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Evaluation of Dredged Material Proposed for Ocean Disposal from Shark River Project Area

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Battelle Marine Sciences Laboratory
Sequim, Washington

September 1996

Prepared for the
U.S. Army Corps of Engineers - New York District
under a Related Services Agreement
with the U.S. Department of Energy
under Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Operated for the U.S. Department of Energy
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Summary

The objective of the Shark River Project was to evaluate proposed dredged material to determine its suitability for unconfined ocean disposal at the Mud Dump Site. Shark River is one of five waterways that the U. S. Army Corps of Engineers-New York District (USACE-NYD) requested the Battelle/Marine Sciences Laboratory (MSL) sample and evaluate for dredging and disposal in May 1995. Sediment samples were collected from the Shark River project area, as well as from Westchester Creek, Shoal Harbor, Bronx River, and Cheesequake River project areas. This report presents data and conclusions only on the Shark River Project.

Tests and analyses were conducted following procedures described in 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*.

This evaluation of proposed dredged material from the Shark River project area consisted of bulk sediment chemical and physical analyses, chemical analyses of dredging site water and elutriate, water-column and benthic acute toxicity tests, and bioaccumulation tests. Eleven individual sediment core samples collected from the Shark River project area were analyzed for grain size, moisture content, and total organic carbon (TOC). One composite sediment sample was prepared from the core samples, representing the entire area proposed for dredging. The sediment composite was analyzed for bulk density, specific gravity, metals, chlorinated pesticides, polychlorinated biphenyl (PCB) congeners, polynuclear aromatic hydrocarbons (PAHs), and 1,4-dichlorobenzene. Dredging site water and the elutriate, prepared from the suspended-particulate phase (SPP) of the Shark River sediment composite, were analyzed for metals, pesticides, and PCBs. Bioassays were also performed using the sediment composite. 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 toxicity tests, using SPP, were performed with three species, the mysid *M. bahia*, the juvenile silverside fish *Menidia beryllina*, and larvae of the bivalve mussel *Mytilus galloprovincialis*. Twenty-eight day bioaccumulation tests were conducted with the clam *Macoma nasuta* and the polychaete worm *Nereis virens*.

Shark River sediment core samples were generally black or brown sand. Eight stations were ≥90% sand and gravel; Stations SR-4 and SR-7 were also predominantly sand and gravel (72% and 86% sand and gravel, respectively). Only Station SR-11 was dominated by finer grain size fractions (68% silt and clay). The Shark River sediment composite contained relatively low but detectable levels of metals, pesticides, PCBs, and 1,4-dichlorobenzene. Total PAH concentration was 3810 µg/kg (dry weight), with approximately 12% low-molecular-weight PAHs (LPAHs) and 88% high-molecular-weight PAHs (HPAHs).

Concentrations of metals were higher in Shark River site water than in either the Shark River elutriate or the control water. Concentrations of metals in Shark River site water were between 1.9 times (Ni) and 7.0 times (Cr) higher than in the Shark River elutriate. No pesticides or PCB congeners were detected in the site water and elutriate samples except 4,4'-DDE, which was measured at 2.89 ng/L in the Shark River site water.

No statistically significant acute toxicity relative to the reference sediment was found in the benthic acute tests with *A. abdita* and *M. bahia*. In water-column toxicity tests, the 100% SPP was acutely toxic to two of the three species tested (*M. beryllina* and *M. galloprovincialis*). The median lethal concentrations (LC_{50}) ranged from 48% SPP for *M. beryllina* to >100% SPP for *M. galloprovincialis* and *M. bahia*. The median effective concentration (EC_{50}) for *M. galloprovincialis* normal development, a more sensitive measure than survival, was 61% SPP.

Following 28-day bioaccumulation tests, concentrations of Cr (*M. nasuta* only) and some PAH compounds were elevated in *M. nasuta* and *N. virens* tissues relative to levels in organisms exposed to the Mud Dump Reference Site (MDRS). Concentrations of PAHs were consistently higher in *M. nasuta* than in *N. virens*. No chemical analytes were significantly elevated relative to the MDRS with a magnification factor greater than 5 with either test species. No contaminants of concern in dredged material-exposed tissues exceeded U.S. Food and Drug Administriation (FDA) action levels for poisonous and deleterious substances in fish and shellfish for human food.

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1.0 Introduction

1.1 Project Objectives

The objective of the Shark River project was to evaluate proposed dredged material from the Shark River project area to determine its suitability for unconfined disposal at either the Shark River Inlet Dredged Material Disposal Site or the Mud Dump Site. Tests and analyses for disposal option evaluations were conducted on Shark 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 Shark River project area consisted of bulk sediment chemical analyses, chemical analyses of dredging site water and elutriate, water-column and benthic acute toxicity tests, and benthic bioaccumulation studies. Individual sediment core samples collected from the Shark River project area were analyzed for grain size, moisture content, and total organic carbon (TOC). One composite sediment sample, representing the entire area 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, which was prepared from the suspended-particulate phase (SPP) of the Shark 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*. Water-column (SPP) toxicity tests were performed with three species, the mysid *M. bahia*, the juvenile silverside fish *Menidia beryllina*, and larvae of the mussel *Mytilus galloprovincialis*. Bioaccumulation tests were conducted with the burrowing, deposit-feeding worm *Nereis virens* and the detrital-feeding clam *Macoma nasuta*. Tissues sampled from bioaccumulation tests were analyzed for metals, chlorinated pesticides, PCB congeners, PAHs, and 1,4-dichlorobenzene.

1.2 Project Background

The proposed Shark River project area is located on the New Jersey coast near Belmar and Avalon By The Sea, New Jersey (Figure 1.1). The project requires dredging and disposal of an estimated 60,000 cu yd of sediment. The project depth is -12 ft mean low water (MLW) in the inland channel as far west as state highway Route 35 (Stations SR-1 through SR-9), and -8 ft MLW west of Route 35 (Stations SR-10 and SR-11). Shark River was one of five waterways that the USACE-NYD requested the Battelle/Marine Sciences Laboratory (MSL) to evaluate in a series of dredged material projects. The other projects evaluated under the Federal Projects 5 Program were the Cheesequake River, Shoal Harbor, Bronx River, and Westchester Creek federal projects. Sediment samples from these waterways were collected during a survey that took place from May 9 to 13, 1995. Combining sample collection and evaluation of multiple dredged material projects was more cost-effective for the USACE-NYD, because the expense of reference site testing and quality control analyses could be shared among projects. Surface grab samples of sediment from the Shark River project area were evaluated in February 1991 for grain size distribution and TOC and found to be mostly sand with TOC of less than 3.2% (USACE-NYD unpublished data). For this report, core samples collected to project depth were subject to more extensive chemical and biological evaluations.

1.3 Organization of This Report

Following this introduction, Section 2 presents the methods and materials used for sample collection, sample processing, sediment sample analysis of physical and chemical parameters, and quality assurance. Results of all physical/chemical analyses and bioassays 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 quality control data for all physical and chemical sediment analyses. 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 (SPP) 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. Appendixes F and G contain tissue chemistry data for *M. nasuta* and *N. virens*, respectively.

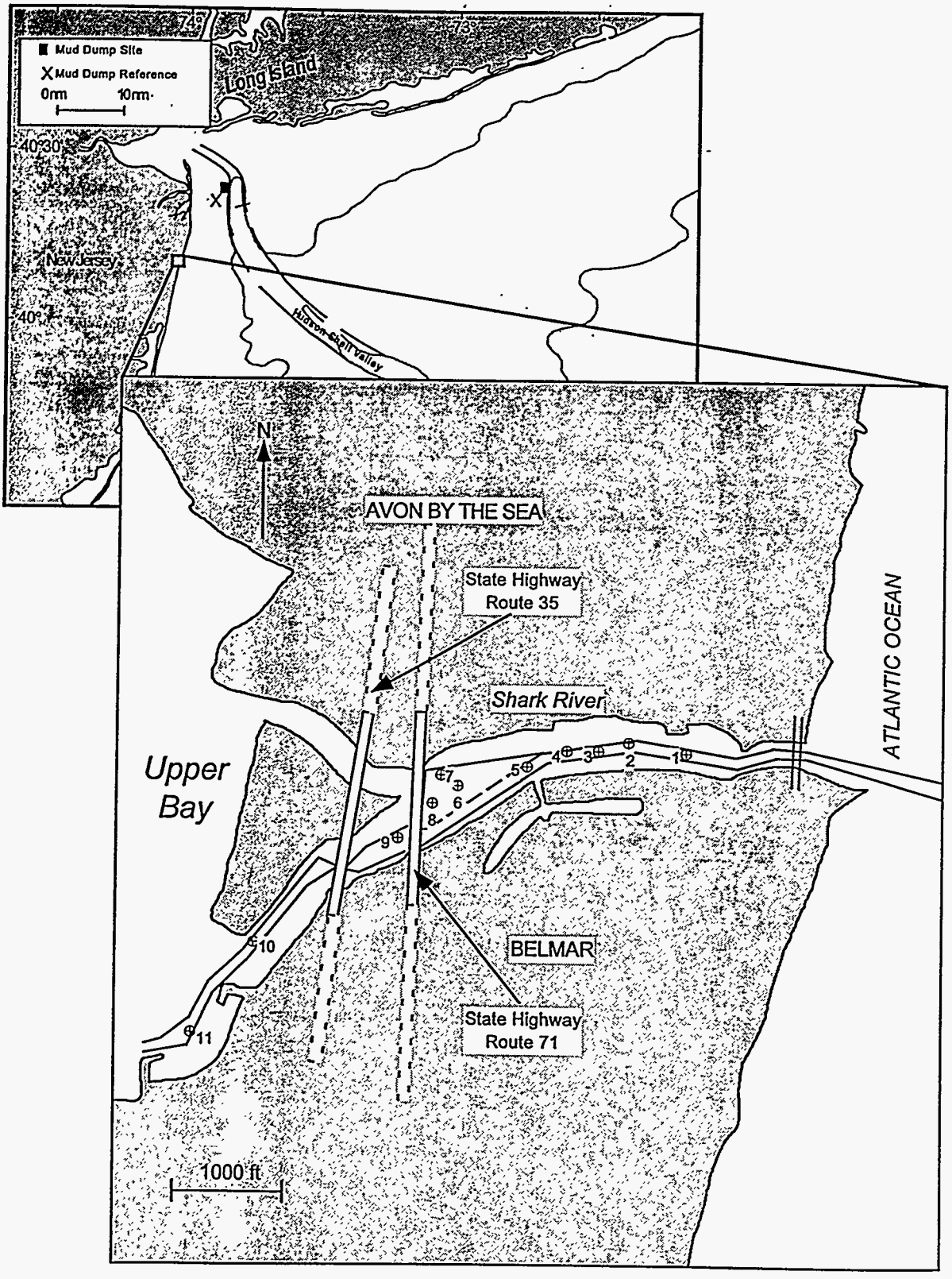

FIGURE 1.1. Location of Shark River Project Area and Sample Collection Stations

2.0 Materials and Methods

2.1 Sediment and Water Collection

Sediment samples were collected from 11 stations from one reach within Shark River project area. Stations SR-1 through SR-9 were in the inland channel and anchorage area east of state highway Route 35, where project depth was -12 ft MLW. Stations SR-10 and SR-11 were in the inland channel west of Route 35, where project depth was -8 ft MLW. Sampling locations were selected by the USACE-NYD. 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 sample station (SR-4) near the center of the Shark River project area and at the Mud Dump Site. Reference sediment was collected from the Mud Dump Reference Site (MDRS). All samples were collected aboard the M/V *Gelberman*, which is owned and operated by USACE-NYD 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 differential Global Positioning System (dGPS) was used to identify and record (within 10 m) each sampling station. The vessel's LORAN was available as a backup system. Water depth at the time of sampling was measured by a lead line. The actual water depth was corrected to 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 vibracore sampler owned and operated by Ocean Surveys, Inc. The vibracore sampler consisted of a 4-in. outer diameter (OD), steel core barrel attached to a 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 (ID), 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 dGPS, and water depth 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. While on board the sampling vessel, cores were kept cool (~4°C) in a large refrigerator on the deck of the ship.

Surface-water samples for dredging site water chemical analysis were collected at Station SR-4. Site water collected from the Mud Dump Site was used as dilution water in water-column toxicity tests (i.e., SPP and elutriate preparation) but was not analyzed for contaminants. Water samples were collected from approximately 1 m below the surface of the water using a peristaltic pump fitted with Teflon tubing. Water was then transferred to precleaned, 20-L polypropylene carboys. The carboys were rinsed with site water three times before filling. Water samples were labeled and stored at 4°C in the on-board refrigerator. 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 refrigerated van that was thermostatically controlled to maintain temperature at approximately 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.

2.1.2 Reference and Control Sediment Sampling

Reference sediments for toxicity and bioaccumulation tests were collected from the MDRS aboard the M/V *Gelberman*. dGPS was used to identify and record vessel position. The ship's fathometer was used to measure water depth. Surficial sediment was collected using a

van Veen sampler. After recovery, water was drained from the sampler, and the sediments were transferred to epoxy-coated, 5-gal steel buckets. The buckets were covered, labeled, and stored at approximately 4°C in the on-board refrigerator. Data recorded during reference sediment collection were navigational 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 toxicity and bioaccumulation tests 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. The location of the control site was determined by reference to known shoreline features. While in transit from the sampling site, control sediment was stored in coolers at ambient temperature and was stored in the walk-in cold room at 4°C±2°C upon arrival at the MSL. Native control sediment for *A. abdita* and *N. virens* was 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 Shark River project area:

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

All test organisms, except mysids and silversides, were wild-captured animals collected either by a commercial supplier or by MSL personnel. 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 Indicators, St. Augustine, Florida. Mysids (*M. bahia*) 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 "blue ice." Silversides (*M. beryllina*) were supplied by Aquatic

Indicators in St. Augustine, Florida, and were shipped via overnight delivery in plastic bags containing oxygen-supersaturated seawater maintained at approximately 20°C with blue ice. Mussels used for obtaining *M. galloprovincialis* larvae were purchased from the commercial supplier Marinus, Inc., Longbeach, California. Mussels were wrapped in moist paper towels and transported in a Styrofoam cooler packed with blue ice 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, Quilcene, Washington. 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 Aquatic Research Organisms in Hampton, New Hampshire, 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 in native sediment or under conditions designed to ensure their viability. After arrival at the MSL, the test organisms were gradually acclimated to test conditions. Information on acclimation and holding procedures is provided in Section 2.5. 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. Glassware was then rinsed with methylene chloride and allowed to dry under a fume hood. Polyvinyl chloride (PVC), Nalgene, and Teflon tools were treated in the same manner as glassware. 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-µm 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 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 Shark 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) were also provided with half-mask respirators.

2.3.2 Preparation of Sediment for Benthic Testing and Bulk Sediment Analyses

Each Lexan core liner was opened by cutting the core longitudinally with a saw 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. Sediment in direct contact with the core liner was not used. 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 large predators or species similar to test organisms were not present 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 homogenized sediment from the individual core stations was combined to create a composite sample representing the entire Shark River project area, designated COMP SR. The sediment composite was homogenized in an epoxy-coated mixer. 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°C±2°C until use for SPP/elutriate preparation, benthic toxicity, or bioaccumulation tests.

The MDRS sediment, *M. nasuta* native control sediment, and *N. virens* native control sediment were also homogenized in the large, epoxy-coated mixer, but prior to mixing, these sediments were pressed through a 1-mm mesh to remove live organisms that might affect the outcome of toxicity tests. After mixing, aliquots for physical and chemical analyses were removed. Native control sediments for *A. abdita* were sieved through a 0.5-mm mesh to remove

live organisms and mixed in stainless-steel bowls after sieving. All reference and control sediments were stored at 4°C±2°C until use in benthic toxicity and bioaccumulation tests.

2.3.3 Preparation of Suspended-Particulate Phase and Elutriate

Toxicological effects of contaminants from dredged sediments that are dissolved and/or suspended in the water-column at an open-water disposal site were simulated in the laboratory by preparation 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 for elutriate preparation in the Green Book. Low speed centrifugation provided a more timely SPP preparation and maintained consistency between projects.

A 4:1 (volume:volume) water-to-sediment slurry was created 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 Shark River dredging site water, which had a salinity of 30‰. Homogenized sediment was added until the water was displaced to the 400-mL mark. Each jar was then filled to 1 L with dredging 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 a relative centrifugal force of approximately 780 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°C±2°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. The supernatant was decanted and reserved for testing with water-column organisms.

The elutriate phase was prepared by centrifuging the SPP at a higher speed and collecting the decanted supernatant. 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. 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 SPP for metals analysis was transferred to acid-washed polycarbonate centrifuge jars, and the SPP for analysis of organic compounds was transferred to Teflon centrifuge jars. 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 were consistent with 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	≥ 62.5-µm and <2000 µm diameter
silt	≥ 3.9-µm and < 62.5-µm 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.

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

TABLE 2.1. (contd)

Analyte	Method(s)	Sediment Detection Limit	Tissue Detection Limit	Water Detection Limit
Endosulfan I	EPA 8080 (sediment, tissue) EPA 608 (water) [d]	1.0 μg/kg	0.4 μg/kg	0.014 μg/L
Endosulfan II	EPA 8080 (sediment, tissue) EPA 608 (water) [d]	1.0 μg/kg	0.4 μg/kg	0.004 μg/L
Endosulfan sulfate	EPA 8080 (sediment, tissue) EPA 608 (water) [d]	1.0 μg/kg	0.4 μg/kg	0.010 μg/L
Heptachlor	EPA 8080 (sediment, tissue) EPA 608 (water) [d]	1.0 μg/kg	0.4 μg/kg	0.003 μg/L
Heptachlor epoxide	EPA 8080 (sediment, tissue) EPA 608 (water) [d]	1.0 μg/kg	0.4 μg/kg	0.100 μg/L
PCBs				
8 (2,4')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
18 (2,2',5)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
28 (2,4,4')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
44 (2,2',3,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
49 (2,2',4,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
52 (2,2',5,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
66 (2,3',4,4')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
87 (2,2',3,4,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
101 (2,2',3,5,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
105 (2,3,3',4,4')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
118 (2,3',4,4',5)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
128 (2,2',3,3',4,4')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
138 (2,2',4,4',5,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
153 (2,2',4,4',5,5')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
170 (2,2',3,3',4,4',5)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
180 (2,2',3,4',5,5',6)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
183 (2,2',3,4,4',5',6)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
184 (2,2',3,4,4',6,6')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
187 (2,2',3,4',5,5',6)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
195 (2,2',3,3',4,4',5,6)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
206 (2,2',3,3',4,4',5,5',6)	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
209 (2,2',3,3',4,4',5,5',6,6')	NYSDEC (1992)/EPA 8080 [d]	1.0 μg/kg	0.4 μg/kg	0.0005 μg/L
PAHs				
Acenapthene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---
Acenaphthylene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---
Anthracene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---
Fluorene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---
Naphthalene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---
Phenanthrene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---
Benzo[*a*]anthracene	NOAA 1993 [d]	10 μg/kg	4 μg/kg	---

TABLE 2.1. (contd)

Analyte	Method(s)	Sediment Detection Limit	Tissue Detection Limit	Water Detection Limit
Benzo[*a*]pyrene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Benzo[*b*]fluoranthene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Benzo[*ghi*]perylene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Benzo[*k*]fluoranthene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Chrysene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Dibenz[*a,h*]anthracene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Fluoranthene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Indeno[1,2,3-*cd*]pyrene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
Pyrene	NOAA 1993 (d)	10 µg/kg	4 µg/kg	---
1,4-Dichlorobenzene	NOAA 1993 (d)	1.0 µg/kg	0.4 µg/kg	---
OTHER MEASUREMENTS				
Total Lipids	Bligh and Dyer (1959)/ Randall (1988)	---	0.1%	---

(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) --- Not applicable or not analyzed.
(d) Equivalent Battelle Ocean Sciences or MSL standard operating procedures were substituted for the methods cited.

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 and 200.9 (EPA 1991). Water was analyzed directly by graphite furnace atomic absorption (GFAA) spectroscopy for Cr and Zn. Water 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 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 with acid. Sediment samples for Ag were digested in aqua-regia and analyzed by GFAA according to EPA Method 200.9 (EPA 1991). For other metals, samples with peroxide and nitric acid were heated in sealed Teflon bombs overnight at approximately 130°C. Sediment samples were analyzed for 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, hydrogen peroxide, and hydrochloric acid. 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).

2.4.5 Chlorinated Pesticides and PCBs

Water samples were prepared and analyzed for chlorinated pesticides and PCBs according to a 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 sample of homogenized 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 concentration of total PCB in each matrix was estimated by calculating the sum of the 22 congeners (x) and multiplying by 2 (personal communication, L.B. Rosman, USACE, 1996). One-half of the achieved detection limit was used in summation when an analyte was undetected.

2.4.6 PAHs and 1,4-Dichlorobenzene

Sediment samples were prepared and analyzed for 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-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.

2.4.7 Lipids

The lipid content of *M. nasuta* and *N. virens* was determined by the analysis of unexposed background tissue samples of each species. The lipid analysis procedure is a modification of the Bligh and Dyer (1959) methods, which involves a chloroform extraction followed by gravimetric measurement of lipids. Randall (1988) modified the original Bligh and

Dyer method to accommodate a smaller tissue sample size. Lipid analysis was performed in triplicate, once for each species. Lipid concentration was reported as a percentage on both a wet and dry weight basis.

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, the *A. abdita* were placed in a tub of clean sand from their collection area and gradually acclimated with holding conditions. *A. abdita* were received at approximately 15°C and acclimated to 20°C±2°C over 2 days. They were not fed prior to testing.

All *A. abdita* 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 outflow and overflow ports (Figure 2.1). Five replicates of the Shark River composite sediment, MDRS sediment, and native test animal control sediment 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 where a toxic effect can be noted (i.e., the no-observable-effects-concentration or NOEC). 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, 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 approximate relative centrifugal force of 780 x gravity. Salinity,

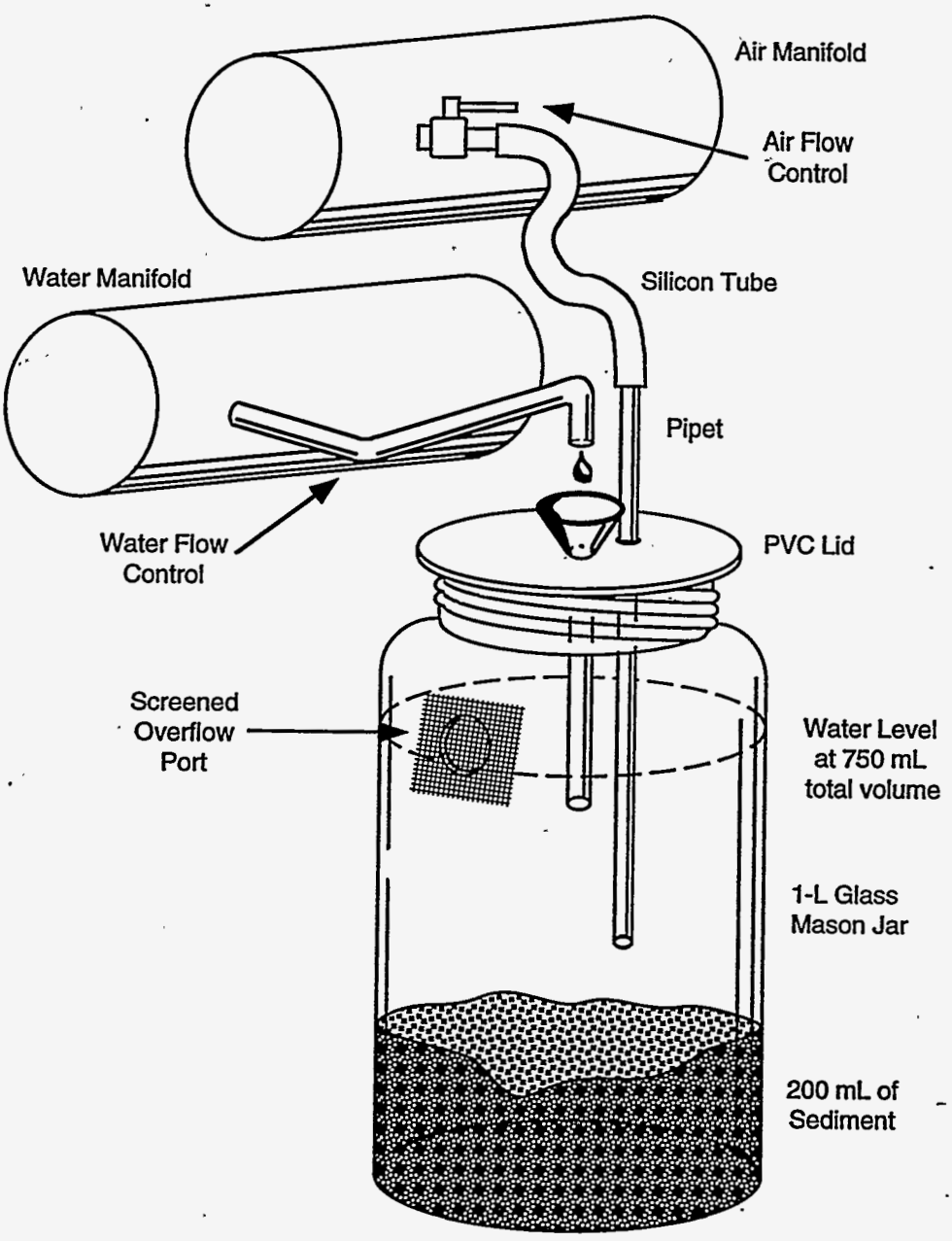

FIGURE 2.1. Testing Containers for *A. abdita* Static Renewal Toxicity Tests

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, 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 (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 is based on a directive from the USACE-NYD (personal communication, M. Greges, USACE, 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 Shark River sediment composite and MDRS 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 is 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 Shark 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‰ seawater to 30‰ 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 *M. beryllina* 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 Mud Dump Site water. Five replicates of each concentration 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 *M. beryllina* 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 silverside 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 (>3.0 mg/L at 20°C, 30‰)
pH	7.8±0.5
Salinity	30.0‰±2.0‰.

The test was run under a 16-h light/8-h dark photoperiod, and *M. beryllina* 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 *M. beryllina* was recorded on termination forms. 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 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. *M. bahia* were received and held at 20°C±2°C until testing and were fed concentrated brine shrimp nauplii twice daily prior to testing.

The water-column toxicity test with *M. bahia* was performed in 200 mL of test solution in 400-mL 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 Mud Dump Site water. 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 concentration. Acceptable water quality parameters for this test were as follows:

Temperature	20°C±2°C
DO	>40% saturation (>3.0 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 *M. bahia* 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 mysid 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 *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 particles 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 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

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 Mud Dump Site 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°C±2°C).

Prior to testing, adult *M. galloprovincialis* had been held in flowing, unfiltered Sequim Bay seawater at ambient temperatures for approximately 12 months. 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-µm 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-µm 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 at a later date.

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 48 h, when greater than 90% 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 set up 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 Shark River sediment composite, MDRS sediment, and native control sediment. Sequim Bay control sediment was used for *M. nasuta* 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 placed in holding trays of control sediment covered with algae, and the trays were partially submerged on a holding table supplied with temperature-controlled seawater at approximately 20°C and 30‰. *N. virens* were held for 6 days before test initiation and were not fed prior to testing. *M. nasuta* were received moist and were placed on a water table supplied with unfiltered seawater at approximately 14°C and 30‰. No food supplement was provided to the clams.

The Regional Guidance Manual provides an acceptable temperature range of 13°C±1°C for *M. nasuta*; however, laboratory logistics required that *M. nasuta* share a 15°C flow-through water supply with other tests. 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°C±2°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:

	M. nasuta	*N. virens*
Temperature	15°C±2°C	20°C±2°C
DO	> 60% saturation	> 60% saturation
pH	7.8±0.5	7.8±0.5
Salinity	30‰±2‰	30‰±2‰
Flow Rate	125±10 mL/min	125±10 mL/min.

Aeration was provided to all test chambers to maintain consistency in DO concentrations among test chambers. Ammonia reduction procedures were not performed on sediments used for bioaccumulation tests. 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°C.

Water-only reference toxicant tests (96-h) were also performed using copper sulfate in six geometrically increasing concentrations plus control seawater. 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, 5.0, and 10.0 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 comparisons 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 *Excel* spreadsheet software.

2.6.2 Statistical Analysis of Benthic Toxicity Tests

Benthic toxicity of all sediment treatments was compared by analysis of variance (ANOVA) on the arcsine square-root of the proportion of organisms surviving the test. The arcsine square root of the proportion of organisms surviving the test was used to stabilize the within-class variances to help meet assumptions of the ANOVA. The Green Book recommends Dunnett's test (Dunnett 1964) for comparing test treatments to a single reference treatment. All treatments were compared using Dunnett's test for comparison of all test treatments to the reference site using an experiment-wise error of α=0.05. A statistically significant difference indicates significant acute toxicity in a test sediment relative to the reference sediment.

2.6.3 Statistical Analysis of Water-Column Toxicity Tests

Two statistical analyses are presented in the Green Book for the interpretation of SPP (water-column) tests. The first is a one-sided Student's t-test between survival in control (0% SPP) test replicates and survival in the 100% SPP test replicates. A significant difference indicates acute toxicity in the 100% SPP treatment(s). This analysis is 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 (arcsine 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 test required by the Green Book is an LC_{50} or EC_{50} calculation, the concentration of SPP that is lethal to (LC_{50}) or affects (EC_{50}) 50% of the organisms tested. The LC_{50} or EC_{50} values for these tests were calculated using the trimmed Spearman-Karber method (Finney 1971). The Spearman-Karber estimator is appropriate only if mortality (or effect) increased with concentration, and if ≥50% mortality (or effect) is observed in test treatments 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.

2.6.4 Statistical Analysis of Bioaccumulation

The results of the chemical analyses of test organism tissues exposed to the dredged sediment treatments were statistically compared with those tissues similarly exposed to the MDRS treatment using Dunnett's test with an experiment-wise error of α=0.05. Dunnett's test was used to determine whether or not the concentrations of contaminants of concern in organisms exposed to proposed dredged sediments 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 "Q" flag in the report tables and a "U" flag in data tables), one-half the detection limit of a compound was used in numerical calculations. If a compound was undetected in all five replicates of a test treatment, or if the mean concentration of a compound was greater in tissue samples from the reference treatment than in tissue samples from the test treatments, no further analysis was necessary. If a compound was undetected in all five replicates of the reference treatment, a one-sided, one-sample t-test (α=0.05) was used to determine if the tissue concentrations from organisms exposed to the dredged sediment treatments were statistically greater than the mean detection limit for that compound from the reference tissue. Results of background and control tissues were not statistically compared with the reference.

Magnification factors were calculated for each compound as the dry weight ratio of the mean tissue concentration from organisms exposed to dredged sediment treatments to the mean tissue concentration from organisms exposed to the Mud Dump Reference Site sediment. Whole detection limits were used for non-detects in this calculation.

2.7 Quality Assurance/Quality Control Procedures

The quality assurance/quality control (QA/QC) procedures for the Shark 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 (PNNL) 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. Analysis of Shark River Project samples occurred 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 Shark 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 Shark River dredging area.

3.1 Sample Collection and Processing

Sediment core samples were collected from the Shark River project area on May 10, 1995 (Figure 1.1). Table 3.1 lists each sampling station within the Shark 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 core samples were collected aboard the M/V *Gelberman*. Eleven core samples were collected. All of the Shark River cores were collected to project depth plus 2-ft overdepth. Site water was collected at Station SR-4.

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. A composited sediment core sample representing the Shark River project area (COMP SR) was analyzed for bulk density, specific gravity, metals, chlorinated pesticides, PCBs, PAHs, and 1,4-dichlorobenzene. Individual core samples and the composite sample were archived for possible dioxin analysis at a later date.

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. Shark River sediment samples were generally dark sand with some silt/clay content.

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

Station	Collection Date	Station Coordinates Latitude N	Station Coordinates Longitude W	Core Length Required (ft)	Core Length Collected (ft)	Water Depth (ft MLW)
SR-1	5/10/95	40° 11.24'	74° 00.88'	3.5	4.0	10.5
SR-2	5/10/95	40° 11.26'	74° 00.97'	6.4	7.0	7.7
SR-3	5/10/95	40° 11.26'	74° 01.02'	4.4	5.0	9.7
SR-4[a]	5/10/95	40° 11.27'	74° 01.08'	5.0	6.0	9.0
SR-5	5/10/95	40° 11.22'	74° 01.16'	2.8	3.5	11.2
SR-6	5/10/95	40° 11.20'	74° 01.29'	3.3	3.5	10.7
SR-7	5/10/95	40° 11.22'	74° 01.34'	3.9	6.0	10.1
SR-8	5/10/95	40° 11.16'	74° 01.36'	6.6	7.0	7.4
SR-9	5/10/95	40° 11.10'	74° 01.47'	4.5	5.9	9.5
SR-10	5/10/95	40° 10.96'	74° 01.75'	3.8	4.5	6.2
SR-11	5/10/95	40° 10.81'	74° 01.87'	5.5	6.0	4.6
Grab Samples						
MDRS[b]	5/10/95	40° 13.91' N	73° 52.13' W	----[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.

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 Shark River core samples for grain size, percentage of moisture, and TOC. A quality control sample summary and associated quality control data for grain size and TOC measurements are provided in Appendix A.

The physical characteristics of Shark River sediments were relatively consistent; eight stations were ≥90% sand and gravel (all stations except SR-4, SR-7, and SR-11); all stations except SR-11 were mostly sand (approximately 60% or more sand by weight). Station SR-4 was 59% sand, with approximately equal portions of gravel, silt, and clay. The station furthest upriver, Station SR-11, was primarily silt (41%), with similar portions of sand and clay (32% and 27%, respectively). The MDRS sediment was composed of 97% sand. Bulk density and specific gravity were also measured on the Shark River composite (Table 3.4). Bulk density, reported in both wet and dry weight, was 119 lb/cu ft and 90 lb/cu ft, respectively. Specific gravity was 2.67.

TABLE 3.2. Shark River Sediment Core Descriptions

Station	Depth (-ft MLW) Core Top	Core Bottom	Project Depth[a]	Description of Observations
SR-1	10.5	14.5	14.0	Black silt/clay with some dead worms.
SR-2	7.7	14.7	14.0	Brown sand with live mussels from mudline to -11.0 ft MLW; then black silt/sand with mussel shell hash to bottom of core.
SR-3	9.7	14.7	14.0	Gray sand throughout with 4-inch thick shell hash bands at approximately -10.0ft MLW, -11.4 ft MLW, and -13.1 ft MLW.
SR-4	9.0	15.0	14.0	Black silt/clay with live mussels from mudline to -9.7 ft MLW; then black silt/clay with mussel shell hash to -13.7 ft MLW; with gray silt/clay to bottom of core.
SR-5	11.2	14.7	14.0	Brown/gray sand with small, live mussels from mudline to -12.2 ft MLW; then black silt/clay to -13.2 ft MLW; followed by black sand and shell hash to bottom of core.
SR-6	10.7	14.2	14.0	Black silt and large, live mussels from mudline to -11.7 ft MLW; then black silt/sand and shell hash to bottom of core.
SR-7	10.1	16.1	14.0	Black silt/sand and shell hash from mudline to bottom of core.
SR-8	7.4	14.4	14.0	Black silt/clay from mudline to -9.0 ft MLW; then gray sand to -9.4 ft MLW, dark gray silt/sand to -10.6 ft MLW, black silt/sand to -10.8 ft MLW, gray sand to -12.4 ft MLW, and black sand to bottom of core.
SR-9	9.5	15.4	14.0	Black silt/clay with live mussels from mudline to -10.7 ft MLW, then black silt and shell hash to -14.7 ft MLW, with clay plug at bottom of core.
SR-10	6.2	10.7	10.0	Black silt and shell hash throughout.
SR-11	4.6	10.6	10.0	Black silt/clay throughout.

(a) Project depth plus 2 ft overdepth.

TABLE 3.3. Results of Analysis of Shark River Sediment for Grain Size, Percentage of Moisture, and Total Organic Carbon

Station	Total Percent (dry weight) Gravel >2000 µm	Sand 62.5-2000 µm	Silt 3.9-62.5 µm	Clay <3.9 µm	Percentage of Moisture	TOC
SR-1	17	73	2	8	30	1.71
SR-2	15	81	2	2	18	0.41
SR-3	10	89	0	1	8	0.11
SR-4	13	59	14	14	36	1.39
SR-5	12	82	1	5	27	1.08
SR-6	4	88	4	4	23	0.77
SR-7	2	84	7	7	28	0.62
SR-8	1	94	3	2	20	0.40
SR-9	26	66	4	4	31	1.44[a]
SR-10	8	84	4	4	23	0.77
SR-11[b]	0	32	41	27	46	2.18
MDRS[c]	0	97	1	2	20	0.07
Mysidopsis /*Macoma* Control	0	23	45	32	68	2.43
Nereis Control	0	72	15	13	51	5.38
Ampelisca Control	0	9	67	24	62	3.35

(a) TOC was a mean of three replicate analyses.
(b) Grain size and percentage of moisture were a mean of three replicate analyses.
(c) MDRS - Mud Dump Reference Site.

TABLE 3.4. Results of Analysis of Shark River Sediment for Bulk Density and Specific Gravity

Bulk Density (lb/cu ft) wet	dry	Specific Gravity
119	90	2.67

TOC ranged from 0.11% (SR-3) to 2.18% (SR-11) in Shark River sediment samples. Stations SR-1, SR-4, SR-5, SR-9, and SR-11 had TOC greater than 1.0%. The moisture content ranged from 8% (SR-3) to 46% (SR-11) in Shark River sediments. Stations SR-1, SR-4, SR-9, and SR-11 had percentage of moisture ≥30%. TOC and percentage of moisture were lower in MDRS sediment (0.07% and 20%, respectively) than in most sediment from the Shark River project area.

3.2.3 Metals

Table 3.5 shows the results of the metals analysis of the Shark River sediment composite. A quality control sample summary and quality control data associated with the metals analysis are provided in Appendix A. The metals found in the highest concentrations were Zn (63.0 mg/kg), Cr (34.8 mg/kg), and Pb (28.4 mg/kg). The metals Ag, Cd, and Hg were all measured at levels between 0.1 mg/kg and 0.4 mg/kg. Other metals ranged from approximately 6 mg/kg (As) to 16 mg/kg (Cu).

3.2.4 Chlorinated Pesticides

Table 3.6 shows the results of the analysis of Shark River sediment for chlorinated pesticides. A quality control sample summary and associated quality control data are provided in Appendix A. The Shark River sediment composite contained relatively low but detectable levels of 6 of the 15 chlorinated pesticides analyzed. The detected pesticides were 4,4'-DDE and 4,4'-DDT, (1.95 µg/kg and 2.55 µg/kg, respectively), with lesser concentrations of α-chlordane, 2,4'-DDD, aldrin, and heptachlor. Total DDT was approximately 5 µg/kg.

3.2.5 PCBs

Table 3.7 shows the results of the analysis of the Shark River sediment composite for PCBs. A quality control sample summary and associated quality control data are provided in Appendix A. Sixteen of the 22 PCB congeners analyzed were detected in Shark River sediment. The total estimated PCB concentration was calculated as 49.6 µg/kg. The total detected PCB concentration was 24.1 µg/kg.

3.2.6 PAHs and 1,4-Dichlorobenzene

Table 3.8 shows the results of the analysis of the Shark River sediment composite 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 the Shark River composite, for a total PAH concentration of 3810 µg/kg. Low-molecular-weight PAHs (LPAH) made up approximately 12% of the total PAH concentration, whereas high-molecular-weight PAHs (HPAH) made up 88% of the total. Phenanthrene (218 µg/kg) was the dominant LPAH and constituted 47% of the total LPAH concentration. Fluoranthene (708 µg/kg) and pyrene (662 µg/kg) were the most concentrated HPAH compounds and together accounted for 41% of the total HPAH concentration. The concentration of 1,4-dichlorobenzene was 8.68 µg/kg.

TABLE 3.5. Results of Analysis of the Shark River Sediment Composite for Metals

Metals (mg/kg dry weight)								
Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Zn
0.149	5.68	0.374	34.8	15.8	0.314	10.2	28.4	63.0

TABLE 3.6. Results of Analysis of the Shark River Sediment Composite for for Chlorinated Pesticides

Analyte	Concentration (µg/kg dry weight)[a]	
2,4'-DDD	0.47	
2,4'-DDE	0.28	Q[b]
2,4'-DDT	0.10	Q
4,4'-DDD	0.11	Q
4,4'-DDE	1.95	
4,4'-DDT	2.55	
α-Chlordane	0.49	
Aldrin	0.33	
Dieldrin	0.09	Q
Endosulfan I	0.15	Q
Endosulfan II	0.15	Q
Endosulfan Sulfate	0.15	Q
Heptachlor	0.08	
Heptachlor Epoxide	0.13	Q
trans Nonachlor	0.10	Q
Total Estimated DDT[c]	5.46	
Total Detected DDT[d]	4.97	

(a) Results are a mean of triplicate analyses.
(b) Q Undetected at or above two times the given concentration.
(c) 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.
(d) Sum of detected concentrations of 2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, 4,4'-DDE, and 4,4'-DDT only.

TABLE 3.7. Results of Analysis of the Shark River Sediment Composite for PCBs

Analyte	Concentration (µg/kg dry weight)[a]	
PCB 8	0.23	Q[b]
PCB 18	0.07	Q
PCB 28	2.88	
PCB 44	0.05	Q
PCB 49	0.41	
PCB 52	1.45	
PCB 66	0.88	
PCB 87	0.71	
PCB 101	3.13	
PCB 105	1.12	
PCB 118	3.44	
PCB 128	0.50	
PCB 138	4.19	
PCB 153	2.82	
PCB 170	0.40	
PCB 180	0.96	
PCB 183	0.67	
PCB 184	0.12	Q
PCB 187	0.14	Q
PCB 195	0.08	Q
PCB 206	0.24	
PCB 209	0.33	
Total Estimated PCBs[c]	49.6	
Total Detected PCBs[d]	24.1	

(a) Value shown is a mean of triplicate analyses.
(b) Q Undetected at or above two times the given concentration.
(c) Total estimated PCB = 2.0(x), where x = sum of all PCB congeners detected; one-half of the detection limit used in summation when analyte was undetected.
(d) Total detected PCBs is a summation of detected concentrations of PCBs only.

TABLE 3.8. Results of Analysis of Shark River Sediment Composite for PAHs and 1,4-Dichlorobenzene[a]

Analyte	Concentration (µg/kg dry weight)
naphthalene	61.1
acenaphthylene	31.3
acenaphthene	26.9
fluorene	39.7
phenanthrene	218
anthracene	85.5
TOTAL LPAH	**463**
fluoranthene	708
pyrene	662
benzo(a)anthracene	352
chrysene	462
benzo(b)fluoranthene	404
benzo(k)fluoranthene	159
benzo(a)pyrene	283
indeno(123-cd)pyrene	147
dibenzo(a,h)anthracene	36.3
benzo(g,h,i)perylene	135
TOTAL HPAH	**3350**
TOTAL PAH	**3810**
1,4-Dichlorobenzene	8.68

(a) Sample size was 10.2 g (wet wt), and moisture content was 26%.

3.3 Site Water and Elutriate Analyses

Metals, chlorinated pesticides, and PCBs were analyzed in dredging site water collected from the Shark River project area and in elutriate samples prepared with dredging site water and the Shark River sediment composite. Sequim Bay water was also analyzed as a control. 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.

3.3.1 Metals

Results of analysis of Sequim Bay control water, Shark River site water, and Shark River composite-sample elutriate are shown in Table 3.9. Concentrations of metals were consistently higher in Shark River site water than in either the sample elutriate or the control water. An exception was Cd, the concentration of which was slightly higher in control water than in dredging site water or elutriate. Metals concentrations were similar between control water and Shark River elutriate. Only Pb differed by a factor of greater than 4, with no detected Pb in control water and 0.251 µg/L Pb in the elutriate. Shark River site water had concentrations of metals between 1.9 times (Ni) and 6.9 times (Cr) higher than the Shark River elutriate.

3.3.2 Chlorinated Pesticides and PCBs

Results of analysis of Sequim Bay control water, Shark River site water, and the Shark River elutriate for chlorinated pesticides and PCBs are shown in Table 3.10. With one exception, pesticides and PCB congeners were not detected in the site water and elutriate samples. Only 4,4'-DDE was detected in the Shark River site water (2.89 ng/L). Total estimated PCBs ranged from 9.8 ng/L in Shark River site water to 10.5 ng/L in Sequim Bay site water (control seawater). Because no PCB congeners were detected, total detected PCBs were 0.0 ng/L for all three water/elutriate samples.

TABLE 3.9. Results of Analysis of Shark River Project Site Water and Elutriate for Metals

	Concentration (µg/L)[a]							
Treatment	Ag	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Site Water								
Shark River	0.0254	0.0498	1.45	1.99	0.0102	1.03	1.08	8.40
Sequim Bay	0.0090 Q[b]	0.0666	0.69	0.607	NA[c]	0.455	0.0055 Q	1.61
Elutriate								
Shark River	0.0090 Q	0.0381	0.21	0.387	0.00246	0.549	0.251	1.24

(a) Value shown is the mean of triplicate analyses
(b) Q Undetected at or above two times given concentration.
(c) NA Not analyzed.

TABLE 3.10. Results of Analysis of Shark River Project Site Water and Elutriate for Chlorinated Pesticides and PCBs

Analyte	Concentration (ng/L)[a] Shark River Water		Shark River Elutriate		Sequim Bay Water	
2,4'-DDD	0.47	Q[b]	0.48	Q	0.50	Q
2,4'-DDE	0.12	Q	0.12	Q	0.12	Q
2,4'-DDT	0.22	Q	0.22	Q	0.23	Q
4,4'-DDD	0.22	Q	0.23	Q	0.24	Q
4,4'-DDE	2.89		0.14	Q	0.15	Q
4,4'-DDT	0.20	Q	0.21	Q	0.22	Q
Total Detected DDT[c]	2.89		0.00		0.00	
α-Chlordane	0.41	Q	0.42	Q	0.44	Q
Aldrin	0.19	Q	0.20	Q	0.21	Q
Dieldrin	0.06	Q	0.07	Q	0.07	Q
Endosulfan I	0.23	Q	0.24	Q	0.25	Q
Endosulfan II	0.23	Q	0.24	Q	0.25	Q
Endosulfan Sulfate	0.23	Q	0.24	Q	0.25	Q
Heptachlor	0.23	Q	0.24	Q	0.25	Q
Heptachlor Epoxide	0.06	Q	0.06	Q	0.06	Q
trans Nonachlor	0.55	Q	0.56	Q	0.59	Q
PCB 8	0.49	Q	0.51	Q	0.53	Q
PCB 18	0.52	Q	0.53	Q	0.56	Q
PCB 28	0.35	Q	0.36	Q	0.38	Q
PCB 44	0.15	Q	0.16	Q	0.17	Q
PCB 49	0.27	Q	0.27	Q	0.29	Q
PCB 52	0.18	Q	0.18	Q	0.19	Q
PCB 66	0.19	Q	0.20	Q	0.21	Q
PCB 87	0.18	Q	0.18	Q	0.19	Q
PCB 101	0.24	Q	0.25	Q	0.26	Q
PCB 105	0.15	Q	0.15	Q	0.16	Q
PCB 118	0.23	Q	0.24	Q	0.25	Q
PCB 128	0.12	Q	0.12	Q	0.13	Q
PCB 138	0.17	Q	0.18	Q	0.18	Q
PCB 153	0.20	Q	0.20	Q	0.21	Q
PCB 170	0.10	Q	0.10	Q	0.11	Q
PCB 180	0.14	Q	0.14	Q	0.15	Q
PCB 183	0.27	Q	0.27	Q	0.29	Q
PCB 184	0.27	Q	0.27	Q	0.29	Q
PCB 187	0.19	Q	0.20	Q	0.21	Q
PCB 195	0.14	Q	0.14	Q	0.15	Q
PCB 206	0.20	Q	0.20	Q	0.21	Q
PCB 209	0.14	Q	0.14	Q	0.15	Q
Total Estimated PCB[d]	9.8		10.0		10.5	
Total Detected PCB[e]	0.00		0.00		0.00	

(a) Value shown is the mean of triplicate analyses.
(b) Q Undetected at or above two times given concentration.
(c) Total detected DDT is a summation of detected concentrations of DDTs only.
(d) Total estimated PCB = 2.0(x), where x = sum of all PCB congeners detected; one-half of the detection limit used in summation when analyte was undetected.
(e) Total detected PCB is a summation of detected concentrations of PCBs only.

3.4 Benthic and Water-Column Toxicity Testing

Both benthic and water-column tests were performed on the Shark River sediment composites. Benthic acute toxicity tests were performed with the infaunal amphipod, *A. abdita* and the mysid *M. bahia*. Water-column (SPP) tests were conducted with the silverside fish, *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 tests. Throughout this section the term "significant difference" is used to express *statistically* significant differences 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 Static Renewal Acute Toxicity Test

Results of the benthic acute toxicity test with *A. abdita* are summarized in Table 3.11. 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. Survival in the Shark River composite was 91% and did not constitute a significant reduction in survival relative to the reference sediment (95% survival).

Water quality parameters were within acceptable ranges throughout the test, except for minor deviations in pH (see Table C.2). The Cd reference toxicant test produced an LC_{50} of 0.64 mg/L Cd, within the control range (mean ± 2 standard deviations) established at the MSL (0.4 mg/L to 0.9 mg/L Cd). After initial addition of sediment to test chambers, overlying water was renewed twice daily for ammonia reduction for 11 days before test initiation. The initial pore water ammonia concentration was 52 mg/L total ammonia. At test initiation, the ammonia concentration was less than 1.0 mg/L in overlying water and was 7.4 mg/L in the pore water. At test termination, ammonia concentrations were below these levels.

3.4.2 *Mysidopsis bahia* Benthic Static Acute Toxicity Test

Results of the benthic static acute toxicity test with *M. bahia* are summarized in Table 3.11. Complete test results and water quality data are presented in Appendix C, Tables C.5 through C.8. Survival in the *M. bahia* control sediment was 92% validating this test. Survival was 92% in the Shark River composite and was not significantly lower than survival in the MDRS (91% survival).

TABLE 3.11. Summary of Benthic Toxicity Tests Performed with Shark River Sediment

Test Organism and Composite	Mean % Survival	Significantly Different Than MD Reference	≥10%/≥20% Difference [a]
A. abdita	91%	No	No
M. bahia	92%	No	No

(a) Benthic toxicity exceeds the limiting permissible concentration when 1) organism mortality in test sediment was statistically greater than the reference and 2) mortality in the test sediment exceeds mortality in the reference sediment by at least 20% (*A. abdita*) or 10% for mysids (*M. bahia*).

All water quality parameters were within acceptable ranges throughout the test, except for minor deviations in pH in all treatments (see Table C.6). The reference toxicant test produced an LC_{50} of 263 µg/L Cu, which is within the control range established at the MSL (154 µg/L to 303 µg/L Cu). After initial addition of sediment to test chambers, overlying water was renewed twice daily for ammonia reduction for 5 days before test initiation. At test initiation, overlying-water ammonia concentrations in the Shark River composite was less than 1.0 mg/L, and the pore water ammonia concentration was 14 mg/L.

3.4.3 *Menidia beryllina* Water-Column Toxicity Test

Results of the *M. beryllina* water-column toxicity test are summarized in Table 3.12. Complete test results, as well as water quality data, are presented in Appendix D, Tables D.1 through D.4. Control survival was 90%, validating this test. Survival in the 100% SPP preparation was 14%, which was a significant reduction in survival relative to the control treatment. The *M. beryllina* LC_{50} was 48.4% SPP for the Shark River composite.

All water quality parameters were within acceptable ranges throughout the test except for a minor elevation in pH in the 100% SPP treatment. Total ammonia in 100% SPP was 13.3 mg/L at test initiation. The copper reference toxicant test produced an LC_{50} of 166 µg/L Cu, which is outside the control range established at the MSL (79 µg/L to 123 µg/L Cu). This indicates that the organisms were slightly less sensitive than normally expected and the test could have underestimated SPP toxicity for this species.

TABLE 3.12. Summary of Water-Column Toxicity Tests Performed with Shark River Sediment

Test Organism	Survival/ Normal Development in 0% SPP	Survival/ Normal Development in 100% SPP	0% and 100% Significantly Different	LC_{50}/EC_{50} (%SPP)
Menidia beryllina	90%	14%	Yes	48.4
Mysidopsis bahia	98%	94%	No	>100
M. galloprovincialis (survival)	98%	65%	Yes	>100
M. galloprovincialis (normal development)	84%	1%	Yes	60.8[a]

(a) Median effective concentration (EC_{50}) based on normal development to the D-shaped, prodissoconch stage.

3.4.4 *Mysidopsis bahia* Water-Column Toxicity Test

Results of the *M. bahia* water-column toxicity test are summarized in Table 3.12. 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 98% in the Shark River composite (0% SPP). Survival in the 100% SPP preparation was 94%, which was not significantly lower than control survival. The *M. bahia* LC_{50} was >100% SPP the Shark River composite.

All water quality parameters were within acceptable ranges throughout the test. Total ammonia in 100% SPP was 13.3 mg/L at test initiation. The copper reference toxicant test revealed an LC_{50} of 283 µg/L Cu, which is 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 3.12. Complete test results and water quality data are presented in Appendix D, Tables D.9 through D.12. This test was validated by greater than 80% survival and normal development in the control treatment (0% SPP). The 100% SPP preparation produced mean survival of 65%, which was significantly reduced relative to the control treatment. The LC_{50} was >100% SPP for the Shark River composite. Normal development, which is considered a more sensitive indicator

of toxicity, was significantly reduced in the 100% SPP treatment (1% normal). The EC_{50} was 60.8% SPP.

All water quality parameters were within acceptable ranges throughout the test, with the exception of minor deviations in pH (50% and 100% SPP) and DO (100% SPP). Total ammonia in 100% SPP was 13.3 mg/L at test initiation. The Cu reference toxicant test produced an EC_{50} of 12.2 µg/L Cu, which is higher than the limits of the control range established for copper at the MSL (4.2 µg/L to 10.0 µg/L Cu). This indicates that bivalve larvae were slightly less sensitive than normally expected and this test could have underestimated SPP toxicity for this species.

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

Bioaccumulation tests with *M. nasuta* and *N. virens* were conducted using the Shark River composite, the MDRS, and control sediments. Both *M. nasuta* and *N. virens* were exposed for 28 days under flow-through conditions. All water quality parameters were within acceptable ranges throughout the test. Survival was 90% in the *M. nasuta* control exposure, and was 76% in the *N. virens* control exposure. Causes of the lower survival in the *N. virens* control treatment are unknown. In MDRS sediment, survival was 95% for *M. nasuta* and 92% for *N. virens*. No statistically significant differences in *M. nasuta* or *N. virens* survival were observed between Shark River composite and the reference sediment. Mean lipid content measured in the background tissue samples for *N. virens* and *M. nasuta* were 1.13% and 0.86% wet weight, and 7.84% and 6.27% dry weight, respectively. Complete test results and water quality data are presented in Appendix E. The tissues of organisms exposed to the Shark River composite were analyzed for metals and selected organic contaminants (pesticides, PCBs, and PAHs); the results are summarized in this section. In this section, magnification factors (extent to which test tissue concentration was elevated above the reference tissue concentration [in 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*.

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

	Concentration (mg/kg wet weight)[a]		
Analyte	MDRS[b]	SR COMP	SD[c]
Silver	0.0770	0.0602	No
Arsenic	4.40	3.93	No
Cadmium	0.0248	0.0349	No
Chromium	0.288	0.432	Yes
Copper	2.50	2.63	No
Mercury	0.0149	0.0187	No
Nickel	0.360	0.444	No
Lead	0.712	0.728	No
Zinc	11.7	14.8	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.

3.5.1 Bioaccumulation of Metals in *Macoma nasuta*

Results of analysis for metals in *M. nasuta* tissues exposed to the Shark River composite and to MDRS sediment are shown in Table 3.13. All nine metals analyzed were detected in tissues exposed to Shark River and MDRS composites. The Shark River composite produced tissues with significantly elevated concentrations of Cr relative to the MDRS sediment. The magnification factor was 1.5 for Cr.

3.5.2 Bioaccumulation of Chlorinated Pesticides in *Macoma nasuta*

Results of analysis of *M. nasuta* tissues exposed to the Shark River composite and MDRS sediment for chlorinated pesticides are shown in Table 3.14. Six of the 15 chlorinated pesticides analyzed were detected in tissues of organisms exposed to the Shark River composite and MDRS sediment. No statistically significant elevations of chlorinated pesticides were found in Shark River-exposed tissues in comparison with MDRS-exposed tissues.

3.5.3 Bioaccumulation of PCBs in *Macoma nasuta*

Results of analysis of *M. nasuta* tissues exposed to the Shark River composite and MDRS sediment for PCBs are shown in Table 3.15. Of the 22 PCBs analyzed, 10 were detected in *M. nasuta* tissues exposed to the Shark River composite and MDRS sediment. No PCBs were observed at concentrations that were significantly elevated in Shark River tissues relative to MDRS-exposed tissues.

TABLE 3.14. Mean Concentrations of Pesticides in *Macoma nasuta* Tissues Exposed to the Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight)[a] MDRS[b]		SR COMP		SD[c]
2,4'-DDD	0.16	Q[d]	0.21	Q	NA[e]
2,4'-DDE	0.17	Q	0.22	Q	NA
2,4'-DDT	0.12	Q	0.15	Q	NA
4,4'-DDD	1.00		0.99		No
4,4'-DDE	1.92		1.76		No
4,4'-DDT	0.62		0.49		No
α-Chlordane	0.12		0.13		No
Aldrin	1.10		1.00		No
Dieldrin	0.34	Q	0.43	Q	NA
Endosulfan I	0.12	Q	0.15	Q	NA
Endosulfan II	0.12	Q	0.15	Q	NA
Endosulfan Sulfate	0.16	Q	0.21	Q	NA
Heptachlor	0.25		0.24		No
Heptachlor Epoxide	0.09	Q	0.11	Q	NA
trans Nonachlor	0.10	Q	0.12	Q	NA
Total DDT[f]	3.99		3.82		No
Total Detected DDT	3.54		3.24		---[g]

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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 Undetected at or above twice the given concentration.
(e) NA Not appropriate; a statistical test could not be conducted due to nondetect values in all reference and test replicates leaving an inappropriate variance for testing.
(f) Total 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.
(g) --- No statistical analysis was performed.

TABLE 3.15. Mean Concentrations of PCBs in *Macoma nasuta* Tissues Exposed to the Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight)[a] MDRS[b]		SR COMP		SD[c]
PCB 8	0.23	Q[d]	0.49		No
PCB 18	0.07	Q	0.12		No
PCB 28	2.31		0.83		No
PCB 44	0.05	Q	0.06	Q	NA[e]
PCB 49	1.35		0.45		No
PCB 52	1.74		0.65		No
PCB 66	1.77		0.95		No
PCB 87	0.20		0.21	Q	No
PCB 101	1.44		0.90		No
PCB 105	0.26		0.14	Q	No
PCB 118	1.00		0.72		No
PCB 128	0.07	Q	0.09	Q	NA
PCB 138	0.62		0.43		No
PCB 153	0.78		0.67		No
PCB 170	0.12	Q	0.15	Q	NA
PCB 180	0.25	Q	0.32	Q	NA
PCB 183	0.12	Q	0.15	Q	NA
PCB 184	0.12	Q	0.15	Q	NA
PCB 187	0.14	Q	0.17	Q	NA
PCB 195	0.08	Q	0.11	Q	NA
PCB 206	0.14	Q	0.18	Q	NA
PCB 209	0.13	Q	0.16	Q	NA
Total Estimated PCB[f]	26.0		16.2		No
Total Detected PCB	11.5		6.21		---[g]

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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 Undetected at or above twice the given concentration. When MDRS mean has Q qualifier, statistical analysis was conducted using Student's t-Test.
(e) NA Not appropriate; a statistical test could not be conducted due to nondetect values in all reference and test replicates leaving an inappropriate variance for testing.
(f) Total PCB = 2.0(x), where x = sum of all PCB congeners detected; one-half of the detection limit used in summation when analyte was undetected.
(g) --- No statistical analysis was performed.

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

Results of analysis of *M. nasuta* tissues exposed to the Shark River composite and MDRS sediments for PAHs and 1,4-dichlorobenzene are shown in Tables 3.16. Of the 16 PAHs analyzed, 12 were detected in *M. nasuta* tissues exposed to the Shark River composite and 14 were detected in MDRS-exposed tissues. Phenanthrene, fluroanthene, and pyrene were measured at significantly elevated concentrations in Shark River-exposed tissues, relative to tissues exposed to the MDRS sediment. None of these three PAHs was found in tissues from the Shark River composite at a concentration over five times higher than that in tissues exposed to MDRS sediment. The compound 1,4-dichlorobenzene was not detected in *M. nasuta* tissues exposed to either the Shark River composite or to the MDRS sediment.

3.5.5 Bioaccumulation of Metals in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Shark River composite and MDRS sediment for metals are shown in Tables 3.17. All metals analyzed except Ag were detected in *N. virens* tissues exposed to the Shark River composite and MDRS sediment. No metals were statistically significantly higher in Shark River-exposed *N. virens* tissues relative to the MDRS-exposed tissues.

3.5.6 Bioaccumulation of Chlorinated Pesticides in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Shark River composite and MDRS sediment for chlorinated pesticides are shown in Table 3.18. Of the 15 chlorinated pesticides analyzed, 7 were detected in Shark River-exposed tissues and 8 were detected in MDRS-exposed tissues. In comparison with the MDRS-exposed tissues, the Shark River-exposed tissues were not statistically significantly elevated for any of the chlorinated pesticides.

3.5.7 Bioaccumulation of PCBs in *Nereis virens*

Results of analysis of *N. virens* tissues exposed to the Shark River composite and Mud Dump Reference sediment for PCBs are shown in Table 3.19. A total of 22 PCB congeners was analyzed, and 14 congeners were detected in Shark River-exposed *N. virens* tissues whereas 13 were detected in MDRS-exposed tissues. None was statistically significantly elevated relative to those in tissues exposed to the MDRS sediment.

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

Results of analysis of *N. virens* tissues exposed to the Shark River composite and MDRS sediment for PAHs and 1,4-dichlorobenzene are shown in Table 3.20. Seven of the 16 PAHs analyzed were detected in tissues exposed to the Shark River composite, and 6 PAHs were

TABLE 3.16. Mean Concentrations of PAHs and 1,4-Dichlorobenzene in *Macoma nasuta* Tissues Exposed to the Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight)[a] MDRS[b]		SR COMP		SD[c]
Naphthalene	3.45		4.53		No
Acenaphthylene	0.56		0.46	Q[d]	No
Acenaphthene	0.89	Q	1.17	Q	NA[e]
Fluorene	1.13		1.07	Q	No
Phenanthrene	2.10		5.30		Yes
Anthracene	1.86		2.21		No
Total LPAH	9.99		14.7		
Fluoranthene	9.11		40.5		Yes
Pyrene	23.6		70.8		Yes
Benzo(a)anthracene	8.48		10.6		No
Chrysene	6.23		7.77		No
Benzo(b)fluoranthene	15.7		20.5		No
Benzo(k)fluoranthene	3.07		2.42		No
Benzo(a)pyrene	7.43		7.27		No
Indeno(123-cd)pyrene	1.58	B[f]	1.49	B	No
Dibenzo(a,h)anthracene	0.80	Q	1.02	Q	NA
Benzo(g,h,i)perylene	2.06	B	1.48	B	No
Total HPAH	78.1		164		
Total PAH	88.1		179		
1,4-Dichlorobenzene	1.28	Q	1.68	Q	NA

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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 Undetected at or above twice the given concentration. When MDRS mean has Q qualifier, statistical analysis was conducted using Student's t-Test.
(e) NA Not appropriate; a statistical test could not be conducted due to nondetect values in all reference and test replicates leaving an inappropriate variance for testing.
(f) B Analyte detected in one or more replicate samples at <5 times the blank value and also undetected in one or more replicates.

TABLE 3.17. Mean Concentrations of Metals in *Nereis virens* Tissues Exposed to the Shark River Composite and the Mud Dump Reference Site Sediment

Analyte	Concentration (mg/kg wet weight)[a] MDRS[b]	SR COMP	SD[c]
Silver	0.0171 Q[d]	0.0185 Q	NA[e]
Arsenic	3.28	2.82	No
Cadmium	0.0728	0.0549	No
Chromium	0.0379	0.0186	No
Copper	1.63	1.40	No
Mercury	0.0257	0.0245	No
Nickel	0.0497	0.0710	No
Lead	0.210	0.170	No
Zinc	8.55	8.04	No

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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 Undetected at or above given concentration.
(e) NA Not applicable; a statistical test could not be conducted due to nondetect values in all reference and test replicates leaving an inappropriate variance for testing.

detected in MDRS-exposed tissues. Fluoranthene, pyrene, and chrysene were statistically significantly elevated relative to PAHs in tissues exposed to the MDRS, but none was elevated by a factor greater than 4. The compound 1,4-dichlorobenzene was not detected in either Shark River-exposed or MDRS-exposed tissues.

TABLE 3.18. Mean Concentrations of Pesticides in *Nereis virens* Tissues Exposed to the Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight)[a] MDRS[b]		SR COMP		SD[c]
2,4'-DDD	0.18		0.14	Q[d]	No
2,4'-DDE	0.15	Q	0.14	Q	NA[e]
2,4'-DDT	0.10	Q	0.10	Q	NA
4,4'-DDD	1.04		0.90		No
4,4'-DDE	0.22		0.34		No
4,4'-DDT	0.78		0.89		No
α-Chlordane	0.18		0.24		No
Aldrin	0.77		0.70		No
Dieldrin	0.29	Q	0.28	Q	NA
Endosulfan I	0.10	Q	0.10	Q	NA
Endosulfan II	0.10	Q	0.10	Q	NA
Endosulfan Sulfate	0.14	Q	0.14	Q	NA
Heptachlor	0.29		0.17		No
Heptachlor Epoxide	0.07	Q	0.07	Q	NA
trans Nonachlor	0.47		0.57		No
Total DDT[f]	2.47		2.51		No
Total Detected DDT	2.22		2.13		---[g]

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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 Undetected at or above twice the given concentration. When MDRS mean has Q qualifier, statistical analysis was conducted using Student's t-Test.
(e) NA Not applicable; a statistical test could not be conducted due to nondetect values in all reference and/or test replicates leaving an inappropriate variance for testing.
(f) Total 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.
(g) --- No statistical analysis was performed.

TABLE 3.19. Mean Concentrations of PCBs in *Nereis virens* Tissues Exposed to the Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight)[a] MDRS[b]		SR COMP		SD[c]
PCB 8	0.20	Q[d]	0.19	Q	NA[e]
PCB 18	0.31		0.15		No
PCB 28	0.06	Q	0.06	Q	NA
PCB 44	0.04	Q	0.53		No
PCB 49	0.36		0.40		No
PCB 52	1.12		1.00		No
PCB 66	0.08	Q	0.08	Q	NA
PCB 87	0.14	Q	0.14	Q	NA
PCB 101	0.96		1.21		No
PCB 105	0.20		0.34		No
PCB 118	0.23		0.66		No
PCB 128	0.19		0.23		No
PCB 138	1.21		1.66		No
PCB 153	1.72		2.29		No
PCB 170	0.24		0.30		No
PCB 180	0.56		0.68		No
PCB 183	0.12		0.14		No
PCB 184	0.10	Q	0.10	Q	NA
PCB 187	0.40		0.54		No
PCB 195	0.07	Q	0.07	Q	NA
PCB 206	0.12	Q	0.12	Q	NA
PCB 209	0.11	Q	0.11	Q	NA
Total Estimated PCB[f]	17.1		22.0		No
Total Detected PCB	7.62		10.1		---[g]

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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 Undetected at or above twice the given concentration. When MDRS mean has Q qualifier, statistical analysis was conducted using Student's t-Test.
(e) NA Not applicable; a statistical test could not be conducted due to nondetect values in all reference and test replicates leaving an inappropriate variance for testing.
(f) Total PCB = 2.0(x), where x = sum of all PCB congeners detected; one-half of the detection limit used in summation when analyte was undetected.
(g) --- No statistical analysis was performed.

TABLE 3.20. Mean Concentrations of PAHs and 1,4-Dichlorobenzene in *Nereis virens* Exposed to the Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Concentration (µg/kg wet weight)[a] MDRS[b]		SR COMP		SD[c]
Naphthalene	3.47	B[d]	3.72	B	No
Acenaphthylene	0.33	Q[e]	0.30	Q	NA[f]
Acenaphthene	0.90		0.91		No
Fluorene	0.87		0.70	Q	No
Phenanthrene	1.48	Q	1.46	Q	NA
Anthracene	1.25	Q	1.23	Q	NA
Total LPAH	8.30		8.32		
Fluoranthene	1.95	Q	12.5		Yes
Pyrene	3.75		18.8		Yes
Benzo(a)anthracene	0.75		1.10		No
Chrysene	1.22		4.39		Yes
Benzo(b)fluoranthene	0.69	Q	0.89		No
Benzo(k)fluoranthene	0.85	Q	0.82	Q	NA
Benzo(a)pyrene	0.74	Q	0.70	Q	NA
Indeno(123-cd)pyrene	0.88	Q	0.84	Q	NA
Dibenzo(a,h)anthracene	0.68	Q	0.67	Q	NA
Benzo(g,h,i)perylene	0.63	Q	0.59	Q	NA
Total HPAH	12.1		41.3		
Total PAH	20.4		49.6		
1,4-Dichlorobenzene	1.10	Q	1.09	Q	NA

(a) Results shown are a mean of five replicate tissue analyses. If any constituents were undetected in a replicate, 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) B Analyte detected in one or more replicate samples at <5 times the blank value and undetected in one or more replicates (MDRS only).
(e) Q Undetected at or above twice the given concentration. When MDRS mean has Q qualifier, statistical analysis was conducted using Student's t-Test.
(f) NA Not applicable; a statistical test could not be conducted due to nondetect values in all reference and test replicates leaving an inappropriate variance for testing.

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

Table 3.21 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 Shark River-exposed tissues over the MDRS-exposed tissues. When a compound was undetected in all replicate analyses, the magnification factor is based on the detection limit of the MDRS-exposed tissues. With *M. nasuta*, fluoranthene and pyrene demonstrated statistically significant bioaccumulation *and* magnification factors greater than 2 (magnification factors of 4.4 and 2.9, respectively). With *N. virens*, fluoranthene, pyrene, and chrysene demonstrated statistically significant bioaccumulation *and* magnification factors equal to or greater than 2 (magnification factors of 3.0, 4.0, and 2.0, respectively). Only fluroanthene and pyrene were statistically significantly higher for both test species relative to the reference site.

TABLE 3.21. Magnification Factors of All Analyzed Compounds in *Macoma nasuta* and *Nereis virens* Tissues Exposed to Shark River Composite and Mud Dump Reference Site Sediment

Analyte	Magnification Factor[a]	
	Macoma nasuta	*Nereis virens*
Ag (silver)	0.8	1.0
As (arsenic)	0.9	0.8
Cd (cadmium)	1.4	0.7
Cr (chromium)	1.5	0.5
Cu (copper)	1.1	0.8
Hg (mercury)	1.3	0.9
Ni (nickel)	1.2	1.2
Pb (lead)	1.0	0.8
Zn (zinc)	1.3	0.9
2,4'-DDD	1.3	0.9
2,4'-DDE	1.3	0.9
2,4'-DDT	1.3	0.9
4,4'-DDD	0.9	0.8
4,4'-DDE	0.9	1.2
4,4'-DDT	0.8	1.1
α-Chlordane	1.3	1.3
Aldrin	0.9	0.9
Dieldrin	1.3	0.9
Endosulfan I	1.3	0.9
Endosulfan II	1.3	0.9
Endosulfan Sulfate	1.3	0.9
Heptachlor	1.1	0.6
Heptachlor Epoxide	1.3	0.9
trans Nonachlor	1.2	1.1
PCB 8	1.6	0.9
PCB 18	1.3	0.5
PCB 28	0.4	0.9
PCB 44	1.2	6.9
PCB 49	0.4	1.0
PCB 52	0.5	0.8
PCB 66	0.6	0.9
PCB 87	1.2	0.9
PCB 101	0.6	1.2
PCB 105	0.9	1.3
PCB 118	0.7	2.1
PCB 128	1.3	1.0
PCB 138	0.8	1.3
PCB 153	1.0	1.2
PCB 170	1.3	1.0

TABLE 3.21. (contd)

Analyte	Magnification Factor[a]	
	Macoma nasuta	*Nereis virens*
PCB 180	1.3	1.0
PCB 183	1.3	0.9
PCB 184	1.3	0.9
PCB 187	1.3	1.2
PCB 195	1.3	0.9
PCB 206	1.3	0.9
PCB 209	1.3	0.9
1,4-Dichlorobenzene	1.3	0.9
Naphthalene	1.3	0.9
Acenaphthylene	1.1	0.8
Acenaphthene	1.3	0.9
Fluorene	1.2	0.9
Phenanthrene	1.7	0.9
Anthracene	1.3	0.9
Fluoranthene	4.4	3.0
Pyrene	2.9	4.0
Benzo(a)anthracene	1.2	1.0
Chrysene	1.2	2.0
Benzo(b)fluoranthene	1.3	0.9
Benzo(k)fluoranthene	1.0	0.9
Benzo(a)pyrene	1.0	0.9
Indeno(123-cd)pyrene	1.2	0.9
Dibenzo(a,h)anthracene	1.3	0.9
Benzo(g,h,i)perylene	0.9	0.9

(a) Magnification factors are the number of times the test treatment concentration is greater than the reference treatment concentration. When the compound is undetected in the Mud Dump Reference Site-exposed tissues, the 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 Shark River sediment composite are evaluated relative to the Mud Dump Reference Site sediment by the guidelines of the Green Book Tier III and by additional guidelines provided by USACE-NYD. Tier III evaluation uses water-column toxicity tests, benthic toxicity tests, and whole-sediment bioaccumulation studies to assess the impact of contaminants in the dredged material on marine organisms and to determine whether there is potential for the material to have an unacceptable environmental effect during ocean disposal. The Green Book Tier III and USACE-NYD provide the following guidance for determining whether the proposed dredged material is unacceptable for ocean disposal:

- Water-Column Toxicity. The limiting permissible concentration (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 LC_{50}; therefore, acute toxicity in SPP tests would require at least 50% mortality in an SPP treatment to be evaluated according to the Green Book. A numerical mixing model may 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.

- Benthic Acute Toxicity. The proposed dredged material does not meet the LPC for benthic toxicity when the difference between organism survival in the test sediment and the reference site sediment is statistically significant, and survival in test is at least 20% lower than survival in reference sediment for amphipods, or at least 10% lower for other test species.

- Bioaccumulation. The proposed dredged material does not meet the LPC for bioaccumulation if tissue concentratons of one or more cntaminants of concern are greater than applicable U.S. Food and Drug Administration (FDA) levels. Regional guidance (USACE-NYD 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 Shark River dredged material in terms of sediment characterization and Tier III evaluations. The matrix in Figure 4.1 summarizes the contribution of the composite to benthic acute or water-column toxicity and potential for bioaccumulation relative to the MDRS. This matrix shows bioaccumulation potential as the

	Sediment Treatment	Shark River Composite
Acute Toxicity	*A. abdita* Benthic Static-Renewal Test	-[a]
	M. bahia Benthic Static Test	-
	M. beryllina SPP Test	S[b]
	M. bahia SPP Test	-
	M. galloprovinciallis SPP Test	S

	Test Species	*N. virens*[c]	*M. nasuta*[c]
Any Significant Bioaccumulation	# of Metals (9 total)	-	1
	# of Pesticide compounds (15 total)	-	-
	# of PCB congeners (22 total)	-	-
	# of PAH compounds (16 total)	3	3
	1,4-dichlorobenzene	-	-
Bioaccumulaton < 2 times Reference	# of Metals (9 total)	-	1
	# of Pesticide compounds (15 total)	-	-
	# of PCB congeners (22 total)	-	-
	# of PAH compounds (16 total)	-	1
	1,4-dichlorobenzene	-	-
Bioaccumulaton ≥2<5 times Reference	# of Metals (9 total)	-	-
	# of Pesticide compounds (15 total)	-	-
	# of PCB congeners (22 total)	-	-
	# of PAH compounds (16 total)	3	2
	1,4-dichlorobenzene	-	-
Bioaccumulaton ≥ 5 <10 times Reference	# of Metals (9 total)	-	-
	# of Pesticide compounds (15 total)	-	-
	# of PCB congeners (22 total)	-	-
	# of PAH compounds (16 total)	-	-
	1,4-dichlorobenzene	-	-
Bioaccumulaton ≥10 times Reference	# of Metals (9 total)	-	-
	# of Pesticide compounds (15 total)	-	-
	# of PCB congeners (22 total)	-	-
	# of PAH compounds (16 total)	-	-
	1,4-dichlorobenzene	-	-

(a) No significant difference/no significant bioaccumulation at this level.
(b) S Significantly different mortality between 0% and 100% SPP.
(c) Number of compounds bioaccumulating in tissues.

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

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

Shark River sediment core samples were mostly black or brown sand (approximately 60% or more sand by weight). Eight stations were ≥90% sand and gravel. Stations SR-4 and SR-7 were 72% and 86% sand and gravel, respectively. The station furthest upriver, Station SR-11, was composed of silt (41%) and similar portions of sand and clay (32% and 27%, respectively). The moisture content ranged from 8% (SR-3) to 46% (SR-11) in individual cores. The metals found in the highest concentrations were Zn (63.0 mg/kg), Cr (34.8 mg/kg), and Pb (28.4 mg/kg). The metals Ag, Cd, and Hg were all measured at levels between 0.1 mg/kg and 0.4 mg/kg. Other metals were measured approximately between 6 mg/kg (As) and 16 mg/kg (Cu). Only 6 of the 15 chlorinated pesticides analyzed were detected. The highest pesticide concentrations found were for 4,4'-DDE and 4,4'-DDT (1.95 µg/kg and 2.55 µg/kg dry weight, respectively). Sixteen of the 22 PCB congeners were detected in Shark River sediment, and the total estimated PCB concentration (dry weight) was calculated as 49.6 µg/kg. Low-molecular-weight PAHs made up approximately 12% of the total PAH concentration, whereas HPAHs made up 88% of the total (3810 µg/kg dry weight). Phenanthrene, fluoranthene, and pyrene were the dominant PAHs. The concentration of 1,4-dichlorobenzene was 8.68 µg/kg dry weight.

4.2 Site Water and Elutriate Chemical Characterization

Concentrations of metals were higher in Shark River site water than in either the sample elutriate or the Sequim Bay control water. Shark River site water had concentrations of metals between 1.9 times (Ni) and 6.9 times (Cr) higher than the Shark River elutriate. From pesticide and PCB congener analyses in site and control waters, only 4,4'-DDE was detected in the Shark River site water (2.89 ng/L).

4.3 Toxicity

In comparison with the MDRS, no statistically significant acute toxicity was found with the Shark River composite with either benthic acute test species (*M. bahia* and *A. abdita*). Therefore, the Shark River sediment composite met the LPC for benthic toxicity to these test organisms at the Mud Dump Site.

In water-column toxicity tests, the 100% SPP treatment (elutriate) prepared from Shark River sediment was acutely toxic to *M. beryllina* and *M. galloprovincialis*, but not to *M. bahia*. The LC_{50}s ranged from 48% SPP for *M. beryllina* to >100% SPP for *M. bahia* and *M. galloprovincialis*. The EC_{50} for *M. galloprovincialis* normal development, a more sensitive measure than survival, was 61% SPP. Based on acute mortality results (LC_{50} values), the LPC for water-column effects outside of the disposal site boundaries after 4 h is 0.48% for Shark River sediment. A projection of SPP concentrations exceeding these values after 4 h at the Mud Dump Site boundary would be unacceptable.

4.4 Bioaccumulation

The Green Book provides the following guidance for determining whether the proposed dredged material is unacceptable for ocean disposal based on the Tier III bioaccumulation test. Concentrations of contaminants of concern in tissues of benthic organisms are compared initially against applicable FDA action levels for poisonous or deleterious substances in fish and shellfish for human food. FDA levels of concern for chronic shellfish consumption are also available for some metals (FDA 1993a, 1993b, 1993c, 1993d, 1993e). If tissue concentrations exceed applicable FDA action levels, the dredged material exceeds the LPC for bioaccumulation and does not comply with the benthic criteria set forth in paragraph 227.13(c)(3) (40 CFR 220). In addition, regional guidance levels are available for interpretation of bioaccumulation from USACE-NYD (1981). In the absence of guidance levels, contaminant concentrations in dredged material-exposed tissues are compared with those of organisms similarly exposed to reference sediment. If contaminants in dredged material-exposed tissues are statistically greater than those from reference-exposed tissues, case-specific evaluative criteria should be developed using factors such as the number of species and contaminants that demonstrate statistically significant bioaccumulation, the magnitude of the difference, the toxicological importance, and biomagnification potential of the contaminants.

Table 4.1 compares the FDA and regional USACE-NYD guidance levels with the mean concentration of contaminants found in dredged material-exposed tissues of each test species. No bioaccumulation with either test species exceeded a guidance level. Statistically significant bioaccumulated levels of chromium, phenanthrene, fluoranthene, and pyrene were found in *M. nasuta*, but no magnification factor exceeded 5. In *N. virens*, statistically significant bioaccumulated levels of fluoranthene, pyrene, and chrysene were found, but no magnification factor exceeded 4.

TABLE 4.1. Comparison of Contaminant Concentrations in *M. nasuta* and *N. virens* Tissues Exposed to Proposed Dredged Material from the Shark River Project Area with FDA and USACE Guidance Levels for Bioaccumulation

Substance	Guidance Level (mg/kg wet wt)	Concentrations[a] in *M. nasuta* Tissues (mg/kg wet wt)	Concentrations[a] in *N. virens* Tissues (mg/kg wet wt)
Chlordane	0.3[b]	0.0001[c]	0.0002[c]
Total DDT[d]	5.0[b]	0.004	0.003
Dieldrin + Aldrin	0.3[b]	0.001	0.001
Heptachlor + Heptachlor epoxide	0.3[b]	0.0004	0.0002
Total PCBs[e]	2.0[b]	0.02	0.03
Arsenic	86[f]	3.93	2.82
Cadmium	3.7[f]	0.0349	0.0549
Chromium	13[f]	0.432	0.0186
Lead	1.7[f]	0.728	0.170
Nickel	80[f]	0.444	0.0710
Methyl Mercury	1.0[f]	0.0187[g]	0.0245[g]
Total DDT[d]	0.04[h]	0.004	0.003
Total PCBs[e]	0.40[h]	0.016	0.022
Mercury (total)	0.20[h]	0.0187	0.0245
Cadmium	0.30[h]	0.0349	0.0549

(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 were available for organic compounds and methyl mercury.
(c) Sum of α-chlordane and *trans* nonachlor only, whereas FDA action level is a sum of nine chlordane analytes.
(d) Sum of mean values for 2,4'-DDT, 4,4'-DDT, 2,4'-DDE, 4,4'-DDE, 2,4'-DDD, and 4,4'-DDD. One-half of the detection limit was used in the summation when mean values were undetected in a replicate.
(e) Total PCBs estimated as (2.0 X 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 (FDA 1993a, 1993b, 1993c, 1993d, 1993e).
(g) Value reported here is for total mercury.
(h) USACE-NYD bioaccumulation matrix value designated in 1981 (USACE-NYD 1981).

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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

	Reference Method	Target Relative Precision	Detection Limit
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.

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.

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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

Reference Method	Range of Recovery	Target Relative Precision	Detection Limit (%)
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

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit (dry wt)
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:

Task	Date Performed
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 ±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 hydroflouric 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

Reference Method	Surrogate Recovery	Spike Recovery	Relative Precision	Target Detection Limit (dry wt)
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 ≤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. 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

Reference Method	MS Recovery	Surrogate Recovery	SRM Accuracy	Relative Precision	Target Detection Limit (dry wt)
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 ±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.

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, Shark 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
SR-1	1	1	17	73	2	8
SR-2	1	1	15	81	2	2
SR-3	1	1	10	89	0	1
SR-4	1	1	13	59	14	14
SR-5	1	1	12	82	1	5
SR-6	1	1	4	88	4	4
SR-7	1	1	2	84	7	7
SR-8	1	1	1	94	3	2
SR-9	1	1	26	66	4	4
SR-10	1	1	8	84	4	4
SR-11	1	1	0	33	41	26
SR-11	2	1	0	31	42	27
SR-11	3	1	0	33	40	27
MDRS[a]	1	1	0	97	1	2
Ampelisca Control	1	1	0	9	67	24
Mysidopsis/Macoma Control	1	1	0	23	45	32
Nereis 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 62.5-2000 µm	Silt 3.9-62.5 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, Shark River

Sediment Treatment	Replicate	Batch	Bulk Density Wet lbs/ft^3	Bulk Density Dry lbs/ft^3	Specific Gravity
SR COMP	1	1	119	90	2.67
Quality Control Data					
Analytical Replicates					
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, Shark River

Sediment Treatment	Replicate	Batch	TOC (% dry wt.)	Solids (%)	Moisture (%)
SR-1	1	1	1.71	70	30
SR-2	1	1	0.41	82	18
SR-3	1	1	0.11	92	8
SR-4	1	1	1.39	64	36
SR-5	1	1	1.08	73	27
SR-6	1	1	0.77	77	23
SR-7	1	1	0.62	72	28
SR-8	1	1	0.40	80	20
SR-9	1	1	1.46	69	31
SR-9	2	1	1.40	NA[a]	NA
SR-9	3	1	1.46	NA	NA
SR-10	1	2	0.77	77	23
SR-11	1	2	2.18	54	46
SR-11	2	NA	NA	54	46
SR-11	3	NA	NA	54	46
MDRS[b]	1	3	0.07	80	20
Ampelisca Control	1	3	3.35	38	62
Macoma/Mysidopsis Control	1	3	2.43	32	68
Nereis Control	1	3	5.45	49	51
Nereis Control	2	3	5.27	NA	NA
Nereis 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.)
Standard Reference Material			
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	1	2
Percent Difference	1	2	1
Percent Difference	1	3	0
Analytical Replicates for TOC			
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 (%)
Analytical Replicates for % Moisture					
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, Shark River

Sediment Treatment	Analytical Replicate	Analytical Batch	Ag GFAA (Concentration mg/kg dry wt)	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
SR COMP	1	1	0.149	5.68	0.374	34.8	15.8	0.314	10.2	28.4	63.0

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

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
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
Matrix Spike Results											
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	131	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	86.2	41.4
Percent Recovery			113	97	101	96	91	92	122	172 [d]	83
Standard Reference Material											
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			NC [e]	11.6	0.36	76	18	0.063	32	28.2	138
Range			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	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
			(Concentration µg/g dry wt)								
Analytical Replicates											
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 (≤20%).
(g) Outside quality control criteria (≤20%) replicate analysis.

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

Sediment Treatment	Concentration (µg/kg dry wt)		
Analytical Replicate	SR COMP 1	SR COMP 2	SR COMP 3
2,4'-DDD[a]	0.66	0.17 U[b]	0.65
2,4'-DDE	0.57 U	0.57 U	0.56 U
2,4'-DDT	0.20 U	0.20 U	0.19 U
4,4'-DDD	0.22 U	0.22 U	0.22 U
4,4'-DDE	2.20	1.38	2.27
4,4'-DDT	2.38	3.14	2.14
α-Chlordane	0.56	0.43 U	0.69
Aldrin	0.18 U	0.82	0.17 U
Dieldrin	0.18 U	0.18 U	0.17 U
Endosulfan I	0.30 U	0.30 U	0.29 U
Endosulfan II	0.30 U	0.30 U	0.29 U
Endosulfan Sulfate	0.30 U	0.30 U	0.29 U
Heptachlor	0.18	0.06 U	0.05 U
Heptachlor Epoxide	0.26 U	0.26 U	0.25 U
Trans Nonachlor	0.20 U	0.20 U	0.19 U
PCB 8	0.47 U	0.47 U	0.46 U
PCB 18	0.14 U	0.14 U	0.13 U
PCB 28	3.07	2.89	2.68
PCB 44	0.09 U	0.09 U	0.09 U
PCB 49	0.27	0.83	0.24 U
PCB 52	0.43 U	3.92	0.42 U
PCB 66	2.44	0.20 U	0.20 U
PCB 87	0.34 U	1.79	0.33 U
PCB 101	1.25	6.76	1.37
PCB 105	0.98	2.28	0.22 U
PCB 118	2.04	6.31	1.96
PCB 128	0.33	1.10	0.14 U
PCB 138	2.36	7.77	2.44
PCB 153	1.80	4.70	1.97
PCB 170	0.26 U	0.77	0.30
PCB 180	0.67	1.54	0.67
PCB 183	0.56	0.99	0.47
PCB 184	0.25 U	0.25 U	0.24 U
PCB 187	0.28 U	0.28 U	0.27 U
PCB 195	0.17 U	0.17 U	0.16 U
PCB 206	0.29 U	0.42	0.28 U
PCB 209	0.26 U	0.26 U	0.72
Surrogate Recoveries (%)			
PCB 103 (SIS)	87	85	77
PCB 198 (SIS)	99	93	84

(a) Target detection limits are 1.0 µg/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				
		Concentration (µg/kg dry wt)				
Sediment Treatment	Method Blank	CQ COMP[a]	CQ COMP (MS)	Concentration		Percent
Analytical Replicate	1	1	1	Spiked	Recovered	Recovery
Batch	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
Surrogate Recoveries (%)						
PCB 103 (SIS)	94	47	89	NA	NA	NA
PCB 198 (SIS)	87	42	100	NA	NA	NA

Table A.10. (contd)

Sediment Treatment	Standard Reference Material			Analytical Replicates			
	Concentration (µg/kg dry wt)			Concentration (µg/kg dry wt)			
Analytical Replicate	SRM 1941a	Certified Value	Percent Difference	SR COMP[a] 1	SR COMP 2	SR COMP 3	RSD (%)
Batch	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 (≤30%).
(i) Outside quality control criteria (≤ 30%) for replicate analysis.

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

	Concentration (µg/kg dry wt)
Sediment Treatment	SR COMP
Analytical Replicate	1
Batch	1
1,4-Dichlorobenzene[(a)]	8.68
Naphthalene	61.1
Acenaphthylene	31.3
Acenaphthene	26.9
Fluorene	39.7
Phenanthrene	218
Anthracene	85.5
Fluoranthene	708
Pyrene	662
Benzo[a]anthracene	352
Chrysene	462
Benzo[b]fluoranthene	404
Benzo[k]fluoranthene	159
Benzo[a]pyrene	283
Indeno[123-cd]pyrene	147
Dibenzo[a,h]anthracene	36.3
Benzo[g,h,i]perylene	135
Surrogate Recoveries (%)	
d4 1,4-Dichlorobenzene	45
d8 Naphthalene	49
d10 Acenaphthene	58
d12 Chrysene	67
d14 Dibenzo[a,h]anthracene	47

(a) Target detection limit is 10 µg/kg for all analytes (except for 1,4-Dichlorobenzene which is 1 µg/kg).

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

Sediment Treatment	Blank	Matrix Spike Results				
		Concentration (µg/kg dry wt)				
		CQ COMP[a]	CQ COMP (MS)	Concentration		Percent Recovery
Analytical Replicate	1	1		Spiked	Recovered	
Batch	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
Surrogate Recoveries (%)						
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)

	Standard Reference Material			
	Concentration (µg/kg dry wt)			
Sediment Treatment	SRM 1941a	Certified		Percent
Analytical Replicate	1	Value	Range	Difference
Batch	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
Surrogate Recoveries (%)				
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 Replicates			
	Concentration (µg/kg dry wt)			
	BX COMP[a]	BX COMP	BX COMP	RSD
Analytical Replicate	1	2	3	(%)
Batch	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
Surrogate Recoveries (%)				
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 (≤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 Assurance/Quality Control Data for Shark 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

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit
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:

Task	Date
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 ±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 ±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 ±20% of mean certified value.

In addition, 1641b, a freshwater sample from NIST, was analyzed twice for Hg. Results were within ±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 Protecion 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

Reference Method	Surrogate Recovery	Spike Recovery	Relative Precision	Target Detection Limit
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 ≤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, Shark 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
SR-4	1	1	0.0254	0.0500	1.48	1.97	0.00917	1.03	1.12	8.52
SR-4	2	1	0.0277	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
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) 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
Matrix Spike Results										
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
SR-4[c]		1	NS	NS	NS	NS	0.0101	NS	NS	8.40
SR-4 (MS)		1	NS	NS	NS	NS	0.0342	NS	NS	16.8
Concentration Spiked			NS	NS	NS	NS	0.0207	NS	NS	8.91
Concentration Recovered			NS	NS	NS	NS	0.0241	NS	NS	8.38
Percent Recovery			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 [e]	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) 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
Standard Reference Material										
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
Analytical Replicates										
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

Table B.2. (contd)

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

Table B.3. Metals in Elutriate Samples, Shark 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	0.082	0.0210	0.00005	0.03	0.011	0.272
SR COMP	1	1	0.018 U[a]	0.0374	0.16	0.398	0.00251	0.559	0.222	1.36
SR COMP	2	1	0.018 U	0.0434	0.24	0.376	0.00250	0.553	0.273	1.36
SR COMP	3	1	0.018 U	0.0335	0.22	0.385	0.00238	0.535	0.258	1.00

(a) U Undetected at or above given concentration.

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
Matrix Spike Results										
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
Standard Reference Material										
CASS-3	1	1	0.0033	0.034	NA	0.520	NA	0.362	0.00440	NA
Certified Value			NC [f]	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
Analytical Replicates										
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, Shark River

	Concentration (ng/L)			
Sediment Treatment	SR-4	SR-4	SR-4	Sequim Bay Water
Replicate	1	2	3	1
Sample Size	1.07	1.07	1.07	1.00
Batch	1	1	1	1
2,4'-DDD[a]	0.93 U[b]	0.93 U	0.94 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	0.44 U	0.46 U
4,4'-DDD	0.44 U	0.44 U	0.45 U	0.48 U
4,4'-DDE	2.50	3.45	2.72	0.29 U
4,4'-DDT	0.40 U	0.40 U	0.40 U	0.43 U
α-Chlordane	0.82 U	0.82 U	0.83 U	0.88 U
Aldrin	0.38 U	0.38 U	0.39 U	0.41 U
Dieldrin	0.12 U	0.12 U	0.12 U	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	0.47 U	0.50 U
Heptachlor Epoxide	0.11 U	0.11 U	0.11 U	0.12 U
Trans Nonachlor	1.10 U	1.10 U	1.11 U	1.18 U
PCB 8	0.98 U	0.98 U	1.00 U	1.06 U
PCB 18	1.04 U	1.04 U	1.05 U	1.12 U
PCB 28	0.70 U	0.70 U	0.71 U	0.75 U
PCB 44	0.30 U	0.30 U	0.31 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	0.30 U	0.32 U
PCB 118	0.46 U	0.46 U	0.47 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	0.39 U	0.39 U	0.39 U	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	0.39 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	69	75
PCB 198 (SIS)	102	95	82	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	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
Surrogate Recoveries (%)						
PCB 103 (SIS)	77	75	92	NA	NA	NA
PCB 198 (SIS)	92	85	92	NA	NA	NA

Table B.6. (contd)

	Analytical Replicates							
	Concentration (ng/L)				Concentration (ng/L)			
Sediment Treatment	SH-8[a]	SH-8	SH-8	RSD	SR-4[a]	SR-4	SR-4	RSD
Replicate	1	2	3	(%)	1	2	3	(%)
Sample Size	1.04	1.07	1.07		1.07	1.07	1.07	
Batch	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
Surrogate Recoveries (%)								
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)

	Analytical Replicates							
	Concentration (ng/L)				Concentration (ng/L)			
Sediment Treatment	WC-8[d]	WC-8	WC-8	RSD	BX-14[d]	BX-14	BX-14	RSD
Replicate	1	2	3	(%)	1	2	3	(%)
Sample Size	1.06	1.07	1.06		1.07	1.07	1.07	
Batch	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
Surrogate Recoveries (%)								
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, Shark River

	Concentration (ng/L)			
Sediment Treatment	Sequim Bay Water	SR COMP	SR COMP	SR COMP
Replicate	1	1	2	3
Sample Size (g)	1.00	1.06	1.06	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	0.45 U	0.45 U	0.45 U
4,4'-DDE	0.29 U	0.28 U	0.28 U	0.28 U
4,4'-DDT	0.43 U	0.41 U	0.41 U	0.41 U
α-Chlordane	0.88 U	0.83 U	0.83 U	0.83 U
Aldrin	0.41 U	0.39 U	0.39 U	0.39 U
Dieldrin	0.13 U	0.13 U	0.13 U	0.13 U
Endosulfan I	0.49 U	0.47 U	0.47 U	0.47 U
Endosulfan II	0.49 U	0.47 U	0.47 U	0.47 U
Endosulfan Sulfate	0.49 U	0.47 U	0.47 U	0.47 U
Heptachlor	0.50 U	0.47 U	0.47 U	0.47 U
Heptachlor Epoxide	0.12 U	0.11 U	0.11 U	0.11 U
Trans Nonachlor	1.18 U	1.12 U	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	1.06 U	1.06 U	1.06 U
PCB 28	0.75 U	0.71 U	0.71 U	0.71 U
PCB 44	0.33 U	0.31 U	0.31 U	0.31 U
PCB 49	0.57 U	0.54 U	0.54 U	0.54 U
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	0.36 U	0.36 U	0.36 U
PCB 101	0.52 U	0.49 U	0.49 U	0.49 U
PCB 105	0.32 U	0.30 U	0.30 U	0.30 U
PCB 118	0.50 U	0.47 U	0.47 U	0.47 U
PCB 128	0.26 U	0.24 U	0.24 U	0.24 U
PCB 138	0.36 U	0.35 U	0.35 U	0.35 U
PCB 153	0.42 U	0.40 U	0.40 U	0.40 U
PCB 170	0.21 U	0.20 U	0.20 U	0.20 U
PCB 180	0.29 U	0.28 U	0.28 U	0.28 U
PCB 183	0.57 U	0.54 U	0.54 U	0.54 U
PCB 184	0.57 U	0.54 U	0.54 U	0.54 U
PCB 187	0.41 U	0.39 U	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	0.28 U	0.28 U	0.28 U
Surrogate Recoveries (%)				
PCB 103 (SIS)	78	0 [c]	0 [c]	65
PCB 198 (SIS)	76	0 [c]	0 [c]	67

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

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

Sediment Treatment Analytical Replicate Sample Size Batch	Blank 1.00 1	Matrix Spike Results Concentration (ng/L) Sequim Bay Water 1.00 1	Sequim Bay Water (MS) 1.00 1	Concentration Spiked	Concentration Recovered	Percent Recovery
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
Surrogate Recoveries (%)						
PCB 103 (SIS)	48	78	79	NA	NA	NA
PCB 198 (SIS)	45	76	77	NA	NA	NA

Table B.8. (contd)

	Analytical Replicates							
	Concentration (ng/L)				Concentration (ng/L)			
Sediment Treatment	SH COMP[a]	SH COMP	SH COMP		WC COMP[a]	WC COMP	WC COMP	
Analytical Replicate				RSD				RSD
Sample Size	1.07	1.08	1.07	(%)	1.06	1.06	1.01	(%)
Batch	1	1	1		1	1	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
Surrogate Recoveries (%)								
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)

	Analytical Replicates							
	Concentration (ng/L)				Concentration (ng/L)			
Sediment Treatment	SR COMP[a]	SR COMP	SR COMP		BX COMP[d]	BX COMP	BX COMP	
Analytical Replicate				RSD				RSD
Sample Size	1.06	1.06	1.05	(%)	1.05	1.05	1.05	(%)
Batch	1	1	1		1	1	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
Surrogate Recoveries (%)								
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 (≤30%) for replicate analysis.
(f) Surrogate not added. Sample quantified using RIS (Recovery Internal Standards).

Appendix C

Benthic Acute Toxicity Test Data for Shark River Project

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

Sediment Composite	Replicate	Live [a]	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
Shark River	1	17	3	0.85		
Shark River	2	19	1	0.95		
Shark River	3	18	2	0.90		
Shark River	4	19	1	0.95		
Shark River	5	18	2	0.90	0.91	0.04
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
Ampelisca Control	1	19	1	0.95		
Ampelisca Control	2	20	0	1.00		
Ampelisca Control	3	20	0	1.00		
Ampelisca Control	4	19	1	0.95		
Ampelisca 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*, Shark 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
SR COMP	19.8	20.3	8.08	8.30	3.8 [c]	7.0	30.0	30.5	0.041	0.180
MDRS[d]	19.9	20.2	7.93	8.12	6.7	7.1	30.0	30.5	0.033	0.136
Ampelisca 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*, Shark River

Sediment Composite	Replicate	Live [a]	Dead or Missing	Proportion Survival	Mean Proportion Survival	Standard Deviation
Shark River	1	19	1	0.95		
Shark River	2	18	2	0.90		
Shark River	3	19	1	0.95		
Shark River	4	19	1	0.95		
Shark River	5	17	3	0.85	0.92	0.04
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*, Shark 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[b]	28.0	32.0	NA	15.0
SR COMP	19.3	20.2	7.87	8.35 [c]	5.8	7.0	30.0	31.0	0.132	6.59
MDRS[d]	19.4	20.3	7.84	8.41 [c]	6.1	7.1	30.0	31.0	0.265	2.49
Mysid 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 for Shark River Project

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

Sediment Treatment	Concentration (% SPP)	Replicate	Live[a]	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
SR COMP	0	1	9	1	0.90		
SR COMP	0	2	9	1	0.90		
SR COMP	0	3	9	1	0.90		
SR COMP	0	4	9	1	0.90		
SR COMP	0	5	9	1	0.90	0.90	0.00
SR COMP	10	1	9	1	0.90		
SR COMP	10	2	6	4	0.60		
SR COMP	10	3	10	0	1.00		
SR COMP	10	4	6	4	0.60		
SR COMP	10	5	8	2	0.80	0.78	0.18
SR COMP	50	1	7	3	0.70		
SR COMP	50	2	4	6	0.40		
SR COMP	50	3	3	7	0.30		
SR COMP	50	4	8	2	0.80		
SR COMP	50	5	5	5	0.50	0.54	0.21
SR COMP	100	1	1	9	0.10		
SR COMP	100	2	1	9	0.10		
SR COMP	100	3	1	9	0.10		
SR COMP	100	4	2	8	0.20		
SR COMP	100	5	2	8	0.20	0.14	0.05

(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*, Shark River

Sediment Treatment	Concentration (% SPP)	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (‰) Min	Salinity (‰) Max
Acceptable Range:		18.0	22.0	7.30	8.30	3.0	NA[a]	28.0	32.0
SR	0	18.9	21.0	8.03	8.13	6.6	7.9	30.0	31.0
SR	10	18.9	21.0	8.01	8.17	6.5	7.6	30.0	30.5
SR	50	18.9	20.9	7.98	8.23	6.2	7.2	30.0	30.0
SR	100	18.8	21.1	7.92	8.31 [b]	4.2	7.3	29.5	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 (µg/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*, Shark River

Sediment Treatment	Concentration (% SPP)	Replicate	Live[a]	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
SR COMP	0	1	10	0	1.00		
SR COMP	0	2	10	0	1.00		
SR COMP	0	3	10	0	1.00		
SR COMP	0	4	10	0	1.00		
SR COMP	0	5	9	1	0.90	0.98	0.04
SR COMP	10	1	10	0	1.00		
SR COMP	10	2	10	0	1.00		
SR COMP	10	3	10	0	1.00		
SR COMP	10	4	10	0	1.00		
SR COMP	10	5	10	0	1.00	1.00	0.00
SR COMP	50	1	10	0	1.00		
SR COMP	50	2	9	1	0.90		
SR COMP	50	3	9	1	0.90		
SR COMP	50	4	10	0	1.00		
SR COMP	50	5	8	2	0.80	0.92	0.08
SR COMP	100	1	10	0	1.00		
SR COMP	100	2	9	1	0.90		
SR COMP	100	3	9	1	0.90		
SR COMP	100	4	10	0	1.00		
SR COMP	100	5	9	1	0.90	0.94	0.05

(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*, Shark 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
SR COMP	0	19.7	20.6	7.83	8.09	6.0	7.7	30.0	31.0
SR COMP	10	19.7	20.5	7.98	8.12	6.1	7.5	30.0	31.0
SR COMP	50	19.7	20.6	8.01	8.28	6.2	7.2	30.0	30.5
SR COMP	100	19.7	20.5	7.95	8.30	4.5	7.1	30.0	30.0

(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	1.00	0.00
0	3	10	0	1.00		
150	1	10	0	1.00		
150	2	10	0	1.00	0.93	0.12
150	3	8	2	0.80		
200	1	7	3	0.70		
200	2	8	2	0.80	0.77	0.06
200	3	8	2	0.80		
300	1	5	5	0.50		
300	2	6	4	0.60	0.50	0.10
300	3	4	6	0.40		
400	1	2	8	0.20		
400	2	2	8	0.20	0.13	0.12
400	3	0	10	0.00		

(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*, Shark River

Sediment Treatment	Conc. (% SPP)	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]
SR COMP	0	1	255	240	15	5	260	0.94		1.00 [d]		
SR COMP	0	2	255	169	19	129	317	0.66		1.00 [d]		
SR COMP	0	3	255	211	30	4	245	0.83		0.96		
SR COMP	0	4	255	227	12	4	243	0.89		0.95		
SR COMP	0	5	255	228	12	11	251	0.89	0.84	0.98	0.98	0.02
SR COMP	10	1	255	232	24	5	261	0.91		1.00 [d]		
SR COMP	10	2	255	ND[e]	ND	ND	NA[f]	NA		NA		
SR COMP	10	3	255	205	9	7	221	0.80		0.87		
SR COMP	10	4	255	206	15	17	238	0.81		0.93		
SR COMP	10	5	255	208	37	9	254	0.82	0.83	1.00	0.95	0.06
SR COMP	50	1	255	120	62	0	182	0.47		0.71		
SR COMP	50	2	255	159	33	20	212	0.62		0.83		
SR COMP	50	3	255	200	40	9	249	0.78		0.98		
SR COMP	50	4	255	184	47	13	244	0.72		0.96		
SR COMP	50	5	255	162	47	23	232	0.64	0.65	0.91	0.88	0.11
SR COMP	100	1	255	2	0	201	203	0.01		0.80		
SR COMP	100	2	255	5	1	100	106	0.02		0.42		
SR COMP	100	3	255	2	1	170	173	0.01		0.68		
SR COMP	100	4	255	3	7	119	129	0.01		0.51		
SR COMP	100	5	255	1	0	210	211	0.00	0.01	0.83	0.64	0.18

(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.
(e) ND No data; sample lost during testing.
(f) NA Not applicable.

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

Sediment Treatment	Concentration (% SPP)	Temperature (°C) Min	Temperature (°C) Max	pH Min	pH Max	Dissolved Oxygen (mg/L) Min	Dissolved Oxygen (mg/L) Max	Salinity (‰) Min	Salinity (‰) Max
Acceptable Range:		14.0	18.0	7.30	8.30	4.9	NA[a]	28.0	32.0
SR COMP	0	16.1	16.9	8.05	8.19	7.4	8.0	30.0	31.0
SR COMP	10	16.1	16.7	8.03	8.21	7.5	8.0	30.0	30.5
SR COMP	50	16.1	16.6	7.97	8.31 [b]	6.1	7.9	30.0	30.0
SR COMP	100	16.0	16.7	7.93	8.40 [b]	3.1 [b]	8.0	29.0	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	0.09
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 for Shark River Project

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

Sediment Treatment	Replicate	Live[a]	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
SR COMP	1	25	0	1.00		
SR COMP	2	23	2	0.92		
SR COMP	3	21	4	0.84		
SR COMP	4	24	1	0.96		
SR COMP	5	24	1	0.96	0.94	0.06
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
Macoma Control	1	23	2	0.92		
Macoma Control	2	23	2	0.92		
Macoma Control	3	23	2	0.92		
Macoma Control	4	24	1	0.96		
Macoma 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*, Shark 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
SR COMP	15.4	16.5	7.90	8.13	7.0	7.8	30.0	31.0
MDRS[b]	15.3	16.6	7.88	8.11	7.1	7.9	30.0	31.0
Macoma 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 (µg/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*, Shark River

Sediment Treatment	Replicate	Live[a]	Dead or Missing	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
SR COMP	1	17	3	0.85		
SR COMP	2	18	2	0.90		
SR COMP	3	18	2	0.90		
SR COMP	4	19	1	0.95		
SR COMP	5	17	3	0.85	0.89	0.04
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
Nereis Control	1	16	4	0.80		
Nereis Control	2	14	6	0.70		
Nereis Control	3	13	7	0.65		
Nereis Control	4	18	2	0.90		
Nereis 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*, Shark 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
SR COMP	19.0	20.3	7.79	8.16	5.7	7.1	30.0	30.5
MDRS[b]	19.0	20.3	7.81	8.08	5.8	7.3	30.0	30.5
Nereis 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 Tissues Chemical Analyses and Quality Assurance/Quality Control Data for Shark 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

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit(dry wt)
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:

Task	Date Performed
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 ±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 ±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

Reference Method	Surrogate Recovery	Spike Recovery	Relative Precision	Detection Limit (wet wt)
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:

Batch	Species	Extraction	Analysis
1	*N. virens*	9/28/95	10/19-20/95
2	*M. nasuta/N. virens*	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 ≤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.

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

Reference Method	MS Recovery	Surrogate Recovery	SRM Accuracy	Relative Precision	Detection Limit (wet wt)
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:

Batch	Species	Extraction	Analysis
1	*N. virens*	9/28/95	10/19-20/95
2	*M. nasuta/N. virens*	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 ±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), Shark River

Sediment Treatment	Replicate	Analytical Replicate	Batch	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
SR COMP	1		1	12.9	0.0465	3.07	0.0366	0.520	2.31	0.0275	0.577	0.824	12.7
SR COMP	2		1	12.5	0.102	5.07	0.0306	0.348	3.63	0.0150	0.336	0.713	13.5
SR COMP	3		1	12.4	0.0943	4.16	0.0388	0.459	3.68	0.0191	0.476	0.851	21.0
SR COMP	4		1	12.1	0.0393	3.27	0.0240	0.356	1.86	0.0141	0.414	0.540	10.3
SR COMP	5		1	13.9	0.0192	4.08	0.0445	0.475	1.67	0.0178	0.417	0.712	16.3
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), Shark River

Sediment Treatment	Replicate	Analytical Replicate	Batch	Percent 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
SR COMP	1		1	12.9	0.362	23.9	0.285	4.05	18.0	0.214	4.49	6.41	98.7
SR COMP	2		1	12.5	0.814	40.6	0.245	2.79	29.1	0.120	2.69	5.71	108
SR COMP	3		1	12.4	0.759	33.5	0.312	3.69	29.6	0.154	3.83	6.85	169
SR COMP	4		1	12.1	0.326	27.1	0.199	2.95	15.4	0.117	3.43	4.48	85.8
SR COMP	5		1	13.9	0.138	29.3	0.319	3.41	12.0	0.128	2.99	5.11	117
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	Replicate	Analytical Replicate	Batch	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
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	±.0067	±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	Replicate	Analytical Replicate	Batch	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
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
Macoma Bkgd. Tissue	1	1	1	0.155	28.9	0.217	1.57	56.8	0.0842	4.80	2.60	103
Macoma Bkgd. Tissue	1	2	1	0.175	29.4	0.148	2.50	14.5	0.0646	4.76	1.14	98.4
Macoma 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 (≤20%).
(f) Outside quality control criteria (≤20%) for replicate analysis.

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

	Concentration (µg/kg wet wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	20.6	20.4	6.63	8.30
Percent Dry Weight	12.9	12.5	12.4	12.1	13.9
Batch	1	1	1	1	1
2,4'-DDD[a]	0.25 U[b]	0.25 U	0.25 U	0.77 U	0.61 U
2,4'-DDE	0.26 U	0.26 U	0.26 U	0.79 U	0.63 U
2,4'-DDT	0.18 U	0.18 U	0.18 U	0.54 U	0.43 U
4,4'-DDD	0.63	0.59	0.72	1.63	1.36
4,4'-DDE	1.38	1.32	1.57	2.37	2.14
4,4'-DDT	0.43	0.15 U	0.15 U	1.04	0.83
α-Chlordane	0.10	0.11	0.17	0.29 U	0.23 U
Aldrin	0.66	0.68	0.68	1.60	1.40
Dieldrin	0.52 U	0.51 U	0.51 U	1.56 U	1.24 U
Endosulfan I	0.18 U	0.18 U	0.18 U	0.54 U	0.43 U
Endosulfan II	0.18 U	0.18 U	0.18 U	0.54 U	0.43 U
Endosulfan Sulfate	0.25 U	0.25 U	0.25 U	0.76 U	0.61 U
Heptachlor	0.34	0.26	0.18 U	0.56 U	0.44 U
Heptachlor Epoxide	0.13 U	0.13 U	0.13 U	0.40 U	0.32 U
Trans Nonachlor	0.15 U	0.14 U	0.14 U	0.44 U	0.35 U
PCB 8	0.35 U	1.17	0.34 U	1.06 U	0.84 U
PCB 18	0.10 U	0.10 U	0.10 U	0.31 U	0.27
PCB 28	1.40	1.25	1.20	0.33 U	0.26 U
PCB 44	0.07 U	0.07 U	0.07 U	0.21 U	0.17 U
PCB 49	0.41	0.47	0.60	0.56 U	0.47
PCB 52	0.75	0.68	0.92	0.98 U	0.78 U
PCB 66	1.07	1.15	1.31	1.06	0.36 U
PCB 87	0.25 U	0.25 U	0.25 U	0.76 U	0.60 U
PCB 101	0.92	0.96	1.11	0.68	0.83
PCB 105	0.17 U	0.16 U	0.16 U	0.50 U	0.40 U
PCB 118	0.70	0.70	0.96	0.60	0.66
PCB 128	0.11 U	0.10 U	0.10 U	0.32 U	0.25 U
PCB 138	0.43	0.43	0.55	0.81 U	0.64 U
PCB 153	0.65	0.63	0.86	1.32 U	1.05 U
PCB 170	0.18 U	0.17 U	0.17 U	0.53 U	0.42 U
PCB 180	0.38 U	0.37 U	0.37 U	1.13 U	0.90 U
PCB 183	0.18 U	0.18 U	0.18 U	0.56 U	0.44 U
PCB 184	0.18 U	0.18 U	0.18 U	0.56 U	0.44 U
PCB 187	0.21 U	0.20 U	0.20 U	0.62 U	0.50 U
PCB 195	0.13 U	0.12 U	0.12 U	0.38 U	0.30 U
PCB 206	0.21 U	0.21 U	0.21 U	0.65 U	0.51 U
PCB 209	0.20 U	0.19 U	0.19 U	0.59 U	0.47 U
Surrogate Recoveries (%)					
PCB 103 (SIS)	84	91	92	97	85
PCB 198 (SIS)	76	84	80	89	83

Table F.4. (contd)

	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS[c]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	15.2	10.4	20.7	20.2
Percent Dry Weight	11.7	14.9	11.9	12.2	12.7
Batch	1	2	1	1	2
2,4'-DDD	0.25 U	0.33 U	0.49 U	0.24 U	NA [d]
2,4'-DDE	0.26 U	0.34 U	0.50 U	0.25 U	NA
2,4'-DDT	0.18 U	0.24 U	0.34 U	0.17 U	NA
4,4'-DDD	1.11	0.34 U	1.58	1.15	NA
4,4'-DDE	1.81	1.61	2.26	2.00	NA
4,4'-DDT	0.15 U	0.91	0.89	0.59	NA
α-Chlordane	0.11	0.14	0.18 U	0.12	NA
Aldrin	0.89	1.21	1.35	0.93	NA
Dieldrin	0.52 U	0.68 U	0.99 U	0.49 U	NA
Endosulfan I	0.18 U	0.24 U	0.35 U	0.17 U	NA
Endosulfan II	0.18 U	0.24 U	0.35 U	0.17 U	NA
Endosulfan Sulfate	0.25 U	0.33 U	0.49 U	0.24 U	NA
Heptachlor	0.26	0.24 U	0.53	0.18 U	NA
Heptachlor Epoxide	0.13 U	0.18 U	0.25 U	0.13 U	NA
Trans Nonachlor	0.15 U	0.19 U	0.28 U	0.14 U	NA
PCB 8	0.35 U	0.46 U	0.68 U	0.34 U	NA
PCB 18	0.10 U	0.13 U	0.20 U	0.10 U	NA
PCB 28	2.16	1.51	3.03	2.54	NA
PCB 44	0.07 U	0.09 U	0.14 U	0.07 U	NA
PCB 49	1.26	1.72	1.07	1.34	NA
PCB 52	1.66	2.12	1.56	1.60	NA
PCB 66	2.01	2.61	0.29 U	2.31	NA
PCB 87	0.25 U	0.33 U	0.48 U	0.27	NA
PCB 101	1.30	1.58	1.24	1.64	NA
PCB 105	0.17 U	0.71	0.32 U	0.16 U	NA
PCB 118	0.91	1.32	0.64	1.12	NA
PCB 128	0.11 U	0.14 U	0.20 U	0.10 U	NA
PCB 138	0.68	0.83	0.51 U	0.71	NA
PCB 153	0.79	0.95	0.84 U	0.97	NA
PCB 170	0.18 U	0.23 U	0.34 U	0.17 U	NA
PCB 180	0.38 U	0.50 U	0.72 U	0.36 U	NA
PCB 183	0.18 U	0.24 U	0.35 U	0.18 U	NA
PCB 184	0.18 U	0.24 U	0.35 U	0.18 U	NA
PCB 187	0.21 U	0.27 U	0.40 U	0.20 U	NA
PCB 195	0.13 U	0.17 U	0.24 U	0.12 U	NA
PCB 206	0.21 U	0.28 U	0.41 U	0.21 U	NA
PCB 209	0.20 U	0.26 U	0.37 U	0.19 U	NA
Surrogate Recoveries (%)					
PCB 103 (SIS)	92	89	81	83	NA
PCB 198 (SIS)	88	73	78	78	NA

Table F.4. (contd)

	Concentration (µg/kg wet wt)		
Sediment Treatment	*Macoma* Bkgd.	*Macoma* Bkgd.	*Macoma* Bkgd.
Replicate	Tissue	Tissue	Tissue
Analytical Replicate	1	2	3
Wet Weight	14.3	10.2	10.5
Percent Dry Weight	13.7	13.7	13.7
Batch	2	2	2
2,4'-DDD	0.35 U	0.50 U	0.49 U
2,4'-DDE	0.37 U	0.51 U	0.50 U
2,4'-DDT	0.25 U	0.35 U	0.34 U
4,4'-DDD	0.36 U	0.51 U	0.50 U
4,4'-DDE	0.26 U	0.37 U	0.36 U
4,4'-DDT	0.21 U	0.30 U	0.29 U
α-Chlordane	0.13 U	0.19 U	0.18 U
Aldrin	0.18 U	0.25 U	0.24 U
Dieldrin	0.72 U	1.01 U	0.99 U
Endosulfan I	0.25 U	0.35 U	0.35 U
Endosulfan II	0.25 U	0.35 U	0.35 U
Endosulfan Sulfate	0.35 U	0.50 U	0.49 U
Heptachlor	0.26 U	0.36 U	0.36 U
Heptachlor Epoxide	0.19 U	0.26 U	0.25 U
Trans Nonachlor	0.20 U	0.28 U	0.28 U
PCB 8	0.49 U	0.69 U	0.68 U
PCB 18	0.14 U	0.20 U	0.20 U
PCB 28	0.15 U	0.22 U	0.21 U
PCB 44	0.10 U	0.14 U	0.14 U
PCB 49	0.26 U	0.36 U	0.35 U
PCB 52	0.45 U	0.64 U	0.62 U
PCB 66	0.21 U	0.30 U	0.29 U
PCB 87	0.35 U	0.49 U	0.48 U
PCB 101	0.19 U	0.26 U	0.26 U
PCB 105	0.23 U	0.33 U	0.32 U
PCB 118	0.27 U	0.37 U	0.37 U
PCB 128	0.15 U	0.21 U	0.20 U
PCB 138	0.37 U	0.52 U	0.51 U
PCB 153	0.61 U	0.86 U	0.84 U
PCB 170	0.25 U	0.34 U	0.34 U
PCB 180	0.53 U	0.74 U	0.72 U
PCB 183	0.26 U	0.36 U	0.35 U
PCB 184	0.26 U	0.36 U	0.35 U
PCB 187	0.29 U	0.40 U	0.40 U
PCB 195	0.18 U	0.25 U	0.24 U
PCB 206	0.30 U	0.42 U	0.41 U
PCB 209	0.27 U	0.38 U	0.37 U
Surrogate Recoveries (%)			
PCB 103 (SIS)	105	103	104
PCB 198 (SIS)	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), Shark River

	Concentration (µg/kg dry wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	20.6	20.4	6.63	8.30
Percent Dry Weight	12.9	12.5	12.4	12.1	13.9
Batch	1	1	1	1	1
2,4'-DDD	1.9 U[a]	2.0 U	2.0 U	6.4 U	4.4 U
2,4'-DDE	2.0 U	2.1 U	2.1 U	6.6 U	4.5 U
2,4'-DDT	1.4 U	1.4 U	1.4 U	4.5 U	3.1 U
4,4'-DDD	4.9	4.7	5.8	13.5	9.76
4,4'-DDE	10.7	10.6	12.6	19.7	15.4
4,4'-DDT	3.3	1.2 U	1.2 U	8.62	6.0
α-Chlordane	0.78	0.88	1.4	2.4 U	1.6 U
Aldrin	5.1	5.4	5.5	13.3	10.0
Dieldrin	4.0 U	4.1 U	4.1 U	12.9 U	8.90 U
Endosulfan I	1.4 U	1.4 U	1.4 U	4.5 U	3.1 U
Endosulfan II	1.4 U	1.4 U	1.4 U	4.5 U	3.1 U
Endosulfan Sulfate	1.9 U	2.0 U	2.0 U	6.3 U	4.4 U
Heptachlor	2.6	2.1	1.4 U	4.6 U	3.2 U
Heptachlor Epoxide	1.0 U	1.0 U	1.0 U	3.3 U	2.3 U
Trans Nonachlor	1.2 U	1.1 U	1.1 U	3.6 U	2.5 U
PCB 8	2.7 U	9.37	2.7 U	8.79 U	6.0 U
PCB 18	0.78 U	0.80 U	0.80 U	2.6 U	1.9
PCB 28	10.9	10.0	9.65	2.7 U	1.9 U
PCB 44	0.5 U	0.6 U	0.6 U	1.7 U	1.2 U
PCB 49	3.2	3.8	4.8	4.6 U	3.4
PCB 52	5.8	5.4	7.4	8.1 U	5.6 U
PCB 66	8.33	9.21	10.5	8.79	2.6 U
PCB 87	1.9 U	2.0 U	2.0 U	6.3 U	4.3 U
PCB 101	7.2	7.7	8.93	5.6	6.0
PCB 105	1.3 U	1.3 U	1.3 U	4.1 U	2.9 U
PCB 118	5.4	5.6	7.7	5.0	4.7
PCB 128	0.86 U	0.80 U	0.80 U	2.7 U	1.8 U
PCB 138	3.3	3.4	4.4	6.7 U	4.6 U
PCB 153	5.1	5.0	6.9	10.9 U	7.53 U
PCB 170	1.4 U	1.4 U	1.4 U	4.4 U	3.0 U
PCB 180	3.0 U	3.0 U	3.0 U	9.37 U	6.5 U
PCB 183	1.4 U	1.4 U	1.4 U	4.6 U	3.2 U
PCB 184	1.4 U	1.4 U	1.4 U	4.6 U	3.2 U
PCB 187	1.6 U	1.6 U	1.6 U	5.1 U	3.6 U
PCB 195	1.0 U	1.0 U	1.0 U	3.2 U	2.2 U
PCB 206	1.6 U	1.7 U	1.7 U	5.4 U	3.7 U
PCB 209	1.6 U	1.5 U	1.5 U	4.9 U	3.4 U

Table F.5. (contd)

	Concentration (µg/kg dry wt)				
Sediment Treatment	MDRS[b]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	15.2	10.4	20.7	20.2
Percent Dry Weight	11.7	14.9	11.9	12.2	12.7
Batch	1	2	1	1	2
2,4'-DDD	2.1 U	2.2 U	4.1 U	2.0 U	NA [c]
2,4'-DDE	2.2 U	2.3 U	4.2 U	2.0 U	NA
2,4'-DDT	1.5 U	1.6 U	2.9 U	1.4 U	NA
4,4'-DDD	9.45	2.3 U	13.3	9.40	NA
4,4'-DDE	15.4	10.8	19.1	16.4	NA
4,4'-DDT	1.3 U	6.1	7.5	4.8	NA
α-Chlordane	0.94	0.94	1.5 U	1.0	NA
Aldrin	7.6	8.12	11.4	7.6	NA
Dieldrin	4.4 U	4.6 U	8.4 U	4.0 U	NA
Endosulfan I	1.5 U	1.6 U	3.0 U	1.4 U	NA
Endosulfan II	1.5 U	1.6 U	3.0 U	1.4 U	NA
Endosulfan Sulfate	2.1 U	2.2 U	4.1 U	2.0 U	NA
Heptachlor	2.2	1.6 U	4.5	1.5 U	NA
Heptachlor Epoxide	1.1 U	1.2 U	2.1 U	1.1 U	NA
Trans Nonachlor	1.3 U	1.3 U	2.4 U	1.1 U	NA
PCB 8	3.0 U	3.1 U	5.7 U	2.8 U	NA
PCB 18	0.85 U	0.87 U	1.7 U	0.82 U	NA
PCB 28	18.4	10.1	25.6	20.8	NA
PCB 44	0.6 U	0.6 U	1.2 U	0.6 U	NA
PCB 49	10.7	11.5	9.03	11.0	NA
PCB 52	14.1	14.2	13.2	13.1	NA
PCB 66	17.1	17.5	2.4 U	18.9	NA
PCB 87	2.1 U	2.2 U	4.1 U	2.2	NA
PCB 101	11.1	10.6	10.5	13.4	NA
PCB 105	1.4 U	4.8	2.7 U	1.3 U	NA
PCB 118	7.8	8.86	5.4	9.16	NA
PCB 128	0.94 U	0.94 U	1.7 U	0.82 U	NA
PCB 138	5.8	5.6	4.3 U	5.8	NA
PCB 153	6.7	6.4	7.1 U	7.9	NA
PCB 170	1.5 U	1.5 U	2.9 U	1.4 U	NA
PCB 180	3.2 U	3.4 U	6.1 U	2.9 U	NA
PCB 183	1.5 U	1.6 U	3.0 U	1.5 U	NA
PCB 184	1.5 U	1.6 U	3.0 U	1.5 U	NA
PCB 187	1.8 U	1.8 U	3.4 U	1.6 U	NA
PCB 195	1.1 U	1.1 U	2.0 U	1.0 U	NA
PCB 206	1.8 U	1.9 U	3.5 U	1.7 U	NA
PCB 209	1.7 U	1.7 U	3.1 U	1.6 U	NA

Table F.5. (contd)

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

			Matrix Spike Results				
			Concentration (µg/kg wet wt)				
Sediment Treatment	Blank	Blank	BX COMP[a]	BX COMP	Concentration		Percent
Replicate	1	1	5	(MS)	Spiked	Recovered	Recovery
Analytical Replicate	1	1	1				
Wet Weight	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
Surrogate Recoveries (%)							
PCB 103 (SIS)	104	113	84	87	NA	NA	NA
PCB 198 (SIS)	108	107	82	81	NA	NA	NA

Table F.6. (contd)

	Matrix Spike Results				
	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS[a]	MDRS	Concentration		Percent
Replicate	2	(MS)	Spiked	Recovered	Recovery
Analytical Replicate	1				
Wet Weight	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
Surrogate Recoveries (%)					
PCB 103 (SIS)	89	97	NA	NA	NA
PCB 198 (SIS)	73	85	NA	NA	NA

Table F.6. (contd)

	Analytical Replicates			
	Concentration (µg/kg wet wt)			
Sediment Treatment	BX COMP[a]	BX COMP	BX COMP	RSD
Replicate	3	3	3	(%)
Analytical Replicate	1	2	3	
Wet Weight	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
Surrogate Recoveries (%)				
PCB 103 (SIS)	80	82	83	NA
PCB 198 (SIS)	74	73	76	NA

Table F.6. (contd)

	Analytical Replicates			
	Concentration (µg/kg wet wt)			
Sediment Treatment	*Macoma* Bkgd.	*Macoma* Bkgd.	*Macoma* Bkgd.	RSD
Replicate	Tissue	Tissue	Tissue	(%)
Analytical Replicate	1	2	3	
Wet Weight	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
Surrogate Recoveries (%)				
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), Shark River

	Concentration (µg/kg wet wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	20.6	20.4	6.63	8.30
Percent Dry Weight	12.9	12.5	12.4	12.1	13.9
Batch	1	1	1	1	1
1,4-Dichlorobenzene[a]	1.99 U[b]	1.95 U	1.96 U	6.03 U	4.82 U
Naphthalene	2.90	2.80	2.92	6.80	7.25
Acenaphthylene	0.55 U	0.54 U	0.54 U	1.66 U	1.33 U
Acenaphthene	1.39 U	1.35 U	1.37 U	4.19 U	3.35 U
Fluorene	1.28 U	1.25 U	1.26 U	3.86 U	3.08 U
Phenanthrene	4.75	3.72	6.37	8.05 U	7.64
Anthracene	2.24 U	2.19 U	2.71	6.79 U	5.42 U
Fluoranthene	32.3	29.6	45.7	44.2	50.8
Pyrene	58.0	56.5	73.1	76.8	89.5
Benzo[a]anthracene	9.70	8.82	12.1	11.6	10.6
Chrysene	6.57	6.75	8.03	8.56	8.96
Benzo[b]fluoranthene	18.1	15.6	21.1	23.8	23.8
Benzo[k]fluoranthene	2.59	2.34	3.12	4.52 U	3.61 U
Benzo[a]pyrene	6.50	5.40	7.42	8.74	8.29
Indeno[123-cd]pyrene	1.52 U	1.49 U	1.81 B[c]	4.62 U	3.69 U
Dibenzo[a,h]anthracene	1.22 U	1.19 U	1.20 U	3.68 U	2.94 U
Benzo[g,h,i]perylene	1.42 B	1.25 B	1.81 B	3.23 U	2.58 U
Surrogate Recoveries (%)					
d4 1,4-Dichlorobenzene	47	47	39	54	40
d8 Naphthalene	52	52	48	60	44
d10 Acenaphthene	65	55	65	77	47
d12 Chrysene	53	56	53	59	46
d14 Dibenzo[a,h]anthracene	42	53	52	29	16 [d]

Table F.7. (contd)

	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS[e]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	15.2	10.4	20.7	20.2
Percent Dry Weight	11.7	14.9	11.9	12.2	12.7
Batch	1	2	1	1	2
1,4-Dichlorobenzene	1.99 U	2.46 U	3.85 U	1.94 U	NA [f]
Naphthalene	2.22	2.62	5.96	2.99	NA
Acenaphthylene	0.55 U	1.16 [g]	1.06 U	0.53 U	NA
Acenaphthene	1.38 U	1.72 U	2.68 U	1.34 U	NA
Fluorene	1.27 U	2.04	2.46 U	1.24 U	NA
Phenanthrene	2.66 U	3.38 U	5.14 U	2.79	NA
Anthracene	2.24 U	3.07 [g]	4.33 U	2.18 U	NA
Fluoranthene	8.44	10.5	9.18	8.31	NA
Pyrene	24.4	23.5	25.2	21.3	NA
Benzo[a]anthracene	7.50	10.0	8.03	8.40	NA
Chrysene	5.25	6.97	6.25	6.43	NA
Benzo[b]fluoranthene	14.6	15.1	16.7	16.5	NA
Benzo[k]fluoranthene	2.31	6.12	2.89 U	2.40	NA
Benzo[a]pyrene	6.32	8.53	7.51	7.35	NA
Indeno[123-cd]pyrene	1.94 B	2.33 U	2.95 U	1.75 B	NA
Dibenzo[a,h]anthracene	1.21 U	1.66 U	2.35 U	1.18 U	NA
Benzo[g,h,i]perylene	1.91 B	3.47	2.06 U	1.81 B	NA
Surrogate Recoveries (%)					
d4 1,4-Dichlorobenzene	49	48	39	42	NA
d8 Naphthalene	55	59	44	48	NA
d10 Acenaphthene	67	69	62	61	NA
d12 Chrysene	52	68	41	55	NA
d14 Dibenzo[a,h]anthracene	36	85	16 [d]	35	NA

Table F.7. (contd)

Sediment Treatment	*Macoma* Bkgd.	*Macoma* Bkgd.	*Macoma* Bkgd.
Replicate	Tissue	Tissue	Tissue
Analytical Replicate	1	2	3
Wet Weight	14.3	10.2	10.5
Percent Dry Weight	13.7	13.7	13.7
Batch	2	2	2
1,4-Dichlorobenzene	2.61 U	3.65 U	3.58 U
Naphthalene	2.64 (g)	3.65 U	3.58 U
Acenaphthylene	1.02 U	1.42 U	1.39 U
Acenaphthene	1.83 U	2.56 U	2.50 U
Fluorene	1.73 U	2.42 U	2.37 U
Phenanthrene	3.58 U	5.02 U	4.91 U
Anthracene	3.13 U	4.39 U	4.30 U
Fluoranthene	7.51 U	10.5 U	10.3 U
Pyrene	6.40 U	8.95 U	8.77 U
Benzo[a]anthracene	2.52 B	3.06 B	3.11 (g)
Chrysene	3.18 U	4.45 U	4.35 U
Benzo[b]fluoranthene	2.30 U	3.22 U	3.15 U
Benzo[k]fluoranthene	2.34 U	3.27 U	3.21 U
Benzo[a]pyrene	2.09 U	2.93 U	2.87 U
Indeno[123-cd]pyrene	2.47 U	3.45 U	3.38 U
Dibenzo[a,h]anthracene	1.76 U	2.47 U	2.42 U
Benzo[g,h,i]perylene	1.96 U	2.75 U	2.69 U
Surrogate Recoveries (%)			
d4 1,4-Dichlorobenzene	42	63	48
d8 Naphthalene	52	73	61
d10 Acenaphthene	67	80	71
d12 Chrysene	87	79	82
d14 Dibenzo[a,h]anthracene	108	96	101

(a) Target detection limits are 4.0 µg/kg for all analytes (except 1,4-Dichlorobenzene which is 0.4 µg/kg).
(b) U Undetected at or above given concentration.
(c) B Analyte detected in sample is < 5 times blank value.
(d) Outside quality control criteria (30-150%) for surrogate recovery.
(e) MDRS Mud Dump Reference Site.
(f) NA Not available; sample dropped during processing.
(g) Ion ratio out or confirmation ion not detected.

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

	Concentration (µg/kg dry wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	20.6	20.4	6.63	8.30
Percent Dry Weight	12.9	12.5	12.4	12.1	13.9
Batch	1	1	1	1	1
1,4-Dichlorobenzene	15.5 U[(a)]	15.6 U	15.8 U	50.0 U	34.6 U
Naphthalene	22.6	22.4	23.5	56.4	52.0
Acenaphthylene	4.3 U	4.3 U	4.3 U	13.8 U	9.54 U
Acenaphthene	10.8 U	10.8 U	11.0 U	34.7 U	24.0 U
Fluorene	10.0 U	10.0 U	10.1 U	32.0 U	22.1 U
Phenanthrene	37.0	29.8	51.2	66.7 U	54.8
Anthracene	17.4 U	17.5 U	21.8	56.3 U	38.9 U
Fluoranthene	251	237	367	366	364
Pyrene	451	452	588	637	642
Benzo[a]anthracene	75.5	70.6	97.3	96.2	76.0
Chrysene	51.1	54.0	64.6	71.0	64.3
Benzo[b]fluoranthene	141	125	170	197	170
Benzo[k]fluoranthene	20.2	18.7	25.1	37.5 U	25.9 U
Benzo[a]pyrene	50.6	43.2	59.7	72.5	59.5
Indeno[123-cd]pyrene	11.8 U	11.9 U	14.6 B[(b)]	38.3 U	26.5 U
Dibenzo[a,h]anthracene	9.49 U	9.53 U	9.65 U	30.5 U	21.1 U
Benzo[g,h,i]perylene	11.1 B	10.0 B	14.6 B	26.8 U	18.5 U

Table F.8. (contd)

	Concentration (µg/kg dry wt)				
Sediment Treatment	MDRS[c]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Weight	20.1	15.2	10.4	20.7	20.2
Percent Dry Weight	11.7	14.9	11.9	12.2	12.7
Batch	1	2	1	1	2
1,4-Dichlorobenzene	17.0 U	16.5 U	32.5 U	15.9 U	NA [d]
Naphthalene	18.9	17.6	50.3	24.4	NA
Acenaphthylene	4.7 U	7.79 [e]	8.95 U	4.3 U	NA
Acenaphthene	11.8 U	11.5 U	22.6 U	11.0 U	NA
Fluorene	10.8 U	13.7	20.8 U	10.1 U	NA
Phenanthrene	22.7 U	22.7 U	43.4 U	22.8	NA
Anthracene	19.1 U	20.6 [e]	36.5 U	17.8 U	NA
Fluoranthene	71.9	70.5	77.5	67.9	NA
Pyrene	208	158	213	174	NA
Benzo[a]anthracene	63.9	67.1	67.8	68.7	NA
Chrysene	44.7	46.8	52.7	52.6	NA
Benzo[b]fluoranthene	125	101	141	135	NA
Benzo[k]fluoranthene	19.7	41.1	24.4 U	19.6	NA
Benzo[a]pyrene	53.8	57.2	63.4	60.1	NA
Indeno[123-cd]pyrene	16.5 B	15.6 U	24.9 U	14.3 B	NA
Dibenzo[a,h]anthracene	10.3 U	11.1 U	19.8 U	9.65 U	NA
Benzo[g,h,i]perylene	16.3 B	23.3	17.4 U	14.8 B	NA

Table F.8. (contd)

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

(a) U Undetected at or above given concentration.
(b) B Analyte detected in sample is < 5 times blank value.
(c) MDRS Mud Dump Reference Site.
(d) NA Not available; sample dropped during processing.
(e) Ion ratio out or confirmation ion not detected.

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

			Matrix Spike Results				
			Concentration (µg/kg wet wt)				
Sediment Treatment	Blank	Blank	BX COMP[a]	BX COMP			
Replicate		NA	5	(MS)	Concentration		Percent
Analytical Replicate	1	1	1	1	Spiked	Recovered	Recovery
Wet Weight	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)

	Matrix Spike Results				
	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS[h]	MDRS (MS)			
Replicate	2		Concentration		Percent
Analytical Replicate	1	1	Spiked	Recovered	Recovery
Wet Weight	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
Surrogate Recoveries (%)					
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)

	Analytical Replicates			
	Concentration (µg/kg wet wt)			
Sediment Treatment	BX COMP[a]	BX COMP	BX COMP	
Replicate	3	3	3	RSD
Analytical Replicate	1	2	3	(%)
Wet Weight	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[f]	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
Surrogate Recoveries (%)				
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)

	Analytical Replicates			
	Concentration (µg/kg wet wt)			
Sediment Treatment	*Macoma* Bkgd.	*Macoma* Bkgd.	*Macoma* Bkgd.	
Replicate	Tissue	Tissue	Tissue	RSD
Analytical Replicate	1	2	3	(%)
Wet Weight	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
Surrogate Recoveries (%)				
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)
Macoma Bkgd. Tissue	13.73	0.80	5.83
Macoma Bkgd. Tissue	13.73	0.98	7.14
Macoma Bkgd. Tissue	13.73	0.80	5.83

Appendix G

Nereis virens Tissues Chemical Analyses and Quality Assurance/Quality Control Data for Shark 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

	Reference Method	Range of Recovery	SRM Accuracy	Relative Precision	Target Detection Limit(dry wt)
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:

Task	Date Performed
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 ±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 ±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

Reference Method	Surrogate Recovery	Spike Recovery	Relative Precision	Detection Limit (wet wt)
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:

Batch	Species	Extraction	Analysis
1	*N. virens*	9/28/95	10/19-20/95
2	*M. nasuta/N. virens*	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 ≤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.

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

Reference Method	MS Recovery	Surrogate Recovery	SRM Accuracy	Relative Precision	Detection Limit (wet wt)
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:

Batch	Species	Extraction	Analysis
1	*N. virens*	9/28/95	10/19-20/95
2	*M. nasuta/N. virens*	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 ±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), Shark River

Sediment Treatment	Replicate	Analytical Replicate	Batch	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
SR COMP	1		1	16.3	0.036 U[a]	3.17	0.0586	0.0309	1.64	0.0234	0.110	0.146	7.09
SR COMP	2		1	16.1	0.035 U	2.48	0.0616	0.0247	1.25	0.0353	0.0768	0.169	8.27
SR COMP	3		1	18.6	0.041 U	2.50	0.0438	0.0158 U	0.994	0.0054	0.0466 U	0.129	6.26
SR COMP	4		1	18.4	0.040 U	3.83	0.0659	0.0186	1.91	0.0226	0.0914	0.245	10.9
SR COMP	5	1	1	14.7	0.032 U	2.10	0.0451	0.0124 U	1.27	0.0388	0.0638	0.159	7.63
SR COMP	5	2	1	14.7	0.032 U	2.15	0.0450	0.0124 U	1.22	0.0348	0.0523	0.150	7.75
SR COMP	5	3.	1	14.7	0.032 U	2.09	0.0432	0.0209	1.17	0.0341	0.0434	0.181	7.59
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
Nereis 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
Nereis 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
Nereis 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), Shark River

Sediment Treatment	Replicate	Analytical Replicate	Batch	Percent 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	0.0810	0.0845	1.20	0.0011	0.25	0.08	1.37
SR COMP	1		1	16.3	0.22 U[a]	19.5	0.360	0.190	10.1	0.144	0.679	0.898	43.6
SR COMP	2		1	16.1	0.22 U	15.4	0.382	0.153	7.76	0.219	0.476	1.05	51.3
SR COMP	3		1	18.6	0.22 U	13.4	0.235	0.0845 U	5.33	0.0291	0.25 U	0.690	33.6
SR COMP	4		1	18.4	0.22 U	20.8	0.358	0.101	10.4	0.123	0.497	1.33	59.3
SR COMP	5	1	1	14.7	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	14.7	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	14.7	0.22 U	14.2	0.294	0.142	7.96	0.232	0.295	1.23	51.6
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
Nereis 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
Nereis 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
Nereis 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	Replicate	Analytical Replicate	Batch	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
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												
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]
Standard Reference Material												
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	±.0067	±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
Analytical Replicates												
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	Replicate	Analytical Replicate	Batch	Concentration (mg/kg dry wt) Blank Corrected: 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[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
Nereis Bkgd. Tissue	1	1	1	0.22 U	20.6	0.462	0.122	9.05	0.137	0.637	0.873	55.1
Nereis Bkgd. Tissue	1	2	1	0.22 U	16.1	0.437	0.135	8.08	0.225	0.492	1.01	54.7
Nereis 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 (≤20%).
(f) Outside quality control criteria (≤20%) for replicate analysis.

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

	Concentration (µg/kg wet wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Wt.	20.4	20.3	13.2	20.3	20.0
Percent Dry Wt.	16.3	16.1	18.6	18.4	14.7
Batch	1	1	1	1	1
2,4'-DDD[a]	0.25 U[b]	0.25 U	0.39 U	0.25 U	0.25 U
2,4'-DDE	0.26 U	0.26 U	0.40 U	0.26 U	0.26 U
2,4'-DDT	0.18 U	0.18 U	0.27 U	0.18 U	0.18 U
4,4'-DDD	0.72	1.06	1.05	0.76	0.89
4,4'-DDE	0.31	0.28	0.35	0.23	0.52
4,4'-DDT	0.85	1.00	0.89	0.71	1.00
α-Chlordane	0.21	0.20	0.23	0.23	0.32
Aldrin	0.63	0.70	0.89	0.57	0.73
Dieldrin	0.51 U	0.51 U	0.78 U	0.51 U	0.52 U
Endosulfan I	0.18 U	0.18 U	0.27 U	0.18 U	0.18 U
Endosulfan II	0.18 U	0.18 U	0.27 U	0.18 U	0.18 U
Endosulfan Sulfate	0.25 U	0.25 U	0.38 U	0.25 U	0.25 U
Heptachlor	0.18 U	0.18 U	0.28 U	0.41	0.19 U
Heptachlor Epoxide	0.13 U	0.13 U	0.20 U	0.13 U	0.13 U
Trans Nonachlor	0.52	0.37	0.51	0.69	0.74
PCB 8	0.34 U	0.34 U	0.53 U	0.34 U	0.35 U
PCB 18	0.10 U	0.10 U	0.16 U	0.10 U	0.50
PCB 28	0.11 U	0.11 U	0.17 U	0.11 U	0.11 U
PCB 44	0.07 U	2.51	0.11 U	0.07 U	0.07 U
PCB 49	0.44	0.18 U	0.35	0.28	0.86
PCB 52	0.83	1.02	0.91	0.72	1.50
PCB 66	0.15 U	0.15 U	0.23 U	0.15 U	0.15 U
PCB 87	0.25 U	0.25 U	0.38 U	0.25 U	0.25 U
PCB 101	1.04	1.41	0.86	1.05	1.69
PCB 105	0.16 U	0.67	0.25 U	0.16 U	0.73
PCB 118	0.19 U	0.92	0.56	0.59	1.14
PCB 128	0.20	0.26	0.20	0.26	0.23
PCB 138	1.26	1.82	1.36	1.56	2.29
PCB 153	1.81	2.51	2.01	2.18	2.93
PCB 170	0.31	0.17 U	0.33	0.34	0.42
PCB 180	0.53	0.66	0.66	0.70	0.84
PCB 183	0.18 U	0.21	0.28 U	0.19	0.18 U
PCB 184	0.18 U	0.18 U	0.28 U	0.18 U	0.18 U
PCB 187	0.38	0.92	0.31 U	0.47	0.77
PCB 195	0.12 U	0.12 U	0.19 U	0.12 U	0.13 U
PCB 206	0.21 U	0.21 U	0.33 U	0.21 U	0.21 U
PCB 209	0.19 U	0.19 U	0.30 U	0.19 U	0.20 U
Surrogate Recoveries (%)					
PCB 103 (SIS)	113	49	104	104	113
PCB 198 (SIS)	95	39	93	91	96

Table G.4. (contd)

	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS[c]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate				1	2
Wet Wt.	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
Surrogate Recoveries (%)					
PCB 103 (SIS)	105	59	123	107	109
PCB 198 (SIS)	91	47	103	95	96

Table G.4. (contd)

	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS	MDRS	*Nereis* Bkgd.	*Nereis* Bkgd.	*Nereis* Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3		1	2	3
Wet Wt.	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 µg/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), Shark River

	Concentration (µg/kg dry wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate					
Wet Wt.	20.4	20.3	13.2	20.3	20.0
Percent Dry Wt.	16.3	16.1	18.6	18.4	14.7
Batch	1	1	1	1	1
2,4'-DDD	1.5 U[a]	1.5 U	2.1 U	1.4 U	1.7 U
2,4'-DDE	1.6 U	1.6 U	2.2 U	1.4 U	1.8 U
2,4'-DDT	1.1 U	1.1 U	1.5 U	1.0 U	1.2 U
4,4'-DDD	4.4	6.57	5.65	4.1	6.1
4,4'-DDE	1.9	1.7	1.9	1.3	3.5
4,4'-DDT	5.2	6.20	4.8	3.9	6.80
α-Chlordane	1.3	1.2	1.2	1.3	2.2
Aldrin	3.9	4.3	4.8	3.1	5.0
Dieldrin	3.1 U	3.2 U	4.2 U	2.8 U	3.5 U
Endosulfan I	1.1 U	1.1 U	1.5 U	1.0 U	1.2 U
Endosulfan II	1.1 U	1.1 U	1.5 U	1.0 U	1.2 U
Endosulfan Sulfate	1.5 U	1.5 U	2.0 U	1.4 U	1.7 U
Heptachlor	1.1 U	1.1 U	1.5 U	2.2	1.3 U
Heptachlor Epoxide	0.80 U	0.81 U	1.1 U	0.71 U	0.88 U
Trans Nonachlor	3.2	2.3	2.7	3.8	5.0
PCB 8	2.1 U	2.1 U	2.8 U	1.8 U	2.4 U
PCB 18	0.61 U	0.62 U	0.86 U	0.54 U	3.4
PCB 28	0.68 U	0.68 U	0.91 U	0.60 U	0.75 U
PCB 44	0.4 U	15.6	0.59 U	0.4 U	0.5 U
PCB 49	2.7	1.1 U	1.9	1.5	5.9
PCB 52	5.1	6.32	4.9	3.9	10.2
PCB 66	0.92 U	0.93 U	1.2 U	0.82 U	1.0 U
PCB 87	1.5 U	1.5 U	2.0 U	1.4 U	1.7 U
PCB 101	6.39	8.74	4.6	5.71	11.5
PCB 105	1.0 U	4.2	1.3 U	0.87 U	5.0
PCB 118	1.2 U	5.7	3.0	3.2	7.76
PCB 128	1.2	1.6	1.1	1.4	1.6
PCB 138	7.74	11.3	7.31	8.48	15.6
PCB 153	11.1	15.6	10.8	11.8	19.9
PCB 170	1.9	1.1 U	1.8	1.8	2.9
PCB 180	3.3	4.1	3.5	3.8	5.7
PCB 183	1.1 U	1.3	1.5 U	1.0	1.2 U
PCB 184	1.1 U	1.1 U	1.5 U	1.0 U	1.2 U
PCB 187	2.3	5.7	1.7 U	2.6	5.2
PCB 195	0.74 U	0.74 U	1.0 U	0.65 U	0.88 U
PCB 206	1.3 U	1.3 U	1.8 U	1.1 U	1.4 U
PCB 209	1.2 U	1.2 U	1.6 U	1.0 U	1.4 U

Table G.5. (contd)

	Concentration (µg/kg dry wt)				
Sediment Treatment	MDRS[b]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate				1	2
Wet Wt.	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)

	Concentration (µg/kg dry wt)				
Sediment Treatment	MDRS	MDRS	*Nereis* Bkgd.	*Nereis* Bkgd.	*Nereis* Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3	1	1	2	3
Wet Wt.	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	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
Surrogate Recoveries (%)							
PCB 103 (SIS)	90	82	104	104	NA	NA	NA
PCB 198 (SIS)	82	81	93	105	NA	NA	NA

Table G.6. (contd)

	Matrix Spike Results				
	Concentration (µg/kg wet weight)				
Sediment Treatment	SH COMP[a]	SH COMP			
Replicate	1	(MS)	Concentration		Percent
Analytical Replicate	1	1	Spiked	Recovered	Recovery
Wet Weight	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
Surrogate Recoveries (%)					
PCB 103 (SIS)	114	94	NA	NA	NA
PCB 198 (SIS)	94	87	NA	NA	NA

Table G.6. (contd)

	Analytical Replicates			
	Concentration (µg/kg wet weight)			
Sediment Treatment	MDRS[1]	MDRS	MDRS	
Replicate	4	4	4	RSD
Analytical Replicate	1	2	3	(%)
Wet Weight	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
Surrogate Recoveries (%)				
PCB 103 (SIS)	107	109	109	NA
PCB 198 (SIS)	95	96	91	NA

Table G.6. (contd)

	Analytical Replicates			
	Concentration (µg/kg wet weight)			
Sediment Treatment	*Nereis* Bkgd.	*Nereis* Bkgd.	*Nereis* Bkgd.	
Replicate	Tissue	Tissue	Tissue	RSD
Analytical Replicate	1	2	3	(%)
Wet Weight	20.4	20.0	20.5	
Batch	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
Surrogate Recoveries (%)				
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), Shark River

	Concentration (µg/kg wet wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate	1	1	1	1	1
Wet Weight	20.4	20.3	13.2	20.3	20.0
Percent Dry Weight	16.3	16.1	18.6	18.4	14.7
Batch	1	1	1	1	1
1,4-Dichlorobenzene[a]	1.96 U[b]	1.97 U	3.03 U	1.98 U	2.00 U
Naphthalene	3.00 B[c]	5.22 B	4.51 B	2.83 B	3.03 B
Acenaphthylene	0.54 U	0.54 U	0.83 U	0.54 U	0.55 U
Acenaphthene	1.36 U	1.37 U	2.10 U	1.37 U	1.44
Fluorene	1.25 U	1.26 U	1.94 U	1.26 U	1.28 U
Phenanthrene	2.62 U	2.63 U	4.04 U	2.64 U	2.67 U
Anthracene	2.20 U	2.22 U	3.40 U	2.22 U	2.25 U
Fluoranthene	12.4	11.2	17.0	8.22	13.8
Pyrene	19.7	17.6	25.6	12.5	18.6
Benzo[a]anthracene	1.23	1.08	1.70	0.89 U	1.04
Chrysene	4.94	4.72	4.27	2.67	5.37
Benzo[b]fluoranthene	1.13	1.12 U	1.72 U	1.13 U	1.32
Benzo[k]fluoranthene	1.47 U	1.48 U	2.27 U	1.48 U	1.50 U
Benzo[a]pyrene	1.25 U	1.26 U	1.94 U	1.26 U	1.28 U
Indeno[123-cd]pyrene	1.50 U	1.51 U	2.31 U	1.51 U	1.53 U
Dibenzo[a,h]anthracene	1.19 U	1.20 U	1.85 U	1.20 U	1.22 U
Benzo[g,h,i]perylene	1.05 U	1.05 U	1.62 U	1.06 U	1.07 U
Surrogate Recoveries (%)					
d4 1,4-Dichlorobenzene	84	32	64	72	64
d8 Naphthalene	80	31	72	80	73
d10 Acenaphthene	91	35	90	94	91
d12 Chrysene	73	35	84	81	88
d14 Dibenzo[a,h]anthracene	121	44	118	113	116

Table G.7. (contd)

	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS[d]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate	1	1	1	1	2
Wet Weight	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
Surrogate Recoveries (%)					
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)

	Concentration (µg/kg wet wt)				
Sediment Treatment	MDRS	MDRS	*Nereis* Bkgd.	*Nereis* Bkgd.	*Nereis* Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3	1	1	2	3
Wet Weight	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
Surrogate Recoveries (%)					
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 µg/kg for all analytes (except 1,4-Dichlorobenzene which is 0.4 µg/kg).
(b) U Undetected at or above given concentration.
(c) B Analyte detected in sample is < 5x blank value.
(d) MDRS Mud dump reference site.

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

	Concentration (µg/kg dry wt)				
Sediment Treatment	SR COMP	SR COMP	SR COMP	SR COMP	SR COMP
Replicate	1	2	3	4	5
Analytical Replicate	1	1	1	1	1
Wet Weight	20.4	20.3	13.2	20.3	20.0
Percent Dry Weight	16.3	16.1	18.6	18.4	14.7
Batch	1	1	1	1	1
1,4-Dichlorobenzene	12.0 U[a]	12.2 U	16.3 U	10.8 U	13.6 U
Naphthalene	18.4 B[b]	32.4 B	24.2 B	15.4 B	20.6 B
Acenaphthylene	3.3 U	3.3 U	4.5 U	2.9 U	3.7 U
Acenaphthene	8.36 U	8.49 U	11.3 U	7.45 U	9.80
Fluorene	7.68 U	7.81 U	10.4 U	6.85 U	8.71 U
Phenanthrene	16.1 U	16.3 U	21.7 U	14.3 U	18.2 U
Anthracene	13.5 U	13.8 U	18.3 U	12.1 U	15.3 U
Fluoranthene	76.2	69.2	91.3	44.7	93.9
Pyrene	121	109	137	68.2	127
Benzo[a]anthracene	7.56	6.70	9.14	4.8 U	7.07
Chrysene	30.4	29.3	23.0	14.5	36.5
Benzo[b]fluoranthene	6.95	6.94 U	9.25 U	6.14 U	8.98
Benzo[k]fluoranthene	9.04 U	9.18 U	12.2 U	8.04 U	10.2 U
Benzo[a]pyrene	7.68 U	7.81 U	10.4 U	6.85 U	8.71 U
Indeno[123-cd]pyrene	9.22 U	9.36 U	12.4 U	8.21 U	10.4 U
Dibenzo[a,h]anthracene	7.31 U	7.44 U	9.95 U	6.52 U	8.30 U
Benzo[g,h,i]perylene	6.45 U	6.51 U	8.71 U	5.76 U	7.28 U

Table G.8. (contd)

	Concentration (µg/kg dry wt)				
Sediment Treatment	MDRS[c]	MDRS	MDRS	MDRS	MDRS
Replicate	1	2	3	4	4
Analytical Replicate	1	1	1	1	2
Wet Weight	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)

	Concentration (µg/kg dry wt)				
Sediment Treatment	MDRS	MDRS	*Nereis* Bkgd.	*Nereis* Bkgd.	*Nereis* Bkgd.
Replicate	4	5	Tissue	Tissue	Tissue
Analytical Replicate	3	1	1	2	3
Wet Weight	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) MDRS Mud dump reference site.

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

			Matrix Spike Results				
			Concentration (µg/kg wet wt)				
Sediment Treatment	Blank	Blank	SR COMP[a]	SR COMP			
Replicate			3	(MS)	Concentration		Percent
Analytical Replicate	1	1	1	1	Spiked	Recovered	Recover
Wet Weight	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
Surrogate Recoveries (%)							
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)

	Matrix Spike Results				
	Concentration (µg/kg wet wt)				
Sediment Treatment	SH COMP[a]	SH COMP (MS)			
Replicate	1		Concentration		Percent
Analytical Replicate	1	1	Spiked	Recovered	Recovery
Wet Weight	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
Surrogate Recoveries (%)					
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)

	Analytical Replicates			
	Concentration (µg/kg wet wt)			
Sediment Treatment	MDRS[h]	MDRS	MDRS	
Replicate	4	4	4	RSD
Analytical Replicate	1	2	3	(%)
Wet Weight	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
Surrogate Recoveries (%)				
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)

	Analytical Replicates			
	Concentration (µg/kg wet wt)			
Sediment Treatment	*Nereis* Bkgd.	*Nereis* Bkgd.	*Nereis* Bkgd.	
Replicate	Tissue	Tissue	Tissue	RSD
Analytical Replicate	1	2	3	(%)
Wet Weight	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
Surrogate Recoveries (%)				
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)
Nereis Bkgd. Tissue	14.37	1.20	8.35
Nereis Bkgd. Tissue	14.37	0.99	6.89
Nereis Bkgd. Tissue	14.37	1.19	8.28