRS	MDRS	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3	1	1	2	3
Wet Weight (g)	12.3	20.1	20.4	20.0	20.5
Percent Dry Wt.	18.9	15.0	17.4	17.4	17.4
Batch	1	1	2	2	2
2,4'-DDD	2.2 U	1.7 U	1.4 U	1.4 U	1.4 U
2,4'-DDE	2.2 U	1.7 U	1.5 U	1.5 U	1.5 U
2,4'-DDT	1.5 U	1.2 U	1.0 U	1.0 U	1.0 U
4,4'-DDD	5.51	6.6	1.5 U	1.5 U	1.5 U
4,4'-DDE	1.6 U	1.4	1.0 U	1.1 U	1.0 U
4,4'-DDT	3.3	5.7	3.9	2.8	3.1
α-Chlordane	1.0	1.1	0.52 U	0.58 U	0.5 U
Aldrin	5.2	4.7	2.7	2.7	2.7
Dieldrin	4.4 U	3.5 U	2.9 U	3.0 U	2.9 U
Endosulfan I	1.5 U	1.2 U	1.0 U	1.0 U	1.0 U
Endosulfan II	1.5 U	1.2 U	1.0 U	1.0 U	1.0 U
Endosulfan Sulfate	2.2 U	1.7 U	1.4 U	1.4 U	1.4 U
Heptachlor	1.6 U	6.68	1.0 U	1.1 U	1.0 U
Heptachlor Epoxide	1.2 U	0.87 U	0.75 U	0.75 U	0.75 U
Trans Nonachlor	1.3 U	3.9	2.0	0.86 U	1.8
PCB 8	3.0 U	2.3 U	2.0 U	2.0 U	2.0 U
PCB 18	0.90 U	8.88	0.6 U	0.6 U	0.58 U
PCB 28	1.0 U	0.73 U	0.6 U	0.6 U	0.63 U
PCB 44	0.58 U	0.5 U	0.4 U	0.4 U	0.4 U
PCB 49	2.5	1.2 U	1.0 U	1.0 U	1.0 U
PCB 52	5.1	6.2	1.8 U	1.8 U	1.8 U
PCB 66	1.3 U	1.0 U	0.9 U	0.9 U	0.86 U
PCB 87	2.2 U	1.7 U	1.4 U	1.4 U	1.4 U
PCB 101	3.4	6.0	1.1	1.0	1.1
PCB 105	1.4 U	1.1 U	0.92 U	1.0 U	0.92 U
PCB 118	1.6 U	1.3 U	1.1 U	1.1 U	1.1 U
PCB 128	0.90 U	1.5	0.6	0.63	0.63
PCB 138	3.4	9.08	3.9	3.7	3.9
PCB 153	4.5	12.8	5.6	5.4	5.5
PCB 170	1.5 U	2.3	1.0 U	1.0 U	1.0 U
PCB 180	3.2 U	4.4	2.1 U	2.2 U	2.1 U
PCB 183	1.6 U	1.2 U	1.0 U	1.0 U	1.0 U
PCB 184	1.6 U	1.2 U	1.0 U	1.0 U	1.0 U
PCB 187	1.7 U	3.3	1.2 U	1.2 U	1.2 U
PCB 195	1.1 U	0.87 U	0.69 U	0.75 U	0.69 U
PCB 206	1.9 U	1.4 U	1.2 U	1.2 U	1.2 U
PCB 209	1.7 U	1.3 U	1.1 U	1.2 U	1.1 U

(a) U Undetected at or above given concentration.

(b) MDRS Mud dump reference site.

Table G.6. Quality Control Data for Pesticide and Polychlorinated Biphenyl (PCB) Analysis of *N. virens* Tissue (Wet Weight)

					Matrix Spike Results		
		Concentration (µg/kg wet weight)					
Sediment Treatment	Blank	Blank	SR COMP ^(a)	SR COMP			
Replicate			3	(MS)	Concentration		Percent
Analytical Replicate	1	1	1	1	Spiked	Recovered	Recovery
Wet Weight (g)	20.0	18.0	13.2	13.1			
Batch	1	2	1	1			
2,4'-DDD	0.25 U ^(b)	0.28 U	0.39 U	0.39 U	NS ^(c)	NA ^(d)	NA
2,4'-DDE	0.26 U	0.29 U	0.40 U	0.40 U	NS	NA	NA
2,4'-DDT	0.18 U	0.20 U	0.27 U	0.27 U	NS	NA	NA
4,4'-DDD	0.26 U	0.29 U	1.05	4.45	3.80	3.40	89
4,4'-DDE	0.19 U	0.21 U	0.35	3.96	3.80	3.61	95
4,4'-DDT	0.15 U	0.17 U	0.89	4.63	3.80	3.74	98
α-Chlordane	0.10 U	0.11 U	0.23	3.92	3.80	3.69	97
Aldrin	0.63	0.14 U	0.89	4.00	3.80	3.11	82
Dieldrin	0.52 U	0.58 U	0.78 U	4.46	3.80	4.46	117
Endosulfan I	0.18 U	0.20 U	0.27 U	3.12	3.80	3.12	82
Endosulfan II	0.18 U	0.20 U	0.27 U	3.51	3.80	3.51	92
Endosulfan Sulfate	0.25 U	0.28 U	0.38 U	4.15	3.80	4.15	109
Heptachlor	0.19 U	0.21 U	0.28 U	4.80	3.80	4.80	126 ^(e)
Heptachlor Epoxide	0.13 U	0.15 U	0.20 U	4.32	3.80	4.32	114
Trans Nonachlor	0.15 U	0.16 U	0.51	0.49	NS	NA	NA
PCB 8	0.35 U	0.39 U	0.53 U	0.53 U	NS	NA	NA
PCB 18	0.10 U	0.11 U	0.16 U	0.16 U	NS	NA	NA
PCB 28	0.11 U	0.12 U	0.17 U	4.86	4.84	4.86	100
PCB 44	0.07 U	0.08 U	0.11 U	0.11 U	NS	NA	NA
PCB 49	0.18 U	0.21 U	0.35	0.35	NS	NA	NA
PCB 52	0.32 U	0.36 U	0.91	12.4	10.1	11.5	114
PCB 66	0.15 U	0.17 U	0.23 U	0.23 U	NS	NA	NA
PCB 87	0.25 U	0.28 U	0.38 U	0.38 U	NS	NA	NA
PCB 101	0.13 U	0.15 U	0.86	9.28	6.86	8.42	123 ^(e)
PCB 105	0.17 U	0.19 U	0.25 U	0.25 U	NS	NA	NA
PCB 118	0.19 U	0.21 U	0.56	0.57	NS	NA	NA
PCB 128	0.11 U	0.12 U	0.20	0.16 U	NS	NA	NA
PCB 138	0.27 U	0.30 U	1.36	4.94	3.10	3.58	115
PCB 153	0.44 U	0.49 U	2.01	6.50	4.01	4.49	112
PCB 170	0.18 U	0.20 U	0.33	0.27 U	NS	NA	NA
PCB 180	0.38 U	0.42 U	0.66	0.57 U	NS	NA	NA
PCB 183	0.18 U	0.21 U	0.28 U	0.28 U	NS	NA	NA
PCB 184	0.18 U	0.21 U	0.28 U	0.28 U	NS	NA	NA
PCB 187	0.21 U	0.23 U	0.31 U	0.36	NS	NA	NA
PCB 195	0.13 U	0.14 U	0.19 U	0.19 U	NS	NA	NA
PCB 206	0.21 U	0.24 U	0.33 U	0.33 U	NS	NA	NA
PCB 209	0.20 U	0.22 U	0.30 U	0.30 U	NS	NA	NA
<u>Surrogate Recoveries (%)</u>							
PCB 103 (SIS)	90	82	104	104	NA	NA	NA
PCB 198 (SIS)	82	81	93	105	NA	NA	NA

Table G.6. (contd)

Sediment Treatment Replicate	Matrix Spike Results				
	Concentration (µg/kg wet weight)				
	SH COMP ^(a)	SH COMP	Concentration		Percent
	1	(MS)	Spiked	Recovered	
Analytical Replicate	1	1			Recovery
Wet Weight (g)	13.1	13.6			
Batch	2	2			
2,4'-DDD	0.44	0.38 U	NS	NA	NA
2,4'-DDE	0.40 U	0.39 U	NS	NA	NA
2,4'-DDT	0.28 U	0.26 U	NS	NA	NA
4,4'-DDD	2.99	5.82	3.70	2.83	76
4,4'-DDE	1.89	4.84	3.70	2.95	80
4,4'-DDT	0.89	3.51	3.70	2.62	71
α-Chlordane	0.68	4.09	3.70	3.41	92
Aldrin	1.77	4.12	3.70	2.35	64
Dieldrin	0.79 U	4.31	3.70	4.31	116
Endosulfan I	0.28 U	2.86	3.70	2.86	77
Endosulfan II	0.28 U	2.70	3.70	2.70	73
Endosulfan Sulfate	0.39 U	3.05	3.70	3.05	82
Heptachlor	0.52	3.90	3.70	3.38	91
Heptachlor Epoxide	0.20 U	3.55	3.70	3.55	96
Trans Nonachlor	0.81	0.58	NS	NA	NA
PCB 8	0.54 U	0.52 U	NS	NA	NA
PCB 18	4.73	3.88	NS	NA	NA
PCB 28	0.17 U	5.62	4.72	5.62	119
PCB 44	2.46	0.10 U	NS	NA	NA
PCB 49	2.96	2.28	NS	NA	NA
PCB 52	5.06	13.1	9.84	8.08	82
PCB 66	4.29	0.22 U	NS	NA	NA
PCB 87	0.39 U	0.37 U	NS	NA	NA
PCB 101	3.03	9.31	6.68	6.28	94
PCB 105	0.26 U	0.92	NS	NA	NA
PCB 118	2.03	1.68	NS	NA	NA
PCB 128	0.33	0.25	NS	NA	NA
PCB 138	1.95	4.66	3.02	2.71	90
PCB 153	2.63	5.97	3.90	3.34	86
PCB 170	0.38	0.26 U	NS	NA	NA
PCB 180	0.74	0.57	NS	NA	NA
PCB 183	0.28 U	0.27 U	NS	NA	NA
PCB 184	0.28 U	0.27 U	NS	NA	NA
PCB 187	0.33	0.31 U	NS	NA	NA
PCB 195	0.20 U	0.19 U	NS	NA	NA
PCB 206	0.33 U	0.32 U	NS	NA	NA
PCB 209	0.30 U	0.29 U	NS	NA	NA
<u>Surrogate Recoveries (%)</u>					
PCB 103 (SIS)	114	94	NA	NA	NA
PCB 198 (SIS)	94	87	NA	NA	NA

Table G.6. (contd)

Sediment Treatment	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet weight)			
	MDRS ⁽¹⁾	MDRS	MDRS	
	4	4	4	
Replicate	4	4	4	
Analytical Replicate	1	2	3	
Wet Weight (g)	12.9	12.1	12.3	
Batch	1	1	1	
2,4'-DDD	0.39 U	0.42 U	0.41 U	NA
2,4'-DDE	0.40 U	0.43 U	0.42 U	NA
2,4'-DDT	0.28 U	0.29 U	0.29 U	NA
4,4'-DDD	1.00	1.26	1.04	13
4,4'-DDE	0.30	0.31 U	0.30 U	NA
4,4'-DDT	0.40	0.73	0.63	29
α-Chlordane	0.19	0.19	0.18	3
Aldrin	0.93	1.01	0.99	4
Dieldrin	0.79 U	0.85 U	0.84 U	NA
Endosulfan I	0.28 U	0.30 U	0.29 U	NA
Endosulfan II	0.28 U	0.30 U	0.29 U	NA
Endosulfan Sulfate	0.39 U	0.41 U	0.41 U	NA
Heptachlor	0.28 U	0.30 U	0.30 U	NA
Heptachlor Epoxide	0.20 U	0.22 U	0.22 U	NA
Trans Nonachlor	0.31	0.32	0.24 U	NA
PCB 8	0.54 U	0.58 U	0.57 U	NA
PCB 18	0.16 U	0.17 U	0.17 U	NA
PCB 28	0.17 U	0.18 U	0.18 U	NA
PCB 44	0.11 U	0.12 U	0.11 U	NA
PCB 49	0.57	0.54	0.48	9
PCB 52	1.07	1.01	0.97	5
PCB 66	0.23 U	0.25 U	0.24 U	NA
PCB 87	0.39 U	0.41 U	0.41 U	NA
PCB 101	0.79	0.70	0.64	11
PCB 105	0.26 U	0.27 U	0.27 U	NA
PCB 118	0.29 U	0.37	0.31 U	NA
PCB 128	0.16 U	0.17 U	0.17 U	NA
PCB 138	0.65	0.67	0.65	2
PCB 153	0.86	0.92	0.85	4
PCB 170	0.27 U	0.29 U	0.28 U	NA
PCB 180	0.58 U	0.62 U	0.61 U	NA
PCB 183	0.28 U	0.30 U	0.30 U	NA
PCB 184	0.28 U	0.30 U	0.30 U	NA
PCB 187	0.32 U	0.34 U	0.33 U	NA
PCB 195	0.20 U	0.21 U	0.21 U	NA
PCB 206	0.33 U	0.35 U	0.35 U	NA
PCB 209	0.30 U	0.32 U	0.32 U	NA
<u>Surrogate Recoveries (%)</u>				
PCB 103 (SIS)	107	109	109	NA
PCB 198 (SIS)	95	96	91	NA

Table G.6. (contd)

Sediment Treatment Replicate Analytical Replicate Wet Weight (g) Batch	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet weight)			
	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.	
	Tissue	Tissue	Tissue	
	1	2	3	
	20.4	20.0	20.5	
	2	2	2	
2,4'-DDD	0.25 U	0.25 U	0.25 U	NA
2,4'-DDE	0.26 U	0.26 U	0.26 U	NA
2,4'-DDT	0.18 U	0.18 U	0.18 U	NA
4,4'-DDD	0.26 U	0.26 U	0.26 U	NA
4,4'-DDE	0.18 U	0.19 U	0.18 U	NA
4,4'-DDT	0.68	0.48	0.53	18
α-Chlordane	0.09 U	0.10 U	0.09 U	NA
Aldrin	0.46	0.47	0.47	1
Dieldrin	0.51 U	0.52 U	0.51 U	NA
Endosulfan I	0.18 U	0.18 U	0.18 U	NA
Endosulfan II	0.18 U	0.18 U	0.18 U	NA
Endosulfan Sulfate	0.25 U	0.25 U	0.25 U	NA
Heptachlor	0.18 U	0.19 U	0.18 U	NA
Heptachlor Epoxide	0.13 U	0.13 U	0.13 U	NA
Trans Nonachlor	0.35	0.15 U	0.32	NA
PCB 8	0.34 U	0.35 U	0.34 U	NA
PCB 18	0.10 U	0.10 U	0.10 U	NA
PCB 28	0.11 U	0.11 U	0.11 U	NA
PCB 44	0.07 U	0.07 U	0.07 U	NA
PCB 49	0.18 U	0.18 U	0.18 U	NA
PCB 52	0.32 U	0.32 U	0.32 U	NA
PCB 66	0.15 U	0.15 U	0.15 U	NA
PCB 87	0.25 U	0.25 U	0.25 U	NA
PCB 101	0.19	0.18	0.19	3
PCB 105	0.16 U	0.17 U	0.16 U	NA
PCB 118	0.19 U	0.19 U	0.19 U	NA
PCB 128	0.11	0.11	0.11	0
PCB 138	0.67	0.65	0.68	2
PCB 153	0.98	0.94	0.96	2
PCB 170	0.17 U	0.18 U	0.17 U	NA
PCB 180	0.37 U	0.38 U	0.37 U	NA
PCB 183	0.18 U	0.18 U	0.18 U	NA
PCB 184	0.18 U	0.18 U	0.18 U	NA
PCB 187	0.20 U	0.21 U	0.20 U	NA
PCB 195	0.12 U	0.13 U	0.12 U	NA
PCB 206	0.21 U	0.21 U	0.21 U	NA
PCB 209	0.19 U	0.20 U	0.19 U	NA
<u>Surrogate Recoveries (%)</u>				
PCB 103 (SIS)	124	103	130	NA
PCB 198 (SIS)	98	82	100	NA

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) U Undetected at or above given concentration.

(c) NS Not spiked.

(d) NA Not applicable.

(e) Outside quality control criteria (50-120%) for spike recovery.

(f) MDRS Mud Dump Reference Site.

Table G.7. Polynuclear Aromatic Hydrocarbons (PAHs) in *N. virens* Tissue (Wet Weight), Bronx River

Sediment Treatment	Concentration (µg/kg wet wt)				
	BX COMP	BX COMP	BX COMP	BX COMP	BX COMP
Replicate	1	2	3	4	5
Analytical Replicate	1	1	1	1	1
Wet Weight (g)	14.4	18.4	20.3	18.6	20.2
Percent Dry Weight	14.0	15.2	15.3	14.2	16.0
Batch	2	1	1	1	1
1,4-Dichlorobenzene ^(a)	2.61 U ^(b)	2.17 U	1.97 U	2.16 U	1.98 U
Naphthalene	2.61 U	4.27	4.94 B ^(c)	4.26	2.89 B
Acenaphthylene	1.97 ^(d)	0.85	0.87	0.59 U	0.77
Acenaphthene	4.08	5.10	5.34	3.58	4.46
Fluorene	2.55 B	1.78	1.88	1.38 U	1.26 U
Phenanthrene	3.58 U	7.64	8.87	2.88 U	6.43
Anthracene	3.13 U	2.44 U	2.33	2.43 U	2.22 U
Fluoranthene	66.8	116	129	29.0	128
Pyrene	89.2	153	166	40.5	160
Benzo[a]anthracene	5.36 B	10.3	14.2	1.53	10.7
Chrysene	33.8	52.0	54.6	9.23	61.1
Benzo[b]fluoranthene	8.60	10.1	13.1	1.87	13.0
Benzo[k]fluoranthene	4.90	4.47	5.79	1.62 U	6.72
Benzo[a]pyrene	3.74 ^(d)	5.51	7.04	1.38 U	8.19
Indeno[123-cd]pyrene	2.47 U	1.66 U	1.87	1.65 U	2.61
Dibenzo[a,h]anthracene	1.76 U	1.32 U	1.20 U	1.32 U	1.21 U
Benzo[g,h,i]perylene	3.31	2.68	2.91	1.15 U	4.96
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	38	59	32	59	68
d8 Naphthalene	46	68	39	65	75
d10 Acenaphthene	56	81	49	77	92
d12 Chrysene	61	73	48	84	91
d14 Dibenzo[a,h]anthracen	73	98	58	98	121

Table G.7. (contd)

Sediment Treatment	Concentration (µg/kg wet wt)				
	MDRS ^(e)	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate	1	1	1	1	2
Wet Weight (g)	20.2	20.4	20.0	12.9	12.1
Percent Dry Weight	16.2	13.9	13.8	18.9	18.9
Batch	1	1	2	1	1
1,4-Dichlorobenzene	1.98 U	1.96 U	1.86 U	3.10 U	3.30 U
Naphthalene	3.07 B	5.84 B	1.86 U	4.48 B	4.70 B
Acenaphthylene	0.55 U	0.54 U	0.73 U	0.85 U	0.91 U
Acenaphthene	1.38 U	1.36 U	1.30 U	2.15 U	2.29 U
Fluorene	1.27 U	1.26 U	1.44 B	1.98 U	2.11 U
Phenanthrene	2.65 U	2.62 U	2.56 U	4.13 U	4.40 U
Anthracene	2.23 U	2.21 U	2.24 U	3.48 U	3.71 U
Fluoranthene	3.07 U	3.04 U	5.36 U	4.80 U	5.11 U
Pyrene	4.71	2.74 U	4.57 U	8.10	7.26
Benzo[a]anthracene	0.89 U	0.88 U	1.09 U	1.55	1.48 U
Chrysene	1.86	1.71 U	2.27 U	2.69 U	2.87 U
Benzo[b]fluoranthene	1.13 U	1.12 U	1.64 U	1.76 U	1.88 U
Benzo[k]fluoranthene	1.49 U	1.47 U	1.67 U	2.32 U	2.47 U
Benzo[a]pyrene	1.27 U	1.26 U	1.49 U	1.98 U	2.11 U
Indeno[123-cd]pyrene	1.52 U	1.50 U	1.76 U	2.37 U	2.52 U
Dibenzo[a,h]anthracene	1.21 U	1.20 U	1.26 U	1.89 U	2.01 U
Benzo[g,h,i]perylene	1.06 U	1.05 U	1.40 U	1.66 U	1.76 U
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	53	33	74	88	75
d8 Naphthalene	62	35	84	81	72
d10 Acenaphthene	84	43	93	91	90
d12 Chrysene	82	46	95	77	85
d14 Dibenzo[a,h]anthracene	115	55	116	125	123

Table G.7. (contd)

Sediment Treatment	Concentration ($\mu\text{g/kg}$ wet wt)				
	MDRS	MDRS	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3	1	1	2	3
Wet Weight (g)	12.3	20.1	20.4	20.0	20.5
Percent Dry Weight	18.9	15.0	17.4	17.4	17.4
Batch	1	1	2	2	2
1,4-Dichlorobenzene	3.26 U	1.99 U	1.83 U	1.86 U	1.83 U
Naphthalene	4.46 B	2.96 B	1.83 U	1.86 U	1.83 U
Acenaphthylene	0.90 U	0.55 U	0.71 U	0.73 U	0.71 U
Acenaphthene	2.27 U	1.38 U	1.28 U	1.30 U	1.28 U
Fluorene	2.09 U	1.27 U	1.86 B	1.24 U	1.21 U
Phenanthrene	4.35 U	2.66 U	2.51 U	2.56 U	2.51 U
Anthracene	3.67 U	2.24 U	2.19 U	2.24 U	2.19 U
Fluoranthene	5.05 U	3.08 U	5.26 U	5.36 U	5.26 U
Pyrene	6.16	3.19	4.48 U	4.57 U	4.48 U
Benzo[a]anthracene	1.47	1.05	1.78 B	1.53 B	1.96 B
Chrysene	2.84 U	1.73 U	2.22 U	2.27 U	2.22 U
Benzo[b]fluoranthene	1.86 U	1.13 U	1.61 U	1.64 U	1.61 U
Benzo[k]fluoranthene	2.44 U	1.49 U	1.64 U	1.67 U	1.64 U
Benzo[a]pyrene	2.09 U	1.27 U	1.46 U	1.49 U	1.46 U
Indeno[123-cd]pyrene	2.49 U	1.52 U	1.73 U	1.76 U	1.73 U
Dibenzo[a,h]anthracene	1.99 U	1.21 U	1.24 U	1.26 U	1.24 U
Benzo[g,h,i]perylene	1.74 U	1.06 U	1.37 U	1.40 U	1.37 U
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	78	73	55	45	63
d8 Naphthalene	80	66	69	57	77
d10 Acenaphthene	95	80	83	68	86
d12 Chrysene	90	73	90	75	90
d14 Dibenzo[a,h]anthracene	113	112	112	91	111

(a) Target detection limits are $4.0 \mu\text{g/kg}$ for all analytes (except 1,4-Dichlorobenzene which is $0.4 \mu\text{g/kg}$).

(b) U Undetected at or above given concentration.

(c) B Analyte detected in sample is $< 5\times$ blank value.

(d) Ion ratio out or confirmation ion not detected.

(e) MDRS Mud dump reference site.

Table G.8. Polynuclear Aromatic Hydrocarbons (PAHs) in *N. virens* Tissue (Dry Weight),
Bronx River

Sediment Treatment	Concentration (µg/kg dry wt)				
	BX COMP	BX COMP	BX COMP	BX COMP	BX COMP
Replicate	1	2	3	4	5
Analytical Replicate	1	1	1	1	1
Wet Weight (g)	14.4	18.4	20.3	18.6	20.2
Percent Dry Weight	14.0	15.2	15.3	14.2	16.0
Batch	2	1	1	1	1
1,4-Dichlorobenzene	18.7 U	14.2 U	12.9 U	15.2 U	12.4 U
Naphthalene	18.7 U	28.0	32.4 B ^(b)	30.0	18.1 B
Acenaphthylene	14.1 ^(c)	5.6	5.7	4.1 U	4.8
Acenaphthene	29.2	33.5	35.0	25.2	27.9
Fluorene	18.2 B	11.7	12.3	9.70 U	7.89 U
Phenanthrene	25.6 U	50.2	58.1	20.3 U	40.3
Anthracene	22.4 U	16.0 U	15.3	17.1 U	13.9 U
Fluoranthene	477	759	847	204	802
Pyrene	638	1000	1090	285	1000
Benzo[a]anthracene	38.3 B	67.4	92.7	10.8	67.0
Chrysene	241	342	358	64.9	383
Benzo[b]fluoranthene	61.5	66.3	85.8	13.2	81.5
Benzo[k]fluoranthene	35.0	29.3	37.9	11.4 U	42.1
Benzo[a]pyrene	26.7 ^(c)	36.2	46.1	9.70 U	51.3
Indeno[123-cd]pyrene	17.7 U	10.9 U	12.3	11.6 U	16.4
Dibenzo[a,h]anthracene	12.6 U	8.67 U	7.86 U	9.28 U	7.58 U
Benzo[g,h,i]perylene	23.7	17.6	19.1	8.09 U	31.1

Table G.8. (contd)

Sediment Treatment	Concentration ($\mu\text{g/kg dry wt}$)				
	MDRS ^(d)	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate	1	1	1	1	2
Wet Weight (g)	20.2	20.4	20.0	12.9	12.1
Percent Dry Weight	16.2	13.9	13.8	18.9	18.9
Batch	1	1	2	1	1
1,4-Dichlorobenzene	12.2 U	14.1 U	13.5 U	16.4 U	17.5 U
Naphthalene	19.0 B	41.9 B	13.5 U	23.7 B	24.9 B
Acenaphthylene	3.4 U	3.9 U	5.3 U	4.5 U	4.8 U
Acenaphthene	8.52 U	9.76 U	9.43 U	11.4 U	12.1 U
Fluorene	7.84 U	9.05 U	10.4 B	10.5 U	11.2 U
Phenanthrene	16.4 U	18.8 U	18.6 U	21.9 U	23.3 U
Anthracene	13.8 U	15.9 U	16.3 U	18.4 U	19.6 U
Fluoranthene	19.0 U	21.8 U	38.9 U	25.4 U	27.1 U
Pyrene	29.1	19.7 U	33.2 U	42.9	38.4
Benzo[a]anthracene	5.5 U	6.3 U	7.91 U	8.21	7.83 U
Chrysene	11.5	12.3 U	16.5 U	14.2 U	15.2 U
Benzo[b]fluoranthene	6.98 U	8.04 U	11.9 U	9.32 U	9.95 U
Benzo[k]fluoranthene	9.20 U	10.6 U	12.1 U	12.3 U	13.1 U
Benzo[a]pyrene	7.84 U	9.05 U	10.8 U	10.5 U	11.2 U
Indeno[123-cd]pyrene	9.38 U	10.8 U	12.8 U	12.5 U	13.3 U
Dibenzo[a,h]anthracene	7.47 U	8.61 U	9.14 U	10.0 U	10.6 U
Benzo[g,h,i]perylene	6.54 U	7.54 U	10.2 U	8.79 U	9.32 U

Table G.8. (contd)

Sediment Treatment	Concentration (µg/kg dry wt)				
	MDRS	MDRS	Nereis Bkgd.	Nereis Bkgd.	Nereis Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3	1	1	2	3
Wet Weight (g)	12.3	20.1	20.4	20.0	20.5
Percent Dry Weight	18.9	15.0	17.4	17.4	17.4
Batch	1	1	2	2	2
1,4-Dichlorobenzene	17.3 U	13.3 U	10.5 U	10.7 U	10.5 U
Naphthalene	23.6 B	19.8 B	10.5 U	10.7 U	10.5 U
Acenaphthylene	4.8 U	3.7 U	4.1 U	4.2 U	4.1 U
Acenaphthene	12.0 U	9.22 U	7.38 U	7.49 U	7.38 U
Fluorene	11.1 U	8.48 U	10.7 B	7.15 U	6.97 U
Phenanthrene	23.0 U	17.8 U	14.5 U	14.8 U	14.5 U
Anthracene	19.4 U	15.0 U	12.6 U	12.9 U	12.6 U
Fluoranthene	26.7 U	20.6 U	30.3 U	30.9 U	30.3 U
Pyrene	32.6	21.3	25.8 U	26.3 U	25.8 U
Benzo[a]anthracene	7.78	7.01	10.3 B	8.82 B	11.3 B
Chrysene	15.0 U	11.6 U	12.8 U	13.1 U	12.8 U
Benzo[b]fluoranthene	9.8 U	7.55 U	9.28 U	9.45 U	9.28 U
Benzo[k]fluoranthene	12.9 U	10.0 U	9.45 U	9.63 U	9.45 U
Benzo[a]pyrene	11.1 U	8.48 U	8.41 U	8.59 U	8.41 U
Indeno[123-cd]pyrene	13.2 U	10.2 U	10.0 U	10.1 U	9.97 U
Dibenzo[a,h]anthracene	10.5 U	8.08 U	7.15 U	7.26 U	7.15 U
Benzo[g,h,i]perylene	9.21 U	7.08 U	7.90 U	8.07 U	7.90 U

(a) U Undetected at or above given concentration.

(b) B Analyte detected in sample is < 5x blank value.

(c) Ion ratio out or confirmation ion not detected.

(d) MDRS Mud dump reference site.

Table G.9. Quality Control Data for Polynuclear Aromatic Hydrocarbon (PAH) Analysis of *N. virens* Tissue (Wet Weight)

Sediment Treatment Replicate	Matrix Spike Results						
			Concentration (µg/kg wet wt)				
	Blank	Blank	SR COMP ^(a)	SR COMP	Concentration		Percent
			3	(MS)	Spiked	Recovered	Recover
Analytical Replicate	1	1	1	1			
Wet Weight (g)	20.0	18.0	13.2	13.1			
Batch	1	2	1	1			
1,4-Dichlorobenzene	2.00 U ^(b)	2.09 U	3.03 U	3.05 U	NS ^(c)	NA ^(d)	NA
Naphthalene	2.34	2.09 U	4.51 B ^(e)	49.0	38.1	44.5	117
Acenaphthylene	0.55 U	0.81 U	0.83 U	41.9	38.1	41.9	110
Acenaphthene	1.39 U	1.46 U	2.10 U	44.3	38.1	44.3	116
Fluorene	1.28 U	1.72	1.94 U	47.4	38.1	47.4	124 ^(f)
Phenanthrene	2.67 U	2.87 U	4.04 U	43.4	38.1	43.4	114
Anthracene	2.25 U	2.51 U	3.40 U	41.6	38.1	41.6	109
Fluoranthene	3.10 U	6.01 U	17.0	68.5	38.1	51.6	135 ^(f)
Pyrene	2.79 U	5.12 U	25.6	80.5	38.1	55.0	144 ^(f)
Benzo[a]anthracene	0.90 U	1.59	1.70	48.5	38.1	46.8	123 ^(f)
Chrysene	1.74 U	2.54 U	4.27	48.2	38.1	43.9	115
Benzo[b]fluoranthene	1.14 U	1.84 U	1.72 U	44.6	38.1	44.6	117
Benzo[k]fluoranthene	1.50 U	1.87 U	2.27 U	42.2	38.1	42.2	111
Benzo[a]pyrene	1.28 U	1.67 U	1.94 U	43.4	38.1	43.4	114
Indeno[123-cd]pyrene	1.53 U	1.97 U	2.31 U	42.0	38.1	42.0	110
Dibenzo[a,h]anthracene	1.22 U	1.41 U	1.85 U	41.6	38.1	41.6	109
Benzo[g,h,i]perylene	1.07 U	1.57 U	1.62 U	40.7	38.1	40.7	107
<u>Surrogate Recoveries (%)</u>							
d4 1,4-Dichlorobenzene	53	55	64	65	NA	NA	NA
d8 Naphthalene	66	61	72	76	NA	NA	NA
d10 Acenaphthene	78	65	90	93	NA	NA	NA
d12 Chrysene	99	76	84	86	NA	NA	NA
d14 Dibenzo[a,h]anthracene	79	88	118	128	NA	NA	NA

Table G.9. (contd)

Sediment Treatment	Matrix Spike Results				
	Concentration (µg/kg wet wt)				
	SH COMP ^(a)	SH COMP (MS)	Concentration		Percent
	1	1	Spiked	Recovered	Recovery
Replicate	1				
Analytical Replicate	1	1			
Wet Weight (g)	13.1	13.6			
Batch	2	2			
1,4-Dichlorobenzene	2.87 U	2.76 U	NS	NA	NA
Naphthalene	2.87 U	47.1	38.5	47.1	122 ^(f)
Acenaphthylene	1.52 ^(g)	36.0	38.5	34.5	90
Acenaphthene	4.84	39.7	38.5	34.8	90
Fluorene	2.56 B	38.4	38.5	35.8	93
Phenanthrene	3.94 U	34.4	38.5	34.4	89
Anthracene	3.45 U	41.2	38.5	41.2	107
Fluoranthene	47.6	75.6	38.5	28.0	73
Pyrene	62.2	86.8	38.5	24.6	64
Benzo[a]anthracene	1.68 U	44.3	38.5	44.3	115
Chrysene	12.8	46.8	38.5	34.0	88
Benzo[b]fluoranthene	4.11 ^(g)	47.2	38.5	43.1	112
Benzo[k]fluoranthene	2.96	43.8	38.5	40.9	106
Benzo[a]pyrene	2.30 U	40.4	38.5	40.4	105
Indeno[123-cd]pyrene	2.71 U	34.8	38.5	34.8	90
Dibenzo[a,h]anthracene	1.94 U	33.0	38.5	33.0	86
Benzo[g,h,i]perylene	2.16 U	30.0	38.5	30.0	78
<u>Surrogate Recoveries (%)</u>					
d4 1,4-Dichlorobenzene	64	50	NA	NA	NA
d8 Naphthalene	78	63	NA	NA	NA
d10 Acenaphthene	88	73	NA	NA	NA
d12 Chrysene	89	81	NA	NA	NA
d14 Dibenzo[a,h]anthracene	108	101	NA	NA	NA

Table G.9. (contd)

Sediment Treatment	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet wt)			
	MDRS ^(h)	MDRS	MDRS	
Replicate	4	4	4	
Analytical Replicate	1	2	3	
Wet Weight (g)	12.9	12.1	12.3	
Batch	1	1	1	
1,4-Dichlorobenzene	3.10 U	3.30 U	3.26 U	NA
Naphthalene	4.48 B	4.70 B	4.46 B	3
Acenaphthylene	0.85 U	0.91 U	0.90 U	NA
Acenaphthene	2.15 U	2.29 U	2.27 U	NA
Fluorene	1.98 U	2.11 U	2.09 U	NA
Phenanthrene	4.13 U	4.40 U	4.35 U	NA
Anthracene	3.48 U	3.71 U	3.67 U	NA
Fluoranthene	4.80 U	5.11 U	5.05 U	NA
Pyrene	8.10	7.26	6.16	14
Benzo[a]anthracene	1.55	1.48 U	1.47	NA
Chrysene	2.69 U	2.87 U	2.84 U	NA
Benzo[b]fluoranthene	1.76 U	1.88 U	1.86 U	NA
Benzo[k]fluoranthene	2.32 U	2.47 U	2.44 U	NA
Benzo[a]pyrene	1.98 U	2.11 U	2.09 U	NA
Indeno[123-cd]pyrene	2.37 U	2.52 U	2.49 U	NA
Dibenzo[a,h]anthracene	1.89 U	2.01 U	1.99 U	NA
Benzo[g,h,i]perylene	1.66 U	1.76 U	1.74 U	NA
<u>Surrogate Recoveries (%)</u>				
d4 1,4-Dichlorobenzene	88	75	78	NA
d8 Naphthalene	81	72	80	NA
d10 Acenaphthene	91	90	95	NA
d12 Chrysene	77	85	90	NA
d14 Dibenzo[a,h]anthracene	125	123	113	NA

Table G.9. (contd)

Sediment Treatment Replicate	Analytical Replicates			RSD (%)
	Concentration (µg/kg wet wt)			
	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.	<i>Nereis</i> Bkgd.	
	Tissue	Tissue	Tissue	
Analytical Replicate	1	2	3	
Wet Weight (g)	20.4	20.0	20.5	
Batch	2	2	2	
1,4-Dichlorobenzene	1.83 U	1.86 U	1.83 U	NA
Naphthalene	1.83 U	1.86 U	1.83 U	NA
Acenaphthylene	0.71 U	0.73 U	0.71 U	NA
Acenaphthene	1.28 U	1.30 U	1.28 U	NA
Fluorene	1.86 ^(g)	1.24 U	1.21 U	NA
Phenanthrene	2.51 U	2.56 U	2.51 U	NA
Anthracene	2.19 U	2.24 U	2.19 U	NA
Fluoranthene	5.26 U	5.36 U	5.26 U	NA
Pyrene	4.48 U	4.57 U	4.48 U	NA
Benzo[a]anthracene	1.78 B	1.53 B	1.96 B	12
Chrysene	2.22 U	2.27 U	2.22 U	NA
Benzo[b]fluoranthene	1.61 U	1.64 U	1.61 U	NA
Benzo[k]fluoranthene	1.64 U	1.67 U	1.64 U	NA
Benzo[a]pyrene	1.46 U	1.49 U	1.46 U	NA
Indeno[123-cd]pyrene	1.73 U	1.76 U	1.73 U	NA
Dibenzo[a,h]anthracene	1.24 U	1.26 U	1.24 U	NA
Benzo[g,h,i]perylene	1.37 U	1.40 U	1.37 U	NA
<u>Surrogate Recoveries (%)</u>				
d4 1,4-Dichlorobenzene	55	45	63	NA
d8 Naphthalene	69	57	77	NA
d10 Acenaphthene	83	68	86	NA
d12 Chrysene	90	75	90	NA
d14 Dibenzo[a,h]anthracene	112	91	111	NA

(a) Sample randomly selected for use as a quality control sample in analytical batch.

(b) U Undetected at or above given concentration.

(c) NS Not spiked.

(d) NA Not applicable.

(e) B Analyte detected in the sample is >5 times the blank value.

(f) Outside quality control criteria (50-120%) for spike recovery.

(g) Ion ratio out or confirmation ion not detected.

(h) MDRS Mud Dump Reference Site.

Table G.10. Lipids in Tissue of *N. virens*

Sample ID	% Dry Weight	% Lipid (wet wt)	% Lipid (dry wt)
<i>Nereis</i> Bkgd. Tissue	14.37	1.20	8.35
<i>Nereis</i> Bkgd. Tissue	14.37	0.99	6.89
<i>Nereis</i> Bkgd. Tissue	14.37	1.19	8.28