The Remedial Investigation of Marine Sediment at the United Heckathorn Superfund Site

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Sequim, Washington

February 1994

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SUMMARY

The former United Heckathorn site in Richmond, California, was used to process and package chlorinated pesticides from the 1940s to the mid-1960s. These activities resulted in the contamination of upland soils and marine sediment in the adjacent waterways. The site was placed on the National Priorities List by the U.S. Environmental Protection Agency (USEPA) in 1990. Battelle/Marine Sciences Laboratory (MSL) was requested by USEPA to conduct a remedial investigation and feasibility study (RI/FS) of the marine portion of the site. The purpose of this report is to present the results of the RI.

The objectives of this RI are as follows: 1) determine the extent of pesticide contamination in inner Richmond Harbor; 2) estimate the total volume of contaminated sediment; 3) characterize the subsurface geology; 4) characterize the biological effects of contaminated sediment; and 5) characterize the quality of effluent derived from dewatered sediment through treatability testing. Sediment cores were collected from 53 stations in the Lauritzen Canal, Santa Fe Channel, Inner Harbor Channel, and Parr Canal. Vertical subsamples from each sediment core were analyzed for chlorinated pesticides. Sediment from selected cores was also analyzed for other contaminants. Sediment thickness and chemistry data were used to estimate volumes of sediment above various levels of contamination. Younger Bay Mud (YBM) sediment from multiple stations was mixed to form composite samples representing various segments of the study area. These composites were used for solid-phase toxicity and bioaccumulation tests, and the preparation of liquid-phase samples for treatability testing. The probable quality of effluent produced by dewatering sediment was evaluated by chemical and toxicological testing of suspended-particulate-phase (SPP) and elutriate samples.

The pesticides 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and dieldrin were found at higher concentrations and over a larger area relative to background levels for San Francisco Bay than other contaminants. Total DDT (sum of 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE) concentrations were highest in sediment from the Lauritzen Canal (up to approximately 600,000 micrograms per kilogram [$\mu\text{g}/\text{kg}$] dry weight) and decreased to background levels for San Francisco Bay (less than 20 $\mu\text{g}/\text{kg}$ dry weight) near Point Potrero. Contamination was concentrated in the YBM; in general, only traces of contamination were detected in the underlying Older Bay Mud (OBM).

Sediment cleanup criteria have not yet been established for the United Heckathorn site. The volume of YBM sediment exceeding both 1000 $\mu\text{g}/\text{kg}$ and 500 $\mu\text{g}/\text{kg}$ total DDT includes all sediment in the Lauritzen and Parr Canals and is estimated to be approximately 65,000 cu yd. Sediment exceeding 100 $\mu\text{g}/\text{kg}$ total DDT extends to the northern end of the Inner Harbor Channel, and has a volume of approximately 350,000 cu yd. Sediment exceeding 50 $\mu\text{g}/\text{kg}$ total

DDT extends to the center of the Inner Harbor Channel and has a volume of approximately 600,000 cu yd.

Results of solid-phase toxicity and bioaccumulation tests indicate that the greatest biological impacts are associated with sediment from the Lauritzen Canal. Toxicity to the amphipod, *Rhepoxynius abronius*, and tissue residues in the clam, *Macoma nasuta*, decreased with increasing distance from the Lauritzen Canal. These results are consistent with data collected during USEPA's ecological risk assessment for the United Heckathorn site.

Concentrations of DDT and dieldrin in SPP and elutriate samples prepared from Lauritzen Canal sediment exceeded state and federal water quality criteria by two to five orders of magnitude. Pesticide concentrations in SPP and elutriate samples prepared from composites outside the Lauritzen Canal were one to four orders of magnitude lower. The SPP and elutriate samples prepared from Lauritzen Canal sediment composites caused acute toxicity to the mysid, *Holmesimysis costata*, and chronic effects in mussel larvae, *Mytilus galloprovincialis*.

A strong gradient in pesticide concentrations indicates that the Lauritzen Canal is the source of contaminated sediment found in inner Richmond Harbor. A sharp drop in contaminant concentrations from the Lauritzen Canal to the Santa Fe Channel suggests that the rate of contaminant transport out of the Lauritzen Canal is relatively slow. If the highly contaminated sediments were removed from or confined to the Lauritzen Canal, contaminant concentrations in the Santa Fe and Inner Harbor Channels would probably slowly decrease over time.

The fine-grained nature and high water content of the YBM will be an important consideration in the evaluation of remedial alternatives because many remedial technologies are not effective at removing contaminants that are strongly bound to fine-grained particles (USEPA 1993). If YBM sediments are moved, a dredging technique that minimizes sediment resuspension should be selected. The OBM appears to be an excellent barrier to the downward migration of contaminants from recent sediment. Its firm to hard consistency prevents mixing with overlying sediment, and its low water content and relatively low permeability minimize the migration of contaminants by porewater diffusion.

Treatability testing results suggest that controlling for fine-grained particles would not be sufficient to reduce pesticide concentrations in effluent from a confined disposal facility to levels below state water quality objectives. Effluent from Lauritzen Canal sediment would be likely to require treatment with a filtration and carbon-adsorption system capable of removing high concentrations of pesticides. Toxicity must be removed from an effluent prior to discharge to meet the state water quality objectives. A further evaluation might be required to identify reasonable steps necessary to reduce toxicity.

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CONTENTS

SUMMARY	iii
ACKNOWLEDGMENTS	v
1.0 INTRODUCTION	1.1
1.1 SITE BACKGROUND	1.1
1.1.1 Site Description	1.1
1.1.2 Site History	1.2
1.1.3 Previous Investigations	1.3
1.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS	1.4
1.3 REMEDIAL INVESTIGATION OBJECTIVES	1.5
1.4 REPORT ORGANIZATION	1.5
2.0 DESIGN AND APPROACH	2.1
2.1 SITE CHARACTERIZATION	2.1
2.1.1 Field Investigation	2.1
2.1.2 Sample Analysis	2.2
2.1.3 Sediment Volume Calculations	2.3
2.1.4 Biological Testing	2.3
2.2 TREATABILITY TESTING	2.4
2.2.1 Chemical Analysis of SPP and Elutriate Samples	2.5
2.2.2 Biological Testing of SPP and Elutriate Samples	2.5
3.0 RESULTS	3.1
3.1 FIELD INVESTIGATION	3.1
3.1.1 Sediment Core Sampling	3.1
3.1.2 Geology of Marine Sediment	3.2
3.1.3 Shoreline Survey and Sediment Grab Sampling	3.3
3.1.4 Control Sediment and Seawater Sampling	3.3
3.1.5 Sample Preparation	3.4

3.2	SEDIMENT CHEMISTRY	3.5
3.2.1	Conventional Parameters	3.5
3.2.2	Chlorinated Pesticides	3.5
3.2.2.1	Areal Distribution of Pesticides in Sediment	3.6
3.2.2.2	Vertical Distribution of DDT in Sediment	3.7
3.2.2.3	Distribution of Analogues in Total DDT	3.10
3.2.3	Other Contaminants	3.10
3.2.3.1	Oil and Grease and Total Petroleum Hydrocarbons	3.10
3.2.3.2	Polynuclear Aromatic Hydrocarbons	3.11
3.2.3.3	PCBs	3.11
3.2.3.4	Metals	3.11
3.2.3.5	Butyltins	3.12
3.3	SEDIMENT VOLUMES	3.12
3.4	SOLID-PHASE BIOLOGICAL TESTING	3.13
3.4.1	Composite Sediment Chemistry	3.14
3.4.1.1	Conventional Parameters	3.14
3.4.1.2	Chlorinated Pesticides	3.14
3.4.1.3	Other Contaminants	3.15
3.4.2	10-Day Static Test With <i>Rhepoxynius abronius</i>	3.16
3.4.3	28-Day Flow- Through Test With <i>Macoma nasuta</i>	3.17
3.4.3.1	Chlorinated Pesticides and Lipid Content	3.17
3.4.3.2	Other Contaminants	3.18
3.4.3.3	Accumulation Factors	3.19
3.5	TREATABILITY TESTING	3.20
3.5.1	Suspended Particulate Phase and Elutriate Phase Chemistry	3.20
3.5.1.1	Chlorinated Pesticides	3.20
3.5.1.2	Other Contaminants	3.22

	3.5.2	96-Hour Static Test with <i>Holmesimysis costata</i>	3.23
	3.5.3	48-Hour Static Test with Larval <i>Mytilus galloprovincialis</i>	3.24
	3.6	FISH TISSUE CHEMISTRY	3.25
4.0		DISCUSSION	4.1
4.1		FIELD INVESTIGATION	4.1
4.2		SEDIMENT CHEMISTRY	4.2
	4.2.1	Nature and Extent of Chlorinated Pesticide Contamination	4.2
	4.2.1.1	Areal and Vertical Distribution of Pesticides in Sediment	4.3
	4.2.1.2	Contaminant Fate and Transport	4.4
	4.2.2	Other Contaminants	4.6
4.3		SEDIMENT VOLUMES	4.7
4.4		BIOLOGICAL EFFECTS OF CONTAMINATED SEDIMENT	4.7
	4.4.1	Solid-Phase Acute Toxicity	4.7
	4.4.2	Sediment Bioaccumulation	4.8
4.5		TREATABILITY TESTING	4.9
	4.5.1	Contaminant Concentrations	4.10
	4.5.2	Toxicity of Effluent	4.11
5.0		SUMMARY AND CONCLUSIONS	5.1
5.1		SUMMARY	5.1
	5.1.1	Subsurface Geology of Inner Richmond Harbor	5.1
	5.1.2	Areal and Vertical Extent of Marine Contamination	5.1
	5.1.3	Volume of Contaminated Sediment	5.2
	5.1.4	Biological Effects of Contaminated Sediment	5.2
	5.1.5	Probable Quality of Effluent From Dewatered Sediment	5.3
5.2		CONCLUSIONS	5.3
	5.2.1	Subsurface Geology of Inner Richmond Harbor	5.3
	5.2.2	Areal and Vertical Extent of Marine Contamination	5.4
	5.2.3	Volume of Contaminated Sediment	5.4

5.2.4	Biological Effects of Contaminated Sediment	5.4
5.2.5	Probable Quality of Effluent from Dewatered Sediment	5.5
6.0	REFERENCES	6.1
APPENDIX A:	METHODS	A.I
APPENDIX B:	GEOLOGIC CORE DATA LOGS	B.1
APPENDIX C:	SEDIMENT CHEMISTRY AND QUALITY ASSURANCE DATA	C.I
APPENDIX D:	BIOASSAY RESULTS FOR 10-DAY SOLID-PHASE TEST WITH <i>Rhepoxynius abronius</i>	D.1
APPENDIX E:	BIOASSAY RESULTS FOR 28-DAY SOLID-PHASE TEST WITH <i>Macomanasuta</i>	E.I
APPENDIX F:	TISSUE CHEMISTRY AND QUALITY ASSURANCE DATA FOR <i>Macomanasuta</i>	F.I
APPENDIX G:	LIQUID-PHASE CHEMISTRY AND QUALITY ASSURANCE DATA.	G.I
APPENDIX H:	BIOASSAY RESULTS FOR 96-HOUR SUSPENDED-PARTICULATE- PHASE TEST AND 96-HOUR REFERENCE TOXICANT TEST FOR <i>Holmesimysis costata</i>	H.1
APPENDIX I:	BIOASSAY RESULTS FOR 48-HOUR SUSPENDED-PARTICULATE- PHASE TEST AND 48-HOUR REFERENCE TOXICANT TEST FOR <i>Mytilus galloprovincialis</i>	1.1
APPENDIX J:	FISH TISSUE CHEMISTRY AND QUALITY ASSURANCE DATA	J.I

FIGURES

1.1	Site Location Map	1.7
1.2	Map of Richmond Harbor	1.8
1.3	Map of Lauritzen Canal	1.9
2.1	Core Sampling Stations	2.7
2.2	Sediment Sampling and Processing Procedure	2.8
2.3	Example of Vertical Core Segments. Station LZ-1	2.9
2.4	Sediment Compositing Strategy	2.10
2.5	Suspended-Particulate Phase and Elutriate Preparation Procedure	2.11
3.1	Core Sampling Station Designations	3.27
3.2	Elevation of the Mudline and YBM/OBM Contact in the Lauritzen Canal	3.28
3.3	Mudline Elevation in Santa Fe and Inner Harbor Channels	3.29
3.4	Elevation of YBM/OBM Contact in Santa Fe and Inner Harbor Channels	3.30
3.5	Map of YBM Thickness	3.31
3.6	Shoreline Features	3.32
3.7	Approximate Locations of Channel Edge and Graving Dock Grab Sampling Sites ...	3.33
3.8	Distribution of DDT and Dieldrin in YBM, Log Scale	3.35
3.9	Distribution of DDT and Dieldrin in YBM, Linear Scale	3.37
3.10	Distribution of Total DDT in YBM With Increasing Depth	3.39
3.11	Distribution of Total DDT Above and Below the YBM/OBM Contact	3.41
3.12	Cross-Sections of the Lauritzen Canal Showing Total DDT Concentrations	3.43
3.13	Cross-Sections of the Santa Fe channel Showing Total DDT Concentrations	3.45
3.14	Cross-Sections of Inner Harbor Channel Showing Total DDT Concentrations	3.47
3.15	Cross-Section Locations	3.49
3.16	Boundaries of Sediment Volume Categories	3.50

3.23	Metals and Butyltins in Tissues of <i>Macoma nasuta</i>	3.80
3.24	Accumulation Factors for DDT Compounds, Dieldrin, Aroclor 1254, and PAHs in <i>Macoma nasuta</i> Tissue	3.81
3.25	Dieldrin and DDT Compounds in Liquid-Phase Samples	3.82
3.26	Chlorinated Pesticides Other Than Dieldrin and DDT Compounds in Liquid-Phase Samples	3.83
3.27	PAH, PCB, and Tributyltin in Liquid-Phase Samples	3.84
3.28	Metals in Liquid-Phase Samples	3.85
3.29	Results of the 96-Hour SPP Test with <i>Holmesimysis costata</i>	3.86
3.30	Results of the 96-Hour Elutriate Test with <i>Holmesimysis costata</i>	3.87
3.31	Results of the 48-Hour SPP Test with Larval <i>Mytilus galloprovincialis</i>	3.88
3.32	Results of the 48-Hour Elutriate Test with Larval <i>Mytilus galloprovincialis</i>	3.89
4.1	Comparison of Total DDT in Marine Sediment With Previous Studies	4.13
4.2	Relative Contribution of DDT Analogues to Total DDT in Upland and Marine Sediment Samples	4.14
4.3	Concentrations of Contaminants in Sediments from San Francisco Bay and Apparent Effects Thresholds	4.15
4.4	Comparison of Action Levels With Contaminant Levels in <i>M. nasuta</i> Exposed to Sediment Composites	4.16
4.5	Comparison of Accumulation Factors for DDT and Dieldrin in <i>M. nasuta</i> Tissue	4.17
4.6	State and Federal Water Quality Objectives	4.18

1.0 INTRODUCTION

The former United Heckathorn site is located in Richmond Harbor on the eastern side of San Francisco Bay, California (Figure 1.1). The site was used by several operators to process and package chlorinated pesticides from the 1940s to the 1960s. These activities resulted in the contamination of upland and embankment soils and marine sediment in the adjacent waterways. The site was placed on the National Priorities List (NPL) by the U.S. Environmental Protection Agency (USEPA) in 1990, and became subject to the requirements of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), also known as Superfund. Battelle/Marine Sciences Laboratory (MSL) was requested by USEPA to conduct a remedial investigation and feasibility study (RI/FS) of the marine portion of the site. The purpose of this report is to present the results of the RI of contaminated marine sediment in inner Richmond Harbor.

1.1 SITE BACKGROUND

The former United Heckathorn facility is located on the eastern shore of the Lauritzen Canal in Richmond, California (Figure 1.2). The site is currently an active marine shipping terminal owned by Levin Enterprises, Incorporated (formerly the Levin Metals Corporation) and operated by the Levin Richmond Terminal Corporation. The marine portion of the Superfund site includes all areas in Richmond Harbor that USEPA determines are adversely affected by contaminants from the former United Heckathorn site.

1.1.1 Site Description

The study area for the marine portion of the site includes the Lauritzen Canal, Santa Fe Channel, Richmond Inner Harbor Channel to Point Potrero, and Parr Canal (Figure 1.2). Historical maps indicate that the Richmond Harbor area was originally intertidal marshlands. Dredge and fill activities began prior to 1917 (CH2M Hill 1988). The upland area is 7 ft to 11 ft above mean lower low water (MLLW) and is generally level. The channel shorelines are generally armored with rip rap, sandy gravel fill, or pile-supported docks within a tidal zone that ranges between about -2 ft and +7 ft MLLW.

The Lauritzen Canal is approximately 1800 ft long and varies in width from about 120 ft at its north end to about 350 ft at its south end. The depth of the canal ranges from approximately -10 ft to -40 ft MLLW. Portions of the canal have been periodically dredged; the most recent maintenance dredging occurred in December 1984 and January 1985, and included an area about 120 ft in width on the eastern side of the channel from the Santa Fe Channel northward about 850 ft (Figure 1.3). The canal was dredged to a depth of approximately -41 ft MLLW. It is not known when the northern and western portions of the canal were last dredged. Submerged

debris in the northern part of the canal include a sunken barge and one tank 5 ft in diameter and 5 ft high. A 5-ft-diameter, reinforced concrete culvert enters the north end of the canal and provides storm drainage for the area north of the Lauritzen Canal.

The south end of the Lauritzen Canal enters the Santa Fe Channel. The Santa Fe Channel is approximately 4000 ft long and 300 ft wide. Approximately half of its length is maintained at a depth of -35 ft MLLW by the U.S. Army Corps of Engineers (USACE). The head of the channel and berth areas are maintained by the Port of Richmond or private owners; bathymetric maps provided by USACE indicate a depth of about -32 ft MLLW. The Santa Fe Channel connects at its east end with the Inner Harbor Channel, which flows into San Francisco Bay. The Inner Harbor Channel is maintained by USACE to a depth of -35 ft MLLW; a proposed deepening project will increase the depth of the channel to -38 ft MLLW. The Inner Harbor Channel terminates at Point Potrero. Five former drydocks, known as the graving docks, are located at Point Potrero and are included in the study area for this RI.

The study area also includes the Parr Canal, which extends north from the north end of the Inner Harbor Channel. The Parr Canal is approximately 750 ft long and 100 ft wide. It is less than 10 ft deep. It is armored on both shores with rip-rap. Little is known about its history. Aerial photographs indicate that it was wider during the 1940s and was gradually filled to its present width.

Marine sediment throughout inner Richmond Harbor consists of two geologic units: the Younger Bay Mud (YBM) and the underlying Older Bay Mud (OBM) (USACE 1979). The YBM is typically composed of black or dark gray, very soft to soft clay, silt, and fine-grained sand with a high water content. The YBM was deposited in estuarine and shallow marine environments as sea level rose following the last retreat of glacial ice, about 15,000 to 18,000 years ago (Prest 1969). The YBM is up to 70 ft thick (USACE 1979) and is generally less than 10 ft thick in inner Richmond Harbor. The underlying OBM consists of relatively dry, firm to hard silts and clays with variable amounts of sand. The marine portions of the OBM are finer-grained and generally olive or gray in color. It is believed that the OBM was deposited in shallow marine and terrestrial environments during the interglacial epoch immediately preceding the formation of the Wisconsin ice sheet, and was exposed and subjected to erosion during the first Wisconsinian glacial advance (USACE 1979). While exposed, the OBM sediments desiccated and consolidated. The OBM is up to 200 ft thick. The OBM may be largely unaffected by anthropogenic contamination because of its pre-industrial age, low water content, and consolidated character.

1.1.2 Site History

An operational history of the United Heckathorn site is provided in a technical memorandum prepared for the California Department of Health Services (CDHS) (CH2M Hill 1988). Other reports provide additional information about site history and operations,

hazardous materials used on the site, and spills and unauthorized releases (Harding Lawson Associates [HLA] 1984, 1986a, 1986b; CH2M Hill 1987). The most significant aspects of the site history are summarized below.

In the early 1940s, World War II shipbuilding operations were conducted in the area east of the Lauritzen Canal and north of Santa Fe Channel. The site was used from approximately 1945 to 1966 by several operators, including the Parr Richmond Terminal Company, the Universal Pigment and Chemical Company, R.J. Prentiss and Company, Heckathorn and Company, United Chemetrics, and Chemwest (collectively referred to as "United Heckathorn"). Operations on the site prior to 1958 are not well documented. In 1958, Montrose Chemical Corporation began shipping the pesticide dichlorodiphenyltrichloroethane (DDT) to United Heckathorn for processing and packaging. Formulation, processing, and packaging of DDT, dieldrin, and other pesticides continued on the site until 1965 or 1966. The United Heckathorn buildings were demolished by 1970, and the site was apparently unused during the 1970s. In 1981, the site was purchased by the Levin Metals Corporation.

Little information about the types or quantities of materials used on the site or waste disposal methods is available. An inspection by the California Regional Water Pollution Control Board and California Department of Fish and Game (CDFG) in 1960 indicated that waste water was released directly from the United Heckathorn site into the Lauritzen Canal. These discharges included sewage and laboratory waste, industrial waste from the main plant and outside areas, and wastewater from the vats used to settle solids from DDT air mill wash waters. The discharges entered the canal via pipes on the wharf.

United Heckathorn was cited in 1960 for a release of DDT-laden waste water into the Lauritzen Canal (CH2M Hill 1988). In 1965, CDFG wardens identified a discharge of waste water which had overflowed from or bypassed the DDT settling vats. In addition, surface runoff carrying DDT residue from discarded bags into the canal was noted.

In 1980, the United Heckathorn site was inspected and sampled by the CDHS as part of the Abandoned Site Project. Chlorinated pesticides and metals were detected in soil samples, and the area was designated a state Superfund site in March 1982. In March 1990, USEPA listed the United Heckathorn site on the NPL of federal Superfund sites, and took over as lead agency in August 1990. Contaminated soils were removed from the upland area from 1990 through 1993 (Levine-Fricke 1991b, 1993)

1.1.3 Previous Investigations

From 1983 through 1990, investigations were performed at the United Heckathorn site to characterize the nature and extent of contamination of upland soils, canal embankment sediment, marine sediment, and ground water (HLA 1986a; Levine-Fricke 1990, 1991a, 1991b, 1993). Contamination of the upland area was well characterized as a result of these investigations, and

soil from all known areas of highest contamination has been removed from the site. However, the nature and extent of marine contamination was not delineated. The results of previous investigations are discussed and evaluated in the work plan for this investigation (MSL 1992) and are summarized below.

HLA collected sediment samples from 19 locations in the Lauritzen Canal, most of them from less than 6 ft below mudline. DDT concentrations of up to 765 parts per million (ppm) wet weight were detected. DDT concentrations were much higher in the soft, recent sediment than in the stiffer, underlying clay (presumed to be OBM). Levine-Fricke collected sediment core samples in the Lauritzen Canal and Santa Fe Channel, and found that DDT concentrations decreased from the tens of ppm at the head of the Lauritzen Canal to generally less than 1 ppm at its mouth (Levine-Fricke 1990). In addition, DDT concentrations increased with depth in the sediment. DDT concentrations were generally less than 500 parts per billion (ppb) wet weight in the Santa Fe Channel sediment. Levine-Fricke also detected almost pure, crystalline DDT in embankment sediment immediately west of the site of the former United Heckathorn buildings. Other chlorinated pesticides were detected in sediment from the Lauritzen Canal (e.g., aldrin and endrin); however, DDT, DDT analogues dichlorodiphenyldichloroethane (4,4'-DDD) and dichlorodiphenyldichloroethylene (4,4'-DDE), and dieldrin showed much higher concentrations and a wider distribution. Semivolatile and volatile organic compounds, organophosphorus pesticides, and metals were either not detected or detected at lower concentrations and over a more limited area than the chlorinated pesticides.

Five grab samples collected from the Parr Canal in 1985 showed DDT concentrations up to 9 ppm wet weight (HLA 1985). Dredged material disposal studies for inner Richmond Harbor showed DDT concentrations ranging from about 600 ppb dry weight in Santa Fe Channel to less than 5 ppb dry weight west of Point Potrero (Brown et al. 1990, Pinza et al. 1992). For comparison, a range of background values for total DDT in San Francisco Bay sediments is about 3 ppb to 20 ppb dry weight (Long et al. 1988). This range is based upon median values from a compilation of data from 13 studies conducted between 1971 and 1987, excluding areas of known contamination such as Richmond Harbor. Based on data from previous investigations, it appeared that pesticides from the former United Heckathorn site had affected marine sediment as far south as the Inner Harbor Channel north of Point Potrero.

1.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The remedial action objective for the marine portion of the United Heckathorn site is to attain a cleanup level that will allow full beneficial uses of site water, including fish and shellfish harvesting and protection of aquatic life. During the RI/FS process, remediation goals are established in part through the consideration of applicable or relevant and appropriate

requirements (ARARs) that specify acceptable exposure levels for various constituents. After remediation is complete, concentrations of contaminants must not exceed federal and state environmental regulations, criteria, and standards that are determined to be legally applicable or relevant and appropriate to the site, unless waived by USEPA.

To date, no sediment cleanup criteria for pesticides in marine sediment at the United Heckathorn site have been established. The human health and ecological risk assessments for the site are currently in preparation by USEPA. A discussion of standards, criteria, and other information regarding toxicity used to assess ecological threats at the site is included in the *Ecological Risk Assessment of the Marine Sediments at the United Heckathorn Superfund Site* (draft)^(a). These standards provide the basis for establishing cleanup levels at the site.

1.3 REMEDIAL INVESTIGATION OBJECTIVES

Previous investigations established the approximate areal extent of pesticide contamination in inner Richmond Harbor, but did not adequately delineate its vertical extent. As a result, alternatives for the remediation of contaminated marine sediment could not be analyzed in detail because the volume of contaminated sediment was not known. The objectives of the RI/FS of the marine portion of the Heckathorn site are the following:

- Determine the areal extent and depth of contamination in the Lauritzen Canal, Santa Fe Channel, Inner Harbor Channel, and Parr Canal.
- Determine the total volume of contaminated sediment at contamination ranges down to about 2 ppb dry weight.
- Characterize the subsurface geology (ie., depth to Older Bay Mud) throughout inner Richmond Harbor.
- Characterize the biological effects of contaminated sediment and quality of effluent derived from dewatered sediment.
- Analyze alternatives for removing, containing, and/or treating sediments to a cleanup level that will allow full beneficial uses of site waters, including fish and shellfish harvesting and protection of aquatic life and wildlife.

The first four objectives are addressed in this report. The analysis of remedial alternatives will be presented in a FS report.

1.4 REPORT ORGANIZATION

This RI report is organized in six sections and ten appendixes. Section 1 is the introduction and provides background information for the RI. Section 2 describes the design and

(a) Lee, Henry et al. 1993. *Ecological Risk Assessment of the Marine Sediments at the United Heckathorn Superfund Site* (Draft). ERL-N: N269. Prepared by the U.S. Environmental Protection Agency, Newport, Oregon.

approach used to accomplish the objectives of the RI. Section 3 presents the results of the investigation, including field observations, chemical and biological testing of sediment samples, and treatability testing of effluent from dewatered sediment. Section 4 discusses the nature and extent of marine contamination at the site, biological effects of contaminated sediment, and potential impacts of dredging and dewatering sediment during cleanup. Section 5 summarizes the results of the RI and conclusions of the study. References are provided in Section 6. Figures and tables appear at the end of each section for the reader's convenience. Supporting data for the RI are included in the appendixes as follows:

Appendix A:	Methods used in the RI, including the field investigation, sample preparation, chemical and biological testing, data analysis, and quality assurance
Appendix B:	Geologic core data logs
Appendix C:	Sediment chemistry and quality assurance data
Appendix D-E:	Solid-phase toxicity test data
Appendix F:	<i>Macoma</i> tissue chemistry and quality assurance data
Appendix G:	Liquid-phase chemistry and quality assurance data
Appendix H-I:	Liquid-phase toxicity test data
Appendix J:	Fish tissue chemistry and quality assurance data

FIGURE 1.1. Site Location Map

FIGURE 1.2. Map of Richmond Harbor

2.0 DESIGN AND APPROACH

Tasks were developed to accomplish the RI objectives, after reviewing existing information and identifying data needed to characterize marine contamination at the United Heckathorn site. These tasks and the approach used to conduct the RI are described below. Detailed descriptions of the methods used in the field and laboratory are provided in Appendix A.

2.1 SITE CHARACTERIZATION

The primary objective of the site characterization was to determine the areal and vertical extent of pesticide contamination of marine sediment with sufficient resolution to determine the volume of sediment over a specified cleanup level. The site characterization included a field investigation, chemical and biological analysis of sediment samples, and analysis of field and laboratory data. Each of these elements is described below.

2.1.1 Field Investigation

The field sampling design was based upon the assumption that anthropogenic contamination is confined to the recent sediment of the YBM. The underlying OBM is highly consolidated and appears to act as a barrier to the downward migration of contaminants from the YBM. Sediment cores were collected to a depth of at least 2 ft below the YBM/OBM contact at 53 stations in the Lauritzen Canal, Santa Fe Channel, Inner Harbor Channel, and Parr Canal (Figure 2.1). Sampling locations were spaced most closely in the Lauritzen Canal, where contaminant concentrations were the highest and the greatest variation was expected. Sampling stations were spaced progressively farther apart in the Santa Fe and Inner Harbor Channels, where sediment pesticide concentrations were lower and more uniform.

The sediment sampling and analysis procedure is illustrated in Figure 2.2 and described below. The 12-in. core barrel was used at each station to examine sediment lithology, identify the YBM/OBM contact, and collect sediment for biological testing. The 4-in. core barrel was used to collect cores for sediment chemistry. The vertical core sampling strategy was designed to define pesticide distribution with depth and to establish whether the OBM acts as a barrier to contaminant transport. Pesticides were analyzed in samples of the uppermost 1 ft of the YBM, the 1 ft of YBM immediately above the YBM/OBM contact, and the 1 ft of OBM immediately below the contact (Figure 2.3). Samples were also collected in intervals of no greater than 2 ft between the uppermost 1 ft and the 1 ft interval above the contact. The OBM from the 1 ft to 2 ft interval below the YBM/OBM contact was archived for future analysis, if necessary. Grain size distribution and total organic carbon (TOC) were also measured in each of the vertical samples to provide information about the availability of contaminants to marine organisms.

Samples representing the entire thickness of the YBM at selected stations were analyzed for contaminants other than pesticides. All cores from the upper Santa Fe Channel and Parr Canal were analyzed because of the lack of existing data for these areas. Composite samples of YBM were collected from approximately half of the stations in the Lauritzen Canal and federal Santa Fe Channel. Composite samples of YBM were collected from three stations in the Inner Harbor Channel; existing data for the remainder of the channel are considered adequate. Two composite samples of the OBM (fine-grained and coarse-grained) were also analyzed for other contaminants.

Sediment samples representing different segments of the study area were collected for biological testing (Section 2.1.4). Composites of subsamples collected from the uppermost 1 ft of YBM were prepared to represent the Lauritzen Canal, upper Santa Fe Channel, federal Santa Fe Channel, Inner Harbor Channel, and the graving docks at Point Potrero. Composite samples of YBM representing the 1-ft- to 4-ft- and 4-ft- to 7-ft-below-mudline intervals in the Lauritzen Canal were also prepared. Samples of fine-grained and coarse-grained sediment from San Francisco Bay were collected for use as grain-size controls in biological testing.

In addition to core sampling, a shoreline survey was conducted throughout the study area to document the nature of the channel banks and identify locations where grab samples of soft sediment could be collected. Sediment along the channel edges could not be sampled with the core barrel because the banks are generally armored with rip-rap or sheetpile. Grab samples (1 gal to 2 gal of sediment each) were collected at 16 stations and combined to form seven composite samples. These samples were analyzed for pesticides to assess whether the channel edges might act as a continuing source of contaminated sediment after dredging of the channels was complete. Seawater from Richmond Harbor was also collected during the field investigation for use in the treatability study (Section 2.2).

2.1.2 Sample Analysis

Sediment samples collected during the field investigation were prepared for chemical and biological testing, or archived for possible future analysis. In addition, tissue samples generated during bioaccumulation studies were chemically analyzed. Data quality objectives (DQOs) for sample analysis were specified in the Quality Assurance Project Plan (QAPP) for the RI (MSL 1992). Analytical data underwent quality control (QC) review by the Task Leader and the Quality Engineer prior to data evaluation to ensure that DQOs were met.

Analytical requirements for the sediment core samples are outlined in Figure 2.2. Vertical core samples and grab samples were analyzed for chlorinated pesticides, grain size, and total organic carbon (TOC). Composite samples of the YBM and OBM were analyzed for oil and grease, total petroleum hydrocarbons (TPH), polynuclear aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), metals, and butyltins. Composite sediment samples for

biological testing and grain-size control sediment from San Francisco Bay were analyzed for all of the above-referenced parameters.

A number of sediment samples were archived to minimize the need for additional field sampling. The following sediment samples were frozen and archived for possible future analysis:

- a duplicate of every sample
- OBM material from the 1 ft to 2 ft interval below the YBM/OBM contact to be analyzed if contamination was detected in the uppermost 1 ft of the OBM
- native control sediments collected for biological testing (excluding the San Francisco Bay controls).

Tissue samples of organisms exposed to sediment composites in a laboratory bioaccumulation test were analyzed for chlorinated pesticides, PAHs, PCBs, metals, and butyltins (Section 2.1.4). The lipid content of the tissues was also measured to provide information about contaminant uptake. Tissue samples from organisms exposed to control sediment were archived. Ten whole fish tissue samples (*Cymatogaster aggregata*) that were collected by USEPA during the ecological risk assessment were analyzed for chlorinated pesticides, PCBs, PAHs, and phthalate esters.

2.1.3 Sediment Volume Calculations

The thickness of the YBM at each coring station was measured in both the 12-in. and 4-in. cores. These data were used to calculate approximate volumes of recent sediment (YBM) present in various segments of the study area and volumes of sediment above specified contaminant concentration levels. In addition, weighted average contaminant concentrations were determined for given volumes of sediment.

2.1.4 Biological Testing

Solid-phase toxicity and bioaccumulation tests were conducted using composite sediment samples collected from segments throughout the study area to characterize the effects of contaminated sediment on marine organisms. Figure 2.4 shows the compositing strategy for toxicity testing. Solid-phase toxicity tests were conducted on sediment composites (treatments) of the uppermost 1 ft of sediment from the following areas: the Lauritzen Canal (four treatments), upper Santa Fe Channel, federal Santa Fe Channel, Inner Harbor Channel (three treatments), and the graving docks. Two grain-size control treatments (fine-grained and coarse-grained) from San Francisco Bay were also tested. The amphipod, *Rhepoxynius abronius*, was exposed in each of five replicates for each sediment treatment under static conditions for 10 days. Native control sediment from West Beach, Washington, was used to validate test results, and cadmium chloride reference toxicant tests were performed to evaluate the relative sensitivity of the test stock of *R. abronius* used during the solid-phase toxicity testing. Data from solid-phase toxicity tests were analyzed using analysis of variance (ANOVA) to assess statistical differences in test

organism survival between sediment treatments. Test results were compared to acute toxicity data collected during the ecological risk assessment of marine sediments at the United Heckathom site.

A 28-day bioaccumulation test was conducted using the bentnose clam, *Macoma nasuta*. YBM composites of the uppermost 1 ft of sediment from the following areas were tested: the Lauritzen Canal, upper Santa Fe Channel, federal Santa Fe Channel, upper Inner Harbor Channel, and graving docks (Figure 2.4). Twenty-five *M. nasuta* were exposed in each of five replicates of each sediment treatment, plus two control treatments (*M. nasuta* native sediment from Sequim Bay, Washington, and a fine-grained control sediment from San Francisco Bay). Following 28 days of sediment exposure, the surviving *M. nasuta* were placed in clean-flowing seawater for two days to depurate (purge all sediment from the gut). The tissues from the test sediment treatments were sent to a laboratory for chemical analysis. Tissues from control organisms were frozen and archived for potential future analysis. A tissue sample from each replicate was analyzed for pesticides and lipid content. Tissues from the five replicates for each treatment were combined to form a composite sample that was analyzed for PAHs, PCBs, metals, and butyltins. Results were evaluated to determine the bioaccumulation of DDT and DDT analogues into the tissues of *M. nasuta*. Data were compared to tissue residues measured by USEPA in the ecological risk assessment for the site.

2.2 TREATABILITY TESTING

Treatability testing was conducted to assist in the evaluation of remedial alternatives. Preliminary remedial alternatives identified for analysis in this study include the no-action alternative, dredging of sediments followed by containment in a confined disposal facility or permitted upland disposal site, and filling of all or a portion of the Lauritzen Canal as an alternative confined disposal facility.

The probable quality of effluent produced by dewatering sediment during confined disposal operations was evaluated by chemical and toxicological testing of suspended-particulate phase (SPP) and elutriate samples derived from sediment composites throughout the study area. The USACE modified elutriate test (Palermo 1986; Palermo and Thackston 1988) was used to predict the dissolved and particulate-associated contaminant concentrations in effluent by simulating confined disposal conditions. In addition, the effect of activated carbon treatment on contaminant concentrations in effluent was evaluated. These results were also used to evaluate potential water quality impacts during dredging. Composite sediment samples of the YBM in the following areas were tested: Lauritzen Canal (four treatments), upper Santa Fe Channel, federal Santa Fe Channel, and Inner Harbor Channel (three treatments)(Figure 2.4). The Lauritzen Canal composites were composed of YBM sediment from the following intervals below the mudline: 0 ft to 1 ft, 1 ft to 4 ft, and 4 ft to 7 ft. The sediment treatments in Santa Fe

Channel and Inner Harbor Channel were composed of the uppermost 1 ft of sediment, which were also tested for solid-phase toxicity.

Procedures used to prepare SPP and **elutriate** samples are described in detail in Appendix A and summarized in Figure 2.5. A slurry was prepared to simulate the influent concentration of sediment entering a confined disposal facility. The slurry was centrifuged at low speed for approximately 15 min to simulate a 24-h settling period. The supernatant after the low-speed centrifugation represents the SPP. A portion of the SPP was centrifuged at high speed for 30 min to prepare the **elutriate** phase samples. The supernatant after the high-speed centrifugation represents the dissolved phase.

2.2.1 Chemical Analysis of SPP and Elutriate Samples

The SPP and **elutriate** of the effluent from each composite were analyzed for pesticides, PAHs, PCBs, metals, and butyltins. Carbon-treated **elutriate** was analyzed for pesticides and TPH. SPP and **elutriate** chemical data were compared to applicable marine water quality criteria and used to predict whether treatment of effluent would be required during disposal operations.

2.2.2 Biological Testina of SPP and Elutriate Samples

SPP and **elutriate** toxicity tests were conducted using mysids (*Holmesimysis costata*) and bivalve larvae (*Mytilus galloprovincialis*) to evaluate the potential impacts of effluent on marine organisms. In each test, organisms were exposed under static conditions to SPP and **elutriate** concentrations of 100%, 50%, 10%, and 0% (control), with three replicates per concentration. In the 4-day mysid test, 10 organisms per replicate were exposed, and in the 2- to 3-day larval test, approximately 8,000 larvae per replicate were exposed. SPP and **elutriate** toxicity test results were analyzed by attempting to construct mean dose-response curves for each treatment. If survival in the control or diluted-water treatments was greater than survival in the 100% SPP or **elutriate** treatment, the data were evaluated statistically to determine whether the 100% treatment was significantly more toxic than the other treatments. If greater than 50% mortality occurred in any of the treatments, the median lethal concentration (LC_{50}) was calculated. If less than 50% mortality occurred in all treatments, the LC_{50} was assumed to be 100%. For one composite with greater than 50% mortality in all treatments, mysids were exposed to additional SPP and **elutriate** dilutions of 0.01%, 0.1%, and 1%. The **elutriate** from this composite was also filtered through granular-activated carbon (GAC); mysids were exposed to filtered and unfiltered **elutriate**. The toxicity data will be used to identify remedial actions that will prevent negative impacts to marine organisms.

FIGURE 2.1. Core Sampling Stations

FIGURE 2.2. Sediment Sampling and Processing Procedure

FIGURE 2.3. Example of Vertical Core Segments, Station LZ-1

FIGURE 2.4. Sediment Corpositing Strategy

FIGURE 2.5. Suspended-Particulate Phase and Elutriate Preparation Procedure

3.0 RESULTS

The characterization of the marine portion of the United Heckathorn site was accomplished through a field investigation and chemical and biological analyses of sediment samples. In addition, treatability testing was conducted to support the evaluation of remedial alternatives. The results of the site characterization and treatability testing are presented in this section and discussed in Section 4.

3.1 FIELD INVESTIGATION

The field investigation for the United Heckathorn RI was conducted in Richmond Harbor from January 5 to 9, 1993. Samples were prepared for analysis the following week at the MSL in Sequim, Washington. The following sections present the results of the field investigation.

3.1.1 Sediment Core Sampling

Core samples were collected from 15 stations in Lauritzen Canal, 18 stations in Santa Fe Channel, 17 stations in the Inner Harbor Channel, and 3 stations in the Parr Canal (Figure 3.1). Station LZ-4 in the Lauritzen Canal was abandoned because debris in the canal prevented the penetration of the core barrel. A 12-in. core and a 4-in. core were collected at each station, with the exception of four Inner Harbor Channel stations and the Parr Canal stations, where only 4-in. cores were collected (Table 3.1). Three cores were collected from the Parr Canal by pushing a 4-in.-diameter Lexan core liner into the sediment by hand from a small vessel.

Table 3.1 lists the coordinates, mudline elevation, YBM thickness, and elevation of the YBMIOBM contact measured at each station in the 12-in. and 4-in. cores. Differences in the thickness of YBM collected in the 12-in. and 4-in. core at each station are probably due to slightly different sampling locations (i.e., the 4-in. core barrel did not penetrate the sediment in the same place as the 12-in. core barrel). With the exception of Station LZ-4, the YBMIOBM contact was well defined in the 12-in. cores and the YBM was measured and collected for composite samples as planned. A minimum of 0.5 ft of OBM was collected from all 4-in. cores except those collected at Station SF-24 and the Parr Canal stations.

The elevation of the mudline and the YBMIOBM contact in the Lauritzen Canal is shown in Figure 3.2. The mudline is approximately -10 ft MLLW in the northern and western portions of the canal, which have not been dredged for a number of years. The channel depth increases to -40 ft MLLW adjacent to the Levin terminal on the southeastern shore of the canal. The surface of the OBM lies beneath approximately 5 ft of YBM and roughly follows the configuration of the mudline. The contact is shallowest in the undredged portions of the Lauritzen Canal (-15 ft to

-20 ft MLLW), and deepest adjacent to the Levin terminal (-45 ft MLLW). The nature of the contact indicates that the OBM was exposed during the initial dredging of the canal, and the YBM sediment has accumulated since that time.

The elevations of the mudline and YBM/OBM contact in the Santa Fe and Inner Harbor Channels are shown in Figures 3.3 and 3.4. The mudline elevation is -29 ft to -34 ft MLLW in upper Santa Fe Channel, -27 ft to -38 ft MLLW in federal Santa Fe Channel, and -34 ft to -38 ft MLLW in Inner Harbor Channel. The YBM/OBM contact is -33 ft to -37 ft MLLW in upper Santa Fe Channel, and -33 ft to -41 ft MLLW in the federally maintained portion of the channel. The contact is -37 ft to -43 ft MLLW in Inner Harbor Channel. As in the Lauritzen Canal, the surface of the OBM generally lies 4 ft to 6 ft beneath the mudline. The elevation of the YBM/OBM contact in the Parr Canal was not determined; however, probes taken along the length of the canal encountered a hard barrier at approximately 6 ft below the mudline.

An isopach map of the YBM throughout the study area is provided in Figure 3.5. The thickness of the YBM is generally 4 ft to 6 ft. The thickness of the YBM in the Lauritzen Canal ranges from approximately 8 ft in the northern portion of the canal to less than 2 ft in the center of the canal. The thickness of YBM in Santa Fe Channel varies from about 2 ft to 8 ft, and is thicker in the upper channel and on the southern side of the channel across from the Lauritzen Canal. The YBM in the Inner Harbor Channel is generally 4 ft to 6 ft thick and is thicker on the east side of the channel.

3.1.2 Geology of Marine Sediment

The sediment cores were described by a geologist as specified in Appendix A. Core logs are provided in Appendix B. The YBM in the study area consisted of recent deposits of very soft black or very dark gray clay with lesser amounts of silt and minor sand and gravel. The sediment contained few roots and shell fragments, and locally had gas holes and a faint odor of sulfur. Sediments from the Lauritzen Canal, Parr Canal, and Stations SF-17 and SF-25 in Santa Fe Channel smelled of petroleum and had an oily appearance. A layer of light gray, granular material was encountered from approximately 1 ft to 3 ft below the mudline at Station LZ-1 and 1 ft to 7 ft below the mudline at Station LZ-8. The material reacted with hydrochloric acid, and analysis by X-ray fluorescence indicated that it contains 16% calcium by weight. This material may have been used in the preparation of pesticide formulations or discharged as a waste from a former concrete batch plant on the western shore of Lauritzen Canal. Samples from approximately 2 ft below the mudline at Stations LZ-13 and LZ-16 contained chunks of bauxite ore. These stations were located adjacent to the Levin terminal. Sediment from Parr Canal was black and contained abundant organic material.

The contact between the YBM and the OBM was generally sharp, with the very soft clay of the YBM overlying stiff to hard OBM. The contact was disrupted at some locations in the

Lauritzen Canal, with a mixture of YBM and OBM sediment over an interval of up to several feet. Up to 4 in. of the OBM below the contact was discolored in some cores, indicating limited local alteration of the OBM by the overlying sediment. The OBM in the study area was composed primarily of silt, silty sand, and clay with minor gravel in shades of gray, brown, and olive. The lithology of the OBM was most variable in Lauritzen Canal; layering defined by changes in grain size was commonly observed. The OBM in the Santa Fe Channel and Inner Harbor Channel was composed of firm to hard, homogeneous silt and clay. The silt and clay in these areas was dark gray or olive brown and locally contains roots and gypsum nodules up to 6 in. in diameter.

3.1.3 Shoreline Survey and Sediment Grab Sampling

Shoreline properties and types of shoreline are shown in Figure 3.6. The construction of the banks of the Lauritzen Canal, Santa Fe Channel, and Inner Harbor Channel varies with the use of the shore property. Distinct changes in the appearance of the bank were commonly observed at property boundaries. Commercial properties with regular ship traffic generally maintain piers or docks extending into the water, and channel banks are generally modified with rip rap, sheet pile, or other concrete structures. These properties include the oil storage facilities of ARCO, GATX, Unocal, Castrol, Texaco, Time Oil, and California Oil. The shorelines adjacent to the Gold Bond and Castrol facilities are not armored or modified to the same degree as the other facilities in the area, and consist primarily of variable sizes of rock or cement debris. Richmond Harbor Terminals 2 and 3 and Point Potrero Marine Terminals 6 and 7 consist of concrete-faced bulkheads built over the natural shoreline. The Levin terminal on the east bank of the Lauritzen Canal consists of a pier supported by dense pilings; the natural shoreline is not visible. The upper end of the Santa Fe Channel is occupied by a marina with rows of covered slips, floating docks, and open moorage for small boats. The shoreline is generally armored or concealed by buildings.

Grab samples of soft surface sediment were collected from a small boat in areas where sampling could not be accomplished by coring (i.e., under piers and in very shallow water). Grab sampling locations are shown in Figure 3.7. Grab samples were combined to form seven composite samples representing the following areas: outer Richmond Harbor, east edge of the Inner Harbor Channel, west edge of the Inner Harbor Channel, west edge of the federal Santa Fe Channel, Santa Fe Channel marina, Parr Canal edge, and the graving docks. Grab sampling information is summarized in Table 3.2.

3.1.4 Control Sediment and Seawater Sampling

Pipe-dredge samples representing relatively uncontaminated fine- and coarse-grained (sandy) sediment were collected from two locations in San Francisco Bay on January 6, 1993. The fine-grained control was collected approximately 0.5 mi east of Brooks Island, and the coarse-grained control was collected approximately 3 mi west of Point Potrero. Both samples were used

were used as grain-size control sediments in the 10-day acute bioassay, and the fine-grained San Francisco Bay Control was used in the 28-day bioaccumulation test. Native control sediment for *M. nasuta* was collected from the deepest part of Sequim Bay, Washington, on January 14, 1993. Native control sediment for *R. abronius* was collected at the time of amphipod collection (January 15, 1993) near West Beach, Whidbey Island, Washington. Control sample information is provided in Table 3.3.

Approximately 400 L of seawater were collected from the center of the Inner Harbor Channel on January 9, 1993. The site water was used to prepare and dilute SPP and elutriate samples. Collection of live clams (*Macoma* spp.) for chemical analysis from the area north of Brooks Island (Figure 1.2) was planned to measure ambient concentrations of pesticides in tissue; however, digging and raking in this area yielded few individuals and no significant population of clams.

3.1.5 Sample Preparation

Within 10 days of field sampling, 341 sediment samples were prepared for physical and chemical analysis and shipped to the appropriate analytical laboratories or archived at MSL. All samples were prepared, shipped, and analyzed within the required holding times, with exceptions noted in the quality control summaries provided in Appendix C. Table 3.4 summarizes sediment preparation and subsequent physical and chemical analyses. Complete sediment sample preparation information including preparation date, sample identification, length of core segment, depth interval, and analytical parameters is provided in Table C.1, Appendix C.

Thirteen composite and four control sediment composites were prepared for chemical and biological testing and preparation of liquid-phase samples. The sediment composites and associated testing program are listed in Table 3.5. SPP and elutriate samples were prepared from Comps LC, LC-5, LC-6, USFC, FSFC, IHC-1, IHC-2, and IHC-3 within 10 days of sediment collection. The liquid-phase samples were used for biological testing and shipped for chemical analysis within 24 h of preparation.

M. nasuta tissue samples were collected following the 28-day bioaccumulation test with Comps LC, USFC, FSFC, IHC-1, and GD. Tissue samples from each of the five exposure replicates were submitted for pesticide analysis; subsamples from each replicate were combined into one composite tissue sample per treatment for PAH, PCB, metals, and butyltin analyses. Tissue lipid content was measured in both the individual replicate samples and in the composite samples for each treatment. Tissues of *M. nasuta* exposed to control sediments were collected and archived in the event that future analysis was required.

3.2 SEDIMENT CHEMISTRY

Vertical core segments and channel edge grab samples were analyzed for chlorinated pesticides, grain size, and TOC. Composite YBM and OBM samples were analyzed for other contaminants (oil and grease, TPH, PAHs, PCBs, metals, and butyltins). Results of these analyses are presented below. Analytical results for composite samples used in biological testing are presented in Section 3.4.1. All sediment chemistry data are presented in dry weight concentrations. Complete analytical results, including QC data, are tabulated in Appendix C. QC summaries for each type of analysis follow the data tables in Appendix C. In general, QC criteria for all analyses were met with the exception of the precision criteria for analytical and compositing duplicates. Analytical duplicates are two aliquots of one sample, and are intended to evaluate analytical precision. Compositing duplicates are the same sample submitted to the laboratory in two separate jars, and are intended to evaluate the effectiveness of sample compositing. The frequent differences in analytical and compositing duplicate measurements are likely to be due to the heterogeneous nature of the sediment samples because the precision between matrix spike and matrix spike duplicate measurements was generally within QC limits.

3.2.1 Conventional Parameters

Results for TOC, grain size, and percent moisture analyses of vertical core segments and channel edge grab samples, including quality control data, are provided in Tables C.2 through C.5, Appendix C. Table 3.6 summarizes the mean TOC content in samples of YBM and OBM from various segments of the study area. Samples of YBM from the Lauritzen Canal averaged about 2% TOC. The average TOC content in samples of YBM from Santa Fe and Inner Harbor Channels was approximately 1%, and samples from the Parr Canal averaged about 5%. TOC content was more variable in sediment from the Lauritzen and Parr Canals than in sediment from the Santa Fe and Inner Harbor Channels. The OBM from all segments of the study area averaged about 0.2% TOC. Typical values for TOC in YBM from San Francisco Bay are less than 1% (Long and Morgan 1990).

Grain size distribution in the YBM and OBM is summarized in Table 3.6. Analyses show that both the YBM and OBM are predominately fine grained. The YBM throughout the study area was composed primarily of silty clay. The OBM was composed primarily of silt, with some silty sand, clay, and gravel. Samples of YBM ranged from 18% to 81% solids, with most samples containing 40% to 50% solids. The percent solids in OBM samples ranged from 71% to 87%, with an average of 77%.

3.2.2 Chlorinated Pesticides

Two hundred thirty-nine vertical core segments and channel edge grab samples were analyzed for chlorinated pesticides to delineate the areal and vertical extent of marine

contamination. Complete results for these analyses, including QC data, are provided in Tables C.6 through C.10 and Table C.25, Appendix C. The QC summary on page C.110 summarizes the results of the pesticide data review. The pesticides 4,4'-DDT and 4,4'-DDD were detected at low levels in the method blanks for six batches of samples; sample results less than five times the concentration in the associated blank were flagged as not detected in accordance with *Laboratory Data Validation Functional Guidelines for Evaluating Organic Analyses* (USEPA 1988). Otherwise, the pesticide data were of excellent quality.

The pesticides 4,4'-DDT and 4,4'-DDD showed the highest concentrations and widest distribution throughout the study area (Table 3.7). The pesticides 4,4'-DDE and dieldrin were also widely distributed but were detected at lower concentrations. Eight other pesticides were detected locally at lower concentrations. Analytical results for DDT, DDT analogues, and dieldrin are presented in Table 3.7 and discussed in the following sections. Samples designated A through X represent the YBM core sections, and samples designated Y or Z represent the OBM sections.

3.2.2.1 Areal Distribution of Pesticides in Sediment

Figures 3.8 and 3.9 present the average total DDT (sum of 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE) concentration in the YBM at each coring station. Total DDT concentrations are depicted on a log scale in Figure 3.8 and a linear scale in Figure 3.9. The maximum and median total DDT and maximum dieldrin concentrations throughout the study area are also shown. Pesticide concentrations were highest in the Lauritzen Canal, and decreased with increasing distance from the former United Heckathorn site. The highest total DDT concentration of 633,358 $\mu\text{g/kg}$ was measured in a sample from 1 ft to 3 ft below the mudline at Station LZ-7. Pesticide concentrations of greater than 100,000 $\mu\text{g/kg}$ were detected in sediment from eight stations in the northern and western portions of the canal. The most highly contaminated samples were collected from Stations LZ-1, LZ-2, LZ-6, and LZ-7. The median total DDT concentration was approximately 47,000 $\mu\text{g/kg}$ at the head of the Lauritzen Canal, which has not been dredged in a number of years. The median concentration of total DDT decreased to about 14,000 $\mu\text{g/kg}$ in the western, undredged portion of the canal, and to 1500 $\mu\text{g/kg}$ in the dredged portion of the canal near the Levin terminal. Dieldrin concentrations were lower (maximum concentration of 16,000 $\mu\text{g/kg}$), but exhibited the same geographic trend in relative concentration.

Total DDT concentrations in sediment decreased by at least two orders of magnitude from the Lauritzen Canal to the Santa Fe Channel. The median concentration of total DDT was 110 $\mu\text{g/kg}$ in the upper Santa Fe Channel and 210 $\mu\text{g/kg}$ in the federally maintained portion of the channel. DDT and dieldrin concentrations were higher in the federally maintained portion of the Santa Fe Channel, which includes the area downstream of the Lauritzen Canal. Total DDT and dieldrin concentrations decreased by another order of magnitude from the Santa Fe Channel to the

Inner Harbor Channel. The median total DDT concentration was 60 $\mu\text{g/kg}$ in the upper Inner Harbor Channel, and 10 $\mu\text{g/kg}$ in the lower Inner Harbor Channel. The maximum total DDT concentration near Point Potrero was 19 $\mu\text{g/kg}$, which is approximately equal to the median DDT concentration for the periphery of San Francisco Bay, excluding the Lauritzen Canal (Long et al. 1988).

Pesticide concentrations in Parr Canal sediment were lower than those measured in the Lauritzen Canal but greater than those measured in Santa Fe or Inner Harbor Channels. The maximum and median total DDT concentrations measured in Parr Canal sediment were 4080 $\mu\text{g/kg}$ and 840 $\mu\text{g/kg}$, respectively. The maximum dieldrin concentration was 170 pg/kg .

Grab samples collected from channel edges throughout the study area showed the same geographic trend in pesticide concentrations as the core samples (Table 3.7). The highest total DDT concentration was measured in the Parr Canal edge sample (1143 $\mu\text{g/kg}$), followed by the west side of the Santa Fe Channel, Santa Fe Channel marina, east shore of the Inner Harbor Channel, west shore of the Inner Harbor Channel, and Outer Harbor Edge. The total DDT concentrations in channel edge samples were consistent with the median concentration measured in core samples from that area.

Table 3.8 summarizes pesticides other than DDT, DDT analogues, and dieldrin detected in core and grab samples from the study area. The following pesticides were detected at one or more stations: alpha-BHC, aldrin, trans-chlordane, endosulfan I, cis-chlordane, endrin, endosulfan II, and endrin aldehyde. These compounds were generally detected at concentrations of less than 3 $\mu\text{g/kg}$ in samples from the Lauritzen Canal, Santa Fe Channel, and Inner Harbor Channel. Concentrations in samples from the Parr Canal ranged up to 68 $\mu\text{g/kg}$. Other pesticides could be present in sediment from the Lauritzen Canal, but were not detected because they were either diluted below the detection limit during analyses of DDT and DDT analogues, or obscured by the signals from DDT and DDT analogues.

3.2.2.2 Vertical Distribution of DDT in Sediment

The vertical distribution of total DDT in sediment is illustrated in contaminant distribution maps representing increasing depth intervals throughout the study area. Figure 3.10 shows the concentration of total DDT in sediment with increasing depth below the mudline. Samples with total DDT concentrations of greater than 500 $\mu\text{g/kg}$ were grouped into one category because of the large magnitude and range of values in these samples. The highest total DDT concentrations in the 0-ft- to 1-ft-below-mudline interval occurred in sediment from the Lauritzen Canal, with concentrations ranging from 471 $\mu\text{g/kg}$ at Station LZ-14 to 111,625 $\mu\text{g/kg}$ at Station LZ-6 (Table 3.7). Station LZ-6 was the only station with surface sediment exceeding 100,000 $\mu\text{g/kg}$ total DDT. The other Lauritzen Canal stations (excluding LZ-14 and LZ-16) had total DDT concentrations in the thousands and tens of thousands of $\mu\text{g/kg}$. Total DDT concentrations

decreased to less than 400 $\mu\text{g/kg}$ in surface sediment from the Santa Fe Channel, except at Stations SF-25 and SF-34, where total DDT was 749 $\mu\text{g/kg}$ and 535 $\mu\text{g/kg}$, respectively. Station SF-25 was adjacent to the Castrol Pier, and Station SF-34 was downstream of the Lauritzen Canal. Total DDT concentrations were higher in the portion of the Santa Fe Channel downstream of the Lauritzen Canal. Total DDT concentrations decreased to less than 50 $\mu\text{g/kg}$ in the lower two-thirds of the Inner Harbor Channel surface sediment (except Station IH-42).

In general, total DDT concentrations were higher in sediment from the 1-ft- to 3-ft-below-mudline interval than in the surface sediment. Six stations in Lauritzen Canal had sediment exceeding 100,000 $\mu\text{g/kg}$ total DDT in this interval (Table 3.7). As with the surface sediment, DDT concentrations decreased by several orders of magnitude in the Santa Fe Channel. However, a larger area of the federal Santa Fe Channel had sediment with greater than 400 $\mu\text{g/kg}$ total DDT in this interval than is found in the surface sediment. Sediment from the upper Santa Fe Channel was less contaminated than in the federally maintained portion of the channel. The highest DDT concentrations in the federal Santa Fe Channel were found upstream of the mouth of the Lauritzen Canal. The channel is shallower above the Lauritzen Canal than below it, and it is likely that some sediment from the lower portion of the channel was removed during maintenance dredging in 1985. Total DDT concentrations of less than 50 $\mu\text{g/kg}$ were restricted to sediment in the lower one-third of the Inner Harbor Channel.

The distribution of total DDT in sediment from the 3-ft- to 5-ft-below-mudline interval was similar to the distribution in the 1-ft- to 3-ft-below-mudline interval. Total DDT concentrations generally decreased in sediment from the Lauritzen Canal and upper Santa Fe Channel, and increased in the federal Santa Fe Channel and upper Inner Harbor Channel (data were not available in areas where the YBM/OBM contact was less than 2 ft below mudline). Pockets of sediment with greater than 100,000 $\mu\text{g/kg}$ total DDT occurred at the head of Lauritzen Canal (Stations LZ-1 and LZ-2) and at Stations LZ-8 and LZ-10 (Table 3.7). The federal Santa Fe Channel above the Lauritzen Canal contained a greater volume of sediment with greater than 500 $\mu\text{g/kg}$ total DDT in this interval. Total DDT concentrations decreased to less than 100 $\mu\text{g/kg}$ by the center of Inner Harbor Channel, and to less than 50 $\mu\text{g/kg}$ at Stations IH-47 through IH-51.

Figure 3.11 shows the distribution of total DDT in sediment in the intervals 1 ft above and 1 ft below the YBM/OBM contact, regardless of its depth below mudline. The maximum total DDT concentration above the contact was approximately 130,000 $\mu\text{g/kg}$ at Station LZ-11 (Table 3.7). The base of the YBM contained greater than 500 $\mu\text{g/kg}$ total DDT at all stations in the Lauritzen Canal except LZ-7 and LZ-14, and at Station SF-28. Sediment with greater than 100 $\mu\text{g/kg}$ total DDT extends from approximately the middle of Inner Harbor Channel north. Below the YBM/OBM contact, total DDT concentrations were less than 50 $\mu\text{g/kg}$ everywhere except in the Lauritzen Canal, and in a small area of the federal Santa Fe Channel north of it.

Total DDT concentrations of greater than 100 $\mu\text{g/kg}$ were measured at six stations in the Lauritzen Canal (Stations LZ-1, LZ-2, LZ-3, LZ-5, LZ-9, and LZ-11). Archived samples from the 1-ft to 2-ft interval below the contact at these stations (and Station LZ-6) were analyzed; results for all but two of these samples showed less than 50 $\mu\text{g/kg}$ total DDT (these samples are specified with a "Z" in Table 3.7). The samples from Stations LZ-2 and LZ-5 contained 181 $\mu\text{g/kg}$ and 66 $\mu\text{g/kg}$ total DDT, respectively.

Table 3.9 lists the total DDT concentrations and percent solids in samples from 1 ft above and 1 ft below the YBMIOBM contact in the Lauritzen Canal. The total DDT concentrations in sediment decreased across the contact by factors ranging from about 4 to 36,000. The solids content averaged about 60% in the YBM samples and 80% in the OBM samples. The greatest change was observed at Station LZ-10, where the concentration of total DDT decreased from over 120,000 $\mu\text{g/kg}$ to 7.4 $\mu\text{g/kg}$. At Station LZ-10, the YBM sample was 49% solids; whereas, the OBM sample, a silt, was 81% solids.

Cross sections showing the thickness of the YBM and distribution of total DDT along and across the Lauritzen Canal, Santa Fe Channel, and Inner Harbor Channel are presented in Figures 3.12 through 3.14, respectively. Cross-section locations are shown on Figure 3.15. The Lauritzen Canal cross sections (Figure 3.12) show total DDT concentrations on a log scale because they span seven orders of magnitude. The YBM was thickest at the head and on the western side of the central part of the canal; total DDT concentrations were also highest in these areas. Distinct layers of contaminated sediment were not discernible, and DDT concentrations varied over short vertical distances within the cores. DDT concentrations were higher in buried sediment. Although sediment concentrations were highly variable on a small scale, a large-scale pattern was evident. Sediment contamination decreases toward the mouth of the Lauritzen Canal and below the YBMIOBM contact.

The Santa Fe Channel cross sections (Figure 3.13) show total DDT concentrations on a linear scale. The YBM was thicker at the head of the channel, and on the south side of the channel across from the Lauritzen Canal. Again, distinct layers of contaminated sediment were not discernible and DDT concentrations were variable on a small scale. The highest total DDT concentrations were found adjacent to the Lauritzen Canal, and decreased toward the head of the Santa Fe Channel and the Inner Harbor Channel. Sediment with total DDT exceeding 500 $\mu\text{g/kg}$ was found just above the YBMIOBM contact at Stations SF-28 and SF-29, and at the surface at Stations SF-34 and SF-25 (SF-25 is not shown on the cross sections). Concentrations of total DDT in the OBM did not exceed 25 $\mu\text{g/kg}$, and are generally less than 2 $\mu\text{g/kg}$.

Cross sections of the Inner Harbor Channel (Figure 3.14) show that the YBM thickness and concentration of total DDT were more uniform than in the Santa Fe Channel and Lauritzen

Canal. Total DDT concentrations exceeded 200 µg/kg only at the head of the channel, and decreased to less than 50 µg/kg by the south end of the channel.

3.2.2.3 Distribution of Analogues in Total DDT

Table 3.10 shows the average relative percent of each DDT analogue contributing to total DDT. The 2,4' isomers of DDT were not analyzed in this study; however, these compounds were not detected at significant concentrations in marine sediment samples collected during the ecological risk assessment. The compound 4,4'-DDD contributed the most to total DDT, from 55% in sediment from the Lauritzen Canal to approximately 70% in upper Santa Fe Channel, Inner Harbor Channel, and Parr Canal sediment. The relative percent contribution of 4,4'-DDT was highest in sediment from the Lauritzen Canal (42%), and progressively decreased in the federal Santa Fe Channel, Inner Harbor Channel, Parr Canal, and upper Santa Fe Channel (12%). The compound 4,4'-DDE comprised less than 5% of total DDT in sediment from the Lauritzen Canal (except samples of gray, granular material collected at Stations LZ-1 and LZ-8, in which 4,4'-DDE constituted 50% of the total DDT). The relative percent of 4,4'-DDE increased to 10% or more in sediment outside Lauritzen Canal.

3.2.3 Other Contaminants

Composite samples of YBM sediment from selected stations and fine-grained and coarse-grained composite samples of OBM sediment were analyzed for oil and grease, total petroleum hydrocarbons, PAHs, PCBs, metals, and butyltins to identify contaminants other than pesticides. Sample locations are shown in Figure 3.1. Results of these analyses are presented in the following sections.

3.2.3.1 Oil and Grease and Total Petroleum Hydrocarbons

Oil and grease and TPH were measured to estimate the amount of hydrocarbons in the sediment and the relative contribution of petroleum products to the hydrocarbons. Complete analytical results for TPH and oil and grease, including QC data, are provided in Tables C.11 and C.12, Appendix C. The QC summaries for these analyses are on pages C.115 and C.117. The specified holding times for oil and grease and TPH analyses were exceeded because the samples required reanalysis. However, the sediment samples were stored frozen until reanalysis and the concentrations of hydrocarbons should not have decreased significantly during this time.

Oil and grease concentrations in the YBM ranged from 190 mg/kg to 26,000 mg/kg (Table 3.11). Concentrations were highest in samples from the Lauritzen and Parr Canals. TPH results indicate that petroleum products constituted the majority of the hydrocarbons in the Lauritzen Canal, Santa Fe Channel, and Parr Canal samples. TPH was not detected in composite YBM samples from the Inner Harbor Channel. Neither oil and grease nor TPH were detected in the OBM composite samples.

3.2.3.2 Polynuclear Aromatic Hydrocarbons

Composite sediment samples were analyzed for 16 PAH compounds. Complete analytical results, including QC data, for individual PAH compounds are provided in Tables C.13 through C.18, Appendix C. The QC summary for PAH analyses is on page C.119.

PAH data are summarized as high-molecular-weight PAHs (HPAH) and low-molecular-weight PAHs (LPAH) in Table 3.11. Total PAH concentrations in YBM composite samples ranged from 195 $\mu\text{g/kg}$ to 32,118 pg/kg . Concentrations of HPAHs exceeded those of LPAHs in all samples except LZ-1 M. PAH concentrations exceeded 20,000 $\mu\text{g/kg}$ at three stations: LZ-13, SF-25, and PC-53. Station LZ-13 was adjacent to the Levin terminal in the Lauritzen Canal. The odor of naphtha was reported by samplers in this core; a spill of naphthenic acid occurred near this location in 1951 (CH2M Hill 1988). Station SF-25 was located adjacent to the Castrol pier. The uppermost 1 ft of sediment from this core was very oily in appearance. This station corresponded to a station sampled as part of the ecological risk assessment; surface sediments collected from this area contained 149,000 $\mu\text{g/kg}$ total PAHs. The sediment at the Parr Canal Station PC-53 was also very oily in appearance. PAH concentrations were also elevated at Station LZ-1 at the head of Lauritzen Canal (12,500 pg/kg). PAHs were detected at concentrations of 143 $\mu\text{g/kg}$ and 35 $\mu\text{g/kg}$ in the coarse and fine OBM composites, respectively.

3.2.3.3 PCBs

Complete analytical results for PCBs, including QC data, are provided in Tables C.19 and C.20, Appendix C. The QC summary is on page C.121. Aroclor 1254 was the only PCB detected in samples from the United Heckathorn study area (Table 3.11). PCB concentrations in the YBM composite samples ranged from 5 pg/kg to 1982 pg/kg . The highest values were measured in samples from the Parr Canal, with concentrations of 675 pg/kg , 1982 $\mu\text{g/kg}$, and 568 $\mu\text{g/kg}$ at Stations PC-52, PC-53, and PC-54, respectively. PCB concentrations were greater than 200 pg/kg in samples from all Lauritzen Canal stations except LZ-13 and LZ-15. PCBs were not detected in the OBM composite samples.

3.2.3.4 Metals

Sediment samples were analyzed for 10 metals: silver, arsenic, cadmium, chromium, copper, mercury, nickel, lead, selenium, and zinc. Complete results for metals analyses, including QC data, are provided in Tables C. 21 and C.22, Appendix C. The QC summary for metals analyses is on page C.123.

Results for metals analyses are presented in Table 3.12. With the exception of chromium, concentrations of metals, particularly lead, zinc, and mercury, were generally higher in YBM samples than in the two OBM composite samples. The concentration of chromium in the coarse

OBM composite was higher than all but one YBM sample. The OBM likely contains material eroded from the chromium-rich ultramafic rocks exposed in the Bay area.

In general, concentrations of six metals (arsenic, chromium, copper, mercury, nickel, and selenium) in the composite YBM samples showed little spatial variation throughout the study area. Arsenic concentrations ranged from less than 7 mg/kg to 26.6 mg/kg. Chromium concentrations ranged from 166 mg/kg to 3990 mg/kg. The highest concentration was observed at Station LZ-13, which was located adjacent to the Levin Terminal pier where metal ore is offloaded. Copper concentrations ranged from 50 mg/kg to 212 mg/kg. Mercury concentrations ranged from 0.31 mg/kg to 2.18 mg/kg, with the highest concentrations measured in samples from the head of the Lauritzen Canal. Nickel values ranged from 83 mg/kg to 124 mg/kg. Selenium concentrations ranged from 0.26 mg/kg to 0.60 mg/kg.

Concentrations of silver, cadmium, lead, and zinc were elevated in samples from the Lauritzen and Parr Canals. Silver concentrations ranged from 0.16 mg/kg to 1.62 mg/kg, with the highest measured in samples from the head of the Lauritzen Canal (Stations LZ-1 and LZ-3). Cadmium concentrations ranged from 0.39 mg/kg to 3.17 mg/kg, and were higher at three stations in the Lauritzen Canal (LZ-1, LZ-3, and LZ-11) and all three stations in the Parr Canal. Lead concentrations ranged from 23 mg/kg to 849 mg/kg. Lead concentrations were much higher in samples from the head of the Lauritzen Canal (over 200 mg/kg at Stations LZ-1 and LZ-3), and were greater than 800 mg/kg at two stations in the Parr Canal. Zinc concentrations ranged from 105 mg/kg to 709 mg/kg, with the highest concentrations measured in samples from Stations PC-52 and PC-53 in the Parr Canal.

3.2.3.5 Butyltins

Complete analytical results for butyltins, including QC data, are provided in Tables C.23 and C.24, Appendix C. The QC summary for butyltin analyses is found on page C.125. Analytical results for butyltin analyses are provided in Table 3.12. Tributyltin concentrations in the YBM composite samples ranged from 5.1 µg/kg to 85.5 µg/kg. Dibutyltin concentrations ranged from 3.6 µg/kg to 56.3 µg/kg dry weight. The highest butyltin concentrations were measured in samples from at Stations SF-18 and SF-19, at the upper end of the Santa Fe Channel. These stations were adjacent to a marina. Traces of tributyltin were detected in both OBM composite samples; dibutyltin was not detected in either sample.

3.3 SEDIMENT VOLUMES

The volume of marine sediment potentially requiring remediation was estimated based on the areal and vertical distribution of DDT contamination. Cleanup criteria for marine sediment at the United Heckathorn site have not yet been established; therefore, sediment volumes above

various contaminant levels were calculated. The volume of YBM in each category includes sediment down to the YBM/OBM contact because significant contamination appears to be restricted to the YBM, and distinct layers of contaminated sediment were not identified within the YBM. The 12-in. core data for YBM thickness were used to estimate sediment volumes because they are believed to be more accurate than the 4-in. core data (the soft sediment is less likely to be influenced by friction along the inner surface of the wider barrel as it advances through soft sediment). The boundary for each category includes all stations with an average total DDT concentration exceeding the specified level. The average total DDT concentration was calculated for sediment in each category using the method described in Section A.5, Appendix A. The weighted average contaminant concentrations assume that the sediment within the given volume is homogenized.

Sediment volumes and average contaminant concentrations are summarized in Table 3.13. The volume estimates are an average of three values calculated using different surface modeling programs (with the exception of the Parr Canal, which is a single estimate). The standard deviation associated with each estimate is also provided. The volumes of YBM with total DDT concentrations above 1000 $\mu\text{g/kg}$, 500 $\mu\text{g/kg}$, 100 $\mu\text{g/kg}$, and 50 $\mu\text{g/kg}$ were estimated. A map showing the boundary for each category is provided in Figure 3.16.

The 1000- $\mu\text{g/kg}$ and 500- $\mu\text{g/kg}$ boundaries both include all recent sediment in the Lauritzen and Parr Canals. Small areas of sediment with a total DDT concentration of greater than 500 $\mu\text{g/kg}$ were found in the Santa Fe Channel (near the contact at Stations SF-28 and SF-29, and at the surface at Stations SF-34 and SF-25); these areas were not included in the 500- $\mu\text{g/kg}$ volume estimate. The 100- $\mu\text{g/kg}$ boundary is located at the northern end of the Inner Harbor Channel, and the 50- $\mu\text{g/kg}$ boundary is located at the center of the Inner Harbor Channel. The total volumes and average contaminant concentrations of sediment exceeding 50 $\mu\text{g/kg}$ and 100 $\mu\text{g/kg}$ total DDT were calculated including and excluding Lauritzen Canal sediment because of its relatively small volume and highly contaminated nature.

The volume of sediment exceeding a total DDT concentration of 50 $\mu\text{g/kg}$ is approximately 600,000 cu yd. Approximately 60% of this sediment has an average total DDT concentration above 100 $\mu\text{g/kg}$, 10% above 500 $\mu\text{g/kg}$, and 10% above 1000 $\mu\text{g/kg}$. The weighted average total DDT concentration in the 100- $\mu\text{g/kg}$ and 50- $\mu\text{g/kg}$ categories decreases by one to two orders of magnitude if the Lauritzen Canal sediment is excluded.

3.4 SOLID-PHASE BIOLOGICAL TESTING

Solid-phase toxicity and bioaccumulation tests were conducted with sediment composites from inner Richmond Harbor to characterize the biological effects of contaminated sediment. A

solid-phase toxicity test with the amphipod, *R. abronius*, was conducted using Comps LC-1, LC-2, LC-3, LC-4, LC-5, USFC, FSFC, IHC-1, IHC-2, IHC-3, GD, two San Francisco Bay grain-size controls, and a native control. All of these composites except Comp LC-5 represent the uppermost 1 ft of sediment throughout the study area. After toxicity of SPP and elutriate from Comp LC-5 to mysids was observed, this composite was added to the solid-phase test. The bioaccumulation test was conducted using Comps LC, USFC, FSFC, IHC-1, GD, a San Francisco Bay fine-grained control, and a native control. Composite sediment chemistry data, acute toxicity data for *R. abronius*, and results of the bioaccumulation test with *M. nasuta* are presented in the following sections.

3.4.1 Composite Sediment Chemistry

The 13 sediment composites and two San Francisco Bay grain-size control sediments prepared for biological testing were analyzed for grain size, TOC, oil and grease, total petroleum hydrocarbons, chlorinated pesticides, PCBs, PAHs, metals, and butyltins (Tables 3.14 to 3.17). Complete sediment chemistry data for the composites and controls, including QC data, are reported in Appendix C. All sediment chemistry data are reported in dry weight concentrations.

3.4.1.1 Conventional Parameters

The sediment composites were predominantly fine grained; silt and clay comprised at least 62% of the total solids in all composites and over 90% in composites from the Inner Harbor Channel and graving docks. The fine-grained San Francisco Bay control C-SFBF, at 91% silt and clay, was an appropriate grain-size control for the solid-phase bioassays. TOC was 1% to 2% in all composites except Comps LC-1 and IHC-1, with TOC contents of about 5% (Table 3.14). The San Francisco Bay coarse-grained control sediment (83% sand) had much less TOC (0.05%) than the other composites.

3.4.1.2 Chlorinated Pesticides

Chlorinated pesticide concentrations in the sediment composites were consistent with pesticide concentrations in the contributing core segments (Section 3.2.2). The pesticides 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and dieldrin were detected in most composites (Table 3.15). Concentrations of 4,4'-DDT in Lauritzen Canal composites, except for Comp LC-4, were at least two orders of magnitude greater than concentrations in Santa Fe Channel composites. Inner Harbor Channel composites were one order of magnitude lower than Santa Fe Channel composites. Only traces of pesticides were detected in the graving docks composite and the San Francisco Bay grain-size control sediments. Individual values for the upper 1 ft of sediment from Comp LC-4 stations (samples LZ-11 A, LZ-12 A, and LZ-13 A) indicate that the actual 4,4'-DDT concentration may be greater than 1000 yg/kg instead of the 461 yg/kg reported for the

composite (Table 3.7). Total DDT was nearly 90,000 $\mu\text{g}/\text{kg}$ in the YBM at depth in the Lauritzen Canal (Comps LC-5 and LC-6).

3.4.1.3 Other Contaminants

Analytical results for oil and grease, TPH, PAHs, and PCBs in sediment composites are provided in Table 3.16. Oil and grease ranged from 4310 mg/kg to 290 mg/kg , which was higher than the San Francisco Bay controls. Concentrations were highest in composites from the Lauritzen Canal. TPH data indicate that petroleum hydrocarbons constituted the majority of the oil and grease.

Both LPAHs and HPAHs were found in relatively high concentrations in composites from the Lauritzen Canal and Santa Fe Channel, indicating that these compounds have not undergone extensive weathering (Table 3.16). Total PAHs were highest in Comp LC-4 (21,566 $\mu\text{g}/\text{kg}$); most appeared to be contributed by Station LZ-13 (32,118 yg/kg). Station LZ-13 was located on the east side of Lauritzen Canal, in the active berthing area for the Levin Terminal. The PAHs in Comp USFC (9233 $\mu\text{g}/\text{kg}$ total PAH) appear to be contributed by sediment from SF-25 (24,199 $\mu\text{g}/\text{kg}$ total PAH), where concentrations of individual PAH compounds were thousands of times higher than at other contributing stations. Total PAH in sediment composites decreased with increasing distance from the Lauritzen Canal, with the lowest concentrations less than or equal to 1000 $\mu\text{g}/\text{kg}$ in the Inner Harbor Channel and graving dock composites.

Aroclor 1254 was detected in most composites (Table 3.16). Most Aroclor 1254 concentrations were two orders of magnitude lower than total DDT concentrations in the composites. Estimated concentrations were below the method detection limits in the Inner Harbor Channel and graving docks composites. Comp LC-1 from the head of Lauritzen Canal had over 1000 yg/kg Aroclor 1254; the other Lauritzen Canal composites had concentrations of 200 $\mu\text{g}/\text{kg}$ to 300 $\mu\text{g}/\text{kg}$. Concentrations of Aroclor 1254 were much lower in the dredged portions of the study area (federal Santa Fe Channel, Inner Harbor Channel).

In general, concentrations of metals were highest in Lauritzen Canal composites, and decreased with increasing distance from the canal (Table 3.17). Nearly all metals were higher in Lauritzen, Santa Fe, and Inner Harbor Channel composites than in the San Francisco Bay control sediment. Cadmium, chromium, copper, mercury, lead, and zinc were elevated the most relative to the San Francisco Bay controls. The values for these metals probably reflect the industrial uses of the waterways. The unusually high chromium concentrations in Comp LC-6 (1540 mg/kg) could be attributed to sediment from Station LZ-13, which had 3990 mg/kg chromium (Table 3.12).

Tributyltin in all sediment composites except Comp LC-4 ranged from below detection to 83.6 $\mu\text{g/kg}$ dry weight (Table 3.17). The extremely high value of 210 $\mu\text{g/kg}$ TBT for Comp LC-4 does not agree with the much lower TBT measured in YBM from contributing Stations LZ-11 and LZ-13 (5.3 $\mu\text{g/kg}$ and 37.5 $\mu\text{g/kg}$ respectively)(Table 3.12). The YBM from the other contributing station, LZ-12, was not analyzed for TBT. It is possible that a TBT source such as a paint chip could have been in the sample. Excluding Comp LC-4, butyltin concentrations were highest in the northern, undredged portion of Lauritzen Canal, and decreased with distance and with depth.

3.4.2 10-Day Static Test With *Rhepoxynius abronius*

The acute toxicity of surface sediments in the Heckathom study area to the burrowing amphipod, *R. abronius*, was evaluated in a 10-day static toxicity test as described in Section A.3.2. Twenty *R. abronius* were exposed in each of 5 replicates of 11 composites, 2 San Francisco Bay grain-size controls, and a native control. Five additional replicates of the native control were tested with Comp LC-5 when this composite was added to the experiment one week after initiation of the test. Complete survival data for all replicates are reported in Appendix D, Table D.1. Water quality monitoring and reference toxicant data are also tabulated in Appendix D.

The *R. abronius* test was validated by 96% and 99% survival in the native control C-WB and C-WB Rerun, respectively (Table 3.18). In the reference toxicant test with cadmium chloride, an LC_{50} of 0.90 mg/L Cd was estimated using the trimmed Spearman-Kärber method (11% trim). This LC_{50} is comparable to the 0.92 mg/L value cited for Cd toxicity to *R. abronius* in the standard guide to conducting toxicity tests with marine amphipods (ASTM 1990). These results indicate that the test population of *R. abronius* responded as expected. Water quality parameters were within acceptable ranges throughout the test except for on the last day, when pH in three replicates of Comp LC-1 exceeded the acceptable range.

The results of the *R. abronius* test, Tukey's HSD Test ($\alpha = 0.05$), and ANOVA are summarized in Tables 3.18 and 3.19. *R. abronius* survival is not significantly different in treatments that share a letter under the statistical grouping column in Table 3.18. Overall, *R. abronius* survival corresponded with the degree of sediment contamination: the highest mortality was observed in Lauritzen Canal composites, and mortality decreased with increasing distance from the canal. Survival was 0% in Comps LC-1, LC-2, LC-3, and LC-5, which was significantly different from all other treatments. Comp LC-4, from the mouth of Lauritzen Canal, and all other composites showed 74% to 92% survival and were not significantly different from each other or from the fine-grained San Francisco Bay Control. Some of the difference between Comps LC-4, FSFC, and IHC-3 and the coarse-grained San Francisco Bay Control is probably due to the sensitivity of *R. abronius* to fine-grained sediment (DeWitt et al. 1988).

3.4.3 28-Day Flow-Through Test With *Macoma nasuta*

The 28-day exposure of the bentnose clam, *M. nasuta*, to sediment composites from inner Richmond Harbor was conducted to evaluate bioaccumulation of contaminants. Five Heckathom sediment composites and two control sediments were tested as described in Section A.3.3. Twenty-five *M. nasuta* were exposed in each of five replicates of each treatment. After the 28-day exposure and 48-h depuration period, tissue samples from each replicate were analyzed for pesticides and lipids. Composite tissue samples were prepared by combining a subsample from each of the five replicates to measure concentrations of PAHs, PCBs, metals, and butyltins.

Complete survival data for the 28-day *M. nasuta* test are reported in Appendix E, Table E.1. Water quality parameters remained within acceptable ranges throughout the 28-day test (Appendix E, Table E.2). The test was validated by 98% survival in the Sequim Bay control sediment C-SB. Survival in the fine-grained San Francisco Bay control was 98%. Survival in the composites ranged from 94% to 96%, indicating that the sediments were not acutely toxic to adult *M. nasuta*.

All tissue chemistry and quality control data are reported in Appendix F; chemistry results are reported on a wet weight and dry weight basis. Nearly all QC criteria were met for the analyses. No analytical duplicates were analyzed for PAHs, PCBs, metals, and butyltins, because these parameters were measured in only five samples.

3.4.3.1 Chlorinated Pesticides and Lipid Content

Thirteen chlorinated pesticides were detected in the tissue samples. Pesticide results are reported in dry weight in Tables 3.20 and 3.21. Measured lipid values and the calculated Bligh-Dyer equivalents are also reported in dry weight in Table 3.20. The lipid content of tissue samples ranged from 3.1 % to 15.5% (1.4% to 7.1% in Bligh-Dyer equivalents). The average lipid content was 6.2% (2.8% in Bligh-Dyer equivalents).

Dieldrin, 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD were detected in all *M. nasuta* tissue samples at higher concentrations than any other pesticides (Table 3.20). These pesticides showed a clear pattern of decreasing concentrations in *M. nasuta* with increasing distance from the Lauritzen Canal, with at least an order of magnitude of reduction outside of Lauritzen Canal. The mean concentration of total DDT in clams exposed to Comp LC was approximately 35,000 µg/kg; mean total DDT in tissue decreased to 725 µg/kg in Comps FSFC and USFC, and to approximately 200 µg/kg in upper Inner Harbor Channel (Comp IHC-1). Pinza et al. (1992) measured approximately 100 µg/kg total DDT in *M. nasuta* exposed to composites from the southern part of Inner Harbor Channel. Mean total DDT in *M. nasuta* exposed to graving docks sediment was 36 µg/kg.

The distribution of DDT analogues as percentage of total DDT was different in tissues than in composite sediment samples. In *M. nasuta* tissue, 4,4'-DDD made up the highest percentage (generally around 80%) of total DDT; 4,4'-DDT the least (1% to 5%) except in *M. nasuta* exposed to Lauritzen Canal sediment (5% to 14%). In sediment composites, 4,4'-DDT contributed a similar amount or more than 4,4'-DDD to total DDT.

Dieldrin concentrations in tissue were an order of magnitude lower than total DDT, but showed the same spatial **pattern** of decreasing concentrations with increasing distance from Lauritzen Canal (Table 3.20). The mean *M. nasuta* dieldrin concentration of 10 µg/kg for Comp IHC-1 was slightly higher than the 6 pg/kg to 7 pg/kg in *M. nasuta* exposed to southern Inner Harbor Channel sediments measured by Pinza et al. (1992). Dieldrin in *M. nasuta* exposed to Comp GD was 3 pg/kg dry weight.

Table 3.21 lists the chlorinated pesticides other than dieldrin and DDT compounds that were detected in *M. nasuta*. Endrin was detected in three replicates of Comp LC. Aldrin, trans-chlordane, cis-chlordane, and endosulfan I were detected at more than 10 times the detection limit in the 5 replicates of Comp LC, but were either undetected or close to the detection limit in *M. nasuta* exposed to other composites. The following compounds were detected in several samples, at concentrations below the target detection limit of 2 µg/kg wet weight: α-BHC, γ-BHC, endosulfan II, endosulfan sulfate.

3.4.3.2 Other Contaminants

Concentrations of PAHs and the PCB Aroclor 1254 detected in composite *M. nasuta* tissue samples are reported in Table 3.22. The PAH data are summarized as total LPAH and HPAH; values for individual compounds are provided in Appendix F. Bioaccumulation of PAHs was greater than pesticides in all areas except Lauritzen Canal, where tissue pesticide concentrations were an order of magnitude higher. Total PAHs were highest in *M. nasuta* exposed to Comp USFC and Comp LC, with about 5500 pg/kg. Total PAH concentrations decreased to between 500 pg/kg and 2000 pg/kg in *M. nasuta* exposed to other composites. HPAHs, especially pyrene, fluoranthene, and the benzofluoranthenes, constituted a higher proportion of total PAH in *M. nasuta* exposed to Comp LC. In Comp USFC, LPAHs (primarily phenanthrene, anthracene, and fluorene) made a greater contribution to total PAH (approximately 20%). The relative proportions of LPAH and HPAH in *M. nasuta* tissues reflect the distribution of PAH compounds in the sediment composites. Aroclor 1254 was highest in *M. nasuta* exposed to Comp LC, with a concentration of 308 µg/kg. *M. nasuta* exposed to Comps USFC and FSFC had approximately 180 pg/kg Aroclor 1254. Tissue PCB concentrations in *M. nasuta* exposed to Comps IHC-1 and GD decreased to 91 µg/kg and 55 pg/kg, respectively. These tissue PCB concentrations reflect relative PCB concentrations in sediment composites (Table 3.16).

Metals and butyltins in *M. nasuta* tissues are reported in Table 3.23. Tissue metal concentrations showed little variation (within 2-fold) between composites, and were very similar to the mean *M. nasuta* metal concentrations reported by Pinza et al. (1992) for *M. nasuta* exposed to sediments from other parts of Richmond Harbor. *M. nasuta* tissue butyltin concentrations also did not vary significantly between composites (2.4-fold). The similarity of metal and butyltin concentrations between tissue composites does not reflect the variability of the sediment composite concentrations (Table 3.17).

3.4.3.3 Accumulation Factors

The composite sediment chemistry and bioaccumulation data collected in this study were used to calculate accumulation factors, which describe the preference of contaminants (particularly nonpolar organic compounds) for organism lipids relative to sediment organic carbon. They are important variables in modeling bioaccumulation of sediment-bound contaminants with a high affinity for organic carbon and lipids. The simplest definition of an accumulation factor is the ratio of the tissue contaminant concentration (normalized to lipid content) of an organism to the contaminant concentration (normalized to organic carbon) in sediment to which the organism was exposed (Lee et al. 1989), as shown below:

$$AF = \frac{C_t/L}{C_s/TOC}$$

where AF = accumulation factor in g organic carbon/g lipid
 Ct = tissue contaminant concentration in ng/g dry weight
 L = tissue lipid content in g/g dry weight
 Cs = sediment contaminant concentration in ng/g dry weight
 TOC = sediment organic carbon in g/g dry weight.

Accumulation factors calculated for DDT analogues and total DDT, dieldrin, PCB Aroclor 1254, and PAHs are listed in Table 3.24. The accumulation factors for *M. nasuta* tissue for DDT compounds did not appear related to sediment concentration, except that the accumulation factors were higher when sediment concentrations were very low (e.g., Comp GD). This was also true for Aroclor 1254 and PAHs. The high TOC in Comp IHC-1 (5.2% vs. 1.2% to 1.9% in other composites) also contributed to higher accumulation factors for all compounds.

3.5 TREATABILITY TESTING

Treatability testing was conducted to support the evaluation of selected remedial alternatives for contaminated marine sediment. SPP and elutriate phase samples were prepared and analyzed to predict the probable quality of effluent from dewatering sediment; test results were also used to evaluate the potential effects of dredging contaminated sediment. Two liquid phases were prepared from eight sediment composites and tested as described in Appendix A. The eight composites were Comps LC, LC-5, LC-6, USFC, FSFC, IHC-1, IHC-2, and IHC-3. These samples represent the uppermost 1 ft of sediment from various sections of the project area (Comps LC, USFC, FSFC, IHC-1, IHC-2, and IHC-3), as well as the 1- to 4-ft- and 4- to 7-ft- below-mudline intervals of YBM in the Lauritzen Canal (Comps LC-5 and LC-6, respectively). SPP and elutriate samples prepared from each composite were chemically analyzed and tested for acute toxicity to mysids and bivalve larvae. Additional dilutions of liquid-phase samples and GAC-filtered elutriate from Comp LC-5 were also tested. The Richmond Harbor site water used to prepare and dilute SPP and elutriate phases was analyzed, as was a procedural blank of site water carried through the SPP and elutriate preparation process. Liquid-phase chemistry and toxicity test results are discussed below.

3.5.1 Suspended Particulate Phase and Elutriate Phase Chemistry

The liquid phases of eight sediment composites were chemically analyzed for total suspended solids (TSS), chlorinated pesticides, PCBs, PAHs, metals, and butyltins (Tables 3.25 to 3.28). GAC-filtered elutriate from Comp LC-5 was analyzed for pesticides and TPH. Complete liquid-phase chemistry and analytical QC data are reported in Appendix G. Data quality was acceptable for all water analyses except butyltins. The butyltin blanks were contaminated with dibutyltin; therefore, only tributyltin results are reported in this section.

TSS in SPP samples ranged from 34 mg/L to 62 mg/L (Table 3.25). As expected, TSS were reduced 80% to 100% by centrifugation to the elutriate phase in most samples; however, TSS were reduced by only 65% and 39% in Comps LC-5 and LC-6, respectively. Oily surface films observed on these samples may have retained particles during centrifugation.

3.5.1.1 Chlorinated Pesticides

Liquid-phase sample results for DDT, DDT analogues, and dieldrin are presented in Table 3.25. The procedural blank is site water that was carried through the SPP and elutriate preparation process. The procedural blank had higher concentrations of pesticides (particularly 4,4'-DDD) and PAHs than the site water sample. Reanalysis confirmed the concentrations of pesticides in the procedural blank. Two possible causes for the irregularity are as follows: 1) the site water was not homogeneous, or 2) cross-contamination occurred during sample preparation. The site water used to prepare SPP and elutriate samples was collected from Inner Harbor

Channel in 20 20-liter containers, and was not homogenized before sample preparation. The site water used to prepare the procedural blank was decanted from a different container than the site water sample that was analyzed directly. All Teflon containers used in SPP and elutriate preparation were decontaminated between composites following procedures described in Appendix A; however, the wash, rinse, and acid bath may not have been adequate to remove all traces of contaminants. Consequently, sample results that are less than five times the concentration in the procedural blank might be attributed to the site water or cross-contamination during sample preparation. The five times criteria was applied in accordance with the guidelines for blank contamination provided in *Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses* (USEPA 1988). Pesticides detected in samples from the following composites might be derived from the site water or cross-contamination, and not from the sediment: Comps USFC (except 4,4'-DDE), FSFC (except 4,4'-DDE in the SPP), IHC-1, IHC-2 (except 4,4'-DDT in the elutriate), and IHC-3. Pesticide concentrations (except 4,4'-DDD) were near or below the method detection limit in most of these samples.

Pesticide concentrations in SPP and elutriate samples from the Lauritzen Canal composites greatly exceeded the concentrations in the procedural blank. Dieldrin and DDT compounds were present in liquid-phase samples from Lauritzen Canal at concentrations ranging from about 450 ng/L to 300,000 ng/L (Table 3.25). Concentrations of 4,4'-DDD were the highest of all the pesticides and were an order of magnitude higher than 4,4'-DDT, 4,4'-DDE, and dieldrin concentrations. Pesticide concentrations increased with the depth of the composite from which the liquid phase was prepared: highest in Comp LC-6, followed by Comp LC-5 and then Comp LC. Concentrations were reduced by 15% to 90% in the elutriate with the exception of Comps LC-6, USFC, and IHC-2, where elutriate concentrations were more than twice as high as in the SPP. Higher concentrations in the elutriate were observed even though the TSS concentrations were reduced (39% to 100%) during elutriate preparation. Reanalysis confirmed the initial values. The reason for higher contaminant concentrations in elutriate samples is not clear, but may be explained in part by sample inhomogeneity. Analytical duplicates of SPP and elutriate samples showed a 50% to 94% difference in pesticide concentrations, indicating that aliquots of liquid from the same sample container were not homogeneous, even after mixing.

Elutriate from Comp LC-5 was filtered through GAC as described in Appendix A to test whether treatment would reduce contaminant concentrations. GAC filtration of Comp LC-5 elutriate reduced the total DDT concentration by 23%, and dieldrin by 27%. TPH was analyzed in the unfiltered and filtered elutriate of Comp LC-5. Filtration reduced the TPH in the elutriate from 16 mg/L to 14 mg/L, or by 12.5%.

Table 3.26 shows pesticides other than dieldrin and DDT that were detected in liquid-phase samples. These compounds were only detected in Lauritzen Canal samples. Most

notably, chlordane isomers were detected at concentrations from 10 ng/L to 1240 ng/L. GAC filtration appeared to effectively remove trans-chlordane from the Comp LC-5 elutriate.

3.5.1.2 Other Contaminants

As with pesticides, PAHs were detected in the procedural blank at concentrations higher than those detected in the site water (Table 3.27). Therefore, sample results less than five times the concentration in the procedural blank might be attributed to the site water or to cross-contamination during SPP and elutriate sample preparation. PAH results for SPP and elutriate samples from Comps FSFC, IHC-1, IHC-2, and IHC-3 are less than five times the PAH concentrations in the procedural blank.

PAH concentrations in SPP and elutriate samples from the Lauritzen Canal and upper Santa Fe Channel composites are at least an order of magnitude higher than the others (Table 3.27). Total PAHs in these liquid-phase samples ranged from 1120 ng/L to 40,812 ng/L. The highest concentrations were found in Comp LC-6 elutriate and SPP, followed by Comp LC-5, Comp USFC, and Comp LC. PAHs in the liquid phase of Comps LC and LC-5 composites consisted mostly of HPAH. In Comp LC-6 liquid-phase samples, LPAH and HPAH contributed about equally to total PAH. In contrast, the PAHs in Comp USFC liquid-phase samples were primarily LPAH. This distribution of LPAH and HPAH in the liquid phase is similar to the distribution in the solid phase (sediment), especially for Comp LC-6 (Table 3.16). LPAHs were not the primary contributor of PAH in Comp USFC sediment, but they did account for a higher percentage of total PAH than in other composites. In most cases, PAH concentrations were reduced by removal of particulates (centrifugation to elutriate phase). Exceptions were Comp LC-6 and Comp IHC-2, where PAHs were higher in the elutriate phase.

The PCB Aroclor 1254 was detected in liquid-phase samples (Table 3.27). Aroclor 1254 was present in SPP samples only; it appeared to be effectively removed by centrifugation. Aroclor 1254 was only present in the SPP from surface (upper 1 ft of YBM) composites, decreasing in concentration from about 350 ng/L in Comp LC SPP to 64 ng/L in Comp IHC-1 SPP. Aroclor 1254 was not detected in SPP from composites at depth (Comps LC-5 and LC-6) or further out the Inner Harbor Channel (Comps IHC-2 and IHC-3).

Tributyltin ranged from less than 10 ng/L to 40.5 ng/L in Comp LC-5 (Table 3.27). Most values were not much higher than the 27.2 ng/L measured in the site water, indicating a relatively small contribution from sediments. Centrifugation to the elutriate phase reduced TBT levels somewhat in the liquid phases of Comps LC, LC-5, and USFC. TBT levels were similar or increased between SPP and elutriate of other composites.

Of the 10 priority pollutant metals measured in liquid-phase samples, only arsenic and mercury were consistently detected at higher levels than was found in Richmond Harbor site

water (Table 3.28). In general, metals concentrations were reduced by centrifugation to **elutriate** phase, particularly chromium, copper, mercury, and lead. Notable exceptions were arsenic in Comps LC-5 and FSFC, cadmium and selenium in Comp USFC, and zinc in Comp IHC-1. In those cases, metals concentrations were slightly higher in **elutriate** than in SPP.

3.5.2 96-Hour Static Test with *Holmesimysis costata*

The 96-h mysid test was conducted following the procedures described in Appendix A. *H. costata* were exposed to eight SPP and eight **elutriate** treatments at concentrations of 0%, 10%, 50%, and 100%. In addition, lower concentrations of Comp LC-5 SPP and **elutriate** were tested, as were the unfiltered and **GAC-filtered elutriate** of Comp LC-5. Complete survival data for all replicates are reported in Appendix H, Tables H.1 and H. 3. Water quality monitoring and reference toxicant data are also tabulated in Appendix H.

All SPP and **elutriate** tests with *H. costata* were validated by greater than 90% control (0% SPP or **elutriate**) survival for each composite dilution series (Tables 3.29 and 3.30). Water quality parameters were within acceptable ranges throughout the test, with the exception of pH, which was slightly elevated in several 100% **elutriate** and SPP replicates. However, these values were within the acceptable pH range (6.5-8.5) for marine life listed in *USEPA's Quality Criteria for Water 1986* (USEPA 1987). The pH was elevated above 8.5 in the 100% SPP and **elutriate** from Comps LC-5 and L-6, but were within the suggested pH range of 6.5 to 9.0 for estuarine organisms (USEPA 1987). Results of the reference toxicant tests showed that *H. costata* were sensitive to copper, with **LC₅₀s** of 92 µg/L and 109 µg/L for the two populations of organisms tested. The close agreement of the **LC₅₀s** demonstrates a consistent response to copper for the two populations. These values were higher than previous **LC₅₀s** found both in the literature (27 µg/L, Hunt et al. 1989), and at this laboratory (50 µg/L), indicating that these populations may have been less sensitive to toxicants.

H. costata were sensitive to SPP prepared from all eight sediment composites. T-test comparisons ($\alpha = 0.05$) showed that all 100% SPP treatments had statistically significantly higher mortality than the 0% SPP controls. However, results for the composites outside of the Lauritzen Canal might be influenced by possible cross-contamination during sample preparation (Sections 3.5.1.1 and 3.5.1.2). *H. costata* exposed to SPP prepared with Comps LC, LC-5, and LC-6 sediment experienced 100% mortality in all concentrations, with **LC₅₀s** of less than 10% SPP. Comp LC-5 SPP was retested at lower concentrations (0.01%, 0.1% and 1%); an **LC₅₀** was estimated at 0.38% SPP.

Similar results were seen in the *H. costata* tests with **elutriate** preparations: *H. costata* mortality in each of the 100% **elutriate** treatments was significantly higher than its respective control. Again, results for composites outside of the Lauritzen Canal might be influenced by

procedural cross-contamination. As with the SPP, exposure to Comps LC, LC-5, and LC-6 **elutriates** resulted in 100% mortality in the 10%, 50%, and 100% concentrations and **LC₅₀s** of less than 10% **elutriate**. With the additional 0.01 %, 0.1%, and 1% **elutriate** concentrations, the **LC₅₀** for Comp LC-5 **elutriate** was estimated to be 0.8% **elutriate**. Carbon filtration of Comp LC-5 **elutriate** did not reduce its toxicity to *H. wstata*.

3.5.3 48-Hour Static Test with Larval *Mytilus galloprovincialis*

The 48-h larval bivalve test was conducted following the procedures described in Appendix A. Larvae of the bivalve, *M. galloprovincialis*, were exposed to four concentrations (0%, 10%, 50%, and 100%) of eight SPP and eight **elutriate** treatments. Complete survival and normal development data for all replicates are reported in Appendix I, Tables 11 and 13. Water quality and reference toxicant **test data** are also reported in Appendix I.

All SPP and **elutriate** tests with *M. galloprovincialis* were validated by greater than 90% survival in controls (0% SPP or **elutriate**), except the Comp USFC **elutriate** control which had 89.3% survival (Tables 3.31 and 3.32). The high percentage of normally developed larvae in the controls (87.9% to 100%) also indicate that the organisms responded as expected. Water quality parameters were within acceptable ranges throughout the test, with the exception of pH which was slightly elevated in several 100% **elutriate** and SPP samples. The pH values were less than 8.5 for all 100% concentrations except for Comps LC-5 and LC-6 100% SPP and **elutriate**, which were less than pH 9.0.

Reference toxicant tests indicated that the *M. galloprovincialis* larvae used in these tests were sensitive to copper, with **LC₅₀s** ranging from 9.9 µg/L to 27.7 µg/L. Median effective concentrations (**EC₅₀s**) based on normal larval development ranged from 7.5 µg/L to 8.9 µg/L. These values are within the range of responses (**LC₅₀s** 5.8 µg/L to 35.0 µg/L Cu; **EC₅₀s** 5.7 µg/L to 21.0 µg/L Cu) previously reported both by MSL and other scientists (Dinnel et al. 1983; USEPA 1985). The close range of responses to copper indicates that all batches of larvae used in these tests produced a similar response.

In the SPP test with larval *M. galloprovincialis*, statistically significant survival differences were observed between 0% and 100% SPP of Comps LC-5 and LC-6 (Table 3.31). SPP from composites outside of Lauritzen Canal showed no significant differences in survival between the 100% and 0% concentrations. Although survival in Comp USFC 100% SPP was much lower than in the 0% SPP, the difference was not statistically significant because the variance between replicates was very high. Despite the significantly lower survival in 100% SPP and **elutriate** of most Lauritzen Canal composites, mortality did not exceed 50% relative to controls, and **LC₅₀s** for both SPP and **elutriate** of all composites were greater than 100%.

Exposure to SPP composites affected normal larval development. Normal development is a more sensitive indicator of liquid-phase toxicity than survival because larvae with abnormal or delayed development at 48-h are much less likely to survive to adulthood in the natural environment. Statistically significant differences in normal development between 0% and 100% concentrations were observed in the SPP of all except Comp USFC (Table 3.31). However, results for composites outside of the Lauritzen Canal might be affected by procedural cross-contamination. EC_{50} s based on the percent normal were 21.2% and 23.1% SPP for Comps LC-5 and LC-6, and Comp LC had an EC_{50} of 70.1% SPP. The larval test results were similar to the mysid test (Table 3.29) in that removal of the suspended particles did not appear to reduce toxicity.

M. galloprovincialis response to elutriate was similar to its response to SPP. Statistically significant survival differences were observed between 0% and 100% elutriate of Comps LC, LC-5, and LC-6 (Table 3.32). Elutriate from composites outside of Lauritzen Canal showed no significant differences in survival between the 100% and 0% concentrations. In elutriate from all composites, mortality did not exceed 50% relative to controls; therefore, LC_{50} s were greater than 100%.

Exposure to elutriates resulted in statistically significant differences in normal larval development between 0% and 100% concentrations of all composites (Table 3.32). As with the other tests, results for composites outside of the Lauritzen Canal might be influenced by sample cross-contamination. EC_{50} s for Comps LC-5 and LC-6 were 21.4% and 19.8% elutriate, nearly identical to the SPP EC_{50} s. Comp LC had an EC_{50} of 69.5%, again similar to the SPP EC_{50} . The larval test results were similar to the mysid test (Table 3.30) in that removal of suspended particles by centrifugation did not appear to reduce toxicity.

3.6 FISH TISSUE CHEMISTRY

Ten whole fish tissue samples of shiner surfperch (*Cymatogaster aggregata*) were analyzed for chlorinated pesticides, PCBs, PAHs, and phthalate esters. The samples were collected by USEPA for the ecological risk assessment of marine sediments at the United Heckathorn site. Complete analytical results, including QC data, are provided in Appendix J.

FIGURE 3.1. Core Sampling Station Designations

FIGURE 3.2. Elevation of the Mudline and YBM/OBM Contact in the Lauritzen Canal

FIGURE 3.3. Mudline Elevation in Santa Fe and Inner Harbor Channels

FIGURE 3.4. Elevation of YBM/OBM Contact in Santa Fe and Inner Harbor Channels

FIGURE 3.5. Map of YBM Thickness

FIGURE 3.6. Shoreline Features

FIGURE 3.7. Approximate Locations of Channel Edge and Graving Dock Grab Sampling Sites

FIGURE 3.8. Distribution of DDT and Dieldrin in YBM, Log Scale

FIGURE 3.9. Distribution of DDT and Dieldrin in YBM, Linear Scale

FIGURE 3.10. Distribution of Total DDT in YBM With Increasing Depth

FIGURE 3.11 Distribution of Total DDT Above and Below the YBM/OBM Contact

3.43

FIGURE 3.12. Cross-Sections of the Lauritzen Canal Showing Total DDT Concentrations

FIGURE 3.13. Cross-Sections of the Santa Fe Channel Showing Total DDT Concentrations

3.47

FIGURE 3.14. Cross-Sections of Inner Harbor Channel Showing Total DDT Concentrations

FIGURE 3.15. Cross-Section Locations

FIGURE 3.16. Boundaries of Sediment Volume Categories

TABLE 3.1. Core Sampling Site Locations, Mudline Elevations, and Thickness of Younger Bay Mud

Battelle Station Desianation	Date Collected	California State Plane (Zone III) Coordinates		Mudline (ft MLLW)	12-in. Core		4-in. Core	
					YBM/OBM		YBM/OBM	
		North	East		Thickness of YBM (ft)	Contact (ft MLLW)	Thickness of YBM (ft)	Contact (ft MLLW)
<u>Lauritzen Canal</u>								
LZ- 1	5-Jan-93	524,031	1,461,898	-10.2	8.5	-18.7	7.0	-17.2
LZ- 2	5-Jan-93	523,801	1,461,799	-12.1	8.1	-20.2	4.8	-16.9
LZ- 3	5-Jan-93	523,787	1,461,880	-16.5	5.9	-22.4	4.2	-20.7
LZ- 4	5-Jan-93	523,590	1,461,784	-12.6	No core collected; subsurface debris in channel			
LZ- 5	5-Jan-93	523,591	1,461,843	-18.3	2.0	-20.3	1.2	-19.5
LZ- 6	5-Jan-93	523,379	1,461,712	-12.3	4.0	-16.3	4.9	-17.2
LZ- 7	5-Jan-93	523,380	1,461,760	-19.4	5.0	-24.4	5.3	-24.7
LZ- 8	6-Jan-93	523,193	1,461,674	-12.3	8.5	-20.8	13.4	-25.7
LZ- 9	5-Jan-93	523,176	1,461,743	-25.4	1.0	-26.4	2.0	-27.4
LZ- 10	6-Jan-93	523,178	1,461,833	-34.7	6.0	-40.7	4.3	-39.0
LZ- 11	6-Jan-93	522,930	1,461,630	-12.0	2.3	-14.3	1.7	-13.7
LZ- 12	6-Jan-93	522,917	1,461,727	-37.5	3.3	-40.8	2.2	-39.7
LZ- 13	6-Jan-93	522,889	1,461,816	-34.9	6.6	-41.5	6.2	-41.1
LZ- 14	6-Jan-93	522,701	1,461,597	-23.1	1.5	-24.6	1.9	-25.0
LZ- 15	6-Jan-93	522,654	1,461,708	-36.7	4.3	-41.0	2.8	-39.5
LZ- 16	6-Jan-93	522,580	1,461,785	-35.2	3.0	-38.2	7.4	-42.6
<u>Upper Santa Fe Channel</u>								
SF-17	7-Jan-93	523,747	1,459,134	-29.4	7.3	-36.7	4.3	-33.7
SF-18	7-Jan-93	523,768	1,459,344	-31.6	1.7	-33.3	2.8	-34.4
SF-19	7-Jan-93	523,889	1,459,541	-31.9	2.0	-33.9	2.1	-34.0
SF-20	7-Jan-93	523,505	1,459,547	-32.7	2.8	-35.5	2.1	-34.8
SF-21	7-Jan-93	523,678	1,459,668	-30.8	6.0	-36.8	5.6	-36.4
SF-22	7-Jan-93	523,802	1,459,768	-28.9	6.9	-35.8	6.1	-35.0
SF-23	7-Jan-93	523,397	1,460,023	-34.2	2.0	-36.2	2.7	-36.9
SF-24	7-Jan-93	523,529	1,460,120	-31.4	2.9	-34.3	5.0	N/A(a)
SF-25	8-Jan-93	523,068	1,460,452	-29.5	4.2	-33.7	4.4	-33.9
SF-26	8-Jan-93	523,191	1,460,545	-31.4	1.9	-33.3	4.7	-36.1

TABLE 3.1. (contd)

Battelle Station Designation	Date Collected	California State Plane (Zone III) Coordinates		Mudline (ft MLLW)	12-in. Core		4-in. Core	
		North	East		Thickness of YBM (ft)	YBWOBM Contact (ft MLLW)	Thickness of YBM (ft)	YBWOBM Contact (ft MLLW)
<u>Federal Santa Fe Channel</u>								
SF-27	8-Jan-93	522,774	1,460,819	-35.3	4.5	-39.8	5.0	-40.3
SF-28	8-Jan-93	522,879	1,460,940	-35.6	1.0	-36.6	3.7	-39.3
SF-29	8-Jan-93	522,417	1,461,172	-27.1	8.3	-35.4	9.8	-36.9
SF-30	8-Jan-93	522,488	1,461,263	-36.1	2.5	-38.6	2.8	-38.9
SF-31	8-Jan-93	522,570	1,461,339	-36.9	1.8	-38.7	2.0	-38.9
SF-32	7-Jan-93	521,890	1,461,758	-27.5	7.0	-34.5	5.7	-33.2
SF-33	7-Jan-93	521,971	1,461,843	-35.9	4.3	-40.2	4.2	-40.1
SF-34	7-Jan-93	522,059	1,461,920	-38.0	2.5	-40.5	2.8	-40.8
<u>Inner Harbor Channel</u>								
IH- 35	8-Jan-93	521,677	1,462,462	-35.6	2.5	-38.1	2.4	-38.0
IH- 36	8-Jan-93	521,431	1,462,414	-35.7	5.1	-40.8	3.7	-39.4
IH- 37	8-Jan-93	521,163	1,462,361	-34.8	7.0	-41.8	5.5	-40.3
IH- 38	8-Jan-93	521,096	1,462,700	-36.5	3.3	-39.8	2.2	-38.7
IH- 39	8-Jan-93	520,990	1,463,135	-34.5	5.0	-39.5	5.5	-40.0
IH- 40(b)	9-Jan-93	520,548	1,462,416	-35.5	NA(c)	NA	3.5	-39.0
IH- 41(b)	9-Jan-93	520,575	1,463,144	-35.4	NA	NA	5.0	-40.4
IH- 42	9-Jan-93	519,928	1,462,468	-38.4	1.8	-40.2	1.6	-40.0
IH- 43	9-Jan-93	519,939	1,462,841	-35.1	6.0	-41.1	4.0	-39.1
IH- 44	9-Jan-93	519,953	1,463,216	-34.6	8.0	-42.6	8.0	-42.6
IH- 45(b)	9-Jan-93	519,310	1,462,522	-34.8	NA	NA	5.3	-40.1
IH- 46(b)	9-Jan-93	519,331	1,463,286	-33.5	NA	NA	6.0	-39.5
IH- 47	9-Jan-93	518,685	1,462,575	-36.7	3.8	-40.5	4.8	-41.5
IH- 48	9-Jan-93	518,699	1,462,961	-35.1	3.7	-38.8	4.4	-39.5
IH- 49	9-Jan-93	518,711	1,463,354	-35.4	1.2	-36.6	3.7	-39.1
IH- 50	4-Jan-93	516,597	1,461,461	-35.9	3.3	-39.2	4.8	-40.7
IH- 51	4-Jan-93	516,060	1,461,551	-35.3	4.4	-39.7	3.0	-38.3

TABLE 3.1. (contd)

Battelle Station Desianation	Date Collected	California State Plane (Zone III) Coordinates		Mudline (ft MLLW)	12-in. Core		4-in. Core	
		North	East		Thickness of YBM (ft)	YBM/OBM Contact (ft MLLW)	Thickness of YBM (ft)	YBM/OBM Contact (ft MLLW)
<u>Parr Canal</u>								
PC- 52(b)	9-Jan-93	522,411	1,463,012	-3.8	NA	NA	>4.1	N/A
PC- 53(b)	9-Jan-93	522,282	1,463,014	-3.5	NA	NA	>3.4	N/A
PC- 54(b)	9-Jan-93	522,095	1,463,011	-2.8	NA	NA	>3.6	N/A

(a) N/A Not available; no OBM collected.

(b) No 12-in. core collected.

(c) NA Not applicable.

TABLE 3.2. Sampling Information for Channel Edge and Graving Dock Grabs in Richmond Harbor

Station	Replicate	Date Sampled	Location (GPS, NAD 83)(a)		Water Depth (ft MLLW)	Sampler Type	Comments
			Latitude	Longitude			
Outer Harbor Edge	1	6-Jan-93	N 37° 54.13'	W 122° 22.07'	10.0	Pipe dredge	Loosely compacted clay
IHC Edge-West	1	6-Jan-93	N 37° 54.30'	W 122° 21.82'	38.5	Pipe dredge	Loosely compacted silt, clay
IHC Edge-West	2	6-Jan-93	N 37° 54.43'	W 122° 21.79'	39.5	Pipe dredge	Very loosely compacted clay
FSFC Edge-West	1	6-Jan-93	N 37° 55.16'	W 122° 22.06'	41.0	Pipe dredge	Loosely compacted silt
FSFC Edge-West	2	6-Jan-93	N 37° 55.18'	W 122° 22.09'	37.5	Pipe dredge	Clay
FSFC Edge-West	3	6-Jan-93	N 37° 55.28'	W 122° 22.22'	27.0	Pipe dredge	N/A(b)
SFC Marina	1	6-Jan-93	N 37° 55.39'	W 122° 22.50'	37.5	Ponar Grab	Silt, clay
SFC Marina	2	6-Jan-93	N 37° 55.40'	W 122° 22.55'	36.5	Ponar Grab	Silt, clay
SFC Marina	3	6-Jan-93	N 37° 55.44'	W 122° 22.49'	36.5	Ponar Grab	Silt, clay
Parr Edge	1	6-Jan-93	N 37° 55.10'	W 122° 21.72'	9.0	Ponar Grab	Clay; blackened sediment, oil sheen
Parr Edge	2	6-Jan-93	N 37° 55.14'	W 122° 21.73'	9.5	Ponar Grab	Clay
IHC Edge-East	1	6-Jan-93	N 37° 54.90'	W 122° 21.69'	39.5	Ponar Grab	Clay
IHC Edge-East	2	6-Jan-93	N 37° 54.72'	W 122° 21.66'	37.5	Ponar Grab	Clay
GD-1	1	6-Jan-93	N 37° 54.34'	W 122° 22.02'	19.5	Pipe dredge	Watery clay
GD-1	2	6-Jan-93	N 37° 54.31'	W 122° 22.02'	20.0	Pipe dredge	Watery clay
GD-1	3	6-Jan-93	N 37° 54.33'	W 122° 22.04'	22.0	Pipe dredge	Loosely compacted clay
GD-1	4	6-Jan-93	N 37° 54.32'	W 122° 22.04'	21.0	Pipe dredge	Loosely compacted clay
GD-2	1	6-Jan-93	N 37° 54.27'	W 122° 22.02'	29.0	Pipe dredge	Loosely compacted clay
GD-2	2	6-Jan-93	N 37° 54.28'	W 122° 21.98'	26.5	Pipe dredge	Loosely compacted clay
GD-3	1	6-Jan-93	N 37° 54.33'	W 122° 21.98'	32.0	Pipe dredge	Loosely compacted clay; slight oil sheen
GD-3	2	6-Jan-93	N 37° 54.33'	W 122° 21.99'	32.0	Pipe dredge	Loosely compacted clay; slight oil sheen
GD-4	1	6-Jan-93	N 37° 54.30'	W 122° 21.92'	21.5	Pipe dredge	Loosely compacted clay
GD-4	2	6-Jan-93	N 37° 54.29'	W 122° 21.92'	23.0	Pipe dredge	Loosely compacted clay; some shell debris

(a) Global Positioning System, North American Datum 1983.

(b) N/A Not available.

TABLE 3.3. Sampling Information for Control Sediments

<u>Station</u>	<u>Replicate</u>	<u>Date Sampled</u>	<u>Location (GPS, NAD 83)(a)</u>		<u>Water Depth (ft MLLW)</u>	<u>Sampler Type</u>	<u>Comments</u>
			<u>Latitude</u>	<u>Longitude</u>			
C-SFBF	1	6-Jan-93	N 37° 54.00'	W 122° 20.70'	11.5	Pipe dredge	Silt, clay;
C-SFBF	2	6-Jan-93	N 37° 54.02'	W 122° 20.80'	11.5	Pipe dredge	polychaete
C-SFBF	3	6-Jan-93	N 37° 54.01'	W 122° 20.80'	11.5	Pipe dredge	tubes present in
C-SFBF	4	6-Jan-93	N 37° 54.03'	W 122° 20.77'	11.5	Pipe dredge	all replicates;
C-SFBF	5	6-Jan-93	N 37° 54.03'	W 122° 20.70'	11.5	Pipe dredge	shell debris in
C-SFBF	6	6-Jan-93	N 37° 54.02'	W 122° 20.80'	11.5	Pipe dredge	Rep 3
C-SFBC	1	6-Jan-93	N 37° 54.46'	W 122° 26.25'	43.5	Pipe dredge	Medium-coarse sand
C-SB	NA	14-Jan-93	Center of Sequim Bay (approx. N 48° 03.70' W 123° 01.50')		80	Ponar Grab	Silt; polychaetes present
C-WB	NA	15-Jan-93	50 yd off West Beach (approx. N 48° 23.83' W 122° 40.00')		12	Amphipod Dredge	Medium sand

(a) Global Positioning System, North American Datum 1983.

TABLE 3.4. Summary of Sediment Sample Preparation and Analysis

Sediment Sample Type	Total Number of Samples	Number of Samples for Each Parameter					
		Chlorinated Pesticides	Grain Size	TOC	PAH, PCB metals, butyltins	Oil & Grease, TPH	Archive
Vertical Searnents From 4-in. Cores							
A...X (YBM) and Y (OBM)	236	236	236	236	0	0	236
Z (OBM)	46	0	0	0	0	0	46
M (all YBM in a core)	31	0	0	0	31	31	31
Grab Samples From							
Channel Edaes	7	7	7	7	0	0	7
OBM Composites From							
Combined 4-in. Cores	2	0	0	0	2	2	2
Composites From 12-in. Cores							
Comp LC	1	1	1	1	1	1	1
Comp LC-1	1	1	1	1	1	1	1
Comp LC-2	1	1	1	1	1	1	1
Comp LC-3	2	2	2	2	2	2	2
Comp LC-4	1	1	1	1	1	1	1
Comp LC-5	1	1	1	1	1	1	1
Comp LC-6	1	1	1	1	1	1	1
Comp USFC	1	1	1	1	1	1	1
Comp FSFC	1	1	1	1	1	1	1
Comp IHC-1	1	1	1	1	1	1	1
Comp IHC-2	2	2	2	2	2	2	2
Comp IHC-3	1	1	1	1	1	1	1
Gravina Dock Composite							
Comp GD	1	1	1	1	1	1	1
Control Sediments							
C-SB	1	0	0	0	0	0	1
C-WB	1	0	0	0	0	0	1
C-SFBF	1	1	1	1	1	1	1
C-SFBC	1	1	1	1	1	1	1
TOTAL	341	260	260	260	48	48	341

TABLE 3.5. Samples for Biological Testing and Related Chemical Analysis

<u>Sample Type</u>	<u>Solid Phase Testing and Tissue Chemistry</u>					<u>SPP and Elutriate Testing and Chemistry</u>		
	<u>10-day <i>R. abronius</i> Acute Toxicity</u>	<u>28-day <i>M. nasuta</i> Bioaccu- mulation</u>	<u>Tissue Chlorinated Pesticides</u>	<u>Tissue PAH, PCB metals, butyltins</u>	<u>Tissue Lipid Content</u>	<u>4day Mysid Test 2-3day Larval Test SPP</u>	<u>Elutriate</u>	<u>TSS, Chlorinated Pesticides, PCBs, PAHs, metals, butyltins</u>
<u>Sediment Composites</u>								
Comp LC	0	1	5	1	6	1	1	2
Comp LC-1	1	0	0	0	0	0	0	0
Comp LC-2	1	0	0	0	0	0	0	0
Comp LC-3	1	0	0	0	0	0	0	0
Comp LC-4	1	0	0	0	0	0	0	0
Comp LC-5	1(a)	0	0	0	0	1	1	2(b)
Comp LC-6	0	0	0	0	0	1	1	2
Comp USFC	1	1	5	1	6	1	1	2
Comp FSFC	1	1	5	1	6	1	1	2
Comp IHC-1	1	1	5	1	6	1	1	2
Comp IHC-2	1	0	0	0	0	1	1	2
Comp IHC-3	1	0	0	0	0	1	1	2
Comp GD	1	1	5	1	6	0	0	0
<u>Control Sediments</u>								
C-SFBF	1	1	0	0	0	0	0	0
C-SFBC	1	0	0	0	0	0	0	0
C-SB	0	1	0	0	0	0	0	0
C-WB	1	0	0	0	0	0	0	0
<u>Site Water</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>0</u>	<u>2(c)</u>
TOTAL	14	7	25	5	30	8	8	18

(a) Comp LC-5 added to *R. abronius* test following initial liquid phase test results.

(b) Two additional samples (unfiltered and carbon-filtered elutriate) analyzed for pesticides only.

(c) One site water sample tested as a procedural blank.

TABLE 3.6. Mean Total Organic Carbon, Percent Solids, and Grain Size Distribution in Vertical Core Segments and Channel Edge Grab Samples

<u>Location</u>	<u>Sediment Type</u>	<u>Mean Percent TOC dry weight)</u>	<u>Mean Percent Solids</u>	<u>Mean Percent Gravel</u>	<u>Mean Percent Sand</u>	<u>Mean Percent Silt</u>	<u>Mean Percent Clay</u>
Lauritzen Canal	YBM	1.91	49	6	26	25	42
Santa Fe Channel	YBM	1.14	47	2	11	28	59
Inner Harbor Channel	YBM	1.14	45	0	5	32	62
Parr Canal	YBM	5.19	45	4	24	37	34
Lauritzen Canal	OBM	0.12	80	8	42	31	20
Santa Fe Channel	OBM	0.23	77	1	30	37	32
Inner Harbor Channel	OBM	0.21	76	5	16	41	38

TABLE 3.7. Dieldrin and DDT Compounds in Vertical Core Segments and Channel Edge Grab Samples

			Pesticide Concentration (ug/kg dry weight)				Total DDT(a)
Sediment Sample ID	Thickness (ft)		Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
LZ-1 A	1.0		401.65 J(b)	13843.61	2865.23	11228.33	27937.2
LZ-1 B	2.0		205.94 J	595.70	4855.60	363.48 J	5814.8
LZ-1 C	2.0		10304.57	30541.48	7915.53	322304.49	360761.5
LZ-1 D	1.0		723.37 J	700.53 J	1441.28 J	136929.91	139071.7
LZ-1 X	1.0		25.92 J	41.32 J	15.44 J	487.21	544.0
LZ-1 Y	1.0		1.50	1.77	1.71	140.22	143.7
LZ-1 Z	1.0		NM(c)	0.23 J	0.10 J	6.70	7.0
LZ-2 A	1.0		311.02 J	43298.77	462.14 J	11414.95	55175.9
LZ-2 B	2.0		685.75 J	111047.83	989.25 J	21516.06	133553.1
LZ-2 C	0.8		4344.56 J	45332.96	3656.61 J	212115.89	261105.5
LZ-2 X	1.0		439.81 J	6827.19	345.82 J	103190.29	110363.3
LZ-2 Y	1.0		12.43	188.34	10.54	776.60	975.5
LZ-2 Z	1.0		NM	15.36	1.45	164.24	181.1
LZ-3 A	1.0		882.34 J	41784.21	826.31 J	29781.44	72392.0
LZ-3 B	2.0		2271.21 J	38901.66	2366.27 J	112717.87	153985.8
LZ-3 X	1.2		519.38	2323.78	165.91 J	17054.30	19544.0
LZ-3 Y	1.0		3.69	60.93	2.20	189.28	252.4
LZ-3 Z	1.0		NM	7.76	0.57 J	28.32	36.7
LZ-5 A	1.2		467.28 J	29641.09	378.69 J	14791.94	44811.7
LZ-5 Y	1.0		17.09	476.54	10.23	445.10	931.9
LZ-5 Z	1.0		NM	27.84	0.99	37.37	66.2
LZ-6 A	1.0		930.71 J	92956.22	842.97 J	17825.73	111624.9
LZ-6 B	2.0		1894.04 J	161331.74	2573.81 J	113865.44	277771.0
LZ-6 C	0.9		155.14 J	12496.97	447.25 J	33972.04	46916.3
LZ-6 X	1.0		41.59 J	141.28 J	16.34 J	670.27	827.9
LZ-6 Y	1.0		0.98	37.33	0.73	54.78	92.8
LZ-6 Z	0.7		NM	0.37 J	0.03 J	1.04 U(d)	0.4
LZ-7 A	1.0		1311.68	38600.63	857.32 J	37505.99	76963.9
LZ-7 B	2.0		15971.27	334563.58	6274.29	292520.38	633358.3
LZ-7 C	1.3		1475.77	48493.85	739.18 J	68456.14	117689.2
LZ-7 X	1.0		6.63 J	69.40	2.42 J	101.19	173.0
LZ-7 Y	1.0		0.45 J	1.85	0.19 J	9.73	11.8
LZ-8 A	1.0		409.19 J	26511.54	415.45 J	8983.00	35910.0
LZ-8 B	2.0		2344.70 J	53736.21	4511.69	101508.55	159756.5
LZ-8 C	2.0		1576.51 J	59262.41	27663.04	50720.09	137645.5
LZ-8 D	2.0		778.95 J	22355.96	31498.99	13787.46	67642.4
LZ-8 E	2.0		435.71 J	34123.38	41767.87	5786.51	81677.8
LZ-8 F	2.0		6980.94	45252.16	2275.90 J	143993.28	191521.3
LZ-8 G	1.4		28.61 J	1029.47	24.66 J	873.30	1927.4
LZ-8 X	1.0		7.96 J	957.42	10.88 J	98.51	1066.8
LZ-8 Y	1.0		0.04 J	0.73 U	0.68 U	0.67 J	0.7

TABLE 3.7. (contd)

Sediment Sample ID	Thickness (ft)	Pesticide Concentration (ug/kg dry weight)				Total DDT(a)
		Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
LZ-9 A	1.0	343.16 J	27403.36	356.27 J	9862.51	37622.1
LZ-9 X	1.0	281.94 J	13956.56	219.06 J	5695.97	19871.6
LZ-9 Y	1.0	52.07	1001.17	36.81	866.52	1904.5
LZ-9 Z	1.0	NM	0.98	0.07 J	0.88 U	1.1
LZ-10 A	1.0	48.85 J	2951.54	55.40 J	1116.28	4123.2
LZ-10 B	2.0	339.79	12591.73	331.07	12061.52	24984.3
LZ-10 X	1.3	530.10 J	89109.29	1010.44 J	30415.95	120535.7
LZ-10 Y	1.0	0.94	1.04	0.67 U	6.36	7.4
LZ-11 A	1.0	124.92 J	2258.61	149.67 J	5368.23	7776.5
LZ-11 X	0.7	2246.89 J	19837.68	2399.22 J	106725.42	128962.3
LZ-11 Y	1.0	38.90	79.61	15.99	559.06	654.7
LZ-11 Z	1.0	NM	0.42 J	0.11 J	3.57 U	0.5
LZ-12 A	1.0	43.97 J	1400.33	62.04 J	1213.26	2675.6
LZ-12 X	1.2	43.51 J	528.55	59.84 J	959.08	1547.5
LZ-12 Y	1.0	0.65 J	8.58	0.73	20.43	29.7
LZ-13 A	1.0	99.10 J	1538.68	177.46	1430.44	3146.6
LZ-13 B	2.0	80.79 J	472.40	140.78	1402.63	2015.8
LZ-13 C	2.0	108.19 J	4781.08	233.24	2298.08	7312.4
LZ-13 X	1.2	237.35	1915.71	481.78	4793.95	7191.4
LZ-13 Y	1.0	0.67 U	0.08 J	0.68 U	0.15 J	0.2
LZ-14 A	1.0	25.05 J	187.93 U	25.34 J	445.61	471.0
LZ-14 X	0.9	4.55 J	82.34	8.16	110.30	200.8
LZ-14 Y	1.0	0.13 J	0.26 J	0.06 J	1.18	1.5
LZ-15 A	1.0	31.90 J	414.80	45.35 J	711.72	1171.9
LZ-15 B	0.8	31.30 J	641.43	54.73 J	683.41	1379.6
LZ-15 X	1.0	42.62 J	1460.35	60.60 J	883.31	2404.3
LZ-15 Y	1.0	0.40 J	8.99	0.37 J	9.24	18.6
LZ-16 A	1.0	7.47 J	169.60	22.62	276.92	469.1
LZ-16 B	2.0	74.90 J	167.08	139.81	946.84	1253.7
LZ-16 C	2.0	164.25	1574.53	266.24	2598.46	4439.2
LZ-16 D	1.4	39.98 J	646.93	75.19	690.96	1413.1
LZ-16 X	1.0	34.63	163.49	96.94	627.30	887.7
LZ-16 Y	0.5	0.04 J	0.39 J	0.09 J	0.69 J	1.2
SF-17 A	1.0	11.37	10.06 U	64.72	193.13	257.9
SF-17 B	2.3	11.03	7.19 U	60.14	137.80	197.9
SF-17 X	1.0	2.06	1.77 U	7.82	60.00	67.8
SF-17 Y	0.8	0.02 J	0.76 U	0.06 J	0.88 U	0.1

TABLE 3.7. (contd)

Sediment Sample ID	Thickness (ft)	Pesticide Concentration (ug/kg dry weight)				Total DDT(a)
		Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
SF-18 A	1.0	7.90	86.21	21.16	109.78	217.2
SF-18 B	0.8	12.36	19.28 U	18.14	135.47	153.6
SF-18 X	1.0	4.66	2.97 U	10.56	78.94	89.5
SF-18 Y	1.0	0.73 U	0.08 J	0.03 J	0.92 U	0.1
SF-19 A	1.0	3.90	12.68 U	10.37	112.35	122.7
SF-19 X	1.1	7.22	16.16 U	22.80	94.90	117.7
SF-19 Y	1.0	0.69 U	0.75 U	0.70 U	0.87 U	0.0
SF-20 A	1.0	3.83	13.82 U	11.01	116.55	127.6
SF-20 X	1.1	11.20	50.66	26.57	191.09	268.3
SF-20 Y	1.0	0.77 U	0.31 J	2.28	10.41 U	2.3
SF-21 A	1.0	4.54	40.57	11.20	83.71	135.5
SF-21 B	2.0	4.29	5.50	11.05	119.36	135.9
SF-21 C	1.6	7.09	22.57	13.30	102.96	138.8
SF-21 X	1.0	6.74	3.39	25.19	89.02	117.6
SF-21 Y	1.0	0.69 U	0.07 J	0.70 U	0.21 J	0.3
SF-22 A	1.0	10.88	14.17	42.85	144.00	201.0
SF-22 B	2.0	9.89	6.12	47.48	135.50	189.1
SF-22 C	2.1	1.06 U	0.11 J	0.11 J	0.22 J	0.4
SF-22 X	1.0	0.88 U	0.96 U	0.89 U	0.07 J	0.1
SF-22 Y	1.0	0.70 U	0.06 J	0.71 U	0.06 J	0.1
SF-23 A	1.0	2.49	50.23	12.37	93.41	156.0
SF-23 B	0.7	4.05	16.75	11.52	75.15	103.4
SF-23 X	1.0	3.21	4.06 U	10.48	53.69	64.2
SF-23 Y	1.0	0.02 J	0.05 J	0.04 J	0.31 J	0.4
SF-24 A	1.0	6.25	29.36	17.06	118.56	165.0
SF-24 B	2.0	4.34	12.12	13.62	129.30	155.0
SF-24 C	1.8	0.81 J	0.63 J	2.65	18.57	21.9
SF-25 A	1.0	33.04	10.68	290.07	440.33	741.1
SF-25 B	2.4	2.67	19.24	8.08	51.28	78.6
SF-25 X	1.0	0.72 U	0.78 U	0.72 U	0.59 J	0.6
SF-25 Y	1.0	0.69 U	0.75 U	0.70 U	0.87 U	0.0
SF-26 A	1.0	0.53 J	1.42 U	3.50	5.77	9.3
SF-26 B	2.0	2.90	18.28	7.16	54.43	79.9
SF-26 C	0.7	12.60	35.40	28.92	180.37	244.7
SF-26 X	1.0	11.77	54.72	25.71	172.42	252.9
SF-26 Y	1.0	0.69 U	0.75 U	0.70 U	0.38 J	0.4

TABLE 3.7. (contd)

Sediment Sample ID	Thickness (ft)	Pesticide Concentration (µg/kg dry weight)				Total DDT(a)
		Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
SF-27 A	1.0	1.65	98.26	3.40	124.65	226.3
SF-27 B	2.0	4.97	129.07	10.74	119.43	259.2
SF-27 C	1.0	8.71	94.02	20.33	225.39	339.7
SF-27 X	1.0	12.26	32.90	12.58	135.42	180.9
SF-27 Y	1.0	0.67 U	0.73 U	0.68 U	0.50 J	0.5
SF-28 A	1.0	3.80	19.17	19.13	96.19	134.5
SF-28 B	1.7	12.86	188.41	26.87	278.67	494.0
SF-28 X	1.0	17.40	168.56	33.14	335.56	537.3
SF-28 Y	0.5	0.53 J	0.77	1.37	12.17	14.3
SF-29 A	1.0	1.83	125.24	3.59	32.85	161.7
SF-29 B	2.0	6.55	277.91	20.50	147.01	445.4
SF-29 C	2.0	12.10	111.03	21.87	283.52	416.4
SF-29 D	2.0	8.83	181.17	36.18	163.16	380.5
SF-29 E	1.8	29.65	109.13	121.33	863.54	1094.0
SF-29 X	1.0	0.92	3.68	3.15	23.65	30.5
SF-29 Y	1.0	0.68 U	0.74 U	0.16 J	1.07	1.2
SF-30 A	1.0	1.02 J	13.80	2.20	32.56	48.6
SF-30 B	0.8	4.71	48.85	20.25	164.72	233.8
SF-30 X	1.0	10.96	101.54	32.21	299.76	433.5
SF-30 Y	1.0	0.19 J	0.74 U	0.09 J	1.17	1.3
SF-31 A	1.0	0.58 J	16.19	1.28	14.17	31.6
SF-31 X	1.0	19.99	103.70	24.67	325.51	453.9
SF-31 Y	1.0	1.36	0.34 J	1.75	21.15	23.2
SF-32 A	1.0	9.87	80.76	41.24	205.26	327.3
SF-32 B	2.0	5.51	50.70	23.56	129.13	203.4
SF-32 C	1.7	0.78 U	0.23 J	0.09 J	0.61 J	0.9
SF-32 X	1.0	0.87 U	0.94 U	0.88 U	0.48 J	0.5
SF-32 Y	1.0	0.66 U	0.72 U	0.67 U	0.08 J	0.1
SF-33 A	1.0	10.11	76.28	26.95	173.46	276.7
SF-33 B	2.2	11.83	153.73	31.95	198.05	383.7
SF-33 X	1.0	16.70	69.32	62.85	217.76	349.9
SF-33 Y	1.0	0.10 J	1.85	0.03 J	0.62 J	2.5
SF-34 A	1.0	36.59	38.70	193.73	302.60	535.0
SF-34 B	0.8	2.43	24.86	9.42	65.98	100.3
SF-34 X	1.0	5.50	108.51	13.79	125.95	248.3
SF-34 Y	1.0	0.03 J	0.72 U	0.04 J	0.83 U	0.0
IH-35 A	1.0	2.18	24.22	7.51	68.47	100.2
IH-35 X	1.4	3.78	91.79	12.85	113.37	218.0
IH-35 Y	1.0	0.06 J	0.77 U	0.08 J	0.87 J	1.0

TABLE 3.7. (contd)

Sediment Sample ID		Thickness (ft)	Pesticide Concentration (µg/kg dry weight)				Total DDT(a)
			Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
IH-36	A	1.0	0.86 J	13.30	1.93	29.34	44.6
IH-36	B	1.7	5.43	64.91	12.90	110.16	188.0
IH-36	X	1.0	4.70	8.70	20.19	134.94	163.8
IH-36	Y	1.0	0.13 J	0.16 J	0.15 J	1.18	1.5
IH-37	A	1.0	0.43 J	1.11 J	0.86 J	6.96	8.9
IH-37	B	2.0	1.02 J	6.21	2.64	26.56	35.4
IH-37	C	1.5	1.39	16.63	2.80	38.99	58.4
IH-37	X	1.0	1.88	6.69	7.92	56.10	70.7
IH-37	Y	1.0	0.12 J	0.76 U	0.71 U	0.16 J	0.2
IH-38	A	1.0	3.19	39.69	7.31	71.60	118.6
IH-38	X	1.2	2.18	5.91	5.31	71.54	82.8
IH-38	Y	1.0	0.10 J	0.76 U	0.70 U	0.21 J	0.2
IH-39	A	1.0	1.38	33.83	5.97	57.28	97.1
IH-39	B	2.0	2.71	23.87	12.45	66.56	102.9
IH-39	C	1.5	3.98	37.37	18.69	109.02	165.1
IH-39	X	1.0	5.09	47.63	22.33	127.69	197.7
IH-39	Y	1.0	0.07 J	0.73 U	0.06 J	0.52 J	0.6
IH-40	A	1.0	0.92 J	4.92	3.38	32.98	41.3
IH-40	B	1.5	1.10 J	16.22	3.17	32.70	52.1
IH-40	X	1.0	1.61	68.27	3.79	43.70	115.8
IH-40	Y	1.0	0.09 J	0.76 U	0.71 U	0.12 J	0.1
IH-41	A	1.0	1.19	21.65	3.73	24.16	49.5
IH-41	B	2.0	1.13 J	1.75	3.24	19.22	24.2
IH-41	C	1.0	3.22	34.51	9.18	98.66	142.4
IH-41	X	1.0	3.07	13.99	9.05	78.73	101.8
IH-41	Y	1.0	0.68 U	0.73 U	0.68 U	0.09 J	0.1
IH-42	A	1.0	1.72	4.42	6.28	40.53	51.2
IH-42	X	0.6	1.10 J	1.55	3.93	21.52	27.0
IH-42	Y	1.0	0.68 U	0.75 U	0.69 U	0.09 J	0.1
IH-43	A	1.0	1.18 U	1.29 U	0.09 J	0.31 J	0.4
IH-43	B	2.0	2.13	18.44	5.58	49.03	73.1
IH-43	X	1.0	1.66	12.82	5.63	37.17	55.6
IH-43	Y	1.0	0.10 J	0.75 U	0.70 U	0.17 J	0.2
IH-44	A	1.0	1.03 J	14.60	3.10	17.82	35.5
IH-44	B	2.0	2.15	14.07	6.26	60.74	81.1
IH-44	C	2.0	1.27	3.05	3.74	18.33	25.1
IH-44	D	2.0	1.53	8.73	6.43	35.28	50.4
IH-44	X	1.0	3.24	4.45	19.18	50.74	74.4
IH-44	Y	1.0	0.04 J	0.08 J	0.08 J	0.53 J	0.7

TABLE 3.7. (contd)

Sediment Sample ID	Thickness (ft)	Pesticide Concentration ($\mu\text{g/kg}$ dry weight)				Total DDT(a)
		Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
IH-45 A	1.0	0.42 J	2.72	1.55	8.53	12.8
IH-45 B	2.0	1.15 J	3.13	2.55	20.65	26.3
IH-45 C	1.3	2.21	10.48	7.45	61.17	79.1
IH-45 X	1.0	0.45 J	7.42	1.00 J	8.60	17.0
IH-45 Y	1.0	0.02 J	0.76 U	0.05 J	0.39 J	0.4
IH-46 A	1.0	1.33	7.33	1.41	8.70	17.4
IH-46 B	2.0	0.52 J	10.66	1.29	8.49	20.4
IH-46 C	2.0	1.32	52.75	3.15	18.80	74.7
IH-46 X	1.0	0.60 J	0.18 J	2.03	10.98	13.2
IH-46 Y	1.0	0.10 J	0.76 U	0.71 U	0.19 J	0.2
IH-47 A	1.0	0.17 J	0.70 J	0.46 J	1.63	2.8
IH-47 B	2.0	0.94 J	8.39	1.91	14.11	24.4
IH-47 C	0.8	0.59 J	0.24 J	1.75	9.17	11.2
IH-47 X	1.0	0.44 J	0.29 J	1.50	8.68	10.5
IH-47 Y	1.0	0.68 U	0.74 U	0.69 U	0.10 J	0.1
IH-48 A	1.0	0.24 J	0.31 J	0.61 J	3.55	4.5
IH-48 B	2.4	0.42 J	0.36 J	1.11 J	7.43	8.9
IH-48 X	1.0	0.62 J	1.85	0.88 J	5.74	8.5
IH-48 Y	1.0	0.11 J	0.74 U	0.69 U	0.19 J	0.2
IH-49 A	1.0	0.21 J	0.37 J	0.64 J	2.28	3.3
IH-49 B	1.7	1.20 J	3.90	2.74	16.45	23.1
IH-49 X	1.0	0.96 J	0.83 J	2.84	22.01	25.7
IH-49 Y	0.8	0.10 J	0.79 U	0.73 U	0.21 J	0.2
IH-50 A	1.0	0.21 J	0.26 J	0.36 J	9.58	10.2
IH-50 B	2.0	0.25 J	0.88 J	1.14 J	3.08	5.1
IH-50 C	0.8	0.38 J	8.13	1.95	8.67	18.8
IH-50 X	1.0	0.25 J	0.70 J	1.27	5.33	7.3
IH-50 Y	1.0	0.60 U	0.65 U	0.61 U	0.08 J	0.1
IH-51 A	1.0	0.48 J	0.65 J	2.10	6.34	9.1
IH-51 B	1.0	1.03 U	0.18 J	0.49 J	1.78	2.5
IH-51 X	1.0	0.56 J	0.61 J	2.51	10.38	13.5
IH-51 Y	1.0	0.01 J	0.74 U	0.69 U	0.08 J	0.1
PC-52 A	1.0	7.91	45.90	30.86	123.52	200.3
PC-52 B	2.0	6.94	2.15	21.37	75.16	98.7
PC-52 C	1.1	18.58	10.51	48.94	155.05	214.5
PC-53 A	1.0	29.38	122.85	102.12	617.02	842.0
PC-53 B	1.4	39.32	52.46	81.86	526.74	661.1
PC-53 C	1.0	44.57	119.98	179.57	1142.75	1442.3

TABLE 3.7. (contd)

Sediment Sample ID	Thickness (ft)	Pesticide Concentration (µg/kg dry weight)				Total DDT(a)
		Dieldrin	4,4'-DDT	4,4'-DDE	4,4'-DDD	
PC-54 A	1.0	36.29	192.79	85.50	690.05	968.3
PC-54 B	1.6	44.86	433.31	131.83	1005.82	1571.0
PC-54 C	1.0	167.79	721.50	370.35	2986.02	4077.9
SFC Marina	NA(e)	1.98	8.67	7.17	46.54	62.4
FSFC Edge-West	NA	5.66	90.83	23.44	140.83	255.1
Parr Canal Edge	NA	11.55	758.73	56.54	327.83	1143.1
IHC Edge-East	NA	1.77 J	4.33	4.81	28.01	37.2
IHC Edge-West	NA	0.47 J	0.90 J	0.84 J	2.68	4.4
Outer Harbor Edge	NA	1.15 U	0.49 J	0.36 J	1.70	2.6

(a) Sum of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD. Undetected analytes are assigned a value of 0.

(b) J Analyte detected below method detection limit but above instrument detection limit.

(c) NM Analyte not measured in sample.

(d) U Analyte undetected above given concentration; some detection limits are elevated because of sample dilutions of 1:10 to 1:5000.

(e) NA Not applicable.

TABLE 3.8. Pesticides Other Than DDT, DDD, DDE, and Dieldrin in Vertical Core Segments and Channel Edge Grab Samples

<u>Sediment Treatment</u>	<u>Concentrations in µg/kg dry weight</u>							
	<u>Alpha-BHC</u>	<u>Aldrin</u>	<u>trans- Chlordane</u>	<u>Endo- sulfan I</u>	<u>cis- Chlordane</u>	<u>Endrin</u>	<u>Endo- sulfan II</u>	<u>Endrin- Aldehyde</u>
LZ-9Y	0.83	1.29	0.81	ND(a)	ND	1.15	ND	ND
LZ-11Y	0.74	ND	ND	ND	ND	ND	ND	ND
LZ-16 C	ND	ND	ND	ND	ND	116.53	ND	ND
SF-17 A	ND	ND	2.09	ND	ND	ND	ND	ND
SF-17 B	ND	ND	1.54	ND	ND	ND	ND	ND
SF-18 B	ND	ND	1.89	ND	ND	ND	ND	ND
SF-20 X	ND	ND	1.45	ND	ND	ND	ND	ND
SF-22 A	ND	ND	2.25	ND	ND	ND	ND	ND
SF-22 B	ND	ND	1.34	ND	ND	ND	ND	ND
SF-24 A	ND	ND	1.44	ND	ND	ND	ND	ND
SF-26 C	0.96	ND	ND	1.38	ND	ND	ND	ND
SF-26 X	ND	ND	ND	1.09	ND	ND	ND	ND
SF-27 A	ND	ND	ND	ND	ND	ND	ND	2.23
SF-28 B	0.66	ND	ND	ND	ND	ND	ND	ND
SF-28 X	1.01	ND	1.37	ND	ND	ND	ND	ND
SF-29 C	1.01	ND	ND	ND	ND	ND	ND	ND
SF-29 D	0.98	ND	ND	ND	ND	ND	ND	ND
SF-29 E	2.07	ND	ND	ND	ND	ND	ND	ND
SF-31 X	0.82	ND	ND	ND	ND	ND	ND	ND
SF-32 A	ND	ND	1.53	ND	ND	ND	1.83	ND
SF-33 A	0.66	ND	ND	ND	ND	ND	ND	ND
SF-33 X	ND	ND	1.33	ND	ND	ND	ND	ND
SF-34 A	ND	ND	2.62	ND	ND	ND	ND	ND
IH-44 X	ND	ND	ND	ND	ND	ND	1.12	ND
IH-46 A	ND	ND	ND	ND	ND	2.19	ND	ND
PC-52 A	ND	ND	6.15	ND	5.65	ND	2.93	ND
PC-52 B	ND	ND	10.24	ND	8.24	ND	ND	ND
PC-52 C	1.37	ND	24.95	ND	19.50	ND	ND	ND
PC-53 A	ND	ND	17.64	3.34	21.58	ND	ND	ND
PC-53 B	ND	ND	14.65	3.13	44.20	ND	9.31	ND
PC-53 C	9.14	ND	68.52	7.31	56.72	ND	ND	ND
PC-54 A	ND	ND	17.85	2.19	20.07	ND	6.69	ND
PC-54 B	ND	ND	34.59	ND	26.01	ND	9.78	ND
PC-54 C	8.55	ND	ND	ND	5.44	3.77	ND	ND

(a) ND Not detected above the target detection limit.

TABLE 3.9. Total DDT Concentrations and Percent Solids in Samples Above and Below the YBM/OBM Contact

<u>Treatment</u>	<u>1 ft Above YBM/OBM Contact</u>		<u>1 ft Below YBM/OBM Contact</u>	
	<u>Total DDT^(a)</u> <u>(µg/kg dry)</u>	<u>% Solids</u>	<u>Total DDT</u> <u>(µg/kg dry)</u>	<u>% Solids</u>
LZ-1	544	52	144	75
LZ-2	110,363	52	976	78
LZ-3	19,544	57	252	78
LZ-5	44,812	55	932	75
LZ-6	828	70	93	80
LZ-7	173	65	12	78
LZ-8	1,067	73	0.7	80
LZ-9	19,872	50	1,905	84
LZ-10	120,536	49	7.4	81
LZ-11	128,962	59	655	86
LZ-12	1,548	40	30	78
LZ-13	7,191	59	0.2	80
LZ-14	201	81	1.5	85
LZ-15	2,404	46	19	80
LZ-16	888	76	1.2	79
Mean	30,596	59	335	80

(a) Sum of 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE.

TABLE 3.10. Relative Contribution of DDT Metabolites to Total DDT

<u>Location</u>	<u>Percent 4,4'-DDT</u>	<u>Percent 4,4'-DDE</u>	<u>Percent 4,4'-DDD</u>
Lauritzen Canal ^(a)	42%	3%	55%
Federal Santa Fe Channel	30%	9%	61%
Inner Harbor Channel	21%	11%	68%
Parr Canal	14%	14%	72%
Upper Santa Fe Channel	12%	15%	73%

(a) Excluding samples LZ-1B, LZ-8C, LZ-8D, and LZ-8E.

TABLE 3.11. Oil and Grease, Total Petroleum Hydrocarbons, PAHs, and Aroclor 1254 in YBM from Selected Cores and in OBM Composites

Sediment Treatment	mg/kg dry weight		µg/kg dry weight			
	Oil and Grease	TPH	Total LPAH	Total HPAH	Total	Aroclor 1254
LZ-1 M	26,000	22,900	7,819.1	4,684.4	12,503	310.86
LZ-3 M	2,100	1,800	773.6	5,281.0	6,055	465.88
LZ-6 M	1,700	1,400	1,538.1	2,999.9	4,538	280.07
LZ-9 M	770	490	587.2	2,324.6	2,912	201.07
LZ-11 M	940	600	606.0	1,294.4	1,900	236.45
LZ-13 M	670	470	11,693.1	20,424.9	32,118	108.41
LZ-15 M	400	240	84.8	665.0	750	44.80 U(a)
SF-17 M	340	400	76.4	724.2	801	78.18
SF-18 M	510	360	143.6	1,331.7	1,475	125.69
SF-19 M	520	370	34.7	286.9	322	25.68 J(b)
SF-20 M	450	370	93.2	855.6	949	44.05 J
SF-21 M	300	290	34.8	288.1	323	37.77 J
SF-22 M	220	170	110.3	1,249.8	1,360	91.46
SF-23 M	190	330	62.4	366.4	429	21.43 J
SF-24 M	240	330	46.1	555.4	602	49.83
SF-25 M	520	520	9,714.2	14,484.4	24,199	109.92
SF-26 M	370	250	77.3	509.8	587	14.70 J
SF-27 M	390	450	21.6	173.1	195	4.82 J
SF-28 M	200	130	228.8	1,626.7	1,856	59.36
SF-30 M	400	170	63.9	501.1	565	11.80 J
SF-32 M	250	150	87.6	557.6	645	17.35 J
SF-34 M	310	210	190.6	1,637.2	1,828	58.62
IH-37 M	250	90 U	62.0	566.2	628	13.76 J
IH-38 M	270	90 U	23.4	191.1	215	6.21 J
IH-39 M	246	90 U	80.0	805.9	886	30.60 J
PC-52 M	19,800	14,800	1,726.8	5,056.0	6,783	675.00
PC-53 M	14,200	11,200	6,789.3	19,696.1	26,485	1,981.91
PC-54 M	3,700	2,300	562.3	4,170.7	4,733	567.81
OBM Comp-Fine	30 U	30 U	14.8	20.4	35	21.71 U
OBM Comp-Coarse	30 U	30 U	42.2	101.0	143	24.15 U

(a) U Analyte undetected above given concentration.

(b) J Analyte detected below method detection limit but above instrument detection limit.

TABLE 3.12. Metals and Butyltins in Younger Bay Mud from Selected Cores and in Older Bay Mud Composites

Sediment Treatment		Metal Concentration (mg/kg dry weight)										Butyltins (µg/kg dry weight)	
		Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	Tributyltin	Dibutyltin
LZ-1	M	1.62	16.4	2.12	177	138	2.18	91	223	0.60	544	13.2	11.6
LZ-3	M	1.27	15.5	1.87	224	134	1.70	102	222	0.50	378	17.6	15.0
LZ-6	M	0.60	15.7	1.28	237	113	0.96	105	120	0.30	279	10.8	10.6
LZ-9	M	0.59	18.4	1.04	254	105	0.78	102	79	0.40	262	22.0	23.6
LZ-11	M	0.70	15.1	1.70	235	99	1.41	93	82	0.60	228	5.3 J ^(a)	4.5 J
LZ-13	M	0.42	20.1	1.02	3990	212	0.55	124	102	0.46	360	37.5	21.9
LZ-15	M	0.41	15.6	0.53	251	155	0.53	122	96	0.40	255	24.9	12.4
SF-17	M	0.57	14.1	0.92	166	104	1.39	98	69	0.45	196	19.6	27.2
SF-18	M	0.53	15.0	0.74	176	101	1.13	109	75	0.41	223	85.5	50.5
SF-19	M	0.62	14.5	0.73	170	104	1.11	103	67	0.41	202	39.0	56.3
SF-20	M	0.52	14.5	0.50	168	106	0.76	116	59	0.51	209	29.9	45.9
SF-21	M	0.55	17.0	0.60	170	95	0.99	116	66	0.45	200	12.2	16.7
SF-22	M	0.45	26.6	1.21	173	168	1.18	106	66	0.45	396	19.9	13.9
SF-23	M	0.48	16.8	0.54	177	89	0.69	104	49	0.45	182	23.6	31.8
SF-24	M	0.47	17.4	0.66	180	114	1.01	112	60	0.45	206	27.2	28.7
SF-25	M	0.39	13.4	0.78	200	65	0.92	91	46	0.45	169	17.2	11.0
SF-26	M	0.74	17.6	0.88	196	107	1.25	108	71	0.49	226	13.2	10.4
SF-27	M	0.51	15.4	0.67	187	86	0.85	104	61	0.36	190	28.0	16.0
SF-28	M	0.43	11.6	0.50	181	69	0.61	93	43	0.40	157	13.1	16.7
SF-30	M	0.51	14.3	0.47	211	100	0.61	110	62	0.40	242	16.0	14.7
SF-32	M	0.16	14.8	0.39	199	50	0.31	83	23	0.26	105	7.9 J	3.6 J
SF-34	M	0.34	14.2	0.77	241	62	0.33	97	33	0.40	143	12.0	7.6
IH-37	M	0.47	13.0	0.47	183	73	0.52	112	56	0.36	181	5.1 J	7.6
IH-38	M	0.48	15.5	0.50	177	75	0.47	117	49	0.40	184	7.4 J	8.9
IH-39	M	0.58	15.7	0.60	192	74	0.53	115	55	0.35	192	8.1	6.7
PC-52	M	0.98	7.0 U ^(b)	3.17	245	138	0.92	86	849	0.45	709	28.0 D1 ^(c)	8.3 D1
PC-53	M	0.87	6.8 U	3.06	233	124	0.80	85	807	0.41	707	20.2 D1	15.9 D1
PC-54	M	0.60	11.9	1.99	266	98	0.71	86	323	0.40	401	36.3	28.7
OBM Comp - Fine		0.13	6.8	0.54	170	29	0.09	76	17	0.21	80	2.8 J	5.0 U
OBM Comp - Coarse		0.10	9.4	0.39	267	16	0.08	64	9	0.10 U	54	3.5 J	5.0 U

(a) J Analyte detected below method detection limit but above instrument detection limit.

(b) U Analyte undetected above given concentration.

(c) D1 Sample diluted 1:10

TABLE 3.13. Estimated Volume of Younger Bay Mud and Average DDT Concentration

<u>Category</u>	<u>Average Volume (cubic yards)</u>	<u>Standard Deviation</u>	<u>Average Total DDT^(a) ($\mu\text{g/kg}$ dry weight)</u>
Lauritzen Canal	54,376	16,513	73,112
Parr Canal ^(b)	10,000	NA	1,000
Santa Fe Channel	232,780	40,747	204
Inner Harbor Channel >100 $\mu\text{g/kg}$ ^(c)	63,686	25,633	135
Inner Harbor Channel >50 $\mu\text{g/kg}$ ^(d)	296,001	45,604	87
Total YBM >1000 $\mu\text{g/kg}$	64,376	NA ^(e)	61,910
Total YBM >500 $\mu\text{g/kg}$	64,376	NA	61,910
Total YBM >100 $\mu\text{g/kg}$	360,842	NA	11,201
Total YBM >100 $\mu\text{g/kg}$, excluding Lauritzen Canal	306,466	NA	216
Total YBM >50 $\mu\text{g/kg}$	593,157	NA	6,843
Total YBM >50 $\mu\text{g/kg}$, excluding Lauritzen Canal	538,781	NA	154

(a) Sum of 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE; Undetected analytes are assigned a value of 0.

(b) Single estimate assuming a uniform YBM thickness of 6 ft.

(c) Includes stations with average total DDT concentration greater than 100 $\mu\text{g/kg}$.

(d) Includes stations with average total DDT concentration greater than 50 $\mu\text{g/kg}$.

(e) NA Not applicable.

TABLE 3.14. Conventional Parameters in Sediment Composites

<u>Sediment Treatment</u>	<u>Percent Dry Weight</u>				<u>TOC</u>
	<u>Gravel >2000</u>	<u>Sand 62.5-2000</u>	<u>Silt 3.9-62.5</u>	<u>Clay < 3.9</u>	
Comp LC	7	25	27	41	1.90
Comp LC-1	5	23	26	46	5.24
Comp LC-2	1	23	34	42	1.93
Comp LC-3	7	31	25	37	1.62
Comp LC-4	4	20	27	49	1.90
Comp LC-5	5	26	30	39	1.77
Comp LC-6	4	28	34	34	1.89
Comp USFC	2	9	26	63	1.43
Comp FSFC	3	17	27	53	1.24
Comp IHC-1	1	5	30	64	5.24
Comp IHC-2	0	3	19	78	1.26
Comp IHC-3	0	2	33	65	1.20
Comp GD	1	5	36	58	1.81
C-SFBF	0	9	60	31	0.82
C-SFBC	9	83	5	3	0.05

TABLE 3.15. Dieldrin and DDT Compounds in Sediment Composites

Sediment Sample ID	Pesticide Concentration (µg/kg dry weight)				Total DDT(a)
	Dieldrin	4,4'-DDT	4,4'-DDD	4,4'-DDE	
Comp LC	480.57 J(b)	32776.54	20658.65	461.32 J	53886.5
Comp LC-1	318.51	11993.68	13762.32	1245.70	27001.7
Comp LC-2	1696.20 J	140212.86	75700.61	1982.00 J	217895.5
Comp LC-3	209.81 J	13996.72	7814.17	211.42 J	22022.3
Comp LC-4	34.46 J	460.72	611.27	40.30 J	1112.3
Comp LC-5	1568.82	41560.53	45625.72	974.08 J	88160.3
Comp LC-6	1515.15	15974.54	71441.35	1207.27	88623.2
Comp USFC	13.71	106.58	288.38	86.25	481.2
Comp FSFC	9.50	191.41	188.63	30.50	410.5
Comp IHC-1	0.66 J	7.29	8.73	1.24	17.3
Comp IHC-2	1.21 J	1.69	15.85	2.52	20.1
Comp IHC-3	1.00 J	6.81	12.16	1.70	20.7
Comp GD	0.30 J	1.38 U(c)	0.97 J	1.28 U	1.0
C-SFBF	0.98 U	0.62 J	2.48	0.99 U	3.1
C-SFBC	0.01 J	0.71 U	0.82 U	0.01 J	0.0

(a) Sum of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD. Undetected analytes are assigned a value of 0.

(b) J Analyte detected below method detection limit but above instrument detection limit.

(c) U Analyte undetected above given concentration; some detection limits are elevated because of sample dilutions of 1:10 to 1:5000.

TABLE 3.16. PAH, PCB, Oil and Grease, and TPH in Sediment Composites

Sediment Treatment	Concentration ($\mu\text{g/kg dry weight}$)				Concentration (mg/kg dry weight)	
	Total LPAH	Total HPAH	Total PAH	Aroclor 1254	Oil and Grease	TPH
Comp LC	959	6521	7480	283	1000	840
Comp LC-1	1150	10,357	11,507	1117	4310	3960
Comp LC-2	642	4311	4953	304	2600	2300
Comp LC-3	545	4269	4814	245	1340	1080
Comp LC-4	3654	17,912	21,566	171	630	480
Comp LC-5	1702	7762	9464	274	1200	1000
Comp LC-6	4495	4829	9324	297	2200	2000
Comp USFC	3542	5691	9233	153	910	660
Comp FSFC	200	1595	1795	64	450	330
Comp IHC-1	115	952	1067	34 J(a)	390	290
Comp IHC-2	74	649	723	13 J	380	180
Comp IHC-3	64	587	651	17 J	290	190
Comp GD	33	198	231	15 J	480	290
C-SFBF	70	497	567	7 J	260	160
C-SFBC	0.4	6	6.4	22 U(b)	110	69

(a) J Analyte detected below method detection limit but above instrument detection limit.

(b) U Analyte undetected above given concentration.

TABLE 3.17. Metals and Butyltins in Sediment Composites

Sediment Treatment	Metal Concentration (mg/kg dry weight)										Butyltins (µg/kg dry weight)	
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	Tributyltin	Dibutyltin
Comp LC	0.42	4.6 U(a)	0.94	273	97	1.12	93	314	0.50	238	33.7	28.1
Comp LC-1	0.67	16.1	2.06	285	202	1.27	106	225	0.75	517	83.6	85.6
Comp LC-2	0.75	19.1	1.37	273	171	0.98	103	152	0.55	444	60.7	56.9
Comp LC-3	0.40	14.4	0.90	242	119	0.69	92	119	0.41	313	30.3	31.4
Comp LC-4	0.37	14.4	0.55	248	118	0.59	100	54	0.45	201	209.6 D(b)	55.9 D
Comp LC-5	0.60	19.7	1.25	326	214	0.83	92	92	0.65	244	14.9	13.0
Comp LC-6	0.95	12.1	1.54	1540	100	1.37	101	372	0.51	369	6.0 J(c)	5.3
Comp USFC	0.66	9.3	1.02	143	92	1.48	81	66	0.45	213	39.3	37.4
Comp FSFC	0.44	15.9	0.65	221	91	0.52	113	53	0.35	199	18.0	12.3
Comp IHC-1	0.43	15.7	0.42	200	85	0.54	114	46	0.40	194	13.3	7.6
Comp IHC-2	0.36	17.0	0.29	209	76	0.48	130	43	0.40	187	8.7	4.0 J
Comp IHC-3	0.37	16.8	0.36	203	67	0.46	115	42	0.26	171	7.3 J	3.7 J
Comp GD	0.36	13.9	0.21	192	71	0.44	106	36	0.31	172	16.6	5.7
C-SFBF	0.20	13.7	0.25	191	36	0.25	90	20	0.26	108	5.9 J	19.6
C-SFBC	0.05	9.8	0.10	383	11	0.03	84	11	0.11	77	2.7 J	5.0 U

(a) U Analyte undetected above given concentration.

(b) D Sample diluted 1:2.

(c) J Analyte detected below the method detection limit but above the instrument detection limit.

TABLE 3.18. Results of the 10-day *Rhepoxynius abronius* Test

<u>Sediment Treatment</u>	<u>Mean Proportion Survival</u>	<u>Standard Deviation</u>	<u>Statistical Grouping^(a)</u>
Comp LC-1	0.00	0.00	A
Comp LC-2	0.00	0.00	A
Comp LC-3	0.00	0.00	A
Comp LC-5	0.00	0.00	A
Comp LC-4	0.74	0.11	B
Comp FSFC	0.74	0.26	B
Comp IHC-3	0.85	0.09	B
Comp USFC	0.88	0.08	BC
Comp IHC-1	0.89	0.11	BC
Comp IHC-2	0.89	0.05	BC
Comp GD	0.92	0.08	BC
C-SFBF	0.92	0.06	BC
C-SFBC	1.00	0.00	C
C-WB	0.96	0.09	NA ^(b)
C-WB Rerun	0.99	0.02	NA

(a) Derived from Tukey's HSD Test, $\alpha = 0.05$.

(b) NA Not applicable; treatment not included in statistical analysis.

TABLE 3.19. ANOVA Data for 10-day *Rhepoxynius abronius* Test

<u>Source of Variation</u>	<u>Sum of Sauares</u>	<u>d.f.(a)</u>	<u>Mean Sauares</u>	<u>F-ratio</u>	<u>Significance Level</u>
Treatment	22.845	12	1.904	81.230	0.0001
Residual	1.219	52	0.023	NA ^(b)	NA

(a) Degrees of freedom.

(b) NA Not applicable.

TABLE 3.20. Lipids, Dieldrin, and DDT Compounds in Tissues of *Macoma nasuta*

Sediment Treatment	Replicate	Lipids (percent dry weight)		Pesticide Concentration (µg/kg dry weight)				
		Measured	Bligh-Dyer Equivalent	Dieldrin	4,4'-DDE	4,4'-DDD	4,4'-DDT	Total DDT(a)
Comp LC	1	3.11	1.43	1895.18	1543.08	29898.65	2727.61	34169.3
Comp LC	2	5.05	2.32	1504.59	1894.71	32894.79	2478.44	37267.9
Comp LC	3	6.81	3.13	3054.35	2396.20	46507.78	2778.19	51682.2
Comp LC	4	8.53	3.92	2353.21	2761.38	12632.04	2436.72	17830.1
Comp LC	5	3.91	1.80	1518.68	1784.88	31119.74	2219.08	35123.7
Comp USFC	1	5.11	2.35	36.08	96.92	662.04	9.43	768.4
Comp USFC	2	3.79	1.74	32.07	102.22	654.49	6.95	763.7
Comp USFC	3	5.64	2.59	40.55	114.84	694.56	8.54	817.9
Comp USFC	4	4.48	2.06	31.84	87.63	583.51	9.21	680.4
Comp USFC	5	4.15	1.91	27.71	79.63	510.09	11.01	600.7
Comp FSFC	1	10.94	5.03	51.28	288.66	752.40	2.04	1043.1
Comp FSFC	2	10.89	5.00	37.42	246.82	576.64	5.79	829.3
Comp FSFC	3	5.07	2.33	27.68	220.62	589.83	3.48	813.9
Comp FSFC	4	7.33	3.37	43.19	193.73	479.14	4.80	677.7
Comp FSFC	5	4.38	2.01	21.28	112.97	147.49	1.28 J(b)	261.7
Comp IHC-1	1	15.51	7.13	6.95	26.31	121.83	2.13	150.3
Comp IHC-1	2	4.48	2.06	9.32	31.67	140.71	9.67	182.1
Comp IHC-1	3	3.97	1.82	10.68	26.54	141.25	3.98	171.8
Comp IHC-1	4	7.30	3.36	12.67	30.78	168.45	0.95 J	200.2
Comp IHC-1	5	4.32	1.99	11.87	31.24	204.23	4.09	239.6
Comp GD	1	4.86	2.23	3.28	6.47	64.66	4.40	75.5
Comp GD	2	4.37	2.01	1.75	4.52	14.21	0.83 J	19.6
Comp GD	3	10.93	5.02	1.94	4.55	21.59	1.69	27.8
Comp GD	4	4.95	2.27	1.70	4.85	33.12	1.70	39.7
Comp GD	5	4.46	2.05	1.66	4.34	12.81	0.43 J	17.6

(a) Sum of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD.

(b) J Analyte detected below method detection limit but above instrument detection limit.

TABLE 3.21. Detected Pesticides Other Than Dieldrin and DDT Compounds in Tissues of *Macoma nasuta*

Sediment Treatment	Replicate	Pesticide Concentration (µg/kg dry weight)				
		<u>Dieldrin</u>	<u>Aldrin</u>	<u>trans-Chlordane</u>	<u>cis-Chlordane</u>	<u>Endosulfan I</u>
Comp LC	1	0.34 U(a)	7.66	1091.57	49.88	55.76
Comp LC	2	13.39	4.20	114.01	51.67	67.08
Comp LC	3	0.51 U	11.07	2117.50	76.50	77.18
Comp LC	4	12.77	4.04	114.51	63.44	62.01
Comp LC	5	11.16	5.21	98.28	46.80	59.08
Comp USFC	1	0.86 U	0.69 U	2.57	2.14	2.57
Comp USFC	2	0.65 U	0.56 U	2.04	1.11	1.85
Comp USFC	3	0.60 U	0.52 U	2.85	1.81	2.59
Comp USFC	4	0.61 U	0.53 U	1.49 U	1.23	1.58
Comp USFC	5	0.73 U	0.55 U	1.65 J(b)	1.28	1.83
Comp FSFC	1	0.82 U	0.61 U	5.72	3.06	5.21
Comp FSFC	2	0.66 U	0.57 U	3.13	2.37	3.80
Comp FSFC	3	0.92 U	0.73 U	2.29 U	1.37 U	2.29 U
Comp FSFC	4	1.37 U	1.08 U	5.00	2.15	2.55 J
Comp FSFC	5	0.64 U	0.46 U	1.55 U	0.91 U	1.55 U
Comp IHC-1	1	0.40 U	0.29 U	0.98	0.69	0.52 J
Comp IHC-1	2	0.49 U	0.42 U	1.54	1.12	0.63 J
Comp IHC-1	3	0.36 U	0.30 U	0.66 J	0.66	0.48 J
Comp IHC-1	4	0.60 U	0.52 U	1.47 U	1.29	1.29 J
Comp IHC-1	5	0.48 U	0.34 U	1.91	1.36	0.68 J
Comp GD	1	0.60 U	0.52 U	0.52 J	0.52 J	0.09 J
Comp GD	2	0.65 U	0.55 U	1.57 U	0.65 J	0.74 J
Comp GD	3	0.67 U	0.51 U	0.51 J	0.51 J	0.08 J
Comp GD	4	0.57 U	0.40 U	0.48 J	0.32 J	1.29 U
Comp GD	5	0.51 U	0.36 U	1.16 U	0.58 J	1.16 U

(a) U Analyte undetected above given concentration.

(b) J Analyte detected below method detection limit but above instrument detection limit.

TABLE 3.22. PAH and PCB in Tissues of *Macoma nasuta*

<u>Sediment Treatment</u>	<u>Total Lipids (percent dry weight)</u>		<u>Concentration ($\mu\text{g/kg}$ dry weight)</u>			
	<u>Measured</u>	<u>Bligh-Dyer Equivalent</u>	<u>Total LPAH</u>	<u>Total HPAH</u>	<u>Total PAH</u>	<u>Aroclor 1254</u>
Comp LC	5.25	2.41	63.9	5367.9	5432	307.9
Comp USFC	5.22	2.40	1094.4	4476.9	5571	181.4
Comp FSFC	7.57	3.48	149.1	1667.2	1816	178.8
Comp IHC-1	7.46	3.43	23.9	550.9	575	90.7
Comp GD	9.11	4.18	155.0	873.1	1028	55.0

TABLE 3.23. Metals and Butyltins in Tissues of *Macoma nasuta*

Sediment Treatment	Metal Concentration (mg/kg drv weight)										Butyltins (µg/kg drv weight)	
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	Tributyltin	Dibutyltin
Comp LC	0.63	28.1	0.40	1.69	24.6	0.131	3.7	2.82	1.84	103	41.8	26.0
Comp USFC	0.66	30.3	0.29	2.06	24.1	0.136	5.1	2.35	1.85	98.5	43.9	26.8
Comp FSFC	0.59	25.5	0.39	2.20	21.8	0.131	3.1	1.88	1.80	125	39.2	60.4
Comp IHC-1	0.50	32.7	0.45	2.67	20.4	0.138	4.9	2.47	1.48	96.8	19.7	26.9
Comp GD	0.47	28.2	0.33	2.85	18.9	0.138	4.1	1.66	2.06	122	47.2	26.8

TABLE 3.24. Accumulation Factors for DDT Compounds, Dieldrin, Aroclor 1254, and PAHs in *Macoma nasuta* Tissue

Treatment	Accumulation Factor (g OC/g lipid)(a)						Total PAH	LPAH	HPAH
	Total DDT (b)	4,4'-DDT	4,4'-DDD	4,4'-DDE	Dieldrin	Aroclor 1254			
Comp LC	0.515	0.061	1.1 68	3.546	3.39(c)	0.857	0.572	0.052	0.649
Comp USFC	0.900	0.051	1.284	0.665	1.46	0.707	0.360	0.184	0.469
Comp FSFC	0.630	0.006	0.962	2.485	1.36	0.996	0.361	0.266	0.373
Comp IHC-1	16.68	0.873	27.19	36.12	23.8(c)	4.077	0.824	0.318	0.885
Comp GD	15.59	0.567	13.07	1.656	2.98(c)	1.585	1.925	2.032	1.908

(a) Factors for DDT compounds and dieldrin calculated using mean tissue contaminant concentration and mean lipid content of five replicates.

(b) Sum of 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE.

(c) Sediment concentration was below method detection limit but above instrument detection limit.

TABLE 3.25. Dieldrin and DDT Compounds in Liquid-Phase Samples

Liquid Phase Treatment	TSS (mg/L)	Pesticide Concentration (ng/L)				
		Dieldrin	4,4'-DDT	4,4'-DDD	4,4'-DDE	Total DDT(a)
Site Water	14	0.42 J(b)	0.76 J	2.74 J	8.09 U(c)	3.5
Procedural Blank	8	7.15 J	6.33 J	249	5.20 J	260
Comp LC SPP	41	448	701	9,542	611	10,854
Comp LC Elutriate	8	546	310	2,070	522	2,902
Comp LC-5 SPP	57	4,653	2,228	78,634	7,578	88,441
Comp LC-5 Elutriate	20	3,332	1,419	54,427	4,495	60,341
Comp LC-5 Elutriate UF(d)	NM(e)	2,966	1,088	42,986	3,529	47,603
Comp LC-5 Elutriate F(f)	NM	2,159	941	32,855	2,811	36,607
Comp LC-6 SPP	59	5,351	2,764	117,169	4,964	124,897
Comp LC-6 Elutriate	36	9,636	6,801	283,065	10,615	300,481
Comp USFC SPP	62	8.31 JB(g)	4.75 JB	101.44 B	41.35	147.5 B
Comp USFC Elutriate	8	22.89 B	18.45 B	882.17 B	29.93	930.6 B
Comp FSFC SPP	42	11.28 JB	9.33 JB	203.86 B	37.52	250.7 B
Comp FSFC Elutriate	2	5.43 JB	1.53 JB	41.18 B	4.09 JB	46.8 B
Comp IHC-1 SPP	34	1.81 JB	1.12 JB	22.07 B	3.24 JB	26.4 B
Comp IHC-1 Elutriate	3	1.12 JB	0.45 JB	17.00 JB	0.69 JB	18.1 B
Comp IHC-2 SPP	52	1.48 JB	3.49 JB	61.11 B	2.62 JB	67.2 B
Comp IHC-2 Elutriate	0	12.80 B	125.89	663.67 B	20.29 B	809.9 B
Comp IHC-3 SPP	40	1.20 JB	1.05 JB	15.02 B	0.85 JB	16.9 B
Comp IHC-3 Elutriate	2	1.17 JB	1.03 JB	18.94 B	0.75 JB	20.7 B

(a) Sum of 4,4'-DDT, 4,4'-DDE, and 4,4'-DDD; undetected analytes assigned value of zero.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte undetected above given concentration.

(d) UF Unfiltered elutriate.

(e) NM Not measured.

(f) F Granular-activated-carbon-filtered elutriate.

(g) B Sample result less than five times the concentration in the procedural blank.

TABLE 3.26. Chlorinated Pesticides Other Than Dieldrin and DDT Compounds in Liquid-Phase Samples

Liquid Phase Treatment	Pesticide Concentration (ng/L)					
	Alpha BHC	Beta BHC	Endrin	trans- Chlordane	cis- Chlordane	Endosulfan Sulfate
Site Water	5.12 U ^(a)	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U
Procedural Blank	5.12 U	4.57 U	9.31 U	0.76 J ^(b)	0.16 J	8.19 U
Comp LC SPP	158.71	6.39	15.53	182.04	46.96	8.19 U
Comp LC Elutriate	171.02	10.16	9.31 U	40.79	10.03	8.19 U
Comp LC-5 SPP	23.39	4.57 U	9.31 U	435.47	189.15	58.67
Comp LC-5 Elutriate	16.81	4.57 U	9.31 U	275.20	129.82	94.81
Comp LC-5 Elutriate UF ^(c)	5.12 U	4.57 U	9.31 U	246.10	70.60	101.90
Comp LC-5 Elutriate F ^(d)	5.12 U	4.57 U	9.31 U	6.33 U	65.16	8.04 J
Comp LC-6 SPP	5.12 U	4.57 U	9.31 U	1114.35	710.01	8.19 U
Comp LC-6 Elutriate	5.12 U	4.57 U	9.31 U	1240.78	400.06	8.19 U
Comp USFC SPP	5.12 U	4.57 U	9.31 U	3.19 JB ^(e)	9.18 U	8.19 U
Comp USFC Elutriate	5.12 U	4.57 U	9.31 U	2.78 JB	0.77 JB	8.19 U
Comp FSFC SPP	6.40 U	5.71 U	11.64 U	7.91 U	11.48 U	10.24 U
Comp FSFC Elutriate	5.12 U	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U
Comp IHC-1 SPP	5.12 U	4.57 U	9.31 U	0.54 JB	9.18 U	8.19 U
Comp IHC-1 Elutriate	5.12 U	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U
Comp IHC-2 SPP	5.12 U	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U
Comp IHC-2 Elutriate	5.12 U	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U
Comp IHC-3 SPP	5.12 U	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U
Comp IHC-3 Elutriate	5.12 U	4.57 U	9.31 U	6.33 U	9.18 U	8.19 U

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) UF Unfiltered elutriate.

(d) F Granular-activated-carbon-filtered elutriate.

(e) B Sample result less than five times the concentration in the procedural blank.

TABLE 3.27. PAH, PCB, and Tributyltin in Liquid-Phase Samples

Liquid Phase Sample	Concentration (ng/L)				
	Total LPAH	Total HPAH	Total PAH	Aroclor 1254	Tributyltin
Site Water	25.7	49.9	76	25 U(a)	27.2
Procedural Blank	40.8	119.5	160	25 U	24.9
Comp LC SPP	413.7	2,829.5	3,243	350	38.8
Comp LC ELUT	311.4	809.0	1,120	25 U	29.8
Comp LC-5 SPP	2,516.3	9,715.0	12,231	25 U	40.5
Comp LC-5 ELUT	2,676.9	7,265.7	9,943	25 U	28.3
Comp LC-5 Elutriate, UF(b)	2,503.2	7,735.6	10,239	25 U	NM(c)
Comp LC-5 Elutriate, F(d)	586.9	4,255.4	4,842	25 U	NM
Comp LC-6 SPP	9,371.7	11,299.8	20,671	25 U	10.0 U
Comp LC-6 ELUT	19,492.1	21,320.3	40,812	25 U	12.2
Comp USFC SPP	7,086.7	3,868.6	10,955	224	35.6
Comp USFC ELUT	7,332.6	1,284.2	8,617	25 U	24.6
Comp FSFC SPP	110.3 B(e)	572.9 B	683 B	124	17.1
Comp FSFC ELUT	25.0 B	129.1 B	154 B	25 U	16.9
Comp IHC-1 SPP	48.7 B	176.6 B	225 B	64	13.9
Comp IHC-1 ELUT	19.7 B	51.2 B	71 B	25 U	26.1
Comp IHC-2 SPP	26.4 B	168.6 B	195 B	25 U	10.0 U
Comp IHC-2 ELUT	164.9 B	147.6 B	312 B	25 U	13.4
Comp IHC-3 SPP	68.3 B	182.0 B	250 B	25 U	12.7
Comp IHC-3 ELUT	60.5 B	139.6 B	200 B	25 U	12.5

(a) U Analyte undetected above given concentration.

(b) UF Unfiltered elutriate.

(c) NM Not measured.

(d) F GAC-filtered elutriate.

(e) B Sample result less than five times the concentration in the procedural blank.

TABLE 3.28. Metals in Liquid-Phase Samples

Liquid Phase Treatment	Metal Concentration (µg/L)									
	Ag	As	Cd	Cr	Cu	Ha	Ni	Pb	Se	Zn
Site Water	0.02 U ^(a)	1.61	0.092	2.11	3.28	0.016	4.32	3.72	2.3 U	21.4
Procedural Blank	0.02 U	0.99	0.103	0.33	2.40	0.005	3.56	0.25	2.3 U	15.2
Comp LC SPP	0.02 U	7.48	0.072	1.31	3.60	0.036	2.67	3.45	2.3 U	8.97
Comp LC Elutriate	0.02 U	3.96	0.048	0.62	1.35	0.010	2.04	0.79	2.3 U	3.43
Comp LC-5 SPP	0.022	16.9	0.110	3.47	5.48	0.063	4.36	4.48	2.3 U	17.3
Comp LC-5 Elutriate	0.02 U	19.1	0.067	0.98	1.84	0.018	3.33	1.92	2.3 U	13.2
Comp LC-6 SPP	0.16	10.9	0.121	1.75	5.28	0.148	2.80	3.01	2.3 U	9.37
Comp LC-6 Elutriate	0.056	14.8	0.090	1.18	2.62	0.067	2.61	2.40	2.3 U	5.54
Comp USFC SPP	0.02 U	7.47	0.042	1.34	2.66	0.033	1.58	1.92	2.3 U	12.9
Comp USFC Elutriate	0.02 U	4.62	0.054	0.33	0.954	0.011	1.30	0.533	3.1	2.11
Comp FSFC SPP	0.02 U	4.26	0.179	1.18	2.94	0.024	2.16	1.44	2.3 U	8.71
Comp FSFC Elutriate	0.02 U	5.07	0.025	0.26	0.858	0.007	1.10	0.295	2.3 U	3.96
Comp IHC-1 SPP	0.02 U	8.17	0.035	1.08	2.52	0.021	2.36	2.11	2.3 U	4.09
Comp IHC-1 Elutriate	0.02 U	4.22	0.026	0.31	0.953	0.007	2.16	0.25	2.3 U	5.28
Comp IHC-2 SPP	0.02 U	7.99	0.02 U	1.36	3.11	0.012	3.66	1.29	2.3 U	4.49
Comp IHC-2 Elutriate	0.02 U	3.00	0.02 U	0.08	0.757	0.004	1.41	0.162	2.3 U	2.38
Comp IHC-3 SPP	0.02 U	7.46	0.02 U	1.03	1.99	0.015	2.97	0.915	2.3 U	29.6
Comp IHC-3 Elutriate	0.02 U	3.33	0.02 U	0.23	0.611	0.004	1.52	0.137	2.3 U	1.45

(a) U Analyte undetected above given concentration.

TABLE 3.29. Results of the 96-Hour SPP Test with *Holmesimysis costata*

<u>Sediment Treatment</u>	<u>Concentration (Percent SPP)</u>	<u>Mean Percent Surviving</u>	<u>Survival in 100% SPP Significantly Lower Than Survival in 0% SPP(a)</u>	<u>96-h LC₅₀ (Percent SPP)</u>
Comp LC	0	93		
Comp LC	10	0		
Comp LC	50	0		
Comp LC	100	0	Yes (t calc=28.000)	<10
Comp LC-5	0	93		
Comp LC-5	0.01	97		
Comp LC-5	0.1	83		
Comp LC-5	1	20		
Comp LC-5	10	0		
Comp LC-5	50	0		
Comp LC-5	100	0	Yes (t calc=28.000)	0.38
Comp LC-6	0	90		
Comp LC-6	10	0		
Comp LC-6	50	0		
Comp LC-6	100	0	Yes (t calc=2.700 E8)	<10
Comp USFC	0	93		
Comp USFC(b)	10	67		
Comp USFC(b)	50	47		
Comp USFC(b)	100	20	Yes (t calc=11.000)	38.8
Comp FSFC	0	97		
Comp FSFC(b)	10	93		
Comp FSFC(b)	50	77		
Comp FSFC(b)	100	63	Yes (t calc=7.071)	>100
Comp IHC-1	0	93		
Comp IHC-1(b)	10	90		
Comp IHC-1(b)	50	80		
Comp IHC-1(b)	100	67	Yes (t calc=7.071)	>100
Comp IHC-2	0	93		
Comp IHC-2(b)	10	87		
Comp IHC-2(b)	50	77		
Comp IHC-2(b)	100	67	Yes (t calc=3.578)	>100
Comp IHC-3	0	93		
Comp IHC-3(b)	10	93		
Comp IHC-3(b)	50	77		
Comp IHC-3(b)	100	57	Yes (t calc=3.889)	>100

(a) Evaluated in 1-tailed t-test ($\alpha = 0.05$, $df = 4$, critical t value = 2.132).

(b) Results may be influenced by possible cross-contamination during sample preparation.

TABLE 3.30. Results of the 96-Hour Elutriate Test with *Holmesimysis costata*

<u>Sediment Treatment</u>	<u>Concentration (Percent Elutriate)</u>	<u>Mean Percent Surviving</u>	<u>Survival in 100% SPP Significantly Lower Than Survival in 0% Elutriate^(a)</u>	<u>96-h LC₅₀ (Percent Elutriate)</u>
Comp LC	0	93		
Comp LC	10	0		
comp LC	50	0		
comp LC	100	0	Yes (t calc=14.000)	<10
comp LC-5	0	97		
comp LC-5	0.01	97		
comp LC-5	0.1	90		
Comp LC-5	1	43		
Comp LC-5	10	0		
comp LC-5	50	0		
Comp LC-5	100	0	Yes (t calc=29.000)	0.80
Comp LC-5 Unfiltered	0	97		
Comp LC-5 Unfiltered	100	0	Yes (t calc=29.000)	NA(b)
Comp LC-5 Filtered	0	97		
Comp LC-5 Filtered	100	0	Yes (t calc=29.000)	NA
Comp LC-6	0	93		
Comp LC-6	10	0		
Comp LC-6	50	0		
comp LC-6	100	0	Yes (t calc=28.000)	<10
USFC	0	90		
USFC ^(c)	10	67		
USFC ^(c)	50	50		
USFC ^(c)	100	20	Yes (t calc=6.062)	47.2
FSFC	0	93		
FSFC ^(c)	10	93		
FSFC ^(c)	50	80		
FSFC ^(c)	100	73	Yes (t calc=3.578)	>100
Comp IHC-1	0	100		
Comp IHC-1 ^(c)	10	90		
Comp IHC-1 ^(c)	50	83		
Comp IHC-1 ^(c)	100	67	Yes (t calc=10.000)	>100
Comp IHC-2	0	93		
Comp IHC-2 ^(c)	10	90		
Comp IHC-2 ^(c)	50	73		
Comp IHC-2 ^(c)	100	63	Yes (t calc=6.364)	>100
Comp IHC-3	0	97		
Comp IHC-3 ^(c)	10	87		
Comp IHC-3 ^(c)	50	77		
Comp IHC-3 ^(c)	100	53	Yes (t calc=9.192)	>100

(a) Evaluated in 1-tailed t-test ($\alpha = 0.05$, $df = 4$, critical t value = 2.132).

(b) NA Not applicable; insufficient data to estimate LC₅₀.

(c) Results may be influenced by possible cross-contamination during sample preparation.

TABLE 3.31. Results of the 48-Hour SPP Test with Larval *Mytilus galloprovincialis*

Sediment Treatment	Concentration [Percent SPP]	Mean Percent	Normal in 100% SPP	96-h EC ₅₀ (Percent SPP)	Mean Percent	Survival in 100% SPP	96-h LC ₅₀ (Percent SPP)
		Normal	Significantly Lower Than Normal in 0% SPP (a)		Survival	Significantly Lower Than Survival in 0% SPP (a)	
Comp LC	0	94.8			96.1		
Comp LC	10	93.7			95.7		
Comp LC	50	92.4			93.7		
Comp LC	100	0.3	Yes (t calc=35.10)	70.1	88.4	No (t calc=1.114)	>100
Comp LC-5	0	99.5			99.7		
Comp LC-5	10	93.8			94.6		
Comp LC-5	50	0.3			62.7		
Comp LC-5	100	0.0	Yes (t calc=149.00)	21.2	81.9	Yes (t calc=11.300)	>100
Comp LC-6	0	97.0			97.5		
Comp LC-6	10	98.4			99.2		
Comp LC-6	50	0.0			82.5		
Comp LC-6	100	0.4	Yes (t calc=65.59)	23.1	66.8	Yes (t calc=4.383)	>100
Comp USFC	0	98.9			99.3		
Comp USFC ^(b)	10	95.5			96.3		
Comp USFC ^(b)	50	99.9			100.0		
Comp USFC ^(b)	100	83.9	No (t calc=1.828)	>100	100.0	No	>100
Comp FSFC	0	96.9			97.7		
Comp FSFC ^(b)	10	86.6			89.0		
Comp FSFC ^(b)	50	93.5			95.3		
Comp FSFC ^(b)	100	13.6	Yes (t calc=53.30)	73.2	88.4	No (t calc=1.583)	>100
Comp IHC-1	0	98.9			99.3		
Comp IHC-1 ^(b)	10	93.2			94.5		
Comp IHC-1 ^(b)	50	75.1			84.5		
Comp IHC-1 ^(b)	100	0.1	Yes (t calc=148.00)	57.2	95.9	No (t calc=1.372)	>100
Comp IHC-2	0	97.5			98.0		
Comp IHC-2 ^(b)	10	90.1			90.9		
Comp IHC-2 ^(b)	50	80.5			84.1		
Comp IHC-2 ^(b)	100	0.2	Yes (t calc=36.09)	62.2	94.0	No (t calc=1.109)	>100
Comp IHC-3	0	94.0			95.3		
Comp IHC-3 ^(b)	10	90.8			91.9		
Comp IHC-3 ^(b)	50	0.1			95.3		
Comp IHC-3 ^(b)	100	0.0	Yes (t calc=20.51)	21.4	84.9	No (t calc=1.356)	>100

(a) Evaluated in 1-tailed t-test ($\alpha = 0.05$, $df = 4$, critical t value = 2.132).

(b) Results may be influenced by possible cross-contamination during sample preparation.

TABLE 3.32. Results of the 48-Hour Elutriate Test with Larval *Mytilus galloprovincialis*

Sediment Treatment	Concentration (Percent Elutriate)	Mean Percent Normal	Normal in 100% Elutriate Significantly Lower Than Normal in 0% Elutriate ^(a)	96-h EC ₅₀ (Percent Elutriate)	Mean Percent Survival	Survival in 100% Elutriate Significantly Lower Than Survival in 0% Elutriate ^(a)	96-h LC ₅₀ (Percent Elutriate)
Comp LC	0	97.6			97.9		
Comp LC	10	91.8			93.9		
Comp LC	50	92.9			94.5		
Comp LC	100	0.7	Yes (t calc=40.73)	69.5	73.6	Yes (t calc=6.478)	>100
Comp LC-5	0	98.6			99.0		
Comp LC-5	10	93.6			95.8		
Comp LC-5	50	0.4			67.4		
Comp LC-5	100	0.0	Yes (t calc=111.88)	21.4	57.3	Yes (t calc=3.233)	>100
Comp LC-6	0	100.0			100.0		
Comp LC-6	10	86.7			94.3		
Comp LC-6	50	0.1			70.4		
Comp LC-6	100	0.0	Yes (t calc=3.000 E8)	19.8	67.9	Yes (t calc=2.893)	>100
Comp USFC	0	87.9			89.3		
Comp USFC ^(b)	10	98.6			98.6		
Comp USFC ^(b)	50	89.0			92.0		
Comp USFC ^(b)	100	14.3	Yes (t calc=9.432)	75.8	80.5	No (t calc=0.7453)	>100
Comp FSFC	0	91.5			93.8		
Comp FSFC ^(b)	10	94.1			95.2		
Comp FSFC ^(b)	50	92.2			92.8		
Comp FSFC ^(b)	100	0.1	Yes (t calc=39.29)	70.7	59.0	No (t calc=1.477)	>100
Comp IHC-1	0	95.5			96.9		
Comp IHC-1 ^(b)	10	89.5			90.1		
Comp IHC-1 ^(b)	50	75.0			88.4		
Comp IHC-1 ^(b)	100	0.0	Yes (t calc=41.00)	64.0	81.1	No (t calc=1.026)	>100
Comp IHC-2	0	100.0			100.0		
Comp IHC-2 ^(b)	10	100.0			100.0		
Comp IHC-2 ^(b)	50	100.0			100.0		
Comp IHC-2 ^(b)	100	0.3	Yes (t calc=149.0)	71.0	100.0	No	>100
Comp IHC-3	0	97.1			98.4		
Comp IHC-3 ^(b)	10	100.0			100.0		
Comp IHC-3 ^(b)	50	0.1			91.6		
Comp IHC-3 ^(b)	100	0.0	Yes (t calc=55.18)	22.9	95.2	No (t calc=0.605)	>100

(a) Evaluated in 1-tailed t-test ($\alpha = 0.05$, $df = 4$, critical t value = 2.132).

(b) Results may be influenced by possible cross-contamination during sample preparation.

4.0 DISCUSSION

This section summarizes the results of the RI and discusses the physical characteristics of marine sediment at the United Heckathorn site, nature and extent of marine contamination, biological effects of contaminated sediment, and potential impacts of dredging and dewatering sediment during site remediation.

4.1 FIELD INVESTIGATION

The sampling strategy employed in the site characterization was based upon the assumption that the OBM would be present throughout the study area, and that anthropogenic contamination would be restricted to the overlying recent sediment of the YBM. Consequently, one of the RI objectives was to identify the depth to OBM throughout inner Richmond Harbor. The OBM was penetrated at every coring location, except the three stations in Parr Canal that were cored by hand. The elevation of the YBM/OBM contact ranged from **-15 ft** to **-20 ft** MLLW in the shallow portions of the Lauritzen Canal to approximately **-40 ft** MLLW in the Inner Harbor Channel. The thickness of the YBM varied from less than 2 ft to over 8 ft throughout the study area, with the thickest sediment in shallow areas that have not been dredged for some time. The YBM averaged **4 ft** to **6 ft** over most of the study area. This relatively constant YBM thickness suggests uniform sediment deposition in areas with similar dredging histories. The elevation of the OBM in the Parr Canal is not known; however, probes taken along the length of the canal encountered a hard surface at approximately 6 ft below the mudline.

The YBM in inner Richmond Harbor was on average more than **50%** clay, and had an average solids content of **47%**. These physical characteristics will be an important consideration in the selection of a remedial alternative. The USEPA guidance document *Selecting Remediation Techniques for Contaminated Sediment* (USEPA 1993) notes that many remedial technologies cannot effectively remove contaminants that are strongly bound to small particles, whereas others cannot successfully process fines. Treatment technologies such as dechlorination, soil washing, solvent extraction, incineration, and thermal desorption are not effective for sediment with high clay content. Solidification or stabilization are not feasible for clays because of the small particle size. The high water content and small particle size of the YBM sediment will increase the time required to dewater it. If contaminated sediments are removed or otherwise disturbed as part of a remedial action, a dredging technique that minimizes the resuspension of fine particulate matter should be selected.

The physical and chemical characteristics of the OBM indicate that it forms an excellent barrier to the migration of contaminants from recent sediment. The OBM consisted primarily of silty sand in the shallower portions of Lauritzen Canal, and finer-grained sandy silt and silt in the

deeper part of the channel. The OBM in the Santa Fe and Inner Harbor channels was generally a homogeneous, firm to hard silt and clay unit that is probably continuous beneath the coarser-grained sediment observed at shallower depths in the Lauritzen Canal. The OBM had an average of about 80% solids throughout the study area. The low water content and relatively low permeability of silt and clay minimize the likelihood of contamination by porewater diffusion, and its highly consolidated, unfractured character precludes the possibility of contamination by mixing with recent sediment. The concentrations of pesticides in sediment decreased significantly below the YBM/OBM contact, even in the coarser-grained OBM underlying the highly contaminated sediment in the northern and western portions of the Lauritzen Canal. Sediment chemistry is discussed further in Section 4.2.

The shoreline survey and analysis of grab samples from channel edges outside of the Lauritzen Canal identified few areas with soft sediment that would be difficult to remove by dredging, and that could potentially act as sources of contamination after remediation is complete. The majority of the shoreline is armored with riprap, sheetpile, or concrete-faced bulkheads. In areas where soft sediment was identified and sampled, no pockets of highly contaminated sediment were identified, except along the edge of the Parr Canal. The Parr Canal is restricted in area, has a narrow mouth, and is not likely to be a sediment source to Richmond Harbor. Grab samples were not collected from the edges of the Lauritzen Canal. Many of the core locations were close to the banks of the channel, and pesticide concentrations in most of these samples were extremely high. Therefore, if sediment were dredged from the Lauritzen Canal as part of a remedial action, highly contaminated sediment along the shoreline could be missed. The shoreline sediment could recontaminate adjacent areas.

4.2 SEDIMENT CHEMISTRY

The nature and extent of marine contamination are discussed in this section. As expected, the occurrence of pesticides, particularly DDT and dieldrin, was more widespread and at higher concentrations relative to San Francisco Bay background levels than the other measured contaminants. Other contaminants were detected in the YBM; however, average concentrations were generally comparable to background values for the periphery of San Francisco Bay (Long et al. 1988).

4.2.1 Nature and Extent of Chlorinated Pesticide Contamination

Sediment pesticide concentrations were highest in the Lauritzen Canal and decreased to background levels for San Francisco Bay near Point Potrero. Significant contamination was concentrated in the recent sediment of the YBM. Pesticide distribution in sediment, and contaminant fate and transport are discussed in the following sections.

1 Areal and Vertical Distribution of Pesticides in Sediment

The spatial trend in sediment pesticide concentrations delineated in this study is consistent with past data for Richmond Harbor (Table 4.1). A strong concentration gradient exists from the Lauritzen Canal to the Santa Fe Channel; the gradient is less steep from the Santa Fe Channel to the Inner Harbor Channel. The most highly-contaminated sediment was located in the shallow portions of the Lauritzen Canal, with total DDT concentrations in the tens to hundreds of parts per million (ppm). Total DDT concentrations dropped by an order of magnitude (to less than 10 ppm) in the dredged portion of the canal near the Levin terminal. The total DDT concentrations dropped by another order of magnitude (to less than 1 ppm) in the Santa Fe Channel. The most contaminated sediment in the Santa Fe Channel was located adjacent to the Lauritzen Canal; total DDT concentrations decreased toward the upper Santa Fe Channel and the Inner Harbor Channel. Total DDT concentrations decreased to less than 100 µg/kg by the center of the Inner Harbor Channel, 50 µg/kg by the south end of the channel, and 20 µg/kg by Point Potrero. Pesticide concentrations in sediment from the Parr Canal were lower than in the Lauritzen Canal sediment, but higher than in the Santa Fe and Inner Harbor Channel sediment. These data are consistent with data from previous studies in Richmond Harbor and with the ecological risk assessment for the Heckathorn site, although the median pesticide concentrations detected in Lauritzen Canal sediment in this study were higher (Table 4.1). Samples from previous studies were primarily collected from surface sediment, and results of this study show that the most highly contaminated sediments in the Lauritzen Canal are below the mudline surface.

Dieldrin was detected throughout the study area at much lower concentrations than was DDT. It showed the same spatial trend in relative concentration as DDT, with a maximum concentration of 16,000 µg/kg at the head of the Lauritzen Canal, 37 µg/kg in Santa Fe Channel, and 5.4 µg/kg in Inner Harbor Channel. Dieldrin was identified at concentrations near the detection limit in most samples from Inner Harbor Channel. Eight other pesticides were detected locally at lower concentrations.

The strong DDT and dieldrin concentration gradients indicate that the Lauritzen Canal is the source of contamination to the Santa Fe and Inner Harbor Channels. The primary source of DDT and dieldrin appears to be waste discharges to the canal during pesticide processing activities at the United Heckathorn site. In 1991, Parametrix reported the presence of four large steel tanks and a sunken barge near the north end of the Lauritzen Canal (Parametrix 1991). In August 1993, USEPA divers located one steel tank and a barge. Sediment collected from the barge and tank contained a maximum of 9000 µg/kg total DDT, indicating that the contents of these vessels are not a source of DDT to the Lauritzen Canal.

Significant pesticide contamination was concentrated in the YBM; samples from the OBM generally contained only traces of pesticides. In the Lauritzen Canal, the average concentration of total DDT in sediment decreased by two orders of magnitude from the base of the YBM to the top of the OBM, from about 30,000 $\mu\text{g/kg}$ to 300 $\mu\text{g/kg}$ (51 $\mu\text{g/kg}$ if four values of greater than 500 $\mu\text{g/kg}$ are disregarded). OBM samples from the 1-ft to 2-ft interval below the contact showed a further reduction in contamination (three samples had 1 $\mu\text{g/kg}$ or less total DDT, and four had between 7 $\mu\text{g/kg}$ and 181 $\mu\text{g/kg}$). Some (and possibly most) of the pesticides detected in the OBM samples from the Lauritzen Canal are believed to originate from contamination during sample preparation. Extreme care was taken to avoid sampling OBM that was in contact with the core liner; however, it is possible that a small amount of contamination by the very soft and highly contaminated overlying sediment occurred during the splitting and opening of the cores. The concentrations of pesticides in the uppermost 1 ft of OBM in the Santa Fe and Inner Harbor Channels were near the detection limit.

Vertical stratification in contaminant concentrations in the YBM was generally not well developed. In the shallow portions of the Lauritzen Canal, contaminant concentrations increased, and then decreased with increasing depth. The most highly contaminated sediment was generally found from 1 ft to 5 ft below the mudline. In the Santa Fe Channel, the most contaminated sediment was found down-channel of the mouth of the Lauritzen Canal in the surface sediment, and just up-channel of the mouth in deeper sediment. Contaminant concentrations were generally higher in deeper sediment in the Inner Harbor Channel. The reduced level of contamination in surface sediment throughout most of the site suggests that the primary source of contamination to the system is no longer present. The need for occasional maintenance dredging indicates that net deposition occurs in inner Richmond Harbor. Accumulation of sediment buries previously deposited contaminated material and may result in a decrease in contamination in surface sediment over time if the source of contamination no longer exists. The higher surface concentrations in the Santa Fe Channel downstream of the Lauritzen Canal relative to subsurface sediment may be due to the removal of sediment from this area as part of maintenance dredging of the Lauritzen Canal in 1985.

4.2.1.2 Contaminant Fate and Transport

DDT is essentially non-volatile, almost insoluble in water, and has very high soil adsorption constant. It is highly persistent in the environment. Dieldrin and DDT analogues have similar properties. The dominant transport mechanism for DDT is the migration of fine-grained sediment because DDT tends to bind to silt- and clay-sized particles. Contaminants can also move vertically in sediment by desorption, transport in porewater, and subsequent adsorption (porewater diffusion), or can disperse in the dissolved state by desorbing from sediment, being transported in solution, and later adsorbing back onto sediment. Porewater diffusion and

dissolved-phase transport are not likely to be important processes at the Heckathorn site because of the extremely low solubility of pesticides. Thus, DDT-contaminated sediment can leave the site by 1) exposure of contaminated sediment at the surface by vertical mixing, 2) resuspension of contaminated sediment, 3) transport, and 4) deposition.

The progressive burial of previously contaminated sediment does not necessarily prevent the dispersion of contaminants. Physical and biological processes can mix surface and subsurface sediment. Physical mixing due to wave resuspension is probably not significant in the protected waters of inner Richmond Harbor. Ship wakes and propeller wash resuspend and mix sediment. Sediment can also be disturbed and subsequently mixed by the grounding of ship keels and propellers, or by liquefaction and slumping. Biological activity (bioturbation) can mix sediment over an interval of millimeters to tens of centimeters, depending upon the resident species. Consequently, the exposure of previously contaminated sediment at the surface depends upon the relative rates of deposition and vertical mixing.

For the transport of contaminated sediment to occur, the particles must first be resuspended. Sediment and associated contaminants in inner Richmond Harbor are likely resuspended by ship wakes and propeller wash, dredging or construction activities, and biologic processes. Once suspended, the sediments are transported by wind or tidal currents, causing dispersal of the contaminants. Current speeds in Richmond Harbor are generally slow and are seldom capable of eroding fine sediment in the absence of other disturbances. Over the past 50 years, the periodic resuspension and transport of sediment out of the Lauritzen Canal have led to the gradual contamination of the Santa Fe Channel, and subsequently of the Inner Harbor Channel. If contaminated sediment were removed from or confined in the Lauritzen Canal, contaminant concentrations in Santa Fe and Inner Harbor Channels would be likely to slowly decrease over time.

The YBM in the Lauritzen Canal is contaminated throughout. Although the vertical profile of contamination has been defined, it is not possible to reconstruct the depositional history of the site without knowing the sediment deposition and mixing rates, and the relative importance of various sediment resuspension and transport processes. It is clear that surface sediments in the canal are still highly contaminated 27 years after activities at the United Heckathorn site ceased. The sharp drop in contaminant levels from the Lauritzen Canal to the Santa Fe Channel indicates that sediment is being transported out of the canal at a very slow rate.

DDT, DDT analogues, and dieldrin are more persistent in the environment than other chlorinated pesticides (Gould 1972). DDT may be broken down by chemical and biological means to 4,4'-DDD, 4,4'-DDE, and other compounds. 4,4'-DDD was also manufactured as an insecticide; it is not known whether it was processed at the United Heckathorn facility. DDT in sediment is converted primarily to DDE under aerobic conditions, and to DDD in anaerobic

conditions (Murty 1986). Table 4.2 summarizes the relative percentage of DDT analogues contributing to total DDT in samples from the upland and embankment areas near the former United Heckathorn facility (Levine-Fricke 1990), marine sediment samples collected in this study, and marine sediment samples collected during the ecological risk assessment of the Heckathorn site. The results from this study and the ecological risk assessment are in good agreement. The marine sediment contained a lower percentage of 4,4'-DDT relative to the upland and embankment samples, indicating that DDT is being degraded in the marine environment. The degradation is likely occurring under anaerobic conditions in the Lauritzen Canal, as evidenced by the large percentage of 4,4'-DDD relative to 4,4'-DDE (although some of the 4,4'-DDD may have been directly released in waste discharges from the United Heckathorn facility).

The percentage of 4,4'-DDE in Lauritzen Canal sediment is similar to its contribution in the upland and embankment samples, with the exception of samples of gray material (primarily calcium carbonate) collected from Stations LZ-1 and LZ-8. These samples had relative percentages of 18% and 50% of 4,4'-DDD and 4,4'-DDE, respectively. Conditions in this sediment apparently enhanced the formation of DDE. In sediment outside of the Lauritzen Canal, the relative percent of 4,4'-DDT decreased, indicating that degradation has proceeded to a greater degree in these sediments. The relative percent of 4,4'-DDE increased in these sediments to between 10% and 20%, although 4,4'-DDD remained the dominant DDT compound. The increase in 4,4'-DDE may reflect slightly more aerobic conditions.

4.2.2 Other Contaminants

Table 4.3 summarizes the median concentrations of contaminants other than pesticides detected in samples of the YBM from this study and a 1992 dredged material disposal study for Richmond Harbor (Pinza et al. 1992). These data are compared to median concentrations for the periphery of San Francisco Bay, as tabulated in National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NOS OMA 41 (Long et al. 1988). The NOAA data are median values from a compilation of data from 13 studies conducted between 1971 and 1987, excluding areas of known contamination, and are considered background conditions for the periphery of San Francisco Bay in the following discussion. Also provided for comparison are Apparent Effects Threshold (AET) concentrations for San Francisco Bay, which are contaminant concentrations above which significantly toxic effects were always observed (Long and Markel 1992). These values are based on the evaluation of matching sediment chemistry and bioassay data from numerous studies, and do not represent regulatory criteria or standards.

Metals concentrations in Richmond Harbor measured in 1992 and 1993 were generally consistent with those in sediment along the periphery of San Francisco Bay. Chromium, mercury, and lead concentrations exceeded background conditions, but were below the AET. The median copper concentration measured in this study was approximately equal to the AET. The median

concentrations of total PAHs and PCBs measured in this study were less than the median for the periphery of San Francisco Bay, and far below the **AETs**. Butyltin concentrations were higher than measured in 1992; however, only samples from the upper Lauritzen Canal and upper Santa Fe Channel had higher concentrations than those measured in other industrialized waterways of San Francisco Bay such as Oakland Inner Harbor (up to 48 $\mu\text{g/kg}$ near Todd Shipyards) (Ward et al. 1992). Compilations of sediment chemistry and solid-phase toxicity data for butyltins are not currently available.

Although the median concentrations of metals, PAHs, and PCBs were within expected ranges for an industrialized area, sediment in the upper Lauritzen Canal and Parr Canal had higher concentrations of these contaminants than elsewhere in Richmond Harbor. Sediment in the Lauritzen and Parr Canals had extremely high pesticide concentrations as well. In general, metals, PAHs, PCBs, and butyltins were not present at elevated concentrations or over a large area compared to chlorinated pesticides.

4.3 SEDIMENT VOLUMES

The cleanup criteria for total DDT in sediment at the United Heckathom site have not yet been established; however, the volume of sediment requiring remediation can be estimated from the data generated in this study once the cleanup level has been established. Volumes of sediment were estimated with total DDT concentrations exceeding 1000 $\mu\text{g/kg}$, 500 $\mu\text{g/kg}$, 100 $\mu\text{g/kg}$, and 50 $\mu\text{g/kg}$. The cleanup level for pesticides in sediment at the Heckathorn site is likely to fall within the range of these four concentrations. These concentrations yielded, respectively, approximately 65,000-, 65,000-, 350,000-, and 600,000-cu-yd in-place volumes. These estimates will be used to evaluate the feasibility of various remedial alternatives.

4.4 BIOLOGICAL EFFECTS OF CONTAMINATED SEDIMENT

Results of the solid-phase and bioaccumulation tests were consistent with data from the ecological risk assessment and another previous study (Pinza et al. 1992). The greatest biological impact was associated with sediment from the Lauritzen Canal; toxicity and levels of bioaccumulation decreased with increasing distance from the United Heckathom site. Test results are discussed in the following sections.

4.4.1 Solid-Phase Acute Toxicity

Lauritzen Canal sediment, except for the surface 1 ft from the south end of the canal, was acutely toxic (0% survival) to the amphipod, *R. abronius*. *R. abronius* survival was reduced, but not extreme (74% survival), in the southern portion of Lauritzen Canal and in the federal portion of Santa Fe Channel. Acute toxicity decreased with distance from Lauritzen Canal, with 85% to 89% survival in upper Santa Fe Channel and in Richmond Inner Harbor Channel. Part of the

reduced survival outside of Lauritzen Canal may also be attributed to an inappropriate habitat for the amphipods: a fine-grained control sediment from San Francisco Bay resulted in 92% *R. abronius* survival while a coarse-grained control sediment resulted in 100% survival. The grain-size distribution of Santa Fe and Inner Harbor Channel sediments was similar to or finer than the fine-grained control.

4.4.2 Sediment Bioaccumulation

Wet weight concentrations of contaminants in tissues of *M. nasuta* were compared to available Food and Drug Administration (FDA) action levels for fish and shellfish consumption and to National Academy of Sciences (NAS) action levels for fish consumption by marine birds or mammals (Table 4. 4). Most tissue concentrations of contaminants were well below the FDA limits. The maximum dieldrin level in *M. nasuta* exposed to Comp LC exceeded the 0.3 mg/kg (wet weight) limit. *M. nasuta* exposed to Comp LC-5 exceeded the 5 mg/kg FDA limit for total DDT. No FDA action levels for fish and shellfish consumption have been established for PAHs, PCBs, butyltins, or metals other than methyl mercury. Dieldrin, DDT, and DDT analogues in *M. nasuta* exposed to Comp LC were well in excess of the NAS action levels for those compounds in fish. *M. nasuta* exposed to Comps USFC and FSFC also exceeded the NAS action level for DDT and DDT analogues. Nearly all Comp USFC and FSFC *M. nasuta* replicates had dieldrin concentrations of 3 µg/kg to 5 µg/kg wet weight, but the NAS limit of 5 µg/kg was exceeded in just one replicate of Comp FSFC.

Average total DDT levels in *M. nasuta* are comparable to those reported in the ecological risk assessment and another previous investigation (HLA 1986a). The bioaccumulation results from this study confirm the conclusions of USEPA's ecological assessment of laboratory bioaccumulation. Dieldrin and DDT compounds were available in a form that could be bioaccumulated by shellfish, and tissue pesticide levels dropped by at least an order of magnitude from Lauritzen Canal to the Santa Fe Channel, and by at least two orders of magnitude in Inner Harbor Channel. The distribution of DDT analogues in tissues, expressed as a percentage of the total DDT, was similar to that measured by USEPA. The primary analogue present in *M. nasuta* was 4,4'-DDD (approximately 85% in MSL study and 95% in USEPA study), while DDE made up a small proportion (10% to 14% in MSL study and about 4% in USEPA study), and DDT made the smallest contribution to total DDT in tissues (1% to 5% in MSL study, less than 1% in USEPA study). The ratio of DDT analogues was different in tissue than in sediments, in which 4,4'-DDT contributed a similar amount or more than 4,4'-DDD to total DDT.

In the ecological risk assessment, USEPA estimated that 30% to 50% of the steady-state concentration of most DDT analogues in *M. nasuta* was reached at 28 days of exposure. Only 9% of the steady-state concentration of 4,4'-DDT was reached at 28 days. The accumulation

factors (**AFs**) calculated using data from this study can be compared to USEPA's **AFs** if the tissue pesticide concentrations are corrected from 28-day values to steady-state values. The correction factors, provided by **USEPA**, are based on comparison of 28-day values to 42-, 60-, and 90-day values. Table 4.5 shows both MSL and **USEPA AFs**, with all 28-day data corrected to steady-state values. The **AFs** were generally comparable for the **Lauritzen Canal** and Santa Fe Channel; the MSL values were slightly higher in some cases. The **AFs** from this study were much higher than USEPA's for the Inner Harbor Channel, probably because the detection limits for sediment analyses achieved by MSL were low in comparison to USEPA's.

Literature values for **AFs** typically used for equilibrium partitioning models of bioaccumulation range from 1 to 4 (USEPA/USACE 1991; McFarland 1984; Rubinstein et al. 1987). The steady-state **AFs** of MSL and **USEPA** show that an **AF** of 4 may underestimate maximum tissue concentration for some compounds, especially those obtained from sediment with low contaminant concentrations. A more ecologically protective approach would be to use a higher **AF** value. The MSL data show that even with very low sediment concentrations, *M. nasuta* can accumulate pesticides well beyond what would be predicted by the sediment concentration and TOC. However, in the case of extremely high **AFs** for the Inner Harbor Channel and graving docks, it is likely that some assumptions of the equilibrium partitioning model were not met (e.g., the chemical behaved conservatively, sediment was the only source of the chemical, no metabolic degradation or transformation of the chemical occurred, the **desorption** rate of the chemical from TOC did not vary with the sediment concentration of TOC).

4.5 TREATABILITY TESTING

Several potential remedial alternatives under consideration for the Heckathorn site require dredging and dewatering of marine sediment. The purpose of treatability testing was to provide a preliminary evaluation of potential problems associated with the dredging and dewatering of contaminated sediment in Richmond Harbor, and the effectiveness of various effluent treatment methods. The effluent from dewatering sediment would represent a short-term point discharge to a receiving water body. Any discharge from a confined disposal facility could not cause a violation of water quality standards applicable to San Francisco Bay. CERCLA requires that remedial actions at a Superfund site meet all ARARs of federal and state environmental laws, unless a waiver is justified. Potential **ARARs** include the following standards:

- **State of California Water Quality Objectives.** The State of California Enclosed Bays and Estuaries Plan identifies numerical water **quality** objectives for contaminants pursuant to the requirements of Section 303 of the Clean Water Act. The values are based upon USEPA's Ambient Water Quality Criteria. These objectives apply to all surface waters of San Francisco Bay. Toxicity objectives state that there shall be no acute toxicity in ambient waters, including mixing zones, and that there shall be no chronic toxicity in ambient waters outside mixing zones. Narrative water quality objectives under the plan state that enclosed bay and estuarine communities and populations shall not be degraded

as a result of the waste discharge, and that concentrations of toxic pollutants in the water column shall not adversely affect beneficial uses.

- **USEPA Ambient Water Quality Criteria.** CERCLA requires that remedial actions meet water quality criteria established under Section 304 or 303 of the Clean Water Act, where relevant and appropriate.

The analytical results for liquid-phase samples and results of toxicity testing are compared to these potential **ARARs** in the following sections.

4.5.1 Contaminant Concentrations

Federal and state water quality criteria and objectives are identified in Table 4.6. The federal marine chronic criteria and state water quality objectives for DDT, dieldrin, and other pesticides are below the detection limit for the water analyses. Pesticide concentrations in all liquid-phase samples prepared from Lauritzen Canal composites exceeded the criteria for DDT and dieldrin by large factors. Chlordane isomers exceeded both acute and chronic water quality criteria in nearly all Lauritzen Canal liquid-phase samples. Options for the treatment of effluent from Lauritzen Canal sediment include control for fine particulates, dilution to achieve water quality criteria, or treatment with a GAC-adsorption system. Concentrations of pesticides in elutriate samples exceeded water quality criteria; therefore, controlling for fine-particulates by increasing the settling time of the effluent would not be likely to sufficiently improve its quality. Effluent would require more than a thousand-fold dilution to decrease concentrations to acceptable levels, which is not likely to be practical.

Treatment by GAC-adsorption reduced DDT and dieldrin concentrations in elutriate from Comp LC-5 by approximately 25%; however, additional testing is needed to assess whether this type of treatment is capable of reducing contaminant concentrations to acceptable levels. Additional testing could identify the most effective adsorbent material, quantity of adsorbent material needed, and optimal flow rate of effluent through the adsorbent material. Based on available data, GAC-adsorption may be a feasible option for the treatment of effluent from dewatered sediment from the Lauritzen Canal, depending upon the volume of effluent requiring treatment.

Pesticide concentrations in effluent from sediments outside the Lauritzen Canal were much lower; however, procedural blank contamination prevented a determination of whether they would exceed state water quality objectives. The site water used to prepare the liquid-phase samples exceeded the state water quality objective of 1 ng/L total DDT.

Concentrations of PCBs, copper, and mercury also exceeded marine water quality criteria in some instances. Where detected in liquid-phase samples, Aroclor 1254 concentrations exceeded federal marine chronic water quality criteria for PCBs (30 ng/L), but were lower than the marine acute criteria (10,000 ng/L). Concentrations of copper in the site water exceeded both

acute and chronic water quality criteria, as did copper in SPP of Comps LC, LC-5, LC-6, FSFC, and IHC-2. Of those, only Comp LC-5 had an unusually high sediment copper concentration (214 **mg/kg**, or twice the concentration in the other sediment composites). Four SPP samples (Comps LC, LC-5, LC-6, and USFC) also exceeded the chronic water quality criterion for mercury.

4.5.2 Toxicity of Effluent

The presence of dieldrin, DDT, DDT analogues, and **PAHs** in the procedural blank at higher concentrations than those measured in site water indicates that liquid-phase samples could have been contaminated during the SPP and elutriate preparation process. Toxicity results for liquid-phase samples prepared from Lauritzen Canal sediment were not likely to have been influenced by potential cross-contamination because pesticide and PAH concentrations in these samples greatly exceeded the concentrations in the procedural blank. However, toxicity results for liquid-phase samples prepared from sediment outside the Lauritzen Canal could have been influenced by potential cross-contamination because contaminant concentrations in the liquid-phase samples and procedural blank are generally comparable. Consequently, the potential effects of effluent from Santa Fe and Inner Harbor Channel sediments on marine organisms are uncertain.

SPP and elutriate prepared from Lauritzen Canal sediment composites produced statistically significant reductions in survival of the test organism *H. costata*. Survival of the mysid in the 100% SPP and elutriate prepared from each Lauritzen Canal sediment composite was 0%. Survival of mussel larvae was statistically significantly reduced in the 100% SPP and elutriate from Comps LC-5 and LC-6, and in elutriate from Comp LC. The California Enclosed Bays and Estuaries Plan defines acute toxicity as less than 90% survival 50% of the time, and less than 70% survival 10% of the time, of standard test organisms in undiluted effluent in a 96-hour static or continuous-flow test. Based on this definition, effluent from a confined disposal facility containing sediment from the Lauritzen Canal would likely not meet the water quality objective of no acute toxicity in ambient waters, including mixing zones. The process of dredging in the Lauritzen Canal is also likely to produce toxic effects in the water column by the resuspension of fine-grained sediment.

Chronic effects on mussel larvae were observed with SPP and elutriate prepared from all Lauritzen Canal composites. The state water quality objective for chronic toxicity is 1.0 **TU_c**, where **TU_c** equals 100/No Observed Effect Level (NOEL). NOEL is the maximum percent of test water that causes no observed effect on a test organism, as determined in a critical life stage toxicity test. Chronic toxicity in SPP and elutriate from all Lauritzen Canal sediment composites exceeded this criteria. Effluent from a confined disposal facility containing Lauritzen Canal

sediment would likely require additional treatment beyond the removal of fine particles to meet this objective.

TABLE 4.1. Comparison of Total DDT in Marine Sediment With Previous Studies

Location	This Study		Previous Studies(a)		Ecological Risk Assessment(b)	
	Median Total DDT (µg/kg)	n(c)	Median Total DDT (µg/kg)	n	Median Total DDT (µg/kg)	n
Upper Lauritzen Canal	46,916	27	11,000(d)	51	36,917(e)	4
Western Lauritzen Canal	13,824	18	975(d)	8	NA(f)	NA
Dredged Area, Lauritzen Canal	1480	22	282(d)	23	NA	NA
Santa Fe Channel	131	76	250(d)	35	626	6
Inner Harbor Channel	19.6	74	25	28	60	6

(a) HLA 1986a, Levine-Fricke 1990, Brown et al. 1990, Pinza et al. 1992.

(b) Lee, Henry et al. 1993. *Ecological Risk Assessment of the Marine Sediments at the United Heckathorn Superfund Site* (Draft). ERLN: N269. Prepared by the U.S. Environmental Protection Agency, Newport, Oregon.

(c) n = Number of samples.

(d) Wet weight concentrations converted to dry weight concentrations assuming 55% moisture content.

(e) Entire Lauritzen Canal.

(f) NA = Not applicable.

TABLE 4.2. Relative Contribution of DDT Analogues to Total DDT in Upland and Marine Sediment Samples

<u>Location</u>	<u>Average Percent 4,4'-DDT</u>	<u>Average Percent 4,4'-DDE</u>	<u>Average Percent 4,4'-DDD</u>
Upland and Embankment Samples ^(a)	73	7	20
Lauritzen Canal			
This study	42	3	55
Ecological Risk Assessment ^(b)	44	3	53
Santa Fe/Inner Harbor Channels			
This study	21	12	68
Ecological Risk Assessment	23	17	60

(a) Levine-Fricke 1990. Data for 2,4'-DDT not included.

(b) Lee, Henry et al. 1993. *Ecological Risk Assessment of the Marine Sediments at the United Heckathorn Superfund Site* (Draft). ERL-N: N269. Prepared by the U.S. Environmental Protection Agency, Newport, Oregon.

TABLE 4.3. Concentrations of Contaminants in Sediments from San Francisco Bay and Apparent Effects Thresholds

<u>Contaminants</u>	<u>San Francisco Bay Periphery Median (Long et al. 1988)</u>	<u>Richmond Inner Harbor, 1991 Median^(a) (Pinza et al., 1992)</u>	<u>United Heckathorn Site 1993 Median^(b) (this study)</u>	<u>Apparent Effects Threshold (Long and Markel, 1992)</u>
<u>Trace Metals (ppm dry weight)</u>				
Ag	1.2	0.34	0.53	>8.6
As	NA ^(c)	12.3	15.3	>72
Cd	0.76	0.43	0.76	1.7
Cr	66	200	194	>240
Cu	55	62	103	98
Hg	0.40	0.34	0.83	1.2
Ni	NA	114	104	NA
Pb	43	33.4	67	120
Se	NA	0.83	0.41	0.2
Zn	NA	137	216	230
<u>Organic Compounds (ppb dry weight)</u>				
Total PAH	4600	968	1155	>15,000
Total PCB	221	38	59	260
TBT	NA	2.5	18.6	NA
DBT	NA	2.4	14.9	NA

(a) Samples collected from Inner Harbor Channel and Point Potrero only.

(b) YBM composite samples only.

(c) NA Not available.

TABLE 4.4. Comparison of Action Levels With Contaminant Levels in *M. nasuta* Exposed to Sediment Composites

<u>Contaminant</u>	<u>FDA Action Level(a) ($\mu\text{g/kg}$ wet weight)</u>	<u>NAS Action Level(b) ($\mu\text{g/kg}$ wet weight)</u>	<u>Concentration Range in <i>M. nasuta</i> ($\mu\text{g/kg}$ wet weight)</u>
Methyl Mercury	1000(c)	NA(d)	16 to 20(e)
Chlordane	300(f)	50	ND(g) to 260(h)
DDT and metabolites(i)	5000(f)	50	2 to 7090
Dieldrin + Aldrin	300(f)	5	0.2 to 395
Dieldrin	300(f)	5	0.2 to 393
Endrin	NA(j)	5	ND to 1.7
Heptachlor + Heptachlor Epoxide	300(f)	5	ND to 1.4
Toxaphene	5000(f)	50	ND
PCBs	2000(k)	500	7 to 44

- (a) **Action Levels for Poisonous or Deleterious Substances in Human Food and Animal Feed**, Department of Health and Human Services, Public Health Service, Food and Drug Administration, Washington D.C. Current as of August 1992.
- (b) National Academy of Sciences and National Academy of Engineering, EPA-R3-73-033, March 1973. Values apply to whole fish consumption by birds and mammals in the marine environment.
- (c) Edible portion of fish, shellfish, crustaceans, and other aquatic animals.
- (d) NA Not applicable.
- (e) Value is for total mercury; methyl mercury is fraction of total but was not analyzed separately.
- (f) Edible portion of fish.
- (g) ND Not detected.
- (h) Sum of cis- and trans-chlordane.
- (i) DDT + DDD + DDE
- (j) Action level for endrin revoked, Federal Register July 28, 1993.
- (k) Tolerance level for fish and shellfish, 21CFR109.30(a)(7).

TABLE 4.5. Comparison of Accumulation Factors for DDT and Dieldrin in *M. nasuta* Tissue

Compound	Accumulation Factors (all data corrected to steady state)					
	Lauritzen Canal		Upper Santa Fe Channel		Upper Inner Harbor Channel	
	<u>MSL (a)</u>	<u>USEPA (b)</u>	<u>MSL</u>	<u>USEPA</u>	<u>MSL</u>	<u>USEPA</u>
4,4'-DDE	7.45	0.52-3.94	1.40	0.29-2.09	75.9	0.59-1.45
4,4'-DDD	3.50	0.41-4.78	3.85	0.32-2.87	81.6	0.31-1.00
4,4'-DDT	0.66	0.01-0.57	0.55	0.89-1.39	9.4	0.24-1.83
Total DDT(c)	1.49	0.18-3.26	2.61	0.19-2.45	48.4	0.30-0.96
Dieldrin	5.76	0.40-3.22	2.49	0.60-5.50	40.5	0.50-1.40

(a) This study.

(b) Lee, Henry et al. 1993. *Ecological Risk Assessment of the Marine Sediments at the United Heckathorn Superfund Site* (Draft). ERL-N: N269. Prepared by the U.S. Environmental Protection Agency, Newport, Oregon.

(c) Sum of 4,4'-DDT, 4,4'-DDD, and 4,4'-DDE.

TABLE 4.6. State and Federal Water Quality Objectives

Parameter	Unit	Federal Marine Acute WQC	Federal Marine Chronic WQC	State WQO Saltwater Aquatic Life, Daily Ava	State WQO Saltwater Aquatic Life, 1-hr Ava	State WQO Human Health, 30-Day Ava
Dieldrin	ng/L	710	1.9	1.9	NA	0.14
4,4'-DDT	ng/L	130	1.0	See tDDT(a)	NA	See tDDT
4,4'-DDD	ng/L	14,000(b)	1.0	See tDDT	NA	See tDDT
4,4'-DDE	ng/L	3,600(b)	1.0	See tDDT	NA	See tDDT
Total DDT(c)	ng/L	NA(d)	1.0	1.0	NA	0.6
Endrin	ng/L	37	2.3	2.3	37	800
Chlordane(e)	ng/L	90	4.0	4.0	NA	0.081
Endosulfan(f)	ng/L	34	8.7	8.7	34	2000
Total PAH	ng/L	300,000	NA	NA	NA	31
PCB(g)	ng/L	10,000	30	30	NA	0.070
Silver	µg/L	2.3	NA	NA	2.3(h)	NA
Arsenic	µg/L	69	36	NA	69	NA
Cadmium	µg/L	43	9.3	NA	43	NA
Chromium(i)	µg/L	1100	50	NA	1100	NA
Copper	µg/L	2.9	2.9	NA	2.9	NA
Mercury	µg/L	21	0.025	NA	2.1	0.025
Nickel	µg/L	75	8.3	NA	75	4,600
Lead	µg/L	140	5.6	NA	140	NA
Selenium	µg/L	410	54	NA	300	NA
Zinc	µg/L	95	86	NA	95	NA
Tributyltin	ng/L	NA	NA	NA	NA	5.0

(a) See Total DDT.

(b) USEPA lacks sufficient criteria to establish criterion; value is lowest observable effect level.

(c) Sum of the 4,4'- and 2,4'- isomers of DDT, DDD, and DDE.

(d) NA Not applicable.

(e) Sum of chlordane isomers.

(f) Sum of endosulfan isomers.

(g) Sum of Aroclors.

(h) Instantaneous maximum.

(i) Hexavalent.

5.0 SUMMARY AND CONCLUSIONS

This section summarizes the results and conclusions of the RI of marine sediment at the United Heckathorn site. The summary and conclusions are presented in terms of the study objectives stated in Section 1.3.

5.1 SUMMARY

The areal and vertical extent of pesticide contamination in marine sediment at the United Heckathorn site has been delineated as a result of this RI. The volume and nature of sediment requiring remediation can be characterized from the RI data after sediment cleanup criteria have been established. Biological testing results from this study were consistent with the results of the ecological risk assessment for the United Heckathorn site. Treatability testing characterized the probable quality of effluent from dewatered sediment; test results will be used to evaluate remedial alternatives for contaminated sediment. RI results are summarized below.

5.1.1 Subsurface Geology of Inner Richmond Harbor

The OBM was present below the YBM throughout inner Richmond Harbor. The elevation of the YBM/OBM contact ranged from approximately -15 ft MLLW in the shallow portions of the Lauritzen Canal to -40 ft MLLW in the Inner Harbor Channel. The YBM varied in thickness from approximately 2 ft to 8 ft throughout the site, with an average thickness of 4 ft to 6 ft. It had an average clay content of greater than 50%, and an average solids content of 47%. The OBM consisted primarily of silty sand in the shallow part of Lauritzen Canal, and homogeneous, unfractured silt and clay in the deeper part of Lauritzen Canal, the Santa Fe Channel, and the Inner Harbor Channel. The homogeneous silt and clay unit is likely to be continuous under the entire Lauritzen Canal. The OBM had an average of 77% solids, and was firm to very hard in consistency. It is highly consolidated and does not mix with the overlying sediment.

5.1.2 Areal and Vertical Extent of Marine Contamination

The pesticides 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and dieldrin were found at higher concentrations and over a larger area relative to San Francisco Bay background levels than other contaminants in inner Richmond Harbor. The median total DDT concentration decreased from 47,000 $\mu\text{g/kg}$ to 1500 $\mu\text{g/kg}$ from the head of the Lauritzen Canal to its mouth, and to 131 $\mu\text{g/kg}$ and 20 $\mu\text{g/kg}$ in the Santa Fe and Inner Harbor Channels, respectively. The median total DDT concentration in the Parr Canal was 840 $\mu\text{g/kg}$. Maximum total DDT concentrations in sediment were less than 20 $\mu\text{g/kg}$ by Point Potrero. The maximum dieldrin concentrations measured in sediment were 16,000 $\mu\text{g/kg}$ at the head of the Lauritzen Canal, 500 $\mu\text{g/kg}$ at its mouth, 37 $\mu\text{g/kg}$ in the Santa Fe Channel, 5 $\mu\text{g/kg}$ in the Inner Harbor Channel, and 170 $\mu\text{g/kg}$ in the Parr Canal.

Total DDT concentrations in sediment generally decreased by two orders of magnitude from the base of the YBM to the top of the OBM in the Lauritzen Canal. OBM samples from all but four stations the Lauritzen Canal had less than 20 pg/kg total DDT. The total DDT concentrations in the OBM in Santa Fe and Inner Harbor Channels were generally less than 1 pg/kg. Vertical stratification of contamination within the YBM was not well-defined; however, the highest levels of contamination were generally found in sediment from 1 ft to 5 ft below the mudline.

Other contaminants were detected in sediment from inner Richmond Harbor; however, median concentrations were generally comparable to background values for the periphery of San Francisco Bay. Elevated concentrations of PAHs, PCBs, and metals were detected in sediment from the head of the Lauritzen Canal and the Parr Canal; both of these areas had extremely high pesticide concentrations as well.

5.1.3 Volume of Contaminated Sediment

The volumes of sediment exceeding 1000 pg/kg, 500 µg/kg, 100 pg/kg, and 50 pg/kg total DDT were estimated because cleanup criteria for total DDT in sediment at the Heckathorn site have not yet been established and are likely to fall within this range of concentrations. Sediment volumes include the YBM down to the YBM/OBM contact. The volume exceeding 1000 pg/kg and 500 µg/kg total DDT includes all YBM sediment in the Lauritzen and Parr canals, and is estimated as approximately 65,000 cu yd. Pockets of sediment exceeding 500 µg/kg total DDT were found in the Santa Fe Channel near the YBM/OBM contact up-channel and across from the mouth of the Lauritzen Canal, and in surface sediment adjacent to the Castrol pier and downstream of the mouth of the Lauritzen Canal. Sediment exceeding 100 pg/kg total DDT extends to the northern end of the Inner Harbor Channel, and has a volume of approximately 350,000 cu yd. Sediment exceeding 50 pg/kg total DDT extends to the center of the Inner Harbor Channel and has a volume of approximately 600,000 cu yd. The volume of YBM in the Parr Canal is approximately 10,000 cu yd. Weighted average total DDT concentrations for each category of sediment (including and excluding sediment from the Lauritzen Canal) were estimated and will be used to evaluate remedial alternatives for the site.

5.1.4 Biological Effects of Contaminated Sediment

Lauritzen Canal sediment, with the exception of sediment from the south end of the canal, was acutely toxic (0% survival) to the amphipod, *R. abronius*. Sediment from the south end of the Lauritzen Canal and the federal Santa Fe Channel was less toxic (74% survival). Survival in sediment from the upper Santa Fe and Inner Harbor Channel was 85% to 89%. The average total DDT concentration in the tissue of *M. nasuta* decreased from approximately 35,000 pg/kg (dry weight) in the Lauritzen Canal to 700 pg/kg in the Santa Fe Channel, and to 200 pg/kg in the Inner Harbor Channel.

5.1.5 Probable Quality of Effluent From Dewatered Sediment

Concentrations of DDT, DDT analogues, and dieldrin in SPP and elutriate samples prepared from Lauritzen Canal sediment exceeded state and federal water quality criteria by two to five orders of magnitude. Elutriate concentrations were 15% to 90% lower than those in SPP samples (with the exception of two composites with higher elutriate concentrations). GAC treatment of the elutriate from one Lauritzen Canal composite resulted in about a 25% reduction in total DDT and dieldrin concentrations. Pesticide and PAH concentrations in SPP and elutriate prepared from composites outside the Lauritzen Canal were one to three orders of magnitude lower; however, potential cross-contamination during sample preparation prevented a determination of whether water quality criteria were exceeded.

The SPP and elutriate samples prepared from all sediment composites from the Lauritzen Canal caused statistically significant acute toxicity to the mysid *H. costata*. The elutriate sample prepared from Comp LC and the SPP and elutriate samples prepared from Comps LC-5 and LC-6 (all from the Lauritzen Canal) caused statistically significant reductions in survival of bivalve larvae. Chronic effects in mussel larvae were observed with SPP and elutriate prepared from all Lauritzen Canal sediment composites. Toxicity test results for SPP and elutriate samples prepared from Santa Fe and Inner Harbor Channel sediment composites were not reliable because of potential cross-contamination during sample preparation.

5.2 CONCLUSIONS

The conclusions of the RI of marine sediment at the United Heckathom site are summarized below.

5.2.1 Subsurface Geology of Inner Richmond Harbor

The fine-grained nature and high water content of the YBM in inner Richmond Harbor will be an important consideration in the evaluation of remedial alternatives because many remedial technologies are not effective at removing contaminants that are strongly bound to fine-grained particles (USEPA 1993). In addition, if YBM sediments are dredged as part of a remedial action, a dredging technique that minimizes sediment resuspension should be selected.

The physical characteristics of the OBM indicate that it should form an excellent barrier to the downward migration of contaminants from recent sediment. Its firm to hard consistency prevents mixing of the OBM with overlying sediment, and its low water content and relatively low permeability minimize the migration of contaminants by porewater diffusion.

The shoreline survey identified few areas with soft sediment that could potentially act as a continuing source of contamination after site remediation is complete. Contaminated sediment

might be left in place along the shorelines of the Lauritzen and Parr Canals if sediments were dredged as part of a remedial action.

5.2.2 Areal and Vertical Extent of Marine Contamination

The pesticides 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, and dieldrin were found at higher concentrations and over a larger area relative to San Francisco Bay background than any other contaminants in inner Richmond Harbor. Concentrations were highest in sediment from the Lauritzen Canal and decreased to background levels for San Francisco Bay in Inner Harbor Channel. A strong concentration gradient exists within the Lauritzen Canal and from the Lauritzen Canal to the Santa Fe Channel. A smaller concentration gradient exists from the federally maintained portion of the Santa Fe Channel to the upper Santa Fe Channel, and from the federal Santa Fe Channel to the Inner Harbor Channel. Significant pesticide contamination was concentrated in the YBM sediment.

The strong gradient in pesticide concentrations indicates that the Lauritzen Canal is the source of contaminated sediment to inner Richmond Harbor. The pesticide contamination in Lauritzen Canal sediment is apparently due to waste discharges to the canal during pesticide processing activities at the former United Heckathorn facility. The lower contaminant concentrations in the uppermost 1 ft of sediment compared to deeper sediment suggest that the primary source of contamination to the system is no longer present. The surface sediment is periodically resuspended by some type of disturbance and transported out of the canal by wind or tidal currents. The sharp drop in contaminant concentrations from the Lauritzen Canal to the Santa Fe Channel suggests that the rate of contaminant transport out of the Lauritzen Canal is relatively slow. If the highly contaminated sediments were removed from or confined to the Lauritzen Canal, contaminant concentrations in the Santa Fe and Inner Harbor Channels would be likely to slowly decrease over time.

5.2.3 Volume of Contaminated Sediment

Assuming that the cleanup criteria for total DDT in sediment at the United Heckathorn site falls between 50 $\mu\text{g/kg}$ and 1000 $\mu\text{g/kg}$, the volume of sediment requiring remediation is between approximately 65,000 cu yd and 600,000 cu yd. The average total DDT concentrations of sediment above 50 $\mu\text{g/kg}$ and 100 $\mu\text{g/kg}$ total DDT decreased by an order of magnitude if the sediment from the Lauritzen Canal was excluded.

5.2.4 Biological Effects of Contaminated Sediment

Results of solid-phase toxicity and bioaccumulation tests indicate that the greatest biological impacts were associated with sediment from the Lauritzen Canal, and that toxicity and tissue residues in clams decreased with increasing distance from the Lauritzen Canal. These

results are consistent with data reported in USEPA's ecological risk assessment for the United Heckathorn site.

5.2.5 Probable Quality of Effluent from Dewatered Sediment

The pesticide concentrations measured in SPP and elutriate samples prepared from Lauritzen Canal sediment composites suggest that controlling for fine-grained particles would not be sufficient to reduce pesticide concentrations in effluent from a confined disposal facility to levels below the state numerical water quality objectives. Dilution would not be practical for effluent from Lauritzen Canal sediment because a dilution factor of thousands to hundreds of thousands would be required. The effluent would be likely to require treatment with a filtration and carbon-adsorption system capable of removing high concentrations of pesticides. Additional testing is required to evaluate the feasibility of this type of system.

The SPP and elutriate samples prepared from Lauritzen Canal sediment composites produced statistically significant acute toxicity to *H. costata* and chronic toxicity to *M. galloprovincialis*. Toxicity must be removed from an effluent prior to discharge to meet the state water quality objective of no acute toxicity in ambient water, including mixing zones. Further evaluation might be required to identify reasonable steps necessary to reduce toxicity.

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APPENDIX A

METHODS

APPENDIX A

METHODS

Methods used in the laboratory to prepare and analyze samples collected in the field are described in Sections A.1 through A.4. Data analysis procedures are summarized in Section A.5, and quality assurance/quality control (QA/QC) procedures are specified in Section A.6.

A.1 SEDIMENT CHEMISTRY SAMPLE PREPARATION

Procedures used in the laboratory to prepare sediment samples for chemical testing are discussed below. The glassware and equipment preparation procedures also apply to all equipment used in the biological testing laboratory. To assure that holding time limits for chemical analyses were met, sediment cores were processed and samples prepared in the same order in which they were collected.

A.1.1 Laboratory Glassware and Equipment Preparation

All glassware, stainless steel or titanium utensils, Nalgene, Teflon, and other laboratory containers and equipment were cleaned according to stringent procedures to avoid contamination of samples. Glassware (including test containers, aquaria, and sediment transfer dishes) was washed with warm, soapy water, rinsed five times with deionized water, then soaked in a **5%** reagent grade nitric acid bath for a minimum of 4 h. After soaking, glassware was rinsed with deionized water five times and allowed to dry. Polyvinyl chloride (PVC), Nalgene, and Teflon tools were also washed and soaked in acid baths in the same manner as was glassware. The only exception was chemistry sample containers (glass with Teflon-lined lids) that were purchased already cleaned.

Stainless steel bowls, spoons, spatulas, and other utensils were washed with warm, soapy water, rinsed five times with deionized water, and allowed to air dry. They were then rinsed with methylene chloride under a fume hood, where they remained until the methylene chloride had evaporated.

Neoprene stoppers and polyethylene sheets or other porous materials were washed with warm, soapy water and rinsed five times with deionized water. These items were then "seasoned" by continuous soaking in 0.45- μ m-filtered seawater for at least 2 days prior to use. Large pieces of laboratory equipment, such as the epoxy-coated mixer used to mix sediment and epoxy-coated boards used to hold cores for geologic descriptions, were washed with a mild soap solution and thoroughly rinsed with tap water followed by deionized water.

A.1.2 Geologic Description of Sediment Cores

The subsurface geology throughout the study area was described by the geologic characteristics of each 4-in. core sample. The description protocol was consistent with ASTM Method D2488-84 (ASTM 1984). Each core section was removed from storage, scored longitudinally with a circular saw, and cut open with a stainless steel linoleum knife. The core was then carefully opened to expose the sediment stratigraphy. The geologist measured and described the sediment, and recorded the following characteristics on a core data log form: lithology, color, consistency, cementation, structure, maximum particle size, odor, and any other notable characteristics. Care was taken not to disturb or disrupt the sediment during description. The geologist determined and marked the YBMIOBM boundary based on color, consistency, and sediment type. The geologist also measured and marked the vertical segments for sample preparation. The vertical segments were defined as follows: 1) Segment A - the top 1 ft of YBM; 2) Segment X - the 1 ft of YBM above the YBMIOBM contact; 3) Segment Y - the 1 ft of OBM below the YBMIOBM contact; 4) Segments B, C...G - intermediate YBM samples in ≤ 2 ft increments; 5) Segment M - the entire length of YBM; and 6) Segment Z - the OBM 1 ft to 2 ft below the YBMIOBM contact (see Figure 2.3). If the sediment at the YBMIOBM contact was disturbed or not well defined, it was not included in the chemistry sample. Selected cores were photographed in color.

A.1.3 Preparation of Sediment Samples

Following geologic description and demarcation of segments for subsampling, the 4-in. cores were moved to a sediment preparation table. The number, lengths, and corresponding depths of the segments were recorded and assigned sample identification codes, and the appropriate analysis jars were labeled. The sediment from each marked segment was carefully transferred to a clean glass baking dish or a stainless steel bowl, using a clean stainless steel spatula. Extreme care was taken to avoid removing sediment in contact with the Lexan core liner and Lexan shavings. Each channel-edge grab sample was emptied from its epoxy-coated pail into a clean, labeled stainless steel bowl. Each core segment or grab sample was homogenized to uniform color and consistency using stainless steel spoon or spatula. Aliquots of homogenized sample were placed in the appropriate, labeled jars. The filled jars were placed on ice in coolers. An inventory of samples in each cooler was maintained on chain-of-custody forms. Samples were shipped daily to analytical laboratories; any coolers not shipped were stored at $4^{\circ} \pm 2^{\circ}\text{C}$ in MSL's cold room until the following day. In addition to the samples prepared for immediate study, the following samples were archived for possible future analysis: duplicates of every sediment sample, OBM from 1 ft to 2 ft below the YBMIOBM contact, and control sediments used for biological testing only.

A2 SOLID-PHASE BIOLOGICAL TESTING

Procedures used to prepare for and conduct solid-phase bioassays are described in this section. Two solid-phase tests were used to characterize the acute toxicity and bioaccumulation potential of the uppermost 1 ft of YBM in the study area: a 10-day static acute toxicity test using the amphipod, *R. abronius*, and a 28-day flow-through bioaccumulation test with the bent-nose clam, *M. nasuta*.

A.2.1 Preparation of Sediment for Testing

Sediment from selected stations was combined into a composite sample for biological testing. Sediments were transferred from 5-gal pails into a mixer coated with a special epoxy paint (TNEMEC Epoxy converter 83-83-B). The mixer homogenized the large volume of sediment necessary for biological testing. Minimal amounts of 0.45- μ m-filtered seawater were added as needed to achieve a homogeneous consistency. After mixing, the composite samples were returned to the labeled, epoxy-coated metal pails. Aliquots for chemical analyses were placed in cleaned and labeled sample jars. The composite sediment chemistry samples were placed on ice in coolers along with the individual core sediment chemistry samples as described in Section A.1.3. The remaining pail(s) of composite sediment sample were stored at 4° $\pm$ 2°C in MSL's cold room.

The control sediments were stored in their sampling containers at 4° $\pm$ 2°C until sieving. The sediments were placed on 1- or 2-mm stainless steel mesh and press-sieved (no water added) into clean stainless steel bowls or epoxy-coated pails. Any organisms collected on the sieves were discarded, and any large particles were returned to the sieved sediment. The sieved sediment was then mixed thoroughly by hand in the bowl or pail using a stainless steel spoon. Homogenized control sediments were stored in clean bowls or pails at 4° $\pm$ 2°C until needed for testing. A 500-mL aliquot of sediment was archived for possible future analysis. Between sieving of reference sediments, all equipment was thoroughly rinsed with 0.45- μ m-filtered seawater to avoid cross-contamination between samples. All control sediments were sieved, homogenized, and used for biological testing within the 6-week holding limit from the sampling date.

A.2.2 10-Day Static Test with *Rhepoxynius abronius*

R. abronius amphipods were captured by MSL staff near West Beach, Whidbey Island, Washington, using a specially-designed anchor dredge deployed from a 17-ft Boston Whaler. Sediment brought up with the dredge was sieved through a 2-mm mesh screen to remove large debris and predatory organisms. Amphipods were kept in coolers partially filled with native sediment and seawater until they were delivered to a holding tank at the MSL. The amphipods were held in a large tank containing their native sediment and flowing 15°C seawater. Organisms

were not fed during the holding period, because food was available from the holding sediment. The amphipods were held for one week before test initiation.

The 10-day test was conducted in 1-quart glass jars placed in random positions on a water table maintained at 15°C. After the test sediment was mixed (Section A.2.1), it was added to the jars to a depth of 2 cm. Each jar was slowly filled with 0.45-µm-filtered seawater to the test volume of 750 mL, placed on the water table to stabilize the temperature, and covered with a PVC lid with an aeration pipette connected to an overhead air manifold. After the sediment in the jars was allowed to settle overnight, initial water quality parameters were measured in each container and recorded on water quality forms.

The test was initiated by adding 20 *R. abronius* to each test container. Amphipods were gently sieved from the holding tank into clean seawater and counted into small transfer containers. The number of organisms was confirmed before they were transferred into the test container. The date and time of initiation were recorded on data forms. Amphipods were observed daily during the test, and the number of organisms floating on the surface, swimming in the jar, or resting on the sediment surface was recorded on observation forms. Amphipods floating on the surface were gently pushed below the water surface with a pipette tip and observed as they either burrowed or did not burrow into the sediment.

Water temperature, salinity, pH, and dissolved oxygen (DO) were measured daily in one replicate of each treatment and in all containers at initiation and termination of the bioassay. Acceptable ranges for water quality parameters during the experiment were as follows:

DO	16.0 mg/L
pH	ambient ±0.5 unit
salinity	30 ± 0 ppt
temperature	15.0° ±2.0°C

At the end of the test (Day 10), the contents of each jar were sieved through a 0.5-mm Nytex screen to collect the *R. abronius*. Organisms were placed in clean seawater in a glass dish labeled with the treatment and replicate number. The number of live and dead organisms in each dish was counted, and the presence or absence of body parts recovered at the end of the test was noted. If a *R. abronius* did not respond to gentle probing after several minutes of observation, the organism was considered dead. At least 10% of the mortality counts were confirmed by a second analyst.

To assess the sensitivity of *R. abronius* response to a known contaminant, a reference toxicant test with cadmium was conducted. The reference toxicant test was a static 96-h exposure to four concentrations of cadmium chloride (0.5, 1.0, 2.0, 4.0 milligrams per liter [mg/L] as cadmium) in the absence of sediment. Three 750-ml replicates of each concentration, including a

seawater control, were placed randomly on the water table. The test was initiated, monitored, and terminated in a manner similar to that of the 10-day sediment test.

A.2.3 28-Day Flow-Through Test with *Macoma nasuta*

M. nasuta were collected from the intertidal zones of beaches in Discovery Bay, near Gardiner, Washington, by Gunstone and Johnson commercial suppliers. The clams were held in large tanks of clean sediment with flow-through 15°C seawater. Temperature, pH, DO, and salinity of water in each holding tank water were monitored daily. The *M. nasuta* were not fed during the holding or testing periods, because the organisms were able to obtain food from the sediment.

The flow-through test with *M. nasuta* was conducted in 10-gal glass aquaria placed in random positions on water tables. Each sediment treatment had five replicate aquaria, each containing 25 *M. nasuta*. Each aquarium was partially filled (about 8 L of sand-filtered seawater) via the flow-through system. Test sediment was added to a depth of 3 cm by measuring out the required amount (3870 mL) in a clean glass container and using seawater to wash and distribute the sediment evenly in the tank. After the sediment was allowed to settle overnight, the flow-through and aeration systems were started, and the flows adjusted to deliver 125 ± 10 mL/min of seawater to each aquarium.

Initial water quality parameters were measured in every replicate before 25 *M. nasuta* were added to each tank. The initiation time and date were noted on each aquarium and on a data sheet. Salinity, temperature, DO, and pH were measured daily in at least one replicate of each treatment and recorded on water quality data sheets. The acceptable ranges for water quality parameters during the experiment were as follows:

DO	26.0 mg/L
pH	ambient ± 0.5 unit
salinity	30 ± 2.0 ppt
temperature	$15.0^\circ \pm 2.0^\circ\text{C}$
flow rates	125 ± 10 mL/min.

The number of *M. nasuta* on the sediment surface and the number of those with their siphons exposed were observed and recorded daily. Dead organisms were removed, but not replaced. At the end of the 28-day exposure, water quality measurements were taken in all tanks and the contents of each aquarium were gently passed through a 1.0-mm Nytex screen to recover the *M. nasuta*. The organisms were placed in glass baking dishes labeled with the treatment number, and the number of dead and live *M. nasuta* was determined. Those with

unresponsive or gaping shells were considered dead. At least 10% of the mortality counts were confirmed by a second analyst.

To ensure that tissue chemistry results would not be biased by contaminants associated with sediment grains in the digestive tract, surviving *M. nasuta* were allowed to depurate, or void the digestive tract, for 48 h following the 28-day exposure. The surviving *M. nasuta* were placed in a clean depuration aquarium (without sediment). After 48 h of depuration, the *M. nasuta* shells were cleaned with a scrub brush to minimize potential contamination of tissues during the dissection process. The tissues were then removed using titanium instruments and transferred to labeled containers for chemical analysis. The tissue samples were immediately sent to the analytical laboratory, where they were frozen until analysis.

A.3 LIQUID-PHASE BIOLOGICAL TESTING

The following sections describe the procedures used to prepare suspended-particulate phase (SPP) and elutriate samples, and to conduct acute toxicity tests with mysids (*Holmesimysis costata*) and larval mussels (*Mytilus galloprovincialis*). The toxicity testing procedures for SPP and elutriate samples are identical.

A.3.1 Preparation of Suspended-Particulate and Elutriate Phase Samples

The procedures used to prepare SPP and elutriate samples were adapted from those described in *Development of a Modified Elutriate Test for Estimating the Quality of Effluent from Confined Disposal Areas* (Palermo 1986). Figure 2.5 provides a graphical representation of the liquid-phase preparation and testing steps. Basically, a sediment-water slurry representative of the influent into a confined disposal area is created. The slurry is agitated under aerobic conditions, then allowed to settle undisturbed for 24 h. The supernatant (SPP) is decanted for testing or for filtration to remove particles (elutriate phase). Low-speed centrifugation was substituted for 24-h settling because it saved preparation time. A pilot study indicated that the low-speed centrifugation resulted in a worse case scenario because fewer particulates were removed. High-speed centrifugation was substituted for filtration in the elutriate preparation step because the incompatibility of filter materials needed for the variety of chemical analyses (metals, pesticides, PAHs, butyltins) precluded the use of a single filtration system. The most important elements of the procedure were not changed: using a slurry (influent) concentration of 150 grams (g) dry sediment per liter of seawater, agitation under aerobic conditions, and the solid-liquid contact time (agitation time).

SPP was prepared by creating a 150 g/L dry weight sediment-to-water slurry in 1-L glass jars with Teflon-lined lids. Seawater from Richmond Harbor, used to make the slurry, was salinity-adjusted to 30 ppt with concentrated brine. The proportion dry weight of each sediment composite was determined by drying five replicates of 10 to 20 g wet sediment each at 105°C for

2 h. The dried sediment was cooled in a desiccator and reweighed; the dry weight was divided by the wet weight to obtain the proportion dry weight. Once the appropriate mass of wet sediment, calculated by dividing 150 g by the proportion of dry weight, was weighed into each jar, each was filled to 1 L with unfiltered Richmond Harbor seawater.

The jars of slurry were capped, placed on a shaker table, and agitated for 30 min at a rate of 120 to 150 cycles/min. After shaking, the slurry was poured into 500-mL Teflon containers with tightly fitting lids. These containers were placed in a centrifuge and spun for 10 to 15 min at approximately 1750 rpm. After this low-speed centrifugation, the supernatant SPP was poured into clean, labeled, 1-gal glass jars. When all SPP for a treatment was prepared, the appropriate containers for chemical analysis were filled and immediately stored at $4^{\circ} \pm 2^{\circ}\text{C}$. The sample for metals analysis was acidified to $\text{pH} < 2$ with 0.1 mL of concentrated (18N) nitric acid.

Elutriate phase samples were immediately prepared from about 2 gal of the SPP liquid, while the remaining volume was stored at $4^{\circ} \pm 2^{\circ}\text{C}$ to be used for toxicity tests within 24 h. To prepare the elutriate, SPP was poured into 250-mL Teflon bottles and centrifuged for 30 min at 2000 rpm. The supernatant (elutriate) was carefully poured into clean, labeled, 1-gal glass jars with Teflon-lined lids. When all elutriate for a treatment was prepared, the appropriate containers for chemical analysis were filled and immediately stored at $4^{\circ} \pm 2^{\circ}\text{C}$. Samples were shipped to analytical laboratories within one day of preparation. Between preparation of SPP and elutriate from different sediment treatments, all glass and Teflon containers were appropriately cleaned according to procedures described in Section A.1.1.

Approximately 8 L of additional elutriate from one composite was prepared to test whether filtration through a granular activated carbon (GAC) system would reduce the concentrations of organic contaminants. Half of the elutriate was filtered; the unfiltered portion was used as a control. In addition, Richmond Harbor site water was filtered and used as a control. The filtering system consisted of a 1.3-in.-diameter stainless steel cylinder with a stainless steel mesh screen at its base. The cylinder was filled with an 8-in. column of GAC (approximately 200 mL) and capped with a glass wool plug. The flow rate through the column was adjusted to 2 L/h with a teflon stopcock. The unfiltered and filtered elutriate samples were analyzed for pesticides and for acute toxicity to mysids.

A.3.2 96-Hour Static Test with *Holmesimysis costata*

H. costata were received from Brezina and Associates in Dillon Beach, California, and were held in a 10-gal flow-through aquarium maintained at test temperature ($16^{\circ}\text{C} \pm 2^{\circ}\text{C}$) for at least 48 h prior to testing. Water quality parameters were monitored daily, and *H. costata* were fed concentrated brine shrimp twice daily.

The *H. costata* tests were conducted in 400-mL glass jars labeled with sediment treatment code, concentration, position number, and replicate number. Appropriate volumes of 100% SPP or elutriate and Richmond Harbor site water were combined in a clean, 1000-mL glass graduated cylinder to make 0%, 10%, 50%, and 100% SPP or elutriate concentrations for *H. costata* testing. The effect of filtering elutriate through GAC was also evaluated by testing both filtered and unfiltered 100% elutriate from one sediment treatment. A total of 600 mL of each concentration was prepared, from which the 200-mL test volume was poured into each replicate chamber. Each chamber was then placed in its randomly assigned position on a controlled-temperature water table ($16^{\circ}\text{C} \pm 2^{\circ}\text{C}$) and allowed to equilibrate to test temperature. Aeration was provided through glass pipettes connected to an overhead air manifold by silastic tubing.

After the concentrations were prepared and placed on the water table, each container was gently aerated, and water quality parameters were measured in all replicates of each sediment treatment. To initiate the test, *H. costata* were transferred from the holding tank to test chambers with wide-bore pipettes. Ten individuals were added to each chamber to produce a test population of 30 individuals per concentration (120 individuals per treatment). Test initiation time and date were documented on data forms. After test initiation, water quality parameters were measured daily in one replicate concentration of each sediment treatment. Acceptable water quality parameters for this test were:

DO	24.0 mg/l
pH	ambient ± 0.5 units
salinity	32 ± 2.0 ppt
temperature	$16^{\circ} \pm 2.0^{\circ}\text{C}$

Although the test plan called for a salinity of 32 ± 2 ppt, the test was conducted at 30 ± 2 ppt because the SPP and elutriate had been prepared with Richmond Harbor water adjusted to the latter salinity. The test results should not be affected by this variation because *H. costata* can tolerate a wide range of salinity. Observations of test organisms were performed at test initiation and at 4 h, 24 h, 48 h, and 72 h using a light table to enhance visibility of the organisms. During the 96-h exposure, *H. costata* were fed <24-h-old brine shrimp daily. Excess food was removed with a small pipette; care was taken not to disturb test animals. Molted exoskeletons and any particulates from the liquid-phase 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 organism 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 reference toxicant test was also conducted with each batch of *H. costata* to establish the health and expected response of the test organisms. The reference toxicant test was conducted in the same manner as the liquid-phase tests. *H. costata* were exposed to a seawater control plus four concentrations of copper (0.4 mg/L, 0.2 mg/L, 0.1 mg/L, and 0.05 mg/L) using three replicates of each treatment.

A.3.3 48-Hour Static Test with Larval *Mytilus galloprovincialis* (formerly *M. edulis*)

Adult bay mussels (*M. galloprovincialis*) were obtained from Carlsbad Aquafarms in Carlsbad, California. Mussels were held in flowing unfiltered Sequim Bay seawater at ambient temperatures for approximately five days. Chambers for the bivalve larvae test were 500-mL glass jars labeled with sediment treatment code, concentration, position number, and replicate number. Concentrations of both SPP and elutriate (0%, 10%, 50%, and 100%) were prepared with unfiltered Richmond Harbor site water in a 100-mL graduated cylinder. Three hundred mL of test solution was poured directly into each test chamber. Test chambers were placed in random positions on a water table and each chamber was provided with gentle aeration. After test chambers reached testing temperatures ($16^{\circ}\text{C} \pm 2^{\circ}\text{C}$), initial water quality was measured in all replicates.

Spawning was induced by placing the mussels into 15°C , filtered Sequim Bay seawater and then rapidly raising the holding water temperature to 20°C . Spawning occurred within 1 h of temperature elevation. Males and females were isolated in individual jars with filtered Sequim Bay seawater and allowed to shed gametes for approximately 45 min. Eggs from each female were then filtered through a $75\text{-}\mu\text{m}$ Nytex screen into separate jars to remove feces, detritus, and byssal fibers. Sperm from at least three males were pooled and 10 mL of sperm solution was then added to the egg stocks. Egg-sperm solutions were mixed every 10 min with a perforated plunger. Fertilization proceeded for 1 h, then fertilization success (percent fertilized) was determined by removing a subsample and observing the number of multi-cell stage embryos. Fertilization was considered successful if greater than 90% of the eggs were in the multi-cell stage. To prevent polyspermy, egg stocks with greater than 90% fertilization were rinsed on a $20\text{-}\mu\text{m}$ Nytex screen to remove excess sperm. Stock embryo solution density was estimated by removing a 0.1-mL subsample and counting all multi-cell embryos, then multiplying by 10 to yield embryo density (embryos/mL). Stock solution was diluted or concentrated to yield 7,500 to 9,000 embryos/mL. The test was initiated by introducing 1 mL of stock solution into each test chamber, to produce test embryo densities of 25-30 embryos/mL. Test initiation date and time were recorded on data sheets. Following initiation, 10-mL subsamples were removed from each container and preserved in 10% formaldehyde to determine the actual embryo stocking density.

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

DO	24.0 mg/l
pH	ambient ± 0.5 units
salinity	30 ppt ± 2 ppt
temperature	16° ± 2 °C

The bivalve test was terminated after 48 h, at which time greater than 90% of the larvae in the controls had reached the D-cell stage. Final water quality parameters were recorded for all replicates. Each chamber was then homogenized with a perforated plunger, and a 10-mL subsample removed and preserved with 1 mL of 50% formalin in seawater in a labeled, 20-mL scintillation vial. Samples were scored for the appearance of normal D-shaped larvae, abnormal and blastula larvae, and total number of larvae. At least 10% of the counts were confirmed by a second observer.

Four 48-h reference toxicant tests were conducted with the SPP and elutriate tests to establish the health and expected response of the test organisms. Because not all SPP and elutriate treatments could be tested concurrently, a separate reference toxicant test was performed each day a set of tests was initiated to compare gamete sensitivity to a known toxicant. 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 1 µg/L, 4 µg/L, 16 µg/L, 64 µg/L, and 256 µg/L as copper, with three replicates per concentration in each test.

A.4 ANALYTICAL CHEMISTRY

The following sections briefly describe the methods used for the chemical analysis of sediment, tissue and water samples. Analyses follow established USEPA procedures as applicable. Vertical subsamples from sediment cores, grab samples, composite sediment samples for biological testing, and selected control sediments were analyzed for conventional parameters (percent solids, grain size, and total organic carbon), and chlorinated pesticides. Composite sediment samples from selected stations were analyzed for oil and grease, total petroleum hydrocarbons, PCBs, PAHs, metals, and butyltins. All *M. nasuta* tissue samples were analyzed for chlorinated pesticides and percent lipids. Composite samples representing *M. nasuta* tissues exposed to each sediment treatment were analyzed for PCBs, PAHs, metals, and butyltins. SPP and elutriate water samples were analyzed for chlorinated pesticides, PCBs, PAHs, metals, and butyltins. In addition, two water samples were analyzed for total petroleum hydrocarbons. Quality control samples included method blanks, matrix spike (MS) and matrix spike duplicate (MSD) samples, compositing duplicates (sediment only), and analytical

duplicates. The method blanks, MS, and MSD samples were used to evaluate analytical accuracy. Compositing duplicates were used to evaluate the effect of compositing on the reproducibility of sample results. Analytical duplicates were used to evaluate analytical precision, as were the MS and MSD where applicable.

A.4.1 Conventional Sediment Measurements

Conventional sediment measurements consist of percent solids, grain size, and total organic carbon (TOC). Percent solids and grain size analysis were conducted by Soil Technology, Inc., of Bainbridge Island, Washington. The test samples were split into representative water content and grain size test samples. Percent solids was determined by oven-drying the samples at $105^{\circ} \pm 5^{\circ}\text{C}$ for at least 8 h followed by cooling in a desiccator. The ratio of dry weight to wet weight was multiplied by 100 to determine the percent solids.

Four grain-size fractions were determined by a combination of sieve and hydrometer techniques. These methods are consistent with ASTM D-2217 (ASTM 1985) and ASTM D422 (ASTM 1972). Sediment was washed with distilled water through a U.S. No. 230 (62.5 μm) sieve into a hydrometer cylinder to separate the fine (silt and clay) fraction from the coarse (sand and gravel) fraction. The coarse fraction was oven-dried and shaken through U.S. No. 10 (2 mm) and No. 230 sieves. The sediments retained in the sieves were weighed and recorded. The fraction passing the No. 230 sieve was added to the hydrometer cylinder, which is used to analyze the silt/clay portion of the sample. The silt/clay boundary was interpolated using the 2-h and 4-h hydrometer readings plotted in a graphical format. Duplicate analysis at a frequency of 1 per 20 samples was performed as a quality control measure.

TOC is the amount of non-volatile, partially volatile, volatile, and particulate organic carbon compounds in a sample. Analysis of TOC was performed by Global Geochemistry in Canoga Park, California. Each sediment sample was dried and ball-milled to a fine powder. Inorganic carbon in the sample was removed by acidification before combustion. The TOC in sediment was then determined by measuring the carbon dioxide released during combustion of the sample (SW-846 Method 9060, USEPA 1986), and reported as percent of dry weight. Quality control measures to assess precision included duplicate analysis at a frequency of 1 per 20 samples. MS samples are not applicable to the combustion method of TOC analysis.

A.4.2 Chlorinated Pesticides

Analyses for chlorinated pesticides in sediment, tissue, and water samples were performed by Battelle Ocean Sciences (BOS) in Duxbury, Massachusetts. Chlorinated pesticides were quantified by gas chromatography with electron capture detection (GC/ECD) following USEPA SW-846 Method 8080 (USEPA 1986). Chlorinated pesticides were extracted from sediment samples following the low-level methods for extraction of pesticides from soil

(SW-846). The procedure involved a methylene chloride/acetone mixture extraction using sonication (for sediments) or a Tekmar tissuemizer (for tissues). Water samples were extracted with methylene chloride in a separatory funnel. A portion of the methylene chloride extract was solvent-exchanged to hexane, and interferences were removed through Florisil and gel permeation chromatography (GPC) cleanup. Analytical quantification was performed using GC/ECD analysis, with second column qualitative confirmation.

Three surrogate compounds [DBOFB, CL5(112), and CL5(103)] were added to each sample before extraction to assess extraction efficiency. Quality control samples included a method blank, duplicate, MS, and MSD analysis at a minimum frequency of 1 per 20 samples. The matrix spiking solution consisted of six pesticide compounds.

A.4.3 Oil and Grease and Total Petroleum Hydrocarbons

Total oil and grease includes vegetable oils, animal fats, soaps, waxes, and any other carbon-hydrogen material extractable by the solvent Freon. Total petroleum hydrocarbons comprise the nonpolar mineral fraction of total oil and grease that is not removed by silica gel absorption. These analyses were performed by Analytical Resources, Inc., of Seattle, Washington. Infrared spectrophotometry (IR) was used to determine concentrations of oil and grease (Method 413.2, USEPA 1979) and total petroleum hydrocarbons (Method 418.1, USEPA 1979). A 20-g aliquot of sample was dried with an excess of anhydrous sodium sulfate, then extracted with Freon. For total oil and grease, sample extracts were scanned from 4000 to 600 cm^{-1} on an infrared spectrophotometer and the peak height measured at 2930 cm^{-1} . This wavelength represents the $-\text{CH}_2$ configurations of hydrocarbons and was the standard used to determine oil and grease. For total petroleum hydrocarbons, silica gel was added to the extract to remove the more polar animal- and vegetable-based oils. The extract was then shaken and allowed to settle. An aliquot was then removed and scanned in the same manner as for the oil and grease sample. The relationship of peak height to oil concentration was determined by regressing the peak height versus a known concentration of fuel oil. Quality control samples included method blanks, MS/MSD samples, and analytical duplicates.

A.4.4 Polynuclear Aromatic Hydrocarbons and Polychlorinated Biphenyls

Sediment, tissue and water samples were analyzed for 16 PAHs listed in USEPA Method 610 (USEPA 1986) and for PCBs as Aroclors. Analyses were performed by BOS. These compounds were extracted with the solvent methylene chloride, following the methods used by NOAA for its Status and Trends monitoring program. The surrogate compounds naphthalene-d8, acenaphthene-d10, and benzo(a)pyrene-d12 were added to all samples for PAH analysis prior to extraction to assess extraction efficiency. The surrogate compounds DBOFB, CL5(112), and

CL5(103) were added to samples for PCB analysis. A portion of the extract was used for PAH analysis by gas chromatography/mass spectroscopy in the Selective Ion Mode (GC/MS SIM) following USEPA SW-846 Method 8270 (USEPA 1986). Tissue extracts were run through a phenogel size-exclusion high pressure liquid chromatograph (HPLC) prior to analysis to remove any additional interferences. PCBs were quantified by gas chromatography with electron capture detection (GC/ECD) following USEPA SW-846 Method 8080 (USEPA 1986). Quality control samples included a method blank, MS, MSD, and analytical duplicate for each batch of samples.

A.4.5 Metals

Ten metals were measured in sediments and tissues: silver (Ag), arsenic (As), cadmium (Cd), chromium (Cr), copper (Cu), mercury (Hg), nickel (Ni), lead (Pb), selenium (Se), and zinc (Zn). Samples of sediment, *M. nasuta* tissue, and water were analyzed using four methods: 1) energy-dispersive x-ray fluorescence (XRF); 2) Zeeman graphite-furnace atomic absorption spectroscopy (GFAA), following USEPA SW-846 Method 7000 (USEPA 1986) and the method of Bloom and Crecelius (1984); 3) cold-vapor atomic absorption spectroscopy (CVAA), according to USEPA SW-846 Method 7471 (USEPA 1986) and the method of Bloom and Crecelius (1983); and 4) inductively coupled plasma mass spectrometry (ICP/MS), following USEPA Method 200.8 (USEPA 1990). Analyses were performed by the Pacific Northwest Laboratory (PNL) in Richland, Washington, and the MSL. The analytical methods for each sample matrix and the corresponding metals for which each method was used are presented in Table A.1.

To prepare sediment and tissues for analysis, samples were freeze-dried, then blended in a Spex mixer-mill. Approximately 5 g of mixed sample was ground in a ceramic ball mill. The XRF analysis was performed on a 0.5-g aliquot of this dried, ground material pressed into a pellet with a diameter of 2 cm. For GFAA, CVAA, and ICP/MS analyses, 0.2- to 0.5-g aliquots of dried homogeneous sample went through an acid digestion process to separate and isolate the metals from the matrix. Sediment samples were digested with a mixture of nitric, perchloric, and hydrofluoric acids. Tissues were digested using nitric and perchloric acids.

Quality control measures for metals analyses included analysis of blanks, matrix spikes (blanks and spikes are not applicable to XRF technique), and duplicate analyses for each batch of up to 20 samples, and analysis of a standard reference material (SRM) for metals analyzed by XRF at a frequency of at least 1 per 20 samples. The SRM for sediment was SRM 1646 (obtained from the National Institute of Standards and Technology). The tissue SRM was an oyster tissue, 1566a, obtained from National Research Council of Canada.

TABLE A.1. Analytical Method and Corresponding Metal for Each Sample Matrix

<u>Sediment</u>			<u><i>M. nasuta</i> Tissue</u>			<u>Water</u>			
<u>XRF</u>	<u>E A A</u>	<u>CVAA</u>	<u>XRF</u>	<u>CVAA</u>	<u>GFAA</u>	<u>HAA</u>	<u>GFAA</u>	<u>ICP/MS</u>	<u>CVAF</u>
As	Ag	Hg	As	Hg	Ag	As	Cr	Ag	Hg
Cu	Cd		Cu		Cd		Se	Cd	
Cr	Se		Se		Cr		Zn	Cu	
Ni			Zn		Pb			Ni	
Pb			Ni					Pb	
Zn									

A.4.6. Butyltins

Butyltin compounds in sediment, tissue and water were analyzed using gas chromatography/ flame photometric detection (GC/FPD) following the methods of Unger et al. (1986). Butyltins were analyzed at MSL. Wet samples were extracted with methylene chloride and tropolone using a roller under ambient conditions. Water samples were extracted with methylene chloride using a separatory funnel. The surrogate compound triphenyltin chloride was added before extraction to assess extraction efficiency. The di- and tributyltin compounds extracted from the sediment and tissues were derivatized to a less volatile, more thermally stable form (nonionic n-hexyl or n-pentyl derivatives). The extracts were passed through a florisil liquid chromatography column for cleanup, and the butyltins were quantified by GC/FPD. Samples were spiked with di- and tributyltins prior to extraction to assess the accuracy of the procedure. Method blanks and analytical duplicates were analyzed with each batch of samples.

A.4.7 Lipid Content

The percent lipid content in *M. nasuta* tissue samples was determined by BOS. This investigation required that lipid weights be determined by the method of Bligh and Dyer (1959), as recommended by Lee et al. (1989) to ensure comparability of data from various bioaccumulation studies. The Bligh and Dyer method calls for a separate extraction of tissue from the extraction prepared for chemical analysis, which requires a large volume of tissue mass. BOS used its standard method for lipid determination and calibrated its results to the Bligh and Dyer method to conserve sample material. Prior to the analysis of tissue samples, a composite of 30 tissue samples was analyzed in triplicate by both the BOS and Bligh and Dyer methods. An

algebraic relationship between the results of the two methods was determined using the following formula:

$$\text{Bligh and Dyer Lipid Weight (g)} = \text{BOS Lipid Weight (g)} \times \text{Correction Factor}$$

where the Correction Factor is 0.4594 (average Bligh and Dyer Weight/average BOS Weight).

This conversion factor was used to convert lipid weights obtained by BOS to Bligh and Dyer "equivalent" lipids weights.

A.4.8 Total Suspended Solids

SPP and elutriate water samples were analyzed for total suspended solids. Well-mixed water samples were filtered through a standard glass fiber filter and the filter, containing non-filterable residue, was dried in a tared crucible for at least 4 h at $105^{\circ} \pm 5^{\circ}\text{C}$. The crucible was cooled in a desiccator, then weighed. The increase in crucible weight represents the total suspended solids.

A.5 DATA ANALYSIS

This section describes the methods used to estimate sediment volumes and average total DDT concentrations in sediment. Survey and elevation data for the mudline and depth to OBM (as measured in the 12-in. cores) were compiled and used to calculate the thickness of the YBM at each station. These data were used to generate models of the YBM thickness in the following discrete segments of the study area: the Lauritzen Canal, Santa Fe Channel, the northern portion of the Inner Harbor Channel, and the Inner Harbor Channel north of Stations IH-42, IH-45, and IH-46. A 50-ft grid spacing was used to model the YBM thickness in the Lauritzen Canal and Santa Fe Channel; a 100-ft grid spacing was used for the Inner Harbor Channel. Grids were created using three different computer surface modeling programs: Surfer, Surface III+, and Quicksurf. In Surfer and Surface III+, the YBM thickness at each grid node was calculated from the data points using a distance-weighted averaging algorithm and nearest neighbor search. The weighting varied inversely with the square of the distance between the grid node and the nearest data points. In Quicksurf, a triangulated irregular network (TIN) was constructed from the data points using the Delauney criterion, and a grid was created by calculating a polynomial equation for each TIN face and evaluating the equation for each grid node on the face. The volume of YBM in each segment of the study area was estimated in each modeling program by integrating the 3-dimensional solid formed by a planar lower surface with zero thickness, and an upper surface consisting of the grid of YBM thickness. The mean and standard deviation of the three volume estimates yielded by these programs were reported.

The weighted average total DDT concentration in the YBM at each coring station was calculated using the following formula:

$$C_{av} = \frac{\sum(C \times T)}{\sum T}$$

where C_{av} = average total DDT concentration at station

C = total DDT concentration in sample

T = thickness of YBM sample segment

The weighted average total DDT concentration for the YBM in each segment of the study area was calculated by generating two grids of equal size for each segment using the Surfer modeling program. One grid contained estimated values for YBM thickness at each grid node, and the other contained weighted average total DDT concentrations at each grid node. The two grids were multiplied, and the resultant values were summed and divided by the total thickness of YBM using the following formula:

$$C_{vol} = \frac{\sum(C \times T)}{\sum T}$$

where C_{vol} = average total DDT concentration of volume of sediment

C = average total DDT concentration at each grid node

T = Thickness of YBM at each grid node

A.6 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

The quality assurance/quality control (QA/QC) procedures followed in this investigation were documented by PNL Quality Engineering Division in the Quality Assurance Project Plan (QAPP). Laboratory notebooks (Data Accumulation Notebooks) were assigned to each portion of the study and served as records of day-to-day activities during sample preparation and toxicity testing. All entries in the laboratory notebooks were signed, dated, and reviewed by the project manager. The following discussion summarizes QA/QC procedures followed for sediment sampling, biological testing, and chemical testing.

A.6.1 Sample Tracking and Storage

All sediment samples were accompanied by chain-of-custody forms from the time of collection to receipt at MSL. After sample compositing, a new set of custody forms was initiated for the sediment subsamples requiring chemical analyses. These accompanied the samples to

the appropriate laboratory, where the forms were signed and returned to the MSL project manager. Custody forms were also initiated for all tissue samples upon completion of the biological testing. These forms accompanied the samples to the appropriate laboratory for chemical analyses.

All sediment collected for these studies was stored in glass, Lexan containers, or steel drums lined with 9-C-4-A-phenolic epoxy, a non-contaminating coating. Sediment samples were stored at $4^{\circ} \pm 2^{\circ}\text{C}$ prior to biological testing. Subsamples of sediment for chemical analyses and archival were obtained prior to biological testing. These subsamples were stored frozen (approximately -20°C) until chemical analyses were performed. Samples for grain size and organic analyses were held at $4^{\circ} \pm 2^{\circ}\text{C}$. Samples for metals analysis were freeze dried upon receipt at the laboratory and held less than six months.

A.6.2 Quality Control Procedures for Sediment and Tissue Chemistry

QA/QC guidelines specific to this project are described in the QAPP for this project. These QC guidelines include the following, where applicable:

- analysis of a method blank with each batch
- analysis of surrogate internal standards with each sample analyzed for organic compounds
- analysis of MS/MSD at a frequency of 5% (as applicable)
- duplicate analyses at a frequency of 5%.

Accuracy can be measured by analyzing MS and surrogate spikes of known concentrations. The MS samples were analyzed for selected metals and organic parameters. Percent recoveries were calculated based on the differences between the amount spiked and the amount recovered in the sample. Surrogate compounds were added in known amounts to samples analyzed for PCBs, pesticides, PAHs, and butyltins. Surrogate compounds were added to samples prior to extraction, and their recoveries were a measurement of the efficiency or procedural accuracy of the analysis.

Measurements of precision were obtained through replicate analysis of selected sediment samples. Replicate analyses quantify the repeatability of the measurements as well as intersample variability and efficiency of compositing. The measurements of precision are the industrial statistic (I-stat) and relative percent difference (RPD) for duplicate analyses. The I-stat is defined as the absolute value of the difference between duplicate measurements divided by the sum of the duplicates. The RPD is defined as the absolute value of the difference between two duplicate measurements, divided by the mean of the duplicates, multiplied by 100. All instrument printouts and other raw data generated using MSL analytical instruments are filed at MSL for future reference. Procedures and related data were written into the appropriate Data

Accumulation Notebooks. Copies of data generated by offsite analytical facilities are maintained at the MSL.

A.6.3 Toxicological Testina Quality Control Procedures

Appropriate procedures for organism care were maintained from collection through testing. Organisms shipped to MSL were gradually acclimated to test conditions and kept in their native sediment whenever possible. Animals were fed if necessary before biological testing. Selection of species was consistent with the 1991 Implementation Manual. Representatives of all test organisms were taxonomically identified by qualified experts at MSL before use in testing. During testing, water quality parameters were measured to ensure that acceptable experimental conditions were maintained. These conditions included a stable temperature ($\pm 2.0^{\circ}\text{C}$), minimum DO representing at least 60% saturation (40% in some cases) and controlled levels of light each day. Salinity and pH were permitted to vary within narrow ranges, as defined in the Toxicological Testing Plan. Water quality instruments were calibrated according to the manufacturer's specification or PNL protocols.

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APPENDIX B

GEOLOGIC CORE DATA LOGS

KEY TO CORE DATA LOGS

LITHOLOGY

	Clay
	Silt
	Sandy silt/silty sand
	Sand
	Pebbles
	Shells
	Roots/organic matter

CEMENTATION

N = Not cemented
W = Weakly cemented
M = Moderately cemented
S = Strongly cemented

STRUCTURE

H = Homogeneous
S = Stratified
L = laminated
M = Mottled

TYPE

GW Well-graded gravels, gravel-sand mixtures
GP Poorly-graded gravels, gravel-sand mixtures
GM Silty gravels, gravel-sand-silt mixtures
GC Clayey gravels, gravel-sand-clay mixtures
SW Well-graded sands, gravelly sands
SP Poorly-graded sands, gravelly sands
SM Silty sands, sand-silt mixtures
SC Clayey sands, sand-clay mixtures
ML Silts and very fine sands, silty or clayey fine sands, or clayey silts, with slight plasticity
CL Clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
MH Silts or fine sandy silts with moderate plasticity
CH Clays of high plasticity, fat clays

HCl REACTION

N = None
W = Weak
S = Strong

MAXIMUM PARTICLE SIZE

CS = Coarse sand
MS = Medium sand
FS = Fine sand
VFS = Very fine sand
Z = silt

ODOR

N = None
S = Sulfide
P = Petroleum

COLOR

Selected from Munsell Soil Color Chart

CONSISTENCY

Penetration of thumb:

<0.25 cm = hard (H)
0.25 - 2.0 cm = firm (F)
2.0 - 4.0 cm = soft (S)
>4.0 cm = very soft (VS)

CLAY / SILT CHARACTERISTICS

DILATANCY

N = None
S = Slow
R = Rapid

TOUGHNESS

L = Low
M = Medium
H = High

PLASTICITY

N = None
L = Low
M = Medium
H = High

Core Data Log

Project: Heckathorn

Core #: LZ-1

Logger: PJ White

Date: 1-14-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-10.2	0	CL/CH	2.5YN2/	VS	N	H	N	Z	P	odd, can't identify	A	0.5' of black, oily-looking sed
-11.2	1	?	5Y6/1 gray								B	saturated but granular appearance, not cohesive - not natural? (photo)
		doesn't look like sed.	5YRS/3 reddish brown									
-13.2	3	CL/CH	2.5YN2/						v. strong		C	very black, oily appearance & strong smell
-15.2	5								P		D	mussel shell
-16.2	6										X	M sample
-17.2	7	M L	5Y4/2 olive gray	S	N	N	N	FS	N		Y	OBM
-18.2											Z	
-19.2												
												2 photos

Core Data Log

Project: Heckathorn

Core #: LZ-2

Logger: PJ White

Date: 1-15-93

Page 1 of 1

[illegible]

Core Data Log

Project: Heckathorn

Core #: LZ-3

Logger: PJ White

Date: 1-14-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-16.5	0	CL	CH	2.5YN2/ black	VS	N	H	N	Z	N	A	oily appearance iridescent spots Approx. 2" sed fell out of bottom of liner-not sampled
-17.5	1									slt. P	B	
-19.5	3										X	
-20.7	4.2	CL		2.5Y5/4 H. olive brown	S to H	N	S	N	Z	N	Y	OBM - strata
-21.7	5.2	SC		2.5Y4/2 dk. gr. brown					CS			1-8" thick w/variable grain size
		CL		2.5Y5/4 lt. olive brown					Z		Z	
-22.7	6.2			(band of gray)					pebbles < 0.5"			
		GC		2.5YN5/					CS			
		SC							pebbles			
		GC										
8.4												2 photos

Core Data Log

Project: Heckathorn

Core #: LZ-5

Logger: PJ White

Date: 1-15-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-18.3	0		CL	2.5YN2/ black	VS	N	H	N	FS	P	A	1" of muck - oily app., shell frags, roots
-19.5	1.2		SC	5Y4/2 olive gray	S to F	N	H	N	MS	N	Y	disrupted OBM/YBM contact
-20.5	2.2		CL	2.5Y5/4 H. olive brown	F	N	S	N	Z		Z	OBM - sand
-21.5	3.2			2.5YN4/ dk. gray					MS			clay
			SM	2.5Y3/2 v. dk. grayish brown					MS			sand
			SP						pebbles			

Core Data Log

Project: Heckathom

Core #: LZ-6

Logger: PJ White

Date: 1-15-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-12.3	0		SC	2.5YN3/ v. dark gray	VS	N	H	N	FS	N	A	whole mussel shell roots oily appearance
-13.3	1		CL	2.5YN2/ black	VS	N	H	N	FS	N	B	
-15.3	3				VS	N	H	N	FS	N	C	
-16.2	3.9			2.5YN3/ v. dk. gray	VS	N	H	N	FS	N	X	
-17.2	4.9		CL		F	N	H	N	Z	N	Y	OBM
-18.2	5.9		SP	2.5Y/4 olive brown 10YR3/4 dk. yellowish brown	H	S	N	CS/ pebbles			Z	subang. grains
-18.9	6.6											photo

Core Data Log

Project: Heckathorn

Core #: LZ-7

Logger: PJ White

Date: 1-15-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-19.4	0	CL		2.5YN3/ v. dk. gray	VS	N	H	N	FS	N	A	
-20.4	1			2.5YN2/ black							B	gas holes
-22.4	3									P	C	iridescent appearance on surface
-23.7	4.3			2.5YN4/ dk. gray				Z			X	shells
-24.7	5.3											
-25.0	5.6	SC		2.5YN/ dk. gray	F	N	M locally mottled black	N	FS MS	N		altered, not sampled
-26.0	6.6			2.5Y5/4 light olive brown							Y	
-27.0	7.6										Z	
												Upper 0.3' of OBM altered by overlying YBM - stained gray
												photo

Core Data Log

Project: Heckathorn

Core #: LZ-8

Logger: PJ White

Date: 1-15-93

Page 1 of 2

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-12.3	0		CL	2.5YN2/ black	VS	N	H	N	FS	N	A	
-13.3	1			5Y6/1 gray 2.5YN2/ black			S H			P (odd odor to gray mat.)	B	oily appearance 2" of gray material granular appearance some w/ greenish tint
-15.3	3			5Y6/1 gray			M grays, green, black			mildew smell	C	chunks of gray & green material dispersed throughout black silty clay 4" of grayish material - similar to LZ-1
-17.3	5										D	more gray, lumpy material locally mixed with black silty clay Fibers? - one 5" thin thread
-19.3	7			2.5YN2/ black			H				E	pinkish area small clam shell
-21.3	9										F	shells oily appearance
-23.3	11										G	roots
-24.7	12.4			2.5YN3/ v. dk. gray							X	
-25.7	13.4										Y	
-26.7	14.4		SC	2.5Y4/4 olive brown	F to H	H	N	N	FS	N		OBM

B.7

Core Data Log

Project: Heckathorn

Core #: LZ-8 (cont'd)

Logger: PJ White

Date: 1-15-93

Page 2 of 2

[illegible]

Core Data Log

Project: Heckathorn

Core #: LZ-9

Logger: PJ White

Date: 1-15-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-25.4	0		CL	2.5YN3/ 2.5YN2/ black	VS	N	H	N	FS	N	A	roots
-26.4	1										X	
-27.4	2											
-27.7	2.3		GC SC	2.5Y5/4 olive brown	F	N	S	N	pebbles ≤ 0.5"	N	Y*	not sampled - mixture of YBM & OBM
-28.7	3.3		CL	2.5YN4/ dark gray			H		Z		Z	
-29.7	4.3											
												<p>⊙ Y sample contains gravel & may be mixed with YBM material -grayish color to OBM</p> <p>Did not contribute to OBM composite because of poor quality of sample (disrupted).</p> <p>photo</p>

Page 1 of 1

[illegible]

Core Data Log

Project: Heckathorn

Core #: LZ-12

Logger: PJ White

Date: 1-15-93

Page 1 of 1

[illegible]

Core Data Log

Project: Heckathorn

Core #: LZ-13

Logger: PJ White

Date: 1-16-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-34.9	0	CL		2.5YN2/ black	VS	N	H	N	VFS	S	A	
-35.9	1								FS	N	B	chunk of wood chunks of bauxite
-37.9	3										C	gas holes chunks of OBM rubber wheel!
-39.9	5									P*		gas holes
-41.1	6.2										X	shell fragments
-42.1	7.2	CL		5Y4/1 dark gray	H	N	H	N	<Z	N	Y	large OBM chunk wood
-43.1	8.2										Z	very dry & hard
-43.9	9											CaCO ₃ as white coating on fractures
												* samplers report an odor of naptha (mothballs)
												photo

Page 1 of 1

B.14

Page 1 of 1

B.15

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments	
-35.2	0		CL	2.5YN3/ v. dk. gray and 2.5YN2/ black	VS	N	faint S	N	FS	slight S	A	chunks of bauxite in CL	
-36.2	1												B
-38.2	3		↓ SC CL						↓ MS Z FS				C
-40.2	5											D	2" clast of OBM shells 1" clast of OBM
-41.6	6.4										X		
-42.6	7.4												
-43.1	7.9		CL	5Y4/1 dark gray	H	N	H	N	Z	N	Y	OBM	

Core Data Log

Project: Heckathorn

Core #: SF-17

Logger: PJ White

Date: 1-16-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-29.4	0	NA	NA	NA	CL	2.5YN/3 v. dark gray	VS	N	faint S	N	FS	faint S, P	A		
-30.4	1					2.5N2/blk									oily appearance
						2.5YN/3 v. dark gray							B		
-32.7	3.3					dk gray/gray 5Y4/1	S						N		mixture of YBM & OBM? Gray clay is soft
-33.7	4.3												X		
		NA	NA	NA	CL	5Y4/1 dark gray	S/F	N	S	N	Z MS	N	Y		0.8' OBM layer
-34.7	5.3				CL										not sampled - YBM layer
-35.7	6.3	NA	M	M	CL		H				Z		Z		YBM between SC & CL ⊕
															NOTE: Did not contribute Y to
-38.1	8.7														OBM composite because of potential contamination with YBM
															⊕ YBM appears to have oozed into spaces between segments of OBM that may have pulled apart during coring

Page 1 of 1B.18

Page 1 of 1

B.19

Page 1 of 1B.20

Core Data Log

Project: Heckathorn

Core #: SF-21

Logger: PJ White

Date: 1-18-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-30.8	0	NA	NA	NA	CL	2.5YN3/v. dark gray	VS	N	H	N	FS	faint S	A		
-31.8	1												B		
-33.8	3												C		
-35.4	4.6					5Y4/1 dk. gray			M w/ black streaks		VFS	N	X		
-36.4	5.6	NA	M	M	CL	5Y4/1 dk. gray	F	N	H	N	Z	N	Y		OBM
-37.4	6.6				SC						FS		Z		
-38.4	7.6										VFS				
-39.3	8.5														

Core Data Log

Project: Heckathorn

Core #: SF-22

Logger: PJ White

Date: 1-18-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-28.9	0	NA	NA	NA	CL	2.5YN2/black	VS	N	faint S/L	N	FS	faint S	A	roots	
-29.9	1					2.5YN3/v. dark gray			H		Z	N	B	shell fragments	
-31.9	3					5Y4/1 dk. gray							C		
						2.5YN3/v. dark gray									
						5Y4/1 dk. gray									
-34.0	5.1												X		
-35.0	6.1	NA	M	M	CL	5Y4/1 dk. gray	F	N	H	N	Z	N	Y		OBM
-36.0	7.1												Z		local very small patches of CaCO ₃ alt.
-37.0	8.1														
-37.6	8.7														

Core Data Log

Project: Heckathorn

Core #: SF-23

Logger: PJ White

Date: 1-18-93

Page 1 of 1

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Core Data Log

Project: Heckathorn

Core #: SF-24

Logger: PJ White

Date: 1-18-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-31.4	0	NA	NA	NA	CL	2.5YN3/ v. dark gray	VS	N	H	N	FS	faint S N	A		
-32.4	1												B		local black streaks
-34.4	3					5Y4/1 dk. gray					Z		C		
-36.2	4.8														<u>No OBM</u>
															Only 3' of YBM was present in the 12" core; therefore, only 5' of 4" core was collected. Apparently, the 4" core penetrated a thicker layer of YBM. The contact was probably very close to 5 ft below mudline because the 5Y4/1 dark gray clay layer in the YBM has been within 1.5' of the contact at other USFC stations.

Core Data Log

Project: Heckathorn

Core #: SF-25

Logger: PJ White

Date: 1-18-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-29.5	0	NA	NA	NA	CL	2.5YN2/black	VS	N	S/H	N	FS	str	A		roots
-30.5	1					2.5YN3/v. dark gray						P			oily appearance
						5Y4/1 dk. gray	S				Z	N	B		
-32.9	3.4												X		
-33.9	4.4														
-34.2	4.7	NA	M	M	CL	5Y4/1 dk. gray	FH	N	H	N	Z	N	Y		0.3' of light olive brown OBM mixed with YBM - not sampled
-35.2	5.7												Z		
-36.2	6.7														very hard
-37.2	7.7														

Page 1 of 1

B.26

Page 1 of 1B.27

Page 1 of 1B.28

Core Data Log

Project: Heckathorn

Core #: SF-29

Logger: PJ White

Date: 1-18-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-27.1	0	NA	NA	NA	CL	2.5YN3/	v. dark gray	VS	N	H	N	FS	N	A	
-28.1	1													B	sparse roots
-30.1	3							S						C	root shell
-32.1	5					2.5YN2/	black							D	clast of OBM-dark gray SC
-34.1	7									M, faint S		Z FS Z		E	
-35.9	8.8				SC/CL							pebbles ≥0.5'		X	
-36.9	9.8	NA	M	M	CL	5Y4/1	dk. gray	H	N	H	N	Z	N	Y	OBM
-37.9	10.8										except CaCO ₃ alt.			Z	local CaCO ₃ alt.
-38.9	11.8														white, powdery
-39.7	12.6														

Page 1 of 1B.30

Page 1 of 1B.31

Core Data Log

Project: Heckathorn

Core #: SF-32

Logger: PJ White

Date: 1-16-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-27.5	0	NA	NA	NA	CL	2.5YN3/dk. gray	VS	N	H	N	VFS	faint S	A		clam shell fragments
-28.5	1												B		many roots
-30.5	3											rubbery smell	C		
-32.2	4.7										FS	Z			
-33.2	5.7	NA	M	M	CL	5Y5/2 olive gray 5Y4/1 dk. gray	H	N	H	N, except alt.	Z	N	X		
-34.2	6.7												Y		~3" band of olive gray clay over gray clay
-35.2	7.7												Z		
-35.8	8.3														CaCO ₃ alteration -
															sparse, white powder surfaces

Page 1 of 1B.33

Page 1 of 1B.34

Page 1 of 1B.35

Core Data Log

Project: Heckathorn

Core #: IH-36

Logger: PJ White

Date: 1-19-93

Page 1 of 1[illegible]

Core Data Log

Project: Heckathorn

Core #: IH-37

Logger: PJ White

Date: 1-19-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-34.8	0	NA	NA	NA	CL	2.5Y4/2 grayish brown	VS	N	H	N	FS	N	A		
-35.8	1					2.5YN3/ v. dark gray							B		
-37.8	3										VFS		C		
-39.3	4.5												X		
-40.3	5.5	NA	M	M	CL	2.5Y4/4 olive brown	F	N	H	N	Z	N	Y		YBM in 0.2" crack in OBM
-41.3	6.5												Z		
-42.3	7.5	NA	NA	SC/CL							FS				
-44.4	9.6														
															2 photos

Page 1 of 1

B.38

Core Data Log

Project: Heckathorn

Core #: IH-39

Logger: PJ White

Date: 1-19-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-34.5	0	NA	NA	NA	CL	2.5Y4/2	dark grayish brown	VS	N	H	N	VFS	N	A	
-35.5	1					2.5YN3/	v. dark gray							B	
-37.5	3					2.5YN2/	black					FS		C	clast of OBM
-39.0	4.5											VFS		X	
-40.0	5.5	NA	M	M	CL	2.5Y4/2	dark grayish brown	F	N	H	N except CaCO ₃ alt.	VFS	N	Y	very hard!
-41.0	6.5							H				Z		Z	patches of CaCO ₃ alt.
-42.0	7.5														
-42.7	8.2														

Core Data Log

Project: Heckathorn

Core #: IH-40

Logger: PJ White

Date: 1-19-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-35.5	0	NA	NA	NA	CL	2.5YN3/	VS	N	H	N	FS	N	N	A	roots
-36.5	1					v. dark gray								B	
-38.0	2.5													X	
-39.0	3.5	NA	M	M	CL	5Y4/1	H	N	H	N	Z	N	N	Y	
-40.0	4.5					dk. gray								Z	
-41.0	5.5						F				FS				
-43.9	8.4														

Core Data Log

Project: Heckathorn

Core #: IH-41

Logger: PJ White

Date: 1-19-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-35.4	0	NA	NA	NA	CL	2.5YN3/v. dark gray	VS	N	H	N	FS	N	N	A	grayish brown at surface
-36.4	1													B	
-38.4	3									M-H				C	black areas
-39.4	4									H				X	
-40.4	5	NA	M	M	CL	5Y4/1 dk. gray	H	N	H	N except alt.	Z	N	N	Y	
-41.4	6													Z	CaCO ₃ alt. in patches
-42.4	7														
-44.1	8.7														

Page 1 of 1

B.42

Core Data Log

Project: Heckathorn

Core #: IH-43

Logger: PJ White

Date: 1-19-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-35.1	0	M	NA	NA	CL	2.5YN3/ v. dark gray	VS	N	H	N	FS	N	A		
-36.1	1												B		
-38.1	3														
-39.1	4	NA	M	M	CL	5Y4/1 dk. gray	HI	N	H	N	Z	N	X		
-40.1	5												Y		
-41.1	6												Z		
-43.9	8.8														photo

Core Data Log

Project: Heckathorn

Core #: IH-44

Logger: PJ White

Date: 1-19-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-34.6	0	NA	NA	NA	CL	2.5YN3/ v. dark gray	VS	N	H	N	VFS	faint S	A		grayish brown on top
-35.6	1												B		
-37.6	3					2.5YN2/ black							C		gas holes
-39.6	5												D		
-41.6	7												X		
-42.6	8	NA	M	M	CL	2.5Y4/2 dark grayish brown	F H	N	H	N	Z	N	Y		upper 2" disrupted
-43.6	9												Z		
-44.6	10														
-46.4	11.8														

Core Data Log

Project: Heckathorn

Core #: IH-45

Logger: PJ White

Date: 1-20-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-34.8	0	NA	NA	NA	CL	5Y4/1 dk. gray	VS	N	H	N	VFS	N	A		
-35.8	1					2.5Y4/1 v. dark gray							B		contact between lighter gray muck and darker clay
-37.8	3												C		gas holes
-39.1	4.3														
-40.1	5.3	NA	M	M	CL	5Y4/1 dk. gray	F	N	H	N	Z	N	*		
-41.1	6.3												Y		0.2' brownish alt. in OBM below contact
-42.1	7.3												Z		
-43.1	8.3														

Core Data Log

Project: Heckathorn

Core #: IH-46

Logger: PJ White

Date: 1-20-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-34.8	0	NA	NA	NA	CL	5Y4/1 dk. gray	VS	N	H	N	VFS	N		A	
-35.8	1													B	
-37.8	3					2.5Y4/3 v. dark gray								C	contact between gray muck and dark gray YBM gas holes
-39.8	5														
-40.8	6	NA	M	M	CL	2.5Y4/4 olive brown	H	N	H	N	Z	N		X	
-41.8	7													Y	very sharp contact
-42.5	7.7													Z	
															photo

Page 1 of 1

B.47

Page 1 of 1

B.48

Page 1 of 1B.49

Page 1 of 1

B.50

Project: Heckathorn

Core #: 1H-51

Logger: PJ White

Date: 1-14-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-35.0	0		NA	NA	CL	CH	2.5Y4/4 olive brown	VS	N	H	N	N	A		YBM
-36.3	1		NA	NA	CL	CH	2.5YN3/ v. dark gray		N	H	N	N	B		
-37.3	2		NA	NA	CL	CH	2.5YN2/ black		N	H	N	N	X		
-38.3	3		NA	NA	CL	CH	2.5Y4/4 F to S		N	H	N	N			altered zone- grayish OBM
-38.5	3.2				CL	CH	2.5Y4/4 olive brown						Y		
-39.5	3.9				CL	CH									
-40.5	4.2				CL	CH									
-43.6	8.3				SC						FS				Sand shows flow structures- concentric and longitudinal layering
											MS				2 photos

Page 1 of 1

B.52

Page 1 of 1B.53

Core Data Log

Project: Heckathorn

Core #: PC-54

Logger: PJ White

Date: 1-20-93

Page 1 of 1

Depth Below Water Surface (ft)	Depth Below Mudline (ft)	Lithology	Dilatancy	Toughness	Plasticity	Type	Color	Consistency	Cementation	Structure	HCl Reaction	Maximum Particle Size	Odor	Samples	Comments
-2.8	0	NA	NA	NA	CL	2.5YN3/	VS	N	H	N	FS	S		A	gas holes
-3.8	1	NA	NA	NA	CL	2.5YN2/ black	VS	N	H	N	FS	S		B	roots
-5.4	2.6	NA	NA	NA	CL	2.5YN3/ v. dark gray	VS	N	H	N	FS	S		C	black, oily appearance
-6.4	3.6	NA	NA	NA	CL	2.5YN3/ v. dark gray	VS	N	H	N	FS	S		C	chunk of wood
															photo
															This core does not appear to be as contaminated as PC-52 & 53 - gray rather than black, less strong-smelling, and does not have oily, shiny appearance except at -2 to -3 ft.

APPENDIX C

SEDIMENT CHEMISTRY AND QUALITY ASSURANCE DATA

TABLE C.1. Sediment Samples Prepared from 4-in. Cores and Channel Edge Grab Samples, United Heckathorn Remedial Investigation

Sample Preparation Date	Sediment Treatment		Segment Length (ft)	Segment Range (ft MLLW)	OBM Composite Contribution	Pesticides, TOC, Grain Size	Oil and Grease, TPH, Metals PAH, PCB Butylins	Archive
14-Jan-93	LZ-1	A	1.0	-10.2 to -11.2	NA (YBM) ^(a)	Yes	No	Yes
14-Jan-93	LZ-1	B	2.0	-11.2 to -13.2	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-1	C	2.0	-13.2 to -15.2	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-1	D	1.0	-15.2 to -16.2	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-1	X	1.0	-16.2 to -17.2	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-1	Y	1.0	-17.2 to -18.2	OBM Comp-Fine ^(a)	Yes	No	Yes
14-Jan-93	LZ-1	Z	1.0	-18.2 to -19.2	NA (ARC) ^(b)	No	No	Yes
14-Jan-93	LZ-1	M	7.0	-10.2 to -17.2	NA (YBM)	No	Yes	Yes
15-Jan-93	LZ-2	A	1.0	-12.1 to -13.1	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-2	B	2.0	-13.1 to -15.1	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-2	C	0.8	-15.1 to -15.9	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-2	X	1.0	-15.9 to -16.9	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-2	Y	1.0	-16.9 to -17.9	OBM Comp-Fine	Yes	No	Yes
15-Jan-93	LZ-2	Z	1.0	-17.9 to -18.9	NA (ARC)	No	No	Yes
14-Jan-93	LZ-3	A	1.0	-16.5 to -17.5	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-3	B	2.0	-17.5 to -19.5	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-3	X	1.2	-19.5 to -20.7	NA (YBM)	Yes	No	Yes
14-Jan-93	LZ-3	Y	1.0	-20.7 to -21.7	OBM Comp-Fine	Yes	No	Yes
14-Jan-93	LZ-3	Z	1.0	-21.7 to -22.7	NA (ARC)	No	No	Yes
14-Jan-93	LZ-3	M	4.2	-16.5 to -20.7	NA (YBM)	No	Yes	Yes
15-Jan-93	LZ-5	A	1.2	-18.3 to -19.5	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-5	Y	1.0	-19.5 to -20.5	OBM Comp-Coarse	Yes	No	Yes
15-Jan-93	LZ-5	Z	1.0	-20.5 to -21.5	NA (ARC)	No	No	Yes
15-Jan-93	LZ-6	A	1.0	-12.3 to -13.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-6	B	2.0	-13.3 to -15.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-6	C	0.9	-15.3 to -16.2	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-6	X	1.0	-16.2 to -17.2	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-6	Y	1.0	-17.2 to -18.2	OBM Comp-Coarse	Yes	No	Yes
15-Jan-93	LZ-6	Z	0.7	-18.2 to -18.9	NA (ARC)	No	No	Yes
15-Jan-93	LZ-6	M	4.9	-12.3 to -17.2	NA (YBM)	No	Yes	Yes
15-Jan-93	LZ-7	A	1.0	-19.4 to -20.4	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-7	B	2.0	-20.4 to -22.4	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-7	C	1.3	-22.4 to -23.7	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-7	X	1.0	-23.7 to -24.7	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-7	Y	1.0	-25.0 to -26.0	OBM Comp-Coarse	Yes	No	Yes
15-Jan-93	LZ-7	Z	1.0	-26.0 to -27.0	NA (ARC)	No	No	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment		Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides,	Oil and Grease,	Archive
						TOC, Grain Size	TPH, Metals PAH, PCB Butylins	
15-Jan-93	LZ-8	A	1.0	-12.3 to -13.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	B	2.0	-13.3 to -15.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	C	2.0	-15.3 to -17.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	D	2.0	-17.3 to -19.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	E	2.0	-19.3 to -21.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	F	2.0	-21.3 to -23.3	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	G	1.4	-23.3 to -24.7	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	X	1.0	-24.7 to -25.7	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-8	Y	1.0	-25.7 to -26.7	CBM Comp-Fine	Yes	No	Yes
15-Jan-93	LZ-8	Z	1.0	-26.7 to -27.7	NA (ARC)	No	No	Yes
15-Jan-93	LZ-9	A	1.0	-25.4 to -26.4	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-9	X	1.0	-26.4 to -27.4	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-9	Y	1.0	-27.7 to -28.7	No Contribution	Yes	No	Yes
15-Jan-93	LZ-9	Z	1.0	-28.7 to -29.7	NA (ARC)	No	No	Yes
15-Jan-93	LZ-9	M	2.0	-25.4 to -27.4	NA (YBM)	No	Yes	Yes
16-Jan-93	LZ-10	A	1.0	-34.7 to -35.7	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-10	B	2.0	-35.7 to -37.7	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-10	X	1.3	-37.7 to -39.0	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-10	Y	1.0	-39.0 to -40.0	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	LZ-10	Z	1.0	-40.0 to -41.0	NA (ARC)	No	No	Yes
15-Jan-93	LZ-11	A	1.0	-12.0 to -13.0	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-11	X	0.7	-13.0 to -13.7	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-11	Y	1.0	-13.9 to -14.9	CBM Comp-Coarse	Yes	No	Yes
15-Jan-93	LZ-11	Z	1.0	-14.9 to -15.9	NA (ARC)	No	No	Yes
15-Jan-93	LZ-11	M	1.7	-12.0 to -13.7	NA (YBM)	No	Yes	Yes
16-Jan-93	LZ-12	A	1.0	-37.5 to -38.5	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-12	X	1.2	-38.5 to -39.7	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-12	Y	1.0	-39.7 to -40.7	CBM Comp-Coarse	Yes	No	Yes
16-Jan-93	LZ-12	Z	0.9	-40.7 to -41.6	NA (ARC)	No	No	Yes
16-Jan-93	LZ-13	A	1.0	-34.9 to -35.9	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-13	B	2.0	-35.9 to -37.9	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-13	C	2.0	-37.9 to -39.9	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-13	X	1.2	-39.9 to -41.1	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-13	Y	1.0	-41.1 to -42.1	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	LZ-13	Z	1.0	-42.1 to -43.1	NA (ARC)	No	No	Yes
16-Jan-93	LZ-13	M	6.2	-34.9 to -41.1	NA (YBM)	No	Yes	Yes
15-Jan-93	LZ-14	A	1.0	-23.1 to -24.1	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-14	X	0.9	-24.1 to -25.0	NA (YBM)	Yes	No	Yes
15-Jan-93	LZ-14	Y	1.0	-25.0 to -26.0	CBM Comp-Coarse	Yes	No	Yes
15-Jan-93	LZ-14	Z	1.0	-26.0 to -27.0	NA (ARC)	No	No	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment	Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides, TOC, Grain Size	Oil and Grease, TPH, Metals PAH, PCB Butylins	Archive
16-Jan-93	LZ-15 A	1.0	-36.7 to -37.7	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-15 B	0.8	-37.7 to -38.5	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-15 X	1.0	-38.5 to -39.5	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-15 Y	1.0	-39.5 to -40.5	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	LZ-15 Z	1.0	-40.5 to -41.5	NA (ARC)	No	No	Yes
16-Jan-93	LZ-15 M	2.8	-36.7 to -39.5	NA (YBM)	No	Yes	Yes
16-Jan-93	LZ-16 A	1.0	-35.2 to -36.2	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-16 B	2.0	-36.2 to -38.2	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-16 B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-16 C	2.0	-38.2 to -40.2	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-16 D	1.4	-40.2 to -41.6	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-16 X	1.0	-41.6 to -42.6	NA (YBM)	Yes	No	Yes
16-Jan-93	LZ-16 Y	0.5	-42.6 to -43.1	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	SF-17 A	1.0	-29.4 to -30.4	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-17 B	2.3	-30.4 to -32.7	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-17 B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
16-Jan-93	SF-17 X	1.0	-32.7 to -33.7	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-17 Y	0.8	-33.7 to -34.5	No Contribution	Yes	No	Yes
16-Jan-93	SF-17 Z	1.0	-34.7 to -35.7	NA (ARC)	No	No	Yes
16-Jan-93	SF-17 M	4.3	-29.4 to -33.7	NA (YBM)	No	Yes	Yes
16-Jan-93	SF-18 A	1.0	-31.6 to -32.6	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-18 B	0.8	-32.6 to -33.4	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-18 X	1.0	-33.4 to -34.4	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-18 Y	1.0	-34.4 to -35.4	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	SF-18 Z	0.5	-35.4 to -35.9	NA (ARC)	No	No	Yes
16-Jan-93	SF-18 M	2.8	-31.6 to -34.4	NA (YBM)	No	Yes	Yes
16-Jan-93	SF-19 A	1.0	-31.9 to -32.9	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-19 X	1.1	-32.9 to -34.0	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-19 Y	1.0	-34.0 to -35.0	CBM Comp-Coarse	Yes	No	Yes
16-Jan-93	SF-19 Z	1.0	-35.0 to -36.0	NA (ARC)	No	No	Yes
16-Jan-93	SF-19 M	2.1	-31.9 to -34.0	NA (YBM)	No	Yes	Yes
16-Jan-93	SF-20 A	1.0	-32.7 to -33.7	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-20 X	1.1	-33.7 to -34.8	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-20 Y	1.0	-34.8 to -35.8	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	SF-20 Z	1.0	-35.8 to -36.8	NA (ARC)	No	No	Yes
16-Jan-93	SF-20 M	2.1	-32.7 to -34.8	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-21 A	1.0	-30.8 to -31.8	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-21 B	2.0	-31.8 to -33.8	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-21 C	1.6	-33.8 to -35.4	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-21 C	Compositing Duplicate		NA (YBM)	Yes	No	Yes
18-Jan-93	SF-21 X	1.0	-35.4 to -36.4	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-21 Y	1.0	-36.4 to -37.4	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-21 Z	1.0	-37.4 to -38.4	NA (ARC)	No	No	Yes
18-Jan-93	SF-21 M	5.6	-30.8 to -36.4	NA (YBM)	No	Yes	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment		Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides,	Oil and Grease,	Archive
						TOC, Grain Size	TPH, Metals PAH, PCB Butylins	
18-Jan-93	SF-22	A	1.0	-28.9 to -29.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-22	B	2.0	-29.9 to -31.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-22	C	2.1	-31.9 to -34.0	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-22	X	1.0	-34.0 to -35.0	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-22	Y	1.0	-35.0 to -36.0	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-22	Z	1.0	-36.0 to -37.0		NA (ARC)	No	No
18-Jan-93	SF-22	M	6.1	-28.9 to -35.0	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-23	A	1.0	-34.2 to -35.2	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-23	B	0.7	-35.2 to -35.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-23	X	1.0	-35.9 to -36.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-23	Y	1.0	-36.9 to -37.9	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-23	Z	0.8	-37.9 to -38.7		NA (ARC)	No	No
18-Jan-93	SF-23	M	2.7	-34.2 to -36.9	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-24	A	1.0	-31.4 to -32.4	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-24	B	2.0	-32.4 to -34.4	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-24	C	1.8	-34.4 to -36.2	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-24	M	4.8	-31.4 to -36.2	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-25	A	1.0	-29.5 to -30.5	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-25	B	2.4	-30.5 to -32.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-25	X	1.0	-32.9 to -33.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-25	Y	1.0	-34.2 to -35.2	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-25	Z	1.0	-35.2 to -36.2		NA (ARC)	No	No
18-Jan-93	SF-25	M	4.4	-29.5 to -33.9	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-26	A	1.0	-31.4 to -32.4	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-26	B	2.0	-32.4 to -34.4	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-26	C	0.7	-34.4 to -35.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-26	X	1.0	-35.1 to -36.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-26	Y	1.0	-36.1 to -37.1	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-26	Z	1.0	-37.1 to -38.1		NA (ARC)	No	No
18-Jan-93	SF-26	M	4.7	-31.4 to -36.1	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-27	A	1.0	-35.3 to -36.3	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-27	B	2.0	-36.3 to -38.3	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-27	B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
18-Jan-93	SF-27	C	1.0	-38.3 to -39.3	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-27	X	1.0	-39.3 to -40.3	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-27	Y	1.0	-40.3 to -41.3	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-27	Z	0.5	-41.3 to -41.8		NA (ARC)	No	No
18-Jan-93	SF-27	M	5.0	-35.3 to -40.3	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-28	A	1.0	-35.6 to -36.6	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-28	B	1.7	-36.6 to -38.3	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-28	X	1.0	-38.3 to -39.3	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-28	Y	0.5	-39.3 to -39.8	CBM Comp-Coarse	Yes	No	Yes
18-Jan-93	SF-28	M	3.7	-35.6 to -39.3		NA (YBM)	No	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment	Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides, TOC, Grain Size	Oil and Grease, TPH, Metals PAH, PCB Butylins	Archive
18-Jan-93	SF-29 A	1.0	-27.1 to -28.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-29 B	2.0	-28.1 to -30.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-29 C	2.0	-30.1 to -32.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-29 D	2.0	-32.1 to -34.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-29 E	1.8	-34.1 to -35.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-29 X	1.0	-35.9 to -36.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-29 Y	1.0	-36.9 to -37.9	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-29 Z	1.0	-37.9 to -38.9	NA (ARC)	No	No	Yes
18-Jan-93	SF-30 A	1.0	-36.1 to -37.1	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-30 B	0.8	-37.1 to -37.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-30 X	1.0	-37.9 to -38.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-30 Y	1.0	-38.9 to -39.9	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-30 Z	0.9	-39.9 to -40.8	NA (ARC)	No	No	Yes
18-Jan-93	SF-30 M	2.8	-36.1 to -38.9	NA (YBM)	No	Yes	Yes
18-Jan-93	SF-31 A	1.0	-36.9 to -37.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-31 X	1.0	-37.9 to -38.9	NA (YBM)	Yes	No	Yes
18-Jan-93	SF-31 Y	1.0	-38.9 to -39.9	CBM Comp-Fine	Yes	No	Yes
18-Jan-93	SF-31 Z	1.0	-39.9 to -40.9	NA (ARC)	No	No	Yes
16-Jan-93	SF-32 A	1.0	-27.5 to -28.5	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-32 B	2.0	-28.5 to -30.5	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-32 C	1.7	-30.5 to -32.2	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-32 X	1.0	-32.2 to -33.2	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-32 Y	1.0	-33.2 to -34.2	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	SF-32 Z	1.0	-34.2 to -35.2	NA (ARC)	No	No	Yes
16-Jan-93	SF-32 M	5.7	-27.5 to -33.2	NA (YBM)	No	Yes	Yes
16-Jan-93	SF-32 M	Compositing Duplicate		NA (YBM)	No	Yes	Yes
16-Jan-93	SF-33 A	1.0	-35.9 to -36.9	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-33 B	2.2	-36.9 to -39.1	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-33 X	1.0	-39.1 to -40.1	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-33 Y	1.0	-40.1 to -41.1	CBM Comp-Coarse	Yes	No	Yes
16-Jan-93	SF-33 Z	1.0	-41.1 to -42.1	NA (ARC)	No	No	Yes
16-Jan-93	SF-34 A	1.0	-38.0 to -39.0	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-34 B	0.8	-39.0 to -39.8	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-34 X	1.0	-39.8 to -40.8	NA (YBM)	Yes	No	Yes
16-Jan-93	SF-34 Y	1.0	-40.8 to -41.8	CBM Comp-Fine	Yes	No	Yes
16-Jan-93	SF-34 Z	0.4	-41.8 to -42.2	NA (ARC)	No	No	Yes
16-Jan-93	SF-34 M	2.8	-38.0 to -40.8	NA (YBM)	No	Yes	Yes
19-Jan-93	IH-35 A	1.0	-35.6 to -36.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-35 X	1.4	-36.6 to -38.0	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-35 Y	1.0	-38.0 to -39.0	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-35 Z	1.0	-39.0 to -40.0	NA (ARC)	No	No	Yes
19-Jan-93	IH-36 A	1.0	-35.6 to -36.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-36 B	1.7	-36.6 to -38.3	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-36 B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
19-Jan-93	IH-36 X	1.0	-38.3 to -39.3	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-36 Y	1.0	-39.3 to -40.3	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-36 Z	1.0	-40.3 to -41.3	NA (ARC)	No	No	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment		Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides,	Oil and Grease,	Archive
						TOC, Grain Size	TPH, Metals, PAH, PCB Butylins	
19-Jan-93	IH-37	A	1.0	-34.8 to -35.8	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-37	B	2.0	-35.8 to -37.8	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-37	B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
19-Jan-93	IH-37	C	1.5	-37.8 to -39.3	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-37	X	1.0	-39.3 to -40.3	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-37	Y	1.0	-40.3 to -41.3	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-37	Z	1.0	-41.3 to -42.3	NA (ARC)	No	No	Yes
19-Jan-93	IH-37	M	5.5	-34.8 to -40.3	NA (YBM)	No	Yes	Yes
19-Jan-93	IH-38	A	1.0	-36.5 to -37.5	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-38	X	1.2	-37.5 to -38.7	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-38	Y	1.0	-38.7 to -39.7	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-38	Z	1.0	-39.7 to -40.7	NA (ARC)	No	No	Yes
19-Jan-93	IH-38	M	2.2	-36.5 to -38.7	NA (YBM)	No	Yes	Yes
19-Jan-93	IH-39	A	1.0	-34.5 to -35.5	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-39	B	2.0	-35.5 to -37.5	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-39	B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
19-Jan-93	IH-39	C	1.5	-37.5 to -39.0	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-39	X	1.0	-39.0 to -40.0	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-39	Y	1.0	-40.0 to -41.0	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-39	Z	1.0	-41.0 to -42.0	NA (ARC)	No	No	Yes
19-Jan-93	IH-39	M	5.5	-34.5 to -40.0	NA (YBM)	No	Yes	Yes
19-Jan-93	IH-40	A	1.0	-35.5 to -36.5	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-40	B	1.5	-36.5 to -38.0	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-40	X	1.0	-38.0 to -39.0	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-40	Y	1.0	-39.0 to -40.0	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-40	Z	1.0	-40.0 to -41.0	NA (ARC)	No	No	Yes
19-Jan-93	IH-41	A	1.0	-35.4 to -36.4	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-41	B	2.0	-36.4 to -38.4	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-41	C	1.0	-38.4 to -39.4	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-41	X	1.0	-39.4 to -40.4	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-41	Y	1.0	-40.4 to -41.4	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-41	Z	1.0	-41.4 to -42.4	NA (ARC)	No	No	Yes
19-Jan-93	IH-42	A	1.0	-38.4 to -39.4	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-42	X	0.6	-39.4 to -40.0	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-42	Y	1.0	-40.0 to -41.0	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-42	Z	1.0	-41.0 to -42.0	NA (ARC)	No	No	Yes
19-Jan-93	IH-43	A	1.0	-35.1 to -36.1	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-43	B	2.0	-36.1 to -38.1	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-43	B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
19-Jan-93	IH-43	X	1.0	-38.1 to -39.1	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-43	Y	1.0	-39.1 to -40.1	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-43	Z	1.0	-40.1 to -41.1	NA (ARC)	No	No	Yes
19-Jan-93	IH-44	A	1.0	-34.6 to -35.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-44	B	2.0	-35.6 to -37.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-44	C	2.0	-37.6 to -39.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-44	D	2.0	-39.6 to -41.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-44	X	1.0	-41.6 to -42.6	NA (YBM)	Yes	No	Yes
19-Jan-93	IH-44	Y	1.0	-42.6 to -43.6	CBM Comp-Fine	Yes	No	Yes
19-Jan-93	IH-44	Z	1.0	-43.6 to -44.6	NA (ARC)	No	No	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment	Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides, TOC, Grain Size	Oil and Grease, TPH, Metals PAH, PCB Butylins	Archive
20-Jan-93	IH-45 A	1.0	-34.8 to -35.8	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-45 B	2.0	-35.8 to -37.8	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-45 C	1.3	-37.8 to -39.1	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-45 X	1.0	-39.1 to -40.1	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-45 Y	1.0	-40.1 to -41.1	CBM Comp-Fine	Yes	No	Yes
20-Jan-93	IH-45 Z	1.0	-41.1 to -42.1	NA (ARC)	No	No	Yes
20-Jan-93	IH-46 A	1.0	-34.8 to -35.8	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-46 B	2.0	-35.8 to -37.8	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-46 C	2.0	-37.8 to -39.8	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-46 X	1.0	-39.8 to -40.8	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-46 Y	1.0	-40.8 to -41.8	CBM Comp-Fine	Yes	No	Yes
20-Jan-93	IH-46 Z	0.7	-41.8 to -42.5	NA (ARC)	No	No	Yes
20-Jan-93	IH-47 A	1.0	-36.7 to -37.7	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-47 B	2.0	-37.7 to -39.7	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-47 C	0.8	-39.7 to -40.5	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-47 X	1.0	-40.5 to -41.5	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-47 Y	1.0	-41.5 to -42.5	CBM Comp-Fine	Yes	No	Yes
20-Jan-93	IH-47 Z	1.0	-42.5 to -43.5	NA (ARC)	No	No	Yes
20-Jan-93	IH-48 A	1.0	-35.1 to -36.1	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-48 B	2.4	-36.1 to -38.5	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-48 X	1.0	-38.5 to -39.5	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-48 Y	1.0	-39.5 to -40.5	CBM Comp-Fine	Yes	No	Yes
20-Jan-93	IH-48 Z	0.4	-40.5 to -40.9	NA (ARC)	No	No	Yes
20-Jan-93	IH-49 A	1.0	-35.4 to -36.4	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-49 B	1.7	-36.4 to -38.1	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-49 X	1.0	-38.1 to -39.1	NA (YBM)	Yes	No	Yes
20-Jan-93	IH-49 Y	0.8	-39.1 to -39.9	CBM Comp-Fine	Yes	No	Yes
14-Jan-93	IH-50 A	1.0	-35.9 to -36.9	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-50 B	2.0	-36.9 to -38.9	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-50 C	0.8	-38.9 to -39.7	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-50 X	1.0	-39.7 to -40.7	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-50 Y	1.0	-41.2 to -42.2	CBM Comp-Coarse	Yes	No	Yes
14-Jan-93	IH-50 Z	1.0	-42.2 to -43.2	NA (ARC)	No	No	Yes
14-Jan-93	IH-51 A	1.0	-35.3 to -36.3	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-51 B	1.0	-36.3 to -37.3	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-51 X	1.0	-37.3 to -38.3	NA (YBM)	Yes	No	Yes
14-Jan-93	IH-51 Y	1.0	-38.5 to -39.5	CBM Comp-Fine	Yes	No	Yes
14-Jan-93	IH-51 Z	1.0	-39.5 to -40.5	NA (ARC)	No	No	Yes
20-Jan-93	PC-52 A	1.0	-3.8 to -4.8	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-52 B	2.0	-4.8 to -6.8	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-52 C	1.1	-6.8 to -7.9	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-52 M	4.1	-3.8 to -7.9	NA (YBM)	No	Yes	Yes
20-Jan-93	PC-53 A	1.0	-3.5 to -4.5	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-53 B	1.4	-4.5 to -5.9	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-53 C	1.0	-5.9 to -6.9	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-53 M	3.4	-3.5 to -6.9	NA (YBM)	No	Yes	Yes

TABLE C.1. (contd)

Sample Preparation Date	Sediment Treatment	Segment Length (ft)	Segment Range (ft MLLW)	CBM Composite Contribution	Pesticides, TOC, Grain Size	Oil and Grease, TPH, Metals PAH, PCB Butylins	Archive	
20-Jan-93	PC-54	A	1.0	-2.8 to -3.8	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-54	B	1.6	-3.8 to -5.4	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-54	B	Compositing Duplicate		NA (YBM)	Yes	No	Yes
20-Jan-93	PC-54	C	1.0	-5.4 to -6.4	NA (YBM)	Yes	No	Yes
20-Jan-93	PC-54	M	3.6	-2.8 to -6.4	NA (YBM)	No	Yes	Yes
15-Jan-93	SFC Marina			NA (YBM)	Yes	No	Yes	
15-Jan-93	FSFC Edge-West			NA (YBM)	Yes	No	Yes	
15-Jan-93	Parr Canal Edge			NA (YBM)	Yes	No	Yes	
15-Jan-93	Parr Canal Edge	Compositing Duplicate		NA (YBM)	Yes	No	Yes	
15-Jan-93	IHC Edge-East			NA (YBM)	Yes	No	Yes	
15-Jan-93	IHC Edge-West			NA (YBM)	Yes	No	Yes	
15-Jan-93	Outer Harbor Edge				NA (YBM)	Yes	No	Yes
20-Jan-93	CBM COMP-Coarse			NA (c)	No	Yes	Yes	
20-Jan-93	CBM COMP-Fine			NA	No	Yes	Yes	

(a) NA (YBM) Not applicable; sample consists entirely of Younger Bay Mud.

(b) NA (ARC) Not applicable; sample was for archive only.

(c) NA Not applicable.

TABLE C.2. Sediment Grain Size and Percent Solids, Including Quality Control Data, United Heckathorn Remedial Investigation

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} >2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
LZ-1 A	25	2	30	21	47
LZ-1 B	18	1	35	14	50
LZ-1 C	34	2	30	33	35
LZ-1 D	43	3	24	31	42
LZ-1 X	52	0	18	39	43
LZ-1 Y	75	1	47	29	23
LZ-2 A	46	4	32	18	46
LZ-2 B	48	2	29	33	36
LZ-2 C	41	1	17	34	48
LZ-2 X	52	2	21	33	44
LZ-2 Y	78	2	54	26	18
LZ-3 A	41	0	22	27	51
LZ-3 B	40	1	22	34	43
LZ-3 X	57	1	36	32	31
LZ-3 Y	78	2	26	36	36
LZ-5 A	55	2	25	34	39
LZ-5 Y	75	2	50	32	16
LZ-6 A	62	5	41	23	31
LZ-6 B	57	3	43	20	34
LZ-6 C	54	5	26	31	38
LZ-6 X	70	3	35	35	27
LZ-6 Y	80	12	56	17	15
LZ-7 A	47	3	26	24	47
LZ-7 B	43	0	16	42	42
LZ-7 C	49	0	21	39	40
LZ-7 X	65	0	28	41	31
LZ-7 Y	78	0	53	39	8
LZ-8 A	49	3	33	20	44
LZ-8 B	34	3	31	21	45
LZ-8 C	26	1	37	26	36
LZ-8 D	22	6	45	13	36
LZ-8 E	25	5	43	21	31
LZ-8 F	49	0	20	36	44
LZ-8 G	55	2	21	39	38
LZ-8 X	73	2	47	31	20
LZ-8 Y	80	1	59	29	11

TABLE C.2. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} >2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
LZ-9 A	44	0	22	27	51
LZ-9 X	50	1	30	29	40
LZ-9 Y	84	15	45	24	16
LZ-10 A	42	11	15	13	61
LZ-10 B	44	2	10	26	62
LZ-10 X	49	2	26	25	47
LZ-10 Y	81	3	46	36	15
LZ-11 A	61	31	32	10	27
LZ-11 X	59	5	34	23	38
LZ-11 Y	86	39	38	15	8
LZ-12 A	41	0	9	25	66
LZ-12 X	40	0	9	21	70
LZ-12 Y	78	3	30	46	21
LZ-13 A	35	1	14	20	65
LZ-13 B	60	31	23	17	29
LZ-13 C	64	6	34	25	35
LZ-13 X	59	4	27	28	41
LZ-13 Y	80	3	21	45	31
LZ-14 A	77	45	33	8	14
LZ-14 X	81	34	41	15	10
LZ-14 Y	85	31	67	1	1
LZ-15 A	37	0	6	21	73
LZ-15 B	41	0	8	25	67
LZ-15 X	46	1	10	30	59
LZ-15 Y	80	1	15	45	39
LZ-16 A	37	1	10	22	67
LZ-16 B	51	19	19	20	42
LZ-16 C	55	2	31	30	37
LZ-16 D	73	5	50	21	24
LZ-16 X	76	38	32	15	15
LZ-16 Y	79	1	17	41	41
SF-17 A	40	1	6	29	64
SF-17 B	44	7	7	22	64
SF-17 X	61	0	19	39	42
SF-17 Y	75	1	34	39	26

TABLE C.2. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} >2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
SF-18 A	40	0	4	20	76
SF-18 B	40	1	5	25	69
SF-18 X	46	2	10	23	65
SF-18 Y	74	0	13	46	41
SF-19 A	38	0	9	18	73
SF-19 X	43	0	9	26	65
SF-19 Y	76	0	77	14	9
SF-20 A	37	0	5	14	81
SF-20 X	40	0	3	19	78
SF-20 Y	74	1	19	37	43
SF-21 A	37	0	3	22	75
SF-21 B	40	0	3	16	81
SF-21 C	45	2	10	25	63
SF-21 X	54	2	10	34	54
SF-21 Y	73	1	13	43	43
SF-22 A	41	1	13	19	67
SF-22 B	47	1	3	33	63
SF-22 C	48	0	0	39	61
SF-22 X	58	1	5	49	45
SF-22 Y	75	0	9	57	34
SF-23 A	37	0	4	24	72
SF-23 B	42	0	9	28	63
SF-23 X	54	1	23	30	46
SF-23 Y	77	1	33	36	30
SF-24 A	39	0	4	26	70
SF-24 B	41	0	4	27	69
SF-24 C	48	0	1	33	66
SF-25 A	44	18	23	20	39
SF-25 B	53	9	15	32	44
SF-25 X	71	1	17	46	36
SF-25 Y	76	0	11	36	53
SF-26 A	35	1	5	29	65
SF-26 B	42	0	5	28	67
SF-26 C	46	0	6	33	61
SF-26 X	52	0	8	41	51
SF-26 Y	76	0	16	41	43

TABLE C.2. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} > 2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
SF-27 A	38	0	6	35	59
SF-27 B	43	0	5	34	61
SF-27 C	44	0	5	31	64
SF-27 X	56	1	18	37	44
SF-27 Y	79	1	38	37	24
SF-28 A	51	1	15	35	49
SF-28 B	58	6	21	34	39
SF-28 X	64	2	21	39	38
SF-28 Y	87	16	76	4	4
SF-29 A	40	0	13	31	56
SF-29 B	43	0	8	34	58
SF-29 C	44	1	7	33	59
SF-29 D	51	1	14	34	51
SF-29 E	50	1	11	32	56
SF-29 X	75	31	39	15	15
SF-29 Y	75	1	22	33	44
SF-30 A	38	0	10	24	66
SF-30 B	41	6	27	0	67
SF-30 X	44	0	7	28	65
SF-30 Y	76	0	22	49	29
SF-31 A	39	3	7	17	73
SF-31 X	60	1	11	46	42
SF-31 Y	76	1	16	46	37
SF-32 A	51	36	21	2	41
SF-32 B	52	8	14	28	50
SF-32 C	61	1	24	40	35
SF-32 X	56	2	14	37	47
SF-32 Y	77	0	23	39	38
SF-33 A	51	1	16	28	55
SF-33 B	54	1	20	29	50
SF-33 X	64	5	27	29	39
SF-33 Y	80	1	61	29	9
SF-34 A	42	1	11	24	64
SF-34 B	46	0	9	25	66
SF-34 X	67	3	22	35	40
SF-34 Y	76	1	20	38	41

TABLE C.2. (contd)

<u>Sediment Treatment</u>	<u>Percent Solids</u>	<u>Fractional Percent (dry weight)</u>			
		<u>Gravel μm >2000</u>	<u>Sand 62.5-2000</u>	<u>Silt 3.9-62.5</u>	<u>Clay <3.9</u>
IH-35 A	41	0	6	26	68
IH-35 X	60	0	27	37	36
IH-35 Y	76	0	17	58	25
IH-36 A	42	0	8	27	65
IH-36 B	52	1	9	32	58
IH-36 X	61	1	21	31	47
IH-36 Y	75	2	17	34	47
IH-37 A	39	0	6	30	64
IH-37 B	41	0	5	24	71
IH-37 C	44	1	7	25	67
IH-37 X	51	1	13	28	58
IH-37 Y	74	0	19	42	39
IH-38 A	43	0	5	22	73
IH-38 X	49	8	5	33	54
IH-38 Y	76	0	8	45	47
IH-39 A	38	0	5	29	66
IH-39 B	44	1	4	32	63
IH-39 C	51	0	7	35	58
IH-39 X	50	1	7	33	59
IH-39 Y	79	0	24	42	34
IH-40 A	40	0	4	18	78
IH-40 B	44	0	5	24	71
IH-40 X	47	1	7	30	62
IH-40 Y	74	1	21	29	49
IH-41 A	39	0	4	27	69
IH-41 B	43	0	4	23	73
IH-41 C	47	0	5	26	69
IH-41 X	50	1	8	27	64
IH-41 Y	77	0	13	42	45
IH-42 A	49	2	7	31	60
IH-42 X	48	0	4	29	67
IH-42 Y	74	1	14	29	56
IH-43 A	43	0	2	26	72
IH-43 B	44	0	3	29	68
IH-43 X	49	0	4	36	60
IH-43 Y	78	0	13	52	35

TABLE C.2. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} >2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
IH-44 A	40	0	2	27	71
IH-44 B	44	0	2	26	72
IH-44 C	43	0	3	29	68
IH-44 D	45	0	5	36	59
IH-44 X	47	0	7	36	57
IH-44 Y	74	1	18	45	36
IH-45 A	41	0	5	28	67
IH-45 B	44	0	7	30	63
IH-45 C	44	0	4	31	65
IH-45 X	46	0	6	32	62
IH-45 Y	76	0	12	63	25
IH-46 A	40	0	3	36	61
IH-46 B	45	0	3	37	60
IH-46 C	45	0	4	35	61
IH-46 X	45	1	3	34	62
IH-46 Y	75	0	8	57	35
IH-47 A	40	0	2	21	77
IH-47 B	43	0	3	29	68
IH-47 C	42	0	5	33	62
IH-47 X	54	0	12	33	55
IH-47 Y	82	19	19	33	29
IH-48 A	44	0	3	35	62
IH-48 B	44	0	3	39	58
IH-48 X	45	0	3	35	62
IH-48 Y	77	0	15	46	39
IH-49 A	38	0	3	31	66
IH-49 B	41	0	2	38	60
IH-49 X	45	0	5	29	66
IH-49 Y	71	0	7	50	43
IH-50 A	41	0	3	43	54
IH-50 B	46	0	2	33	65
IH-50 C	49	0	4	32	64
IH-50 X	51	2	6	33	59
IH-50 Y	84	58	35	2	5
IH-51 A	44	0	3	41	56
IH-51 B	49	0	4	42	54
IH-51 X	54	0	6	39	55
IH-51 Y	74	0	16	31	53

TABLE C.2. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel μm >2000	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
PC-52 A	41	1	25	41	33
PC-52 B	44	2	29	39	30
PC-52 C	51	1	28	44	27
PC-53 A	42	1	26	41	32
PC-53 B	43	1	28	34	37
PC-53 C	49	0	26	40	34
PC-54 A	44	0	24	37	39
PC-54 B	50	1	29	38	32
PC-54 C	57	13	22	32	33
SFC Marina	32	0	6	25	69
FSFC Edge-West	25	0	13	24	63
Parr Canal Edge	32	5	28	33	34
IHC Edge-East	35	0	4	33	63
IHC Edge-West	34	0	8	46	46
Outer Harbor Edge	47	0	1	64	35
Comp LC	51	7	25	27	41
Comp LC-1	36	5	23	26	46
Comp LC-2	42	1	23	34	42
Comp LC-3	52	7	31	25	37
Comp LC-4	46	4	20	27	49
Comp LC-5	50	5	26	30	39
Comp LC-6	49	4	28	34	34
Comp USFC	42	2	9	26	63
Comp FSFC	47	3	17	27	53
Comp IHC-1	42	1	5	30	64
Comp IHC-2	41	0	3	19	78
Comp IHC-3	43	0	2	33	65
Comp GD	35	1	5	36	58
C-SFBF	54	0	9	60	31
C-SFBC	70	9	83	5	3

TABLE C.3. Quality Control Data for Sediment Grain Size and Percent Solids Data, United Heckathorn Remedial Investigation

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel <u>μm >2000</u>	Sand <u>62.5-2000</u>	Silt <u>3.9-62.5</u>	Clay <u><3.9</u>
Analytical Duplicates					
Comp IHC-1	42	1	5	30	64
Comp IHC-1 Duplicate	42	0	6	32	62
RPD		200% ^(a)	18%	6%	3%
I-Stat		1.00	0.09	0.03	0.02
IH-50 C	49	0	4	32	64
IH-50 C Duplicate	50	1	4	34	61
RPD		200% ^(a)	0%	6%	5%
I-Stat		1.00	0.00	0.03	0.02
IH-51 A	44	0	3	41	56
IH-51 A Duplicate	44	0	3	37	60
RPD		0%	0%	10%	7%
I-Stat		0.00	0.00	0.05	0.03
LZ-13 A	35	1	14	20	65
LZ-13 A Duplicate	35	2	16	19	63
RPD		67% ^(a)	13%	5%	3%
I-Stat		0.33	0.07	0.03	0.02
LZ-12 X	40	0	9	21	70
LZ-12 X Duplicate	40	0	10	19	71
RPD		0%	11%	10%	1%
I-Stat		0.00	0.05	0.05	0.01
LZ-15 A	37	0	6	21	73
LZ-15 A Duplicate	37	0	5	21	74
RPD		0%	18%	0%	1%
I-Stat		0.00	0.09	0.00	0.01
SF-34 B	46	0	9	25	66
SF-34 B Duplicate	45	0	9	23	68
RPD		0%	0%	8%	3%
I-Stat		0.00	0.00	0.04	0.01
SF-24 B	41	0	4	27	69
SF-24 B Duplicate	41	0	4	28	68
RPD		0%	0%	4%	1%
I-Stat		0.00	0.00	0.02	0.01

TABLE C.3. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} > 2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
SF-22 C	48	0	0	39	61
SF-22 C Duplicate	48	0	1	37	62
RPD		0%	200% ^(a)	5%	2%
I-Stat		0.00	1.00	0.03	0.01
IH-46 B	45	0	3	37	60
IH-46 B Duplicate	45	0	3	35	62
RPD		0%	0%	6%	3%
I-Stat		0.00	0.00	0.03	0.02
SF-30 X	44	0	7	28	65
SF-30 X Duplicate	44	0	8	29	63
RPD		0%	13%	4%	3%
I-Stat		0.00	0.07	0.02	0.02
IH-44 C	43	0	3	29	68
IH-44 C Duplicate	43	0	3	29	68
RPD		0%	0%	0%	0%
I-Stat		0.00	0.00	0.00	0.00
IH-47 C	42	0	5	33	62
IH-47 C Duplicate	42	0	5	32	63
RPD		0%	0%	3%	2%
I-Stat		0.00	0.00	0.02	0.01
IH-44 B	44	0	2	26	72
IH-44 B Duplicate	43	0	2	29	69
RPD		0%	0%	11%	4%
I-Stat		0.00	0.00	0.05	0.02
<u>Compositing Duplicates</u>					
LZ-8 B	34	3	31	21	45
LZ-8 B Cdup ^(b)	37	35	27	1	37
RPD		168% ^(a)	14%	182% ^(a)	20%
I-Stat		0.84	0.07	0.91	0.10
LZ-16 B	51	19	19	20	42
LZ-16 B Cdup	47	10	20	20	50
RPD		62% ^(a)	5%	0%	17%
I-Stat		0.31	0.03	0.00	0.09
SF-17 B	44	7	7	22	64
SF-17 B Cdup	44	0	5	23	72
RPD		200% ^(a)	33% ^(a)	4%	12%
I-Stat		1.00	0.17	0.02	0.06

TABLE C.3. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} > 2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
SF-21 C	45	2	10	25	63
SF-21 C Cdup	45	0	2	26	72
RPD		200% ^(a)	133% ^(a)	4%	13%
I-Stat		1.00	0.67	0.02	0.07
SF-27 B	43	0	5	34	61
SF-27 B Cdup	43	0	6	34	60
RPD		0%	18%	0%	2%
I-Stat		0.00	0.09	0.00	0.01
IH-36 B	52	1	9	32	58
IH-36 B Cdup	50	1	9	31	59
RPD		0%	0%	3%	2%
I-Stat		0.00	0.00	0.02	0.01
IH-37 B	41	0	5	24	71
IH-37 B Cdup	41	0	5	20	75
RPD		0%	0%	18%	5%
I-Stat		0.00	0.00	0.09	0.03
IH-39 B	44	1	4	32	63
IH-39 B Cdup	44	0	4	30	66
RPD		0%	0%	6%	5%
I-Stat		0.00	0.00	0.03	0.02
IH-43 B	44	0	3	29	68
IH-43 B Cdup	44	0	3	28	69
RPD		0%	0%	4%	1%
I-Stat		0.00	0.00	0.02	0.01
PC-54 B	50	1	29	38	32
PC-54 B Cdup	52	10	27	35	28
RPD		164% ^(a)	7%	8%	13%
I-Stat		0.82	0.04	0.04	0.07
Parr Canal Edge	32	5	28	33	34
Parr Canal Edge Cdup	41	21	20	33	26
RPD		123% ^(a)	33% ^(a)	0%	27% ^(a)
I-Stat		0.62	0.17	0.00	0.13
Comp LC	51	7	25	27	41
Comp LC Cdup	50	9	26	24	41
RPD		0%	4%	12%	0%
I-Stat		0.00	0.02	0.06	0.00

TABLE C.3. (contd)

Sediment Treatment	Percent Solids	Fractional Percent (dry weight)			
		Gravel $\mu\text{m} >2000$	Sand 62.5-2000	Silt 3.9-62.5	Clay <3.9
Comp IHC-2	41	0	3	19	78
Comp IHC-2 Cdup	41	0	3	32	65
RPD		0%	0%	51% ^(a)	18%
I-Stat		0.00	0.00	0.25	0.09

(a) Value exceeds relative precision goal of $\leq 20\%$.

(b) Compositing duplicate.

TABLE C.4. Sediment Total Organic Carbon (TOC), United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
Target DL ^(a)	0.1
Achieved DL High	0.009
Achieved DL Low	0.001
LZ-1 A	3.08
LZ-1 B	0.40
LZ-1 C	3.62
LZ-1 D	8.75
LZ-1 X	2.22
LZ-1 Y	0.32
LZ-2 A	2.77
LZ-2 B	2.12
LZ-2 C	3.33
LZ-2 X	2.97
LZ-2 Y	0.15
LZ-3 A	2.53
LZ-3 B	2.50
LZ-3 X	1.51
LZ-3 Y	0.11
LZ-5 A	1.17
LZ-5 Y	0.13
LZ-6 A	1.10
LZ-6 B	1.80
LZ-6 C	2.47
LZ-6 X	0.51
LZ-6 Y	0.02
LZ-7 A	1.94
LZ-7 B	2.96
LZ-7 C	3.02
LZ-7 X	0.83
LZ-7 Y	0.06
LZ-8 A	1.99
LZ-8 B	1.82
LZ-8 C	0.74
LZ-8 D	0.26
LZ-8 E	0.26
LZ-8 F	3.27
LZ-8 G	1.40
LZ-8 X	0.55
LZ-8 Y	0.04

TABLE C.4. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
LZ-9 A	1.84
LZ-9 X	1.38
LZ-9 Y	0.12
LZ-10 A	1.88
LZ-10 B	2.10
LZ-10 X	1.39
LZ-10 Y	0.11
LZ-11 A	0.94
LZ-11 X	1.51
LZ-11 Y	0.08
LZ-12 A	1.87
LZ-12 X	1.67
LZ-12 Y	0.12
LZ-13 A	3.22
LZ-13 B	2.80
LZ-13 C	1.78
LZ-13 X	1.79
LZ-13 Y	0.15
LZ-14 A	1.22
LZ-14 X	0.23
LZ-14 Y	0.04
LZ-15 A	1.65
LZ-15 B	1.53
LZ-15 X	1.31
LZ-15 Y	0.13
LZ-16 A	2.14
LZ-16 B	2.04
LZ-16 C	1.55
LZ-16 D	0.74
LZ-16 X	0.63
LZ-16 Y	0.21
SF-17 A	1.62
SF-17 B	1.42
SF-17 X	0.49
SF-17 Y	0.13

TABLE C.4. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent drv weight)</u>
SF-18 A	1.50
SF-18 B	1.55
SF-18 X	1.01
SF-18 Y	0.20
SF-19 A	1.35
SF-19 X	1.27
SF-19 Y	0.06
SF-20 A	1.37
SF-20 X	1.36
SF-20 Y	0.17
SF-21 A	1.33
SF-21 B	1.44
SF-21 C	1.16
SF-21 X	0.63
SF-21 Y	0.19
SF-22 A	1.67
SF-22 B	1.03
SF-22 C	0.90
SF-22 X	0.41
SF-22 Y	0.26
SF-23 A	1.35
SF-23 B	1.25
SF-23 X	0.69
SF-23 Y	0.18
SF-24 A	1.45
SF-24 B	1.66
SF-24 C	1.00
SF-25 A	2.34
SF-25 B	0.87
SF-25 X	0.22
SF-25 Y	0.22
SF-26 A	1.61
SF-26 B	1.10
SF-26 C	1.26
SF-26 X	0.92
SF-26 Y	0.22

TABLE C.4. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
SF-27 A	1.32
SF-27 B	1.17
SF-27 C	1.29
SF-27 X	0.62
SF-27 Y	0.07
SF-28 A	1.14
SF-28 B	0.78
SF-28 X	0.58
SF-28 Y	0.10
SF-29 A	1.28
SF-29 B	1.30
SF-29 C	1.21
SF-29 D	1.00
SF-29 E	1.10
SF-29 X	0.32
SF-29 Y	0.16
SF-30 A	1.43
SF-30 B	1.33
SF-30 X	1.23
SF-30 Y	0.18
SF-31 A	1.25
SF-31 X	0.55
SF-31 Y	0.23
SF-32 A	1.25
SF-32 B	1.32
SF-32 C	0.83
SF-32 X	1.12
SF-32 Y	0.10
SF-33 A	1.02
SF-33 B	0.89
SF-33 X	0.63
SF-33 Y	0.08
SF-34 A	1.33
SF-34 B	1.21
SF-34 X	0.12
SF-34 Y	1.36
IH-35 A	1.32
IH-35 X	0.54
IH-35 Y	0.15

TABLE C.4. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent drv weight)</u>
IH-36 A	1.15
IH-36 B	0.69
IH-36 X	0.60
IH-36 Y	0.18
IH-37 A	0.80
IH-37 B	0.73
IH-37 C	1.15
IH-37 X	0.02
IH-37 Y	0.08
IH-38 A	1.76
IH-38 X	0.88
IH-38 Y	1.37
IH-39 A	1.27
IH-39 B	1.21
IH-39 C	1.09
IH-39 X	0.95
IH-39 Y	0.13
IH-40 A	1.23
IH-40 B	1.16
IH-40 X	1.05
IH-40 Y	0.15
IH-41 A	1.28
IH-41 B	1.26
IH-41 C	1.22
IH-41 X	1.17
IH-41 Y	0.20
IH-42 A	1.04
IH-42 X	1.14
IH-42 Y	0.32
IH-43 A	1.20
IH-43 B	1.17
IH-43 X	1.08
IH-43 Y	0.15
IH-44 A	1.24
IH-44 B	1.27
IH-44 C	1.30
IH-44 D	1.28
IH-44 X	1.08
IH-44 Y	0.14

TABLE C.4. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
IH-45 A	1.21
IH-45 B	1.35
IH-45 C	0.97
IH-45 X	1.21
IH-45 Y	0.14
IH-46 A	1.24
IH-46 B	1.25
IH-46 C	1.25
IH-46 X	1.26
IH-46 Y	0.09
IH-47 A	1.23
IH-47 B	1.19
IH-47 C	1.15
IH-47 X	1.13
IH-47 Y	0.17
IH-48 A	1.17
IH-48 B	1.16
IH-48 X	1.19
IH-48 Y	0.07
IH-49 A	1.16
IH-49 B	1.23
IH-49 X	1.19
IH-49 Y	0.09
IH-50 A	1.17
IH-50 B	1.18
IH-50 C	1.24
IH-50 X	1.22
IH-50 Y	0.05
IH-51 A	1.30
IH-51 B	1.26
IH-51 X	1.15
IH-51 Y	0.03
PC-52 A	5.54
PC-52 B	5.69
PC-52 C	5.53
PC-53 A	7.47
PC-53 B	8.74
PC-53 C	5.98

TABLE C.4. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
PC-54 A	5.09
PC-54 B	3.26
PC-54 C	0.85
SFC Marina	1.76
FSFC Edge-West	2.01
Parr Canal Edge	3.71
IHC Edge-East	1.49
IHC Edge-West	1.32
Outer Harbor Edge	0.99
Comp LC	1.90
Comp LC-1	5.24
Comp LC-2	1.93
Comp LC-3	1.62
Comp LC-4	1.90
Comp LC-5	1.77
Comp LC-6	1.89
Comp USFC	1.43
Comp FSFC	1.24
Comp IHC - 1	5.24
Comp IHC-2	1.26
Comp IHC-3	1.20
Comp GD	1.81
C-SFBF	0.82
C-SFBC	0.05

(a) DL Detection limit.

TABLE C.5. Quality Control Data for Total Organic Carbon (TOC), United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
<u>Method Blanks</u>	
BLANK	0.001
BLANK	0.007
BLANK	0.003
BLANK	0.003
BLANK	0.001
BLANK	0.001
BLANK	0.004
BLANK	0.009
BLANK	0.001
BLANK	0.001
BLANK	0.001
BLANK	0.001
BLANK	0.001
BLANK	0.001
BLANK	0.001
BLANK	0.003
BLANK	0.004
<u>Analytical Duplicates</u>	
LZ-3 A	2.53
LZ-3 A Duplicate	2.54
RPD	0%
I-Stat	0.00
LZ-6 Y	0.02
LZ-6 Y Duplicate	0.03
RPD	40% (a)
I-Stat	0.20
LZ-8 G	0.26
LZ-8 G Duplicate	0.24
RPD	8%
I-Stat	0.04
LZ-9 X	1.38
LZ-9 X Duplicate	1.37
RPD	1%
I-Stat	0.00
LZ-13 C	1.78
LZ-13 C Duplicate	1.72
RPD	3%
I-Stat	0.02

TABLE C.5. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
LZ-16 B	2.04
LZ-16 B Duplicate	1.82
RPD	11% (a)
I-Stat	0.06
SF-18 X	1.01
SF-18 X Duplicate	1.00
RPD	1%
I-Stat	0.00
SF-20 A	1.37
SF-20 A Duplicate	1.42
RPD	4%
I-Stat	0.02
SF-24 B	1.66
SF-24 B Duplicate	1.66
RPD	0%
I-Stat	0.00
SF-25 A	2.34
SF-25 A Duplicate	2.14
RPD	9%
I-Stat	0.04
SF-27 B	1.17
SF-27 B Duplicate	1.14
RPD	3%
I-Stat	0.01
SF-29 D	1.00
SF-29 D Duplicate	0.98
RPD	2%
I-Stat	0.01
SF-30 Y	0.18
SF-30 Y Duplicate	0.18
RPD	0%
I-Stat	0.00
SF-33 A	1.02
SF-33 A Duplicate	1.01
RPD	1%
I-Stat	0.00

TABLE C.5. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent dry weight)</u>
IH-37 Y	0.08
IH-37 Y Duplicate	0.08
RPD	0%
I-Stat	0.00
IH-39 B	1.27
IH-39 B Duplicate	1.28
RPD	1%
I-Stat	0.00
IH-41 X	1.17
IH-41 X Duplicate	1.15
RPD	2%
I-Stat	0.01
IH-42 A	1.04
IH-42 A Duplicate	1.10
RPD	6%
I-Stat	0.03
IH-45 B	1.35
IH-45 B Duplicate	1.30
RPD	4%
I-Stat	0.02
IH-48 Y	0.07
IH-48 Y Duplicate	0.07
RPD	0%
I-Stat	0.00
IH-49 A	1.16
IH-49 A Duplicate	1.27
RPD	9%
I-Stat	0.05
IH-50 A	1.17
IH-50 A Duplicate	1.25
RPD	7%
I-Stat	0.03
PC-53 B	8.74
PC-53 B Duplicate	8.55
RPD	2%
I-Stat	0.01

TABLE C.5. (contd)

<u>Sediment Treatment</u>	<u>TOC</u> <u>(percent dry weight)</u>
SFC Marina	1.76
SFC Marina Duplicate	1.78
RPD	1%
I-Stat	0.01
Comp LC	1.76
Comp LC Duplicate	1.88
RPD	7%
I-Stat	0.03
Comp USFC	1.43
Comp USFC Duplicate	1.43
RPD	0%
I-Stat	0.00
Comp IHC-2	1.26
Comp IHC-2 Duplicate	1.28
RPD	2%
I-Stat	0.01
<u>Compositing Duplicates</u>	
LZ-8 B	1.82
LZ-8 B Cdup ^(b)	1.71
RPD	6%
I-Stat	0.03
LZ-16 B	2.04
LZ-16 B Cdup	4.16
RPD	68% ^(a)
I-Stat	0.34
SF-17 B	1.42
SF-17 B Cdup	1.42
RPD	0%
I-Stat	0.00
SF-21 C	1.16
SF-21 C Cdup	1.33
RPD	14% ^(a)
I-Stat	0.07
SF-27 B	1.17
SF-27 B Cdup	1.14
RPD	3%
I-Stat	0.01

TABLE C.5. (contd)

<u>Sediment Treatment</u>	<u>TOC (percent drv weight)</u>
IH-36 B	0.69
IH-36 B Cdup	0.82
RPD	17% ^(a)
I-Stat	0.09
IH-37 B	0.73
IH-37 B Cdup	1.29
RPD	55% ^(a)
I-Stat	0.28
IH-39 B	1.21
IH-39 B Cdup	1.27
RPD	5%
I-Stat	0.02
IH-43 B	1.17
IH-43 B Cdup	1.16
RPD	1%
I-Stat	0.00
PC-54 B	3.26
PC-54 B Cdup	2.13
RPD	42% ^(a)
I-Stat	0.21
Parr Canal Edge	3.71
Parr Canal Edge Cdup	3.37
RPD	10%
I-Stat	0.05
Comp LC	1.90
Comp LC Cdup	1.76
RPD	8%
I-Stat	0.04
Comp IHC-2	1.26
Comp IHC-2 Cdup	1.24
RPD	2%
I-Stat	0.01

(a) Value exceeds relative precision goal of $\leq 10\%$.

(b) Compositing duplicate.

TABLE C.6. Chlorinated Pesticides (elution order, Alpha-BHC to Endosulfan I) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment		Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
			Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endosulfan I
Target DL ^(a)			2	2	2	2	2	2	2	2	
Achieved DL High			407.67	602.76	547.65	547.65	623.60	623.60	608.71	658.97	658.97
Achieved DL Low			0.41	0.61	0.56	0.56	0.63	0.63	0.62	0.67	0.67
LZ-1	A	3	372.45 U ^(b)	550.68 U	500.34 U	500.34 U	569.73 U	569.73 U	556.12 U	109.24 J ^(c)	602.04 U
LZ-1	B	3	216.83 U	320.59 U	291.29 U	291.29 U	331.68 U	331.68 U	323.76 U	69.59 J	350.50 U
LZ-1	C	3	4644.75 U	6867.44 U	6239.66 U	6239.66 U	7104.98 U	7104.98 U	6935.31 U	7507.95 U	7507.95 U
LZ-1	D	3	1731.23 U	2559.68 U	2325.69 U	2325.69 U	2648.22 U	2648.22 U	2584.98 U	2798.42 U	2798.42 U
LZ-1	X	3	68.22 U	100.87 U	91.65 U	91.65 U	104.36 U	104.36 U	101.87 U	110.28 U	110.28 U
LZ-1	Y	21	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.19 J	0.77 U
LZ-2	A	4	734.90 U	1086.58 U	987.25 U	987.25 U	1124.16 U	1124.16 U	1097.32 U	1187.92 U	1187.92 U
LZ-2	B	4	1483.74 U	2193.77 U	1993.22 U	1993.22 U	2269.65 U	2269.65 U	2215.45 U	2398.37 U	2398.37 U
LZ-2	C	4	3225.33 U	4768.78 U	4332.84 U	4332.84 U	4933.73 U	4933.73 U	4815.91 U	5213.55 U	5213.55 U
LZ-2	X	4	688.68 U	1018.24 U	925.16 U	925.16 U	1053.46 U	1053.46 U	1028.30 U	1113.21 U	1113.21 U
LZ-2	Y	21	0.18 J	0.08 J	0.06 J	0.16 J	0.70 U	0.70 U	0.69 U	0.63 J	0.74 U
LZ-3	A	4	835.24 U	1234.94 U	1122.04 U	1122.04 U	1277.65 U	1277.65 U	1247.14 U	1350.11 U	1350.11 U
LZ-3	B	4	1735.34 U	2565.77 U	2331.22 U	2331.22 U	2654.52 U	2654.52 U	2591.13 U	2805.07 U	2805.07 U
LZ-3	X	4	315.38 U	466.30 U	423.68 U	423.68 U	482.43 U	482.43 U	470.91 U	509.79 U	509.79 U
LZ-3	Y	21	0.08 J	0.04 J	0.61 U	0.09 J	0.70 U	0.04 J	0.68 U	0.36 J	0.74 U
LZ-5	A	6	326.87 U	483.28 U	439.10 U	439.10 U	500.00 U	500.00 U	488.06 U	528.36 U	528.36 U
LZ-5	Y	21	0.24 J	0.11 J	0.04 J	0.19 J	0.70 U	0.28 J	0.69 U	0.63 J	0.74 U
LZ-6	A	6	1125.39 U	1663.93 U	1511.82 U	1511.82 U	1721.48 U	1721.48 U	1680.37 U	1819.12 U	1819.12 U
LZ-6	B	6	2515.80 U	3719.70 U	3379.67 U	3379.67 U	3848.36 U	2059.71 J	3756.46 U	4066.63 U	4066.63 U
LZ-6	C	6	328.24 U	485.31 U	440.95 U	440.95 U	502.10 U	502.10 U	490.11 U	530.58 U	530.58 U
LZ-6	X	6	99.01 U	146.38 U	133.00 U	133.00 U	151.45 U	151.45 U	147.83 U	160.04 U	160.04 U
LZ-6	Y	21	0.13 J	0.04 J	0.04 J	0.08 J	0.65 U	0.37 J	0.63 U	0.09 J	0.68 U
LZ-7	A	6	759.36 U	1122.75 U	1020.11 U	1020.11 U	1161.58 U	1161.58 U	1133.84 U	1227.46 U	1227.46 U
LZ-7	B	6	4076.69 U	6027.55 U	5476.55 U	5476.55 U	6236.04 U	6236.04 U	6087.12 U	6589.72 U	6589.72 U
LZ-7	C	6	699.23 U	1033.84 U	939.34 U	939.34 U	1069.60 U	1069.60 U	1044.06 U	1130.27 U	1130.27 U
LZ-7	X	6	5.47 U	8.09 U	7.35 U	7.35 U	8.37 U	8.37 U	8.17 U	8.84 U	8.84 U
LZ-7	Y	21	0.02 J	0.65 U	0.59 U	0.59 U	0.67 U	0.67 U	0.66 U	0.71 U	0.71 U

TABLE C.6. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ drv weight)								
		Alpha- BHC	Beta- BHC	Lindane	Delta- BHC	Hepta- chlor	Aldrin	Heptachlor Epoxide	trans- Chlordane	Endo- sulfan
LZ-8 A	7	683.09 U	1009.98 U	917.65 U	917.65 U	1044.92 U	1044.92 U	1019.96 U	1104.18 U	1104.18 U
LZ-8 B	7	2058.27 U	3043.23 U	2765.04 U	2765.04 U	3148.50 U	3148.50 U	3073.31 U	3327.07 U	3327.07 U
LZ-8 C	7	1440.79 U	2130.26 U	1935.53 U	1935.53 U	2203.95 U	2203.95 U	2151.32 U	2328.95 U	2328.95 U
LZ-8 D	7	806.33 U	1192.19 U	1083.21 U	1083.21 U	1233.43 U	1233.43 U	1203.98 U	1303.39 U	1303.39 U
LZ-8 E	7	697.45 U	1031.21 U	936.94 U	936.94 U	1066.88 U	1066.88 U	1041.40 U	1127.39 U	1127.39 U
LZ-8 F	7	2782.72 U	4114.36 U	3738.25 U	3738.25 U	4256.67 U	4256.67 U	4155.02 U	4498.09 U	4498.09 U
LZ-8 G	7	66.89 U	98.90 U	89.86 U	89.86 U	102.32 U	102.32 U	99.88 U	108.12 U	108.12 U
LZ-8 X	7	48.86 U	72.24 U	65.64 U	65.64 U	74.74 U	74.74 U	72.96 U	78.98 U	78.98 U
LZ-8 Y	21	0.46 U	0.68 U	0.62 U	0.62 U	0.70 U	0.70 U	0.69 U	0.74 U	0.74 U
LZ-9 A	6	386.93 U	572.08 U	519.79 U	519.79 U	591.87 U	591.87 U	577.74 U	625.44 U	625.44 U
LZ-9 X	7	356.68 U	527.36 U	479.15 U	479.15 U	545.60 U	545.60 U	532.57 U	576.55 U	576.55 U
LZ-9 Y	21	0.83	0.31 J	0.21 J	0.50 J	0.67 U	1.29	0.66 U	0.81	0.71 U
LZ-10 A	8	83.65 U	123.68 U	112.38 U	112.38 U	127.96 U	127.96 U	124.90 U	135.22 U	135.22 U
LZ-10 B	8	200.55 U	296.52 U	269.41 U	269.41 U	306.78 U	306.78 U	299.45 U	324.18 U	324.18 U
LZ-10 X	9	1443.64 U	2134.48 U	1939.35 U	1939.35 U	2208.31 U	2208.31 U	2155.57 U	2333.55 U	2333.55 U
LZ-10 Y	22	0.45 U	0.67 U	0.61 U	0.61 U	0.70 U	0.70 U	0.68 U	0.73 U	0.73 U
LZ-11 A	7	155.89 U	230.50 U	209.42 U	209.42 U	238.47 U	238.47 U	232.77 U	251.99 U	251.99 U
LZ-11 X	7	2539.13 U	3754.20 U	3411.01 U	3411.01 U	3884.06 U	3884.06 U	3791.30 U	4104.35 U	4104.35 U
LZ-11 Y	21	0.74	0.28 J	0.21 J	0.51 J	0.65 U	0.47 J	0.63 U	0.40 J	0.69 U
LZ-12 A	9	84.62 U	125.12 U	113.68 U	113.68 U	129.44 U	129.44 U	126.35 U	136.79 U	136.79 U
LZ-12 X	9	86.15 U	127.38 U	115.74 U	115.74 U	131.79 U	131.79 U	128.64 U	139.26 U	139.26 U
LZ-12 Y	22	0.46 U	0.67 U	0.61 U	0.61 U	0.70 U	0.70 U	0.68 U	0.74 U	0.74 U
LZ-13 A	9	92.33 U	136.51 U	124.03 U	124.03 U	141.23 U	141.23 U	137.86 U	149.24 U	149.24 U
LZ-13 B	9	60.63 U	89.65 U	81.45 U	81.45 U	92.75 U	92.75 U	90.53 U	98.01 U	98.01 U
LZ-13 C	9	144.54 U	213.70 U	194.17 U	194.17 U	221.09 U	221.09 U	215.81 U	233.63 U	233.63 U
LZ-13 X	9	154.75 U	228.80 U	207.89 U	207.89 U	236.72 U	236.72 U	231.06 U	250.14 U	250.14 U
LZ-13 Y	22	0.46 U	0.68 U	0.62 U	0.62 U	0.71 U	0.71 U	0.69 U	0.75 U	0.75 U
LZ-14 A	7	48.86 U	72.24 U	65.64 U	65.64 U	74.74 U	74.74 U	72.96 U	78.98 U	78.98 U
LZ-14 X	8	4.71 U	6.97 U	6.33 U	6.33 U	7.21 U	7.21 U	7.04 U	7.62 U	7.62 U
LZ-14 Y	22	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-15 A	9	44.77 U	66.19 U	60.14 U	60.14 U	68.48 U	68.48 U	66.84 U	72.36 U	72.36 U
LZ-15 B	9	41.63 U	61.56 U	55.93 U	55.93 U	63.69 U	63.69 U	62.17 U	67.30 U	67.30 U
LZ-15 X	9	77.55 U	114.66 U	104.18 U	104.18 U	118.63 U	118.63 U	115.79 U	125.35 U	125.35 U
LZ-15 Y	22	0.46 U	0.68 U	0.62 U	0.62 U	0.70 U	0.70 U	0.69 U	0.74 U	0.74 U

C.33

TABLE C.6. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
LZ-16 A	8	9.13 U	13.49 U	12.26 U	12.26 U	13.96 U	13.96 U	13.63 U	14.75 U	14.75 U
LZ-16 B	9	73.74 U	109.02 U	99.06 U	99.06 U	112.79 U	112.79 U	110.10 U	119.19 U	119.19 U
LZ-16 C	9	63.04 U	93.21 U	84.69 U	84.69 U	96.43 U	96.43 U	94.13 U	23.88 J	101.90 U
LZ-16 D	9	50.02 U	73.96 U	67.20 U	67.20 U	76.52 U	76.52 U	74.69 U	80.86 U	80.86 U
LZ-16 X	8	4.98 U	7.36 U	6.68 U	6.68 U	7.61 U	7.61 U	7.43 U	8.04 U	8.04 U
LZ-16 Y	22	0.45 U	0.66 U	0.60 U	0.60 U	0.69 U	0.69 U	0.67 U	0.73 U	0.73 U
SF-17 A	11	0.27 J	1.28 U	1.16 U	1.16 U	1.33 U	1.33 U	1.29 U	2.09	1.40 U
SF-17 B	11	0.58 J	1.16 U	1.06 U	1.06 U	1.20 U	1.20 U	1.17 U	1.54	1.27 U
SF-17 X	11	0.09 J	0.87 U	0.79 U	0.79 U	0.90 U	0.90 U	0.88 U	0.42 J	0.96 U
SF-17 Y	11	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
SF-18 A	11	0.31 J	1.24 U	1.12 U	1.12 U	1.28 U	1.28 U	1.25 U	1.26 J	1.35 U
SF-18 B	11	0.35 J	1.25 U	1.13 U	1.13 U	1.29 U	1.29 U	1.26 U	1.89	1.36 U
SF-18 X	11	0.35 J	1.16 U	1.05 U	1.05 U	1.20 U	1.20 U	1.17 U	0.86 J	1.26 U
SF-18 Y	11	0.50 U	0.74 U	0.67 U	0.67 U	0.77 U	0.77 U	0.75 U	0.81 U	0.81 U
SF-19 A	11	0.35 J	1.28 U	1.16 U	1.16 U	1.32 U	1.32 U	1.29 U	0.73 J	1.39 U
SF-19 X	11	0.34 J	1.21 U	1.10 U	1.10 U	1.26 U	1.26 U	1.23 U	1.04 J	1.33 U
SF-19 Y	11	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
SF-20 A	11	0.27 J	1.37 U	1.25 U	1.25 U	1.42 U	1.42 U	1.39 U	1.14 J	1.50 U
SF-20 X	11	0.36 J	1.22 U	1.11 U	1.11 U	1.27 U	1.27 U	1.24 U	1.45	1.34 U
SF-20 Y	11	0.05 J	0.72 U	0.66 U	0.66 U	0.75 U	0.75 U	0.73 U	0.07 J	0.79 U
SF-21 A	12	0.33 J	1.24 U	1.12 U	1.12 U	1.28 U	1.28 U	1.25 U	0.92 J	1.35 U
SF-21 B	12	0.30 J	1.18 U	1.08 U	1.08 U	1.22 U	1.22 U	1.20 U	0.74 J	1.29 U
SF-21 C	12	0.50 J	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	0.84 J	1.33 U
SF-21 X	12	0.25 J	1.02 U	0.92 U	0.92 U	1.05 U	1.05 U	1.03 U	0.92 J	1.11 U
SF-21 Y	12	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
SF-22 A	12	0.52 J	1.26 U	1.14 U	1.14 U	1.30 U	1.30 U	1.27 U	2.25	1.37 U
SF-22 B	12	0.46 J	1.07 U	0.97 U	0.97 U	1.11 U	1.11 U	1.08 U	1.34	1.17 U
SF-22 C	12	0.73 U	1.08 U	0.98 U	0.98 U	1.12 U	1.12 U	1.09 U	1.18 U	1.18 U
SF-22 X	12	0.61 U	0.90 U	0.82 U	0.82 U	0.93 U	0.93 U	0.91 U	0.98 U	0.98 U
SF-22 Y	12	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
SF-23 A	12	0.26 J	1.35 U	1.23 U	1.23 U	1.40 U	1.40 U	1.36 U	1.13 J	1.48 U
SF-23 B	13	0.55 J	0.20 J	1.03 U	1.03 U	1.17 U	1.17 U	1.14 U	1.24 U	1.24 U
SF-23 X	13	0.28 J	0.92 U	0.84 U	0.84 U	0.95 U	0.95 U	0.93 U	1.01 U	1.01 U
SF-23 Y	12	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U

C.34

TABLE C.6. (contd)

	Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ drv weight)								trans- Chlordane	Endo- sulfan I
			Alpha- BHC	Beta-	Lindane	Delta- BHC	Hepta- chlor	Aldrin	Heptachlor Epoxide			
C.35	SF-24 A	12	0.30 J	1.27 U	1.15 U	1.15 U	1.31 U	1.31 U	1.28 U	1.44	1.39 U	
	SF-24 B	12	0.32 J	1.24 U	1.13 U	1.13 U	1.29 U	1.29 U	1.25 U	0.71 J	1.36 U	
	SF-24 C	12	0.08 J	1.09 U	0.99 U	0.99 U	1.12 U	1.12 U	1.10 U	0.23 J	1.19 U	
	SF-25 A	13	0.58 J	1.20 U	1.09 U	1.09 U	1.24 U	1.24 U	1.21 U	1.31 U	1.31 U	
	SF-25 B	13	0.24 J	1.00 U	0.90 U	0.90 U	1.03 U	1.03 U	1.01 U	1.09 U	1.09 U	
	SF-25 X	13	0.49 U	0.73 U	0.66 U	0.66 U	0.75 U	0.75 U	0.74 U	0.80 U	0.80 U	
	SF-25 Y	13	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U	
	SF-26 A	13	0.90 U	1.34 U	1.21 U	1.21 U	1.38 U	1.38 U	1.35 U	1.46 U	1.46 U	
	SF-26 B	13	0.40 J	1.28 U	1.16 U	1.16 U	1.32 U	1.32 U	1.29 U	0.29 J	1.40 U	
	SF-26 C	13	0.96	1.12 U	1.02 U	1.02 U	1.16 U	1.16 U	1.13 U	1.19 J	1.38	
	SF-26 X	13	0.56 J	0.99 U	0.90 U	0.90 U	1.02 U	1.02 U	1.00 U	0.58 J	1.09	
	SF-26 Y	13	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U	
	SF-27 A	13	0.34 J	1.27 U	1.16 U	1.16 U	1.32 U	1.32 U	1.29 U	1.39 U	1.39 U	
	SF-27 B	13	0.51 J	1.23 U	1.12 U	0.25 J	1.27 U	1.27 U	1.24 U	0.53 J	1.35 U	
	SF-27 C	13	0.65 J	1.19 U	1.08 U	0.45 J	1.23 U	1.23 U	1.20 U	0.85 J	1.30 U	
	SF-27 X	14	0.49 J	0.93 U	0.85 U	0.14 J	0.97 U	0.97 U	0.94 U	0.48 J	1.02 U	
	SF-27 Y	13	0.46 U	0.68 U	0.62 U	0.62 U	0.70 U	0.70 U	0.69 U	0.74 U	0.74 U	
	SF-28 A	14	0.49 J	1.06 U	0.96 U	0.96 U	1.10 U	1.10 U	1.07 U	0.70 J	1.16 U	
	SF-28 B	14	0.66	0.90 U	0.82 U	0.25 J	0.93 U	0.93 U	0.91 U	0.94 J	0.99 U	
	SF-28 X	14	1.01	0.78 U	0.71 U	0.27 J	0.81 U	0.81 U	0.79 U	1.37	0.85 U	
	SF-28 Y	14	0.41 U	0.61 U	0.56 U	0.56 U	0.63 U	0.63 U	0.62 U	0.67 U	0.67 U	
	SF-29 A	14	0.15 J	1.20 U	1.09 U	1.09 U	1.25 U	1.25 U	1.22 U	0.33 J	1.32 U	
	SF-29 B	14	0.50 J	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	0.86 J	0.45 J	
	SF-29 C	14	1.01	1.13 U	1.03 U	0.49 J	1.17 U	1.17 U	1.14 U	0.65 J	1.04 J	
	SF-29 D	13	0.98	0.32 J	0.89 U	0.46 J	1.02 U	1.02 U	0.99 U	0.94 J	1.08 U	
	SF-29 E	14	2.07	1.03 U	0.46 J	0.80 J	1.06 U	1.06 U	1.04 U	1.08 J	1.13 U	
	SF-29 X	14	0.49 U	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.78 U	0.78 U	
	SF-29 Y	14	0.47 U	0.69 U	0.63 U	0.63 U	0.72 U	0.72 U	0.70 U	0.76 U	0.76 U	
	SF-30 A	14	0.25 J	1.31 U	1.19 U	1.19 U	1.35 U	1.35 U	1.32 U	0.20 J	1.43 U	
	SF-30 B	15	0.42 J	1.27 U	1.16 U	0.21 J	1.32 U	1.32 U	1.29 U	0.61 J	1.39 U	
	SF-30 X	15	0.87 J	1.30 U	1.18 U	0.38 J	1.35 U	1.35 U	1.32 U	1.02 J	0.64 J	
	SF-30 Y	14	0.47 U	0.69 U	0.63 U	0.63 U	0.72 U	0.72 U	0.70 U	0.76 U	0.76 U	
	SF-31 A	14	0.26 J	1.25 U	1.14 U	1.14 U	1.30 U	1.30 U	1.27 U	1.37 U	1.37 U	
	SF-31 X	14	0.82	0.85 U	0.19 J	0.36 J	0.88 U	0.88 U	0.86 U	0.54 J	0.93 U	
	SF-31 Y	14	0.04 J	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.09 J	0.79 U	

TABLE C.6. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan I
SF-32 A	24	0.51 J	1.01 U	0.23 J	0.21 J	1.05 U	1.05 U	1.02 U	1.53	1.11 U
SF-32 B	24	0.35 J	1.02 U	0.20 J	0.22 J	1.05 U	1.05 U	1.03 U	1.11 U	1.11 U
SF-32 C	24	0.54 U	0.80 U	0.73 U	0.73 U	0.83 U	0.83 U	0.81 U	0.87 U	0.87 U
SF-32 X	24	0.60 U	0.89 U	0.80 U	0.80 U	0.92 U	0.92 U	0.89 U	0.97 U	0.97 U
SF-32 Y	22	0.46 U	0.68 U	0.61 U	0.61 U	0.70 U	0.70 U	0.68 U	0.74 U	0.74 U
SF-33 A	24	0.66	0.94 U	0.23 J	0.30 J	0.98 U	0.98 U	0.95 U	1.03 U	1.03 U
SF-33 B	24	0.46 J	0.95 U	0.87 U	0.39 J	0.99 U	0.99 U	0.96 U	1.04 U	1.04 U
SF-33 X	25	0.43 J	0.83 U	0.07 J	0.76 U	0.86 U	0.86 U	0.84 U	1.33	0.91 U
SF-33 Y	22	0.46 U	0.69 U	0.62 U	0.62 U	0.71 U	0.71 U	0.69 U	0.75 U	0.75 U
SF-34 A	24	0.65 J	1.17 U	1.06 U	0.28 J	1.21 U	1.21 U	1.18 U	2.62	1.28 U
SF-34 B	24	0.22 J	1.02 U	0.93 U	0.93 U	1.06 U	1.06 U	1.03 U	1.12 U	1.12 U
SF-34 X	23	0.28 J	0.73 U	0.66 U	0.16 J	0.75 U	0.75 U	0.74 U	0.80 U	0.80 U
SF-34 Y	11	0.46 U	0.67 U	0.61 U	0.61 U	0.70 U	0.70 U	0.68 U	0.74 U	0.74 U
IH-35 A	15	0.32 J	1.12 U	1.01 U	1.01 U	1.15 U	1.15 U	1.13 U	1.22 U	1.22 U
IH-35 X	15	0.30 J	0.87 U	0.79 U	0.79 U	0.90 U	0.90 U	0.88 U	0.54 J	0.34 J
IH-35 Y	17	0.49 U	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.79 U	0.79 U
IH-36 A	15	0.27 J	1.20 U	1.09 U	1.09 U	1.24 U	1.24 U	1.21 U	0.35 J	1.31 U
IH-36 B	15	0.60 J	1.00 U	0.91 U	0.91 U	1.04 U	1.04 U	1.01 U	0.60 J	0.44 J
IH-36 X	15	0.51 J	0.86 U	0.78 U	0.19 J	0.88 U	0.88 U	0.86 U	0.70 J	0.44 J
IH-36 Y	17	0.48 U	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-37 A	15	0.86 U	1.26 U	1.15 U	1.15 U	1.31 U	1.31 U	1.28 U	1.38 U	1.38 U
IH-37 B	15	0.86 U	1.27 U	1.15 U	1.15 U	1.31 U	1.31 U	1.28 U	0.30 J	0.06 J
IH-37 C	15	0.28 J	1.17 U	1.07 U	1.07 U	1.21 U	1.21 U	1.18 U	0.25 J	0.07 J
IH-37 X	15	0.36 J	1.04 U	0.94 U	0.94 U	1.08 U	1.08 U	1.05 U	0.39 J	0.29 J
IH-37 Y	17	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-38 A	16	0.85 U	1.26 U	1.15 U	1.15 U	1.31 U	1.31 U	1.27 U	0.74 J	0.27 J
IH-38 X	16	0.35 J	1.13 U	1.03 U	1.03 U	1.17 U	1.17 U	1.15 U	0.64 J	0.30 J
IH-38 Y	17	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.72 U	0.77 U	0.77 U
IH-39 A	16	0.85 U	1.26 U	1.15 U	1.15 U	1.31 U	1.31 U	1.27 U	1.05 J	0.22 J
IH-39 B	16	0.49 J	1.18 U	1.07 U	1.07 U	1.22 U	1.22 U	1.19 U	0.55 J	0.45 J
IH-39 C	16	0.39 J	0.95 U	0.87 U	0.87 U	0.99 U	0.99 U	0.96 U	0.49 J	0.38 J
IH-39 X	16	0.44 J	1.09 U	0.99 U	0.99 U	1.13 U	1.13 U	1.10 U	1.17 J	0.52 J
IH-39 Y	17	0.47 U	0.69 U	0.63 U	0.63 U	0.71 U	0.71 U	0.69 U	0.75 U	0.75 U

C.36

TABLE C.6. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ drv weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
IH-40 A	16	0.85 U	1.25 U	1.14 U	1.14 U	1.30 U	1.30 U	1.27 U	0.85 J	0.07 J
IH-40 B	25	0.79 U	1.16 U	1.06 U	1.06 U	1.20 U	1.20 U	1.18 U	0.22 J	1.27 U
IH-40 X	16	0.57 J	1.15 U	1.04 U	1.04 U	1.19 U	1.19 U	1.16 U	0.34 J	0.15 J
IH-40 Y	17	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-41 A	18	0.29 J	1.22 U	0.13 J	1.11 U	1.26 U	1.26 U	1.23 U	0.40 J	1.33 U
IH-41 B	18	0.36 J	1.20 U	1.09 U	1.09 U	1.24 U	1.24 U	1.21 U	0.27 J	1.32 U
IH-41 C	16	0.48 J	1.08 U	0.98 U	0.98 U	1.11 U	1.11 U	1.09 U	0.74 J	0.34 J
IH-41 X	16	0.35 J	1.08 U	0.98 U	0.98 U	1.12 U	1.12 U	1.09 U	0.80 J	0.25 J
IH-41 Y	17	0.47 U	0.69 U	0.63 U	0.63 U	0.71 U	0.71 U	0.70 U	0.75 U	0.75 U
IH-42 A	18	0.15 J	1.11 U	0.09 J	1.01 U	1.15 U	1.15 U	1.12 U	0.53 J	1.22 U
IH-42 X	18	0.14 J	1.14 U	0.13 J	1.04 U	1.18 U	1.18 U	1.15 U	0.34 J	1.25 U
IH-42 Y	17	0.47 U	0.70 U	0.63 U	0.63 U	0.72 U	0.72 U	0.71 U	0.76 U	0.76 U
IH-43 A	25	0.82 U	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	1.32 U	1.32 U
IH-43 B	18	0.30 J	1.22 U	0.13 J	1.11 U	1.26 U	1.26 U	1.23 U	0.53 J	1.33 U
IH-43 X	18	0.23 J	1.09 U	0.16 J	0.99 U	1.13 U	1.13 U	1.10 U	0.56 J	1.19 U
IH-43 Y	17	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
IH-44 A	18	0.83 U	1.23 U	0.16 J	1.12 U	1.27 U	1.27 U	1.24 U	0.38 J	1.35 U
IH-44 B	18	0.27 J	1.27 U	0.17 J	1.16 U	1.32 U	1.32 U	1.29 U	0.51 J	1.39 U
IH-44 C	18	0.80 U	1.18 U	0.12 J	1.07 U	1.22 U	1.22 U	1.19 U	0.38 J	1.29 U
IH-44 D	18	0.32 J	1.17 U	0.10 J	1.06 U	1.21 U	1.21 U	1.18 U	0.56 J	1.28 U
IH-44 X	25	0.76 U	1.12 U	1.02 U	0.24 J	1.16 U	1.16 U	1.13 U	0.38 J	1.23 U
IH-44 Y	17	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-45 A	19	0.86 U	1.27 U	1.15 U	1.15 U	1.31 U	1.31 U	1.28 U	1.38 U	1.38 U
IH-45 B	18	0.81 U	1.19 U	0.10 J	1.08 U	1.23 U	1.23 U	1.20 U	0.20 J	1.30 U
IH-45 C	18	0.41 J	1.07 U	0.20 J	0.97 U	1.10 U	1.10 U	1.08 U	0.45 J	1.17 U
IH-45 X	19	0.80 U	1.18 U	1.07 U	1.07 U	1.22 U	1.22 U	1.19 U	1.29 U	1.29 U
IH-45 Y	17	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-46 A	19	0.79 U	1.17 U	1.06 U	1.06 U	1.21 U	1.21 U	1.18 U	0.20 J	1.28 U
IH-46 B	19	0.77 U	1.14 U	1.03 U	1.03 U	1.18 U	1.18 U	1.15 U	0.28 J	1.24 U
IH-46 C	19	0.81 U	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	1.30 U	1.30 U
IH-46 X	19	0.79 U	1.17 U	1.06 U	1.06 U	1.21 U	1.21 U	1.18 U	0.53 J	0.25 J
IH-46 Y	17	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U

C.37

TABLE C.6. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		<u>Alpha-BHC</u>	<u>Beta-BHC</u>	<u>Lindane</u>	<u>Delta-BHC</u>	<u>Hepta-chlor</u>	<u>Aldrin</u>	<u>Heptachlor Epoxide</u>	<u>trans-Chlordane</u>	<u>Endo-sulfan I</u>
IH-47 A	19	0.81 U	1.20 U	1.09 U	1.09 U	1.25 U	1.25 U	1.22 U	1.32 U	1.32 U
IH-47 B	19	0.77 U	1.14 U	1.04 U	1.04 U	1.18 U	1.18 U	1.15 U	0.41 J	1.25 U
IH-47 C	19	0.82 U	1.22 U	1.11 U	1.11 U	1.26 U	1.26 U	1.23 U	0.43 J	1.33 U
IH-47 X	25	0.67 U	1.00 U	0.91 U	0.91 U	1.03 U	1.03 U	1.01 U	1.09 U	1.09 U
IH-47 Y	17	0.47 U	0.70 U	0.63 U	0.63 U	0.72 U	0.72 U	0.70 U	0.76 U	0.76 U
IH-48 A	19	0.77 U	1.14 U	1.04 U	1.04 U	1.18 U	1.18 U	1.15 U	1.25 U	1.25 U
IH-48 B	19	0.80 U	1.18 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	0.30 J	1.29 U
IH-48 X	19	0.77 U	1.13 U	1.03 U	1.03 U	1.17 U	1.17 U	1.15 U	0.24 J	1.24 U
IH-48 Y	17	0.47 U	0.69 U	0.63 U	0.63 U	0.72 U	0.72 U	0.70 U	0.76 U	0.76 U
IH-49 A	19	0.84 U	1.25 U	1.13 U	1.13 U	1.29 U	1.29 U	1.26 U	1.36 U	1.36 U
IH-49 B	19	0.83 U	1.23 U	1.12 U	1.12 U	1.27 U	1.27 U	1.24 U	1.34 U	1.34 U
IH-49 X	19	0.82 U	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	0.83 J	1.32 U
IH-49 Y	17	0.50 U	0.74 U	0.67 U	0.67 U	0.76 U	0.76 U	0.74 U	0.80 U	0.80 U
IH-50 A	25	0.90 U	1.34 U	1.21 U	1.21 U	1.38 U	1.38 U	1.35 U	1.46 U	1.46 U
IH-50 B	22	0.03 J	1.15 U	1.05 U	1.05 U	1.19 U	1.19 U	1.17 U	0.04 J	1.26 U
IH-50 C	22	0.16 J	1.13 U	1.02 U	1.02 U	1.16 U	1.16 U	1.14 U	0.07 J	0.03 J
IH-50 X	22	0.73 U	1.08 U	0.11 J	0.98 U	1.11 U	1.11 U	1.09 U	0.05 J	1.18 U
IH-50 Y	21	0.41 U	0.61 U	0.56 U	0.56 U	0.63 U	0.63 U	0.62 U	0.67 U	0.67 U
IH-51 A	23	0.81 U	1.20 U	1.09 U	1.09 U	1.25 U	1.25 U	1.22 U	1.32 U	1.32 U
IH-51 B	23	0.71 U	1.05 U	0.95 U	0.95 U	1.09 U	1.09 U	1.06 U	1.15 U	1.15 U
IH-51 X	22	0.05 J	1.02 U	0.93 U	0.93 U	1.06 U	1.06 U	1.03 U	0.19 J	0.10 J
IH-51 Y	21	0.47 U	0.69 U	0.63 U	0.63 U	0.72 U	0.72 U	0.70 U	0.76 U	0.76 U
PC-52 A	25	0.84 U	1.25 U	1.13 U	1.13 U	1.29 U	1.29 U	1.26 U	6.15	1.36 U
PC-52 B	25	0.81 U	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	10.24	1.30 U
PC-52 C	25	1.37	1.02 U	0.03 J	0.93 U	1.06 U	1.06 U	1.03 U	24.95	1.12 U
PC-53 A	20	0.82 U	1.22 U	1.11 U	1.11 U	1.26 U	1.26 U	1.23 U	17.64	3.34
PC-53 B	20	0.81 U	1.20 U	1.09 U	1.09 U	1.24 U	1.24 U	1.21 U	14.65	3.13
PC-53 C	25	9.14	1.05 U	0.95 U	0.95 U	1.09 U	1.09 U	1.06 U	68.52	7.31
PC-54 A	20	0.81 U	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	17.85	2.19
PC-54 B	20	0.57 J	1.02 U	0.93 U	0.93 U	1.06 U	1.06 U	1.03 U	34.59	1.12 U
PC-54 C	20	8.55	0.80 U	0.73 U	0.73 U	0.83 U	0.83 U	0.81 U	7.61	0.88 U

TABLE C.6. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
SFC Marina	23	1.11 U	1.65 U	0.37 J	1.50 U	1.70 U	1.70 U	1.66 U	1.80 U	1.80 U
FSFC Edge-West	24	0.97 U	1.44 U	1.31 U	1.31 U	1.49 U	1.49 U	1.45 U	1.57 U	1.57 U
Parr Canal Edge	24	0.73 U	1.09 U	0.99 U	0.99 U	1.12 U	1.12 U	1.10 U	1.19 U	1.19 U
IHC Edge-East	23	1.01 U	1.49 U	1.35 U	1.35 U	1.54 U	1.54 U	1.50 U	1.63 U	0.65 J
IHC Edge-West	23	0.93 U	1.37 U	1.25 U	1.25 U	1.42 U	1.42 U	1.39 U	1.50 U	1.50 U
Outer Harbor Edge	23	0.79 U	1.17 U	1.06 U	1.06 U	1.21 U	1.21 U	1.18 U	1.28 U	1.28 U
Comp LC	3	382.60 U	565.69 U	513.98 U	513.98 U	585.26 U	585.26 U	571.28 U	618.45 U	618.45 U
Comp LC-1	8	97.33 U	143.91 U	130.76 U	130.76 U	148.89 U	148.89 U	145.33 U	49.41 J	157.33 U
Comp LC-2	8	654.08 U	445.62 U	2222.05 U	2222.05 U	2530.21 U	2530.21 U	2469.79 U	2673.72 U	2673.72 U
Comp LC-3	8	163.04 U	241.07 U	219.03 U	219.03 U	249.40 U	249.40 U	243.45 U	263.55 U	263.55 U
Comp LC-4	6	77.06 U	113.93 U	103.52 U	103.52 U	117.87 U	117.87 U	115.06 U	124.56 U	124.56 U
Comp LC-5	3	739.86 U	1093.92 U	993.92 U	993.92 U	1131.76 U	151.84 J	1104.73 U	1195.95 U	1195.95 U
Comp LC-6	4	742.88 U	1098.37 U	997.96 U	997.96 U	1136.36 U	1136.36 U	1109.23 U	1200.81 U	1200.81 U
Comp USFC	23	0.81 U	1.20 U	1.09 U	1.09 U	1.25 U	1.25 U	1.22 U	1.32 U	1.32 U
Comp FSFC	24	0.51 J	1.08 U	0.98 U	0.37 J	1.12 U	1.12 U	1.09 U	0.73 J	1.18 U
Comp IHC-1	23	0.82 U	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	1.32 U	1.32 U
Comp IHC-2	23	0.87 U	1.28 U	1.16 U	1.16 U	1.33 U	1.33 U	1.29 U	1.40 U	1.40 U
Comp IHC-3	23	0.73 U	1.08 U	0.98 U	0.98 U	1.11 U	1.11 U	1.09 U	1.18 U	1.18 U
Comp Ø	23	0.27 J	1.29 U	1.17 U	1.17 U	1.34 U	1.34 U	1.30 U	1.41 U	1.41 U
C-SFBF	21	0.68 U	1.00 U	0.91 U	0.91 U	1.03 U	1.03 U	1.01 U	1.09 U	1.09 U
C-SFBC	21	0.45 U	0.66 U	0.60 U	0.60 U	0.68 U	0.68 U	0.67 U	0.72 U	0.72 U

(a) DL Detection limit; detection limits are elevated in some batches because of sample dilutions.

(b) U Analyte was not present above the associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE C.7. Chlorinated Pesticides (elution order, cis-Chlordane to Toxaphene) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									Toxaphene
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
Target DL ^(a)		2	2	2	2	2	2	2	2	2	30
Achieved DL High		590.84	590.84	598.66	685.03	602.38	745.72	653.76	568.88	642.96	20750.19
Achieved DL Low		0.60	0.60	0.61	0.69	0.61	0.76	0.66	0.58	0.65	21.04
LZ-1 A	3	539.80 U ^(b)	401.65 J ^(c)	2865.23	625.85 U	550.34 U	11228.33	597.28 U	519.73 U	13843.61	18957.48 U
LZ-1 B	3	314.26 U	205.94 J	4855.60	364.36 U	320.40 U	363.48 J	347.72 U	302.57 U	595.70	11036.63 U
LZ-1 C	3	6731.71 U	10304.57	7915.53	7804.88 U	6863.20 U	322304.49	7448.57 U	6481.44 U	30541.48	236415.69 U
LZ-1 D	3	2509.09 U	723.37 J	1441.28 J	2909.09 U	2558.10 U	136929.91	2776.28 U	2415.81 U	700.53 J	88118.58 U
LZ-1 X	3	98.88 U	25.92 J	15.44 J	114.64 U	100.81 U	487.21	109.41 U	95.20 U	41.32 J	3472.59 U
LZ-1 Y	21	0.12 J	1.50	1.71	0.80 U	0.71 U	140.22	0.77 U	0.67 U	1.77	24.29 U
LZ-2 A	4	1065.10 U	311.02 J	462.14 J	1234.90 U	1085.91 U	11414.95	1178.52 U	1025.50 U	43298.77	37406.04 U
LZ-2 B	4	2150.41 U	685.75 J	989.25 J	2493.22 U	2192.41 U	21516.06	2379.40 U	2070.46 U	111047.83	75521.68 U
LZ-2 C	4	4674.52 U	4344.56 J	3656.61 J	5419.73 U	4765.83 U	212115.89	5172.31 U	4500.74 U	45332.96	164167.89 U
LZ-2 X	4	998.11 U	439.81 J	345.82 J	1157.23 U	1017.61 U	103190.29	1104.40 U	961.01 U	6827.19	35053.46 U
LZ-2 Y	21	0.34 J	12.43	10.54	0.77 U	0.68 U	776.60	0.74 U	0.64 U	188.34	23.40 U
LZ-3 A	4	1210.53 U	882.34 J	826.31 J	1403.51 U	1234.17 U	29781.44	1339.44 U	1165.52 U	41784.21	42513.35 U
LZ-3 B	4	2515.06 U	2271.21 J	2366.27 J	2916.01 U	2564.18 U	112717.87	2782.88 U	2421.55 U	38901.66	88328.05 U
LZ-3 X	4	457.09 U	519.38	165.91 J	529.95 U	466.01 U	17054.30	505.76 U	440.09 U	2323.78	16052.71 U
LZ-3 Y	21	0.13 J	3.69	2.20	0.12 J	0.67 U	189.28	0.73 U	0.64 U	60.93	23.19 U
LZ-5 A	6	473.73 U	467.28 J	378.69 J	549.25 U	482.99 U	14791.94	524.18 U	456.12 U	29641.09	16637.31 U
LZ-5 Y	21	0.19 J	17.09	10.23	0.77 U	0.68 U	445.10	0.74 U	0.64 U	476.54	23.41 U
LZ-6 A	6	1631.04 U	930.71 J	842.97 J	1891.06 U	1662.90 U	17825.73	1804.73 U	1570.40 U	92956.22	57281.60 U
LZ-6 B	6	3646.18 U	1894.04 J	2573.81 J	4227.46 U	3717.40 U	113865.44	4034.46 U	3510.63 U	161331.74	128052.84 U
LZ-6 C	6	475.72 U	155.14 J	447.25 J	551.56 U	485.01 U	33972.04	526.38 U	458.03 U	12496.97	16707.13 U
LZ-6 X	6	143.49 U	41.59 J	16.34 J	166.37 U	146.29 U	670.27	158.77 U	138.16 U	141.28 J	5039.33 U
LZ-6 Y	21	0.03 J	0.98	0.73	0.71 U	0.63 U	54.78	0.68 U	0.59 U	37.33	21.54 U
LZ-7 A	6	1100.55 U	1311.68	857.32 J	1276.01 U	1122.05 U	37505.99	1217.75 U	1059.64 U	38600.63	38651.18 U
LZ-7 B	6	5908.41 U	15971.27	6274.29	6850.34 U	6023.83 U	292520.38	6537.60 U	5688.76 U	334563.58	207501.86 U
LZ-7 C	6	1013.41 U	1475.77	739.18 J	1174.97 U	1033.21 U	68456.14	1121.33 U	975.73 U	48493.85	35590.68 U
LZ-7 X	6	7.93 U	6.63 J	2.42 J	9.19 U	8.08 U	101.19	8.77 U	7.63 U	69.40	278.40 U
LZ-7 Y	21	0.64 U	0.45 J	0.19 J	0.74 U	0.65 U	9.73	0.71 U	0.61 U	1.85	22.41 U

TABLE C.7. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
LZ-8 A	7	990.02 U	409.19 J	415.45 J	1147.85 U	1009.36 U	8983.00	1095.45 U	953.21 U	26511.54	34769.18 U
LZ-8 B	7	2983.08 U	2344.70 J	4511.69	3458.65 U	3041.35 U	101508.55	3300.75 U	2872.18 U	53736.21	104765.04 U
LZ-8 C	7	2088.16 U	1576.51 J	27663.04	2421.05 U	2128.95 U	50720.09	2310.53 U	2010.53 U	59262.41	73335.53 U
LZ-8 D	7	1168.63 U	778.95 J	31498.99	1354.93 U	1191.46 U	13787.46	1293.08 U	1125.18 U	22355.96	41041.97
LZ-8 E	7	1010.83 U	435.71 J	41767.87	1171.97 U	1030.57 U	5786.51	1118.47 U	973.25 U	34123.38	35500.00 U
LZ-8 F	7	4033.04 U	6980.94	2275.90 J	4675.98 U	4111.82 U	143993.28	4462.52 U	3883.10 U	45252.16	141639.14 U
LZ-8 G	7	96.95 U	28.61 J	24.66 J	112.40 U	98.84 U	873.30	107.27 U	93.34 U	1029.47	3404.70 U
LZ-8 X	7	70.82 U	7.96 J	10.88 J	82.11 U	72.20 U	98.51	78.36 U	68.18 U	957.42	2487.06 U
LZ-8 Y	21	0.67 U	0.04 J	0.68 U	0.77 U	0.68 U	0.67 J	0.74 U	0.64 U	0.73 U	23.41 U
LZ-9 A	6	560.78 U	343.16 J	356.27 J	650.18 U	571.73 U	9862.51	620.49 U	539.93 U	27403.36	19694.35 U
LZ-9 X	7	516.94 U	281.94 J	219.06 J	599.35 U	527.04 U	5695.97	571.99 U	497.72 U	13956.56	18154.72 U
LZ-9 Y	21	0.39 J	52.07	36.81	1.15	0.65 U	866.52	0.71 U	0.62 U	1001.17	22.45 U
LZ-10 A	8	121.24 U	48.85 J	55.40 J	140.57 U	123.61 U	1116.28	134.15 U	116.73 U	2951.54	4257.83 U
LZ-10 B	8	290.66 U	339.79	331.07	337.00 U	296.34 U	12061.52	321.61 U	279.85 U	12591.73	10207.88 U
LZ-10 X	9	2092.29 U	530.10 J	1010.44 J	2425.84 U	2133.16 U	30415.95	2315.10 U	2014.50 U	89109.29	73480.55 U
LZ-10 Y	22	0.01 J	0.94	0.67 U	0.76 U	0.67 U	6.36	0.73 U	0.63 U	1.04	23.13 U
LZ-11 A	7	225.94 U	124.92 J	149.67 J	261.96 U	230.35 U	5368.23	250.00 U	217.54 U	2258.61	7934.94 U
LZ-11 X	7	3680.00 U	2246.89 J	2399.22 J	4266.67 U	3751.88 U	106725.42	4071.88 U	3543.19 U	19837.68	129240.58 U
LZ-11 Y	21	0.62 U	38.90	15.99	0.31 J	0.63 U	559.06	0.68 U	0.59 U	79.61	21.64 U
LZ-12 A	9	122.64 U	43.97 J	62.04 J	142.19 U	125.04 U	1213.26	135.70 U	118.08 U	1400.33	4307.19 U
LZ-12 X	9	124.86 U	43.51 J	59.84 J	144.77 U	127.30 U	959.08	138.16 U	120.22 U	528.55	4385.13 U
LZ-12 Y	22	0.02 J	0.65 J	0.73	0.77 U	0.67 U	20.43	0.73 U	0.64 U	8.58	23.20 U
LZ-13 A	9	133.81 U	99.10 J	177.46	155.14 U	136.42 U	1430.44	148.06 U	128.84 U	1538.68	4699.41 U
LZ-13 B	9	87.87 U	80.79 J	140.78	101.88 U	89.59 U	1402.63	97.23 U	84.61 U	472.40	3086.10 U
LZ-13 C	9	209.48 U	108.19 J	233.24	242.87 U	213.57 U	2298.08	231.78 U	201.69 U	4781.08	7356.78 U
LZ-13 X	9	224.28 U	237.35	481.78	260.03 U	228.66 U	4793.95	248.16 U	215.94 U	1915.71	7876.63 U
LZ-13 Y	22	0.67 U	0.67 U	0.68 U	0.78 U	0.68 U	0.15 J	0.74 U	0.65 U	0.08 J	23.56 U
LZ-14 A	7	70.82 U	25.05 J	25.34 J	82.11 U	72.20 U	445.61	78.36 U	68.18 U	187.93 U	2487.06 U
LZ-14 X	8	6.83 U	4.55 J	8.16	7.92 U	6.96 U	110.30	7.56 U	6.57 U	82.34	239.82 U
LZ-14 Y	22	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-15 A	9	64.88 U	31.90 J	45.35 J	75.22 U	66.15 U	711.72	71.79 U	62.47 U	414.80	2278.62 U
LZ-15 B	9	60.34 U	31.30 J	54.73 J	69.96 U	61.52 U	683.41	66.77 U	58.10 U	641.43	2119.20 U
LZ-15 X	9	112.39 U	42.62 J	60.60 J	130.31 U	114.59 U	883.31	124.36 U	108.22 U	1460.35	3947.24 U
LZ-15 Y	22	0.67 U	0.40 J	0.37 J	0.77 U	0.68 U	9.24	0.74 U	0.64 U	8.99	23.37 U

C.41

TABLE C.7. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								4,4'-DDT	Toxaphene
		cis- Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo- sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate		
LZ-16 A	8	13.23 U	7.47 J	22.62	15.33 U	13.48 U	276.92	14.63 U	12.73 U	169.60	464.46 U
LZ-16 B	9	106.87 U	74.90 J	139.81	123.91 U	108.96 U	946.84	118.25 U	102.90 U	167.08	3753.20 U
LZ-16 C	9	18.50 J	164.25	266.24	116.53	93.15 U	2598.46	101.09 U	87.97 U	1574.53	3208.69 U
LZ-16 D	9	72.50 U	39.98 J	75.19	84.06 U	73.92 U	690.96	80.22 U	69.80 U	646.93	2546.14 U
LZ-16 X	8	7.21 U	34.63	96.94	8.36 U	7.35 U	627.30	7.98 U	6.94 U	163.49	253.23 U
LZ-16 Y	22	0.65 U	0.04 J	0.09 J	0.76 U	0.66 U	0.69 J	0.72 U	0.63 U	0.39 J	22.89 U
SF-17 A	11	1.04 J	11.37	64.72	0.30 J	1.28 U	193.13	1.39 U	1.21 U	10.06 U	44.13 U
SF-17 B	11	0.69 J	11.03	60.14	0.14 J	1.16 U	137.80	1.26 U	1.10 U	7.19 U	40.04 U
SF-17 X	11	0.18 J	2.06	7.82	0.04 J	0.87 U	60.00	0.95 U	0.82 U	1.77 U	30.08 U
SF-17 Y	11	0.70 U	0.02 J	0.06 J	0.81 U	0.71 U	0.88 U	0.77 U	0.67 U	0.76 U	24.57 U
SF-18 A	11	0.61 J	7.90	21.16	0.12 J	1.24 U	109.78	1.34 U	1.17 U	86.21	42.55 U
SF-18 B	11	0.85 J	12.36	18.14	0.22 J	1.24 U	135.47	1.35 U	1.18 U	19.28 U	42.87 U
SF-18 X	11	0.50 J	4.66	10.56	0.21 J	1.16 U	78.94	1.25 U	1.09 U	2.97 U	39.81 U
SF-18 Y	11	0.73 U	0.73 U	0.03 J	0.84 U	0.74 U	0.92 U	0.80 U	0.70 U	0.79 U	25.48 U
SF-19 A	11	0.45 J	3.90	10.37	0.12 J	1.28 U	112.35	1.38 U	1.20 U	12.68 U	43.92 U
SF-19 X	11	0.48 J	7.22	22.80	0.17 J	1.21 U	94.90	1.32 U	1.15 U	16.16 U	41.81 U
SF-19 Y	11	0.69 U	0.69 U	0.70 U	0.80 U	0.71 U	0.87 U	0.77 U	0.67 U	0.75 U	24.30 U
SF-20 A	11	0.39 J	3.83	11.01	0.16 J	1.37 U	116.55	1.49 U	1.29 U	13.82 U	47.23 U
SF-20 X	11	0.63 J	11.20	26.57	0.13 J	1.22 U	191.09	1.33 U	1.15 U	50.66	42.13 U
SF-20 Y	11	0.04 J	0.43 J	2.28	0.82 U	0.72 U	10.41 U	0.78 U	0.68 U	0.77 U	24.85 U
SF-21 A	12	0.41 J	4.54	11.20	0.09 J	1.24 U	83.71	1.34 U	1.17 U	40.57	42.58 U
SF-21 B	12	0.38 J	4.29	11.05	0.15 J	1.18 U	119.36	1.28 U	1.12 U	5.50	40.74 U
SF-21 C	12	0.42 J	7.09	13.30	0.26 J	1.21 U	102.96	1.32 U	1.14 U	22.57	41.75 U
SF-21 X	12	0.41 J	6.74	25.19	0.10 J	1.02 U	89.02	1.10 U	0.96 U	3.39	34.99 U
SF-21 Y	12	0.69 U	0.69 U	0.70 U	0.80 U	0.70 U	0.21 J	0.76 U	0.67 U	0.07 J	24.26 U
SF-22 A	12	0.80 J	10.88	42.85	0.25 J	1.26 U	144.00	1.36 U	1.19 U	14.17	43.27 U
SF-22 B	12	0.45 J	9.89	47.48	0.10 J	1.07 U	135.50	1.16 U	1.01 U	6.12	36.89 U
SF-22 C	12	1.06 U	1.06 U	0.11 J	1.23 U	1.08 U	0.22 J	1.17 U	1.02 U	0.11 J	37.21 U
SF-22 X	12	0.88 U	0.88 U	0.89 U	1.02 U	0.90 U	0.07 J	0.97 U	0.85 U	0.96 U	30.90 U
SF-22 Y	12	0.70 U	0.70 U	0.71 U	0.81 U	0.71 U	0.06 J	0.77 U	0.67 U	0.06 J	24.47 U
SF-23 A	12	0.29 J	2.49	12.37	0.10 J	1.35 U	93.41	1.47 U	1.28 U	50.23	46.52 U
SF-23 B	13	0.36 J	4.05	11.52	0.26 J	1.13 U	75.15	1.23 U	1.07 U	16.75	39.03 U
SF-23 X	13	0.25 J	3.21	10.48	1.05 U	0.92 U	53.69	1.00 U	0.87 U	4.06 U	31.74 U
SF-23 Y	12	0.69 U	0.02 J	0.04 J	0.80 U	0.71 U	0.31 J	0.77 U	0.67 U	0.05 J	24.35 U

TABLE C.7. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g}/\text{kg}$ dry weight)									
		cis- Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo- sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
SF-24 A	12	0.43 J	6.25	17.06	0.15 J	1.27 U	118.56	1.38 U	1.20 U	29.36	43.75 U
SF-24 B	12	0.32 J	4.34	13.62	0.14 J	1.24 U	129.30	1.35 U	1.17 U	12.12	42.77 U
SF-24 C	12	0.08 J	0.81 J	2.65	1.23 U	1.09 U	18.57	1.18 U	1.03 U	0.63 J	37.41 U
SF-25 A	13	1.18 U	33.04	290.07	1.37 U	1.20 U	440.33	1.30 U	1.13 U	10.68	41.38 U
SF-25 B	13	0.21 J	2.67	8.08	1.13 U	1.00 U	51.28	1.08 U	0.94 U	19.24	34.28 U
SF-25 X	13	0.72 U	0.72 U	0.72 U	0.83 U	0.73 U	0.59 J	0.79 U	0.69 U	0.78 U	25.12 U
SF-25 Y	13	0.69 U	0.69 U	0.70 U	0.80 U	0.70 U	0.87 U	0.76 U	0.66 U	0.75 U	24.20 U
SF-26 A	13	1.31 U	0.53 J	3.50	1.52 U	1.33 U	5.77	1.45 U	1.26 U	1.42 U	45.99 U
SF-26 B	13	1.25 U	2.90	7.16	1.45 U	1.28 U	54.43	1.39 U	1.21 U	18.28	43.99 U
SF-26 C	13	1.10 U	12.60	28.92	1.28 U	1.12 U	180.37	1.22 U	1.06 U	35.40	38.68 U
SF-26 X	13	0.41 J	11.77	25.71	1.12 U	0.99 U	172.42	1.07 U	0.93 U	54.72	33.98 U
SF-26 Y	13	0.69 U	0.69 U	0.70 U	0.80 U	0.71 U	0.38 J	0.77 U	0.67 U	0.75 U	24.30 U
SF-27 A	13	1.25 U	1.65	3.40	1.45 U	1.27 U	124.65	2.23	1.20 U	98.26	43.82 U
SF-27 B	13	0.23 J	4.97	10.74	1.40 U	1.23 U	119.43	1.34 U	1.16 U	129.07	42.38 U
SF-27 C	13	0.37 J	8.71	20.33	1.35 U	1.19 U	225.39	1.29 U	1.12 U	94.02	40.92 U
SF-27 X	14	0.34 J	12.26	12.58	1.06 U	0.93 U	135.42	1.01 U	0.88 U	32.90	32.16 U
SF-27 Y	13	0.67 U	0.67 U	0.68 U	0.77 U	0.68 U	0.50 J	0.74 U	0.64 U	0.73 U	23.41 U
SF-28 A	14	0.24 J	3.80	19.13	1.20 U	1.06 U	96.19	1.15 U	1.00 U	19.17	36.50 U
SF-28 B	14	0.34 J	12.86	26.87	1.03 U	0.90 U	278.67	0.98 U	0.85 U	188.41	31.07 U
SF-28 X	14	0.51 J	17.40	33.14	0.88 U	0.78 U	335.56	0.84 U	0.73 U	168.56	26.80 U
SF-28 Y	14	0.60 U	0.53 J	1.37	0.70 U	0.61 U	12.17	0.66 U	0.58 U	0.77	21.10 U
SF-29 A	14	0.08 J	1.83	3.59	1.37 U	1.20 U	32.85	1.31 U	1.14 U	125.24	41.44 U
SF-29 B	14	0.35 J	6.55	20.50	1.35 U	1.19 U	147.01	1.29 U	1.12 U	277.91	40.95 U
SF-29 C	14	0.32 J	12.10	21.87	1.29 U	1.13 U	283.52	1.23 U	1.07 U	111.03	39.03 U
SF-29 D	13	0.66 J	8.83	36.18	1.12 U	0.98 U	163.16	1.07 U	0.93 U	181.17	33.90 U
SF-29 E	14	0.67 J	29.65	121.33	1.17 U	1.03 U	863.54	1.12 U	0.97 U	109.13	35.43 U
SF-29 X	14	0.06 J	0.92	3.15	0.82 U	0.72 U	23.65	0.78 U	0.68 U	3.68	24.72 U
SF-29 Y	14	0.68 U	0.68 U	0.16 J	0.79 U	0.69 U	1.07	0.75 U	0.65 U	0.74 U	23.84 U
SF-30 A	14	0.06 J	1.02 J	2.20	1.49 U	1.31 U	32.56	1.42 U	1.23 U	13.80	44.98 U
SF-30 B	15	0.23 J	4.71	20.25	1.45 U	1.27 U	164.72	1.38 U	1.20 U	48.85	43.82 U
SF-30 X	15	0.37 J	10.96	32.21	0.39 J	1.30 U	299.76	1.41 U	1.23 U	101.54	44.84 U
SF-30 Y	14	0.68 U	0.19 J	0.09 J	0.79 U	0.69 U	1.17	0.75 U	0.65 U	0.74 U	23.82 U
SF-31 A	14	0.05 J	0.58 J	1.28	1.42 U	1.25 U	14.17	1.36 U	1.18 U	16.19	43.14 U
SF-31 X	14	0.47 J	19.99	24.67	0.97 U	0.85 U	325.51	0.92 U	0.80 U	103.70	29.27 U
SF-31 Y	14	0.04 J	1.36	1.75	0.82 U	0.72 U	21.15	0.78 U	0.68 U	0.34 J	24.78 U

TABLE C.7. (contd)

Sediment Treatment	Pesticides ($\mu\text{g/kg}$ dry weight)										Toxaphene
	Batch	cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
SF-32 A	24	0.78 J	9.87	41.24	1.15 U	1.83	205.26	1.10 U	0.95 U	80.76	34.81 U
SF-32 B	24	0.47 J	5.51	23.56	1.15 U	1.01 U	129.13	1.10 U	0.96 U	50.70	34.94 U
SF-32 C	24	0.78 U	0.78 U	0.09 J	0.91 U	0.80 U	0.61 J	0.87 U	0.75 U	0.23 J	27.54 U
SF-32 X	24	0.87 U	0.87 U	0.88 U	1.01 U	0.89 U	0.48 J	0.96 U	0.84 U	0.94 U	30.49 U
SF-32 Y	22	0.66 U	0.66 U	0.67 U	0.77 U	0.68 U	0.08 J	0.73 U	0.64 U	0.72 U	23.30 U
SF-33 A	24	0.21 J	10.11	26.95	1.07 U	0.94 U	173.46	1.02 U	0.89 U	76.28	32.46 U
SF-33 B	24	0.29 J	11.83	31.95	1.08 U	0.95 U	198.05	1.03 U	0.90 U	153.73	32.79 U
SF-33 X	25	0.40 J	16.70	62.85	0.31 J	0.83 U	217.76	0.90 U	0.79 U	69.32	28.71 U
SF-33 Y	22	0.67 U	0.10 J	0.03 J	0.78 U	0.69 U	0.62 J	0.74 U	0.65 U	1.85	23.60 U
SF-34 A	24	0.82 J	36.59	193.73	1.33 U	1.17 U	302.60	1.27 U	1.10 U	38.70	40.24 U
SF-34 B	24	1.00 U	2.43	9.42	1.16 U	1.02 U	65.98	1.11 U	0.97 U	24.86	35.28 U
SF-34 X	23	0.15 J	5.50	13.79	0.83 U	0.73 U	125.95	0.79 U	0.69 U	108.51	25.11 U
SF-34 Y	11	0.66 U	0.03 J	0.04 J	0.77 U	0.67 U	0.83 U	0.73 U	0.64 U	0.72 U	23.21 U
IH-35 A	15	0.13 J	2.18	7.51	1.27 U	1.12 U	68.47	1.21 U	1.05 U	24.22	38.41 U
IH-35 X	15	0.22 J	3.78	12.85	0.99 U	0.87 U	113.37	0.95 U	0.82 U	91.79	30.08 U
IH-35 Y	17	0.71 U	0.06 J	0.08 J	0.82 U	0.72 U	0.87 J	0.78 U	0.68 U	0.77 U	24.76 U
IH-36 A	15	0.06 J	0.86 J	1.93	1.36 U	1.20 U	29.34	1.30 U	1.13 U	13.30	41.25 U
IH-36 B	15	0.20 J	5.43	12.90	1.14 U	1.00 U	110.16	1.09 U	0.95 U	64.91	34.53 U
IH-36 X	15	0.22 J	4.70	20.19	0.97 U	0.85 U	134.94	0.93 U	0.81 U	8.70	29.44 U
IH-36 Y	17	0.70 U	0.13 J	0.15 J	0.81 U	0.71 U	1.18	0.78 U	0.67 U	0.16 J	24.62 U
IH-37 A	15	1.24 U	0.43 J	0.86 J	1.44 U	1.26 U	6.96	1.37 U	1.19 U	1.11 J	43.54 U
IH-37 B	15	0.07 J	1.02 J	2.64	1.44 U	1.27 U	26.56	1.38 U	1.20 U	6.21	43.75 U
IH-37 C	15	0.07 J	1.39	2.80	1.33 U	1.17 U	38.99	1.27 U	1.11 U	16.63	40.39 U
IH-37 X	15	0.14 J	1.88	7.92	1.18 U	1.04 U	56.10	1.13 U	0.98 U	6.69	35.80 U
IH-37 Y	17	0.70 U	0.12 J	0.71 U	0.81 U	0.71 U	0.16 J	0.77 U	0.67 U	0.76 U	24.53 U
IH-38 A	16	0.32 J	3.19	7.31	1.43 U	1.26 U	71.60	1.37 U	1.19 U	39.69	43.44 U
IH-38 X	16	0.20 J	2.18	5.31	1.29 U	1.13 U	71.54	1.23 U	1.07 U	5.91	39.06 U
IH-38 Y	17	0.69 U	0.10 J	0.70 U	0.81 U	0.71 U	0.21 J	0.77 U	0.67 U	0.76 U	24.40 U
IH-39 A	16	0.21 J	1.38	5.97	1.43 U	1.26 U	57.28	1.37 U	1.19 U	33.83	43.44 U
IH-39 B	16	0.22 J	2.71	12.45	1.34 U	1.18 U	66.56	1.28 U	1.11 U	23.87	40.65 U
IH-39 C	16	0.19 J	3.98	18.69	1.08 U	0.95 U	109.02	1.03 U	0.90 U	37.37	32.80 U
IH-39 X	16	0.33 J	5.09	22.33	1.24 U	1.09 U	127.69	1.18 U	1.03 U	47.63	37.58 U
IH-39 Y	17	0.67 U	0.07 J	0.06 J	0.78 U	0.69 U	0.52 J	0.75 U	0.65 U	0.73 U	23.69 U

C.44

TABLE C.7. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
IH-40 A	16	0.11 J	0.92 J	3.38	1.42 U	1.25 U	32.98	1.36 U	1.18 U	4.92	43.14 U
IH-40 B	25	0.12 J	1.10 J	3.17	1.32 U	1.16 U	32.70	1.26 U	1.10 U	16.22	40.07 U
IH-40 X	16	0.11 J	1.61	3.79	1.30 U	1.15 U	43.70	0.61 J	1.08 U	68.27	39.44 U
IH-40 Y	17	0.70 U	0.09 J	0.71 U	0.81 U	0.71 U	0.12 J	0.77 U	0.67 U	0.76 U	24.60 U
IH-41 A	18	0.14 J	1.19	3.73	1.38 U	1.22 U	24.16	1.32 U	1.15 U	21.65	41.91 U
IH-41 B	18	0.08 J	1.13 J	3.24	1.37 U	1.20 U	19.22	1.30 U	1.14 U	1.75	41.41 U
IH-41 C	16	0.31 J	3.22	9.18	1.22 U	1.07 U	98.66	1.17 U	1.01 U	34.51	37.01 U
IH-41 X	16	0.23 J	3.07	9.05	1.23 U	1.08 U	78.73	1.17 U	1.02 U	13.99	37.21 U
IH-41 Y	17	0.68 U	0.68 U	0.68 U	0.78 U	0.69 U	0.09 J	0.75 U	0.65 U	0.73 U	23.72 U
IH-42 A	18	0.22 J	1.72	6.28	1.27 U	1.11 U	40.53	1.21 U	1.05 U	4.42	38.33 U
IH-42 X	18	0.16 J	1.10 J	3.93	1.30 U	1.14 U	21.52	1.24 U	1.08 U	1.55	39.25 U
IH-42 Y	17	0.68 U	0.68 U	0.69 U	0.79 U	0.70 U	0.09 J	0.76 U	0.66 U	0.75 U	24.04 U
IH-43 A	25	1.18 U	1.18 U	0.09 J	1.37 U	1.21 U	0.31 J	1.31 U	1.14 U	1.29 U	41.56 U
IH-43 B	18	0.25 J	2.13	5.58	1.38 U	1.22 U	49.03	1.32 U	1.15 U	18.44	41.94 U
IH-43 X	18	0.23 J	1.66	5.63	1.24 U	1.09 U	37.17	1.18 U	1.03 U	12.82	37.61 U
IH-43 Y	17	0.69 U	0.10 J	0.70 U	0.80 U	0.70 U	0.17 J	0.76 U	0.66 U	0.75 U	24.18 U
IH-44 A	18	0.12 J	1.03 J	3.10	1.40 U	1.23 U	17.82	1.34 U	1.16 U	14.60	42.42 U
IH-44 B	18	0.21 J	2.15	6.26	1.45 U	1.27 U	60.74	1.38 U	1.20 U	14.07	43.82 U
IH-44 C	18	0.18 J	1.27	3.74	1.34 U	1.18 U	18.33	1.28 U	1.11 U	3.05	40.48 U
IH-44 D	18	0.12 J	1.53	6.43	1.33 U	1.17 U	35.28	1.27 U	1.10 U	8.73	40.24 U
IH-44 X	25	0.23 J	3.24	19.18	1.28 U	1.12	50.74	1.22 U	1.06 U	4.45	38.65 U
IH-44 Y	17	0.70 U	0.04 J	0.08 J	0.81 U	0.71 U	0.53 J	0.77 U	0.67 U	0.08 J	24.59 U
IH-45 A	19	0.06 J	0.42 J	1.55	1.44 U	1.27 U	8.53	1.37 U	1.19 U	2.72	43.58 U
IH-45 B	18	0.14 J	1.15 J	2.55	1.35 U	1.19 U	20.65	1.29 U	1.13 U	3.13	41.04 U
IH-45 C	18	0.16 J	2.21	7.45	1.21 U	1.07 U	61.17	1.16 U	1.01 U	10.48	36.76 U
IH-45 X	19	1.15 U	0.45 J	1.00 J	1.34 U	1.18 U	8.60	1.28 U	1.11 U	7.42	40.51 U
IH-45 Y	17	0.70 U	0.02 J	0.05 J	0.81 U	0.71 U	0.39 J	0.77 U	0.67 U	0.76 U	24.52 U
IH-46 A	19	0.06 J	1.33	1.41	2.19	0.37 J	8.70	1.27 U	1.10 U	7.33	40.30 U
IH-46 B	19	0.06 J	0.52 J	1.29	1.29 U	1.14 U	8.49	1.23 U	1.07 U	10.66	39.11 U
IH-46 C	19	1.17 U	1.32	3.15	1.35 U	1.19 U	18.80	1.29 U	1.12 U	52.75	41.01 U
IH-46 X	19	1.15 U	0.60 J	2.03	1.33 U	1.17 U	10.98	1.27 U	1.10 U	0.18 J	40.30 U
IH-46 Y	17	0.70 U	0.10 J	0.71 U	0.81 U	0.71 U	0.19 J	0.77 U	0.67 U	0.76 U	24.49 U

C.45

TABLE C.7. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									Toxaphene
		cis- Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo- sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
IH-47 A	19	1.18 U	0.17 J	0.46 J	1.37 U	1.20 U	1.63	1.31 U	1.14 U	0.70 J	41.47 U
IH-47 B	19	0.07 J	0.94 J	1.91	1.30 U	1.14 U	14.11	1.24 U	1.08 U	8.39	39.25 U
IH-47 C	19	0.04 J	0.59 J	1.75	1.38 U	1.22 U	9.17	1.32 U	1.15 U	0.24 J	41.94 U
IH-47 X	25	0.02 J	0.44 J	1.50	1.13 U	1.00 U	8.68	1.08 U	0.94 U	0.29 J	34.34 U
IH-47 Y	17	0.68 U	0.68 U	0.69 U	0.79 U	0.70 U	0.10 J	0.76 U	0.66 U	0.74 U	24.00 U
IH-48 A	19	1.12 U	0.24 J	0.61 J	1.30 U	1.14 U	3.55	1.24 U	1.08 U	0.31 J	39.28 U
IH-48 B	19	0.04 J	0.42 J	1.11 J	1.35 U	1.18 U	7.43	1.28 U	1.12 U	0.36 J	40.77 U
IH-48 X	19	0.04 J	0.62 J	0.88 J	1.29 U	1.13 U	5.74	1.23 U	1.07 U	1.85	39.06 U
IH-48 Y	17	0.68 U	0.11 J	0.69 U	0.79 U	0.69 U	0.19 J	0.75 U	0.65 U	0.74 U	23.85 U
IH-49 A	19	1.22 U	0.21 J	0.64 J	1.42 U	1.25 U	2.28	1.35 U	1.18 U	0.37 J	42.94 U
IH-49 B	19	0.14 J	1.20 J	2.74	1.40 U	1.23 U	16.45	1.33 U	1.16 U	3.90	42.35 U
IH-49 X	19	0.09 J	0.96 J	2.84	1.37 U	1.20 U	22.01	1.31 U	1.14 U	0.83 J	41.50 U
IH-49 Y	17	0.72 U	0.10 J	0.73 U	0.84 U	0.74 U	0.21 J	0.80 U	0.69 U	0.79 U	25.33 U
IH-50 A	25	1.31 U	0.21 J	0.36 J	1.52 U	1.34 U	9.58	1.45 U	1.26 U	0.26 J	46.02 U
IH-50 B	22	1.13 U	0.25 J	1.14 J	1.31 U	1.15 U	3.08	1.25 U	1.09 U	0.88 J	39.75 U
IH-50 C	22	1.10 U	0.38 J	1.95	1.28 U	1.12 U	8.67	1.22 U	1.06 U	8.13	38.73 U
IH-50 X	22	1.05 U	0.25 J	1.27	1.22 U	1.08 U	5.33	1.17 U	1.02 U	0.70 J	37.03 U
IH-50 Y	21	0.60 U	0.60 U	0.61 U	0.69 U	0.61 U	0.08 J	0.66 U	0.58 U	0.65 U	21.04 U
IH-51 A	23	0.14 J	0.48 J	2.10	1.37 U	1.20 U	6.34	1.31 U	1.14 U	0.65 J	41.44 U
IH-51 B	23	0.05 J	1.03 U	0.49 J	1.19 U	1.05 U	1.78	1.14 U	0.99 U	0.18 J	36.17 U
IH-51 X	22	1.00 U	0.56 J	2.51	1.16 U	1.02 U	10.38	1.11 U	0.96 U	0.61 J	35.14 U
IH-51 Y	21	0.68 U	0.01 J	0.69 U	0.79 U	0.69 U	0.08 J	0.75 U	0.65 U	0.74 U	23.81 U
PC-52 A	25	5.65	7.91	30.86	1.42 U	2.93	123.52	1.35 U	1.18 U	45.90	42.94 U
PC-52 B	25	8.24	6.94	21.37	1.35 U	1.19 U	75.16	1.29 U	1.12 U	2.15	41.01 U
PC-52 C	25	19.50	18.58	48.94	1.16 U	1.02 U	155.05	1.11 U	0.96 U	10.51	35.14 U
PC-53 A	20	21.58	29.38	102.12	1.38 U	1.22 U	617.02	1.32 U	1.15 U	122.85	41.91 U
PC-53 B	20	44.20	39.32	81.86	1.37 U	9.31	526.74	1.30 U	1.13 U	52.46	41.38 U
PC-53 C	25	56.72	44.57	179.57	1.19 U	1.05 U	1142.75	1.14 U	0.99 U	119.98	36.12 U
PC-54 A	20	20.07	36.29	85.50	1.35 U	6.69	690.05	1.29 U	1.13 U	192.79	41.04 U
PC-54 B	20	26.01	44.86	131.83	1.16 U	9.78	1005.82	1.11 U	0.96 U	433.31	35.19 U
PC-54 C	20	5.44	167.79	370.35	3.77	0.80 U	2986.02	0.87 U	0.76 U	721.50	27.67 U

C.46

TABLE C.7. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									4,4'-DDT	Toxaphene
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate			
SFC Marina	23	0.18 J	1.98	7.17	1.87 U	1.65 U	46.54	1.79 U	1.55 U	8.67	56.70 U	
FSFC Edge-West	24	1.41 U	5.66	23.44	1.64 U	1.44 U	140.83	1.56 U	1.36 U	90.83	49.59 U	
Parr Canal Edge	24	4.30	11.55	56.54	1.23 U	1.09 U	327.83	1.18 U	1.03 U	758.73	37.41 U	
IHC Edge-East	23	1.46 U	1.77 J	4.81	1.69 U	1.49 U	28.01	1.62 U	1.41 U	4.33	51.27 U	
IHC Edge-West	23	1.35 U	0.47 J	0.84 J	1.56 U	1.37 U	2.68	1.49 U	1.30 U	0.90 J	47.31 U	
Outer Harbor Edge	23	0.07 J	1.15 U	0.36 J	1.33 U	1.17 U	1.70	1.27 U	1.10 U	0.49 J	40.24 U	
Comp LC	3	554.51 U	480.57 J	461.32 J	642.91 U	565.34 U	20658.65	613.56 U	533.89 U	32766.54	19474.14 U	
Comp LC-1	8	141.07 U	318.51	1245.70	163.56 U	143.82 U	13762.32	156.09 U	135.82 U	11993.68	4954.22 U	
Comp LC-2	8	2397.28 U	1696.20 J	1982.00 J	9756.33	2444.11 U	75700.61	2652.57 U	2308.16 U	140212.86	84191.84 U	
Comp LC-3	8	236.30 U	209.81 J	211.42 J	273.97 U	240.92 U	7814.17	261.47 U	227.52 U	13996.72	8298.84 U	
Comp LC-4	6	111.68 U	34.46 J	40.30 J	129.49 U	113.86 U	611.27	123.57 U	107.53 U	460.72	3922.24 U	
Comp LC-5	3	1072.30 U	1568.82	974.08 J	1243.24 U	1093.24 U	45625.72	1186.49 U	1032.43 U	41560.53	37658.78 U	
Comp LC-6	4	1076.66 U	1515.15	1207.27	1248.30 U	1097.69 U	71441.35	1191.32 U	1036.64 U	15974.54	37812.08 U	
Comp USFC	23	0.63 J	13.71	86.25	1.37 U	1.20 U	288.38	1.31 U	1.14 U	106.58	41.47 U	
Comp FSFC	24	0.33 J	9.50	30.50	1.23 U	1.08 U	188.63	1.17 U	1.02 U	191.41	37.13 U	
Comp IHC-1	23	0.05 J	0.66 J	1.24	1.37 U	1.21 U	8.73	1.31 U	1.14 U	7.29	41.56 U	
Comp IHC-2	23	0.16 J	1.21 J	2.52	1.46 U	1.28 U	15.85	1.39 U	1.21 U	1.69	44.09 U	
Comp IHC-3	23	0.07 J	1.00 J	1.70	1.22 U	1.07 U	12.16	1.17 U	1.01 U	6.81	37.01 U	
Comp GD	23	1.27 U	0.30 J	1.28 U	1.47 U	1.29 U	0.97 J	1.40 U	1.22 U	1.38 U	44.48 U	
C-SFBF	21	0.98 U	0.98 U	0.99 U	1.14 U	1.00 U	2.48	1.08 U	0.94 U	0.62 J	34.40 U	
C-SFBC	21	0.65 U	0.01 J	0.01 J	0.75 U	0.66 U	0.82 U	0.72 U	0.62 U	0.71 U	22.76 U	

(a) DL Detection limit; detection limits are elevated in some batches because of sample dilutions.

(b) U Analyte was not present above the associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE C.8. Quality Control Data for Chlorinated Pesticides (elution order, Alpha-BHC to Endosulfan I) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan I
Method Blanks										
MC44PB	3	92.25 U ^(a)	136.39 U	123.93 U	123.93 U	141.11 U	141.11 U	137.74 U	149.12 U	149.12 U
MC48PB	4	373.72 U	552.56 U	502.05 U	502.05 U	571.67 U	571.67 U	558.02 U	604.10 U	604.10 U
MC73PB	6	6.53 U	9.65 U	8.77 U	8.77 U	9.99 U	9.99 U	9.75 U	10.55 U	10.55 U
MC77PB	7	75.21 U	111.20 U	101.03 U	101.03 U	115.04 U	115.04 U	112.29 U	121.57 U	121.57 U
MC81PB	8	6.99 U	10.33 U	9.39 U	9.39 U	10.69 U	10.69 U	10.43 U	11.30 U	11.30 U
MC95PB	9	34.85 U	51.53 U	46.82 U	46.82 U	53.31 U	53.31 U	52.04 U	56.33 U	56.33 U
MD81PB	15	0.74 U	1.10 U	1.00 U	1.00 U	1.13 U	1.13 U	1.11 U	1.20 U	1.20 U
MD85PB	16	0.77 U	1.13 U	1.03 U	1.03 U	1.17 U	1.17 U	1.14 U	1.24 U	1.24 U
MD89PB	17	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.72 U	0.77 U	0.77 U
MD95PB	18	0.79 U	1.17 U	1.07 U	1.07 U	1.21 U	1.21 U	1.19 U	1.28 U	1.28 U
MD10PB	11	0.67 U	0.99 U	0.90 U	0.90 U	1.02 U	1.02 U	1.00 U	1.08 U	1.08 U
MD14PB	12	0.70 U	1.04 U	0.95 U	0.95 U	1.08 U	1.08 U	1.05 U	1.14 U	1.14 U
MD49PB	13	0.68 U	1.00 U	0.91 U	0.91 U	1.04 U	1.04 U	1.01 U	1.10 U	1.10 U
MD53PB	14	0.60 U	0.89 U	0.81 U	0.81 U	0.92 U	0.92 U	0.90 U	0.97 U	0.97 U
MD99PB	19	0.80 U	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	1.30 U	1.30 U
ME04PB	20	0.73 U	1.08 U	0.98 U	0.98 U	1.12 U	1.12 U	1.09 U	1.18 U	1.18 U
ME63PB	21	0.46 U	0.68 U	0.62 U	0.62 U	0.70 U	0.70 U	0.68 U	0.74 U	0.74 U
ME67PB	22	0.54 U	0.80 U	0.72 U	0.72 U	0.82 U	0.82 U	0.81 U	0.87 U	0.87 U
ME71PB	23	0.79 U	1.17 U	1.06 U	1.06 U	1.21 U	1.21 U	1.18 U	1.28 U	1.28 U
ME75PB	24	0.69 U	1.01 U	0.92 U	0.92 U	1.05 U	1.05 U	1.02 U	1.11 U	1.11 U
MH35PB	25	0.75 U	1.10 U	1.00 U	1.00 U	1.14 U	1.14 U	1.11 U	1.21 U	1.21 U
Matrix Spikes										
SF-20 Y	11	0.05 J ^(b)	0.72 U	0.66 U	0.66 U	0.75 U	0.75 U	0.73 U	0.07 J	0.79 U
SF-20 Y MS	11	12.11	9.69	11.47	12.70	10.00	11.11	9.92	9.17	10.20
Concentration Recovered	11	12.06	9.69	11.47	12.70	10.00	11.11	9.92	9.10	10.20
Amount Spiked	11	12.99	12.23	12.23	12.23	12.23	12.23	12.23	12.99	12.23
Percent Recovery	11	93%	79%	94%	104%	82%	91%	81%	70%	83%
SF-20 Y	11	0.05 J	0.72 U	0.66 U	0.66 U	0.75 U	0.75 U	0.73 U	0.07 J	0.79 U
SF-20 Y MSD	11	11.96	10.20	12.12	13.41	10.46	11.00	9.97	9.16	10.15
Concentration Recovered	11	11.91	10.20	12.12	13.41	10.46	11.00	9.97	9.09	10.15
Amount Spiked	11	12.88	12.13	12.13	12.13	12.13	12.13	12.13	12.88	12.13
Percent Recovery	11	92%	84%	100%	111%	86%	91%	82%	71%	84%
RPD	11	0%	6%	6%	6%	5%	0%	1%	1%	0%
I-Stat	11	0.00	0.03	0.03	0.03	0.03	0.00	0.01	0.00	0.00

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endosulfan
SF-22 Y	12	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
SF-22 Y MS	12	13.41	11.39	13.31	15.10	12.16	12.18	10.67	9.31	11.02
Concentration Recovered	12	13.41	11.39	13.31	15.10	12.16	12.18	10.67	9.31	11.02
Amount Spiked	12	13.43	12.64	12.64	12.64	12.64	12.64	12.64	13.43	12.64
Percent Recovery	12	100%	90%	105%	119%	96%	96%	84%	69%	87%
SF-22 Y	12	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
SF-22 Y MSD	12	11.19	9.53	11.04	12.35	9.75	10.07	8.89	7.68	9.08
Concentration Recovered	12	11.19	9.53	11.04	12.35	9.75	10.07	8.89	7.68	9.08
Amount Spiked	12	13.35	12.56	12.56	12.56	12.56	12.56	12.56	13.35	12.56
Percent Recovery	12	84%	76%	88%	98%	78%	80%	71%	58%	72%
RPD	12	17%	17%	18%	19%	21%	18%	18%	19%	19%
I-Stat	12	0.09	0.09	0.09	0.10	0.11	0.09	0.09	0.09	0.09
SF-25 Y	13	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
SF-25 Y MS	13	14.41	15.29	14.25	14.71	13.74	12.44	12.68	10.94	13.35
Concentration Recovered	13	14.41	15.29	14.25	14.71	13.74	12.44	12.68	10.94	13.35
Amount Spiked	13	21.74	20.46	20.46	20.46	20.46	20.46	20.46	21.74	20.46
Percent Recovery	13	66%	75%	70%	72%	67%	61%	62%	50%	65%
SF-25 Y	13	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
SF-25 Y MSD	13	13.34	14.28	13.20	13.67	12.85	11.86	12.12	9.83	12.41
Concentration Recovered	13	13.34	14.28	13.20	13.67	12.85	11.86	12.12	9.83	12.41
Amount Spiked	13	20.76	19.54	19.54	19.54	19.54	19.54	19.54	20.76	19.54
Percent Recovery	13	64%	73%	68%	70%	66%	61%	62%	47%	64%
RPD	13	3%	2%	3%	3%	2%	0%	0%	6%	3%
I-Stat	13	0.02	0.01	0.02	0.01	0.01	0.00	0.00	0.03	0.01
SF-31 Y	14	0.04 J	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.09 J	0.79 U
SF-31 Y MS	14	18.35	18.73	18.25	18.92	16.41	16.22	16.54	13.29	16.74
Concentration Recovered	14	18.31	18.73	18.25	18.92	16.41	16.22	16.54	13.20	16.74
Amount Spiked	14	22.54	21.21	21.21	21.21	21.21	21.21	21.21	22.54	21.21
Percent Recovery	14	81%	88%	86%	89%	77%	76%	78%	59%	79%
SF-31 Y	14	0.04 J	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.09 J	0.79 U
SF-31 Y MSD	14	17.34	16.65	16.53	16.50	14.71	14.40	14.35	11.23	14.37
Concentration Recovered	14	17.30	16.65	16.53	16.50	14.71	14.40	14.35	11.14	14.37
Amount Spiked	14	21.24	19.99	19.99	19.99	19.99	19.99	19.99	21.24	19.99
Percent Recovery	14	81%	83%	83%	83%	74%	72%	72%	52%	72%
RPD	14	0%	6%	4%	8%	5%	6%	8%	11%	9%
I-Stat	14	0.00	0.03	0.02	0.04	0.03	0.03	0.04	0.06	0.05

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha- BHC	Beta- BHC	Lindane	Delta- BHC	Hepta- chlor	Aldrin	Heptachlor Epoxide	trans- Chlordane	Endo- sulfan
IH-35 Y	15	0.49 U	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.79 U	0.79 U
IH-35 Y MS	15	9.49	9.95	8.53	8.42	8.71	7.96	8.26	6.73	8.17
Concentration Recovered	15	9.49	9.95	8.53	8.42	8.71	7.96	8.26	6.73	8.17
Amount Spiked	15	13.47	12.68	12.68	12.68	12.68	12.68	12.68	13.47	12.68
Percent Recovery	15	70%	78%	67%	66%	69%	63%	65%	50%	64%
IH-35 Y	15	0.49 U	0.72 U	0.65 U	0.65 U	0.74 U	0.74 U	0.73 U	0.79 U	0.79 U
IH-35 Y MSD	15	8.68	9.22	7.82	7.79	8.28	7.32	7.62	6.19	7.32
Concentration Recovered	15	8.68	9.22	7.82	7.79	8.28	7.32	7.62	6.19	7.32
Amount Spiked	15	13.65	12.85	12.85	12.85	12.85	12.85	12.85	13.65	12.85
Percent Recovery	15	64%	72%	61%	61%	64%	57%	59%	45%	57%
RPD	15	10%	9%	10%	9%	6%	10%	9%	10%	12%
I-Stat	15	0.05	0.04	0.05	0.05	0.03	0.05	0.05	0.05	0.06
IH-38 Y	16	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.72 U	0.77 U	0.77 U
IH-38 Y MS	16	10.52	10.89	9.35	9.81	9.77	8.43	8.98	7.33	8.88
Concentration Recovered	16	10.52	10.89	9.35	9.81	9.77	8.43	8.98	7.33	8.88
Amount Spiked	16	13.13	12.36	12.36	12.36	12.36	12.36	12.36	13.13	12.36
Percent Recovery	16	80%	88%	76%	79%	79%	68%	73%	56%	72%
IH-38 Y	16	0.48 U	0.71 U	0.64 U	0.64 U	0.73 U	0.73 U	0.72 U	0.77 U	0.77 U
IH-38 Y MSD	16	11.15	11.24	9.89	10.23	9.98	8.87	9.26	7.43	9.01
Concentration Recovered	16	11.15	11.24	9.89	10.23	9.98	8.87	9.26	7.43	9.01
Amount Spiked	16	13.55	12.75	12.75	12.75	12.75	12.75	12.75	13.55	12.75
Percent Recovery	16	82%	88%	78%	80%	78%	70%	73%	55%	71%
RPD	16	3%	0%	3%	1%	1%	2%	0%	2%	2%
I-Stat	16	0.01	0.00	0.01	0.01	0.00	0.01	0.00	0.01	0.01
IH-49 Y	17	0.50 U	0.74 U	0.67 U	0.67 U	0.76 U	0.76 U	0.74 U	0.80 U	0.80 U
IH-49 Y MS	17	14.59	11.67	13.35	14.64	12.57	13.90	10.84	10.24	12.48
Concentration Recovered	17	14.59	11.67	13.35	14.64	12.57	13.90	10.84	10.24	12.48
Amount Spiked	17	14.06	13.23	13.23	13.23	13.23	13.23	13.23	14.06	13.23
Percent Recovery	17	104%	88%	101%	111%	95%	105%	82%	73%	94%
IH-49 Y	17	0.50 U	0.74 U	0.67 U	0.67 U	0.76 U	0.76 U	0.74 U	0.80 U	0.80 U
IH-49 Y MSD	17	12.80	11.22	12.46	13.95	11.83	12.93	10.72	9.78	11.89
Concentration Recovered	17	12.80	11.22	12.46	13.95	11.83	12.93	10.72	9.78	11.89
Amount Spiked	17	14.08	13.25	13.25	13.25	13.25	13.25	13.25	14.08	13.25
Percent Recovery	17	91%	85%	94%	105%	89%	98%	81%	69%	90%
RPD	17	13%	4%	7%	5%	6%	7%	1%	5%	5%
I-Stat	17	0.07	0.02	0.04	0.02	0.03	0.04	0.01	0.02	0.02

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
IH-43 Y	18	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
IH-43 Y MS	18	12.54	11.57	12.36	13.96	12.59	12.33	10.69	10.25	11.19
Concentration Recovered	18	12.54	11.57	12.36	13.96	12.59	12.33	10.69	10.25	11.19
Amount Spiked	18	13.12	12.35	12.35	12.35	12.35	12.35	12.35	13.12	12.35
Percent Recovery	18	96%	94%	100%	113%	102%	100%	87%	78%	91%
IH-43 Y	18	0.48 U	0.70 U	0.64 U	0.64 U	0.73 U	0.73 U	0.71 U	0.77 U	0.77 U
IH-43 Y MSD	18	12.53	10.90	12.08	13.11	11.93	11.74	9.97	9.44	10.66
Concentration Recovered	18	12.53	10.90	12.08	13.11	11.93	11.74	9.97	9.44	10.66
Amount Spiked	18	13.32	12.54	12.54	12.54	12.54	12.54	12.54	13.32	12.54
Percent Recovery	18	94%	87%	96%	105%	95%	94%	80%	71%	85%
RPD	18	2%	7%	4%	8%	7%	6%	8%	10%	6%
I-Stat	18	0.01	0.04	0.02	0.04	0.03	0.03	0.04	0.05	0.03
IH-46 Y	19	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-46 Y MS	19	9.23	9.89	8.98	9.02	9.47	8.48	8.98	8.02	8.12
Concentration Recovered	19	9.23	9.89	8.98	9.02	9.47	8.48	8.98	8.02	8.12
Amount Spiked	19	13.32	12.54	12.54	12.54	12.54	12.54	12.54	13.32	12.54
Percent Recovery	19	69%	79%	72%	72%	76%	68%	72%	60%	65%
IH-46 Y	19	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-46 Y MSD	19	9.17	9.45	8.75	8.90	9.22	8.41	8.77	8.00	11.68
Concentration Recovered	19	9.17	9.45	8.75	8.90	9.22	8.41	8.77	8.00	11.68
Amount Spiked	19	13.51	12.72	12.72	12.72	12.72	12.72	12.72	13.51	12.72
Percent Recovery	19	68%	74%	69%	70%	72%	66%	69%	59%	92%
RPD	19	2%	6%	4%	3%	4%	2%	4%	2%	35% ^(c)
I-Stat	19	0.01	0.03	0.02	0.01	0.02	0.01	0.02	0.01	0.17
IH-45 Y	20	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-45 Y MS	20	8.49	8.57	7.17	6.74	7.97	6.00	6.61	6.26	8.41
Concentration Recovered	20	8.49	8.57	7.17	6.74	7.97	6.00	6.61	6.26	8.41
Amount Spiked	20	12.80	12.05	12.05	12.05	12.05	12.05	12.05	12.80	12.05
Percent Recovery	20	66%	71%	60%	56%	66%	50%	55%	49%	70%
IH-45 Y	20	0.48 U	0.71 U	0.65 U	0.65 U	0.74 U	0.74 U	0.72 U	0.78 U	0.78 U
IH-45 Y MSD	20	9.52	9.43	7.99	7.71	8.72	6.77	7.56	6.84	7.64
Concentration Recovered	20	9.52	9.43	7.99	7.71	8.72	6.77	7.56	6.84	7.64
Amount Spiked	20	12.85	12.10	12.10	12.10	12.10	12.10	12.10	12.85	12.10
Percent Recovery	20	74%	78%	66%	64%	72%	56%	62%	53%	63%
RPD	20	11%	9%	10%	13%	9%	12%	13%	8%	10%
I-Stat	20	0.06	0.05	0.05	0.07	0.04	0.06	0.06	0.04	0.05

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
IH-50 Y	21	0.41 U	0.61 U	0.56 U	0.56 U	0.63 U	0.63 U	0.62 U	0.67 U	0.67 U
IH-50 Y MS	21	6.79	7.29	6.01	5.71	7.20	5.00	5.72	5.19	5.71
Concentration Recovered	21	6.79	7.29	6.01	5.71	7.20	5.00	5.72	5.19	5.71
Amount Spiked	21	11.89	11.19	11.19	11.19	11.19	11.19	11.19	11.89	11.19
Percent Recovery	21	57%	65%	54%	51%	64%	45%	51%	44%	51%
IH-50 Y	21	0.41 U	0.61 U	0.56 U	0.56 U	0.63 U	0.63 U	0.62 U	0.67 U	0.67 U
IH-50 Y MSD	21	8.21	7.93	7.02	6.46	7.75	5.91	6.28	5.69	6.34
Concentration Recovered	21	8.21	7.93	7.02	6.46	7.75	5.91	6.28	5.69	6.34
Amount Spiked	21	11.81	11.12	11.12	11.12	11.12	11.12	11.12	11.81	11.12
Percent Recovery	21	70%	71%	63%	58%	70%	53%	56%	48%	57%
RPD	21	20%	9%	16%	13%	8%	17%	10%	10%	11%
I-Stat	21	0.10	0.05	0.08	0.06	0.04	0.09	0.05	0.05	0.06
LZ-14 Y	22	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-14 Y MS	22	8.68	8.52	7.59	6.91	8.70	6.03	6.83	5.92	6.67
Concentration Recovered	22	8.68	8.52	7.59	6.91	8.70	6.03	6.83	5.92	6.67
Amount Spiked	22	12.09	11.37	11.37	11.37	11.37	11.37	11.37	12.09	11.37
Percent Recovery	22	72%	75%	67%	61%	77%	53%	60%	49%	59%
LZ-14 Y	22	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-14 Y MSD	22	7.37	7.37	6.50	5.93	7.35	5.17	5.82	5.00	5.74
Concentration Recovered	22	7.37	7.37	6.50	5.93	7.35	5.17	5.82	5.00	5.74
Amount Spiked	22	12.00	11.29	11.29	11.29	11.29	11.29	11.29	12.00	11.29
Percent Recovery	22	61%	65%	58%	53%	65%	46%	52%	42%	51%
RPD	22	16%	14%	15%	15%	16%	15%	15%	16%	14%
I-Stat	22	0.08	0.07	0.07	0.07	0.08	0.07	0.08	0.08	0.07
LZ-14 Y	23	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-14 Y MS	23	8.38	9.72	8.37	8.43	9.00	7.41	8.50	7.12	10.92
Concentration Recovered	23	8.38	9.72	8.37	8.43	9.00	7.41	8.50	7.12	10.92
Amount Spiked	23	11.94	11.24	11.24	11.24	11.24	11.24	11.24	11.94	11.24
Percent Recovery	23	70%	86%	74%	75%	80%	66%	76%	60%	97%
LZ-14 Y	23	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-14 Y MSD	23	5.37	6.98	5.58	5.72	6.44	5.01	6.29	4.90	7.72
Concentration Recovered	23	5.37	6.98	5.58	5.72	6.44	5.01	6.29	4.90	7.72
Amount Spiked	23	12.10	11.39	11.39	11.39	11.39	11.39	11.39	12.10	11.39
Percent Recovery	23	44%	61%	49%	50%	57%	44%	55%	40%	68%
RPD	23	45% ^(c)	34% ^(c)	41% ^(c)	40% ^(c)	34% ^(c)	40% ^(c)	31% ^(c)	38% ^(c)	36% ^(c)
I-Stat	23	0.23	0.17	0.21	0.20	0.17	0.20	0.16	0.19	0.18

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endosulfan
LZ-14 Y	24	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-14 Y MS	24	8.84	9.45	8.58	8.37	8.44	7.04	8.41	6.88	11.77
Concentration Recovered	24	8.84	9.45	8.58	8.37	8.44	7.04	8.41	6.88	11.77
Amount Spiked	24	11.85	11.15	11.15	11.15	11.15	11.15	11.15	11.85	11.15
Percent Recovery	24	75%	85%	77%	75%	76%	63%	75%	58%	106%
LZ-14 Y	24	0.43 U	0.64 U	0.58 U	0.58 U	0.66 U	0.66 U	0.65 U	0.70 U	0.70 U
LZ-14 Y MSD	24	9.63	9.95	9.34	9.06	8.91	7.76	8.83	7.20	11.60
Concentration Recovered	24	9.63	9.95	9.34	9.06	8.91	7.76	8.83	7.20	11.60
Amount Spiked	24	11.89	11.19	11.19	11.19	11.19	11.19	11.19	11.89	11.19
Percent Recovery	24	81%	89%	83%	81%	80%	69%	79%	61%	104%
RPD	24	8%	5%	8%	8%	5%	9%	5%	4%	2%
I-Stat	24	0.04	0.02	0.04	0.04	0.03	0.05	0.02	0.02	0.01
IH-50 A	25	0.90 U	1.34 U	1.21 U	1.21 U	1.38 U	1.38 U	1.35 U	1.46 U	1.46 U
IH-50 A MS	25	11.77	12.37	11.01	10.25	12.33	11.10	10.15	9.36	11.51
Concentration Recovered	25	11.77	12.37	11.01	10.25	12.33	11.10	10.15	9.36	11.51
Amount Spiked	25	25.33	23.84	23.84	23.84	23.84	23.84	23.84	25.83	23.84
Percent Recovery	25	46%	52%	46%	43%	52%	47%	43%	36% ^(d)	48%
IH-50 A	25	0.90 U	1.34 U	1.21 U	1.21 U	1.38 U	1.38 U	1.35 U	1.46 U	1.46 U
IH-50 A MSD	25	11.79	13.45	11.87	11.36	13.08	12.05	11.40	10.38	13.30
Concentration Recovered	25	11.79	13.45	11.87	11.36	13.08	12.05	11.40	10.38	13.30
Amount Spiked	25	25.46	23.96	23.96	23.96	23.96	23.96	23.96	25.96	23.96
Percent Recovery	25	46%	56%	50%	47%	55%	50%	48%	40%	56%
RPD	25	0%	8%	7%	10%	5%	8%	11%	10%	14%
I-Stat	25	0.00	0.04	0.04	0.05	0.03	0.04	0.06	0.05	0.07
<u>Analytical Duplicates</u>										
LZ-1 D	3	1731.23 U	2559.68 U	2325.69 U	2325.69 U	2648.22 U	2648.22 U	2584.98 U	2798.42 U	2798.42 U
LZ-1 D Duplicate	3	1767.55 U ^(e)	2613.40 U	2374.50 U	2374.50 U	2703.79 U	2703.79 U	2639.23 U	2857.14 U	2857.14 U
RPD	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
LZ-2 B	4	1483.74 U	2193.77 U	1993.22 U	1993.22 U	2269.65 U	2269.65 U	2215.45 U	2398.37 U	2398.37 U
LZ-2 B Duplicate	4	367.94 U	544.02 U	494.29 U	494.29 U	562.84 U	562.84 U	549.40 U	594.76 U	594.76 U
RPD	4	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	4	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
LZ-5 A	6	326.87 U	483.28 U	439.10 U	439.10 U	500.00 U	500.00 U	488.06 U	528.36 U	528.36 U
LZ-5 A Duplicate	6	323.20 U	477.86 U	434.18 U	434.18 U	494.39 U	494.39 U	482.59 U	522.43 U	522.43 U
RPD	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	6	NA	NA	NA	NA	NA	NA	NA	NA	NA
LZ-11 A	7	155.89 U	230.50 U	209.42 U	209.42 U	238.47 U	238.47 U	232.77 U	251.99 U	251.99 U
LZ-11 A Duplicate	7	157.33 U	232.61 U	211.35 U	211.35 U	240.66 U	240.66 U	234.91 U	254.31 U	254.31 U
RPD	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
Comp LC-3	8	163.04 U	241.07 U	219.03 U	219.03 U	249.40 U	249.40 U	243.45 U	263.55 U	263.55 U
Comp LC-3 Duplicate	8	386.08 U	49.37 U	1862.03 U	1862.03 U	2120.25 U	2120.25 U	2069.62 U	2240.51 U	2240.51 U
RPD	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	8	NA	NA	NA	NA	NA	NA	NA	NA	NA
LZ-13 X	9	154.75 U	228.80 U	207.89 U	207.89 U	236.72 U	236.72 U	231.06 U	250.14 U	250.14 U
LZ-13 X Duplicate	9	148.37 U	219.38 U	199.32 U	199.32 U	226.96 U	226.96 U	221.54 U	239.84 U	239.84 U
RPD	9	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	9	NA	NA	NA	NA	NA	NA	NA	NA	NA
IH-37 X	15	0.36 J	1.04 U	0.94 U	0.94 U	1.08 U	1.08 U	1.05 U	0.39 J	0.29 J
IH-37 X Duplicate	15	0.30 J	1.05 U	0.95 U	0.95 U	1.08 U	1.08 U	1.06 U	0.22 J	0.20 J
RPD	15	18%	NA	NA	NA	NA	NA	NA	56%	37%
I-Stat	15	0.09	NA	NA	NA	NA	NA	NA	0.28	0.18
IH-41 X	16	0.35 J	1.08 U	0.98 U	0.98 U	1.12 U	1.12 U	1.09 U	0.80 J	0.25 J
IH-41 X Duplicate	16	0.46 J	1.06 U	0.96 U	0.96 U	1.10 U	1.10 U	1.07 U	0.89 J	0.32 J
RPD	16	27%	NA	NA	NA	NA	NA	NA	11%	25%
I-Stat	16	0.14	NA	NA	NA	NA	NA	NA	0.05	0.12
IH-49 Y	17	0.50 U	0.74 U	0.67 U	0.67 U	0.76 U	0.76 U	0.74 U	0.80 U	0.80 U
IH-49 Y Duplicate	17	0.49 U	0.73 U	0.66 U	0.66 U	0.75 U	0.75 U	0.73 U	0.79 U	0.79 U
RPD	17	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	17	NA	NA	NA	NA	NA	NA	NA	NA	NA
IH-41 A	18	0.29 J	1.22 U	0.13 J	1.11 U	1.26 U	1.26 U	1.23 U	0.40 J	1.33 U
IH-41 A Duplicate	18	0.33 J	1.21 U	0.17 J	1.10 U	1.25 U	1.25 U	1.22 U	0.54 J	1.32 U
RPD	18	13%	NA	27%	NA	NA	NA	NA	30%	NA
I-Stat	18	0.06	NA	0.13	NA	NA	NA	NA	0.15	NA

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endosulfan
SF-17 B Cdup ^(f)	11	0.55 J	1.18 U	1.08 U	1.08 U	1.22 U	1.22 U	1.20 U	2.40	1.29 U
SF-17 B Cdup Duplicate	11	0.37 J	1.12 U	1.02 U	1.02 U	1.16 U	1.16 U	1.13 U	1.38	1.22 U
RPD	11	39%	NA	NA	NA	NA	NA	NA	54%	NA
I-Stat	11	0.20	NA	NA	NA	NA	NA	NA	0.27	NA
SF-22 A	12	0.52 J	1.26 U	1.14 U	1.14 U	1.30 U	1.30 U	1.27 U	2.25	1.37 U
SF-22 A Duplicate	12	0.55 J	1.26 U	1.14 U	1.14 U	1.30 U	1.30 U	1.27 U	2.40	1.37 U
RPD	12	6%	NA	NA	NA	NA	NA	NA	6%	NA
I-Stat	12	0.03	NA	NA	NA	NA	NA	NA	0.03	NA
SF-26 A	13	0.90 U	1.34 U	1.21 U	1.21 U	1.38 U	1.38 U	1.35 U	1.46 U	1.46 U
SF-26 A Duplicate	13	0.63 J	1.34 U	1.22 U	1.22 U	1.39 U	1.39 U	1.35 U	2.01	1.04 J
RPD	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	13	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF-31 X	14	0.82	0.85 U	0.19 J	0.36 J	0.88 U	0.88 U	0.86 U	0.54 J	0.93 U
SF-31 X Duplicate	14	0.75	0.84 U	0.23 J	0.40 J	0.87 U	0.87 U	0.85 U	0.54 J	0.92 U
RPD	14	9%	NA	19%	11%	NA	NA	NA	0%	NA
I-Stat	14	0.04	NA	0.10	0.05	NA	NA	NA	0.00	NA
IH-46 A	19	0.79 U	1.17 U	1.06 U	1.06 U	1.21 U	1.21 U	1.18 U	0.20 J	1.28 U
IH-46 A Duplicate	19	0.81 U	1.19 U	1.08 U	1.08 U	1.24 U	1.24 U	1.21 U	0.17 J	1.31 U
RPD	19	NA	NA	NA	NA	NA	NA	NA	16%	NA
I-Stat	19	NA	NA	NA	NA	NA	NA	NA	0.08	NA
PC-54 A	20	0.81 U	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	17.85	2.19
PC-54 A Duplicate	20	0.82 U	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	19.22	3.85
RPD	20	NA	NA	NA	NA	NA	NA	NA	7%	55%
I-Stat	20	NA	NA	NA	NA	NA	NA	NA	0.04	0.27
LZ-5 Y	21	0.24 J	0.11 J	0.04 J	0.19 J	0.70 U	0.28 J	0.69 U	0.63 J	0.74 U
LZ-5 Y Duplicate	21	1.01	0.46 J	0.18 J	0.78	0.70 U	0.52 J	0.68 U	1.04	0.74 U
RPD	21	123%	123%	127%	122%	NA	60%	NA	49%	NA
I-Stat	21	0.62	0.61	0.64	0.61	NA	0.30	NA	0.25	NA
IH-50 A	25	0.90 U	1.34 U	1.21 U	1.21 U	1.38 U	1.38 U	1.35 U	1.46 U	1.46 U
IH-50 A Duplicate	22	0.91 U	1.35 U	1.23 U	1.23 U	1.40 U	1.40 U	1.36 U	0.05 J	0.03 J
RPD	22	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	22	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
Comp USFC	23	0.81 U	1.20 U	1.09 U	1.09 U	1.25 U	1.25 U	1.22 U	1.32 U	1.32 U
Comp USFC Duplicate	23	0.80 U	1.19 U	1.08 U	1.08 U	1.23 U	1.23 U	1.20 U	1.30 U	1.30 U
RPD	23	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	23	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF-33 X	25	0.43 J	0.83 U	0.07 J	0.76 U	0.86 U	0.86 U	0.84 U	1.33	0.91 U
SF-33 X Duplicate	24	1.15	0.82 U	0.33 J	0.58 J	0.85 U	0.85 U	0.83 U	0.89 U	0.89 U
RPD	24	91%	NA	130%	NA	NA	NA	NA	NA	NA
I-Stat	24	0.46	NA	0.65	NA	NA	NA	NA	NA	NA
IH-40 B	25	0.79 U	1.16 U	1.06 U	1.06 U	1.20 U	1.20 U	1.18 U	0.22 J	1.27 U
IH-40 B Duplicate	25	0.09 J	1.13 U	1.02 U	1.02 U	1.17 U	1.17 U	1.14 U	0.19 J	1.23 U
RPD	25	NA	NA	NA	NA	NA	NA	NA	15%	NA
I-Stat	25	NA	NA	NA	NA	NA	NA	NA	0.07	NA
<u>Compositing Duplicates</u>										
LZ-8 B	7	2058.27 U	3043.23 U	2765.04 U	2765.04 U	3148.50 U	3148.50 U	3073.31 U	3327.07 U	3327.07 U
LZ-8 B Cdup	7	1045.85 U	1546.32 U	1404.97 U	1404.97 U	1599.81 U	1599.81 U	1561.60 U	1690.54 U	1690.54 U
RPD	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	7	NA	NA	NA	NA	NA	NA	NA	NA	NA
LZ-16 B	9	73.74 U	109.02 U	99.06 U	99.06 U	112.79 U	112.79 U	110.10 U	119.19 U	119.19 U
LZ-16 B Cdup	9	33.75 U	49.91 U	45.35 U	45.35 U	51.63 U	51.63 U	50.40 U	54.56 U	54.56 U
RPD	9	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	9	NA	NA	NA	NA	NA	NA	NA	NA	NA
SF-17 B	11	0.58 J	1.16 U	1.06 U	1.06 U	1.20 U	1.20 U	1.17 U	1.54	1.27 U
SF-17 B Cdup	11	0.55 J	1.18 U	1.08 U	1.08 U	1.22 U	1.22 U	1.20 U	2.40	1.29 U
RPD	11	5%	NA	NA	NA	NA	NA	NA	44%	NA
I-Stat	11	0.03	NA	NA	NA	NA	NA	NA	0.22	NA
SF-21 C	12	0.50 J	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	0.84 J	1.33 U
SF-21 C Cdup	12	0.61 J	1.22 U	1.11 U	1.11 U	1.26 U	1.26 U	1.23 U	1.14 J	1.33 U
RPD	12	20%	NA	NA	NA	NA	NA	NA	30%	NA
I-Stat	12	0.10	NA	NA	NA	NA	NA	NA	0.15	NA
SF-27 B	13	0.51 J	1.23 U	1.12 U	0.25 J	1.27 U	1.27 U	1.24 U	0.53 J	1.35 U
SF-27 B Cdup	13	0.50 J	1.20 U	1.09 U	1.09 U	1.25 U	1.25 U	1.22 U	0.69 J	0.63 J
RPD	13	2%	NA	NA	NA	NA	NA	NA	26%	NA
I-Stat	13	0.01	NA	NA	NA	NA	NA	NA	0.13	NA

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TABLE C.8. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)								
		Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan
IH-36 B	15	0.60 J	1.00 U	0.91 U	0.91 U	1.04 U	1.04 U	1.01 U	0.60 J	0.44 J
IH-36 B Cdup	15	0.62 J	0.98 U	0.89 U	0.89 U	1.01 U	1.01 U	0.99 U	1.02 J	0.53 J
RPD	15	3%	NA	NA	NA	NA	NA	NA	52%	19%
I-Stat	15	0.02	NA	NA	NA	NA	NA	NA	0.26	0.09
IH-37 B	15	0.86 U	1.27 U	1.15 U	1.15 U	1.31 U	1.31 U	1.28 U	0.30 J	0.06 J
IH-37 B Cdup	15	0.84 U	1.25 U	1.13 U	1.13 U	1.29 U	1.29 U	1.26 U	0.37 J	0.05 J
RPD	15	NA	NA	NA	NA	NA	NA	NA	21%	18%
I-Stat	15	NA	NA	NA	NA	NA	NA	NA	0.10	0.09
IH-39 B	16	0.49 J	1.18 U	1.07 U	1.07 U	1.22 U	1.22 U	1.19 U	0.55 J	0.45 J
IH-39 B Cdup	16	0.43 J	1.19 U	0.14 J	1.08 U	1.23 U	1.23 U	1.20 U	1.06 J	0.66 J
RPD	16	13%	NA	NA	NA	NA	NA	NA	63%	38%
I-Stat	16	0.07	NA	NA	NA	NA	NA	NA	0.32	0.19
IH-43 B	18	0.30 J	1.22 U	0.13 J	1.11 U	1.26 U	1.26 U	1.23 U	0.53 J	1.33 U
IH-43 B Cdup	18	0.31 J	1.17 U	0.15 J	1.06 U	1.21 U	1.21 U	1.18 U	0.68 J	1.28 U
RPD	18	3%	NA	14%	NA	NA	NA	NA	25%	NA
I-Stat	18	0.02	NA	0.07	NA	NA	NA	NA	0.12	NA
PC-54 B	20	0.57 J	1.02 U	0.93 U	0.93 U	1.06 U	1.06 U	1.03 U	34.59	1.12 U
PC-54 B Cdup	25	0.70 U	1.03 U	0.93 U	0.93 U	1.06 U	1.06 U	1.04 U	25.84	1.12 U
RPD	25	NA	NA	NA	NA	NA	NA	NA	29%	NA
I-Stat	25	NA	NA	NA	NA	NA	NA	NA	0.14	NA
Parr Canal Edge	24	0.73 U	1.09 U	0.99 U	0.99 U	1.12 U	1.12 U	1.10 U	1.19 U	1.19 U
Parr Canal Edge Cdup	24	0.87 U	1.29 U	1.17 U	1.17 U	1.34 U	1.34 U	1.30 U	2.32	1.41 U
RPD	24	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	24	NA	NA	NA	NA	NA	NA	NA	NA	NA
Comp LC	3	382.60 U	565.69 U	513.98 U	513.98 U	585.26 U	585.26 U	571.28 U	618.45 U	618.45 U
Comp LC Cdup	3	370.93 U	548.44 U	498.31 U	498.31 U	567.41 U	567.41 U	553.86 U	599.59 U	599.59 U
RPD	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	3	NA	NA	NA	NA	NA	NA	NA	NA	NA
Comp IHC-2	23	0.87 U	1.28 U	1.16 U	1.16 U	1.33 U	1.33 U	1.29 U	1.40 U	1.40 U
Comp IHC-2 Cdup	23	0.82 U	1.21 U	1.10 U	1.10 U	1.25 U	1.25 U	1.22 U	1.33 U	1.33 U
RPD	23	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	23	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) Value exceeds relative precision goal of $\leq 30\%$. For duplicates, one sample concentration must be >10 times the MDL.

(d) Recovery outside of quality control range (40%-120%).

(e) NA Not applicable.

(f) Compositing duplicate.

TABLE C.9. Quality Control Data for Chlorinated Pesticides (elution order, cis-Chlordane to Toxaphene) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Pesticides ($\mu\text{g/kg}$ dry weight)										
	Batch	cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
Method Blanks											
MC44PB	3	133.70 U ^(a)	133.70 U	135.47 U	155.01 U	136.31 U	52.30 J ^(b)	147.94 U	128.73 U	145.49 U	4695.45 U
MC48PB	4	541.64 U	541.64 U	548.81 U	627.99 U	552.22 U	683.62 U	599.32 U	521.50 U	589.42 U	19022.18 U
MC73PB	6	9.46 U	9.46 U	9.59 U	10.97 U	9.65 U	11.94 U	10.47 U	9.11 U	10.30 U	332.35 U
MC77PB	7	109.00 U	10.03 J	4.22 J	126.37 U	111.13 U	103.84 J	120.60 U	104.95 U	119.81 B ^(c)	3827.95 U
MC81PB	8	10.13 U	2.17 J	0.54 J	11.74 U	10.33 U	10.52 J	11.21 U	9.75 U	11.88 B	355.68 U
MC95PB	9	50.51 U	50.51 U	51.18 U	58.56 U	51.50 U	4.75 J	55.89 U	48.63 U	54.96 U	1773.87 U
MD81PB	15	1.07 U	1.07 U	1.09 U	1.25 U	1.10 U	0.40 J	1.19 U	1.03 U	1.17 U	37.74 U
MD85PB	16	1.11 U	1.11 U	1.13 U	1.29 U	1.13 U	0.61 J	1.23 U	1.07 U	0.52 J	39.00 U
MD89PB	17	0.69 U	0.69 U	0.70 U	0.81 U	0.71 U	0.10 J	0.77 U	0.67 U	0.76 U	24.39 U
MD95PB	18	1.15 U	1.15 U	1.17 U	1.33 U	1.17 U	0.16 J	1.27 U	1.11 U	1.25 U	40.42 U
MD10PB	11	0.97 U	0.97 U	0.13 J	1.12 U	0.99 U	3.34 B	1.07 U	0.93 U	4.10 B	34.05 U
MD14PB	12	1.02 U	1.02 U	1.03 U	1.18 U	1.04 U	0.47 J	1.13 U	0.98 U	0.50 J	35.82 U
MD49PB	13	0.98 U	0.98 U	1.00 U	1.14 U	1.00 U	1.21 J	1.09 U	0.95 U	1.52 B	34.53 U
MD53PB	14	0.87 U	0.87 U	0.88 U	1.01 U	0.89 U	1.10 U	0.96 U	0.84 U	0.95 U	30.54 U
MD99PB	19	1.16 U	1.16 U	1.18 U	1.35 U	1.19 U	1.47 U	1.29 U	1.12 U	1.27 U	40.86 U
ME04PB	20	1.06 U	1.06 U	1.07 U	1.23 U	1.08 U	1.34 U	1.17 U	1.02 U	1.15 U	37.26 U
ME63PB	21	0.66 U	0.02 J	0.06 J	0.77 U	0.68 U	0.58 J	0.74 U	0.64 U	0.24 J	23.35 U
ME67PB	22	0.78 U	0.78 U	0.79 U	0.91 U	0.80 U	0.21 J	0.86 U	0.75 U	0.85 U	27.44 U
ME71PB	23	1.14 U	1.14 U	1.16 U	1.33 U	1.17 U	0.61 J	1.27 U	1.10 U	0.37 J	40.18 U
ME75PB	24	0.99 U	0.99 U	1.01 U	1.15 U	1.01 U	1.01 J	1.10 U	0.96 U	0.49 J	34.88 U
MH35PB	25	1.08 U	1.08 U	1.10 U	1.25 U	1.10 U	1.36 U	1.20 U	1.04 U	1.18 U	37.97 U
Matrix Spikes											
SF-20 Y	11	0.04 J ^(d)	0.43 J	2.28	0.82 U	0.72 U	10.41	0.78 U	0.68 U	0.77 U	24.85 U
SF-20 Y MS	11	NA	11.16	16.65	11.67	11.28	40.73	10.22	10.76	11.59	NA
Concentration Recovered	11	NA	10.73	14.37	11.67	11.28	30.32	10.22	10.76	11.59	NA
Amount Spiked	11	NS ^(e)	12.23	12.23	12.48	12.23	12.23	12.23	12.23	12.23	NS
Percent Recovery	11	NA	88%	118%	94%	92%	248% ^(f)	84%	88%	95%	NA
SF-20 Y	11	0.04 J	0.43 J	2.28	0.82 U	0.72 U	10.41	0.78 U	0.68 U	0.77 U	24.85 U
SF-20 Y MSD	11	NA	11.48	16.76	11.87	11.61	39.16	10.39	11.17	15.38	NA
Concentration Recovered	11	NA	11.05	14.48	11.87	11.61	28.75	10.39	11.17	15.38	NA
Amount Spiked	11	NS	12.13	12.13	12.38	12.13	12.13	12.13	12.13	12.13	NS
Percent Recovery	11	NA	91%	119%	96%	96%	237% ^(f)	86%	92%	127% ^(f)	NA
RPD	11	NA	4%	2%	3%	4%	5%	2%	5%	30%	NA
I-Stat	11	NA	0.02	0.01	0.01	0.02	0.02	0.01	0.02	0.15	NA

TABLE C.9. (contd)

Sediment Treatment	Pesticides ($\mu\text{g/kg}$ dry weight)										Toxaphene
	Batch	cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
SF-22 Y	12	0.70 U	0.70 U	0.71 U	0.81 U	0.71 U	0.06 J	0.77 U	0.67 U	0.06 J	24.47 U
SF-22 Y MS	12	NA	10.45	12.77	11.71	11.44	15.29	11.98	10.84	13.05	NA
Concentration Recovered	12	NA	10.45	12.77	11.71	11.44	15.23	11.98	10.84	12.99	NA
Amount Spiked	12	NS	12.64	12.64	12.91	12.64	12.64	12.64	12.64	12.64	NS
Percent Recovery	12	NA	83%	101%	91%	91%	120%	95%	86%	103%	NA
SF-22 Y	12	0.70 U	0.70 U	0.71 U	0.81 U	0.71 U	0.06 J	0.77 U	0.67 U	0.06 J	24.47 U
SF-22 Y MSD	12	NA	8.83	10.47	9.97	9.32	11.73	10.56	9.19	11.08	NA
Concentration Recovered	12	NA	8.83	10.47	9.97	9.32	11.67	10.56	9.19	11.02	NA
Amount Spiked	12	NA	12.56	12.56	12.82	12.56	12.56	12.56	12.56	12.56	NS
Percent Recovery	12	NA	70%	83%	78%	74%	93%	84%	73%	88%	NA
RPD	12	NA	16%	19%	15%	20%	26%	12%	16%	16%	NA
I-Stat	12	NA	0.08	0.10	0.08	0.10	0.13	0.06	0.08	0.08	NA
SF-25 Y	13	0.69 U	0.69 U	0.70 U	0.80 U	0.70 U	0.87 U	0.76 U	0.66 U	0.75 U	24.20 U
SF-25 Y MS	13	NA	14.10	15.30	16.50	15.57	14.91	20.53	15.90	16.55	NA
Concentration Recovered	13	NA	14.10	15.30	16.50	15.57	14.91	20.53	15.90	16.55	NA
Amount Spiked	13	NA	20.46	20.46	20.89	20.46	20.46	20.46	20.46	20.46	NS
Percent Recovery	13	NA	69%	75%	79%	76%	73%	100%	78%	81%	NA
SF-25 Y	13	0.69 U	0.69 U	0.70 U	0.80 U	0.70 U	0.87 U	0.76 U	0.66 U	0.75 U	24.20 U
SF-25 Y MSD	13	NA	13.25	14.14	15.01	14.20	17.75	20.78	14.36	19.81	NA
Concentration Recovered	13	NA	13.25	14.14	15.01	14.20	17.75	20.78	14.36	19.81	NA
Amount Spiked	13	NA	19.54	19.54	19.94	19.54	19.54	19.54	19.54	19.54	NS
Percent Recovery	13	NA	68%	72%	75%	73%	91%	106%	73%	101%	NA
RPD	13	NA	2%	3%	5%	5%	22%	6%	6%	22%	NA
I-Stat	13	NA	0.01	0.02	0.02	0.02	0.11	0.03	0.03	0.11	NA
SF-31 Y	14	0.04 J	1.36	1.75	0.82 U	0.72 U	21.15	0.78 U	0.68 U	0.34 J	24.78 U
SF-31 Y MS	14	NA	14.24	17.49	15.28	14.09	16.88	18.83	14.63	15.38	NA
Concentration Recovered	14	NA	12.88	15.74	15.28	14.09	0.00 ^(g)	18.83	14.63	15.04	NA
Amount Spiked	14	NS	21.21	21.21	21.65	21.21	21.21	21.21	21.21	21.21	NS
Percent Recovery	14	NA	61%	74%	71%	66%	NA	89%	69%	71%	NA
SF-31 Y	14	0.04 J	1.36	1.75	0.82 U	0.72 U	21.15	0.78 U	0.68 U	0.34 J	24.78 U
SF-31 Y MSD	14	NA	13.12	15.81	14.24	12.86	16.41	18.79	13.35	15.45	NA
Concentration Recovered	14	NA	11.76	14.06	14.24	12.86	0.00 ^(g)	18.79	13.35	15.11	NA
Amount Spiked	14	NS	19.99	19.99	20.41	19.99	19.99	19.99	19.99	19.99	NS
Percent Recovery	14	NA	59%	70%	70%	64%	NA	94%	67%	76%	NA
RPD	14	NA	3%	5%	1%	3%	NA	6%	3%	6%	NA
I-Stat	14	NA	0.02	0.03	0.01	0.02	NA	0.03	0.02	0.03	NA

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									Toxaphene
		cis- Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo- sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
IH-35 Y	15	0.71 U	0.06 J	0.08 J	0.82 U	0.72 U	0.87 J	0.78 U	0.68 U	0.77 U	24.76 U
IH-35 Y MS	15	NA	8.64	8.76	10.05	9.68	12.88	10.84	9.08	12.77	NA
Concentration Recovered	15	NA	8.58	8.68	10.05	9.68	12.01	10.84	9.08	12.77	NA
Amount Spiked	15	NS	12.68	12.68	12.95	12.68	12.68	12.68	12.68	12.68	NS
Percent Recovery	15	NA	68%	68%	78%	76%	95%	85%	72%	101%	NA
IH-35 Y	15	0.71 U	0.06 J	0.08 J	0.82 U	0.72 U	0.87 J	0.78 U	0.68 U	0.77 U	24.76 U
IH-35 Y MSD	15	NA	7.86	8.02	9.18	8.87	9.95	11.84	8.32	9.86	NA
Concentration Recovered	15	NA	7.80	7.94	9.18	8.87	9.08	11.84	8.32	9.86	NA
Amount Spiked	15	NS	12.85	12.85	13.11	12.85	12.85	12.85	12.85	12.85	NS
Percent Recovery	15	NA	61%	62%	70%	69%	71%	92%	65%	77%	NA
RPD	15	NA	11%	10%	10%	10%	29%	7%	10%	27%	NA
I-Stat	15	NA	0.05	0.05	0.05	0.05	0.15	0.04	0.05	0.14	NA
IH-38 Y	16	0.69 U	0.10 J	0.70 U	0.81 U	0.71 U	0.21 J	0.77 U	0.67 U	0.76 U	24.40 U
IH-38 Y MS	16	NA	7.65	8.37	9.03	8.35	11.25	10.73	8.14	9.83	NA
Concentration Recovered	16	NA	7.55	8.37	9.03	8.35	11.04	10.73	8.14	9.83	NA
Amount Spiked	16	NS	12.36	12.36	12.62	12.36	12.36	12.36	12.36	12.36	NS
Percent Recovery	16	NA	61%	68%	72%	68%	89%	87%	66%	80%	NA
IH-38 Y	16	0.69 U	0.10 J	0.70 U	0.81 U	0.71 U	0.21 J	0.77 U	0.67 U	0.76 U	24.40 U
IH-38 Y MSD	16	NA	8.32	9.01	9.24	8.85	11.77	11.14	8.62	9.98	NA
Concentration Recovered	16	NA	8.22	9.01	9.24	8.85	11.56	11.14	8.62	9.98	NA
Amount Spiked	16	NS	12.75	12.75	13.02	12.75	12.75	12.75	12.75	12.75	NS
Percent Recovery	16	NA	64%	71%	71%	69%	91%	87%	68%	78%	NA
RPD	16	NA	5%	4%	1%	3%	1%	1%	3%	2%	NA
I-Stat	16	NA	0.03	0.02	0.00	0.01	0.01	0.00	0.01	0.01	NA
IH-49 Y	17	0.72 U	0.10 J	0.73 U	0.84 U	0.74 U	0.21 J	0.80 U	0.69 U	0.79 U	25.33 U
IH-49 Y MS	17	NA	12.66	14.54	13.73	12.49	15.35	13.26	12.47	15.36	NA
Concentration Recovered	17	NA	12.56	14.54	13.73	12.49	15.14	13.26	12.47	15.36	NA
Amount Spiked	17	NS	13.23	13.23	13.50	13.23	13.23	13.23	13.23	13.23	NS
Percent Recovery	17	NA	95%	110%	102%	94%	114%	100%	94%	116%	NA
IH-49 Y	17	0.72 U	0.10 J	0.73 U	0.84 U	0.74 U	0.21 J	0.80 U	0.69 U	0.79 U	25.33 U
IH-49 Y MSD	17	NA	11.50	13.46	12.51	12.09	13.57	13.07	11.61	13.79	NA
Concentration Recovered	17	NA	11.40	13.46	12.51	12.09	13.36	13.07	11.61	13.79	NA
Amount Spiked	17	NS	13.25	13.25	13.53	13.25	13.25	13.25	13.25	13.25	NS
Percent Recovery	17	NA	86%	102%	92%	91%	101%	99%	88%	104%	NA
RPD	17	NA	10%	8%	10%	3%	13%	2%	7%	11%	NA
I-Stat	17	NA	0.05	0.04	0.05	0.02	0.06	0.01	0.04	0.05	NA

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
IH-43 Y	18	0.69 U	0.10 J	0.70 U	0.80 U	0.70 U	0.17 J	0.76 U	0.66 U	0.75 U	24.18 U
IH-43 Y MS	18	NA	11.02	13.55	11.12	12.27	15.85	12.06	12.16	13.76	NA
Concentration Recovered	18	NA	10.92	13.55	11.12	12.27	15.68	12.06	12.16	13.76	NA
Amount Spiked	18	NS	12.35	12.35	12.61	12.35	12.35	12.35	12.35	12.35	NS
Percent Recovery	18	NA	88%	110%	88%	99%	127% ^(f)	98%	98%	111%	NA
IH-43 Y	18	0.69 U	0.10 J	0.70 U	0.80 U	0.70 U	0.17 J	0.76 U	0.66 U	0.75 U	24.18 U
IH-43 Y MSD	18	NA	10.76	13.42	11.68	12.10	15.35	12.23	11.98	13.87	NA
Concentration Recovered	18	NA	10.66	13.42	11.68	12.10	15.18	12.23	11.98	13.87	NA
Amount Spiked	18	NS	12.54	12.54	12.80	12.54	12.54	12.54	12.54	12.54	NS
Percent Recovery	18	NA	85%	107%	91%	96%	121% ^(f)	98%	96%	111%	NA
RPD	18	NA	4%	2%	3%	3%	5%	0%	3%	1%	NA
I-Stat	18	NA	0.02	0.01	0.02	0.01	0.02	0.00	0.02	0.00	NA
IH-46 Y	19	0.70 U	0.10 J	0.71 U	0.81 U	0.71 U	0.19 J	0.77 U	0.67 U	0.76 U	24.49 U
IH-46 Y MS	19	NA	10.32	11.33	11.36	12.01	12.60	10.33	6.70	11.40	NA
Concentration Recovered	19	NA	10.22	11.33	11.36	12.01	12.41	10.33	6.70	11.40	NA
Amount Spiked	19	NS	12.54	12.80	12.54	12.54	12.54	12.54	12.54	12.54	NS
Percent Recovery	19	NA	81%	89%	91%	96%	99%	82%	53%	91%	NA
IH-46 Y	19	0.70 U	0.10 J	0.71 U	0.81 U	0.71 U	0.19 J	0.77 U	0.67 U	0.76 U	24.49 U
IH-46 Y MSD	19	NA	10.06	10.96	11.02	12.34	12.63	11.14	11.76	11.38	NA
Concentration Recovered	19	NA	9.96	10.96	11.02	12.34	12.44	11.14	11.76	11.38	NA
Amount Spiked	19	NS	12.72	12.72	12.98	12.72	12.72	12.72	12.72	12.72	NS
Percent Recovery	19	NA	78%	86%	85%	97%	98%	88%	92%	89%	NA
RPD	19	NA	4%	3%	6%	1%	1%	6%	54% ^(h)	2%	NA
I-Stat	19	NA	0.02	0.01	0.03	0.01	0.01	0.03	0.27	0.01	NA
IH-45 Y	20	0.70 U	0.02 J	0.05 J	0.81 U	0.71 U	0.39 J	0.77 U	0.67 U	0.76 U	24.52 U
IH-45 Y MS	20	NA	6.17	6.27	7.10	8.17	7.27	10.28	7.95	7.00	NA
Concentration Recovered	20	NA	6.15	6.22	7.10	8.17	6.88	10.28	7.95	7.00	NA
Amount Spiked	20	NS	12.05	12.05	12.30	12.05	12.05	12.05	12.05	12.05	NS
Percent Recovery	20	NA	51%	52%	58%	68%	57%	85%	66%	58%	NA
IH-45 Y	20	0.70 U	0.02 J	0.05 J	0.81 U	0.71 U	0.39 J	0.77 U	0.67 U	0.76 U	24.52 U
IH-45 Y MSD	20	NA	6.88	7.15	8.10	8.82	8.43	10.96	7.99	7.91	NA
Concentration Recovered	20	NA	6.86	7.10	8.10	8.82	8.04	10.96	7.99	7.91	NA
Amount Spiked	20	NS	12.10	12.10	12.35	12.10	12.10	12.10	12.10	12.10	NS
Percent Recovery	20	NA	57%	59%	66%	73%	66%	91%	66%	65%	NA
RPD	20	NA	11%	13%	13%	7%	15%	6%	0%	12%	NA
I-Stat	20	NA	0.05	0.06	0.06	0.04	0.08	0.03	0.00	0.06	NA

C 61

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									Toxaphene
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
IH-50 Y	21	0.60 U	0.60 U	0.61 U	0.69 U	0.61 U	0.08 J	0.66 U	0.58 U	0.65 U	21.04 U
IH-50 Y MS	21	NA	5.20	5.53	6.86	6.63	8.07	6.67	6.93	7.56	NA
Concentration Recovered	21	NA	5.20	5.53	6.86	6.63	7.99	6.67	6.93	7.56	NA
Amount Spiked	21	NS	11.19	11.19	11.42	11.19	11.19	11.19	11.14	11.19	NS
Percent Recovery	21	NA	46%	49%	60%	59%	71%	60%	62%	68%	NA
IH-50 Y	21	0.60 U	0.60 U	0.61 U	0.69 U	0.61 U	0.08 J	0.66 U	0.58 U	0.65 U	21.04 U
IH-50 Y MSD	21	NA	6.01	6.60	7.93	7.33	9.31	7.22	7.70	8.65	NA
Concentration Recovered	21	NA	6.01	6.60	7.93	7.33	9.23	7.22	7.70	8.65	NA
Amount Spiked	21	NS	11.12	11.12	11.35	11.12	11.12	11.12	11.12	11.12	NS
Percent Recovery	21	NA	54%	59%	70%	66%	83%	65%	69%	78%	NA
RPD	21	NA	15%	18%	15%	11%	15%	9%	11%	14%	NA
I-Stat	21	NA	0.08	0.09	0.08	0.05	0.08	0.04	0.05	0.07	NA
LZ-14 Y	22	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-14 Y MS	22	NA	5.96	6.44	8.16	7.25	10.61	7.05	7.31	10.01	NA
Concentration Recovered	22	NA	5.83	6.38	8.16	7.25	9.43	7.05	7.31	9.75	NA
Amount Spiked	22	NS	11.37	11.37	11.61	11.37	11.37	11.37	11.37	11.37	NS
Percent Recovery	22	NA	51%	56%	70%	64%	83%	62%	64%	86%	NA
LZ-14 Y	22	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-14 Y MSD	22	NA	5.32	5.60	7.00	6.27	9.34	6.28	6.45	7.99	NA
Concentration Recovered	22	NA	5.19	5.54	7.00	6.27	8.16	6.28	6.45	7.73	NA
Amount Spiked	22	NS	11.29	11.29	11.53	11.29	11.29	11.29	11.29	11.29	NS
Percent Recovery	22	NA	46%	49%	61%	56%	72%	56%	57%	68%	NA
RPD	22	NA	11%	13%	15%	14%	14%	11%	12%	22%	NA
I-Stat	22	NA	0.05	0.07	0.07	0.07	0.07	0.05	0.06	0.11	NA
LZ-14 Y	23	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-14 Y MS	23	NA	9.31	9.38	10.34	11.12	11.51	12.18	10.64	10.37	NA
Concentration Recovered	23	NA	9.18	9.32	10.34	11.12	10.33	12.18	10.64	10.11	NA
Amount Spiked	23	NS	11.24	11.24	11.48	11.24	11.24	11.24	11.24	11.24	NS
Percent Recovery	23	NA	82%	83%	90%	99%	92%	108%	95%	90%	NA
LZ-14 Y	23	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-14 Y MSD	23	NA	7.08	6.94	7.85	8.46	8.83	9.12	8.05	8.15	NA
Concentration Recovered	23	NA	6.95	6.88	7.85	8.46	7.65	9.12	8.05	7.89	NA
Amount Spiked	23	NS	11.39	11.39	11.63	11.39	11.39	11.39	11.39	11.39	NS
Percent Recovery	23	NA	61%	60%	67%	74%	67%	80%	71%	69%	NA
RPD	23	NA	29%	31% ^(h)	29%	28%	31% ^(h)	30%	29%	26%	NA
I-Stat	23	NA	0.14	0.16	0.14	0.14	0.16	0.15	0.15	0.13	NA

TABLE C.9. (contd)

Sediment Treatment	Pesticides ($\mu\text{g/kg}$ dry weight)										
	Batch	cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
LZ-5 A	6	473.73 U	467.28 J	378.69 J	549.25 U	482.99 U	14791.94	524.18 U	456.12 U	29641.09	16637.31 U
LZ-5 A Duplicate	6	468.42 U	435.05 J	294.26 J	543.09 U	477.57 U	12601.32	518.30 U	451.00 U	23316.32	16450.71 U
RPD	6	NA	7%	25%	NA	NA	16%	NA	NA	24%	NA
I-Stat	6	NA	0.04	0.13	NA	NA	0.08	NA	NA	0.12	NA
LZ-11 A	7	225.94 U	124.92 J	149.67 J	261.96 U	230.35 U	5368.23	250.00 U	217.54 U	2258.61	7934.94 U
LZ-11 A Duplicate	7	228.02 U	134.04 J	244.32 (h)	264.37 U	232.47 U	7558.91 (h)	252.30 U	219.54 U	3696.36 (h)	8007.90 U
RPD	7	NA	7%	48%	NA	NA	34%	NA	NA	48%	NA
I-Stat	7	NA	0.04	0.24	NA	NA	0.17	NA	NA	0.24	NA
Comp LC-3	8	236.30 U	209.81 J	211.42 J	273.97 U	240.92 U	7814.17	261.47 U	227.52 U	13996.72	8298.84 U
Comp LC-3 Duplicate	8	2008.86 U	806.19 J	1399.42 J	2329.11 U	2048.10 U	36273.99 (h)	2222.78 U	1934.18 U	266336.42 (h)	70550.63 U
RPD	8	NA	117%	148%	NA	NA	129%	NA	NA	180%	NA
I-Stat	8	NA	0.59	0.74	NA	NA	0.65	NA	NA	0.90	NA
LZ-13 X	9	224.28 U	237.35	481.78	260.03 U	228.66 U	4793.95	248.16 U	215.94 U	1915.71	7876.63 U
LZ-13 X Duplicate	9	215.04 U	240.33	375.38	249.32 U	219.24 U	4564.95	237.94 U	207.05 U	6892.07 (h)	7552.17 U
RPD	9	NA	1%	25%	NA	NA	5%	NA	NA	113%	NA
I-Stat	9	NA	0.01	0.12	NA	NA	0.02	NA	NA	0.56	NA
IH-37 X	15	0.14 J	1.88	7.92	1.18 U	1.04 U	56.10	1.13 U	0.98 U	6.69	35.80 U
IH-37 X Duplicate	15	0.12 J	1.57	5.71 (h)	1.19 U	1.05 U	46.21	1.13 U	0.99 U	9.09	36.00 U
RPD	15	15%	18%	32%	NA	NA	19%	NA	NA	30%	NA
I-Stat	15	0.08	0.09	0.16	NA	NA	0.10	NA	NA	0.15	NA
IH-41 X	16	0.23 J	3.07	9.05	1.23 U	1.08 U	78.73	1.17 U	1.02 U	13.99	37.21 U
IH-41 X Duplicate	16	0.27 J	3.49	9.80	1.20 U	1.06 U	88.51	1.15 U	1.00 U	41.60 (h)	36.50 U
RPD	16	16%	13%	8%	NA	NA	12%	NA	NA	99%	NA
I-Stat	16	0.08	0.06	0.04	NA	NA	0.06	NA	NA	0.50	NA
IH-49 Y	17	0.72 U	0.10 J	0.73 U	0.84 U	0.74 U	0.21 J	0.80 U	0.69 U	0.79 U	25.33 U
IH-49 Y Duplicate	17	0.71 U	0.11 J	0.72 U	0.83 U	0.73 U	0.18 J	0.79 U	0.69 U	0.77 U	25.00 U
RPD	17	NA	10%	NA	NA	NA	15%	NA	NA	NA	NA
I-Stat	17	NA	0.05	NA	NA	NA	0.08	NA	NA	NA	NA
IH-41 A	18	0.14 J	1.19	3.73	1.38 U	1.22 U	24.16	1.32 U	1.15 U	21.65	41.91 U
IH-41 A Duplicate	18	0.15 J	1.30	4.28	1.37 U	1.20 U	29.63	1.31 U	1.14 U	14.68 (h)	41.50 U
RPD	18	7%	9%	14%	NA	NA	20%	NA	NA	38%	NA
I-Stat	18	0.03	0.04	0.07	NA	NA	0.10	NA	NA	0.19	NA
SF-17 B Cdup (j)	11	0.88 J	16.75	65.97	0.26 J	1.18 U	183.59	1.28 U	1.12 U	9.63 U	40.74 U
SF-17 B Cdup Duplicate	11	0.60 J	9.98	42.80 (h)	0.14 J	1.12 U	127.77 (h)	1.21 U	1.05 U	5.81 U	38.46 U
RPD	11	38%	51%	43%	60%	NA	36%	NA	NA	NA	NA
I-Stat	11	0.19	0.25	0.21	0.30	NA	0.18	NA	NA	NA	NA

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									
		cis- Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo- sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
LZ-14 Y	24	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-14 Y MS	24	NA	9.87	8.52	10.75	11.09	13.32	10.69	10.44	13.17	NA
Concentration Recovered	24	NA	9.74	8.46	10.75	11.09	12.14	10.69	10.44	12.91	NA
Amount Spiked	24	NS	11.15	11.15	11.39	11.15	11.15	11.15	11.15	11.15	NS
Percent Recovery	24	NA	87%	76%	94%	99%	109%	96%	94%	116%	NA
LZ-14 Y	24	0.63 U	0.13 J	0.06 J	0.73 U	0.64 U	1.18	0.70 U	0.60 U	0.26 J	22.06 U
LZ-14 Y MSD	24	NA	10.70	8.92	11.51	11.66	12.39	12.08	11.68	9.60	NA
Concentration Recovered	24	NA	10.57	8.86	11.51	11.66	11.21	12.08	11.68	9.34	NA
Amount Spiked	24	NS	11.19	11.19	11.42	11.19	11.19	11.19	11.19	11.19	NS
Percent Recovery	24	NA	94%	79%	101%	104%	100%	108%	104%	83%	NA
RPD	24	NA	8%	4%	7%	5%	8%	12%	11%	32% ^(h)	NA
I-Stat	24	NA	0.04	0.02	0.03	0.02	0.04	0.06	0.05	0.16	NA
IH-50 A	25	1.31 U	0.21 J	0.36 J	1.52 U	1.34 U	9.58	1.45 U	1.26 U	0.26 J	46.02 U
IH-50 A MS	25	NA	10.53	12.72	12.94	14.31	M ⁽ⁱ⁾	14.22	15.47	12.56	NA
Concentration Recovered	25	NA	10.32	12.36	12.94	14.31	NA	14.22	15.47	12.30	NA
Amount Spiked	25	NS	23.84	23.84	24.34	23.84	23.84	23.84	23.84	23.84	NS
Percent Recovery	25	NA	43%	52%	53%	60%	NA	60%	65%	52%	NA
IH-50 A	25	1.31 U	0.21 J	0.36 J	1.52 U	1.34 U	9.58	1.45 U	1.26 U	0.26 J	46.02 U
IH-50 A MSD	25	NA	11.21	12.69	14.00	15.29	M	17.07	16.78	12.78	NA
Concentration Recovered	25	NA	11.00	12.33	14.00	15.29	NA	17.07	16.78	12.52	NA
Amount Spiked	25	NS	23.96	23.96	24.46	23.96	23.96	23.96	23.96	23.96	NS
Percent Recovery	25	NA	46%	51%	57%	64%	NA	71%	70%	52%	NA
RPD	25	NA	6%	1%	7%	6%	NA	18%	8%	1%	NA
I-Stat	25	NA	0.03	0.00	0.04	0.03	NA	0.09	0.04	0.01	NA
<u>Analytical Duplicates</u>											
LZ-1 D	3	2509.09 U	723.37 J	1441.28 J	2909.09 U	2558.10 U	136929.91	2776.28 U	2415.81 U	700.53 J	88118.58 U
LZ-1 D Duplicate	3	2561.74 U	702.24 J	1126.94 J	2970.14 U	2611.78 U	105507.48	2834.54 U	2466.51 U	521.64 J	89967.72 U
RPD	3	NA	3%	24%	NA	NA	26%	NA	NA	29%	NA
I-Stat	3	NA	0.01	0.12	NA	NA	0.13	NA	NA	0.15	NA
LZ-2 B	4	2150.41 U	685.75 J	989.25 J	2493.22 U	2192.41 U	21516.06	2379.40 U	2070.46 U	111047.83 J	75521.68 U
LZ-2 B Duplicate	4	533.27 U	514.60 J	581.57 ^(h)	618.28 U	543.68 U	16823.13	590.05 U	513.44 U	22448.59 ^(h)	18728.16 U
RPD	4	NA	29%	52%	NA	NA	24%	NA	NA	133%	NA
I-Stat	4	NA	0.14	0.26	NA	NA	0.12	NA	NA	0.66	NA

C.63

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
SF-22 A	12	0.80 J	10.88	42.85	0.25 J	1.26 U	144.00	1.36 U	1.19 U	14.17	43.27 U
SF-22 A Duplicate	12	0.84 J	10.69	39.21	0.26 J	1.25 U	142.65	1.36 U	1.18 U	16.44	43.21 U
RPD	12	5%	2%	9%	4%	NA	1%	NA	NA	15%	NA
I-Stat	12	0.02	0.01	0.04	0.02	NA	0.00	NA	NA	0.07	NA
SF-26 A	13	1.31 U	0.53 J	3.50	1.52 U	1.33 U	5.77	1.45 U	1.26 U	1.42 U	45.99 U
SF-26 A Duplicate	13	0.68 J	9.27	31.52	1.52 U	1.34 U	203.39	1.45 U	1.27 U	4.35 U	46.18 U
RPD	13	NA	178% ^(h)	160% ^(h)	NA	NA	189% ^(h)	NA	NA	NA	NA
I-Stat	13	NA	0.89	0.80	NA	NA	0.94	NA	NA	NA	NA
SF-31 X	14	0.47 J	19.99	24.67	0.97 U	0.85 U	325.51	0.92 U	0.80 U	103.70	29.27 U
SF-31 X Duplicate	14	0.43 J	17.77	22.99	0.96 U	0.84 U	311.28	0.92 U	0.80 U	115.79	29.06 U
RPD	14	9%	12%	7%	NA	NA	4%	NA	NA	11%	NA
I-Stat	14	0.04	0.06	0.04	NA	NA	0.02	NA	NA	0.06	NA
IH-46 A	19	0.06 J	1.33	1.41	2.19	0.37 J	8.70	1.27 U	1.10 U	7.33	40.30 U
IH-46 A Duplicate	19	0.04 J	0.25 J	0.78 J	1.36 U	1.19 U	4.72	1.29 U	1.13 U	2.59	41.10 U
RPD	19	40%	137%	58%	NA	NA	59% ^(h)	NA	NA	96% ^(h)	NA
I-Stat	19	0.20	0.68	0.29	NA	NA	0.30	NA	NA	0.48	NA
PC-54 A	20	20.07	36.29	85.50	1.35 U	6.69	690.05	1.29 U	1.13 U	192.79	41.04 U
PC-54 A Duplicate	20	23.52	41.78	85.30	2.49	6.87	649.24	1.31 U	1.14 U	267.05	41.53 U
RPD	20	16%	14%	0%	NA	3%	6%	NA	NA	32% ^(h)	NA
I-Stat	20	0.08	0.07	0.00	NA	0.01	0.03	NA	NA	0.16	NA
LZ-5 Y	21	0.19 J	17.09	10.23	0.77 U	0.68 U	445.10	0.74 U	0.64 U	476.54	23.41 U
LZ-5 Y Duplicate	21	0.39 J	37.65	33.42	0.72 J	0.68 U	931.71	0.73 U	0.64 U	1055.28	23.31 U
RPD	21	69%	75% ^(h)	106% ^(h)	NA	NA	71% ^(h)	NA	NA	76% ^(h)	NA
I-Stat	21	0.34	0.38	0.53	NA	NA	0.35	NA	NA	0.38	NA
IH-50 A	25	1.31 U	0.21 J	0.36 J	1.52 U	1.34 U	9.58	1.45 U	1.26 U	0.26 J	46.02 U
IH-50 A Duplicate	22	1.32 U	0.23 J	0.95 J	1.53 U	1.35 U	3.94	1.46 U	1.27 U	0.95 J	46.48 U
RPD	22	NA	9%	90% ^(h)	NA	NA	83% ^(h)	NA	NA	114%	NA
I-Stat	22	NA	0.05	0.45	NA	NA	0.42	NA	NA	0.57	NA
Comp USFC	23	0.63 J	13.71	86.25	1.37 U	1.20 U	288.38	1.31 U	1.14 U	106.58	41.47 U
Comp USFC Duplicate	23	0.42 J	8.45	61.15	1.35 U	1.19 U	177.75	1.29 U	1.12 U	20.55	40.92 U
RPD	23	40%	47% ^(h)	34% ^(h)	NA	1%	47% ^(h)	NA	NA	135% ^(h)	NA
I-Stat	23	0.20	0.24	0.17	NA	0.00	0.24	NA	NA	0.68	NA
SF-33 X	25	0.40 J	16.70	62.85	0.31 J	0.83 U	217.76	0.90 U	0.79 U	69.32	28.71 U
SF-33 X Duplicate	24	0.83	37.02	89.07	0.93 U	0.82 U	400.34	0.89	0.77 U	141.99	28.18 U
RPD	24	70%	76% ^(h)	35% ^(h)	NA	NA	59% ^(h)	NA	NA	69% ^(h)	NA
I-Stat	24	0.35	0.38	0.17	NA	NA	0.30	NA	NA		NA

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									
		cis- Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo- sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
IH-40 B	25	0.12 J	1.10 J	3.17	1.32 U	1.16 U	32.70	1.26 U	1.10 U	16.22	40.07 U
IH-40 B Duplicate	25	0.05 J	1.16	3.41	1.28 U	1.13 U	36.65	1.22 U	1.06 U	12.03	38.81 U
RPD	25	82% ^(h)	5%	7%	NA	NA	11%	NA	NA	30%	NA
I-Stat	25	0.41	0.03	0.04	NA	NA	0.06	NA	NA	0.15	NA
<u>Compositing Duplicates</u>											
LZ-8 B	7	2983.08 U	2344.70 J	4511.69	3458.65 U	3041.35 U	101508.55	3300.75 U	2872.18 U	53736.21	104765.04 U
LZ-8 B Cdup	7	1515.76 U	1889.26	3973.40	1757.40 U	1545.37 U	88549.88	1677.17 U	1459.41 U	47353.90	53233.05 U
RPD	7	NA	22%	13%	NA	NA	14%	NA	NA	13%	NA
I-Stat	7	NA	0.11	0.06	NA	NA	0.07	NA	NA	0.06	NA
LZ-16 B	9	106.87 U	74.90 J	139.81	123.91 U	108.96 U	946.84	118.25 U	102.90 U	167.08	3753.20 U
LZ-16 B Cdup	9	48.92 U	52.36	127.41	56.72 U	49.88 U	859.92	54.13 U	47.10 U	111.87	1718.09 U
RPD	9	NA	35% ^(h)	9%	NA	NA	10%	NA	NA	40% ^(h)	NA
I-Stat	9	NA	0.18	0.05	NA	NA	0.05	NA	NA	0.20	NA
SF-17 B	11	0.69 J	11.03	60.14	0.14 J	1.16 U	137.80	1.26 U	1.10 U	7.19 U	40.04 U
SF-17 B Cdup	11	0.88 J	16.75	65.97	0.26 J	1.18 U	183.59	1.28 U	1.12 U	9.63 U	40.74 U
RPD	11	24%	41% ^(h)	9%	60%	NA	28%	NA	NA	NA	NA
I-Stat	11	0.12	0.21	0.05	0.30	NA	0.14	NA	NA	NA	NA
SF-21 C	12	0.42 J	7.09	13.30	0.26 J	1.21 U	102.96	1.32 U	1.14 U	22.57	41.75 U
SF-21 C Cdup	12	0.53 J	7.96	15.72	0.34 J	1.22 U	125.83	1.32 U	1.15 U	18.76	41.91 U
RPD	12	23%	12%	17%	27%	NA	20%	NA	NA	18%	NA
I-Stat	12	0.12	0.06	0.08	0.13	NA	0.10	NA	NA	0.09	NA
SF-27 B	13	0.23 J	4.97	10.74	1.40 U	1.23 U	119.43	1.34 U	1.16 U	129.07	42.38 U
SF-27 B Cdup	13	0.38 J	7.85	17.70	1.37 U	1.20 U	200.07	1.31 U	1.14 U	199.28	41.47 U
RPD	13	49%	45% ^(h)	49% ^(h)	NA	NA	50% ^(h)	NA	NA	43% ^(h)	NA
I-Stat	13	0.25	0.22	0.24	NA	NA	0.25	NA	NA	0.21	NA
IH-36 B	15	0.20 J	5.43	12.90	1.14 U	1.00 U	110.16	1.09 U	0.95 U	64.91	34.53 U
IH-36 B Cdup	15	0.33 J	6.90	27.47	1.11 U	0.98 U	200.59	1.06 U	0.33 J	38.36	33.68 U
RPD	15	49%	24%	72% ^(h)	NA	NA	58% ^(h)	NA	NA	51% ^(h)	NA
I-Stat	15	0.25	0.12	0.36	NA	NA	0.29	NA	NA	0.26	NA
IH-37 B	15	0.07 J	1.02 J	2.64	1.44 U	1.27 U	26.56	1.38 U	1.20 U	6.21	43.75 U
IH-37 B Cdup	15	0.05 J	0.81 J	1.93	1.42 U	1.24 U	20.02	1.35 U	1.18 U	41.02	42.87 U
RPD	15	33%	23%	31%	NA	NA	28%	NA	NA	147% ^(h)	NA
I-Stat	15	0.17	0.11	0.16	NA	NA	0.14	NA	NA	0.74	NA

C.66

TABLE C.9. (contd)

Sediment Treatment	Batch	Pesticides ($\mu\text{g/kg}$ dry weight)									Toxaphene
		cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	
IH-39 B	16	0.22 J	2.71	12.45	1.34 U	1.18 U	66.56	1.28 U	1.11 U	23.87	40.65 U
IH-39 B Cdup	16	0.36 J	5.04	31.03	1.35 U	1.13 J	108.02	1.29 U	1.12 U	37.64	40.98 U
RPD	16	48%	60%	85% (h)	NA	NA	47% (h)	NA	NA	45% (h)	NA
I-Stat	16	0.24	0.30	0.43	NA	NA	0.24	NA	NA	0.22	NA
IH-43 B	18	0.25 J	2.13	5.58	1.38 U	1.22 U	49.03	1.32 U	1.15 U	18.44	41.94 U
IH-43 B Cdup	18	0.24 J	2.17	5.71	1.33 U	1.17 U	48.11	1.27 U	1.10 U	16.03	40.30 U
RPD	18	4%	2%	2%	NA	NA	2%	NA	NA	14%	NA
I-Stat	18	0.02	0.01	0.01	NA	NA	0.01	NA	NA	0.07	NA
PC-54 B	20	26.01	44.86	131.83	1.16 U	9.78	1005.82	1.11 U	0.96 U	433.31	35.19 U
PC-54 B Cdup	25	20.63	47.66	122.72	1.17 U	1.03 U	651.79	1.11 U	0.97 U	302.01	35.39 U
RPD	25	23%	6%	7%	NA	NA	43% (h)	NA	NA	36% (h)	NA
I-Stat	25	0.12	0.03	0.04	NA	NA	0.21	NA	NA	0.18	NA
Parr Canal Edge	24	4.30	11.55	56.54	1.23 U	1.09 U	327.83	1.18 U	1.03 U	758.73	37.41 U
Parr Canal Edge Cdup	24	6.32	20.10	67.01	1.47 U	1.29 U	397.26	1.40 U	1.22 U	579.32	44.48 U
RPD		38% (h)	54% (h)	17%	NA	NA	19%	NA	NA	27%	NA
I-Stat		0.19	0.27	0.08	NA	NA	0.10	NA	NA	0.13	NA
Comp LC	3	554.51 U	480.57 J	461.32 J	642.91 U	565.34 U	20658.65	613.56 U	533.89 U	32766.54	19474.14 U
Comp LC Cdup	3	537.60 U	519.96 J	488.04 J	623.31 U	548.10 U	21088.05	594.85 U	517.62 U	27993.74	18880.42 U
RPD	3	NA	8%	6%	NA	NA	2%	NA	NA	16%	NA
I-Stat	3	NA	0.04	0.03	NA	NA	0.01	NA	NA	0.08	NA
Comp IHC-2	23	0.16 J	1.21 J	2.52	1.46 U	1.28 U	15.85	1.39 U	1.21 U	1.69	44.09 U
Comp IHC-2 Cdup	23	1.19 U	0.82 J	1.88	1.38 U	1.21 U	10.32	1.32 U	1.14 U	2.47	41.75 U
RPD	23	NA	38%	29%	NA	NA	42% (h)	NA	NA	38%	NA
I-Stat	23	NA	0.19	0.15	NA	NA	0.21	NA	NA	0.19	NA

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) B Procedural blank ng amount greater than MDL.

(d) NA Not applicable.

(e) NS Not spiked.

(f) Recovery outside of quality control range (40%-120%).

(g) Negative values reported as zero.

(h) Value exceeds relative precision goal of $\leq 30\%$. For duplicates, one sample concentration must be >10 times the MDL.

(i) M Matrix interference.

(j) Compositing duplicate.

TABLE C.10. Surrogate Recoveries for Chlorinated Pesticides in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		<u>DBOFB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
LZ-1 A	3	D ^(a)	D	D
LZ-1 B	3	D	D	D
LZ-1 C	3	D	D	D
LZ-1 D	3	D	D	D
LZ-1 X	3	D	D	D
LZ-1 Y	21	106.63	76.99	63.88
LZ-2 A	4	D	D	D
LZ-2 B	4	D	D	D
LZ-2 C	4	D	D	D
LZ-2 X	4	D	D	D
LZ-2 Y	21	109.64	108.45	68.22
LZ-3 A	4	D	D	D
LZ-3 B	4	D	D	D
LZ-3 X	4	D	D	D
LZ-3 Y	21	112.93	83.23	66.83
LZ-5 A	6	D	D	D
LZ-5 Y	21	104.89	102.13	67.78
LZ-6 A	6	D	D	D
LZ-6 B	6	D	D	D
LZ-6 C	6	D	D	D
LZ-6 X	6	D	D	D
LZ-6 Y	21	101.85	81.64	67.00
LZ-7 A	6	D	D	D
LZ-7 B	6	D	D	D
LZ-7 C	6	D	D	D
LZ-7 X	6	D	D	D
LZ-7 Y	21	106.98	77.06	63.71
LZ-8 A	7	D	D	D
LZ-8 B	7	D	D	D
LZ-8 C	7	D	D	D
LZ-8 D	7	D	D	D
LZ-8 E	7	D	D	D
LZ-8 F	7	D	D	D
LZ-8 G	7	D	D	D
LZ-8 X	7	D	D	D
LZ-8 Y	21	99.89	79.94	63.94

TABLE C. 10. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		<u>DBOFB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
LZ-9 A	6	D	D	D
LZ-9 X	7	D	D	D
LZ-9 Y	21	104.59	99.81	67.10
LZ-10 A	8	D	D	D
LZ-10 B	8	D	D	D
LZ-10 X	9	D	D	D
LZ-10 Y	22	108.57	81.78	70.22
LZ-11 A	7	D	D	D
LZ-11 X	7	D	D	D
LZ-11 Y	21	113.06	103.15	70.93
LZ-12 A	9	D	D	D
LZ-12 X	9	D	D	D
LZ-12 Y	22	111.88	83.43	69.67
LZ-13 A	9	D	D	D
LZ-13 B	9	D	D	D
LZ-13 C	9	D	D	D
LZ-13 X	9	D	D	D
LZ-13 Y	22	112.03	76.30	67.74
LZ-14 A	7	D	D	D
LZ-14 X	8	D	D	D
LZ-14 Y	22	98.80	80.49	69.85
LZ-15 A	9	D	D	D
LZ-15 B	9	D	D	D
LZ-15 X	9	D	D	D
LZ-15 Y	22	101.54	80.32	69.33
LZ-16 A	8	D	D	D
LZ-16 B	9	D	D	D
LZ-16 C	9	D	D	D
LZ-16 D	9	D	D	D
LZ-16 X	8	D	D	D
LZ-16 Y	22	100.19	76.64	66.95
SF-17 A	11	91.48	86.74	51.90
SF-17 B	11	74.50	59.60	45.98
SF-17 X	11	72.70	56.44	46.49
SF-17 Y	11	105.27	72.40	66.93

TABLE C. 10. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		<u>DBOFB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
SF-18 A	11	94.02	74.00	55.38
SF-18 B	11	58.75	56.19	38.39 ^(b)
SF-18 X	11	85.85	73.74	52.05
SF-18 Y	11	92.16	61.26	58.77
SF-19 A	11	93.70	70.30	55.53
SF-19 X	11	82.52	67.74	50.55
SF-19 Y	11	97.09	59.92	55.21
SF-20 A	11	89.96	67.81	53.27
SF-20 X	11	83.16	69.98	49.04
SF-20 Y	11	93.95	70.63	59.12
SF-21 A	12	90.61	70.03	54.19
SF-21 B	12	70.67	60.63	45.78
SF-21 C	12	57.29	58.52	39.49 ^(b)
SF-21 X	12	83.40	63.93	50.62
SF-21 Y	12	102.81	71.96	62.61
SF-22 A	12	69.61	69.62	42.70
SF-22 B	12	102.05	77.66	62.36
SF-22 C	12	88.93	52.53	47.71
SF-22 X	12	98.51	67.44	60.90
SF-22 Y	12	96.37	68.73	59.58
SF-23 A	12	93.72	68.37	54.81
SF-23 B	13	100.74	71.67	65.30
SF-23 X	13	92.10	77.46	66.15
SF-23 Y	12	103.66	68.36	65.13
SF-24 A	12	76.19	62.84	44.05
SF-24 B	12	53.27	48.95	34.57 ^(b)
SF-24 C	12	86.13	60.91	52.72
SF-25 A	13	102.09	87.04	71.69
SF-25 B	13	90.16	73.53	61.69
SF-25 X	13	105.23	69.47	67.06
SF-25 Y	13	108.28	74.77	67.86
SF-26 A	13	98.04	63.77	63.77
SF-26 B	13	102.10	75.90	69.01
SF-26 C	13	97.74	81.46	61.89
SF-26 X	13	98.89	81.89	62.40
SF-26 Y	13	93.43	75.35	63.54

TABLE C.10. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		<u>DBOFB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
SF-27 A	13	104.21	75.67	69.49
SF-27 B	13	115.93	75.51	67.80
SF-27 C	13	92.29	75.55	58.68
SF-27 X	14	88.46	65.32	56.84
SF-27 Y	13	98.39	67.13	64.27
SF-28 A	14	116.36	76.67	68.29
SF-28 B	14	97.66	82.96	57.25
SF-28 X	14	113.35	104.82	61.37
SF-28 Y	14	123.31 ^(b)	72.20	73.33
SF-29 A	14	104.47	68.65	64.09
SF-29 B	14	119.14	80.02	61.45
SF-29 C	14	76.15	78.99	49.04
SF-29 D	13	109.00	98.13	71.11
SF-29 E	14	93.85	109.08	58.97
SF-29 X	14	115.09	74.16	66.31
SF-29 Y	14	110.77	68.68	66.78
SF-30 A	14	93.67	66.70	62.78
SF-30 B	15	50.70	52.53	40.04
SF-30 X	15	73.27	81.09	49.16
SF-30 Y	14	105.23	66.72	66.15
SF-31 A	14	93.88	59.73	59.88
SF-31 X	14	113.24	106.64	67.14
SF-31 Y	14	122.08 ^(b)	68.78	65.11
SF-32 A	24	57.76	66.41	39.30 ^(b)
SF-32 B	24	98.65	78.94	65.87
SF-32 C	24	62.23	45.87	41.09
SF-32 X	24	84.76	71.57	65.00
SF-32 Y	22	104.26	80.24	69.25
SF-33 A	24	55.65	62.16	40.13
SF-33 B	24	60.31	70.60	45.88
SF-33 X	25	58.49	81.81	44.32
SF-33 Y	22	108.68	80.49	66.91
SF-34 A	24	117.65	94.16	64.90
SF-34 B	24	117.28	72.93	62.95
SF-34 X	23	106.85	92.41	64.00
SF-34 Y	11	93.19	77.09	63.99
IH-35 A	15	87.09	63.83	59.85
IH-35 X	15	88.02	70.99	59.51
IH-35 Y	17	108.07	81.00	72.22

TABLE C. 10. (contd)

<u>Sediment Treatment</u>	<u>Batch</u>	<u>Surrogate Percent Recoveries</u>		
		<u>DBO/FB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
IH-36 A	15	102.89	71.51	67.02
IH-36 B	15	57.65	49.71	38.76 ^(b)
IH-36 X	15	84.35	83.52	55.98
IH-36 Y	17	106.41	81.72	71.67
IH-37 A	15	85.47	61.67	58.30
IH-37 B	15	90.17	62.68	53.83
IH-37 C	15	85.49	59.87	59.66
IH-37 X	15	80.88	55.83	52.61
IH-37 Y	17	109.86	83.69	73.08
IH-38 A	16	81.52	58.89	49.98
IH-38 X	16	68.15	46.84	38.72 ^(b)
IH-38 Y	17	109.12	82.59	68.97
IH-39 A	16	99.36	63.97	54.52
IH-39 B	16	96.26	67.18	62.27
IH-39 C	16	65.35	58.18	43.12
IH-39 X	16	59.20	56.49	33.88 ^(b)
IH-39 Y	17	98.40	79.51	66.65
IH-40 A	16	83.70	51.48	53.73
IH-40 B	25	70.31	53.62	48.33
IH-40 X	16	105.42	68.87	62.66
IH-40 Y	17	100.77	77.07	66.35
IH-41 A	18	104.71	70.61	61.31
IH-41 B	18	119.06	73.47	67.29
IH-41 C	16	89.53	60.97	47.50
IH-41 X	16	75.61	55.74	44.63
IH-41 Y	17	107.05	78.50	70.99
IH-42 A	18	82.49	61.07	50.82
IH-42 X	18	90.42	65.32	55.15
IH-42 Y	17	83.38	68.63	58.37
IH-43 A	25	81.05	59.15	57.47
IH-43 B	18	95.07	68.87	56.39
IH-43 X	18	90.69	66.92	53.96
IH-43 Y	17	105.80	80.86	68.42

TABLE C.10. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		<u>DBO/FB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
IH-44 A	18	83.08	57.53	49.61
IH-44 B	18	103.30	73.33	59.54
IH-44 C	18	96.93	70.89	59.85
IH-44 D	18	88.20	64.88	53.27
IH-44 X	25	121.77 ^(b)	70.58	90.84
IH-44 Y	17	89.39	66.05	60.92
IH-45 A	19	51.21	41.92	41.11
IH-45 B	18	105.07	75.16	66.62
IH-45 C	18	91.00	66.40	55.27
IH-45 X	19	90.23	65.79	59.43
IH-45 Y	17	108.41	83.24	71.86
IH-46 A	19	96.69	75.85	64.22
IH-46 B	19	91.08	77.62	61.49
IH-46 C	19	49.91	45.41	40.51
IH-46 X	19	82.88	64.47	58.17
IH-46 Y	17	84.17	64.80	57.01
IH-47 A	19	98.90	67.06	65.75
IH-47 B	19	67.53	55.70	50.14
IH-47 C	19	92.75	69.90	61.92
IH-47 X	25	78.77	62.20	50.05
IH-47 Y	17	108.19	84.12	68.38
IH-48 A	19	90.00	61.38	60.51
IH-48 B	19	83.12	62.47	58.97
IH-48 X	19	96.95	72.35	64.07
IH-48 Y	17	107.92	80.44	71.00
IH-49 A	19	102.14	78.64	67.51
IH-49 B	19	67.51	65.63	49.20
IH-49 X	19	47.44	42.62	40.47
IH-49 Y	17	106.59	78.84	68.49
IH-50 A	25	72.44	57.02	52.95
IH-50 B	22	58.49	45.51	42.52
IH-50 C	22	62.83	48.13	45.25
IH-50 X	22	55.43	45.39	43.43
IH-50 Y	21	106.88	81.12	64.61
IH-51 A	23	101.36	79.26	61.73
IH-51 B	23	89.32	71.38	58.53
IH-51 X	22	89.85	64.47	55.16
IH-51 Y	21	104.49	80.46	69.20

TABLE C.10. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		DBO/FB	CL5(112)	CL5(103)
PC-52 A	25	44.20	39.16 ^(b)	36.43 ^(b)
PC-52 B	25	5.94 ^(b)	11.09 ^(b)	11.99 ^(b)
PC-52 C	25	14.34 ^(b)	17.20 ^(b)	17.78 ^(b)
PC-53 A	20	84.51	60.06	72.15
PC-53 B	20	40.38	47.01	44.00
PC-53 C	25	51.30	46.67	94.97
PC-54 A	20	52.46	50.29	45.03
PC-54 B	20	47.00	55.04	38.89 ^(b)
PC-54 C	20	41.64	M ^(c)	59.65
SFC Marina	23	93.64	65.47	57.76
FSFC Edge-West	24	126.77 ^(b)	82.87	69.80
Parr Canal Edge	24	80.76	45.39	55.25
IHC Edge-East	23	94.67	75.94	71.85
IHC Edge-West	23	95.82	68.19	58.78
Outer Harbor Edge	23	114.09	79.04	72.68
Comp LC	3	D	D	D
Comp LC-1	8	D	D	D
Comp LC-2	8	D	D	D
Comp LC-3	8	D	D	D
Comp LC-4	6	D	D	D
Comp LC-5	3	D	D	D
Comp LC-6	4	D	D	D
Comp USFC	23	63.50	64.83	36.34 ^(b)
Comp FSFC	24	69.24	73.91	54.07
Comp IHC-1	23	115.00	82.87	74.44
Comp IHC-2	23	89.17	68.76	59.96
Comp IHC-3	23	66.35	63.91	45.70
Comp GD	23	107.07	79.90	66.62
C-SFBF	21	95.03	69.27	61.87
C-SFBC	21	95.13	82.08	64.94

Quality Control SamplesMethod Blanks

MC44PB	3	D	D	D
MC48PB	4	D	D	D
MC73PB	6	D	D	D
MC77PB	7	D	D	D
MC81PB	8	D	D	D
MC95PB	9	D	D	D
MD81PB	15	92.89	74.17	63.48

TABLE C. 10. (contd)

<u>Sediment Treatment</u>	<u>Batch</u>	<u>Surrogate Percent Recoveries</u>		
		<u>DBO/FB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
MD85PB	16	98.78	72.87	66.35
MD89PB	17	106.29	81.12	71.97
MD95PB	18	113.66	82.44	72.45
MD10PB	11	87.09	70.24	63.13
MD14PB	12	95.74	68.10	60.81
MD49PB	13	81.78	73.65	62.14
MD53PB	14	109.35	68.87	68.25
MD99PB	19	123.78 ^(b)	78.74	76.47
ME04PB	20	108.81	82.04	76.90
ME63PB	21	50.99	57.31	47.65
ME67PB	22	41.75	39.27 ^(b)	35.46 ^(b)
ME71PB	23	92.44	81.29	59.02
ME75PB	24	97.85	82.60	62.21
MH35PB	25	77.53	56.92	53.31
<u>Matrix Spikes</u>				
SF-20 Y MS	11	91	77	64
SF-20 Y MSD	11	96	80	66
SF-22 Y MS	12	101	72	64
SF-22 Y MSD	12	86	63	55
SF-25 Y MS	13	78	72	57
SF-25 Y MSD	13	78	72	59
SF-31 Y MS	14	100	67	66
SF-31 Y MSD	14	97	66	62
IH-35 Y MS	17	86	76	65
IH-35 Y MSD	17	79	70	60
IH-38 Y MS	17	107	81	66
IH-38 Y MSD	17	99	74	63
IH-49 Y MS	17	107	81	66
IH-49 Y MSD	17	99	74	63
IH-43 Y MS	17	106	76	71
IH-43 Y MSD	17	99	74	66
IH-46 Y MS	17	90	87	61
IH-46 Y MSD	17	92	84	59
IH-45 Y MS	17	87	70	65
IH-45 Y MSD	17	97	75	70

TABLE C. 10. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		<u>DBO/FB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
IH-50 Y MS	21	90	70	64
IH-50 Y MSD	21	107	78	66
LZ-14 Y MS	22	106	71	67
LZ-14 Y MSD	22	91	64	58
LZ-14 Y MS	22	87	81	63
LZ-14 Y MSD	22	51	68	49
LZ-14 Y MS	22	87	81	60
LZ-14 Y MSD	22	95	89	63
IH-50 A MS	25	72	61	58
IH-50 A MSD	25	76	64	62

Analytical Duplicates

LZ-1 D Duplicate	3	D	D	D
LZ-2 B Duplicate	4	D	D	D
LZ-5 A Duplicate	6	D	D	D
LZ-11 A Duplicate	7	D	D	D
Comp LC-3 Duplicate	8	D	D	D
LZ-13 X Duplicate	9	D	D	D
IH-37 X Duplicate	15	86.51	63.35	58.32
IH-41 X Duplicate	16	89.40	63.35	54.30
IH-49 Y Duplicate	17	108.19	78.29	71.37
IH-41 A Duplicate	18	103.95	67.49	59.06
SF-17 B Cdup ^(d) Duplicate	11	87.11	70.52	53.98
SF-22 A Duplicate	12	89.10	78.06	49.33
SF-26 A Duplicate	13	104.30	78.30	61.58
SF-31 X Duplicate	14	93.34	90.66	56.23
IH-46 A Duplicate	19	89.38	70.97	62.62
PC-54 A Duplicate	20	65.84	57.14	52.91
LZ-5 Y Duplicate	21	104.05	153.87 ^(b)	70.02
IH-50 A Duplicate	22	103.06	74.26	63.23
Comp USFC Duplicate	23	48.38	40.73	29.54 ^(b)
SF-33 X Duplicate	24	80.72	106.39	51.23
IH-40 B Duplicate	25	58.37	45.52	40.81

Compositing Duplicates

LZ-8 B Cdup	7	D	D	D
LZ-16 B Cdup	9	D	D	D
SF-17 B Cdup	11	65.51	59.80	43.60
SF-21 C Cdup	12	69.45	71.80	46.73
SF-27 B Cdup	13	112.40	87.09	69.93
IH-36 B Cdup	15	85.91	77.90	52.71

TABLE C. 10. (contd)

<u>Sediment Treatment</u>	<u>Batch</u>	<u>Surrogate Percent Recoveries</u>		
		<u>DBO/FB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
IH-37 B Cdup	15	97.75	60.14	63.31
IH-39 B Cdup	16	102.17	83.36	64.91
IH-43 B Cdup	18	92.17	66.27	53.51
PC-54 B Cdup	25	49.28	55.24	41.81
Parr Canal Edge Cdup	24	90.35	59.90	57.81
Comp LC Cdup	3	D	D	D
Comp IHC-2 Cdup	23	96.19	79.41	63.96

-
- (a) D Diluted out.
 (b) Surrogate recovery out of quality control range (40%-120%).
 (c) M Matrix interference.
 (d) Compositing duplicate.

TABLE C. 11. Oil and Grease and Total Petroleum Hydrocarbons in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>Total Solids (Percent)</u>	<u>Oil and Grease (mg/kg dry weight)</u>	<u>Total Petroleum Hydrocarbons (mg/kg dry weight)</u>
Target DL ^(a)	NA ^(b)	20	20
Achieved DL High	NA	30	90
Achieved DL Low	NA	20	30
LZ-1 M	32.27	26,000	22,900
LZ-3 M	44.75	2,100	1,800
LZ-6 M	61.26	1,700	1,400
LZ-9 M	48.08	770	490
LZ-11 M	63.67	940	600
LZ-13 M	48.00	670	470
LZ-15 M	40.48	400	240
SF-17 M	46.41	340	400
SF-18 M	42.05	510	360
SF-19 M	41.62	520	370
SF-20 M	38.10	450	370
SF-21 M	45.19	300	290
SF-22 M	48.72	220	170
SF-23 M	45.61	190	330
SF-24 M	43.47	240	330
SF-25 M	54.68	520	520
SF-26 M	44.31	370	250
SF-27 M	44.66	390	450
SF-28 M	53.61	200	130
SF-30 M	40.96	400	170
SF-32 M	54.53	250	150
SF-34 M	51.48	310	210
IH-37 M	43.50	250	90 U ^(c)
IH-38 M	43.31	270	90 U
IH-39 M	45.36	246	90 U
PC-52 M	44.75	19,800	14,800
PC-53 M	44.66	14,200	11,200
PC-54 M	50.86	3,700	2,300
Comp LC	49.90	1,000	840
Comp LC-1	36.14	4,310	3,960
Comp LC-2	42.07	2,600	2,300
Comp LC-3	51.37	1,340	1,080
Comp LC-4	43.33	630	480
Comp LC-5	47.89	1,200	1,000
Comp LC-6	49.14	2,200	2,000

TABLE C. 11. (contd)

<u>Sediment Treatment</u>	<u>Total Solids (Percent)</u>	<u>Oil and Grease (mg/kg drv weight)</u>	<u>Total Petroleum Hydrocarbons (mg/kg drv weight)</u>
Comp USFC	41.52	910	660
Comp FSFC	46.88	450	330
Comp IHC-1	41.70	390	290
Comp IHC-2	39.78	380	180
Comp IHC-3	42.15	290	190
Comp GD	36.77	480	290
C-SFBF	53.93	260	160
C-SFBC	81.13	110	69
CBM Comp - Fine	80.03	30 U	30 U
CBM Comp - Coarse	75.70	30 U	30 U

(a) DL Detection limit.

(b) NA Not applicable.

(c) U Analyte was not present above the associated value.

TABLE C.12. Quality Control Data for Oil and Grease and Total Petroleum Hydrocarbons, United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>Total Solids (Percent)</u>	<u>Oil and Grease (mg/kg dry weight)</u>	<u>Total Petroleum Hydrocarbons (mg/kg dry weight)</u>
<u>Method Blanks</u>			
Blank	NA ^(a)	20 U ^(b)	20 U
Blank	NA	20 U	20 U
Blank	NA	20 U	20 U
<u>Matrix Spikes</u>			
Comp LC	49.90	1000	840
Comp LC MS	49.90	50900	NA
Concentration Recovered	NA	49900	NA
Amount Spiked	NS ^(c)	44100	NS
Percent Recovery	NA	113%	NA
LZ-15 M	40.48	400	240
LZ-15 M MS	40.48	86100	NA
Concentration Recovered	NA	85700	NA
Amount Spiked	NS	81300	NS
Percent Recovery	NA	105%	NA
SF-32 M Cdup ^(d)	54.57	280	260
SF-32 M Cdup MS	54.57	48500	NA
Concentration Recovered	NA	48220	NA
Amount Spiked	NS	48900	NS
Percent Recovery	NA	99%	NA
<u>Analytical Duplicates</u>			
Comp LC	49.90	1000	840
Comp LC Duplicate	NA	1000	770
RPD	NA	0%	9%
I-Stat	NA	0.00	0.04
LZ-15 M	40.48	400	240
LZ-15 M Duplicate	NA	520	410
RPD	NA	26% ^(e)	52% ^(e)
I-Stat	NA	0.13	0.26
SF-32 M Cdup	54.57	280	260
SF-32 M Cdup Duplicate	NA	390	190
RPD	NA	33% ^(e)	31% ^(e)
I-Stat	NA	0.16	0.16

TABLE C. 12. (contd)

<u>Sediment Treatment</u>	<u>Total Solids (Percent)</u>	<u>Oil and Grease (mg/kg drv weight)</u>	<u>Total Petroleum Hydrocarbons (mg/kg drv weight)</u>
<u>Compositing Duplicates</u>			
Comp LC	49.90	1000	840
Comp LC Cdup	48.50	760	820
RPD	3%	27% ^(e)	2%
I-Stat	0.01	0.14	0.01
Comp IHC-2	39.78	380	180
Comp IHC-2 Cdup	40.41	230	180
RPD	2%	49% ^(e)	0%
I-Stat	0.01	0.25	0.00
SF-32 M	54.53	250	150
SF-32 M Cdup	54.57	280	260
RPD	0%	11%	54% ^(e)
I-Stat	0.00	0.06	0.27

(a) NA Not applicable.

(b) U Analyte was not present above the associated value.

(c) NS Not spiked.

(d) Compositing duplicate.

(e) Value exceeds relative precision goal of $\leq 20\%$.

TABLE C.13. Total Polynuclear Aromatic Hydrocarbons (PAHs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>Batch</u>	<u>PAH Concentration ($\mu\text{g/kg}$ dry weight)</u>		
		<u>Total LPAHs</u>	<u>Total HPAHs</u>	<u>Total PAHs</u>
LZ-1 M	2	7819.1	4684.4	12503
LZ-3 M	2	773.6	5,281.0	6,055
LZ-6 M	2	1538.1	2999.9	4538
LZ-9 M	2	587.2	2324.6	2912
LZ-11 M	2	606.0	1294.4	1900
LZ-13 M ^(a)	25	11693.1	20424.9	32118
LZ-15 M	1	84.8	665.0	750
SF-17 M	2	76.4	724.2	801
SF-18 M	2	143.6	1331.7	1475
SF-19 M	2	34.7	286.9	322
SF-20 M	2	93.2	855.6	949
SF-21 M	2	34.8	288.1	323
SF-22 M	2	110.3	1249.8	1360
SF-23 M	2	62.4	366.4	429
SF-24 M	2	46.1	555.4	602
SF-25 M	2	9714.2	14484.4	24199
SF-26 M	5	77.3	509.8	587
SF-27 M	5	21.6	173.1	195
SF-28 M	23	228.8	1626.7	1856
SF-30 M	5	63.9	501.1	565
SF-32 M	2	87.6	557.6	645
SF-34 M	2	190.6	1637.2	1828
IH-37 M	5	62.0	566.2	628
IH-38 M	5	23.4	191.1	215
IH-39 M	5	80.0	805.9	886
PC-52 M	5	1726.8	5056.0	6783
PC-53 M	5	6789.3	19696.1	26485
PC-54 M	5	562.3	4170.7	4733
Comp LC	1	959.4	6520.8	7480
Comp LC-1	1	1150.2	10356.6	11507
Comp LC-2	1	641.6	4311.3	4953
Comp LC-3	1	544.9	4269.1	4814
Comp LC-4	1	3654.4	17912.2	21567
Comp LC-5	1	1701.9	7761.6	9464
Comp LC-6	1	4494.9	4828.9	9324
Comp USFC	1	3542.2	5691.5	9234
Comp FSFC	1	200.4	1594.9	1795

TABLE C. 13. (contd)

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g/kg}$ dry weight)		
		Total LPAHs	Total HPAHs	Total PAHs
Comp IHC-1	1	115.4	952.4	1068
Comp IHC-2	1	73.9	649.2	723
Comp IHC-3	1	64.4	587.0	651
Comp GD	1	32.8	198.1	231
C-SFBF	1	70.2	497.4	568
C-SFBC	1	0.4	6.2	7
OBM Comp - Fine	5	14.8	20.4	35
OBM Comp - Coarse	5	42.2	101.0	143

(a) Recoveries of all three surrogate compounds were below acceptable quality control range (40%-120%) in original and repeat analyses. Repeat analysis data are reported here.

TABLE C. 14. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g/kg}$ dry weight)							
		Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Target DL ^(a)		20	20	20	20	20	20	20	20
Achieved DL High		13.09	13.09	13.09	8.76	11.37	11.07	11.60	10.06
Achieved DL Low		5.13	5.13	5.13	3.43	4.46	4.34	4.54	3.94
LZ-1 M	2	1071.47	1579.39	1005.06	116.42	553.59	842.99	2274.00	376.16
LZ-3 M	2	118.69	79.24	39.29	14.95	38.19	76.07	221.72	185.46
LZ-6 M	2	272.78	151.98	83.52	12.83	139.99	198.97	493.03	184.95
LZ-9 M	2	110.57	69.75	35.15	11.05	40.09	52.91	170.12	97.59
LZ-11 M	2	208.48	51.73	40.47	4.90	54.83	49.16	129.31	67.09
LZ-13 M ^(b)	25	2155.16	1752.44	1025.62	152.81	894.38	1203.51	2779.13	1730.05
LZ-15 M	1	12.14	10.82	3.87 J ^(c)	2.79 J	3.73 J	5.28 J	29.19	16.94
SF-17 M	2	10.72	5.72 J	2.21 J	3.21 J	3.00 J	3.76 J	30.85	16.92
SF-18 M	2	18.68	10.27 J	4.55 J	5.57 J	4.57 J	8.07 J	62.26	29.63
SF-19 M	2	5.50 J	2.67 J	1.01 J	1.41 J	1.10 J	1.57 J	15.10	6.34 J
SF-20 M	2	10.82 J	7.18 J	3.99 J	3.17 J	2.80 J	4.15 J	42.67	18.44
SF-21 M	2	6.23 J	2.87 J	1.25 J	1.64 J	1.40 J	1.36 J	13.41	6.63 J
SF-22 M	2	17.94	5.86 J	2.84 J	5.02 J	3.82 J	6.06 J	42.85	25.88
SF-23 M	2	9.17 J	3.63 J	1.56 J	2.13 J	1.45 J	4.12 J	26.25	14.05
SF-24 M	2	5.15 J	2.53 J	1.17 J	2.61 J	1.50 J	2.11 J	21.89	9.14
SF-25 M	2	243.79	63.64	59.78	104.15	919.82	1073.32	4992.25	2257.40
SF-26 M	5	25.21	5.21 J	1.84 J	1.95 J	3.98 J	4.25 J	22.42	12.46
SF-27 M	5	4.33 J	1.66 J	0.95 J	1.04 J	0.73 J	0.95 J	8.56	3.42 J
SF-28 M	23	43.73	23.82	10.72	5.27	10.04	18.97	84.08	32.17
SF-30 M	5	9.28 J	6.51 J	2.80 J	2.70 J	2.15 J	3.33 J	23.46	13.70
SF-32 M	2	10.88	6.64 J	2.50 J	2.14 J	3.61 J	6.44	30.31	25.08
SF-34 M	2	24.28	20.67	8.56	7.26	6.95 J	11.28	62.56	49.01
IH-37 M	5	9.24 J	5.24 J	2.41 J	3.09 J	2.67 J	3.25 J	23.70	12.42
IH-38 M	5	4.50 J	2.10 J	0.91 J	1.09 J	1.11 J	1.07 J	8.70	3.96 J
IH-39 M	5	10.33	5.26 J	2.44 J	3.31 J	3.04 J	4.26 J	31.34	20.03
PC-52 M	5	105.05	104.06	98.11	5.87 J	131.48	159.12	694.06	429.02
PC-53 M	5	549.00	149.80	87.43	6.07 U ^(d)	203.77	559.00	1954.59	3285.70
PC-54 M	5	50.23	24.82	10.63	6.67	18.39	27.80	289.45	134.34
Comp LC	1	104.73	84.63	36.80	17.67	55.67	76.02	368.34	215.56
Comp LC-1	1	117.34	193.30	75.21	17.54	32.01	71.05	432.32	211.43
Comp LC-2	1	112.28	70.32	35.84	10.89	28.42	66.58	198.23	118.99
Comp LC-3	1	78.91	56.33	27.25	10.11	26.25	45.98	194.74	105.36
Comp LC-4	1	76.48	168.27	26.89	31.34	108.37	298.35	1489.13	1455.57
Comp LC-5	1	183.51	117.80	63.85	14.92	105.77	167.80	730.71	317.56
Comp LC-6	1	559.44	238.52	203.05	11.81	479.92	690.42	1871.03	440.70
Comp USFC	1	507.10	96.02	83.09	60.95	353.87	421.65	1619.98	399.51
Comp FSFC	1	29.91	19.30	7.45 J	4.32 J	9.52	12.41	80.57	36.91
Comp IHC-1	1	15.22	8.72 J	4.79 J	3.86 J	3.98 J	6.92 J	47.84	24.11
Comp IHC-2	1	8.89 J	5.32 J	2.37 J	2.47 J	2.79 J	4.11 J	34.97	12.94
Comp IHC-3	1	11.21	5.00 J	4.15 J	6.78 U	8.80 U	8.57 U	32.81	11.18
Comp $\oplus$	1	6.00 J	2.54 J	1.70 J	7.91 U	10.28 U	10.00 U	15.21	7.39 J
C-SFBC	1	7.62 J	4.25 J	2.20 J	2.63 J	3.08 J	3.02 J	37.51	9.86
C-SFBC	1	5.18 U	5.18 U	5.18 U	3.46 U	4.49 U	4.38 U	0.37 J	3.98 U
CBM Comp - Fine	5	3.49 J	1.39 J	0.81 J	3.43 U	1.67 J	1.40 J	5.10	0.96 J
CBM Comp - Coarse	5	7.79	8.96	4.64 J	0.63 J	4.40 J	3.09 J	10.65	2.02 J

(a) DL Detection limit.

(b) Recoveries of all three surrogate compounds were below acceptable quality control range (40%-120%) in original and repeat analyses. Repeat analysis data are reported here.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection Limit (IDL).

(d) U Analyte was not present above the associated value.

TABLE C. 15. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g}/\text{kg}$ dry weight)									
		Fluor-anthene	Pvrene	Benzo[a]anthra-cene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pvrene	Indeno-[1,2,3-c,d]pyrene	Dibenzo-[a,h]anthra-cene	Benzo-[g, h, i]perylene
Target DL ^(a)		20	20	20	20	20	20	20	20	20	20
Achieved DL High		11.76	11.42	9.99	12.28	10.42	10.28	16.31	12.39	12.30	11.86
Achieved DL Low		4.61	4.48	3.91	4.81	4.08	4.03	6.39	4.85	4.82	4.65
C.85	LZ-1 M	2	1742.32	1512.00	266.26	444.71	249.79	117.23	141.57	81.28	108.72
	LZ-3 M	2	659.15	1457.88	302.51	444.17	934.90	409.15	530.28	252.82	238.00
	LZ-6 M	2	827.71	1098.46	145.52	271.30	231.73	157.97	128.70	57.90	65.83
	LZ-9 M	2	310.69	736.99	107.87	197.40	362.19	180.89	208.30	96.38	100.66
	LZ-11 M	2	215.33	438.07	72.84	109.40	159.48	93.87	85.56	50.44	57.67
	LZ-13 M ^(b)	25	2983.93	3371.51	2201.04	3365.63	3753.98	1052.96	2265.88	663.74	571.67
	LZ-15 M	1	57.11	139.01	42.88	95.13	91.80	75.77	80.21	37.39	36.73
	SF-17 M	2	80.91	189.93	35.22	63.71	106.83	58.92	76.07	52.08	53.97
	SF-18 M	2	136.07	191.67	60.26	122.19	228.10	143.26	172.73	125.95	130.73
	SF-19 M	2	32.25	52.78	19.12	33.79	43.79	29.28	35.01	18.89	18.85
	SF-20 M	2	100.58	153.31	78.83	82.08	120.35	69.80	98.14	69.14	71.92
	SF-21 M	2	31.46	60.49	13.75	23.12	45.43	24.96	35.00	24.12	25.95
	SF-22 M	2	112.91	316.58	60.86	110.81	182.89	114.29	145.29	93.27	101.04
	SF-23 M	2	45.64	55.72	29.26	71.97	63.86	44.16	26.99	23.89	8.60 ^(d)
	SF-24 M	2	62.61	87.91	34.51	61.69	79.52	59.12	71.09	44.29	48.14
	SF-25 M	2	5299.13	4059.47	1177.16	1324.30	817.52	597.33	659.06	276.09	220.33
	SF-26 M	5	65.00	163.88	28.17	36.83	56.05	40.45	50.05	32.01	32.22
	SF-27 M	5	25.57	31.37	8.97	14.77	23.67	14.70	20.75	15.32	15.49
	SF-28 M	23	138.75	366.46	80.11	154.58	246.57	182.56	182.49	133.06	124.96
	SF-30 M	3	47.36	77.76	25.87	55.20	72.15	52.93	70.31	44.79	46.33
	SF-32 M	2	47.17	152.15	24.62	55.71	74.70	67.73	73.37	29.73	26.87
	SF-34 M	2	135.62	397.02	87.53	193.91	219.69	169.93	204.62	101.75	104.36
	IH-37 M	3	60.45	135.57	25.68	46.62	63.01	49.09	71.43	51.95	55.18
	IH-38 M	3	19.93	32.60	10.09	16.75	23.31	19.62	24.49	20.44	21.46
	IH-39 M	3	77.38	195.21	37.78	62.61	100.36	63.52	95.17	76.74	87.82
	PC-52 M	3	1215.13	1374.02	373.84	679.86	438.93	267.14	323.49	178.45	174.44
	PC-53 M	3	4988.55	5158.97	1220.33	2134.18	1476.74	1283.86	1374.80	937.41	954.59
	PC-54 M	3	672.31	1247.99	234.76	392.88	412.10	374.46	363.06	214.13	218.99

TABLE C.15. (contd)

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g/kg}$ dry weight)									
		Fluor-anthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno-[1,2,3-c,d]pyrene	Dibenzo-[a,h]anthracene	Benzo-[g, h, i]perylene
Comp LC	1	1204.53	1584.11	396.84	752.70	750.17	544.89	616.57	305.38	73.77	291.80
Comp LC-1	1	1365.35	2199.33	666.45	1293.01	1304.37	1003.24	1006.88	659.20	184.07	674.69
Comp LC-2	1	371.85	900.83	243.20	454.75	669.84	424.10	519.83	319.45	74.44	332.97
Comp LC-3	1	425.73	1047.96	238.07	462.50	695.77	393.58	438.80	258.82	53.15	254.75
Comp LC-4	1	5333.03	4413.68	1353.55	2016.53	1566.33	1003.43	1183.49	510.83	110.03	421.28
Comp LC-5	1	1571.53	1999.02	507.91	929.97	774.38	860.57	599.55	239.85	55.64	223.20
Comp LC-6	1	1453.12	1266.50	356.52	573.89	401.21	242.70	260.37	119.68	32.86	122.09
Comp USFC	1	1299.93	1401.28	389.61	516.67	533.67	505.71	451.46	279.46	52.70	260.97
Comp FSFC	1	169.29	300.30	91.89	186.22	204.23	156.50	205.33	126.53	26.22	128.40
Comp IHC-1	1	95.82	175.51	55.31	103.31	101.33	84.44	135.14	93.42	12.73	95.41
Comp IHC-2	1	74.46	117.13	42.85	63.29	79.25	46.67	80.71	65.03	8.81 J	70.97
Comp IHC-3	1	77.43	131.22	32.40	44.49	68.73	35.16	69.25	57.68	7.72 J	62.90
Comp GD	1	39.08	41.13	14.10	22.24	18.53	10.62	19.10	15.16	11.12 U	18.17
C-SFBF	1	82.29	107.55	32.38	40.29	39.58	32.79	58.92	46.58	3.67 J	53.38
C-SFBC	1	1.51 J	2.37 J	0.99 J	1.29 J	4.12 U	4.06 U	6.45 U	4.90 U	4.86 U	4.69 U
CBM Comp - Fine	3	4.51 J	7.18	1.11 J	1.28 J	1.49 J	1.49 J	1.39 J	0.93 J	4.82 U	1.03 J
CBM Comp - Coarse	3	27.07	28.44	7.27	13.29	9.06	5.44	4.33 J	2.71 J	0.51 J	2.89 J

(a) DL Detection limit.

(b) Recoveries of all three surrogate compounds were below acceptable quality control range (40%-120%) in original and repeat analyses. Repeat analysis data are reported here.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(d) U Analyte was not present above the associated value.

TABLE C.16. Quality Control Data for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

		PAH Concentration ($\mu\text{g/kg}$ dry weight)							
Sediment Treatment	Batch	Naphthalene	2-Methylnaphthalene	1-Methylnaphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Method Blanks									
Blank	1	9.17 U ^(a)	9.17 U	9.17 U	6.13 U	7.96 U	7.75 U	8.12 U	7.04 U
Blank	2	1.03 J ^(b)	8.87 U	8.87 U	5.93 U	7.70 U	7.50 U	7.86 U	6.82 U
Blank	5	0.68 J	8.27 U	8.27 U	5.53 U	7.19 U	6.99 U	0.81 J	0.23 J
Blank	23	0.45 J	9.50 U	9.50 U	6.35 U	8.25 U	8.03 U	8.41 U	7.30 U
Blank	25	0.33 J	8.98 U	8.98 U	6.00 U	7.80 U	7.59 U	7.95 U	6.90 U
Matrix Spikes									
C-SFBC	1	5.18 U	5.18 U ^(c)	5.18 U	3.46 U	4.49 U	4.38 U	0.37 J	3.98 U
C-SFBC MS	1	98.00	NA	NA	95.82	97.02	104.88	111.98	106.24
Concentration Recovered		98.00	NA	NA	95.82	97.02	104.88	111.61	106.24
Amount Spiked		125.63	NS ^(d)	NS	125.63	125.63	125.63	125.63	125.63
Percent Recovery		78%	NA	NA	76%	77%	83%	89%	85%
C-SFBC	1	5.18 U	5.18 U	5.18 U	3.46 U	4.49 U	4.38 U	0.37 J	3.98 U
C-SFBC MSD	1	90.03	NA	NA	89.27	89.70	94.73	101.20	98.11
Concentration Recovered		90.03	NA	NA	89.27	89.70	94.73	100.83	98.11
Amount Spiked		119.24	NS	NS	119.24	119.24	119.24	119.24	119.24
Percent Recovery		76%	NA	NA	75%	75%	79%	85%	82%
RPD		3%	NA	NA	2%	3%	5%	5%	3%
I-Stat		0.02	NA	NA	0.01	0.01	0.02	0.02	0.01
LZ-11 M	2	208.48	51.73	40.47	4.90	54.83	49.16	129.31	67.09
LZ-11 M MS	2	401.12	NA	NA	231.46	289.80	278.34	353.09	315.12
Concentration Recovered		192.64	NA	NA	226.56	234.97	229.18	223.78	248.03
Amount Spiked		311.04	NS	NS	311.04	311.04	311.04	311.04	311.04
Percent Recovery		62%	NA	NA	73%	76%	74%	72%	80%
LZ-11 M	2	208.48	51.73	40.47	4.90	54.83	49.16	129.31	67.09
LZ-11 M MSD	2	347.86	NA	NA	226.87	271.40	257.84	334.46	306.84
Concentration Recovered		139.38	NA	NA	221.97	216.57	208.68	205.15	239.75
Amount Spiked		341.10	NS	NS	341.10	341.10	341.10	341.10	341.10
Percent Recovery		41%	NA	NA	65%	63%	61%	60%	70%
RPD		41% ^(e)	NA	NA	11%	17%	19%	18%	13%
I-Stat		0.20	NA	NA	0.06	0.09	0.09	0.09	0.06
OBM Comp - Coarse	5	7.79	8.96	4.64 J	0.63 J	4.40 J	3.09 J	10.65	2.02 J
OBM Comp - Coarse MS	5	94.21	NA	NA	91.89	98.57	82.42	95.79	91.07
Concentration Recovered		86.42	NA	NA	91.26	94.17	79.33	85.14	89.05
Amount Spiked		125.10	NS	NS	125.10	125.10	125.10	125.10	125.10
Percent Recovery		69%	NA	NA	73%	75%	63%	68%	71%
OBM Comp - Coarse	5	7.79	8.96	4.64 J	0.63 J	4.40 J	3.09 J	10.65	2.02 J
OBM Comp - Coarse MSD	5	104.90	NA	NA	102.00	108.84	94.37	111.41	101.55
Concentration Recovered		97.11	NA	NA	101.37	104.44	91.28	100.76	99.53
Amount Spiked		130.83	NS	NS	130.83	130.83	130.83	130.83	130.83
Percent Recovery		74%	NA	NA	77%	80%	70%	77%	76%
RPD		7%	NA	NA	6%	6%	10%	12%	7%
I-Stat		0.04	NA	NA	0.03	0.03	0.05	0.06	0.03

TABLE C.16. (contd)

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g/kg}$ dry weight)							
		Naphtha- lene	2-Methyl- naphtha- lene	1-Methyl- naphtha- lene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
ME73	23	DNA (~)	DNA	DNA	DNA	DNA	DNA	DNA	DNA
ME73 MS	23	202.55	NA	NA	234.19	223.78	207.16	203.47	194.99
Amount Spiked		234.19	NS	NS	234.19	234.19	234.19	234.19	234.19
Percent Recovery		86%	NA	NA	100%	96%	88%	87%	83%
ME73	23	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
ME74 MSD	23	130.74	NA	NA	148.46	143.88	135.57	139.38	126.33
Amount Spiked		237.34	NS	NS	237.34	237.34	237.34	237.34	237.34
Percent Recovery		55%	NA	NA	63%	61%	57%	59%	53%
RPD		44% (e)	NA	NA	46% (e)	45% (e)	43% (e)	39% (e)	44% (e)
I-Stat		0.22	NA	NA	0.23	0.22	0.21	0.19	0.22
MH37	25	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH37 MS	25	330.56	NA	NA	346.27	330.52	331.38	329.87	313.28
Amount Spiked		496.69	NS	NS	496.69	496.69	496.69	496.69	496.69
Percent Recovery		67%	NA	NA	70%	67%	67%	66%	63%
MH37	25	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH38 MSD	25	355.32	NA	NA	369.80	349.02	353.70	350.70	327.84
Amount Spiked		499.17	NS	NS	499.17	499.17	499.17	499.17	499.17
Percent Recovery		71%	NA	NA	74%	70%	71%	70%	66%
RPD		7%	NA	NA	6%	5%	6%	6%	4%
I-Stat		0.03	NA	NA	0.03	0.02	0.03	0.03	0.02
<u>Analytical Duplicates</u>									
LZ-3 M	2	118.69	79.24	39.29	14.95	38.19	76.07	221.72	185.46
LZ-3 M Duplicate	2	130.98	89.93	45.91	16.17	51.57	84.05	274.39	251.61
RPD		10%	13%	16%	8%	30%	10%	21%	30%
I-Stat		0.05	0.06	0.08	0.04	0.15	0.05	0.11	0.15
PC-52 M	5	105.05	104.06	98.11	5.87 J	131.48	159.12	694.06	429.02
PC-52 M Duplicate	5	57.52	59.16	57.07	2.68 J	72.59	85.98	366.13	241.15
RPD		58% (e)	55% (e)	53% (e)	75%	58% (e)	60% (e)	62% (e)	56% (e)
I-Stat		0.29	0.28	0.26	0.37	0.29	0.30	0.31	0.28
C-SFBB	1	7.62 J	4.25 J	2.20 J	2.63 J	3.08 J	3.02 J	37.51	9.86
C-SFBB Duplicate	1	6.22 J	2.80 J	2.17 J	3.04 J	6.86 U	3.45 J	35.80	10.37
RPD		20%	41%	1%	14%	NA	13%	5%	5%
I-Stat		0.10	0.21	0.01	0.07	NA	0.07	0.02	0.03
<u>Compositing Duplicates</u>									
SF-32 M	2	10.88	6.64 J	2.50 J	2.14 J	3.61 J	6.44	30.31	25.08
SF-32 M Cdup (g)	2	14.68	8.18	3.49 J	4.84 J	4.30 J	9.51	61.15	52.13
RPD		30%	21%	33%	77%	17%	38%	67% (e)	70% (e)
I-Stat		0.15	0.10	0.17	0.39	0.09	0.19	0.34	0.35
Comp LC	1	104.73	84.63	36.80	17.67	55.67	76.02	368.34	215.56
Comp LC Cdup	1	11.54	6.97 J	3.28 J	2.47 J	2.24 J	5.64 J	30.47	16.33
RPD		160% (e)	170% (e)	167%	151%	185% (e)	172% (e)	169% (e)	172% (e)
I-Stat		0.80	0.85	0.84	0.75	0.92	0.86	0.85	0.86

TABLE C.16. (contd)

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g/kg}$ dry weight)							
		Naphtha- lene	2-Methyl- naphtha- lene	1-Methyl- naphtha- lene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
Comp IHC-2	1	8.89 J	5.32 J	2.37 J	2.47 J	2.79 J	4.11 J	34.97	12.94
Comp IHC-2 Cdup	1	11.78	7.46 J	2.97 J	3.61 J	3.63 J	5.55 J	47.67	17.09
RPD		28%	33%	22%	37%	26%	30%	31% (e)	28%
I-Stat		0.14	0.17	0.11	0.19	0.13	0.15	0.15	0.14

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) NA Not applicable.

(d) NS Not spiked.

(e) Value exceeds relative precision goal of $\leq 30\%$. For duplicates, one sample concentration must be >10 times the MDL.

(f) DNA Data not available.

(g) Compositing duplicate.

TABLE C.17. Quality Control Data for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

		PAH Concentration (µg/kg dry weight)									
Sediment Treatment	Batch	Fluor-anthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno-[1,2,3-c,d]pyrene	Dibenzo-[a,h]anthracene	Benzo-[g,h,i]perylene
Method Blanks											
Blank	1	8.23 U ^(a)	8.00 U	6.99 U	8.60 U	7.30 U	7.19 U	11.42 U	8.67 U	8.61 U	8.30 U
Blank	2	0.36 J ^(b)	0.22 J	6.76 U	8.32 U	7.06 U	6.96 U	11.05 U	8.39 U	8.33 U	8.03 U
Blank	5	1.73 J	2.00 J	0.89 J	0.87 J	0.85 J	0.83 J	10.31 U	7.83 U	7.77 U	7.49 U
Blank	23	0.09 J	0.15 J	7.24 U	8.91 U	0.10 J	0.08 J	11.83 U	8.98 U	8.92 U	0.09 J
Blank	25	8.06 U	0.12 J	6.85 U	8.42 U	7.15 U	7.05 U	11.18 U	8.49 U	8.43 U	8.13 U
Matrix Spikes											
C-SFBC	1	1.51 J	2.37 J	0.99 J	1.29 J	4.12 U	4.06 U	6.45 U	4.90 U	4.86 U	4.69 U
C-SFBC MS	1	122.05	121.26	112.45	111.98	121.86	109.65	115.25	112.36	103.41	107.05
Concentration Recovered		120.54	118.89	111.46	110.69	121.86	109.65	115.25	112.36	103.41	107.05
Amount Spiked		125.63	125.63	125.63	125.63	125.63	125.63	125.63	125.63	125.63	125.63
Percent Recovery		96%	95%	89%	88%	97%	87%	92%	89%	82%	85%
C-SFBC	1	1.51 J	2.37 J	0.99 J	1.29 J	4.12 U	4.06 U	6.45 U	4.90 U	4.86 U	4.69 U
C-SFBC MSD	1	110.07	111.87	99.02	96.58	99.27	103.75	103.13	100.90	92.38	98.53
Concentration Recovered		108.56	109.50	98.03	95.29	99.27	103.75	103.13	100.90	92.38	98.53
Amount Spiked		119.24	119.24	119.24	119.24	119.24	119.24	119.24	119.24	119.24	119.24
Percent Recovery		91%	92%	82%	80%	83%	87%	86%	85%	77%	83%
RPD		5%	3%	8%	10%	15%	0%	6%	6%	6%	3%
I-Stat		0.03	0.02	0.04	0.05	0.08	0.00	0.03	0.03	0.03	0.02
LZ-11 M	2	215.33	438.07	72.84	109.40	159.48	93.87	85.56	50.44	11.76	57.67
LZ-11 M MS	2	496.24	734.92	317.20	373.36	383.26	332.18	309.18	241.11	188.97	231.29
Concentration Recovered		280.91	296.85	244.36	263.96	223.78	238.31	223.62	190.67	177.21	173.62
Amount Spiked		311.04	311.04	311.04	311.04	311.04	311.04	311.04	311.04	311.04	311.04
Percent Recovery		90%	95%	79%	85%	72%	77%	72%	61%	57%	56%
LZ-11 M	2	215.33	438.07	72.84	109.40	159.48	93.87	85.56	50.44	11.76	57.67
LZ-11 M MSD	2	753.20	912.23	403.06	456.05	464.78	361.54	352.73	250.15	194.09	250.17
Concentration Recovered		537.87	474.16	330.22	346.65	305.3	267.67	267.17	199.71	182.33	192.5
Amount Spiked		341.10	341.10	341.10	341.10	341.10	341.10	341.10	341.10	341.10	341.10
Percent Recovery		158% ^(c)	139% ^(c)	97%	102%	90%	78%	78%	59%	53%	56%
RPD		54% ^(d)	37% ^(d)	21%	18%	22%	2%	9%	5%	6%	1%
I-Stat		0.27	0.19	0.10	0.09	0.11	0.01	0.04	0.02	0.03	0.01

C 90

TABLE C.17. (contd)

Sediment Treatment	Batch	PAH Concentration ($\mu\text{g/kg}$ dry weight)									
		Fluor- anthene	Pyrene	Benzo[a] anthra- cene	Chrysene	Benzo[b] fluor- anthene	Benzo[k] fluor- anthene	Benzo[a] pyrene	Indeno- [1,2,3- c, d] pyrene	Dibenzo- [a, h] anthra- cene	Benzo- [g, h, i] perylene
CBM Comp - Coarse	5	27.07	28.44	7.27	13.29	9.06	5.44	4.33 J	2.71 J	0.51 J	2.89 J
CBM Comp - Coarse MS	5	111.46	116.34	86.32	87.59	97.31	97.39	98.03	109.28	105.63	110.13
Concentration Recovered		84.39	87.9	79.05	74.3	88.25	91.95	93.7	106.57	105.12	107.24
Amount Spiked		125.10	125.10	125.10	125.10	125.10	125.10	125.10	125.10	125.10	125.10
Percent Recovery		67%	70%	63%	59%	71%	73%	75%	85%	84%	86%
CBM Comp - Coarse	5	27.07	28.44	7.27	13.29	9.06	5.44	4.33 J	2.71 J	0.51 J	2.89 J
CBM Comp - Coarse MSD	5	132.70	139.65	98.19	99.23	110.28	115.83	112.99	129.50	129.59	131.82
Concentration Recovered		105.63	111.21	90.92	85.94	101.22	110.39	108.66	126.79	129.08	128.93
Amount Spiked		130.83	130.83	130.83	130.83	130.83	130.83	130.83	130.83	130.83	130.83
Percent Recovery		81%	85%	69%	66%	77%	84%	83%	97%	99%	99%
RPD		18%	19%	10%	10%	9%	14%	10%	13%	16%	14%
I-Stat		0.09	0.09	0.05	0.05	0.05	0.07	0.05	0.06	0.08	0.07
ME73	23	DNA ^(e)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
ME73 MS	23	206.07	204.31	242.16	240.16	241.98	238.03	223.55	207.16	248.70	237.32
Amount Spiked		234.19	234.19	234.19	234.19	234.19	234.19	234.19	234.19	234.19	234.19
Percent Recovery		88%	87%	103%	103%	103%	102%	95%	88%	106%	101%
ME73	23	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
ME74 MSD	23	146.71	147.27	177.54	179.29	175.54	178.74	150.74	144.48	178.00	171.84
Amount Spiked		237.34	237.34	237.34	237.34	237.34	237.34	237.34	237.34	237.34	237.34
Percent Recovery		62%	62%	75%	76%	74%	75%	64%	61%	75%	72%
RPD		35% ^(d)	34% ^(d)	32% ^(d)	30% ^(d)	33% ^(d)	30%	40% ^(d)	37% ^(d)	34% ^(d)	33% ^(d)
I-Stat		0.17	0.17	0.16	0.15	0.16	0.15	0.19	0.18	0.17	0.17
MH37	25	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH37 MS	25	336.65	336.80	401.39	411.62	382.99	408.72	345.35	325.42	376.64	370.60
Amount Spiked		496.69	496.69	496.69	496.69	496.69	496.69	496.69	496.69	496.69	496.69
Percent Recovery		68%	68%	81%	83%	77%	82%	70%	66%	76%	75%
MH37	25	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH38 MSD	25	360.96	363.12	413.46	416.94	393.42	409.28	353.69	333.94	400.07	394.34
Amount Spiked		499.17	499.17	499.17	499.17	499.17	499.17	499.17	499.17	499.17	499.17
Percent Recovery		72%	73%	83%	84%	79%	82%	71%	67%	80%	79%
RPD		6%	7%	2%	1%	2%	0%	2%	2%	6%	6%
I-Stat		0.03	0.04	0.01	0.01	0.01	0.00	0.01	0.01	0.03	0.03

C.91

TABLE C.17. (contd)

		PAH Concentration ($\mu\text{g/kg}$ dry weight)									
Sediment Treatment	Batch	Fluor-anthene	Pyrene	Benz[a]anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benz[a]pyrene	Indeno-[1,2,3-c,d]pyrene	Di benzo-[a,h]anthracene	Benzo-[g,h,i]perylene
Analytical Duplicates											
C-SBBF	1	82.29	107.55	32.38	40.29	39.58	32.79	58.92	46.58	3.67 J	53.38
C-SBBF Duplicate	1	72.82	95.75	27.87	33.89	31.09	28.46	48.77	39.74	4.26 J	42.69
RPD		12%	12%	15%	17%	24%	14%	19%	16%	15%	22%
I-Stat		0.06	0.06	0.07	0.09	0.12	0.07	0.09	0.08	0.07	0.11
LZ-3 M	2	659.15	1457.88	302.51	444.17	934.90	409.15	530.28	252.82	52.14	238.00
LZ-3 M Duplicate	2	909.48	1715.11	285.28	466.86	553.56	293.91	349.54	174.93	37.01	170.75
RPD		32% (d)	16%	6%	5%	51% (d)	33% (d)	41% (d)	36% (d)	34% (d)	33% (d)
I-Stat		0.16	0.08	0.03	0.02	0.26	0.16	0.21	0.18	0.17	0.16
PC-52 M	5	1215.13	1374.02	373.84	679.86	438.93	267.14	323.49	178.45	30.66	174.44
PC-52 M Duplicate	5	610.15	693.36	161.69	298.74	188.68	142.84	162.69	105.50	18.01	137.44
RPD		66% (d)	66% (d)	79% (d)	78% (d)	80% (d)	61% (d)	66% (d)	51% (d)	52%	24%
I-Stat		0.33	0.33	0.40	0.39	0.40	0.30	0.33	0.26	0.26	0.12
Compositins Duplicates											
SF-32 M	2	47.17	152.15	24.62	55.71	74.70	67.73	73.37	29.73	5.50 J	26.87
SF-32 M Cdup (f)	2	113.67	312.52	75.84	197.79	197.10	154.73	189.43	73.51	12.32	61.95
RPD		83% (d)	69% (d)	102% (d)	112% (d)	90% (d)	78% (d)	88% (d)	85% (d)	77%	79% (d)
I-Stat		0.41	0.35	0.51	0.56	0.45	0.39	0.44	0.42	0.38	0.39
Comp LC	1	1204.53	1584.11	396.84	752.70	750.17	544.89	616.57	305.38	73.77	291.80
Comp LC Cdup	1	136.20	180.31	46.57	95.79	97.41	67.04	76.53	35.01	8.92	33.82
RPD		159% (d)	159% (d)	158% (d)	155% (d)	154% (d)	156% (d)	156% (d)	159% (d)	157% (d)	158% (d)
I-Stat		0.80	0.80	0.79	0.77	0.77	0.78	0.78	0.79	0.78	0.79
Comp IHC-2	1	74.46	117.13	42.85	63.29	79.25	46.67	80.71	65.03	8.81 J	70.97
Comp IHC-2 Cdup	1	111.95	180.27	46.79	73.11	85.21	53.48	93.94	76.06	6.27 J	85.51
RPD		40% (d)	42% (d)	9%	14%	7%	14%	15%	16%	34%	19%
I-Stat		0.20	0.21	0.04	0.07	0.04	0.07	0.08	0.08	0.17	0.09

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) Recovery outside of quality control range (40%-120%).

(d) Value exceeds relative precision goal of $\leq 30\%$. For duplicates, one sample concentration must be >10 times the MDL.

(e) DNA Data not available.

(f) Compositing duplicate.

TABLE C. 18. Surrogate Recoveries for Polynuclear Aromatic Hydrocarbons (PAHs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		Naphthalene d8	Acenaphthene d10	Benzo[a]pyrene d12
LZ-1 M	2	45.05	49.22	48.78
LZ-3 M	2	42.93	50.70	48.40
LZ-6 M	2	40.80	45.37	31.03 ^(a)
LZ-9 M	2	43.42	52.35	44.58
LZ-11 M	2	52.24	61.54	62.55
LZ-13 M	25	29.93 ^(a)	38.89 ^(a)	39.53 ^(a)
LZ-15 M	1	45.70	52.86	61.53
SF-17 M	2	40.11	44.29	55.56
SF-18 M	2	43.81	49.05	59.65
SF-19 M	2	41.27	45.91	55.69
SF-20 M	2	42.07	46.76	62.62
SF-21 M	2	49.35	53.86	67.45
SF-22 M	2	47.22	53.17	61.54
SF-23 M	2	58.47	55.23	53.46
SF-24 M	2	42.10	47.78	65.23
SF-25 M	2	44.80	53.63	64.77
SF-26 M	5	58.07	56.72	75.38
SF-27 M	5	53.71	51.01	71.40
SF-28 M	23	48.05	57.20	55.96
SF-30 M	5	43.83	43.17	63.03
SF-32 M	2	48.64	49.89	61.53
SF-34 M	2	47.88	50.50	61.94
IH-37 M	5	58.72	56.54	78.45
IH-38 M	5	46.13	44.30	60.54
IH-39 M	5	45.72	51.77	69.31
PC-52 M	5	53.93	55.08	66.84
PC-53 M	5	55.58	64.14	77.82
PC-54 M	5	39.57 ^(a)	40.29	51.92
Comp LC	1	64.74	78.70	78.94
Comp LC-1	1	52.59	67.39	71.20
Comp LC-2	1	52.56	70.08	67.85
Comp LC-3	1	50.42	60.42	59.74
Comp LC-4	1	55.26	62.91	75.25
Comp LC-5	1	45.83	57.82	49.14
Comp LC-6	1	56.33	70.01	54.14
Comp USFC	1	58.25	70.11	76.55
Comp FSFC	1	50.67	58.88	67.79
Comp IHC-1	1	51.71	63.94	81.26
Comp IHC-2	1	47.93	60.47	73.07
Comp IHC-3	1	50.72	56.86	62.57
Comp GD	1	51.13	58.07	34.73 ^(a)

TABLE C. 18. (contd)

Sediment Treatment	Batch	Surrogate Percent Recoveries		
		Naphthalene d8	Acenaphthene d10	Benzo[a]pyrene d12
C-SFBF	1	50.58	57.12	69.51
C-SFBC	1	58.83	65.00	73.45
CBM Comp - Fine	5	54.58	53.39	66.38
CBM Comp - Coarse	5	69.12	65.79	79.51
<u>Quality Control Samples</u>				
<u>Method Blanks</u>				
Blank	1	68.60	75.07	63.83
Blank	2	55.03	58.01	65.61
Blank	5	75.92	70.05	78.07
Blank	23	80.25	88.30	77.04
Blank	25	61.51	65.78	56.88
<u>Matrix Spikes</u>				
C-SFBC MS	1	67	76	78
C-SFBC MSD	1	66	72	78
LZ-11 M MS	2	54	63	68
LZ-11 M MSD	2	48	54	60
CBM Comp - Coarse MS	5	64	59	76
CBM Comp - Coarse MSD	5	68	62	82
ME73 MS	23	78	83	79
ME74 MSD	23	49	51	52
MH37 MS	25	62	65	58
MH38 MSD	25	65	68	59
<u>Analytical Duplicates</u>				
C-SFBF Duplicate	1	46.19	54.43	66.93
LZ-3 M Duplicate	2	57.04	70.25	70.41
PC-52 M Duplicate	5	52.55	51.80	68.13
<u>Compositing Duplicates</u>				
SF-32 M Cdup ^(b)	2	46.37	54.63	63.86
Comp LC Cdup	1	63.14	71.57	78.11
Comp IHC-2 Cdup	1	48.56	59.82	77.00

(a) Recovery outside of quality control range (40%-120%).

(b) Compositing duplicate.

TABLE C.19. Polychlorinated Biphenyls (PCBs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Surrogate Percent Recovery			PCBs ($\mu\text{g/kg}$ dry weight)			
		DBOFB	CL5(112)	CL5(103)	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Target DL ^(a)					20	20	20	20
Achieved DL High					55.40	55.40	55.40	55.40
Achieved DL Low					21.71	21.71	21.71	21.71
LZ-1 M	2	49.22	MI ^(b)	MI	55.40 U ^(c)	55.40 U	310.86	55.40 U
LZ-3 M	2	45.87	MI	MI	41.22 U	41.22 U	465.88	41.22 U
LZ-6 M	2	74.63	MI	52.45	29.92 U	29.92 U	280.07	29.92 U
LZ-9 M	2	84.04	MI	64.75	36.91 U	36.91 U	201.07	36.91 U
LZ-11 M	2	103.09	MI	50.15	30.18 U	30.18 U	236.45	30.18 U
LZ-13 M	2	49.04	67.59	43.81	35.28 U	35.28 U	108.41	35.28 U
LZ-15 M	1	81.97	81.56	72.71	44.80 U	44.80 U	44.80 U	44.80 U
SF-17 M	2	79.67	74.63	60.72	38.89 U	38.89 U	78.18	38.89 U
SF-18 M	2	78.68	86.96	61.09	43.78 U	43.78 U	125.69	43.78 U
SF-19 M	2	79.45	65.20	61.66	43.85 U	43.85 U	25.68 J ^(d)	43.85 U
SF-20 M	2	81.39	74.29	66.88	47.72 U	47.72 U	44.05 J	47.72 U
SF-21 M	2	95.02	83.98	76.56	41.25 U	41.25 U	37.77 J	41.25 U
SF-22 M	2	86.99	88.59	71.14	38.33 U	38.33 U	91.46	38.33 U
SF-23 M	2	112.18	84.53	75.55	40.15 U	40.15 U	21.43 J	40.15 U
SF-24 M	2	90.88	78.52	70.04	40.68 U	40.68 U	49.83	40.68 U
SF-25 M	2	98.83	111.17	76.55	32.03 U	32.03 U	109.92	32.03 U
SF-26 M	3	57.17	61.54	57.59	39.11 U	39.11 U	14.70 J	39.11 U
SF-27 M	3	53.00	55.87	53.34	38.60 U	38.60 U	4.82 J	38.60 U
SF-28 M ^(e)	23	55.64	69.64	63.01	33.43 U	33.43 U	59.36	33.43 U
SF-30 M	3	45.11	50.69	45.06	42.61 U	42.61 U	11.80 J	42.61 U
SF-32 M	2	92.09	78.07	68.29	28.94 U	28.94 U	17.35 J	28.94 U
SF-34 M	2	89.00	94.47	65.17	34.45 U	34.45 U	58.62	34.45 U
IH-37 M	3	61.84	65.75	59.42	39.50 U	39.50 U	13.76 J	39.50 U
IH-38 M	3	47.83	48.45	46.39	40.95 U	40.95 U	6.21 J	40.95 U
IH-39 M	3	56.17	61.52	56.66	39.92 U	39.92 U	30.60 J	39.92 U
PC-52 M	3	59.82	46.29	54.68	39.70 U	39.70 U	675.00	39.70 U
PC-53 M	3	42.96	94.77	104.06	38.44 U	38.44 U	1981.91	38.44 U
PC-54 M	3	40.04	MI	64.31	35.66 U	35.66 U	567.81	35.66 U
Comp LC	1	119.02	MI	97.29	38.62 U	38.62 U	283.10	38.62 U
Comp LC-1	1	66.20	MI	MI	51.56 U	51.56 U	1116.77	51.56 U
Comp LC-2	1	49.41	MI	MI	43.24 U	43.24 U	303.73	43.24 U
Comp LC-3	1	82.23	MI	82.01	35.68 U	35.68 U	244.63	35.68 U
Comp LC-4	1	108.86	MI	86.83	41.59 U	41.59 U	171.26	41.59 U
Comp LC-5	1	74.52	MI	41.11	36.67 U	36.67 U	274.33	36.67 U
Comp LC-6	1	50.86	MI	MI	37.08 U	37.08 U	296.93	37.08 U
Comp USFC	1	99.95	109.21	78.13	43.34 U	43.34 U	153.30	43.34 U
Comp FSFC	1	79.09	104.12	66.13	39.95 U	39.95 U	63.54	39.95 U
Comp IHC-1	1	102.62	81.25	63.08	40.21 U	40.21 U	33.54 J	40.21 U
Comp IHC-2	1	88.13	80.68	76.58	42.94 U	42.94 U	13.06 J	42.94 U
Comp IHC-3	1	73.55	67.99	65.10	42.87 U	42.87 U	17.38 J	42.87 U
Comp GD	1	85.43	73.39	73.05	50.08 U	50.08 U	14.84 J	50.08 U
C-SFBF	1	58.64	59.50	59.51	34.68 U	34.68 U	6.72 J	34.68 U
C-SFBC	1	84.51	85.33	77.90	21.90 U	21.90 U	21.90 U	21.90 U
OBM Comp - Fine	3	50.64	60.34	53.31	21.71 U	21.71 U	21.71 U	21.71 U
OBM Comp - Coarse	3	69.07	74.30	63.47	24.15 U	24.15 U	24.15 U	24.15

(a) DL Detection limit.

(b) MI Matrix interference.

(c) U Analyte was not present above the level of associated value.

(d) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(e) QC data are not applicable.

TABLE C.20. Quality Control Data for Polychlorinated Biphenyls (PCBs) in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

		PCBs ($\mu\text{g/kg}$ drv weight)						
Sediment Treatment	Batch	Surrogate DBOFB	Percent CL5(112)	Recovery CL5(103)	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Method Blanks								
Blank	1	108.92	80.37	88.02	38.79 U ^(a)	38.79 U	38.79 U	38.79 U
Blank	2	92.26	83.35	75.31	37.53 U	37.53 U	37.53 U	37.53 U
Blank	3	74.26	65.12	69.78	35.01 U	35.01 U	35.01 U	35.01 U
Blank	23	92.44	81.29	59.02	40.18 U	40.18 U	40.18 U	40.18 U
Matrix Spikes								
LZ-11 M	2	103.09	MI ^(b)	50.15	30.18 U ^(c)	30.18 U	236.45	30.18 U
LZ-11 M MS	2				NA	NA	477.94	NA
Concentration Recovered					NA	NA	241.49	NA
Amount Spiked					NS ^(d)	NS	248.83	NS
Percent Recovery		69	MI	MI	NA	NA	97%	NA
LZ-11 M	2	103.09	MI	50.15	30.18 U	30.18 U	236.45	30.18 U
LZ-11 M MS	2				NA	NA	450.91	NA
Concentration Recovered					NA	NA	214.46	NA
Amount Spiked					NS	NS	272.88	NS
Percent Recovery		61	MI	MI	NA	NA	79%	NA
RPD					NA	NA	21%	NA
I-Stat					NA	NA	0.11	NA
C-SFBC	1	84.51	85.33	77.90	21.90 U	21.90 U	21.90 U	21.90 U
C-SFBC MS	1				NA	NA	78.97	NA
Concentration Recovered					NA	NA	78.97	NA
Amount Spiked					NS	NS	100.50	NS
Percent Recovery		88	85	84	NA	NA	79%	NA
C-SFBC	1	84.51	85.33	77.90	21.90 U	21.90 U	21.90 U	21.90 U
C-SFBC MS	1				NA	NA	72.01	NA
Concentration Recovered					NA	NA	72.01	NA
Amount Spiked					NS	NS	95.39	NS
Percent Recovery		88	83	80	NA	NA	75%	NA
RPD					NA	NA	4%	NA
I-Stat					NA	NA	0.02	NA
OBM Comp - Coarse	3	69.07	74.30	63.47	24.15 U	24.15 U	24.15 U	24.15 U
OBM Comp - Coarse	3				NA	NA	53.47	NA
Concentration Recovered					NA	NA	53.47	NA
Amount Spiked					NS	NS	100.08	NS
Percent Recovery		55	60	58	NA	NA	53%	NA
OBM Comp - Coarse	3	69.07	74.30	63.47	24.15 U	24.15 U	24.15 U	24.15 U
OBM Comp - Coarse	3				NA	NA	61.13	NA
Concentration Recovered					NA	NA	61.13	NA
Amount Spiked					NS	NS	104.67	NS
Percent Recovery		63	66	61	NA	NA	58%	NA
RPD					NA	NA	9%	NA
I-Stat					NA	NA	0.04	NA

TABLE C.20. (con td)

Sediment Treatment	Batch	Surrogate Percent Recovery			PCBs ($\mu\text{g/kg}$ dry weight)			
		DBOFB	CL5(112)	CL5(103)	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Analytical Duplicates								
LZ-3 M	2	45.87	MI	MI	41.22 U	41.22 U	465.88	41.22 U
LZ-3 M Duplicate	2	66.08	MI	MI	41.56 U	41.56 U	594.92	41.56 U
RPD					NA	NA	24%	NA
I-Stat					NA	NA	0.12	NA
PC-52 M	3	59.82	46.29	54.68	39.70 U	39.70 U	675.00	39.70 U
PC-52 M Duplicate	3	51.99	54.70	55.40	39.53 U	39.53 U	450.35	39.53 U
RPD					NA	NA	40% ^(e)	NA
I-Stat					NA	NA	0.20	NA
C-SFBF	1	58.64	59.50	59.51	34.68 U	34.68 U	6.72 J ^(f)	34.68 U
C-SFBF Duplicate	1	69.04	69.54	63.94	33.43 U	33.43 U	4.86 J	33.43 U
RPD					NA	NA	32%	NA
I-Stat					NA	NA	0.16	NA
Compositing Duplicates								
SF-32 M	2	92.09	78.07	68.29	28.94 U	28.94 U	17.35 J	28.94 U
SF-32 M Cdup ^(g)	2	91.04	85.23	67.77	32.96 U	32.96 U	17.86 J	32.96 U
RPD					NA	NA	3%	NA
I-Stat					NA	NA	0.01	NA
Comp IHC-2	1	88.13	80.68	76.58	42.94 U	42.94 U	13.06 J	42.94 U
Comp IHC-2 Cdup	1	99.87	84.30	79.40	43.65 U	43.65 U	21.77 J	43.65 U
RPD					NA	NA	50%	NA
I-Stat					NA	NA	0.25	NA
Comp LC	1	119.02	MI	97.29	38.62 U	38.62 U	283.10	38.62 U
Comp LC Cdup	1	112.72	MI	99.27	38.28 U	38.28 U	20.50 J ^(e)	38.28 U
RPD					NA	NA	172%	NA
I-Stat					NA	NA	0.86	NA

(a) U Analyte was not present above the level of associated value.

(b) MI Matrix interference.

(c) NA Not applicable.

(d) NS Not spiked.

(e) Value exceeds relative precision goal of $\leq 30\%$. For duplicates, one sample concentration must be >10 times the MDL.

(f) J Analyte detected below method detection limits (MDL), but above instrument detection limit (IDL).

(g) Compositing duplicate.

TABLE C.21. Metals in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Metals (mg/kg dry weight)									
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Target DL ^(a)	0.02	2.5	0.1	33	5.5	0.01	7.5	6.2	0.20	7.8
Achieved DL High	0.01	7.0	0.01	33	5.5	0.01	7.5	6.2	0.10	7.8
Achieved DL Low	0.01	4.6	0.01	33	5.5	0.006	7.5	6.2	0.10	7.8
LZ-1 M	1.62	16.4	2.12	177	138	2.18	91.4	223	0.60	544
LZ-3 M	1.27	15.5	1.87	224	134	1.70	102	222	0.50	378
LZ-6 M	0.60	15.7	1.28	237	113	0.964	105	120	0.30	279
LZ-9 M	0.59	18.4	1.04	254	105	0.779	102	78.8	0.40	262
LZ-11 M	0.70	15.1	1.70	235	99.3	1.41	93.4	82.0	0.60	228
LZ-13 M	0.42	20.1	1.02	3990	212	0.554	124	102	0.46	360
LZ-15 M	0.41	15.6	0.53	251	155	0.530	122	95.9	0.40	255
SF-17 M	0.57	14.1	0.92	166	104	1.39	97.8	69.1	0.45	196
SF-18 M	0.53	15.0	0.74	176	101	1.13	109	75.2	0.41	223
SF-19 M	0.62	14.5	0.73	170	104	1.11	103	67.4	0.41	202
SF-20 M	0.52	14.5	0.50	168	106	0.758	116	58.6	0.51	209
SF-21 M	0.55	17.0	0.60	170	94.9	0.988	116	65.8	0.45	200
SF-22 M	0.45	26.6	1.21	173	168	1.18	106	65.9	0.45	396
SF-23 M	0.48	16.8	0.54	177	88.5	0.690	104	48.8	0.45	182
SF-24 M	0.47	17.4	0.66	180	114	1.01	112	60.4	0.45	206
SF-25 M	0.39	13.4	0.78	200	64.9	0.915	90.5	46.4	0.45	169
SF-26 M	0.74	17.6	0.88	196	107	1.25	108	70.6	0.49	226
SF-27 M	0.51	15.4	0.67	187	86.2	0.851	104	60.5	0.36	190
SF-28 M	0.43	11.6	0.50	181	68.9	0.611	92.6	42.7	0.40	157
SF-30 M	0.51	14.3	0.47	211	100	0.609	110	62.0	0.40	242
SF-32 M	0.16	14.8	0.39	199	49.5	0.308	83.0	23.4	0.26	105
SF-34 M	0.34	14.2	0.77	241	61.5	0.332	96.9	32.9	0.40	143
IH-37 M	0.47	13.0	0.47	183	72.6	0.519	112	55.5	0.36	181
IH-38 M	0.48	15.5	0.50	177	74.8	0.473	117	48.5	0.40	184
IH-39 M	0.58	15.7	0.60	192	73.8	0.532	115	54.7	0.35	192
PC-52 M	0.98	7.0 U ^(b)	3.17	245	138	0.924	86.0	849	0.45	709
PC-53 M	0.87	6.8 U	3.06	233	124	0.800	84.8	807	0.41	707
PC-54 M	0.60	11.9	1.99	266	98.1	0.707	86.3	323	0.40	401
Comp LC	0.42	4.6 U	0.94	273	96.6	1.12	93.4	314	0.50	238
Comp LC-1	0.67	16.1	2.06	285	202	1.27	106	225	0.75	517
Comp LC-2	0.75	19.1	1.37	273	171	0.983	103	152	0.55	444
Comp LC-3	0.40	14.4	0.90	242	119	0.691	92.3	119	0.41	313
Comp LC-4	0.37	14.4	0.55	248	118	0.593	99.7	53.7	0.45	201
Comp LC-5	0.60	19.7	1.25	326	214	0.826	92.5	92.1	0.65	244
Comp LC-6	0.95	12.1	1.54	1540	100	1.37	101	372	0.51	369
Comp USFC	0.66	9.3	1.02	143	92.5	1.48	81.2	65.6	0.45	213
Comp FSFC	0.44	15.9	0.65	221	91.3	0.520	113	53.2	0.35	199
Comp IHC-1	0.43	15.7	0.42	200	84.8	0.543	114	46.3	0.40	194
Comp IHC-2	0.36	17.0	0.29	209	75.8	0.477	130	43.5	0.40	187
Comp IHC-3	0.37	16.8	0.36	203	67.0	0.461	115	41.9	0.26	171
Comp GD	0.36	13.9	0.21	192	71.5	0.442	106	35.7	0.31	172
C-SFBB	0.20	13.7	0.25	191	36.0	0.249	90.5	20.5	0.26	108
C-SFBC	0.05	9.8	0.10	383	11.5	0.030	84.4	10.7	0.11	76.9
CBM Comp - Fine	0.13	6.8	0.54	170	29.3	0.093	75.6	17.1	0.21	79.9
CBM Comp - Coarse	0.10	9.4	0.39	267	16.2	0.077	63.5	9.0	0.10 U	54.0

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

TABLE C.22. Quality Control Data for Metals in Younger Bay Mud from Selected Cores and Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Metals (mg/kg dry weight)									
	Ag	As	Cd	Cr	Cu	Co	Al	Pb	Se	Zn
<u>Method Blanks</u>										
Blank-1	0.01	NA ^(a)	0.01 U ^(b)	NA	NA	0.01 U	NA	NA	0.10 U	NA
Blank-2	0.02	NA	0.01	NA	NA	0.01 U	NA	NA	0.10 U	NA
Blank-3	0.02	NA	0.01	NA	NA	0.006 U	NA	NA	0.10 U	NA
Blank-4	0.02	NA	0.01	NA	NA	0.006 U	NA	NA	0.10 U	NA
<u>Matrix Spikes</u>										
Comp LC-5 ^(c)	0.59	NA	1.20	NA	NA	0.800	NA	NA	0.66	NA
Comp LC-5 MS	2.31	NA	2.92	NA	NA	2.65	NA	NA	2.81	NA
Concentration Recovered	1.72	NA	1.72	NA	NA	1.85	NA	NA	2.15	NA
Amount Spiked	2.00	NS ^(d)	2.00	NS	NS	2.00	NS	NS	2.00	NS
Percent Recovered	86%	NA	86%	NA	NA	93%	NA	NA	108%	NA
LZ-15 M ^(c)	0.43	15.9	0.53	253	157	0.538	126	97.0	0.40	259
LZ-15 M MS	2.10	NA	2.19	NA	NA	2.69	NA	NA	2.08	NA
Concentration Recovered	1.67	NA	1.66	NA	NA	2.15	NA	NA	1.68	NA
Amount Spiked	2.00	NS	2.00	NS	NS	2.00	NS	NS	2.00	NS
Percent Recovered	84%	NA	83%	NA	NA	108%	NA	NA	84%	NA
IH-37 M ^(c)	0.47	15.8	0.50	191	73.7	0.504	117	55.2	0.36	183
IH-37 M MS	2.35	NA	2.09	NA	NA	2.47	NA	NA	1.96	NA
Concentration Recovered	1.88	NA	1.59	NA	NA	1.97	NA	NA	1.60	NA
Amount Spiked	2.00	NS	2.00	NS	NS	2.00	NS	NS	2.00	NS
Percent Recovered	94%	NA	80%	NA	NA	98%	NA	NA	80%	NA
<u>Standard Reference Material</u>										
Certified Value 1646	NC ^(e)	11.6	0.36	76	18	0.063	32	28.2	NC	138
	NC	±1.3	±0.07	±3	±3	±0.012	±3	±1.8	NC	±6
SRM 1646 Replicate	0.10	13.1	0.37	71	13.8	0.074	36.0	25.7	0.55	136
SRM 1646 Replicate	0.10	10.6	0.38	82	17.7	0.076	36.3	27.5	0.50	135
SRM 1646 Replicate	0.10	9.6	0.40	78	14.7	0.074	31.5	28.3	0.50	132
SRM 1646 Replicate	0.11	NA	0.40	NA	NA	NA	NA	NA	0.50	NA
<u>Analytical Duplicate</u>										
Comp LC-5	0.60	19.7	1.25	326	214	0.826	92.5	92.1	0.65	244
Comp LC-5 Duplicate	0.57	NA	1.14	NA	NA	0.773	NA	NA	0.66	NA
RPD	5%	NA	9%	NA	NA	7%	NA	NA	2%	NA
I-Stat	0.03	NA	0.05	NA	NA	0.03	NA	NA	0.01	NA
Comp LC-6	0.95	12.1	1.54	1540	100	1.37	101	372	0.51	369
Comp LC-6 Duplicate	NA	10.3	NA	1190	102	NA	96.8	310	NA	345
RPD	NA	16%	NA	26% ^(f)	2%	NA	5%	18%	NA	7%
I-Stat	NA	0.08	NA	0.13	0.01	NA	0.02	0.09	NA	0.03
LZ-15 M	0.41	15.6	0.53	251	155	0.530	122	95.9	0.40	255
LZ-15 Duplicate	0.44	16.2	0.52	254	159	0.545	129	98.1	0.40	262
RPD	7%	4%	2%	1%	2%	3%	6%	2%	0%	3%
I-Stat	0.04	0.02	0.01	0.01	0.01	0.01	0.03	0.01	0.00	0.01
IH-37 M	0.47	13.0	0.47	183	72.6	0.519	112	55.5	0.36	181
IH-37 Duplicate	0.46	18.6	0.52	199	74.7	0.488	121	54.9	0.36	184
RPD	2%	35% ^(f)	10%	8%	3%	6%	8%	1%	0%	2%
I-Stat	0.01	0.18	0.05	0.04	0.01	0.03	0.04	0.01	0.00	0.01

TABLE C.22. (contd)

Sediment Treatment	Metals (mg/kg dry weight)									
	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn	
Compositing Duplicates										
SF-32 M	0.16	14.8	0.39	199	49.5	0.308	83.0	23.4	0.26	105
SF-32 M Cdup (g)	0.16	11.5	0.36	205	38.1	0.397	83.7	25.7	0.26	104
RPD	0%	25% (f)	8%	3%	26% (f)	25% (f)	1%	9%	0%	1%
I-Stat	0.00	0.13	0.04	0.01	0.13	0.13	0.00	0.05	0.00	0.01
Comp LC	0.42	4.6 U	0.94	273	96.6	1.12	93.4	314	0.50	238
Comp LC Cdup	0.45	14.4	0.98	230	105	0.806	98.4	86.8	0.51	283
RPD	7%	NA	4%	17%	8%	32% (f)	5%	113% (f)	2%	17%
I-Stat	0.03	NA	0.02	0.09	0.04	0.16	0.03	0.57	0.01	0.09
Comp IHC-2	0.36	17.0	0.29	209	75.8	0.477	130	43.5	0.40	187
Comp IHC-2 Cdup	0.38	15.4	0.27	196	69.9	0.443	116	38.6	0.36	171
RPD	5%	10%	7%	6%	8%	7%	11%	12%	11%	8%
I-Stat	0.03	0.05	0.04	0.03	0.04	0.04	0.06	0.06	0.05	0.04

- (a) NA Not applicable.
 (b) U Analyte was not present above the associated value.
 (c) Mean of duplicated sample.
 (d) NS Not spiked.
 (e) NC Not certified.
 (f) Value exceeds relative precision goal of $\leq 20\%$.
 (g) Compositing duplicate.

TABLE C.23. Butyltins in Younger Bay Mud Sediment from Selected Cores and in Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Triphenyltin Surrogate Percent Recovery	Butyltins ($\mu\text{g/kg}$ dry weight)	
			Tributyltin	Dibutyltin
Target DL ^(a)			10	10
Achieved DL			8	5
LZ-1 M ^(b)	1	77	13.2	11.6
LZ-3 M	1	65	17.6	15.0
LZ-6 M	1	64	10.8	10.6
LZ-9 M	1	82	22.0	23.6
LZ-11 M	1	76	5.3 J ^(c)	4.5 J
LZ-13 M	1	84	37.5	21.9
LZ-15 M	2	101	24.9	12.4
SF-17 M	2	109	19.6	27.2
SF-18 M	2	104	85.5	50.5
SF-19 M	2	109	39.0	56.3
SF-20 M	2	106	29.9	45.9
SF-21 M	2	103	12.2	16.7
SF-22 M	2	105	19.9	13.9
SF-23 M	2	92	23.6	31.8
SF-24 M	2	103	27.2	28.7
SF-25 M	2	102	17.2	11.0
SF-26 M	2	103	13.2	10.4
SF-27 M	2	106	28.0	16.0
SF-28 M	2	103	13.1	16.7
SF-30 M	2	104	16.0	14.7
SF-32 M	2	89	7.9 J	3.6 J
SF-34 M	2	78	12.0	7.6
IH-37 M	4	104	5.1 J	7.6
IH-38 M	4	99	7.4 J	8.9
IH-39 M	3	** ^(d)	8.1	6.7
PC-52 M	4	100	28.0 D1 ^(e)	8.3 D1
PC-53 M	4	100	20.2 D1	15.9 D1
PC-54 M	3	87	36.3	28.7
Comp LC	1	70	33.7	28.1
Comp LC-1	1	51	83.6	85.6
Comp LC-2	1	30 ^(f)	60.7	56.9
Comp LC-3	1	71	30.3	31.4
Comp LC-4	1	85	209.6 D ^(g)	55.9 D
Comp LC-5	1	70	14.9	13.0
Comp LC-6	1	71	6.0 J	5.3

TABLE C.23. (contd)

<u>Sediment Treatment</u>	<u>Batch</u>	<u>Tripentyltin Surrogate Percent Recovery</u>	<u>Butyltins ($\mu\text{g/kg}$ dry weight)</u>	
			<u>Tributyltin</u>	<u>Dibutyltin</u>
Comp USFC	1	54	39.3	37.4
Comp FSFC	1	66	18.0	12.3
Comp IHC-1	1	60	13.3	7.6
Comp IHC-2	2	99	8.7	4.0 J
Comp IHC-3	2	112	7.3 J	3.7 J
Comp GD	1	61	16.6	5.7
C-SFBF	1	75	5.9 J	19.6
C-SFBC	1	93	2.7 J	5.0 U ^(h)
OBM Comp-Fine	3	66	2.8 J	5.0 U
OBM Comp-Coarse	3	93	3.5 J	5.0 U

-
- (a) DL Detection limit. These detection limits represent quantitation limits (LOQ).
- (b) Segment M: mudline to Younger Bay Mud/Older Bay Mud boundary.
- (c) J Analyte detected below Limit of Quantitation (LOQ), but above method detection limit (MDL).
- (d) ** Surrogate internal standard not added; final internal standard used for quantitation.
- (e) D1 Sample diluted 1:10.
- (f) Recovery outside quality control range (40%-120%).
- (g) D Sample diluted 1:2.
- (h) U Analyte was not present above the associated value.

TABLE C.24. Quality Control Data for Butyltins in Younger Bay Mud Sediment from Selected Cores and in Sediment Composites, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Triphenyltin Surrogate Percent Recovery	Butyltins (µg/kg dry weight)	
			Tributyltin	Dibutyltin
Method Blanks				
Blank 1	1	82	5.3 J ^(a)	1.8 J
Blank 2	2	97	6.8 J	5.0 U ^(b)
Blank 3	3	** ^(c)	8.0 U	5.0 U
Blank 4	4	99	8.0 U	5.0 U
Matrix Spikes				
C-SFBC	1	93	2.7 J	5.0 U
C-SFBC MS	1	79	37.3	31.8
Concentration Recovered		NA ^(d)	34.6	31.8
Amount Spiked		NS ^(e)	36.3	36.3
Percent Recovery		NA	95%	88%
C-SFBC	1	93	2.7 J	5.0 U
C-SFBC MSD	1	79	37.6	31.2
Concentration Recovered		NA	34.9	31.2
Amount Spiked		NS	36.7	36.7
Percent Recovery		NA	95%	85%
MS/MSD RPD		NA	0%	3%
MS/MSD I-Stat		NA	0.00	0.02
SF-17 M ^(f)	2	109	19.6	27.2
SF-17 M MS	2	100	62.7	61.6
Concentration Recovered		NA	43.1	34.4
Amount Spiked		NS	50.6	50.6
Percent Recovery		NA	85%	68%
SF-17 M	2	109	19.6	27.2
SF-17 M MSD	2	108	72.3	78.9
Concentration Recovered		NA	52.7	51.7
Amount Spiked		NS	49.5	49.5
Percent Recovery		NA	106%	104%
MS/MSD RPD		NA	22%	42% ^(g)
MS/MSD I-Stat		NA	0.11	0.21

TABLE C.24. (contd)

Sediment Treatment	Batch	Triphenyltin Surrogate Percent Recovery	Butyltins ($\mu\text{g/kg}$ dry weight)	
			Tributyltin	Dibutyltin
IH-39 M	3	**	8.1	6.7
IH-39 M MS	3	98	58.3	36.9
Concentration Recovered		NA	50.2	30.2
Amount Spiked		NS	54.0	54.0
Percent Recovery		NA	93%	56%
IH-39 M	3	**	8.1	6.7
IH-39 M MSD	3	100	56.3	44.0
Concentration Recovered		NA	48.2	37.3
Amount Spiked		NS	55.0	55.0
Percent Recovery		NA	88%	68%
MS/MSD RPD		NA	6%	19%
MS/MSD I-Stat		NA	0.03	0.10
<u>Analytical Duplicates</u>				
C-SFBF	1	75	5.9 J	19.6
C-SFBF Duplicate	1	76	4.8 J	23.4
RPD		NA	21%	18%
I-Stat		NA	0.10	0.09
SF-21 M	2	103	12.2	16.7
SF-21 M Duplicate	2	113	13.0	14.8
RPD		NA	6%	12%
I-Stat		NA	0.03	0.06
PC-54 M	3	87	36.3	28.7
PC-54 M Duplicate	3	84	38.2	30.8
RPD		NA	5%	7%
I-Stat		NA	0.03	0.04
<u>Compositing Duplicates</u>				
SF-32 M	2	89	7.9 J	3.6 J
SF-32 M Cdup ^(h)	2	113	5.9 J	2.9 J
RPD		NA	29%	22%
I-Stat		NA	0.14	0.11
Comp LC	1	70	33.7	28.1
Comp LC Cdup	1	80	35.5	27.0
RPD		NA	5%	4%
I-Stat		NA	0.03	0.02

TABLE C.24. (contd)

Sediment Treatment	Batch	Triphenyltin Surrogate Percent Recovery	Butyltins ($\mu\text{g/kg dry weight}$)	
			Tributyltin	Dibutyltin
Comp IHC-2	2	99	8.7	4.0 J
Comp IHC-2 Cdup	2	126 ⁽ⁱ⁾	8.3	3.7 J
RPD		NA	5%	8%
I-Stat		NA	0.02	0.04

- (a) J Analyte detected below limit of quantitation (LOQ), but above method detection limit (MDL).
- (b) U Analyte was not present above the associated value.
- (c) ** Surrogate internal standard not added; final internal standard used for quantitation.
- (d) NA Not applicable.
- (e) NS Not spiked.
- (f) Segment M: mudline to Younger Bay Mud/Older Bay Mud boundary.
- (g) Value exceeds relative precision goal of $\leq 30\%$.
- (h) Compositing duplicate.
- (i) Recovery outside of quality control range (40% - 120%).

TABLE C.25. Chlorinated Pesticide Analyses of Older Bay Mud Samples, United Heckathorn Remedial Investigation

Sediment Treatment	Batch	Percent Moisture	Surrogate Recoveries (%)			Pesticides ($\mu\text{g/kg}$ drv weight)		
			DBOFB	C15(112)	C15(103)	4,4-DDE	4,4-DDD	4,4-DDT
Method DL ^(a)						2	2	2
Achieved DL High						0.77	0.95	0.82
Achieved DL Low						0.63	0.78	0.68
LZ-1 Z	26	30.57	76.00	67.01	64.78	0.10 J ^(b)	6.70	0.23 J
LZ-2 Z	26	21.32	75.02	72.89	63.80	1.45	164.24	15.36
LZ-3 Z	26	21.13	78.08	69.84	66.14	0.57 J	28.32	7.76
LZ-5 Z	26	23.78	77.69	75.05	64.28	0.99	37.37	27.84
LZ-6 Z	26	19.86	69.58	61.97	61.37	0.03 J	1.04 U ^(c)	0.37 J
LZ-9 Z	26	24.53	76.42	66.99	65.77	0.07 J	0.88 U	0.98
LZ-11 Z	26	16.85	80.64	68.06	66.23	0.11 J	3.57 U	0.42 J
<u>Quality Control Samples</u>								
<u>Method Blanks</u>								
Blank	26	NA ^(d)	85.66	76.25	71.04	0.24 J	0.95 B ^(e)	0.39 J
<u>Matrix Spikes</u>								
LZ-11 Z	26	16.85	80.64	68.06	66.23	0.11 J	3.57 U	0.42 J
LZ-11 Z MS	26	16.85	73.70	69.44	71.29	7.52	11.82	7.39
Concentration Recovered						7.41	8.25	6.97
Amount Spiked						9.54	9.54	9.54
Percent Recovery						78%	124%	73%
LZ-11 Z	26	16.85	80.64	68.06	66.23	0.11 J	3.57 U	0.42 J
LZ-11 Z MSD	26	16.85	78.90	72.98	73.01	7.71	11.12	7.40
Concentration Recovered						7.60	7.55	6.98
Amount Spiked						9.62	9.62	9.62
Percent Recovery						79%	116%	73%
RPD						1%	7%	0%
I-Stat						0.01	0.05	0.00

TABLE C.25. (contd)

<u>Sediment Treatment</u>	<u>Batch</u>	<u>Percent Moisture</u>	<u>Surrogate Recoveries (%)</u>			<u>Pesticides (ug/kg dry weight)</u>		
			<u>DBOFB</u>	<u>C15(112)</u>	<u>C15(103)</u>	<u>4,4-DDE</u>	<u>4,4-DDD</u>	<u>4,4-DDT</u>
<u>Analytical Duplicates</u>								
LZ-2 Z	26	21.32	75.02	72.89	63.80	1.45	164.24	15.36
LZ-2 Z Duplicate	26	22.03	74.64	73.36	64.37	1.61	161.01	17.90
RPD						11%	2%	15%
I-Stat						0.05	0.01	0.08

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the associated value.

(d) NA Not applicable.

(e) B Procedural blank concentration greater than method detection limit.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Grain Size
LABORATORY: Soil Technology
MATRIX: Sediment
SAMPLE NUMBER: 265

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
ASTM D2217 & D422	Not applicable	±20%	Not applicable

HOLDING TIMES

The holding time of 6 months was met for all grain size analyses.

DUPLICATES

The precision criteria for analytical duplicates was exceeded in 4 of 56 measurements; all four exceedances were associated with fractions constituting $\leq 2\%$ dry weight of the sample. Twelve of 52 RPD measurements exceeded the QC criteria in compositing duplicates.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Total Organic Carbon (TOC)
LABORATORY: Global Geochemistry
MATRIX: Sediment
SAMPLE NUMBER: 265

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 9060	Not applicable	±10%	0.1%

HOLDING TIMES

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

PROCEDURAL BLANKS

All procedural blanks contained less than 0.01% TOC. No QC criteria are designated for TOC procedural blanks.

DUPLICATES

Precision between analytical duplicates was good; only 2 of 27 RPD measurements exceeded the QC criteria. Five of 13 RPDs for compositing duplicates exceeded the QC criteria, probably due to sample inhomogeneity.

DETECTION LIMITS

The achieved detection limit met the detection limit specified in the Quality Assurance Project Plan (QAPP).

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Chlorinated Pesticides
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: Sediment
SAMPLE NUMBER: 265

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8080	40%-120%	±30%	2 µg/kg dry weight (toxaphene 30 µg/kg)

HOLDING TIMES

The following is a list of extraction and analysis dates for the 21 batches of sediment samples analyzed for pesticides:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 3	1/5-9/93	1/19/93	1/21/93	2/25-26/93
Batch 4	1/5-9/93	1/19/93	1/21/93	2/26/93
Batch 6	1/5-9/93	1/21/93	1/25/93	2/27/93
Batch 7	1/5-9/93	1/19/93	1/27/93	2/27-28/93
Batch 8	1/5-9/93	1/19/93	1/27/93	2/28/93
Batch 9	1/5-9/93	1/19/93	1/29/93	2/28-3/1, 3/10-11/93
Batch 11	1/5-9/93	1/19/93	2/2/93	2/19-20, 3/9-10/93
Batch 12	1/5-9/93	1/19/93	2/2/93	2/22-24, 3/10/93
Batch 13	1/5-9/93	1/19-20/93	2/2/93	3/3-5, 3/20-21/93

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 14	1/5-9/93	1/20/93	2/2/93	3/5-6, 3/21/93
Batch 15	1/5-9/93	1/20/93	2/3/93	318-9, 3/22-23/93 (dilutions)
Batch 16	1/5-9/93	1/20-21/93	2/3/93	3/9-11, 3/23/93 (dilutions)
Batch 17	1/5-9/93	1/20-21/93	2/3/93	3/16-17/93
Batch 18	1/5-9/93	1/21/93	2/4/93	3/18-19/93
Batch 19	1/5-9/93	1/21/93	2/4/93	3/15-16, 3/19&25/93
Batch 20	1/5-9/93	1/21/93	2/4/93	3/17-18, 3123-24& 4/2/93 (dilutions)
Batch 21	1/5-9/93	1/19/93	2/16/93	3120-21, 413-10193 (dilutions)
Batch 22	1/5-9/93	1/19/93	2/16/93	3/22-23/93
Batch 23	1/5-9/93	1/19/93	2/19/93	3/25-27, 4/5/93 (dilutions)
Batch 24	1/5-9/93	1/19/93	2/19/93	3/27-28, 4/5-6/93 (dilutions)
Batch 25	1/5-9/93	1/19-21/93	4/14/93	4/28-30, 5114-18/93 (dilutions)

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 26	1/5-9/93	6/22/93	6/23/93	7/1-2, 7/10-11/93

The holding time of 30 days from the date of collection to sample extraction was met for all samples except those requiring re-extraction due to laboratory contamination attributed to highly contaminated sediment samples (Batches 21 through 24). The initial extractions for these samples were within the holding time. In addition, holding times were exceeded for samples requiring re-extraction and reanalysis due to poor surrogate recoveries (Batch 25). The 40-day holding time from extraction to analysis was exceeded for Batches 17 and 18 by one and two days, respectively because a severe winter storm caused a power outage at the laboratory. Batch 26 samples were archived sediments that required analysis after initial results were reviewed; they were stored frozen and analyzed after the holding time expired. The analytical results for these analyses are probably not affected because of the stability of pesticide compounds.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. Blanks for Batches 7, 8, 11, and 13 had DDT concentrations above the method detection limit, and the blanks for Batches 11 and 26 had DDD concentrations above the method detection limit. Associated sample results for those compounds were flagged as undetected if the sample concentration was less than five times the concentration in the blank. The table below summarizes the concentrations of DDT and DDD in the blanks, the concentrations below which sample results were flagged as undetected, and the number of positive sample results subsequently flagged with a U.

<u>Batch</u>	<u>Analyte</u>	<u>Blank Concentration µg/kg dry wt</u>	<u>5 X Blank Concentration µg/kg dry wt</u>	<u>Number of detections flagged with U</u>
7	DDT	119.81	599.05	1 *
8	DDT	11.88	59.40	0
11	DDT	4.10	20.50	14
11	DDD	3.34	16.70	5
13	DDT	1.52	7.60	6
26	DDD	0.95	4.75	3

*Sample LZ-14 A

If the analyte was detected above the instrument detection limit but below the method detection limit, the "J" value was replaced with the detection limit for that sample.

MATRIX SPIKES

The recoveries of target pesticides in the matrix spike (MS) and matrix spike duplicate (MSD) samples were acceptable for all compounds except DDD and DDT. The recoveries of DDD were outside the Quality Control (QC) criteria of 40% to 120% in batches 11 and 18, and the recovery of DDT in the MSD sample was above the QC criteria of 120% in Batch 11. The same sample (LZ-14 Y) was used for MS/MSD analysis in Batches 22, 23, and 24 because it was known to have low background concentrations of pesticides.

Greater than expected dilution ranges were necessary to quantify the concentrations of pesticides in six batches of highly contaminated samples. As a result, MS recoveries could not be calculated for Batches 3, 4, 6, 7, 8, and 9 because the MS compounds were diluted out.

SURROGATES

In general, surrogate recoveries were excellent. The recovery of 1 of 3 surrogate compounds was outside QC limits for 16 samples (including duplicates). The recoveries of two of three compounds were outside QC limits for one sample. The recoveries of all three compounds were outside QC limits for two samples. Surrogate recoveries could not be calculated for six batches of highly-contaminated samples because the surrogate compounds were diluted out. However, the excellent recoveries in the remaining batches indicate an efficient extraction procedure.

Eleven sediment samples required re-extraction due to unacceptable recoveries of the surrogate compounds. Data for these samples were provided with Batch 25. After the second extraction and analysis, two samples still showed unacceptable surrogate recoveries, indicating that the sample matrix may be interfering with the recovery of these compounds.

DUPLICATES

Duplicate precision between the MS and MSD was generally good. The relative percent difference (RPD) measurements exceeded the QC criteria for one pesticide in one batch, and two pesticides in two batches. The MS/MSD RPDs exceeded the QC criteria for all pesticides in Batch 23.

The QC criteria of $\pm 30\%$ was exceeded numerous times for DDT, DDD, and DDE in analytical and compositing duplicates. The lack of precision is probably due to sample heterogeneity because the precision between MS/MSD samples is good.

DETECTION LIMITS

Achieved detection limits were lower than the detection limits specified in the Quality Assurance Project Plan (QAPP) for all analyses that did not require dilutions. The detection limits for compounds in diluted samples were increased by the dilution factor.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Total Petroleum Hydrocarbons (TPH)
LABORATORY: Analytical Resources, Inc.
MATRIX: Sediment
SAMPLE NUMBER: 45

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
418.1	50%-150%	±20%	20 mg/kg dry weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the three batches of sediment samples:

	<u>Date Collected</u>	<u>Date Analyzed</u>
Batch 1	1/5-9/93	7/10/93
Batch 2	1/5-9/93	7/11/93
Batch 3	1/5-9/93	7/12/93

The samples were initially analyzed within the holding time of 28 days; however, they were reanalyzed 6 months later because the incorrect method was used for the corresponding oil and grease analyses. The samples were stored in a frozen state prior to reanalysis; therefore, the concentrations of petroleum hydrocarbons should not have significantly decreased during this time.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. No hydrocarbons were detected in the procedural blanks at concentrations above the detection limit.

MATRIX SPIKES

The matrix spike (MS) samples were spiked with vegetable oil and analyzed for total oil and grease. The vegetable oil would not be expected to carry over to the TPH fraction after silica gel cleanup; therefore, MS data for TPH analyses are not available.

DUPLICATES

The relative percent difference (RPD) between analytical duplicates exceeded the QC criteria of 20% in two batches, and the RPD for one compositing duplicate exceeded 20%.

DETECTION LIMITS

Achieved detection limits were 20 to 90 mg/kg, which is higher than the detection limit specified in the Quality Assurance Project Plan (QAPP) for TPH analyses. TPH was detected in all but five samples.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Oil and Grease
LABORATORY: Analytical Resources, Inc.
MATRIX: Sediment
SAMPLE NUMBER: 45

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
413.2	50%-150%	±20%	20 mg/kg dry weight

HOLDING TIMES

The following is a list of analysis dates for the three batches of sediment samples:

	<u>Date Collected</u>	<u>Date Analyzed</u>
Batch 1	1/5-9/93	7/10/93
Batch 2	1/5-9/93	7/11/93
Batch 3	1/5-9/93	7/12/93

The samples were initially analyzed within the holding time of 28 days; however, they were reanalyzed 6 months later because the incorrect method was used for the oil and grease analyses. The samples were stored in a frozen state prior to reanalysis; therefore, the concentrations of oil and grease should not have significantly decreased during this time.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. No hydrocarbons were detected in the procedural blanks at concentrations above the detection limit.

MATRIX SPIKES

Matrix spike recoveries ranged from 99% to 113%, all within the acceptable range.

DUPLICATES

The relative percent difference (RPD) between analytical duplicates and compositing duplicates exceed the quality control (QC) criteria of 20% in two batches.

DETECTION LIMITS

The achieved detection limits were between 20 and 30 mg/kg dry weight, which is higher than the detection limits specified in the Quality Assurance Project Plan (QAPP) for oil and grease analyses. Oil and grease was detected in all but two samples.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: Sediment
SAMPLE NUMBER: 45

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8270	40%-120%	±30%	20 µg/kg dry weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the three batches of sediment samples and two reanalyzed samples:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/MS Analysis</u>
Batch 1	1/5-9/93	1/19/93	1/19/93	1/23-24/93, 1/28-29/93
Batch 2	1/5-9/93	1/19/93	1/19/93	1/30-2/1/93
Batch 5	1/5-9/93	1/21/93	1/25/93	2/3-4/93
Batch 23 (rerun)	1/5-9/93	1/21/93	2/19/93	3/24/93
Batch 25 (rerun)	1/5-9/93	1/19/93	4/14/93	4/29/93

The holding times for all extractions and analyses were met, with the exception of the two samples that required re-extraction. The second extractions exceeded the holding time of 14 days.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. No PAHs were detected in the procedural blanks at concentrations above the method detection limit.

MATRIX SPIKES

The recoveries of target PAHs in the MS and MSD were acceptable, with only two exceedances. In the Batch 2 MSD sample, the percent recoveries of fluoranthene and pyrene were 158% and 139%, respectively. Recoveries were within limits for the corresponding MS sample.

The recovery of target PAHs in the MSIMSD samples for batches 23 and 25 (rerun samples) were not corrected for background levels because the spiked samples were analyzed for pesticides only. However, the MSIMSD sample was screened prior to analysis to ensure that a relatively uncontaminated sample was used.

SURROGATES

Two sediment samples required re-extraction due to unacceptable recoveries of the surrogate compounds. Data for these samples were provided with batches 23 and 25.

The recovery of the PAH surrogate internal standard (SIS) compounds naphthalene-d₈, acenaphthene-d₁₀, and benzo[a]pyrene-d₁₂ were acceptable in all but three sediment samples. The recovery of benzo[a]pyrene-d₁₂ was 35% in one sample (Comp GD) and the recovery of naphthalene-d₈ was 39% in one sample (PC-54 M). The recoveries of all three surrogate compounds were unacceptable in one sample (LZ-13 M). The poor recoveries in this sample were confirmed after a second extraction and analysis, indicating that a matrix-related problem may be interfering with the recovery of the compounds.

DUPLICATES

Duplicate precision between the MS and MSD was excellent except for three compounds (naphthalene, fluoranthene, and pyrene) in Batch 2 and 15 compounds in Batch 23. The large relative percent difference (RPD) for two of the compounds in Batch 2 is due to the high percent recovery in the MSD sample. Replicate precision of the analytical and compositing duplicates exceeded the quality control (QC) criteria of 30% for 19 PAHs in Batch 1, 18 PAHs in Batch 2, and 15 PAHs in Batch 5. The elevated RPD values appear to be due to sample inhomogeneity rather than non-reproducible sample handling, because, as stated above, the RPDs between the MS and MSD samples were generally good.

DETECTION LIMITS

Achieved detection limits were lower than the detection limits specified in the Quality Assurance Project Plan (QAPP) for all analyses.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polychlorinated Biphenyls (PCB)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: Sediment
SAMPLE NUMBER: 45

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8080	40%-120%	±30%	20 µg/kg dry weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the three batches of sediment samples analyzed for PCBs:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 1	1/5-9/93	1/19/93	1/19/93	1124-26193, 2/3&11/93
Batch 2	1/5-9/93	1/19/93	1/19/93	1/26-27/93, 2111193
Batch 5	1/5-9/93	1/21/93	1/25/93	212-4193
Batch 23 (rerun)	1/5-9/93	1/21/93	2/19/93	3/27/93

The holding times for all extractions and analyses were met, with the exception of one sample which required a second extraction and analysis due to poor surrogate recoveries. The re-extraction of this sample exceeded the 14 day holding time.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. No PCBs were detected in the procedural blanks.

MATRIX SPIKES

The recoveries of Aroclor 1254 in the MS and MSD samples were acceptable. The MS/MSD samples analyzed with Batch 23 were not analyzed for Aroclor 1254.

SURROGATES

One sediment sample required re-extraction due to unacceptable recoveries of the surrogate compounds. Data for this sample was provided with Batch 23. Surrogate recoveries in the second analysis were acceptable.

The recoveries of the PCB surrogate internal standard (SIS) compounds DBOFB, Cl₅(103) and Cl₅(112) were acceptable; however, matrix interferences affected the recovery of one or more surrogate compounds in 15 samples (including duplicates).

Duplicate precision between the MS and MSD was good. Replicate precision of Aroclor 1254 in analytical and compositing duplicates exceeded the quality control (QC) criteria of 30% for one duplicate in Batch 1 and one in Batch 3. The elevated relative percent difference (RPD) values appear to be due to sample inhomogeneity rather than non-reproducible sample handling because, as stated above, the RPDs between the MS and MSD samples met QC criteria.

DETECTION LIMITS

Achieved detection limits of 30 to 50 µg/ kg were higher than the detection limit specified in the Quality Assurance Project Plan (QAPP). The higher detection were the result of an uncommonly high moisture content. Detection limits are based on a sample dry weight of approximately 25 g; the Heckathorn samples had a dry weight of approximately 10 to 15 g. As a result, detection limits were affected proportionally.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Metals
LABORATORY: Battelle Marine Sciences Laboratory
MATRIX: Sediment
SAMPLE NUMBER: 45

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Varies by metal	75%-125%, $\leq 30\%$ from certified value for SRM	$\pm 20\%$	Varies by metal

HOLDING TIMES

The following table summarizes all analysis dates:

<u>Task</u>	<u>Date Performed</u>
Sample digestion	1125193
XRF analysis (As, Cr, Cu, Ni, Pb, Zn)	2113-19/93
GFAA analysis (Ag)	3117/93
GFAA analysis (Cd)	3116/93
GFAA analysis (Se)	2/3/93
CVAA analysis (Hg)	1128-29193

The holding times for all analyses were met.

PROCEDURAL BLANKS

Four procedural blanks were analyzed for silver, cadmium, selenium, and mercury. Cadmium and silver were detected in the blanks at levels at or below the target detection limit. All metals data are blank corrected. Method blanks are not analyzed by x-ray fluorescence (XRF), and no blank results are reported for XRF metals.

MATRIX SPIKES

Three MS samples were analyzed with the sediment samples analyzed by GFAA or CVAA. All MS recoveries were within QC limits. Samples analyzed by XRF are analyzed whole and cannot be spiked.

STANDARD REFERENCE MATERIALS

The 1646 standard reference material (SRM) was analyzed for all metals with each batch. This SRM is an estuarine sediment obtained from the National Institute for Standards and Technology. All results were well within the QC range of $\pm 30\%$ of the certified value.

DUPLICATES

Four analytical duplicates were analyzed with the sediment samples. Relative percent differences between the duplicates were within the QC limits for all metals except arsenic in one batch and chromium in one batch. These metals are both analyzed by XRF. Samples for XRF analysis are not processed, limiting the chance for contamination or loss due to handling; therefore, the difference is most likely due to sample inhomogeneity. The RPDs for compositing duplicates exceeded the QC criteria for three metals in one batch and two metals in another batch.

DETECTION LIMITS

Target detection limits were met for all metals except arsenic, with a target detection limit of 2.5 mg/kg. Arsenic was detected in all but three samples, which had detection limits ranging from 4.6 to 7.0 mg/kg.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Butyltins
LABORATORY: Battelle/Marine Sciences Laboratory
MATRIX: Sediment
SAMPLE NUMBER: 45

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Unger, et al.	40%-120%	±30%	10 µg/kg dry weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the three batches of sediment samples analyzed for butyltins:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/FPD Analysis</u>
Batch 1	115-9193	1/18/93	1125-29193	213-17/93
Batch 2	1/5-9/93	1/18/93	1/25-29/93	1/30-2/1/93
Batch 3	1/5-9/93	1118/93	1/25-29/93	2/3-4/93
Batch 4 (reruns)	1/5-9/93	1/18/93	3/2/93	3/10193

The holding times for extractions and analyses for batches 1 through 3 were met. Five samples (Batch 4) were re-extracted on March 2 because the surrogate internal standard (SIS) was not added to the samples prior to the initial extraction. Extraction holding times for these samples were exceeded. These analyses were completed within the holding time.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. Tributyltin (TBT) was detected at concentrations below the limit of quantitation in the procedural blanks for batches 1 and 2. Dibutyltin (DBT) was detected below the limit of quantitation in the

procedural blank for Batch 1. No butyltins were detected in the blanks for batches 3 and 4.

MATRIX SPIKES

The recoveries of tributyltin and dibutyltin in the matrix spike (MS) and matrix spike duplicate (MSD) samples for all batches were within the quality control (QC) limits.

SURROGATES

One surrogate internal standard (SIS), triphenyltin chloride, is added prior to extraction to assess the efficiency of the method. All sample data are corrected for the recovery of this compound. Surrogate recoveries for all but one sample were within the QC limits. One blank and one sample were not spiked with the SIS prior to extraction; these samples were quantified using a final internal standard, which was added just prior to gas chromatography.

DUPLICATES

Relative percent differences between the MS and MSD recoveries for butyltins were within the QC limits except dibutyltin in Batch 2. Replicate precision of the analytical and compositing duplicates met the QC criteria of 230%.

DETECTION LIMITS

Target detection limits of 10 µg/kg dry weight were met for all butyltin compounds; achieved detection limits ranged from 5 to 8 µg/kg.

COMMENTS

Matrix interferences affected the chromatography in terms of retention time drift and peak shape for a number of samples. Samples PC-52 M and PC-53 M were the most affected; dilution of these samples allowed for quantitation of the SIS and corresponding results were found to be acceptable. All sample data were reviewed and found to be acceptable; therefore, no sample data were qualified due to matrix effects.

APPENDIX D

BIOASSAY RESULTS FOR 10-DAY SOLID-PHASE TEST WITH *Rhepoxynius abronius*

TABLE D.1. Results for all Replicates in 10-Day *R. abronius* Solid-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	Replicate	<i>R. abronius</i>		Proportion Survival	Mean Proportion Survival	Standard Deviation
		Number Alive	Number Dead or Missing			
Comp LC-1	1	0	20	0.00	0.00	0.00
Comp LC-1	2	0	20	0.00		
Comp LC-1	3	0	20	0.00		
Comp LC-1	4	0	20	0.00		
Comp LC-1	5	0	20	0.00		
Comp LC-2	1	0	20	0.00	0.00	0.00
Comp LC-2	2	0	20	0.00		
Comp LC-2	3	0	20	0.00		
Comp LC-2	4	0	20	0.00		
Comp LC-2	5	0	20	0.00		
Comp LC-3	1	0	20	0.00	0.00	0.00
Comp LC-3	2	0	20	0.00		
Comp LC-3	3	0	20	0.00		
Comp LC-3	4	0	20	0.00		
Comp LC-3	5	0	20	0.00		
Comp LC-4	1	12	8	0.60	0.74	0.11
Comp LC-4	2	14	6	0.70		
Comp LC-4	3	15	5	0.75		
Comp LC-4	4	15	5	0.75		
Comp LC-4	5	18	2	0.90		
Comp LC-5	1	0	20	0.00	0.00	0.00
Comp LC-5	2	0	20	0.00		
Comp LC-5	3	0	20	0.00		
Comp LC-5	4	0	20	0.00		
Comp LC-5	5	0	20	0.00		
Comp USFC	1	17	3	0.85	0.88	0.08
Comp USFC	2	16	4	0.80		
Comp USFC	3	17	3	0.85		
Comp USFC	4	20	0	1.00		
Comp USFC	5	18	2	0.90		
Comp FSFC	1	16	4	0.80	0.74	0.26
Comp FSFC	2	20	0	1.00		
Comp FSFC	3	19	1	0.95		
Comp FSFC	4	11	9	0.55		
Comp FSFC	5	8	12	0.40		
Comp IHC-1	1	20	0	1.00	0.89	0.11
Comp IHC-1	2	19	1	0.95		
Comp IHC-1	3	16	4	0.80		
Comp IHC-1	4	15	5	0.75		
Comp IHC-1	5	19	1	0.95		
Comp IHC-2	1	17	3	0.85	0.89	0.05
Comp IHC-2	2	19	1	0.95		
Comp IHC-2	3	17	3	0.85		
Comp IHC-2	4	19	1	0.95		
Comp IHC-2	5	17	3	0.85		

TABLE D.1. (contd)

Sediment Treatment	Replicate	<i>R. abronius</i>		Proportion Survival	Mean Proportion Survival	Standard Deviation
		Number Alive	Number Dead or Missing			
Comp IHC-3	1	18	2	0.90	0.85	0.09
Comp IHC-3	2	14	6	0.70		
Comp IHC-3	3	17	3	0.85		
Comp IHC-3	4	19	1	0.95		
Comp IHC-3	5	17	3	0.85		
Comp GD	1	19	1	0.95	0.92	0.08
Comp GD	2	16	4	0.80		
Comp GD	3	19	1	0.95		
Comp GD	4	20	0	1.00		
Comp GD	5	18	2	0.90		
C-WB	1	20	0	1.00	0.96	0.04
C-WB	2	19	1	0.95		
C-WB	3	20	0	1.00		
C-WB	4	19	1	0.95		
C-WB	5	18	2	0.90		
C-WB Rerun	1	20	0	1.00	0.99	0.02
C-WB Rerun	2	19	1	0.95		
C-WB Rerun	3	20	0	1.00		
C-WB Rerun	4	20	0	1.00		
C-WB Rerun	5	20	0	1.00		
C-SFBF	1	17	3	0.85	0.92	0.06
C-SFBF	2	19	1	0.95		
C-SFBF	3	20	0	1.00		
C-SFBF	4	18	2	0.90		
C-SFBF	5	18	2	0.90		
C-SFBC	1	20	0	1.00	1.00	0.00
C-SFBC	2	20	0	1.00		
C-SFBC	3	20	0	1.00		
C-SFBC	4	20	0	1.00		
C-SFBC	5	20	0	1.00		

TABLE D.2. Water Quality Summary for 10-Day *R. abronius* Solid-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	Temperature (°C)		pH(a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min ^(b)	Max ^(b)	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.60	8.60	6.0	NA ^(c)	28.0	32.0
COMP LC-1	15.5	15.9	7.94	8.68 ^(d)	7.4	8.2	30.0	31.5
COMP LC-2	15.5	16.0	7.96	8.59	7.4	8.1	30.0	31.0
COMP LC-3	15.5	15.9	7.82	8.23	7.4	8.0	30.0	31.5
COMP LC-4	15.6	15.9	8.00	8.35	7.4	7.9	30.0	31.0
COMP LC-5	15.6	16.0	8.01	8.24	7.4	8.1	30.0	31.0
COMP USFC	15.6	15.9	8.00	8.17	7.3	8.3	30.0	31.5
COMP FSFC	15.6	15.9	7.93	8.15	7.3	8.4	30.0	32.0
COMP IHC-1	15.5	15.9	7.96	8.27	7.5	8.0	30.0	31.0
COMP IHC-2	15.5	15.9	7.93	8.16	7.3	8.1	30.0	31.5
COMP IHC-3	15.5	15.9	7.99	8.37	7.3	8.2	30.0	31.0
COMP GD	15.6	15.9	7.81	8.12	7.3	8.0	30.0	31.5
C-WB	15.5	15.9	7.93	8.22	7.5	8.3	30.0	31.5
C-WB Rerun	15.6	16.0	7.90	8.33	7.6	8.5	30.0	31.0
C-SFBF	15.5	15.9	7.89	8.13	7.2	8.3	30.0	31.5
C-SFBC	15.5	15.9	8.01	8.16	7.5	8.2	30.0	31.0

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- (a) Acceptable pH range is based on mean pH in all test chambers in 10-day test.
- (b) Minimum and maximum values are derived from all replicates for each treatment.
- (c) NA Not applicable.
- (d) pH outside of acceptable range on Day 10 only, in three of five replicates.

TABLE D.3. Results for all Replicates in 96-h *R. abronius* Reference Toxicant Test, United Heckathorn Remedial Investigation

Cadmium Concentration (mg/L)	Replicate	<i>R. abronius</i>		Proportion Surviving	Mean Proportion Surviving	Standard Deviation
		Number Alive	Number Dead or Missing			
	1	18	2	0.90	0.92	0.03
	2	18	2	0.90		
	3	19	1	0.95		
0.5	1	18	2	0.90	0.82	0.10
	2	17	3	0.85		
	3	14	6	0.70		
	1	6	14	0.30	0.35	0.05
	2	8	12	0.40		
	3	7	13	0.35		
	1	2	18	0.10	0.10	0.05
	2	1	19	0.05		
	3	3	17	0.15		
	1	0	20	0.00	0.00	0.00
	2	0	20	0.00		
	3	0	20	0.00		

TABLE D.4. Water Quality Summary for 96-h R. *abronius* Reference Toxicant Test, United Heckathorn Remedial Investigation

Cadmium Concentration (mg/L)	Temperature (°C)		pH ^(a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min ^(b)	Max ^(b)	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.18	8.18	6.0	NA ^(c)	28.0	32.0
0.0	15.6	15.9	8.01	8.14	7.4	8.1	30.0	31.0
0.5	15.5	15.9	8.03	8.14	7.5	8.3	30.0	31.5
1.0	15.6	15.8	7.99	8.12	7.5	8.2	30.0	31.0
2.0	15.5	15.9	7.97	8.08	7.6	8.4	30.0	31.0
4.0	15.5	15.9	7.80	8.00	7.4	8.1	30.0	31.0

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- (a) Acceptable pH range is based on mean pH in all test chambers in 96-hour test.
- (b) Minimum and maximum values are derived from all replicates for each concentration.
- (c) NA Not applicable.

APPENDIX E

BIOASSAY RESULTS FOR 28-DAY SOLID-PHASE TEST WITH *Macoma nasuta*

TABLE E.1. Results for all Replicates in 96-h *M. nasuta* Solid-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	Replicate	<i>M. nasuta</i>		Mean Proportion Survival	Proportion Survival	Standard Deviation
		Number Alive	Number Dead or Missing			
Comp LC	1	24	1	0.96	0.94	0.02
Comp LC	2	23	2	0.92		
Comp LC	3	24	1	0.96		
Comp LC	4	23	2	0.92		
Comp LC	5	24	1	0.96		
Comp USFC	1	25	0	1.00	0.95	0.07
Comp USFC	2	25	0	1.00		
Comp USFC	3	25	0	1.00		
Comp USFC	4	23	2	0.92		
Comp USFC	5	21	4	0.84		
Comp FSFC	1	23	2	0.92	0.96	0.06
Comp FSFC	2	25	0	1.00		
Comp FSFC	3	25	0	1.00		
Comp FSFC	4	25	0	1.00		
Comp FSFC	5	22	3	0.88		
Comp IHC-1	1	24	1	0.96	0.94	0.05
Comp IHC-1	2	21	4	0.84		
Comp IHC-1	3	24	1	0.96		
Comp IHC-1	4	24	1	0.96		
Comp IHC-1	5	24	1	0.96		
Comp GD	1	24	1	0.96	0.94	0.05
Comp GD	2	23	2	0.92		
Comp GD	3	22	3	0.88		
Comp GD	4	25	0	1.00		
Comp GD	5	23	2	0.92		
C-SB	1	25	0	1.00	0.98	0.04
C-SB	2	25	0	1.00		
C-SB	3	23	2	0.92		
C-SB	4	25	0	1.00		
C-SB	5	24	1	0.96		
C-SFBF	1	25	0	1.00	0.98	0.04
C-SFBF	2	25	0	1.00		
C-SFBF	3	23	2	0.92		
C-SFBF	4	25	0	1.00		
C-SFBF	5	25	0	1.00		

TABLE E.2. Water Quality Summary for 28-Day *M. nasuta* Solid-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	Temperature (°C)		pH (a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)		Flow Rate (mL/min)	
	Min (b)	Max (b)	Min	Max	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.26	8.26	6.0	NA (c)	28.0	32.0	115	135
Comp LC	15.1	16.4	7.61	7.91	7.3	8.6	30.0	32.0	116	132
Comp USFC	15.2	16.3	7.68	7.91	7.1	8.4	30.0	32.0	116	134
Comp FSFC	15.1	16.3	7.62	8.01	7.1	8.6	30.0	32.0	116	132
Comp IHC-1	15.1	16.4	7.68	7.88	7.3	8.6	30.0	32.0	116	132
Comp GD	15.1	16.4	7.65	7.89	7.2	8.6	30.0	31.5	116	132
C-SB	15.1	16.4	7.68	7.86	7.0	8.4	30.0	32.0	116	132
C-SFBF	15.1	16.4	7.66	7.87	7.3	8.5	30.0	32.0	116	134

(a) Acceptable pH range is based on mean pH in all test chambers in 28-day test.

(b) Minimum and maximum values derived from all replicates for each treatment.

(c) Not applicable.

APPENDIX F

TISSUE CHEMISTRY AND QUALITY ASSURANCE DATA FOR *Macoa nasuta*

TABLE F.1. Lipids in Tissues of *M. nasuta*, United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Batch</u>	<u>Measured Lipid Weight (percent wet weight)</u>	<u>Bligh and Dyer Equivalent Weight (percent wet weight)</u>	<u>Percent Dry Weight</u>	<u>Measured Lipid Weight (percent dry weight)</u>	<u>Bligh and Dyer Equivalent Weight (percent dry weight)</u>
<u>Tissue Replicates</u>							
Comp LC	1	2	0.64	0.30	20.75	3.11	1.43
Comp LC	2	2	0.65	0.30	12.85	5.04	2.32
Comp LC	3	2	0.81	0.37	11.83	6.81	3.13
Comp LC	4	1	1.08	0.49	12.61	8.53	3.92
Comp LC	5	2	0.59	0.27	15.15	3.91	1.80
Comp USFC	1	1	0.60	0.27	11.67	5.11	2.35
Comp USFC	1	1	0.60	0.28	11.67	5.16	2.37
Comp USFC	2	1	0.41	0.19	10.79	3.79	1.74
Comp USFC	3	1	0.65	0.30	11.59	5.64	2.59
Comp USFC	4	1	0.51	0.23	11.40	4.48	2.06
Comp USFC	5	1	0.45	0.21	10.90	4.15	1.91
Comp FSFC	1	1	1.07	0.49	9.79	10.94	5.03
Comp FSFC	2	1	1.15	0.53	10.53	10.89	5.00
Comp FSFC	3	1	0.55	0.25	10.91	5.07	2.33
Comp FSFC	4	2	0.75	0.34	10.21	7.32	3.37
Comp FSFC	5	2	0.48	0.22	10.95	4.38	2.01
Comp FSFC	5	2	0.51	0.23	10.95	4.67	2.15
Comp IHC-1	1	1	2.70	1.24	17.41	15.51	7.13
Comp IHC-1	2	1	0.64	0.29	14.27	4.48	2.06
Comp IHC-1	3	2	0.66	0.30	16.58	3.97	1.82
Comp IHC-1	4	1	0.85	0.39	11.60	7.30	3.35
Comp IHC-1	5	1	0.63	0.29	14.66	4.32	1.99
Comp GD	1	2	0.56	0.26	11.60	4.86	2.23
Comp GD	2	1	0.47	0.22	10.84	4.37	2.01
Comp GD	3	2	1.30	0.60	11.86	10.93	5.02
Comp GD	4	2	0.61	0.28	12.38	4.95	2.27
Comp GD	5	1	0.62	0.28	13.82	4.46	2.05
<u>Tissue Composites</u>							
Comp LC		2	0.72	0.33	13.75	5.25	2.41
Comp USFC		2	1.26	0.58	24.06	5.22	2.40
Comp FSFC		2	0.88	0.41	11.68	7.57	3.48
Comp IHC-1		2	1.01	0.46	13.51	7.46	3.43
Comp GD		2	1.17	0.54	12.90	9.11	4.18
<u>Analytical Duplicates</u>							
Comp USFC	1	1	0.60	0.27			
Comp USFC	1	1	0.60	0.28			
RPD			1%	1%			
I-Stat			0.00	0.00			
Comp FSFC	5	2	0.51	0.23			
Comp FSFC	5	2	0.48	0.22			
RPD			6%	6%			
I-Stat			0.03	0.03			

TABLE F.2. Chlorinated Pesticides (elution order, Alpha-BHC to cis-Chlordane) in Tissues of M. nasuta, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Replicate	Batch	Pesticides ($\mu\text{g/kg}$ wet weight)									
			Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Hepta-chlor epoxide	trans-Chlordane	Endo-sulfan	cis-Chlordane
Target DL (a)			2	2	2	2	2	2	2	2	2	2
Achieved DL High			0.17	0.17	0.17	0.17	0.18	0.11	0.16	0.33	0.33	0.19
Achieved DL Low			0.08	0.08	0.08	0.08	0.08	0.05	0.07	0.15	0.15	0.09
Comp LC	1	2	0.63	0.09 U (b)	0.34	0.09 U	0.09 U	1.59	0.08 U	226.50	11.57	10.35
Comp LC	2	2	0.11	0.09 U	0.18	0.09 U	0.10 U	0.54	0.09 U	14.65	8.62	6.64
Comp LC	3	2	0.75	0.08 U	0.29	0.08 U	0.08 U	1.31	0.07 U	250.50	9.13	9.05
Comp LC	4	1	0.17	0.09 U	0.29	0.09 U	0.09 U	0.51	0.08 U	14.44	7.82	8.00
Comp LC	5	2	0.13	0.12 U	0.25	0.12 U	0.13 U	0.79	0.11 U	14.89	8.95	7.09
Comp USFC	1	1	0.11 J (c)	0.12 U	0.12 U	0.12 U	0.12 U	0.08 U	0.11 U	0.30	0.30	0.25
Comp USFC	2	1	0.06 J	0.09 U	0.13	0.09 U	0.09 U	0.06 U	0.08 U	0.22	0.20	0.12
Comp USFC	3	1	0.11	0.09 U	0.09 U	0.09 U	0.09 U	0.06 U	0.08 U	0.33	0.30	0.21
Comp USFC	4	1	0.08 J	0.09 U	0.09 U	0.09 U	0.09 U	0.06 U	0.08 U	0.17 U	0.18	0.14
Comp USFC	5	1	0.05 J	0.09 U	0.16	0.09 U	0.10 U	0.06 U	0.09 U	0.18 J	0.20	0.14
Comp FSFC	1	1	0.18	0.09 U	0.22	0.09 U	0.10 U	0.06 U	0.09 U	0.56	0.51	0.30
Comp FSFC	2	1	0.13	0.09 U	0.09 U	0.09 U	0.09 U	0.06 U	0.08 U	0.33	0.40	0.25
Comp FSFC	3	1	0.17	0.13 U	0.13 U	0.13 U	0.14 U	0.08 U	0.12 U	0.25 U	0.25 U	0.15 U
Comp FSFC	4	2	0.12 J	0.17 U	0.18	0.17 U	0.18 U	0.11 U	0.16 U	0.51	0.26 J	0.22
Comp FSFC	5	3	0.08 U	0.08 U	0.08 U	0.08 U	0.09 U	0.05 U	0.08 U	0.17 U	0.17 U	0.10 U
Comp IHC-1	1	1	0.11	0.08 U	0.19	0.08 U	0.09 U	0.05 U	0.08 U	0.17	0.09 J	0.12
Comp IHC-1	2	1	0.10	0.09 U	0.14	0.09 U	0.09 U	0.06 U	0.08 U	0.22	0.09 J	0.16
Comp IHC-1	3	2	0.08	0.08 U	0.11	0.08 U	0.08 U	0.05 U	0.07 U	0.11 J	0.08 J	0.11
Comp IHC-1	4	1	0.21	0.09 U	0.09 U	0.09 U	0.09 U	0.06 U	0.08 U	0.17 U	0.15 J	0.15
Comp IHC-1	5	1	0.16	0.08 U	0.08 U	0.08 U	0.09 U	0.05 U	0.08 U	0.28	0.10 J	0.20
Comp CD	1	2	0.07 J	0.09 U	0.09 U	0.09 U	0.10 U	0.06 U	0.09 U	0.06 J	0.01 J	0.06 J
Comp CD	2	1	0.05 J	0.09 U	0.11	0.09 U	0.09 U	0.06 U	0.08 U	0.17 U	0.08 J	0.07 J
Comp CD	3	2	0.07 J	0.09 U	0.12	0.09 U	0.10 U	0.06 U	0.02 J	0.06 J	0.01 J	0.06 J
Comp CD	4	2	0.07 J	0.08 U	0.10	0.08 U	0.09 U	0.05 U	0.02 J	0.06 J	0.16 U	0.04 J
Comp CD	5	1	0.08	0.08 U	0.08 U	0.08 U	0.09 U	0.05 U	0.08 U	0.16 U	0.16 U	0.08 J

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE F.3. Chlorinated Pesticides (elution order, Dieldrin to Toxaphene) in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Replicate	Batch	Pesticides ($\mu\text{g/kg}$ wet weight)								Toxaphene
			Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin aldehyde	Endo-sulfan sulfate	4,4'-DDT	
Target DL ^(a)			2	2	2	2	2	2	2	2	2
Achieved DL High			0.13	0.37	0.14	0.33	0.17	0.33	0.33	0.34	3.27
Achieved DL Low			0.06	0.17	0.06	0.15	0.08	0.15	0.15	0.16	1.50
Comp LC	1	2	393.25	320.19	0.07 U ^(b)	0.31	6203.97	0.17	0.17 U	565.98	1.72 U
Comp LC	2	2	193.34	243.47	1.72	0.51	4226.98	0.18	0.18 U	318.48	NA ^(c)
Comp LC	3	2	361.33	283.47	0.06 U	0.85	5501.87	0.15	0.15 U	328.66	1.53 U
Comp LC	4	1	296.74	348.21	1.61	0.55	1592.90	0.17	0.17 U	307.27	1.70 U
Comp LC	5	2	230.08	270.41	1.69	0.57	4714.64	0.23	0.23 U	336.19	NA
Comp USFC	1	1	4.21	11.31	0.10 U	0.29	77.26	0.23	0.38	1.10	2.29 U
Comp USFC	2	1	3.46	11.03	0.07 U	0.16 J ^(d)	70.62	0.17	0.27	0.75	1.71 U
Comp USFC	3	1	4.70	13.31	0.07 U	0.27	80.50	0.17	0.17 U	0.99	1.72 U
Comp USFC	4	1	3.63	9.99	0.07 U	0.18	66.52	0.17	0.17 U	1.05	1.67 U
Comp USFC	5	1	3.02	8.68	0.08 U	0.18 U	55.60	0.18	0.25	1.20	1.79 U
Comp FSFC	1	1	5.02	28.26	0.08 U	0.31	73.66	0.18	0.10 J	0.20	1.83 U
Comp FSFC	2	1	3.94	25.99	0.07 U	0.29	60.72	0.17	0.31	0.61	1.69 U
Comp FSFC	3	1	3.02	24.07	0.10 U	0.31	64.35	0.25	0.25 U	0.38	2.50 U
Comp FSFC	4	2	4.41	19.78	0.14 U	0.32 J	48.92	0.33	0.10 J	0.49	3.27 U
Comp FSFC	5	3	2.33	12.37	0.07 U	0.17 U	16.15	0.17	0.17 U	0.14 J	1.65 U
Comp IHC-1	1	1	1.21	4.58	0.07 U	0.13 J	21.21	0.16	0.16 U	0.37	1.64 U
Comp IHC-1	2	1	1.33	4.52	0.07 U	0.16 J	20.08	0.18	0.18 U	1.38	1.75 U
Comp IHC-1	3	2	1.77	4.40	0.06 U	0.10 J	23.42	0.15	0.19	0.66	NA
Comp IHC-1	4	1	1.47	3.57	0.07 U	0.21	19.54	0.17	0.17 U	0.11 J	1.68 U
Comp IHC-1	5	1	1.74	4.58	0.07 U	0.17 U	29.94	0.17	0.38	0.60	1.65 U
Comp G	1	2	0.38	0.75	0.07 U	0.05 J	7.50	0.18	0.18 U	0.51	NA
Comp G	2	1	0.19	0.49	0.07 U	0.07 J	1.54	0.17	0.17 U	0.09 J	1.70 U
Comp G	3	2	0.23	0.54	0.08 U	0.07 J	2.56	0.19	0.19 U	0.20	NA
Comp G	4	2	0.21	0.60	0.07 U	0.06 J	4.10	0.16	0.16 U	0.21	NA
Comp G	5	1	0.23	0.60	0.07 U	0.10 J	1.77	0.16	0.16 U	0.06 J	1.61 U

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

(c) NA Not analyzed.

(d) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE F.4. Chlorinated Pesticides (elution order, Alpha-BHC to cis-Chlordane) in Tissues of *M. nasuta*, Dry Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Replicate	Batch	Percent Dry Weight	Pesticides ($\mu\text{g/kg}$ dry weight)									
				Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Heptachlor	Aldrin	Heptachlor epoxide	trans-Chlordane	Endosulfan	cis-Chlordane
Comp LC	1	2	20.75	3.04	0.43 U ^(a)	1.64	0.43 U	0.43 U	7.66	0.39 U	1091.57	55.76	49.88
Comp LC	2	2	12.85	0.86	0.70 U	1.40	0.70 U	0.78 U	4.20	0.70 U	114.01	67.08	51.67
Comp LC	3	2	11.83	6.34	0.68 U	2.45	0.68 U	0.68 U	11.07	0.59 U	2117.50	77.18	76.50
Comp LC	4	1	12.61	1.35	0.71 U	2.30	0.71 U	0.71 U	4.04	0.63 U	114.51	62.01	63.44
Comp LC	5	2	15.15	0.86	0.79 U	1.65	0.79 U	0.86 U	5.21	0.73 U	98.28	59.08	46.80
Comp USFC	1	1	11.67	0.94 J ^(b)	1.03 U	1.03 U	1.03 U	1.03 U	0.69 U	0.94 U	2.57	2.57	2.14
Comp USFC	2	1	10.79	0.56 J	0.83 U	1.20	0.83 U	0.83 U	0.56 U	0.74 U	2.04	1.85	1.11
Comp USFC	3	1	11.59	0.95	0.78 U	0.78 U	0.78 U	0.78 U	0.52 U	0.69 U	2.85	2.59	1.81
Comp USFC	4	1	11.40	0.70 J	0.79 U	0.79 U	0.79 U	0.79 U	0.53 U	0.70 U	1.49 U	1.58	1.23
Comp USFC	5	1	10.90	0.46 J	0.83 U	1.47	0.83 U	0.92 U	0.55 U	0.83 U	1.65 J	1.83	1.28
Comp FSFC	1	1	9.79	1.84	0.92 U	2.25	0.92 U	1.02 U	0.61 U	0.92 U	5.72	5.21	3.06
Comp FSFC	2	1	10.53	1.23	0.85 U	0.85 U	0.85 U	0.85 U	0.57 U	0.76 U	3.13	3.80	2.37
Comp FSFC	3	1	10.91	1.56	1.19 U	1.19 U	1.19 U	1.28 U	0.73 U	1.10 U	2.29 U	2.29 U	1.37 U
Comp FSFC	4	2	10.21	1.18 J	1.67 U	1.76	1.67 U	1.76 U	1.08 U	1.57 U	5.00	2.55 J	2.15
Comp FSFC	5	3	10.95	0.73 U	0.73 U	0.73 U	0.73 U	0.82 U	0.46 U	0.73 U	1.55 U	1.55 U	0.91 U
Comp IHC-1	1	1	17.41	0.63	0.46 U	1.09	0.46 U	0.52 U	0.29 U	0.46 U	0.98	0.52 J	0.69
Comp IHC-1	2	1	14.27	0.70	0.63 U	0.98	0.63 U	0.63 U	0.42 U	0.56 U	1.54	0.63 J	1.12
Comp IHC-1	3	2	16.58	0.48	0.48 U	0.66	0.48 U	0.48 U	0.30 U	0.42 U	0.66 J	0.48 J	0.66
Comp IHC-1	4	1	11.60	1.81	0.78 U	0.78 U	0.78 U	0.78 U	0.52 U	0.69 U	1.47 U	1.29 J	1.29
Comp IHC-1	5	1	14.66	1.09	0.55 U	0.55 U	0.55 U	0.61 U	0.34 U	0.55 U	1.91	0.68 J	1.36
Comp GD	1	2	11.60	0.60 J	0.78 U	0.78 U	0.78 U	0.86 U	0.52 U	0.78 U	0.52 J	0.09 J	0.52 J
Comp GD	2	1	10.84	0.46 J	0.83 U	1.01	0.83 U	0.83 U	0.55 U	0.74 U	1.57 U	0.74 J	0.65 J
Comp GD	3	2	11.86	0.59 J	0.76 U	1.01	0.76 U	0.84 U	0.51 U	0.17 J	0.51 J	0.08 J	0.51 J
Comp GD	4	2	12.38	0.57 J	0.65 U	0.81	0.65 U	0.73 U	0.40 U	0.16 J	0.48 J	1.29 U	0.32 J
Comp GD	5	1	13.82	0.58	0.58 U	0.58 U	0.58 U	0.65 U	0.36 U	0.58 U	1.16 U	1.16 U	0.58 J

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL)

TABLE F.5. Chlorinated Pesticides (elution order, Dieldrin to Toxaphene) in Tissues of *M. nasuta*, Dry Weight, United Heckathorn Remedial Investigation

	Sediment Treatment	Replicate	Batch	Percent Dry Weight	Pesticides ($\mu\text{g}/\text{kg}$ dry weight)								
					Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin aldehyde	Endo-sulfan sulfate	4,4'-DDT	Toxaphene
F.5	Comp LC	1	2	20.75	1895.18	1543.08	0.34 U ^(a)	1.49	29898.65	0.82 U	0.82 U	2727.61	8.29 U ^(b)
	Comp LC	2	2	12.85	1504.59	1894.71	13.39	3.97	32894.79	1.40	1.40 U	2478.44	NA ^(b)
	Comp LC	3	2	11.83	3054.35	2396.20	0.51 U	7.19	46507.78	1.27	1.27 U	2778.19	12.93 U
	Comp LC	4	1	12.61	2353.21	2761.38	12.77	4.36	12632.04	1.35	1.35 U	2436.72	13.48 U
	Comp LC	5	2	15.15	1518.68	1784.88	11.16	3.76	31119.74	1.52	1.52 U	2219.08	NA
	Comp USFC	1	1	11.67	36.08	96.92	0.86 U	2.49	662.04	1.97	3.26	9.43	19.62 U
	Comp USFC	2	1	10.79	32.07	102.22	0.65 U	1.48 J ^(c)	654.49	1.58	2.50	6.95	15.85 U
	Comp USFC	3	1	11.59	40.55	114.84	0.60 U	2.33	694.56	1.47	1.47 U	8.54	14.84 U
	Comp USFC	4	1	11.40	31.84	87.63	0.61 U	1.58	583.51	1.49	1.49 U	9.21	14.65 U
	Comp USFC	5	1	10.90	27.71	79.63	0.73 U	1.65 U	510.09	1.65	2.29	11.01	16.42 U
	Comp FSFC	1	1	9.79	51.28	288.66	0.82 U	3.17	752.40	1.84	1.02 J	2.04	18.69 U
	Comp FSFC	2	1	10.53	37.42	246.82	0.66 U	2.75	576.64	1.61	2.94	5.79	16.05 U
	Comp FSFC	3	1	10.91	27.68	220.62	0.92 U	2.84	589.83	2.29	2.29 U	3.48	22.91 U
	Comp FSFC	4	2	10.21	43.19	193.73	1.37 U	3.13 J	479.14	3.23	0.98 J	4.80	32.03 U
	Comp FSFC	5	3	10.95	21.28	112.97	0.64 U	1.55 U	147.49	1.55	1.55 U	1.28 J	15.07 U
	Comp IHC-1	1	1	17.41	6.95	26.31	0.40 U	0.75 J	121.83	0.92	0.92 U	2.13	9.42 U
	Comp IHC-1	2	1	14.27	9.32	31.67	0.49 U	1.12 J	140.71	1.26	1.26 U	9.67	12.26 U
	Comp IHC-1	3	2	16.58	10.68	26.54	0.36 U	0.60 J	141.25	0.90 U	1.15	3.98	NA
	Comp IHC-1	4	1	11.60	12.67	30.78	0.60 U	1.81	168.45	1.47	1.47 U	0.95 J	14.48 U
	Comp IHC-1	5	1	14.66	11.87	31.24	0.48 U	1.16 U	204.23	1.16	2.59	4.09	11.26 U
Comp ③	1	2	11.60	3.28	6.47	0.60 U	0.43 J	64.66	1.55	1.55 U	4.40	NA	
Comp ③	2	1	10.84	1.75	4.52	0.65 U	0.65 J	14.21	1.57	1.57 U	0.83 J	15.68 U	
Comp ③	3	2	11.86	1.94	4.55	0.67 U	0.59 J	21.59	1.60	1.60 U	1.69	NA	
Comp ③	4	2	12.38	1.70	4.85	0.57 U	0.48 J	33.12	1.29	1.29 U	1.70	NA	
Comp ③	5	1	13.82	1.66	4.34	0.51 U	0.72 J	12.81	1.16	1.16 U	0.43 J	11.65 U	

(a) U Analyte was not present above the associated value.

(b) NA Not analyzed.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE F.6. Quality Control Summary for Chlorinated Pesticides (elution order, Alpha-BHC to cis-Chlordane) in Tissues of *M. nasuta*, Wet Weight, United Heckathron Remedial Investigation

			Pesticides ($\mu\text{g/kg}$ wet weight)									
Sediment Treatment	Replicate	Batch	Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Hepta-chlor epoxide	trans-Chlordane	Endo-sulfan I	cis-Chlordane
<u>Procedural Blanks</u>												
Blank	NA ^(a)	1	0.09 U ^(b)	0.09 U	0.09 U	0.09 U	0.10 U	0.06 U	0.09 U	0.18 U	0.18 U	0.10 U
Blank	NA	2	0.12 U	0.12 U	0.12 U	0.12 U	0.13 U	0.08 U	0.11 U	0.23 U	0.23 U	0.14 U
Blank	NA	3	0.09 U	0.09 U	0.09 U	0.09 U	0.09 U	0.06 U	0.08 U	0.17 U	0.17 U	0.10 U
<u>Matrix Spikes</u>												
Comp FSFC	3	1	0.17	0.13 U	0.13 U	0.13 U	0.14 U	0.08 U	0.12 U	0.25 U	0.25 U	0.15 U
Comp FSFC MS	3	1	1.45	2.04	1.57	1.37	2.26	1.82	1.86	2.25	2.33	NA
Concentration Recovered			1.28	2.04	1.57	1.37	2.26	1.82	1.86	2.25	2.33	NA
Amount Spiked			3.65	3.44	3.44	3.44	3.44	3.44	3.44	3.72	3.44	NS ^(c)
Percent Recovery			35% ^(d)	59%	46%	40%	66%	53%	54%	60%	68%	NA
Comp FSFC	3	1	0.17	0.13 U	0.13 U	0.13 U	0.14 U	0.08 U	0.12 U	0.25 U	0.25 U	0.15 U
Comp FSFC MSD	3	1	1.52	2.17	1.61	1.47	2.62	1.61	1.95	2.24	2.29	NA
Concentration Recovered			1.35	2.17	1.61	1.47	2.62	1.61	1.95	2.24	2.29	NA
Amount Spiked			3.88	3.65	3.65	3.65	3.65	3.65	3.65	3.96	3.65	NS
Percent Recovery			35% ^(d)	59%	44%	40%	72%	44%	53%	57%	63%	NA
RPD			0%	0%	3%	1%	9%	18%	1%	7%	8%	NA
I-Stat			0.00	0.00	0.02	0.01	0.04	0.09	0.01	0.03	0.04	NA
Comp FSFC	4	2	0.12 J ^(e)	0.17 U	0.18	0.17 U	0.18 U	0.11 U	0.16 U	0.51	0.26 J	0.22
Comp FSFC MS	4	2	4.13	3.80	3.99	4.28	4.22	3.95	3.70	4.10	4.20	NA
Concentration Recovered			4.01	3.80	3.81	4.28	4.22	3.95	3.70	3.59	3.94	NA
Amount Spiked			5.31	5.00	5.00	5.00	5.00	5.00	5.00	5.41	5.00	NS
Percent Recovery			76%	76%	76%	86%	84%	79%	74%	66%	79%	NA
Comp FSFC	4	2	0.12 J	0.17 U	0.18	0.17 U	0.18 U	0.11 U	0.16 U	0.51	0.26 J	0.22
Comp FSFC MSD	4	2	3.61	3.56	3.70	3.74	3.90	3.66	3.69	4.56	3.99	NA
Concentration Recovered			3.49	3.56	3.52	3.74	3.90	3.66	3.69	4.05	3.73	NA
Amount Spiked			5.06	4.76	4.76	4.76	4.76	4.76	4.76	5.16	4.76	NS
Percent Recovery			69%	75%	74%	79%	82%	77%	78%	78%	78%	NA
RPD			9%	2%	3%	9%	3%	3%	5%	17%	1%	NA
I-Stat			0.05	0.01	0.01	0.04	0.02	0.01	0.02	0.08	0.00	NA

TABLE F.6. (contd)

Sediment Treatment	Replicate	Batch	Pesticides ($\mu\text{g/kg}$ wet weight)									
			Alpha BHC	Beta BHC	Lindane	Delta BHC	Hepta-chlor	Aldrin	Hepta-chlor epoxide	trans-Chlordane	Endo-sulfan I	cis-Chlordane
MH32	NA	3	DNA ^(f)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH32 MS	NA	3	NA	NA	1.06	NA	1.05	0.84	1.00	NA	NA	1.01
Amount Spiked			NS	NS	1.18	NS	1.18	1.18	1.18	NS	NS	1.18
Percent Recovery			NA	NA	90%	NA	89%	71%	85%	NA	NA	85%
MH32	NA	3	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH33 MSD	NA	3	NA	NA	1.06	NA	1.05	0.81	1.03	NA	NA	0.99
Amount Spiked			NS	NS	1.17	NS	1.17	1.17	1.17	NS	NS	1.17
Percent Recovery			NA	NA	90%	NA	90%	69%	88%	NA	NA	84%
RPD			NA	NA	1%	NA	1%	3%	3%	NA	NA	1%
I-Stat			NA	NA	0.00	NA	0.01	0.01	0.02	NA	NA	0.01
<u>Analytical Duplicates</u>												
Comp USFC	1	1	0.11 J	0.12 U	0.12 U	0.12 U	0.12 U	0.08 U	0.11 U	0.30	0.30	0.25
Comp USFC	1	1	0.12 J	0.13 U	0.13 U	0.13 U	0.13 U	0.08 U	0.12 U	0.51	0.36	0.23
RPD			9%	NA	NA	NA	NA	NA	NA	52% ^(g)	18%	8%
I-Stat			0.04	NA	NA	NA	NA	NA	NA	0.26	0.09	0.04
Comp FSFC	5	2	0.08 U	0.08 U	0.08 U	0.08 U	0.09 U	0.05 U	0.08 U	0.17 U	0.17 U	0.10 U
Comp FSFC	5	2	0.11 J	0.16 U	0.13 J	0.16 U	0.17 U	0.10 U	0.15 U	0.30 J	0.20 J	0.19
RPD			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) NA Not applicable.

(b) U Analyte was not present above the associated value.

(c) NS Not spiked.

(d) Recovery outside of acceptable quality control range (40%-120%).

(e) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL)

(f) DNA Data not available.

(g) Precision criteria do not apply because sample results are less than 10 times the MDL

TABLE F.7. Quality Control Summary for Chlorinated Pesticides (elution order, Dieldrin to Toxaphene) in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

			Pesticides ($\mu\text{g/kg}$ wet weight)								
Sediment Treatment	Replicate	Batch	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin aldehyde	Endo-sulfan sulfate	4,4'-DDT	Toxaphene
<u>Procedural Blanks</u>											
Blank	NA ^(a)	1	0.07 U ^(b)	0.20 U	0.08 U	0.18 U	0.09 U	0.18	0.18 U	0.19 U	1.80 U
Blank	NA	2	0.10 U	0.26 U	0.10 U	0.23 U	0.12 U	0.23	0.23 U	0.24 U	2.34 U
Blank	NA	3	0.07 U	0.20 U	0.07 U	0.17 U	0.09 U	0.17	0.17 U	0.18 U	1.75 U
<u>Matrix Spikes</u>											
Comp FSFC	3	1	3.02	24.07	0.10 U	0.31	64.35	0.25	0.25 U	0.38	2.50 U
Comp FSFC MS	3	1	6.12	23.87	2.10	2.71	49.55	0.00	3.04	2.55	NA
Concentration Recovered			3.10	0.00	2.10	2.40	0.00	0.00	3.04	2.17	NA ^(c)
Amount Spiked			3.44	3.44 ^(d)	3.51	3.44	3.44	3.44	3.44	3.44	NS
Percent Recovery			90%	M ^(d)	60%	70%	M	M	88%	63%	NA
Comp FSFC	3	1	3.02	24.07	0.10 U	0.31	64.35	0.25	0.25 U	0.38	2.50 U
Comp FSFC MSD	3	1	5.76	22.70	2.23	2.50	48.43	0.00	3.13	3.46	NA
Concentration Recovered			2.74	0.00	2.23	2.19	0.00	0.00	3.13	3.08	NA
Amount Spiked			3.65	3.65	3.73	3.65	3.65	3.65	3.65	3.65	NS
Percent Recovery			75%	M	60%	60%	M	M	86%	84%	NA
RPD			18%	NA	0%	15%	NA	NA	3%	29%	NA
I-Stat			0.09	NA	0.00	0.08	NA	NA	0.02	0.14	NA
Comp FSFC	4	2	4.41	19.78	0.14 U	0.32 J ^(e)	48.92	0.33	0.10 J	0.49	3.27 U
Comp FSFC MS	4	2	M	M	3.89	4.20	M	M	4.75	5.94	NA
Concentration Recovered			NA	NA	3.89	3.88	NA	NA	4.65	5.45	NA
Amount Spiked			5.00	5.00	5.10	5.00	5.00	5.00	5.00	5.00	NS
Percent Recovery			NA	NA	76%	78%	NA	NA	93%	109%	NA
Comp FSFC	4	2	4.41	19.78	0.14 U	0.32 J	48.92	0.33	0.10 J	0.49	3.27 U
Comp FSFC MSD	4	2	M	M	3.78	4.44	M	M	4.38	6.02	NA
Concentration Recovered			NA	NA	3.78	4.12	NA	NA	4.28	5.53	NA
Amount Spiked			4.76	4.76	4.86	4.76	4.76	4.76	4.76	4.76	NS
Percent Recovery			NA	NA	78%	87%	NA	NA	90%	116%	NA
RPD			NA	NA	2%	11%	NA	NA	3%	6%	NA
I-Stat			NA	NA	0.01	0.05	NA	NA	0.02	0.03	NA

TABLE F.7. (contd)

Sediment Treatment	Replicate	Batch	Pesticides ($\mu\text{g/kg}$ wet weight)								
			Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin aldehyde	Endo-sulfan sulfate	4,4'-DDT	Toxaphene
MH32	NA	3	DNA ^(f)	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH32 MS	NA	3	1.06	1.26	0.91	NA	0.98	NA	NA	1.20	NA
Amount Spiked			1.18	1.18	1.23	NS	1.18	NS	NS	1.18	NS
Percent Recovery			90%	106%	74%	NA	83%	NA	NA	101%	NA
MH32	NA	3	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA	DNA
MH33 MSD	NA	3	1.01	1.26	0.75	NA	1.22	NA	NA	1.12	NA
Amount Spiked			1.17	1.17	1.22	NS	1.17	NS	NS	1.17	NS
Percent Recovery			86%	108%	61%	NA	104%	NA	NA	96%	NA
RPD			4%	1%	18%	NA	23%	NA	NA	6%	NA
I-Stat			0.02	0.01	0.10	NA	0.11	NA	NA	0.03	NA
Analytical Duplicates											
Comp USFC	1	1	4.21	11.31	0.10 U	0.29	77.26	0.23 U	0.38	1.10	2.29 U
Comp USFC	1	1	5.55	16.09	0.10 U	0.33	96.16	0.25 U	0.50	1.16	2.46 U
RPD			27%	35% ^(g)	NA	13%	22%	NA	27%	5%	NA
I-Stat			0.14	0.17	NA	0.06	0.11	NA	0.14	0.03	NA
Comp FSFC	5	2	2.33	12.37	0.07 U	0.17 U	16.15	0.17 U	0.17 U	0.14 J	1.65 U
Comp FSFC	5	2	3.20	15.43	0.13 U	0.23 J	26.72	0.32 U	0.09 J	0.65	NA
RPD			31% ^(g)	22%	NA	NA	49% ^(g)	NA	NA	129% ^(h)	NA
I-Stat			0.16	0.11	NA	NA	0.25	NA	NA	0.65	NA

(a) NA Not applicable.

(b) U Analyte was not present above the associated value.

(c) NS Not spiked.

(d) M Matrix interference. Recovery could not be calculated.

(e) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(f) DNA Data not available.

(g) Value exceeds relative precision goal of $\leq 30\%$.

(h) Precision criteria do not apply because sample results are less than 10 times the MDL.

TABLE F.8. Surrogate Recoveries for Chlorinated Pesticides in Tissues of M. nasuta, United Heckathorn Remedial Investigation

Sediment Treatment	Replicate	Batch	Surrogate Percent Recoveries		
			DBOFB	CL5(112)	CL5(103)
Comp LC	1	2	93.79	M ^(a)	97.81
Comp LC	2	2	86.13	M	75.01
Comp LC	3	2	88.16	107.68	118.52
Comp LC	4	1	56.33	108.70	83.67
Comp LC	5	2	92.49	M	79.01
Comp USFC	1	1	57.49	60.34	75.17
Comp USFC	2	1	67.87	60.34	70.63
Comp USFC	3	1	56.71	60.05	61.98
Comp USFC	4	1	57.05	59.95	73.29
Comp USFC	5	1	59.47	61.50	72.03
Comp FSFC	1	1	64.20	64.64	65.75
Comp FSFC	2	1	59.86	61.06	66.86
Comp FSFC	3	1	57.61	61.95	65.66
Comp FSFC	4	2	92.58	64.89	64.59
Comp FSFC	5	3	84.52	64.93	74.80
Comp IHC-1	1	1	61.11	60.14	61.35
Comp IHC-1	2	1	57.83	61.01	73.53
Comp IHC-1	3	2	81.41	53.78	44.12
Comp IHC-1	4	1	36.06 ^(b)	58.33	69.85
Comp IHC-1	5	1	81.43	65.87	81.11
Comp GD	1	2	96.54	63.36	56.06
Comp GD	2	1	53.72	57.34	68.26
Comp GD	3	2	89.61	55.23	49.18
Comp GD	4	2	86.03	61.54	58.77
Comp GD	5	1	56.86	58.79	65.94

Quality Control Data

Procedural Blanks

Blank	NA ^(c)	1	36.09 ^(b)	52.51	74.25
Blank	NA	2	94.56	69.96	65.13
Blank	NA	3	72.20	70.86	74.16

Matrix Spikes

Comp FSFC MS	3	1	59	64	63
Comp FSFC MSD	3	1	74	64	63
Comp FSFC MS	4	2	95	75	64
Comp FSFC MSD	4	2	95	68	65

TABLE F.8. (contd)

<u>Sediment Treatment</u>	<u>Replicate</u>	<u>Batch</u>	<u>Surrogate Percent Recoveries</u>		
			<u>DBO/FB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
MH32 MS	NA	3	78	71	82
MH33 MSD	NA	3	89	83	95

Analytical Duplicates

Comp USFC Duplicate	1	1	59.76	62.08	64.15
Comp FSFC Duplicate	5	2	87.92	65.10	60.19

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- (a) M Matrix interference. Recovery could not be calculated.
 (b) Recovery outside of acceptable quality control range (40%-120%).
 (c) NA Not applicable.

TABLE F.9. Total Polynuclear Aromatic Hydrocarbons (PAHs) in Tissues of M. nasuta, United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>Concentration ($\mu\text{g/kg}$ wet weight)</u>			<u>Concentration ($\mu\text{g/kg}$ dry weight)</u>		
	<u>Total LPAH</u>	<u>Total HPAH</u>	<u>Total PAH</u>	<u>Total LPAH</u>	<u>Total HPAH</u>	<u>Total PAH</u>
Comp LC	8.8	738.1	747	63.9	5367.9	5432
Comp USFC	263.3	1077.2	1340	1094.4	4476.9	5571
Comp FSFC	17.4	194.7	212	149.1	1667.2	1816
Comp IHC - 1	3.2	74.4	78	23.9	550.9	575
Comp GD	20.0	112.6	133	155.0	873.1	1028

TABLE F. 10. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in the Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	LPAHs ($\mu\text{g/kg}$ wet weight)							
	Naphthalene	2-methyl Naphthalene	1-methyl Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Target DL ^(a)	20	20	20	20	20	20	20	20
Achieved DL High	2.58	1.31	1.35	2.38	0.90	1.52	1.69	1.30
Achieved DL Low	1.76	0.90	0.93	1.63	0.62	1.04	1.15	0.89
Comp LC	0.74 J ^(b)	0.53 J	0.31 J	0.41 J	0.17 J	0.27 J	3.52	2.84
Comp USFC	1.43 J	0.78 J	1.19 J	1.13 J	14.68	20.90	183.54	39.67
Comp FSFC	1.13 J	0.69 J	0.39 J	0.30 J	1.92	1.80	9.55	1.63
Comp IHC-1	0.80 J	0.38 J	0.22 J	1.68 U ^(c)	0.64 U	0.19 J	1.24	0.40 J
Comp $\text{\textcircled{D}}$	1.33 J	0.54 J	0.30 J	0.98 J	1.61	2.05	10.04	3.15

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the level of the associated value.

TABLE F. 11. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (PAHs) in the Tissues of *M. nasuta*, Dry Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Percent Dry Weight	LPAHs ($\mu\text{g/kg}$ dry weight)							
		Naphthalene	2-methyl Naphthalene	1-methyl Naphthalene	Acenaphthylene	Acenaphthene	Fluorene	Phenanthrene	Anthracene
Comp LC	13.75	5.38 J ^(a)	3.85 J	2.25 J	2.98 J	1.24 J	1.96 J	25.60	20.65
Comp USFC	24.06	5.94 J	3.24 J	4.95 J	4.70 J	61.01	86.87	762.84	164.88
Comp FSFC	11.68	9.67 J	5.91 J	3.34 J	2.57 J	16.44	15.41	81.76	13.96
Comp IHC-1	13.51	5.92 J	2.81 J	1.63 J	12.44 U ^(b)	4.74 U	1.41 J	9.18	2.96 J
Comp $\text{\textcircled{D}}$	12.90	10.31 J	4.19 J	2.33 J	7.60 J	12.48	15.89	77.83	24.42

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of the associated value.

TABLE F. 12. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	HPAH ($\mu\text{g/kg}$ wet weight)									
	Fluor-anthene	Pyrene	Benzo(a) - anthra-cene	Chrysene	Benzo(b) - fluor-anthene	Benzo(k) - fluor-anthene	Benzo(a) - pyrene	Indeno-(1,2,3-c,d) pyrene	Dibenzo-(a,h) anthracene	Benzo-(g,h,i) perylene
Target DL ^(a)	20	20	20	20	20	20	20	20	20	20
Achieved DL High	2.25	1.62	2.05	2.35	2.32	1.09	0.86	1.89	1.70	1.59
Achieved DL Low	1.54	1.11	1.40	1.60	1.58	0.74	0.59	1.29	1.16	1.09
Comp LC	154.28	279.02	28.08	39.14	103.30	52.82	57.56	11.61	1.47	10.81
Comp USFC	387.63	359.77	69.28	57.71	89.50	41.75	46.52	11.13	1.38 J ^(b)	12.48
Comp FSFC	18.19	75.45	4.66	7.53	38.81	17.97	20.96	4.66	0.81 J	5.69
Comp IHC-1	3.58	27.58	2.24	3.32	15.39	9.32	8.05	1.95	1.20 U ^(c)	3.00
Comp GD	34.11	31.95	7.46	9.00	10.41	5.21	5.64	3.43	1.14 J	4.28

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL)

(c) U Analyte was not present above the level of the associated value.

TABLE F. 13. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Tissues of *M. nasuta*, Dry Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Percent Dry Weight	HPAH ($\mu\text{g/kg}$ dry weight)									
		Fluor-anthene	Pyrene	Benzo(a) - anthra-cene	Chrysene	Benzo(b) - fluor-anthene	Benzo(k) - fluor-anthene	Benzo(a) - pyrene	Indeno-(1,2,3-c,d) pyrene	Dibenzo-(a,h) anthracene	Benzo-(g,h,i) perylene
Comp LC	13.75	1122.04	2029.24	204.22	284.65	751.27	384.15	418.62	84.44	10.69	78.62
Comp USFC	24.06	1611.10	1495.30	287.95	239.86	371.99	173.52	193.35	46.26	5.74 J ^(a)	51.87
Comp FSFC	11.68	155.74	645.98	39.90	64.47	332.28	153.85	179.45	39.90	6.93 J	48.72
Comp IHC-1	13.51	26.50	204.15	16.58	24.57	113.92	68.99	59.59	14.43	8.88 U ^(b)	22.21
Comp GD	12.90	264.42	247.67	57.83	69.77	80.70	40.39	43.72	26.59	8.84 J	33.18

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of the associated value.

TABLE F.14. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in the Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	LPAHs ($\mu\text{g/kg}$ wet weight)							
	Naph- thalene	2-methyl Naph- thalene	1-methyl Naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
<u>Method Blank</u>								
Blank	0.47 J ^(a)	0.23 J	0.22 J	0.18 J	0.24 J	0.26 J	0.58 J	0.31 J
<u>Matrix Spikes</u>								
Comp FSFC Rep 4	1.01 J	0.37 J ^(b)	1.05	1.17 J	15.58	20.30	163.64	36.90
Comp FSFC Rep 4 MS	88.68	NA ^(b)	NA	93.11	112.82	116.00	255.75	121.42
Concentration Recovered	87.67	NA ^(c)	NA	91.94	97.24	95.7	92.11	84.52
Amount Spiked	104.09	NS ^(c)	NS	104.09	104.09	104.09	104.09	104.09
Percent Recovery	84%	NA	NA	88%	93%	92%	88%	81%
Comp FSFC Rep 4	1.01 J	0.37 J	1.05	1.17 J	15.58	20.30	163.64	36.90
Comp FSFC Rep 4 MSD	85.90	NA	NA	89.39	116.59	116.02	361.47	150.69
Concentration Recovered	84.89	NA	NA	88.22	101.01	95.72	197.83	113.79
Amount Spiked	99.14	NS	NS	99.14	99.14	99.14	99.14	99.14
Percent Recovery	86%	NA	NA	89%	102%	97%	200% ^(d)	115%
RPD	2%	NA	NA	1%	9%	5%	77% ^(e)	34% ^(e)
I-Stat	0.01	NA	NA	0.00	0.04	0.02	0.39	0.17

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) NA Not applicable.

(c) NS Not spiked.

(d) Recovery outside of quality control range (40%-120%).

(e) Value exceeds relative precision goal of $\leq 30\%$

TABLE F.15. Quality Control Summary for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	HPAH ($\mu\text{g/kg}$ wet weight)									
	Fluor- anthene	Pyrene	Benzo(a)- anthra- cene	Chrysene	Benzo(b)- fluor- anthene	Benzo(k)- fluor- anthene	Benzo(a)- pyrene	Indeno- (1,2,3-c,d) pyrene	Dibenzo- (a,h) anthracene	Benzo- (g,h,i) perylene
<u>Method Blank</u>										
Blank	0.46 J ^(a)	0.52 J	0.58 J	0.54 J	0.39 J	0.34 J	0.37 J	0.93 U ^(b)	0.84 U	0.78
<u>Matrix Spikes</u>										
Comp FSFC Rep 4	252.61	248.74	60.06	50.33	80.55	22.47	42.29	6.63	1.59	11.58
Comp FSFC Rep 4 MS	331.51	304.26	136.23	124.59	142.45	109.74	108.22	104.17	94.20	98.72
Concentration Recovered	78.9	55.52	76.17	74.26	61.90	87.27	65.93	97.54	92.61	87.14
Amount Spiked	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09	104.09
Percent Recovery	76%	53%	73%	71%	59%	84%	63%	94%	89%	84%
Comp FSFC Rep 4	252.61	248.74	60.06	50.33	80.55	22.47	42.29	6.63	1.59	11.58
Comp FSFC Rep 4 MSD	491.62	535.52	240.71	229.49	191.96	142.77	174.11	123.56	93.39	120.53
Concentration Recovered	239.01	286.78	180.65	179.16	111.41	120.30	131.82	116.93	91.8	108.95
Amount Spiked	99.14	99.14	99.14	99.14	99.14	99.14	99.14	99.14	99.14	99.14
Percent Recovery	241% ^(c)	289% ^(c)	182% ^(c)	181% ^(c)	112%	121% ^(c)	133% ^(c)	118%	93%	110%
RPD	104% ^(d)	138% ^(d)	85% ^(d)	87% ^(d)	62% ^(d)	37% ^(d)	71% ^(e)	23%	4%	27%
I-Stat	0.52	0.69	0.43	0.43	0.31	0.18	0.35	0.11	0.02	0.14

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of the associated value.

(c) Recovery outside of quality control range (40%-120%).

(d) Value exceeds relative precision goal of $\leq 30\%$

TABLE F.16. Surrogate Recoveries for Analysis of Polynuclear Aromatic Hydrocarbons (PAHs) in Tissues of *M. nasuta*, United Heckathorn Remedial Investigation

Sediment Treatment	Surrogate Percent Recoveries		
	<u>Naphthalene-d8</u>	<u>Acenaphthene-d10</u>	<u>Benzo[a]pyrene-d12</u>
Comp LC	65.70	70.88	68.07
Comp USFC	66.89	70.36	65.68
Comp FSFC	70.50	72.66	67.69
Comp IHC-1	70.71	73.77	64.95
Comp GD	69.97	66.27	62.34
<u>Quality Control Data</u>			
Blank	81.03	76.57	56.95
Comp FSFC Rep 4	66.13	72.59	72.80
Comp FSFC Rep 4 MS	75	71	73
Comp FSFC Rep 4 MSD	75	71	75

TABLE F.17. Polychlorinated Biphenyls (PCBs) in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Surrogate Percent Recoveries			PCBs ($\mu\text{g}/\text{kg}$ wet weight)			
	DBOFB	CL5(112)	CL5(103)	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Target DL ^(a)	NA ^(b)	NA	NA	20	20	20	20
Achieved DL High	NA	NA	NA	4.75	4.75	4.75	4.75
Achieved DL Low	NA	NA	NA	3.24	3.24	3.24	3.24
Comp LC	89.36	M ^(c)	68.37	3.24 U ^(d)	3.24 U	42.33	3.24 U
Comp USFC	86.18	62.35	63.00	4.75 U	4.75 U	43.64	4.75 U
Comp FSFC	90.30	62.92	64.00	4.13 U	4.13 U	20.88	4.13 U
Comp FSFC Rep 4	92.58	64.89	64.59	3.27 U	3.27 U	28.95	3.27 U
Comp IHC-1	95.32	62.65	61.38	3.35 U	3.35 U	12.25	3.35 U
Comp GD	84.26	61.62	59.31	4.52 U	4.52 U	7.09	4.52 U

(a) DL Detection limit.

(b) NA Not applicable.

(c) M Matrix interference.

(d) U Analyte not detected above the level of the associated value.

7

TABLE F.18. Polychlorinated Biphenyls (PCBs) in Tissues of *M. nasuta*, Dry Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Percent Dry Weight	PCBs ($\mu\text{g}/\text{kg}$ drv weight)			
		Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Comp LC	13.75	23.56 U ^(a)	23.56 U	307.85	23.56 U
Comp USFC	24.06	19.74 U	19.74 U	181.38	19.74 U
Comp FSFC	11.68	35.36 U	35.36 U	178.77	35.36 U
Comp FSFC Rep 4	10.21	32.03 U	32.03 U	283.55	32.03 U
Comp IHC-1	13.51	24.80 U	24.80 U	90.67	24.80 U
Comp GD	12.90	35.04 U	35.04 U	54.96	35.04 U

(a) U Analyte not detected above the level of the associated value.

TABLE F.19. Quality Control Summary for Polychlorinated Biphenyls (PCBs) in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Surrogate Percent Recoveries			PCBs ($\mu\text{g}/\text{kg}$ wet weight)			
	<u>DBOFB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>	<u>Aroclor 1242</u>	<u>Aroclor 1248</u>	<u>Aroclor 1254</u>	<u>Aroclor 1260</u>
<u>Procedural Blanks</u>							
Blank	94.56	69.96	65.13	2.34 U ^(a)	2.34 U	2.34 U	2.34 U
<u>Matrix Spikes</u>							
Comp FSFC Rep 4	92.58	64.89	64.59	3.27 U	3.27 U	28.95	3.27 U
Comp FSFC Rep 4 MS	95	75	64	NA ^(b)	NA	69.93	NA
Concentration Recovered				NA	NA	40.98	NA
Amount Spiked				NS ^(c)	NS	83.28	NS
Percent Recovery				NA	NA	49%	NA
Comp FSFC Rep 4	92.58	64.89	64.59	3.27 U	3.27 U	28.95	3.27 U
Comp FSFC Rep 4 MSD	95	68	65	NA	NA	76.53	NA
Concentration Recovered				NA	NA	47.58	NA
Amount Spiked				NS	NS	79.31	NS
Percent Recovery				NA	NA	60%	NA
RPD				NA	NA	20%	NA
I-Stat				NA	NA	0.10	NA

(a) U Analyte not detected above the level of the associated value.

(b) NA Not applicable.

(c) NS Not spiked.

TABLE F.20. Metals in Tissues of *M. nasuta*, Wet Weight, United Heckathorn Remedial Investigation

Sediment Treatment	% Dry Weight	Metals (mg/kg wet weight)									
		Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Comp LC	12.90	0.08	3.6	0.05	0.22	3.2	0.017	0.5	0.36	0.24	13.3
Comp USFC	14.62	0.10	4.4	0.04	0.30	3.5	0.020	0.7	0.34	0.27	14.4
Comp FSFC	12.06	0.07	3.1	0.05	0.27	2.6	0.016	0.4	0.23	0.22	15.1
Comp IHC-1	12.39	0.06	4.1	0.06	0.33	2.5	0.017	0.6	0.31	0.18	12.0
Comp GD	13.63	0.06	3.8	0.04	0.39	2.6	0.019	0.6	0.23	0.28	16.6

TABLE F.21. Results and Quality Control Summary for Metals in Tissues of *M. nasuta*, Dry Weight, United Heckathorn Remedial Investigation

Sediment Treatment	Metals (mg/kg dry weight)									
	Ag	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Target DL (~)	0.10	2.0	0.10	1.00	4.3	0.010	1.0	1.00	1.00	35.0
Achieved DL	0.01	2.0	0.04	0.35	4.3	0.002	1.0	0.08	1.00	35.0
Comp LC	0.63	28.1	0.40	1.69	24.6	0.131	3.7	2.82	1.84	103.0
Comp USFC	0.66	30.3	0.29	2.06	24.1	0.136	5.1	2.35	1.85	98.5
Comp FSFC	0.59	25.5	0.39	2.20	21.8	0.131	3.1	1.88	1.80	125.0
Comp IHC-1	0.50	32.7	0.45	2.67	20.4	0.138	4.9	2.47	1.48	96.8
Comp GD	0.47	28.2	0.33	2.85	18.9	0.138	4.1	1.66	2.06	122.0

Quality Control Data

Method Blank

Blank	0.01 U ^(b)	NA ^(c)	0.04 U	0.52	NA	0.002 U	NA	0.084 U	NA	NA
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Matrix Spike

Comp GD ^(d)	0.46	28.0	0.33	2.79	18.9	0.140	4.0	1.77	1.98	121.5
Comp GD MS	1.30	NA	2.44	6.43	NA	1.010	NA	3.64	NA	NA
Concentration Recovered	0.84	NA	2.11	3.64	NA	0.871	NA	1.87	NA	NA
Amount Spiked	1.00	NS ^(e)	2.00	4.00	NS	1.00	NS	2.00	NS	NS
Percent Recovered	84%	NA	106%	91%	NA	87%	NA	94%	NA	NA

Standard Reference Material

Certified	NA	14.0	NA	NA	66.3	NA	2.3	NA	2.21	830
Value 1566a	NA	±1.2	NA	NA	±4.3	NA	±0.4	NA	±0.24	±57
SRM1566a	NA	14.4	NA	NA	65.6	NA	2.2	NA	2.44	868

Analytical Duplicate

Comp GD	0.47	28.2	0.33	2.85	18.9	0.138	4.1	1.66	2.06	122.0
Comp GD Duplicate	0.45	27.8	0.33	2.72	18.9	0.141	3.8	1.87	1.90	121.0
RPD	4%	1%	0%	5%	0%	2%	8%	12%	8%	1%
I-Stat	0.02	0.01	0.00	0.02	0.00	0.01	0.04	0.06	0.04	0.00

- (a) DL Detection limit.
(b) U Analyte was not present above the associated value.
(c) NA Not applicable.
(d) Mean of replicated sample.
(e) NS Not spiked.

TABLE F.22. Results and Quality Control Summary for Butyltins in Tissues of *M. nasuta*, United Heckathorn Remedial Investigation

Sediment Treatment	Surrogate Percent Recovery Triphenyltin	<i>M. nasuta</i> Butyltins ($\mu\text{g/kg}$ dry weight)		Percent Dry Weight	<i>M. nasuta</i> Butyltins ($\mu\text{g/kg}$ wet weight)	
		Tri- butyltin	Di- butyltin		Tri- butyltin	Di- butyltin
Target DL (a)	NA (b)	10	10	NA	NA	NA
Achieved DL	NA	0.5	1.4	NA	NA	NA
Comp LC	106%	41.8	26.0	13.11	5.48	3.41
Comp USFC	103%	43.9	26.8	14.78	6.49	3.96
Comp FSFC	104%	39.2	60.4	11.55	4.53	6.98
Comp IHC-1	109%	19.7	26.9	13.32	2.62	3.58
Comp GD	101%	47.2	26.8	11.79	5.56	3.16
<u>Quality Control Data</u>						
<u>Method Blank</u>						
Blank	111%	0.5 U ^(c)	1.4 U	NA		
<u>Matrix Spikes</u>						
Comp USFC	103%	43.9	26.8	14.78		
Comp USFC MS	99%	377.7	386.6	NA		
Concentration Recovered		333.8	359.8			
Amount Spiked		354.6	354.6			
Percent Recovery		94%	101%			
Comp USFC	103%	43.9	26.8	14.78		
Comp USFC MSD	100%	374.3	397.9	NA		
Concentration Recovered		330.4	371.1			
Amount Spiked		367.7	367.7			
Percent Recovery		90%	101%			
RPD		5%	1%			
I-Stat		0.02	0.00			
<u>Analytical Duplicate</u>						
Comp LC	106%	41.8	26.0	13.11		
Comp LC Duplicate	96%	39.4	29.0	NA		
RPD		6%	11%			
I-Stat		0.03	0.05			

(a) DL Detection limit.

(b) NA Not applicable.

(c) U Analyte was not present above the associated value.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Total Lipids
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *M. nasuta* tissue
SAMPLE NUMBER: 30

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Bligh & Dyer	NA	±30%	0.1% wet weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the 2 batches of tissue samples analyzed for lipids:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>Lipid Analysis</u>
Batch 1	2/19/93	2/23/93	3/9/93	3/10-11/93
Batch 2	2/19/93	2/23/93	3/9/93	3/11-15/93

Holding times for extractions and analyses were met.

PROCEDURAL BLANKS

Lipids were not measured in procedural blanks.

MATRIX SPIKES

Matrix spikes are not applicable to lipid analysis.

SURROGATES

Surrogates are not applicable to lipid analysis.

DUPLICATES

Two samples were analyzed in duplicate for lipids. Precision was acceptable (RPDs 1% and 6%) in both sets of duplicates.

DETECTION LIMITS

Target detection limits were met for lipid analysis.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Chlorinated Pesticides
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *M. nasuta* tissue
SAMPLE NUMBER: 25

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8080	40%-120%	±30%	2 µg/kg wet weight (30 µg/kg for toxaphene)

HOLDING TIMES

The following is a list of extraction and analysis dates for the two batches of tissue samples analyzed for pesticides:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 1	2/19/93	2/23/93	3/9/93	4/7-9/93, 4/10/93 (dilutions)
Batch 2	2/19/93	2/23/93	3/9/93	3/29-31/93, 4/10/93 (dilutions), 5/17/93 (reanalysis)
Batch 3 (rerun)	2/19/93	2/23/93	4/28/93	5/17/93

Holding times for extractions and analyses were met.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. Endrin aldehyde was detected above the method detection limit in the blanks for all three batches. Sample results less than five times the concentration in the associated blank were flagged as not detected. Affected samples were Comp LC, Replicate 1 and Comp ~~IHC-1~~, Replicate 3.

MATRIX SPIKES

The recoveries of target pesticides in the MS and MSD samples were acceptable for Batch 1 with the exception of low recoveries of alpha-BHC and delta-BHC (35% and 40%, respectively). In Batches 1 and 2, recoveries for DDE, DDD, and endrin aldehyde could not be quantified because of matrix interference. Dieldrin could not be quantified in Batch 2. The MS and MSD recoveries for all other compounds in Batch 2 were acceptable.

SURROGATES

The recovery of one surrogate compound (DBOFB) was less than 40% in one procedural blank and in one sample in Batch 1. In Batch 2, the recovery of another surrogate compound [CL5(112)], could not be determined in three samples because of matrix interferences. Surrogate recoveries for all other samples were acceptable.

DUPLICATES

Duplicate precision between the MS and MSD samples was very good for all compounds in all batches. Precision of laboratory duplicates could be evaluated for three compounds (dieldrin, 4,4'-DDE, and 4,4'-DDD) that had detected values greater than 10 times the achieved detection limit. RPDs ranged from 22% to 49%, with three RPDs exceeding the 30% limit. The high RPDs were probably due to the relatively low values rather than sample inhomogeneity; the acceptable MS/MSD RPDs indicate acceptable analytical precision.

DETECTION LIMITS

Target detection limits were met for tissue pesticide analyses.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: M. nasuta tissue
SAMPLE NUMBER: 5

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8270	40%-120%	±30%	20 µg/kg wet weight

HOLDING TIMES

Tissue samples for PAH analysis were extracted as part of pesticide Batch 2:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/MS Analysis</u>
Batch 2	2/19/93	2/23/93	3/9/93	3/23-24/93 4/28/93 (MS background only)

The holding times for all extractions and analyses were met.

PROCEDURAL BLANKS

One procedural blank was processed with the batch of samples. No PAHs were detected above the method detection limit in the procedural blank.

MATRIX SPIKES

The recoveries of target PAHs in the MS were acceptable. Recoveries of 7 of 16 PAH compounds exceeded quality control limits in the MSD: phenanthrene, fluoranthene, pyrene, benzo[a]anthracene, chrysene, benzo[k]fluoranthene, and benzo[a]pyrene. These seven compounds were present in the unspiked sample at relatively high concentrations.

SURROGATES

All tissue PAH surrogate recoveries were acceptable.

DUPLICATES

The relative percent difference (RPD) between MS and MSD samples were acceptable except where the background sample had high levels of PAHs (the seven compounds with high MSD recoveries, plus anthracene and benzo[*b*]fluoranthene). A sample duplicate was not analyzed because of the small number of samples and limited sample volume.

DETECTION LIMITS

Achieved detection limits were acceptable (≤ 20 $\mu\text{g/kg}$ wet weight).

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polychlorinated Biphenyls (PCB)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *M. nasuta* tissue
SAMPLE NUMBER: 5

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8080	40%-120%	±30%	20 µg/kg wet weight

HOLDING TIMES

Tissue samples analyzed for PCBs were extracted and analyzed with pesticide Batch 2 on these dates:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 2	2/19/93	2/23/93	3/9/93	3/29-31/93, 4/10/93 (dilutions)

Holding times for extractions and analyses were met.

PROCEDURAL BLANKS

One procedural blank was processed with the batch. No PCB compounds were detected in the blank.

MATRIX SPIKES

The recoveries of Aroclor 1254 in the MS and MSD samples were within quality control limits.

SURROGATES

The surrogate CL5(112) could not be measured in Comp GD tissue because of matrix interference; recoveries of the other two surrogates were acceptable in Comp GD. The recoveries of all three surrogate compounds were acceptable in all other samples.

DUPLICATES

Duplicate precision between the MS and MSD samples was acceptable. Sample duplicates were not analyzed.

DETECTION LIMITS

Achieved detection limits for PCBs in tissues ranged from 3.35 to 4.75 yglkg wet weight, well below the target detection limit of 20 yglkg.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Metals
LABORATORY: Battelle Marine Sciences Laboratory
MATRIX: *M. nasuta* tissue
SAMPLE NUMBER: 5

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Varies by metal	75%-125%, <30% from certified value for SRM	±20%	Varies by metal

HOLDING TIMES

Tissue samples were received 2/19/93. The following table summarizes all analysis dates:

<u>Task</u>	<u>Date Performed</u>
APDC	3/5/93
GFAA analysis-silver	4/23/93
GFAA analysis-cadmium	4/22/93
GFAA analysis-chromium	4/23/93
GFAA analysis-lead	4/23/93
CVAA analysis-mercury	3/11/93
XRF analysis-arsenic, copper, nickel, selenium, zinc	3/15/93

The holding times were met for all analyses.

PROCEDURAL BLANKS

One procedural blank was analyzed with all metals analyzed by AA. Silver, cadmium, mercury, and lead were undetected in the blank. Chromium was detected in the blank but at a level less than the target detection limit. All GFAA metal values are blank-corrected.

MATRIX SPIKES

One matrix spike sample was analyzed for all metals analyzed by AA. Matrix spike recoveries ranged from 84% to 106%; all were within the QC limits of 75% to 125%.

DUPLICATES

One sample was analyzed in duplicate. The relative percent difference (RPD) for all metals were 0 to 12%, within the acceptable range of $\leq 20\%$.

DETECTION LIMITS

Target detection limits were met for all metals.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Butyltins
LABORATORY: Battelle Marine Sciences Laboratory
MATRIX: *M. nasuta* tissue
SAMPLE NUMBER: 5

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Unger, et. al	40%-120%	±30%	10 µg/kg dry weight

HOLDING TIMES

Extraction and analysis dates for the batch of tissue samples analyzed for butyltins were as follows:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/FPD Analysis</u>
Batch 1	2/19/93	2/19/93	3/2/93	3/10/93

The holding times for extractions and analyses were met.

PROCEDURAL BLANKS

One blank was processed with the batch of samples. No butyltins were detected in the blank.

MATRIX SPIKES

The recoveries of tributyltin and dibutyltin in the MS and MSD samples ranged from 90% to 101%, with precision between the MS and MSD 5% for tributyltin and 1% for dibutyltin. Both recoveries and RPDs were within acceptable limits.

SURROGATES

One SIS, triphenyltin chloride, is added prior to extraction to assess the efficiency of the method. All sample data are corrected for the recovery of this compound. Surrogate recoveries for all samples were within the QC limits.

DUPLICATES

Relative percent differences between the analytical duplicates were within the QC limit of 30%.

DETECTION LIMITS

Target detection limits of 10 µg/kg dry weight were met for all butyltin compounds.

APPENDIX G

LIQUID-PHASE CHEMISTRY AND QUALITY ASSURANCE DATA

TABLE G.1. Total Suspended Solids, United Heckathorn Remedial Investigation

<u>Sediment Treatment</u>	<u>Batch</u>	<u>Solids (mg/L)</u>
Site Water	1	14
Procedural Blank	1	8
Comp LC SPP	1	41
Comp LC ELUT	1	8
Comp LC-5 SPP	1	57
Comp LC-5 ELUT	1	20
Comp LC-6 SPP	1	59
Comp LC-6 ELUT	1	36
Comp USFC SPP	1	62
Comp USFC ELUT	1	8
Comp FSFC SPP	2	42
Comp FSFC ELUT	2	2
Comp IHC-1 SPP	2	34
Comp IHC-1 ELUT	2	3
Comp IHC-2 SPP	2	52
Comp IHC-2 ELUT	2	0
Comp IHC-3 SPP	2	40
Comp IHC-3 ELUT	2	2
<u>Quality Control Samples</u>		
<u>Method Blanks</u>		
Blank	1	3
Blank	2	3
<u>Analytical Duplicates</u>		
Comp LC SPP	1	41
Comp LC SPP Duplicate	1	46
RPD		11%
I-Stat		0.06
Comp FSFC SPP	2	42
Comp FSFC SPP Duplicate	2	50
RPD		17%
I-Stat		0.09

TABLE G.2. Chlorinated Pesticides (elution order, Alpha-BHC to Endosulfan I) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch Volume (L)		Pesticides (ng/L)								
			Alpha BHC	Beta BHC	Lindane	Delta BHC	Hepta-chlor	Aldrin	Hepta-chlor-epoxide	Trans-chlordane	Endo-sulfan I
Target DL (~)			5	5	5	5	5	5	5	5	5
Achieved DL			5.12	4.57	10.91	10.91	5.48	6.61	4.20	6.33	6.33
Site Water	1	1.00	5.12 U ^(b)	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U ^(c)	6.33 U
Procedural Blank	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	0.76 J ^(c)	6.33 U
Comp LC SPP	1	1.00	158.71	6.39	1.42 J	10.91 U	5.48 U	6.61 U	4.20 U	182.04	6.33 U
Comp LC Elutriate	1	1.00	171.02	10.16	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	40.79	6.33 U
Comp LC-5 SPP	1	1.00	23.39	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	435.47	6.33 U
Comp LC-5 Elutriate	1	1.00	16.81	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	275.20	6.33 U
Comp LC-5 Elutriate U _F ^(d)	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	246.10	6.33 U
Comp LC-5 Elutriate F ^(e)	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp LC-6 SPP	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	1114.35	6.33 U
Comp LC-6 Elutriate	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	1240.78	6.33 U
Comp USFC SPP	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	3.19 J	6.33 U
Comp USFC Elutriate	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	2.78 J	6.33 U
Comp FSFC SPP	2	0.80	6.40 U	5.71 U	13.64 U	13.64 U	6.85 U	8.26 U	5.25 U	7.91 U	7.91 U
Comp FSFC Elutriate	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp IHC-1 SPP	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	0.54 J	6.33 U
Comp IHC-1 Elutriate	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp IHC-2 SPP	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp IHC-2 Elutriate	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp IHC-3 SPP	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp IHC-3 Elutriate	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL)

(d) UF Unfiltered.

(e) F Filtered.

TABLE G.3. Chlorinated Pesticides (elution order, cis-Chlordane to Endosulfan II) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Volume (L)	Pesticides (ng/L)				
			cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II
Target DL ^(a)			5	5	5	5	5
Achieved DL			9.18	9.18	8.09	9.31	11.20
Site Water	1	1.00	9.18 U ^(b)	0.42 J ^(c)	8.09 U	9.31 U	11.20 U
Procedural Blank	1	1.00	0.16 J	7.15 J	5.20 J	9.31 U	11.20 U
Comp LC SPP	1	1.00	46.96	447.81	610.58	15.53	11.20 U
Comp LC Elutriate	1	1.00	10.03	546.42	522.23	9.31 U	11.20 U
Comp LC-5 SPP	1	1.00	189.15	4653.19	7578.31	9.31 U	11.20 U
Comp LC-5 Elutriate	1	1.00	129.82	3332.02	4495.13	9.31 U	11.20 U
Comp LC-5 Elutriate UF ^(d)	2	1.00	70.60	2965.91	3529.10	9.31 U	11.20 U
Comp LC-5 Elutriate F ^(e)	2	1.00	65.16	2159.40	2811.08	9.31 U	11.20 U
Comp LC-6 SPP	1	1.00	710.01	5351.35	4964.23	9.31 U	11.20 U
Comp LC-6 Elutriate	1	1.00	400.06	9636.10	10614.65	9.31 U	11.20 U
Comp USFC SPP	1	1.00	9.18 U	8.31 J	41.35	9.31 U	11.20 U
Comp USFC Elutriate	1	1.00	0.77 J	22.89	29.93	9.31 U	11.20 U
Comp FSFC SPP	2	0.80	11.48 U	11.28 J	37.52	11.64 U	14.00 U
Comp FSFC Elutriate	2	1.00	9.18 U	5.43 J	4.09 J	9.31 U	11.20 U
Comp IHC-1 SPP	2	1.00	9.18 U	1.81 J	3.24 J	9.31 U	11.20 U
Comp IHC-1 Elutriate	2	1.00	9.18 U	1.12 J	0.69 J	9.31 U	11.20 U
Comp IHC-2 SPP	2	1.00	9.18 U	1.48 J	2.62 J	9.31 U	11.20 U
Comp IHC-2 Elutriate	2	1.00	9.18 U	12.80	20.29	9.31 U	11.20 U
Comp IHC-3 SPP	2	1.00	9.18 U	1.20 J	0.85 J	9.31 U	11.20 U
Comp IHC-3 Elutriate	2	1.00	9.18 U	1.17 J	0.75 J	9.31 U	11.20 U

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

(c) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(d) UF Unfiltered.

(e) F Filtered.

TABLE 6.4. Chlorinated Pesticides (elution order, 4,4'-DDD to Toxaphene) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Volume (L)	Pesticides (ng/L)				
			4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
Target DL ^(a)			5	5	5	5	5
Achieved DL			17.25	6.36	8.19	11.95	25.0
Site Water	1	1.00	2.74 J ^(b)	6.36 U ^(c)	8.19 U	0.76 J	25.00 U
Procedural Blank	1	1.00	248.80	6.36 U	8.19 U	6.33 J	25.00 U
Comp LC SPP	1	1.00	9542.14	6.36 U	8.19 U	700.84	25.00 U
Comp LC Elutriate	1	1.00	2069.87	6.36 U	8.19 U	309.58	25.00 U
Comp LC-5 SPP	1	1.00	78634.11	6.36 U	58.67	2228.04	25.00 U
Comp LC-5 Elutriate	1	1.00	54426.46	6.36 U	94.81	1419.21	25.00 U
Comp LC-5 Elutriate UF ^(d)	2	1.00	42986.04	6.36 U	101.90	1087.98	25.00 U
Comp LC-5 Elutriate F ^(e)	2	1.00	32855.14	6.36 U	8.04 J	941.14	25.00 U
Comp LC-6 SPP	1	1.00	117168.80	6.36 U	8.19 U	2764.24	25.00 U
Comp LC-6 Elutriate	1	1.00	283065.07	6.36 U	8.19 U	6801.44	25.00 U
Comp USFC SPP	1	1.00	101.44	6.36 U	8.19 U	4.75 J	25.00 U
Comp USFC Elutriate	1	1.00	882.17	6.36 U	8.19 U	18.45	25.00 U
Comp FSFC SPP	2	0.80	203.86	7.95 U	10.24 U	9.33 J	31.25 U
Comp FSFC Elutriate	2	1.00	41.18	6.36 U	8.19 U	1.53 J	25.00 U
Comp IHC-1 SPP	2	1.00	22.07	6.36 U	8.19 U	1.12 J	25.00 U
Comp IHC-1 Elutriate	2	1.00	17.00 J	6.36 U	8.19 U	0.45 J	25.00 U
Comp IHC-2 SPP	2	1.00	61.11	6.36 U	8.19 U	3.49 J	25.00 U
Comp IHC-2 Elutriate	2	1.00	663.67	6.36 U	8.19 U	125.89	25.00 U
Comp IHC-3 SPP	2	1.00	15.02	6.36 U	8.19 U	1.05 J	25.00 U
Comp IHC-3 Elutriate	2	1.00	18.94	6.36 U	8.19 U	1.03 J	25.00 U

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the associated value.

(d) UF Unfiltered.

(e) F Filtered.

TABLE G.5. Quality Control Summary for Chlorinated Pesticides (elution order, Alpha-BHC to Endosulfan I) in Liquid Phase Samples, United Heckathorn Remedial Investigation

			Pesticides (ng/L)								
Liquid Phase Treatment	Batch	Volume (L)	Alpha BHC	Beta BHC	Lindane	Delta BHC	Hepta-chlor	Aldrin	Hepta-chlor-epoxide	Trans-chlordane	Endo-sulfan I
Method Blanks											
Blank	1	1.00	5.12 U ^(a)	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Blank	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Matrix Spikes											
Site Water	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Site Water MS	1		280.69	237.83	292.41	322.07	226.31	271.20	247.63	211.42	233.03
Concentration Recovered			280.69	237.83	292.41	322.07	226.31	271.20	247.63	211.42	233.03
Amount Spiked			306.00	288.00	288.00	288.00	288.00	288.00	288.00	306.00	288.00
Percent Recovery			92%	83%	102%	112%	79%	94%	86%	69%	81%
Site Water	1	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Site Water MSD	1		281.48	237.63	297.72	331.56	234.14	270.63	253.40	212.49	235.98
Concentration Recovered			281.48	237.63	297.72	331.56	234.14	270.63	253.40	212.49	235.98
Amount Spiked			306.00	288.00	288.00	288.00	288.00	288.00	288.00	306.00	288.00
Percent Recovery			92%	83%	103%	115%	81%	94%	88%	69%	82%
RPD			0%	0%	2%	3%	3%	0%	2%	1%	1%
I-Stat			0.00	0.00	0.01	0.01	0.02	0.00	0.01	0.00	0.01
Comp FSFC SPP	2	0.80	6.40 U	5.71 U	13.64 U	13.64 U	6.85 U	8.26 U	5.25 U	7.91 U	7.91 U
Comp FSFC SPP MS	2		304.59	281.44	318.77	381.29	270.40	270.88	262.73	225.29	241.90
Concentration Recovered			304.59	281.44	318.77	381.29	270.40	270.88	262.73	225.29	241.90
Amount Spiked			306.00	288.00	288.00	288.00	288.00	288.00	288.00	306.00	288.00
Percent Recovery			100%	98%	111%	132% ^(b)	94%	94%	91%	74%	84%
Comp FSFC SPP	2	0.80	6.40 U	5.71 U	13.64 U	13.64 U	6.85 U	8.26 U	5.25 U	7.91 U	7.91 U
Comp FSFC SPP MSD	2		340.67	314.63	362.16	440.76	314.20	306.30	304.60	258.29	271.69
Concentration Recovered			340.67	314.63	362.16	440.76	314.20	306.30	304.60	258.29	271.69
Amount Spiked			306.00	288.00	288.00	288.00 ^(b)	288.00	288.00	288.00	306.00	288.00
Percent Recovery			111%	109%	126% ^(b)	153% ^(b)	109%	106%	106%	84%	94%
RPD			11%	11%	13%	14%	15%	12%	15%	14%	12%
I-Stat			0.06	0.06	0.06	0.07	0.07	0.06	0.07	0.07	0.06

TABLE G.5. (contd)

			Pesticides (ng/L)								
Liquid Phase Treatment	Batch	Volume (L)	Alpha BHC	Beta BHC	Lindane	Delta BHC	Hepta-chlor	Aldrin	Hepta-chlor-epoxide	Trans-chlordane	Endo-sulfan
Analytical Duplicates											
Comp LC SPP	1	1.00	158.71	6.39	1.42 J	10.91 U	5.48 U	6.61 U	4.20 U	182.04	6.33 U
Comp LC SPP Duplicate	1	1.00	212.98	9.09	2.08 J	10.91 U	5.48 U	6.61 U	4.20 U	257.33	6.33 U
RPD			29%	35% (c)	38% (c)	NA	NA	NA	NA	34% (d)	NA
I-Stat			0.15	0.17	0.19	NA	NA	NA	NA	0.17	NA
Comp IHC-2 SPP	2	1.00	5.12 U	4.57 U	10.91 U	10.91 U	5.48 U	6.61 U	4.20 U	6.33 U	6.33 U
Comp IHC-2 SPP Duplicate	2	0.90	5.69 U	5.08 U	12.12 U	12.12 U	6.09 U	7.34 U	4.67 U	7.03 U	7.03 U
RPD			NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat			NA	NA	NA	NA	NA	NA	NA	NA	NA

(a) U Analyte was not present above the associated value.

(b) Recovery outside of quality control range (40% - 120%).

(c) Precision criteria do not apply because sample results are less than 10 times the MDL

(d) Value exceeds relative precision goal of $\leq 30\%$.

TABLE G.6. Quality Control Summary for Chlorinated Pesticides (elution order, cis-Chlordane to Endosulfan II) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Volume (L)	Pesticides (ng/L)				
			cis-Chlordane	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II
Method Blank							
Blank	1	1.00	9.18 U ^(a)	9.18 U	8.09 U	9.31 U	11.20 U
Blank	2	1.00	9.18 U	9.18 U	8.09 U	9.31 U	11.20 U
Matrix Spike							
Site Water	1	1.00	9.18 U	0.42 J ^(b)	8.09 U	9.31 U	11.20 U
Site Water MS	1		NA ^(c)	265.19	324.86	281.69	275.32
Concentration Recovered			NA	264.77	324.86	281.69	275.32
Amount Spiked			NS ^(d)	288.00	288.00	294.00	288.00
Percent Recovery			NA	92%	113%	96%	96%
Site Water	1	1.00	9.18 U	0.42 J	8.09 U	9.31 U	11.20 U
Site Water MSD	1		NA	257.50	333.54	280.82	269.61
Concentration Recovered			NA	257.08	333.54	280.82	269.61
Amount Spiked			NS	288.00	288.00	294.00	288.00
Percent Recovery			NA	89%	116%	96%	94%
RPD			NA	3%	3%	0%	2%
I-Stat			NA	0.01	0.01	0.00	0.01
Comp FSFC SPP	2	0.80	11.48 U	11.28 J	37.52	11.64 U	14.00 U
Comp FSFC SPP MS	2		NA	253.40	356.03	274.86	262.11
Concentration Recovered			NA	242.12	318.51	274.86	262.11
Amount Spiked			NS	288.00	288.00	294.00	288.00
Percent Recovery			NA	84%	111%	93%	91%
Comp FSFC SPP	2	0.80	11.48 U	11.28 J	37.52	11.64 U	14.00 U
Comp FSFC SPP MSD	2		NA	289.81	387.20	313.40	291.24
Concentration Recovered			NA	278.53	349.68	313.40	291.24
Amount Spiked			NS	288.00	288.00	294.00	288.00
Percent Recovery			NA	97%	121% ^(e)	107%	101%
RPD			NA	14%	9%	13%	11%
I-Stat			NA	0.07	0.05	0.07	0.05
Analytical Duplicates							
Comp LC SPP	1	1.00	46.96	447.81	610.58	15.53	11.20 U
Comp LC SPP Duplicate	1	1.00	87.09	748.01	1214.65	25.83	11.20 U
RPD			60% ^(f)	50% ^(g)	66% ^(g)	50% ^(f)	NA
I-Stat			0.30	0.25	0.33	0.25	NA
Comp IHC-2 SPP	2	1.00	9.18 U	1.48 J	2.62 J	9.31 U	11.20 U
Comp IHC-2 SPP Duplicate	2	0.90	10.20 U	0.85 J ^(f)	1.50 J ^(f)	10.34 U	12.44 U
RPD			NA	54%	54%	NA	NA
I-Stat			NA	0.27	0.27	NA	NA

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) NA Not applicable.

(d) NS Not spiked.

(e) Recovery outside of quality control range (40% - 120%).

(f) Precision criteria do not apply because sample results are less than 10 times the MDL.

(g) Value exceeds relative precision goal of $\leq 30\%$.

TABLE 6.7. Quality Control Summary for Chlorinated Pesticides (elution order, 4,4'-DDD to Toxaphene) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Volume (L)	Pesticides (ng/L)				
			4,4'-DDD	Endrin Aldehyde	Endosulfan Sulfate	4,4'-DDT	Toxaphene
Method Blank							
Blank	1	1.00	17.25 U ^(a)	6.36 U	8.19 U	11.95 U	25.00 U
Blank	2	1.00	8.52 J ^(b)	6.36 U	8.19 U	11.95 U	25.00 U
Matrix Spike							
Site Water	1	1.00	2.74 J	6.36 U	8.19 U	0.76 J	25.00 U
Site Water MS	1		325.38	289.66	275.65	278.20	NA ^(c)
Concentration Recovered			322.64	289.66	275.65	277.44	NA
Amount Spiked			288.00	288.00	288.00	288.00	NS ^(d)
Percent Recovery			112%	101%	96%	96%	NA
Site Water	1	1.00	2.74 J	6.36 U	8.19 U	0.76 J	25.00 U
Site Water MSD	1		343.49	276.30	267.26	294.81	NA
Concentration Recovered			340.75	276.30	267.26	294.05	NA
Amount Spiked			288.00	288.00	288.00	288.00	NS
Percent Recovery			118%	96%	93%	102%	NA
RPD			5%	5%	3%	6%	NA
I-Stat			0.03	0.02	0.02	0.03	NA
Comp FSFC SPP	2	0.80	203.86	7.95 U	10.24 U	9.33 J	31.25 U
Comp FSFC SPP MS	2		M ^(e)	234.20	258.98	294.42	NA
Concentration Recovered			NA	234.20	258.98	285.09	NA
Amount Spiked			288.00	288.00	288.00	288.00	NS
Percent Recovery			NA	81%	90%	99%	NA
Comp FSFC SPP	2	0.80	203.86	7.95 U	10.24 U	9.33 J	31.25 U
Comp FSFC SPP MSD	2		M	298.32	293.25	359.07	NA
Concentration Recovered			NA	298.32	293.25	349.74	NA
Amount Spiked			288.00	288.00	288.00	288.00	NS
Percent Recovery			NA	104%	102%	121% ^(f)	NA
RPD			NA	24%	12%	20%	NA
I-Stat			NA	0.12	0.06	0.10	NA
Analytical Duplicates							
Comp LC SPP	1	1.00	9542.14	6.36 U	8.19 U	700.84	25.00 U
Comp LC SPP Duplicate	1	1.00	19611.03	6.36 U	8.19 U	1940.75	25.00 U
RPD			69% ^(g)	NA	NA	94% ^(g)	NA
I-Stat			0.35	NA	NA	0.47	NA
Comp IHC-2 SPP	2	1.00	61.11	6.36 U	8.19 U	3.49 J	25.00 U
Comp IHC-2 SPP Duplicate	2	0.90	26.17	7.07 U	9.10 U	1.60 J ^(h)	27.78 U
RPD			80% ^(h)	NA	NA	74%	NA
I-Stat			0.40	NA	NA	0.37	NA

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) NA Not applicable.

(d) NS Not spiked.

(e) M Matrix interference.

(f) Recovery outside of quality control range (40% - 120%).

(g) Value exceeds relative precision goal of $\leq 30\%$.

(h) Precision criteria do not apply because sample results are less than 10 times the MDL.

TABLE G.8. Surrogate Percent Recoveries and Quality Control Summary for Chlorinated Pesticides and Polychlorinated Biphenyls (PCBs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Volume (L)	Surrogate Percent Recoveries		
			DBOFB	CL5(112)	CL5(103)
Site Water	1	1.00	75	61	55
Procedural Blank	1	1.00	91	69	59
Comp LC SPP	1	1.00	86	101	57
Comp LC Elutriate	1	1.00	96	118	65
Comp LC-5 SPP	1	1.00	84	57	64
Comp LC-5 Elutriate	1	1.00	99	63	42
Comp LC-5 Elutriate UF ^(a)	2	1.00	44	81	31 ^(b)
Comp LC-5 Elutriate F ^(c)	2	1.00	94	87	58
Comp LC-6 SPP	1	1.00	D ^(d)	D	D
Comp LC-6 Elutriate	1	1.00	D	D	D
Comp USFC SPP	1	1.00	90	68	58
Comp USFC Elutriate	1	1.00	107	79	73
Comp FSFC SPP	2	0.80	94	72	60
Comp FSFC Elutriate	2	1.00	90	74	61
Comp IHC-1 SPP	2	1.00	88	70	58
Comp IHC-1 Elutriate	2	1.00	53	62	39 ^(b)
Comp IHC-2 SPP	2	1.00	71	56	49
Comp IHC-2 Elutriate	2	1.00	101	99	93
Comp IHC-3 SPP	2	1.00	83	65	57
Comp IHC-3 Elutriate	2	1.00	83	73	59
<u>Quality Control Data</u>					
<u>Method Blanks</u>					
Blank	1	1.00	92	85	63
Blank	2	1.00	91	75	57
<u>Matrix Spikes</u>					
Site Water MS	1		80	69	56
Site Water MSD	1		77	64	53
Comp FSFC SPP MS	2		87	66	58
Comp FSFC SPP MSD	2		93	69	63

TABLE 6.8. (contd)

Liquid Phase Treatment	Batch	Volume (L)	Surrogate Percent Recoveries		
			DBO/FB	CL5(112)	CL5(103)
Analytical Duplicates					
Comp LC SPP	1	1.00	86	101	57
Comp LC SPP Duplicate	1	1.00	91	104	59
Comp IHC-2 SPP	2	1.00	71	56	49
Comp IHC-2 SPP Duplicate	2	0.90	90	69	59

(a) UF Unfiltered.

(b) Recovery outside of quality control range (40% - 120%).

(c) F Filtered.

(d) D Diluted out.

TABLE G.9. Total Polynuclear Aromatic Hydrocarbons (PAHs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

<u>Liquid Phase Treatment</u>	<u>Batch</u>	<u>PAHs (ng/L)</u>		
		<u>Total Low Molecular Weight PAH</u>	<u>Total High Molecular Weight PAH</u>	<u>Total PAH</u>
Site Water	1	25.7	49.9	76
Procedural Blank	1	40.8	119.5	160
Comp LC SPP	1	413.7	2829.5	3243
Comp LC Elutriate	1	311.4	809.0	1120
Comp LC-5 SPP	1	2516.3	9715.0	12231
Comp LC-5 Elutriate	1	2676.9	7265.7	9943
Comp LC-5 Elutriate UF ^(a)	2	2503.2	7735.6	10239
Comp LC-5 Elutriate F ^(b)	2	586.9	4255.4	4842
Comp LC-6 SPP	1	9371.7	11299.8	20671
Comp LC-6 Elutriate	1	19492.1	21320.3	40812
Comp USFC SPP	1	7086.7	3868.6	10955
Comp USFC Elutriate	1	7332.6	1284.2	8617
Comp FSFC SPP	2	110.3	572.9	683
Comp FSFC Elutriate	2	25.0	129.1	154
Comp IHC-1 SPP	2	48.7	176.6	225
Comp IHC-1 Elutriate	2	19.7	51.2	71
Comp IHC-2 SPP	2	26.4	168.6	195
Comp IHC-2 Elutriate	2	164.9	147.6	312
Comp IHC-3 SPP	2	68.3	182.0	250
Comp IHC-3 Elutriate	2	60.5	139.6	200

(a) UF Unfiltered.

(b) F Filtered.

TABLE G. 10. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	LPAHs (ng/L)							
		Naphtha- lene	2-Methyl- naphtha- lene	1-Methyl naphtha- lene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
Target DL ^(a)		20	20	20	20	20	20	20	20
Achieved DL		29.87	29.87	29.87	31.60	27.37	36.06	23.16	23.96
Site Water	1	9.93 J ^(b)	3.82 J	3.12 J	1.83 J	27.37 U ^(c)	36.06 U	4.00 J	3.01 J
Procedural Blank	1	10.88 J	4.03 J	2.98 J	4.35 J	5.61 J	4.57 J	5.16 J	3.25 J
Comp LC SPP	1	15.38 J	7.77 J	6.42 J	9.91 J	140.49	33.78 J	120.15	79.81
Comp LC Elutriate	1	16.19 J	5.98 J	6.01 J	5.82 J	135.67	32.62 J	87.93	21.14 J
Comp LC-5 SPP	1	281.08	170.61	183.43	64.78	443.07	280.19	683.49	409.60
Comp LC-5 Elutriate	1	196.00	113.78	128.68	51.39	505.19	270.30	1065.38	346.16
Comp LC-5 Elutriate U _F ^(d)	2	180.49	94.72	115.73	45.32	436.42	254.74	996.51	379.31
Comp LC-5 Elutriate F ^(e)	2	13.84 J	14.75 J	14.69 J	34.15	59.34	35.01 J	221.39	193.76
Comp LC-6 SPP	1	198.95	296.82	633.69	35.16	2217.36	1942.80	3279.07	767.81
Comp LC-6 Elutriate	1	317.77	548.14	1125.64	242.61	4006.94	4400.01	7265.38	1585.58
Comp USFC SPP	1	15.52 J	268.64	572.79	455.97	2573.43	1437.89	1522.41	240.01
Comp USFC Elutriate	1	10.96 J	387.15	788.98	447.66	2377.41	1398.82	1724.51	197.12
Comp FSFC SPP	2	18.85 J	9.45 J	7.74 J	5.36 J	17.37 J	6.78 J	22.98 J	21.78 J
Comp FSFC Elutriate	2	7.02 J	4.90 J	3.40 J	3.15 J	27.37 U	36.06 U	2.40 J	4.11 J
Comp IHC-1 SPP	2	10.15 J	6.54 J	5.53 J	2.38 J	4.57 J	4.27 J	8.16 J	7.12 J
Comp IHC-1 Elutriate	2	5.82 J	3.27 J	3.28 J	31.60 U	27.37 U	1.60 J	3.21 J	2.52 J
Comp IHC-2 SPP	2	10.12 J	4.92 J	29.87 U	31.60 U	27.37 U	36.06 U	5.73 J	5.64 J
Comp IHC-2 Elutriate	2	51.59 J	43.96 J	33.29 J	5.99 J	27.37 U	9.13 J	12.90 J	8.07 J
Comp IHC-3 SPP	2	17.26 J	4.98 J	3.28 J	6.66 J	7.95 J	8.23 J	10.51 J	9.42 J
Comp IHC-3 Elutriate	2	17.18 J	5.89 J	4.05 J	5.14 J	7.57 J	6.28 J	8.46 J	5.88 J

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL)

(c) U Analyte was not present above the associated value.

(d) UF Unfiltered.

(e) F Filtered.

TABLE G.11. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	HPAHs (ng/L)									
		Fluor-anthene	Pvrene	Benzo[a]anthra-cene	Chrvsene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno [1,2,3-c,d]pyrene	Di benzo [a,h] anthra-cene	Benzo [g,h,i] perylene
Target DL ^(a)		20	20	20	20	20	20	20	20	20	20
Achieved DL		18.01	19.59	25.40	35.46	29.04	63.40	30.13	43.72	62.07	39.48
Site Water	1	6.57 J ^(b)	7.45 J	3.85 J	4.99 J	3.49 J	4.51 J	6.55 J	4.71 J	62.07 U ^(c)	7.74 J
Procedural Blank	1	10.64 J	12.55 J	3.81 J	4.75 J	4.60 J	4.81 J	2.95 J	3.70 J	2.71 J	69.00
Comp LC SPP	1	733.58	1143.75	105.04	135.59	283.00	172.53	157.89	42.01 J	12.26 J	43.81
Comp LC Elutriate	1	244.26	356.46	18.77 J	24.23 J	59.97	42.59 J	29.37 J	14.69 J	4.35 J	14.27 J
Comp LC-5 SPP	1	2067.68	3785.13	755.22	957.84	944.15	558.55	429.13	102.01	27.29 J	87.95
Comp LC-5 Elutriate	1	1732.62	2829.82	549.37	698.10	631.80	390.52	288.31	61.32	21.27 J	62.56
Comp LC-5 Elutriate, UF ^(d)	2	1792.40	2806.75	663.64	761.89	722.98	462.95	375.53	69.27	15.49 J	64.66
Comp LC-5 Elutriate, F ^(e)	2	795.58	1370.10	409.93	470.40	560.25	296.49	253.48	43.04 J	13.04 J	43.09
Comp LC-6 SPP	1	3772.64	2783.94	1297.02	1656.51	773.45	385.65	340.49	131.53	26.87 J	131.69
Comp LC-6 Elutriate	1	6342.23	5584.44	2547.72	3193.79	1406.16	885.80	772.56	283.54	57.78 J	246.25
Comp USFC SPP	1	1047.14	1171.30	437.57	292.07	332.40	200.42	225.19	83.87	15.16 J	63.49
Comp USFC Elutriate	1	466.45	468.41	93.57	61.42	58.76	47.26 J	46.79	19.58 J	4.30 J	17.65 J
Comp FSFC SPP	2	47.28	183.96	18.27 J	38.34 J	94.27	59.09 J	56.88	33.02 J	6.18 J	35.61 J
Comp FSFC Elutriate	2	12.80 J	60.21	3.90 J	4.38 J	16.03 J	8.41 J	9.75 J	6.75 J	62.07 U	6.91 J
Comp IHC-1 SPP	2	11.26 J	45.79	8.34 J	14.71 J	26.88 J	19.72 J	18.46 J	13.57 J	62.07 U	17.87 J
Comp IHC-1 Elutriate	2	3.58 J	20.12	25.40 U	2.79 J	6.09 J	5.20 J	4.14 J	4.23 J	62.07 U	5.02 J
Comp IHC-2 SPP	2	28.64	41.06	16.42 J	15.80 J	19.16 J	13.31 J	11.98 J	9.78 J	62.07 U	12.47 J
Comp IHC-2 Elutriate	2	19.81	46.09	11.40 J	14.88 J	15.27 J	12.37 J	9.61 J	43.72 U	62.07 U	18.12 J
Comp IHC-3 SPP	2	12.73 J	26.28	11.53 J	17.05 J	13.01 J	11.35 J	7.08 J	9.93 J	6.10 J	66.97
Comp IHC-3 Elutriate	2	8.49 J	17.84 J	8.19 J	8.83 J	9.75 J	7.24 J	6.30 J	5.73 J	62.07 U	67.23

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) U Analyte was not present above the associated value.

(d) UF Unfiltered.

(e) F Filtered.

TABLE 6.12. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

		LPAHs (ng/L)							
Liquid Phase Treatment	Batch	Naphtha- lene	2-Methyl - naphtha- lene	1-Methyl naphtha- lene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
Method Blanks									
Blank	1	6.63 J ^(a)	29.87 U ^(b)	29.87 U	31.60 U	27.37 U	36.06 U	23.16 U	23.96 U
Blank	2	6.46 J	29.87 U	29.87 U	31.60 U	27.37 U	36.06 U	23.16 U	23.96 U
Matrix Spikes									
Site Water	1	9.93 J	3.82 J	3.12 J	1.83 J	27.37 U	36.06 U	4.00 J	3.01 J
Site Water MS	1	4518.13	NA ^(c)	NA	4893.66	4789.04	4703.49	4751.5	4145.46
Concentration Recovered		4508.20	NA	NA	4891.83	4789.04	4703.49	4747.5	4142.45
Amount Spiked		6000.00	NS ^(d)	NS	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		75%	NA	NA	82%	80%	78%	79%	69%
Site Water	1	9.93 J	3.82 J	3.12 J	1.83 J	27.37 U	36.06 U	4.00 J	3.01 J
Site Water MSD	1	4647.84	NA	NA	4962.79	4822.25	4810.88	4699.06	3995.80
Concentration Recovered		4637.91	NA	NA	4960.96	4822.25	4810.88	4695.06	3992.79
Amount Spiked		6000.00	NS	NS	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		77%	NA	NA	83%	80%	80%	78%	67%
RPD		3%	NA	NA	1%	0%	2%	1%	4%
I-Sat		0.01	NA	NA	0.01	0.00	0.01	0.01	0.02
Comp FSFC SPP	2	18.85 J	9.45 J	7.74 J	5.36 J	17.37 J	6.78 J	22.98 J	21.78 J
Comp FSFC SPP MS	2	4263.55	NA	NA	4699.25	4497.50	4622.29	4595.98	4397.78
Concentration Recovered		4244.70	NA	NA	4693.89	4480.13	4615.51	4573.00	4376.00
Amount Spiked		6000.00	NS	NS	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		71%	NA	NA	78%	75%	77%	76%	73%
Comp FSFC SPP	2	18.85 J	9.45 J	7.74 J	5.36 J	17.37 J	6.78 J	22.98 J	21.78 J
Comp FSFC SPP MSD	2	5435.11	NA	NA	5339.66	5258.44	5451.48	5230.88	4916.31
Concentration Recovered		5416.26	NA	NA	5334.30	5241.07	5444.70	5207.90	4894.53
Amount Spiked		6000.00	NS	NS	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		90%	NA	NA	89%	87%	91%	87%	82%
RPD		24%	NA	NA	13%	16%	16%	13%	11%
I-Sat		0.12	NA	NA	0.06	0.08	0.08	0.06	0.06

TABLE 6.12. (contd)

		LPAHs (ng/L)							
Liquid Phase Treatment	Batch	Naphtha- lene	2-Methyl- naphtha- lene	1-Methyl naphtha- lene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
Analvtical Duplicates									
Comp LC SPP	1	15.38 J	7.77 J	6.42 J	9.91 J	140.49	33.78 J	120.15	79.81
Comp LC SPP Duplicate	1	14.72 J	9.24 J	6.54 J	19.33 J	163.87	56.63	254.83	136.46
RPD		4%	17%	2%	64% (e)	15%	51% (e)	72% (f)	52% (e)
I-Stat		0.02	0.09	0.01	0.32	0.08	0.25	0.36	0.26
Comp IHC-2 SPP	2	10.12 J	4.92 J	29.87 U	31.60 U	27.37 U	36.06 U	5.73 J	5.64 J
Comp IHC-2 SPP Duplicate	2	11.91 J	4.26 J	2.43 J	1.92 J	30.41 U	40.07 U	5.93 J	5.48 J
RPD		16%	14%	NA	NA	NA	NA	3%	3%
I-Stat		0.08	0.07	NA	NA	NA	NA	0.02	0.01

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the associated value.

(c) NA Not applicable.

(d) NS Not spiked.

(e) Precision criteria do not apply because sample results are less than 10 times the MDL.

(f) Value exceeds relative precision goal of $\leq 30\%$.

TABLE 6.13. Quality Control Summary for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

		HPAHs (ng/L)									
Liquid Phase Treatment	Batch	Fluor-anthene	Pvrene	Benzo[a]anthra-cene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno [1,2,3-c, d]pvrene	Dibenzo [a, h] anthra-cene	Benzo [g, h, i] perylene
<u>Method Blanks</u>											
Blank	1	18.01 U ^(a)	19.59 U	25.40 U	35.46 U	29.04 U	63.40 U	9.88 J ^(b)	43.72 U	62.07 U	39.48 U
Blank	2	18.01 U	19.59 U	25.40 U	35.46 U	29.04 U	63.40 U	30.13 U	43.72 U	62.07 U	39.48 U
<u>Matrix Spikes</u>											
Site Water	1	6.57 J	7.45 J	3.85 J	4.99 J	3.49 J	4.51 J	6.55 J	4.71 J	62.07 U	7.74 J
Site Water MS	1	5084.17	5007.11	4908.70	4915.16	5182.08	4996.91	3517.57	4442.04	4638.89	4016.75
Concentration Recovered		5077.60	4999.66	4904.85	4910.17	5178.59	4992.40	3511.02	4437.33	4638.89	4009.01
Amount Spiked		6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		85%	83%	82%	82%	86%	83%	59%	74%	77%	67%
Site Water	1	6.57 J	7.45 J	3.85 J	4.99 J	3.49 J	4.51 J	6.55 J	4.71 J	62.07 U	7.74 J
Site Water MSD	1	5093.64	4982.40	4829.18	4896.54	5203.72	5140.88	3732.95	4691.05	4885.10	4384.41
Concentration Recovered		5087.07	4974.95	4825.33	4891.55	5200.23	5136.37	3726.40	4686.34	4885.10	4376.67
Amount Spiked		6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		85%	83%	80%	82%	87%	86%	62%	78%	81%	73%
RPD		0%	0%	2%	0%	1%	3%	6%	5%	5%	9%
I-Stat		0.00	0.00	0.01	0.00	0.01	0.01	0.03	0.03	0.03	0.04
Comp FSFC SPP	2	47.28	183.96	18.27 J	38.34 J	94.27	59.09 J	56.88	33.02 J	6.18 J	35.61 J
Comp FSFC SPP MS	2	5137.14	5155.04	5662.65	5563.09	5214.05	5165.11	4439.42	3640.15	3920.97	3239.66
Concentration Recovered		5089.86	4971.08	5644.38	5524.75	5119.78	5106.02	4382.54	3607.13	3914.79	3204.05
Amount Spiked		6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		85%	83%	94%	92%	85%	85%	73%	60%	65%	53%
Comp FSFC SPP	2	47.28	183.96	18.27 J	38.34 J	94.27	59.09 J	56.88	33.02 J	6.18 J	35.61 J
Comp FSFC SPP MSD	2	5677.38	5679.57	5790.00	5701.23	5932.89	5947.51	4925.53	4884.41	5082.85	4444.20
Concentration Recovered		5630.10	5495.61	5771.73	5662.89	5838.62	5888.42	4868.65	4851.39	5076.67	4408.59
Amount Spiked		6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00	6000.00
Percent Recovery		94%	92%	96%	94%	97%	98%	81%	81%	85%	73%
RPD		10%	10%	2%	2%	13%	14%	11%	29%	26%	32% ^(c)
I-Stat		0.05	0.05	0.01	0.01	0.07	0.07	0.05	0.15	0.13	0.16

96

TABLE 6.13. (contd)

		HPAHs (ng/L)										
		Fluor-anthene	Pyrene	Benzo[a]anthracene	Chrysene	Benzo[b]fluor-anthene	Benzo[k]fluor-anthene	Benzo[a]pyrene	Indeno[1,2,3-c,d]pyrene	Dibenzo[a,h]anthracene	Benzo[g,h,i]perylene	
<u>Analytical Duplicates</u>												
Comp LC SPP	1	733.58	1143.75	105.04	135.59	283.00	172.53	157.89	42.01 J	12.26 J	43.81	
Comp LC SPP Duplicate	1	1046.09	1654.05	204.78	287.17	513.78	274.20	204.38	67.47 (d)	15.26 J	57.66%	
RPD		35% (c)	36% (c)	64% (d)	72% (d)	58% (c)	46% (d)	26%	~47%	22%	27%	
I-Stat		0.18	0.18	0.32	0.36	0.29	0.23	0.13	0.23	0.11	0.14	
Comp IHC-2 SPP	2	28.64	41.06	16.42 J	15.80 J	19.16 J	13.31 J	11.98 J	9.78 J	62.07 U	12.47 J	
Comp IHC-2 SPP Duplicate	2	28.60	43.54	13.53 J	15.93 J	23.07 J	14.44 J	9.01 J	11.19 J	4.26 J	15.86 J	
RPD		0%	6%	19%	1%	19%	8%	28%	13%	NA (e)	24%	
I-Stat		0.00	0.03	0.10	0.00	0.09	0.04	0.14	0.07	NA	0.12	

(a) U Analyte was not present above the associated value.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(c) Value exceeds relative precision goal of $\leq 30\%$.

(d) Precision criteria do not apply because sample results are less than 10 times the MDL.

(e) NA Not applicable.

TABLE 6.14. Surrogate Percent Recoveries for Polynuclear Aromatic Hydrocarbons (PAHs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

<u>Liquid Phase Treatment</u>	<u>Batch</u>	<u>Surrogate Percent Recoveries</u>		
		<u>Naphtha- lene d8</u>	<u>Acenaph- thene d10</u>	<u>Benzo[a] pvrène d12</u>
Site Water	1	64	67	52
Procedural Blank	1	78	83	47
Comp LC SPP	1	50	64	61
Comp LC Elutriate	1	71	76	58
Comp LC-5 SPP	1	73	100	69
Comp LC-5 Elutriate	1	61	81	60
Comp LC-5 Elutriate UF ^(a)	2	60	84	69
Comp LC-5 Elutriate F ^(b)	2	68	91	75
Comp LC-6 SPP	1	61	96	59
Comp LC-6 Elutriate	1	79	154 ^(c)	64
Comp USFC SPP	1	61	70	72
Comp USFC Elutriate	1	72	76	77
Comp FSFC SPP	2	65	72	58
Comp FSFC Elutriate	2	75	80	76
Comp IHC-1 SPP	2	73	80	64
Comp IHC-1 Elutriate	2	47	60	51
Comp IHC-2 SPP	2	54	63	58
Comp IHC-2 Elutriate	2	61	66	71
Comp IHC-3 SPP	2	65	72	39 ^(c)
Comp IHC-3 Elutriate	2	68	74	67
<u>Quality Control Data</u>				
<u>Method Blanks</u>				
Blank	1	82	83	69
Blank	2	81	87	66
<u>Matrix Spikes</u>				
Site Water MS	1	69	72	52
Site Water MSD	1	70	71	54
Comp FSFC SPP MS	2	65	69	69
Comp FSFC SPP MSD	2	81	81	73

TABLE 6.14. (contd)

<u>Liquid Phase Treatment</u>	<u>Batch</u>	<u>Surrogate Percent Recoveries</u>		
		<u>Naphtha- lene d8</u>	<u>Acenaph- thene d10</u>	<u>Benzo[a] pyrene d12</u>
<u>Analvtical Dupliates</u>				
Comp LC SPP Duplicate	1	60	75	62
Comp IHC-2 SPP Duplicate	2	70	76	41

(a) UF Unfiltered.

(b) F Filtered.

(c) Recovery outside quality control range (40%-120%).

TABLE 6.15. Polychlorinated Biphenyls (PCBs) in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Volume (L)	PCBs (ng/L)			
			Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Target DL ^(a)			50	50	50	50
Achieved DL			25.0	25.0	25.0	25.0
Site Water	1	1.00	25.00 U ^(b)	25.00 U	25.00 U	25.00 U
Procedural Blank	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC SPP	1	1.00	25.00 U	25.00 U	349.80	25.00 U
Comp LC Elutriate	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC-5 SPP ^(c)	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC-5 Elutriate ^(c)	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC-5 Elutriate UF ^(c)	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC-5 Elutriate F ^(c)	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC-6 SPP ^(c)	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp LC-6 Elutriate ^(c)	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp USFC SPP	1	1.00	25.00 U	25.00 U	223.62	25.00 U
Comp USFC Elutriate	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp FSFC SPP	2	0.80	31.25 U	31.25 U	124.21	31.25 U
Comp FSFC Elutriate	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp IHC-1 SPP	2	1.00	25.00 U	25.00 U	63.69	25.00 U
Comp IHC-1 Elutriate	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp IHC-2 SPP	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp IHC-2 Elutriate	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp IHC-3 SPP	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp IHC-3 Elutriate	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

(c) These samples exhibited matrix interferences; could not identify/quantify the Aroclors.

TABLE G. 16. Quality Control Summary for Polychlorinated Biphenyls (PCBs)
in Liquid Phase Samples, United Heckathorn Remedial
Investigation

Liquid Phase Treatment	Batch	Volume (L)	PCBs (ng/L)			
			Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Method Blanks						
Blank	1	1.00	25.00 U ^(a)	25.00 U	25.00 U	25.00 U
Blank	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Matrix Spikes						
Site Water	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Site Water MS	1		NA ^(b)	NA	2867.87	NA
Concentration Recovered			NA	NA	2867.87	NA
Amount Spiked			NS ^(c)	NS	4800.00	NS
Percent Recovery			NA	NA	60%	NA
Site Water	1	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Site Water MSD	1		NA	NA	2793.36	NA
Concentration Recovered			NA	NA	2793.36	NA
Amount Spiked			NS	NS	4800.00	NS
Percent Recovery			NA	NA	58%	NA
RPD			NA	NA	3%	NA
I-Stat			NA	NA	0.01	NA
Comp FSFC SPP	2	0.80	25.00 U	25.00 U	124.21	25.00 U
Comp FSFC SPP MS	2		NA	NA	3534.48	NA
Concentration Recovered			NA	NA	3410.27	NA
Amount Spiked			NS	NS	4800.00	NS
Percent Recovery			NA	NA	71%	NA
Comp FSFC SPP	2	0.80	25.00 U	25.00 U	124.21	25.00 U
Comp FSFC SPP MSD	2		NA	NA	3918.20	NA
Concentration Recovered			NA	NA	3793.99	NA
Amount Spiked			NS	NS	4800.00	NS
Percent Recovery			NA	NA	79%	NA
RPD			NA	NA	11%	NA
I-Stat			NA	NA	0.05	NA
Analytical Duplicates						
Comp LC SPP	1	1.00	25.00 U	25.00 U	349.80	25.00 U
Comp LC SPP Duplicate	1	1.00	25.00 U	25.00 U	489.48	25.00 U
RPD			NA	NA		NA
I-Stat			NA	NA	0.17	NA
Comp IHC-2 SPP	2	1.00	25.00 U	25.00 U	25.00 U	25.00 U
Comp IHC-2 SPP Duplicate	2	0.90	27.78 U	27.78 U	27.78 U	27.78 U
RPD			NA	NA	NA	NA
I-Stat			NA	NA	NA	NA

(a) U Analyte was not present above the associated value.

(b) NA Not applicable.

(c) NS Not spiked.

(d) Value exceeds relative precision goal of $\leq 30\%$.

TABLE 6.17. Metals in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Metals ($\mu\text{g/L}$)									
	Aq	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
Target DL ^(a)	0.01	1.0	0.1	1.0	0.1	0.001	0.1	0.1	2.0	2.0
Achieved DL	0.02	0.01	0.02	0.05	0.006	0.001	0.01	0.02	2.3	0.4
Site Water	0.02 U ^(b)	1.61	0.092	2.11	3.28	0.016	4.32	3.72	2.30 U	21.4
Procedural Blank	0.02 U	0.99	0.103	0.33	2.40	0.005	3.56	0.250	2.30 U	15.2
Comp LC SPP	0.02 U	7.48	0.072	1.31	3.60	0.036	2.67	3.45	2.30 U	8.97
Comp LC SPP Duplicate	0.02 U	5.22	0.068	1.29	3.38	0.024	2.49	3.23	2.30 U	9.24
Comp LC Elutriate	0.02 U	3.96	0.048	0.62	1.35	0.010	2.04	0.790	2.30 U	3.43
Comp LC-5 SPP	0.022	16.9	0.110	3.47	5.48	0.063	4.36	4.48	2.30 U	17.3
Comp LC-5 Elutriate	0.02 U	19.1	0.067	0.98	1.84	0.018	3.33	1.92	2.30 U	13.2
Comp LC-6 SPP	0.160	10.9	0.121	1.75	5.28	0.148	2.80	3.01	2.30 U	9.37
Comp LC-6 Elutriate	0.056	14.8	0.090	1.18	2.62	0.067	2.61	2.40	2.30 U	5.54
Comp USFC SPP	0.02 U	7.47	0.042	1.34	2.66	0.033	1.58	1.92	2.30 U	12.9
Comp USFC Elutriate	0.02 U	4.62	0.054	0.33	0.954	0.011	1.30	0.533	3.10	2.11
Comp FSFC SPP	0.02 U	4.26	0.179	1.18	2.94	0.024	2.16	1.44	2.30 U	8.71
Comp FSFC Elutriate	0.02 U	5.07	0.025	0.26	0.858	0.007	1.10	0.295	2.30 U	3.96
Comp IHC-1 SPP	0.02 U	8.17	0.035	1.08	2.52	0.021	2.36	2.11	2.30 U	4.09
Comp IHC-1 Elutriate	0.02 U	4.22	0.026	0.31	0.953	0.007	2.16	0.250	2.30 U	5.28
Comp IHC-2 SPP	0.02 U	7.99	0.02 U	1.36	3.11	0.012	3.66	1.29	2.30 U	4.49
Comp IHC-2 Elutriate	0.02 U	3.00	0.02 U	0.08	0.757	0.004	1.41	0.162	2.30 U	2.38
Comp IHC-3 SPP	0.02 U	7.46	0.02 U	1.03	1.99	0.015	2.97	0.915	2.30 U	29.6
Comp IHC-3 Elutriate	0.02 U	3.33	0.02 U	0.23	0.611	0.004	1.52	0.137	2.30 U	1.45

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

TABLE 6.18. Quality Control Summary of Metals in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Metals (µg/L)									
	Aq	As	Cd	Cr	Cu	Hg	Ni	Pb	Se	Zn
<u>Method Blanks</u>										
Blank	0.02 U ^(a)	0.02	0.02 U	0.10	0.007	0.003	0.01 U	0.02 U	2.30 U	1.32
Blank	NA ^(b)	NA	NA	NA	NA	0.002	NA	NA	NA	NA
<u>Matrix Spikes</u>										
Comp LC-6 SPP	NA	10.9	NA	NA	NA	NA	NA	NA	NA	NA
Comp LC-6 SPP MS	NA	21.7	NA	NA	NA	NA	NA	NA	NA	NA
Concentration Recovered	NA	10.8	NA	NA	NA	NA	NA	NA	NA	NA
Amount Spiked	NS ^(c)	9.00	NS	NS	NS	NS	NS	NS	NS	NS
Percent Recovered	NA	120%	NA	NA	NA	NA	NA	NA	NA	NA
Comp USFC Elutriate	NA	NA	NA	NA	NA	0.011	NA	NA	NA	NA
Comp USFC Elutriate MS	NA	NA	NA	NA	NA	0.046	NA	NA	NA	NA
Concentration Recovered	NA	NA	NA	NA	NA	0.035	NA	NA	NA	NA
Amount Spiked	NS	NS	NS	NS	NS	0.035	NS	NS	NS	NS
Percent Recovered	NA	NA	NA	NA	NA	100%	NA	NA	NA	NA
Procedural Blank	0.02 U	NA	0.103	0.33	2.40	NA	3.56	0.250	2.30 U	15.2
Procedural Blank MS	0.435	NA	0.494	2.28	6.81	NA	8.03	4.95	40.2	25.9
Concentration Recovered	0.435	NA	0.391	1.95	4.41	NA	4.47	4.70	40.2	10.7
Amount Spiked	0.500	NS	0.500	2.39	5.00	NS	5.00	5.00	42.9	8.91
Percent Recovered	87%	NA	78%	82%	88%	NA	89%	94%	94%	120%
<u>Analytical Duplicates</u>										
Comp LC SPP	0.02 U	7.48	0.072	1.31	3.60	0.036	2.67	3.45	2.30 U	8.97
Comp LC SPP Duplicate	0.02 U	5.22	0.068	1.29	3.38	0.024	2.49	3.23	2.30 U	9.24
RPD	NA	36% ^(d)	6%	2%	6%	40% ^(d)	7%	7%	NA	3%
I-Stat	NA	0.18	0.03	0.01	0.03	0.20	0.03	0.03	NA	0.01

(a) U Analyte was not present above the associated value.

(b) NA Not applicable.

(c) NS Not spiked.

(d) Value exceeds relative precision goal of $\leq 20\%$

TABLE G. 19. Butyltins in Liquid Phase Samples, United Heckathorn Remedial Investigation

<u>Liquid Phase Treatment</u>	<u>Batch</u>	<u>Extraction Volume (L)</u>	<u>Tri-butyltin (ng/L)</u>	<u>Di-butyltin (ng/L)</u>	<u>Surrogate Percent Recovery Triphenyltin</u>
Target DL ^(a)			10	10	
Achieved DL			10	10	
Site Water	1	1.060	27.2	11.4 B ^(b)	107
Procedural Blank	1	1.000	24.9	20.2 B	64
Comp LC SPP	1	1.069	38.8	19.8 B	91
Comp LC ELUT	1	1.037	29.8	31.4 B	71
Comp LC-5 SPP	1	1.055	40.5	31.4 B	118
Comp LC-5 ELUT	1	1.055	28.3	23.8 B	95
Comp LC-6 SPP	1	1.060	10.0 U ^(c)	10.5 BE ^(d)	130 ^(e)
Comp LC-6 ELUT	1	1.030	12.2	31.3 B	111
Comp USFC SPP	1	1.068	35.6	22.6 B	105
Comp USFC ELUT	1	1.009	24.6	20.7 B	97
Comp FSFC SPP	2	1.063	17.1	18.9 B	86
Comp FSFC ELUT	2	1.063	16.9	18.7 B	88
Comp IHC-1 SPP	2	1.067	13.9	15.8 B	102
Comp IHC-1 ELUT	2	1.060	26.1	18.3 B	69
Comp IHC-2 SPP	2	1.074	10.0 U	15.5 B	105
Comp IHC-2 ELUT	2	1.061	13.4	19.3 B	99
Comp IHC-3 SPP	2	1.067	12.7	17.5 B	93
Comp IHC-3 ELUT	2	1.025	12.5	18.6 B	102

(a) DL Detection limit.

(b) B Analyte detected in blank associated with sample.

(c) U Analyte was not present above the level of the associated value.

(d) E Quantitation is an estimate due to matrix interference.

(e) Recovery outside of quality control range (40%-120%)

TABLE 6.20. Quality Control Summary for Butyltins in Liquid Phase Samples, United Heckathorn Remedial Investigation

Liquid Phase Treatment	Batch	Extraction Volume (L)	Tri-butyltin (ng/L)	Di-butyltin (ng/L)	Surrogate Percent Recovery Triphenyltin
<u>Method Blanks</u>					
Blank	1	1.000	60.0 ^(a)	14.1	94
Blank	2	1.000	10.0 U ^(b)	14.0	94
<u>Matrix Spikes</u>					
Site Water	1	1.060	27.2	11.4 B ^(c)	107
Site Water MS	1	1.068	235.2	243.0	100
Concentration Recovered			208.0	231.6	NA ^(d)
Amount Spiked			234.0	234.0	NA
Percent Recovery			89%	99%	NA
Site Water	1	1.060	27.2	11.4 B	107
Site Water MSD	1	1.070	238.4	240.9	101
Concentration Recovered			211.2	229.5	NA
Amount Spiked			234.0	234.0	NA
Percent Recovery			90%	98%	NA
RPD			2%	1%	NA
I-Stat			0.01	0.00	NA
Comp FSFC SPP	2	1.063	17.1	18.9 B	86
Comp FSFC SPP MS	2	0.500	439.5	524.2	82
Concentration Recovered			422.4	505.3	NA
Amount Spiked			500.0	500.0	NA
Percent Recovery			84%	101%	NA
Comp FSFC SPP	2	1.063	17.1	18.9 B	86
Comp FSFC SPP MSD	2	0.560	447.1	415.8	78
Concentration Recovered			430.0	396.9	NA
Amount Spiked			446.0	446.0	NA
Percent Recovery			96%	89%	NA
RPD			13%	13%	NA
I-Stat			0.07	0.06	NA

TABLE 6.20. (contd)

Liquid Phase Treatment			Batch	Extraction Volume (L)	Tri-butyltin (ng/L)	Di-butyltin (ng/L)	Surrogate Percent Recovery Tripentyltin
<u>Analytical Duplicates</u>							
Comp	LC	SPP	1	1.069	38.8	19.8 B	91
Comp	LC	SPP Duplicate	1	1.045	71.4	29.3 B	75
RPD					59% ^(e)	39% ^(e)	NA
I-Stat					0.30	0.19	NA

-
- (a) Blank contamination believed to be due to contamination of DI water used for blank; does not affect sample results.
- (b) U Analyte was not present above the level of the associated value.
- (c) B Analyte detected in blank associated with sample.
- (d) NA Not applicable.
- (e) Precision criteria do not apply because sample results are less than 10 times the MDL.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Total Suspended Solids (TSS)
LABORATORY: Battelle/Marine Sciences Laboratory
MATRIX: Water
SAMPLE NUMBER: 20

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
SOP MSL-M-39	Not applicable	±20%	Not applicable

HOLDING TIMES

The holding time of 7 days was met for all analyses.

METHOD BLANKS

Both method blanks contained 3 mg/L TSS. No QC criteria are designated for TSS procedural blanks.

DUPLICATES

Precision between both analytical duplicates met the QC criteria of ±20%.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Chlorinated Pesticides and Polychlorinated Biphenyls (PCB)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: Water
SAMPLE NUMBER: 20

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
8080	40%-120%	±30%	5 ng/L

HOLDING TIMES

The following is a list of extraction and analysis dates for the two batches of water samples analyzed for pesticides and PCBs:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
Batch 1	1/25-26/93	1/27/93	2/4/93	3/5-7/93, 3121-22193 (dilutions)
Batch 2	2/1-2/93	2/3-4/93	2/9/93	317-9193, 3/22/93 (dilutions)

Holding times for extractions and analyses were met.

METHOD BLANKS

One method blank was processed with each batch of samples. No pesticide or PCB compounds were detected above the method detection limit in the blanks.

MATRIX SPIKES

The recoveries of target pesticides and PCBs in the MS and MSD samples were acceptable for Batch 1. Recoveries exceeded 120% for one pesticide in the MS and four pesticides in the MSD sample for Batch 2.

SURROGATES

The recoveries of surrogate compounds were acceptable in all samples in Batch 1. The recovery of one surrogate compound was less than 40% in two samples from Batch 2. Surrogate compounds were diluted out in two samples in Batch 1.

DUPLICATES

Duplicate precision between the MS and MSD samples was acceptable in both batches. The RPDs for sample duplicate results were greater than 30% for five pesticides and one Aroclor in Batch 1. The high RPDs were probably due to sample inhomogeneity; the acceptable MS/MSD RPDs indicate acceptable analytical precision.

DETECTION LIMITS

Achieved detection limits ranged from 4 to 17 ng/L for pesticides (25 ng/L for toxaphene) and 25 ng/L for PCBs. Some of the detection limits were higher than those specified in the Quality Assurance Project Plan (QAPP) because a portion of the sample was archived in the event that the initial extractions or analyses were unsuccessful.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: Water
SAMPLE NUMBER: 20

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
8270	40%-120%	±30%	20 ng/L

HOLDING TIMES

The following is a list of extraction and analysis dates for the two batches of water samples:

	<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/MS Analysis</u>
Batch 1	1125-26193	1/27/93	2/4/93	2/24-25/93
Batch 2	211-2193	2/3-4/93	2/9/93	2126-27193

The holding times for all extractions and analyses were met.

PROCEDURAL BLANKS

One procedural blank was processed with each batch of samples. No PAHs were detected in the procedural blanks.

MATRIX SPIKES

The recoveries of target PAHs in the MS and MSD were acceptable in both batches.

SURROGATES

The recovery of one surrogate compound exceeded 120% in one sample from Batch 1, and was slightly less than 40% in one sample from Batch 2. The remaining surrogate recoveries were acceptable.

DUPLICATES

The RPDs between MS and MSD samples slightly exceeded 30% for one compound in one sample. Replicate precision of the sample duplicates exceeded the QC criteria of 30% for two PAHs in Batch 1.

DETECTION LIMITS

Achieved detection limits ranged between 18 and 63 ng/L. The detection limits for some compounds exceeded the requirements specified in the QAPP because a portion of the sample volume was archived in the event that initial extractions or analyses were unsuccessful. Higher detection limits were achieved because a smaller sample volume was extracted.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Metals
LABORATORY: Battelle/Marine Sciences Laboratory
MATRIX: Water
SAMPLE NUMBER: 20

QA/QC REQUIREMENTS

Reference Method	Range of <u>Recovery</u>	Relative <u>Precision</u>	Detection
Varies by metal	75-125%, <30% from certified value for SRM	±20%	Varies by metal

HOLDING TIMES

The following table summarizes all analysis dates:

<u>Task</u>	<u>Date Performed</u>
APDC	2/11/93
ICP/MS analysis (silver, cadmium, copper, nickel, lead)	2/25/93
HAA (arsenic)	3/5/93
GFAA analysis-chromium	3/18/93
GFAA analysis-selenium	3/30/93
GFAA analysis-zinc	2/5/93
CVAF analysis-mercury	2/19 and 3/1/93

The holding times were met for all analyses.

METHOD BLANKS

One method blank was analyzed for all metals. Arsenic, chromium, copper, mercury and zinc were detected in the blanks at concentrations below the target detection limit. All metals data are blank corrected.

MATRIX SPIKES

One MS sample was analyzed for all metals. Matrix spike recoveries ranged from 78% to 120%; all were within the QC limits of 75% to 125%.

DUPLICATES

One sample was analyzed in duplicate. The relative percent difference (RPD) for all but two metals were less than 20%. The RPD was 40% for mercury and 36% for arsenic. A reanalysis of the same samples for arsenic confirmed a RPD of 36%, indicating that the difference is probably due to sample inhomogeneity.

DETECTION LIMITS

Target detection limits were met for all metals except silver and selenium. The achieved detection limit for silver was 0.02 ug/L and 2.3 ug/L for selenium.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Butyltins
LABORATORY: Battelle/Marine Sciences Laboratory
MATRIX: Water
SAMPLE NUMBER: 18

QA/QC REQUIREMENTS

Reference Method	Range of <u>Recovery</u>	Relative <u>Precision</u>	Detection <u>Limit</u>
Unger, et. al	40%-120%	±30%	10 ng/L

HOLDING TIMES

The following is a list of extraction and analysis dates for the two batches of water samples analyzed for butyltins:

	Date Collected	Date <u>Received</u>	Date <u>Extracted</u>	GC/FPD <u>Analysis</u>
Batch 1	1/25-26/93	1/26/93	1/27/93	2/18-19/93
Batch 2	2/1-2/93	2/3/93	2/3/93	2/18-19/93

The holding times for extractions and analyses were met.

METHOD BLANKS

One method blank was processed with each batch of samples. Tributyltin was detected in both blanks. Two analyses of the surrogate solution used in both batches indicate a TBT concentration of 15 ng/L. Sample results were corrected by subtracting 15 ng/L because the surrogate solution was spiked into all samples, including the blanks. The blank for Batch 1 contained 60 ng/L of TBT in addition to the 15 ng/L contributed by the surrogate solution. The source of this TBT could not be confirmed although it is suspected that it is confined to the DI water used in the blank. The blank contamination does not appear to affect the samples because the sample results are less than the concentration in the blank. However, all sample results for this batch are flagged.

Dibutyltin was also detected in both method blanks at a concentration of 14 ng/L. The source of the DBT is not known, and all sample results for DBT are flagged.

MATRIX SPIKES

The recoveries of tributyltin and dibutyltin in the MS and MSD samples for all batches were within the QC limits.

SURROGATES

One SIS, triphenyltin chloride, is added prior to extraction to assess the efficiency of the method. All sample data are corrected for the recovery of this compound. Surrogate recoveries for all but one sample were within the QC limits. Matrix interferences resulted in poor chromatography for this sample; therefore, the results were flagged as estimated.

DUPLICATES

Relative percent differences between the analytical duplicates for butyltins exceeded the QC limit of 30%. RPDs for matrix spike/matrix spike duplicate samples were very good, indicating that the poor precision in the sample duplicates may be due to sample inhomogeneity.

DETECTION LIMITS

Target detection limits of 10 ng/L were met for all butyltin compounds.

COMMENTS

Matrix interferences affected the chromatography in terms of retention time drift and peak shape for a number of samples.

APPENDIX H

BIOASSAY RESULTS FOR 96-HOUR SUSPENDED-PARTICULATE-PHASE
TEST AND 96-HOUR REFERENCE TOXICANT TEST FOR *Holmesimysis costata*

TABLE H.1. Results for all Replicates in 96-h *H. costata* Suspended-Particulate-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	SPP Concentration Percent	Replicate	<i>H. costata</i>		Proportion Surviving	Mean Proportion Surviving	Standard Deviation
			Number Alive	Number Dead			
Comp LC	0	1	9	1	0.90	0.93	0.06
Comp LC	0	2	10	0	1.00		
Comp LC	0	3	9	1	0.90		
Comp LC	10	1	0	10	0.00	0.00	0.00
Comp LC	10	2	0	10	0.00		
Comp LC	10	3	0	10	0.00		
Comp LC	50	1	0	10	0.00	0.00	0.00
Comp LC	50	2	0	10	0.00		
Comp LC	50	3	0	10	0.00		
Comp LC	100	1	0	10	0.00	0.00	0.00
Comp LC	100	2	0	10	0.00		
Comp LC	100	3	0	10	0.00		
Comp LC-5R (a)	0	1	10	0	1.00	0.93	0.12
Comp LC-5R	0	2	8	2	0.80		
Comp LC-5R	0	3	10	0	1.00		
Comp LC-5R	0.01	1	9	1	0.90	0.97	0.06
Comp LC-5R	0.01	2	10	0	1.00		
Comp LC-5R	0.01	3	10	0	1.00		
Comp LC-5R	0.1	1	8	2	0.80	0.83	0.06
Comp LC-5R	0.1	2	8	2	0.80		
Comp LC-5R	0.1	3	9	1	0.90		
Comp LC-5R	1	1	2	8	0.20	0.20	0.10
Comp LC-5R	1	2	1	9	0.10		
Comp LC-5R	1	3	3	7	0.30		
Comp LC-5	0	1	10	0	1.00	0.93	0.06
Comp LC-5	0	2	9	1	0.90		
Comp LC-5	0	3	9	1	0.90		
Comp LC-5	10	1	0	10	0.00	0.00	0.00
Comp LC-5	10	2	0	10	0.00		
Comp LC-5	10	3	0	10	0.00		
Comp LC-5	50	1	0	10	0.00	0.00	0.00
Comp LC-5	50	2	0	10	0.00		
Comp LC-5	50	3	0	10	0.00		
Comp LC-5	100	1	0	10	0.00	0.00	0.00
Comp LC-5	100	2	0	10	0.00		
Comp LC-5	100	3	0	10	0.00		
Comp LC-6	0	1	9	1	0.90	0.90	0.00
Comp LC-6	0	2	9	1	0.90		
Comp LC-6	0	3	9	1	0.90		
Comp LC-6	10	1	0	10	0.00	0.00	0.00
Comp LC-6	10	2	0	10	0.00		
Comp LC-6	10	3	0	10	0.00		
Comp LC-6	50	1	0	10	0.00	0.00	0.00
Comp LC-6	50	2	0	10	0.00		
Comp LC-6	50	3	0	10	0.00		
Comp LC-6	100	1	0	10	0.00	0.00	0.00
Comp LC-6	100	2	0	10	0.00		
Comp LC-6	100	3	0	10	0.00		
Comp USFC	0	1	10	0	1.00	0.93	0.06
Comp USFC	0	2	9	1	0.90		
Comp USFC	0	3	9	1	0.90		
Comp USFC	10	1	8	2	0.80	0.67	0.12
Comp USFC	10	2	6	4	0.60		
Comp USFC	10	3	6	4	0.60		
Comp USFC	50	1	3	7	0.30		

TABLE H.1. (contd)

Sediment Treatment	SPP Concentration Percent	Replicate	<i>H. costata</i>		Proportion Surviving	Mean Proportion Surviving	Standard Deviation
			Number Alive	Number Dead			
Comp USFC	50	2	6	4	0.60		
Comp USFC	50	3	5	5	0.50	0.47	0.15
Comp USFC	100	1	1	9	0.10		
Comp USFC	100	2	2	8	0.20		
Comp USFC	100	3	3	7	0.30	0.20	0.10
Comp FSFC	0	1	10	0	1.00		
Comp FSFC	0	2	10	0	1.00		
Comp FSFC	0	3	9	1	0.90	0.97	0.06
Comp FSFC	10	1	9	1	0.90		
Comp FSFC	10	2	10	0	1.00		
Comp FSFC	10	3	9	1	0.90	0.93	0.06
Comp FSFC	50	1	8	2	0.80		
Comp FSFC	50	2	7	3	0.70		
Comp FSFC	50	3	8	2	0.80	0.77	0.06
Comp FSFC	100	1	6	4	0.60		
Comp FSFC	100	2	6	4	0.60		
Comp FSFC	100	3	7	3	0.70	0.63	0.06
Comp IHC-1	0	1	9	1	0.90		
Comp IHC-1	0	2	9	1	0.90		
Comp IHC-1	0	3	10	0	1.00	0.93	0.06
Comp IHC-1	10	1	9	1	0.90		
Comp IHC-1	10	2	8	2	0.80		
Comp IHC-1	10	3	10	0	1.00	0.90	0.10
Comp IHC-1	50	1	8	2	0.80		
Comp IHC-1	50	2	7	3	0.70		
Comp IHC-1	50	3	9	1	0.90	0.80	0.10
Comp IHC-1	100	1	6	4	0.60		
Comp IHC-1	100	2	7	3	0.70		
Comp IHC-1	100	3	7	3	0.70	0.67	0.06
Comp IHC-2	0	1	8	2	0.80		
Comp IHC-2	0	2	10	0	1.00		
Comp IHC-2	0	3	10	0	1.00	0.93	0.12
Comp IHC-2	10	1	10	0	1.00		
Comp IHC-2	10	2	8	2	0.80		
Comp IHC-2	10	3	8	2	0.80	0.87	0.12
Comp IHC-2	50	1	8	2	0.80		
Comp IHC-2	50	2	7	3	0.70		
Comp IHC-2	50	3	8	2	0.80	0.77	0.06
Comp IHC-2	100	1	7	3	0.70		
Comp IHC-2	100	2	6	4	0.60		
Comp IHC-2	100	3	7	3	0.70	0.67	0.06
Comp IHC-3	0	1	10	0	1.00		
Comp IHC-3	0	2	9	1	0.90		
Comp IHC-3	0	3	9	1	0.90	0.93	0.06
Comp IHC-3	10	1	9	1	0.90		
Comp IHC-3	10	2	9	1	0.90		
Comp IHC-3	10	3	10	0	1.00	0.93	0.06
Comp IHC-3	50	1	8	2	0.80		
Comp IHC-3	50	2	7	3	0.70		
Comp IHC-3	50	3	8	2	0.80	0.77	0.06
Comp IHC-3	100	1	7	3	0.70		
Comp IHC-3	100	2	6	4	0.60		
Comp IHC-3	100	3	4	6	0.40	0.57	0.15

(a) Test of Comp LC-5 SPP at lower concentrations.

TABLE H.2. Water Quality Summary for 96-h *H. costata* Suspended-Particulate-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	SPP Concentration (Percent)		Temperature (°C)		pH (a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min (b)	Max (b)	Min	Max	Min	Max	Min	Max		
Acceptable Range		13.0	17.0	7.46	8.46	4.0	NA	30.0	34.0	
Comp LC	0	16.3	16.7	7.71	7.98	7.1	8.4	29.0 (c)	30.0	
Comp LC	10	16.5	16.7	8.00	8.03	7.2	8.2	29.0 (c)	30.0	
Comp LC	50	16.5	16.7	8.05	8.29	7.2	7.5	29.5 (c)	30.0	
Comp LC	100	16.6	16.7	8.08	8.48 (d)	6.2	7.0	30.0	30.5	
Comp LC-5	0	16.2	16.7	7.48	7.91	6.7	8.6	28.0 (c)	30.0	
Comp LC-5	10	16.4	16.6	7.89	8.00 (d)	7.3	8.4	28.5 (c)	29.5 (c)	
Comp LC-5	50	16.5	16.7	7.86	8.60 (d)	6.0	7.5	29.5 (c)	30.0	
Comp LC-5	100	16.5	16.7	8.09	8.98 (d)	6.2	7.2	30.0	30.0	
Comp LC-5	0	15.8	16.4	7.81	8.01	6.9	8.8	29.5 (c)	30.0	
Comp LC-5	0.01	15.8	16.5	7.70	7.97	6.7	8.7	29.5 (c)	30.0	
Comp LC-5	0.1	15.7	16.4	7.76	7.98	7.0	8.9	30.0	30.0	
Comp LC-5	1	15.8	16.5	7.69	7.97	6.6	8.8	30.0	30.0	
Comp LC-6	0	16.2	16.4	7.70	7.95	6.6	7.9	28.5 (c)	30.0	
Comp LC-6	10	16.2	16.4	7.93	8.06	7.4	7.9	28.5 (c)	30.0	
Comp LC-6	50	16.3	16.5	7.96	8.43 (d)	7.2	7.5	28.5 (c)	30.0	
Comp LC-6	100	16.3	16.6	8.05	8.73 (d)	6.2	7.6	28.0 (c)	29.5 (c)	
Comp FSFC	0	16.0	16.3	7.72	7.94	6.9	8.7	30.0	30.5	
Comp FSFC	10	16.1	16.3	7.76	7.94	7.0	8.5	30.0	30.5	
Comp FSFC	50	16.2	16.4	7.83	8.18	7.0	7.9	29.5 (c)	30.5	
Comp FSFC	100	16.1	16.4	7.93	8.16	5.6	7.6	29.0 (c)	30.5	
Comp USFC	0	16.1	16.6	7.76	7.92	7.1	8.0	29.0 (c)	30.5	
Comp USFC	10	16.2	16.6	7.82	8.08	7.2	8.0	29.5 (c)	30.5	
Comp USFC	50	16.2	16.6	7.87	8.13	6.7	7.9	30.0	30.5	
Comp USFC	100	16.3	16.7	8.12	8.23	6.3	7.9	29.5 (c)	30.5	
Comp IHC-1	0	16.0	16.2	7.72	7.97	7.0	8.5	30.0	30.5	
Comp IHC-1	10	16.0	16.4	7.70	7.98	7.0	8.6	30.0	30.5	
Comp IHC-1	50	16.0	16.4	7.70	8.10	6.6	8.0	29.5 (c)	30.0	
Comp IHC-1	100	16.0	16.4	7.58	8.26	5.9	7.8	29.0 (c)	30.5	
Comp IHC-2	0	15.6	16.3	7.72	7.92	7.1	8.2	30.0	30.0	
Comp IHC-2	10	15.6	16.3	7.71	7.96	7.0	8.2	30.0	30.0	
Comp IHC-2	50	15.7	16.2	7.76	8.13	7.3	8.0	30.0	30.0	
Comp IHC-2	100	15.6	16.4	7.65	8.15	6.8	7.7	29.5 (c)	30.0	
Comp IHC-3	0	15.6	16.4	7.51	7.89	5.8	8.3	30.0	30.5	
Comp IHC-3	10	15.6	16.3	7.72	7.88	6.4	8.3	30.0	30.5	
Comp IHC-3	50	15.6	16.3	7.72	8.00	6.4	7.8	30.0	30.0	
Comp IHC-3	100	15.6	16.3	7.62	8.30	6.2	7.3	30.0	30.0	

(a) Acceptable pH range is based on mean pH in all test chambers in 96-h test.

(b) Minimum and maximum values are derived from all replicates for each treatment.

(c) The 96-h test was conducted at a salinity of 30 ± 2% instead of the 32 ± 2% specified in the Quality Assurance Plan.

(d) Value exceeds acceptable range.

TABLE H.3. Results for all Replicates in 96-h *H. costata* Elutriate Test, United Heckathorn Remedial Investigation

Sediment Treatment	Elutriate Concentration (Percent)	Replicate	<i>H. costata</i>		Proportion Survival	Mean Proportion Survival	Standard Deviation
			Number Alive	Number Dead			
Comp LC	0	1	8	2	0.80	0.93	0.12
Comp LC	0	2	10	0	1.00		
Comp LC	0	3	10	0	1.00		
Comp LC	10	1	0	10	0.00	0.00	0.00
Comp LC	10	2	0	10	0.00		
Comp LC	10	3	0	10	0.00		
Comp LC	50	1	0	10	0.00	0.00	0.00
Comp LC	50	2	0	10	0.00		
Comp LC	50	3	0	10	0.00		
Comp LC	100	1	0	10	0.00	0.00	0.00
Comp LC	100	2	0	10	0.00		
Comp LC	100	3	0	10	0.00		
Comp LC-5R ^(a)	0	1	9	1	0.90	0.97	0.06
Comp LC-5R	0	2	10	0	1.00		
Comp LC-5R	0	3	10	0	1.00		
Comp LC-5R	0.01	1	9	1	0.90	0.97	0.06
Comp LC-5R	0.01	2	10	0	1.00		
Comp LC-5R	0.01	3	10	0	1.00		
Comp LC-5R	0.1	1	8	2	0.80	0.90	0.10
Comp LC-5R	0.1	2	10	0	1.00		
Comp LC-5R	0.1	3	9	1	0.90		
Comp LC-5R	1	1	3	7	0.30	0.43	0.12
Comp LC-5R	1	2	5	5	0.50		
Comp LC-5R	1	3	5	5	0.50		
Comp LC-5	0	1	10	0	1.00	0.97	0.06
Comp LC-5	0	2	10	0	1.00		
Comp LC-5	0	3	9	1	0.90		
Comp LC-5	10	1	0	10	0.00	0.00	0.00
Comp LC-5	10	2	0	10	0.00		
Comp LC-5	10	3	0	10	0.00		
Comp LC-5	50	1	0	10	0.00	0.00	0.00
Comp LC-5	50	2	0	10	0.00		
Comp LC-5	50	3	0	10	0.00		
Comp LC-5	100	1	0	10	0.00	0.00	0.00
Comp LC-5	100	2	0	10	0.00		
Comp LC-5	100	3	0	10	0.00		
Comp LC-5 UF ^(b)	0	1	9	1	0.90	0.97	0.06
Comp LC-5 UF	0	2	10	0	1.00		
Comp LC-5 UF	0	3	10	0	1.00		
Comp LC-5 UF	100	1	0	10	0.00	0.00	0.00
Comp LC-5 UF	100	2	0	10	0.00		
Comp LC-5 UF	100	3	0	10	0.00		
Comp LC-5 F ^(c)	0	1	9	1	0.90	0.97	0.06
Comp LC-5 F	0	2	10	0	1.00		
Comp LC-5 F	0	3	10	0	1.00		
Comp LC-5 F	100	1	0	10	0.00	0.00	0.00
Comp LC-5 F	100	2	0	10	0.00		
Comp LC-5 F	100	3	0	10	0.00		

TABLE H.3. (contd)

Sediment Treatment	Elutriate Concentration (Percent)	Replicate	<i>H. costata</i>		Proportion Survival	Mean Proportion Survival	Standard Deviation
			Number Alive	Number Dead			
Comp LC-6	0	1	10	0	1.00	0.93	0.06
Comp LC-6	0	2	9	1	0.90		
Comp LC-6	0	3	9	1	0.90		
Comp LC-6	10	1	0	10	0.00	0.00	0.00
Comp LC-6	10	2	0	10	0.00		
Comp LC-6	10	3	0	10	0.00		
Comp LC-6	50	1	0	10	0.00	0.00	0.00
Comp LC-6	50	2	0	10	0.00		
Comp LC-6	50	3	0	10	0.00		
Comp LC-6	100	1	0	10	0.00	0.00	0.00
Comp LC-6	100	2	0	10	0.00		
Comp LC-6	100	3	0	10	0.00		
Comp FSFC	0	1	10	0	1.00	0.93	0.06
Comp FSFC	0	2	9	1	0.90		
Comp FSFC	0	3	9	1	0.90		
Comp FSFC	10	1	9	1	0.90	0.93	0.06
Comp FSFC	10	2	10	0	1.00		
Comp FSFC	10	3	9	1	0.90		
Comp FSFC	50	1	7	3	0.70	0.80	0.10
Comp FSFC	50	2	8	2	0.80		
Comp FSFC	50	3	9	1	0.90		
Comp FSFC	100	1	6	4	0.60	0.73	0.12
Comp FSFC	100	2	8	2	0.80		
Comp FSFC	100	3	8	2	0.80		
Comp USFC	0	1	9	1	0.90	0.90	0.10
Comp USFC	0	2	10	0	1.00		
Comp USFC	0	3	8	2	0.80		
Comp USFC	10	1	7	3	0.70	0.67	0.06
Comp USFC	10	2	7	3	0.70		
Comp USFC	10	3	6	4	0.60		
Comp USFC	50	1	4	6	0.40	0.50	0.10
Comp USFC	50	2	6	4	0.60		
Comp USFC	50	3	5	5	0.50		
Comp USFC	100	1	0	10	0.00	0.20	0.17
Comp USFC	100	2	3	7	0.30		
Comp USFC	100	3	3	7	0.30		
Comp IHC-1	0	1	10	0	1.00	1.00	0.00
Comp IHC-1	0	2	10	0	1.00		
Comp IHC-1	0	3	10	0	1.00		
Comp IHC-1	10	1	9	1	0.90	0.90	0.10
Comp IHC-1	10	2	8	2	0.80		
Comp IHC-1	10	3	10	0	1.00		
Comp IHC-1	50	1	9	1	0.90	0.83	0.12
Comp IHC-1	50	2	7	3	0.70		
Comp IHC-1	50	3	9	1	0.90		
Comp IHC-1	100	1	7	3	0.70	0.67	0.06
Comp IHC-1	100	2	6	4	0.60		
Comp IHC-1	100	3	7	3	0.70		

TABLE H.3. (contd)

Sediment Treatment	Elutriate Concentration (Percent)	Replicate	<i>H. costata</i>		Proportion Survival	Mean Proportion Survival	Standard Deviation
			Number Alive	Number Dead			
Comp IHC-2	0	1	9	1	0.90		
Comp IHC-2	0	2	9	1	0.90		
Comp IHC-2	0	3	10	0	1.00	0.93	0.06
Comp IHC-2	10	1	8	2	0.80		
Comp IHC-2	10	2	9	1	0.90		
Comp IHC-2	10	3	10	0	1.00	0.90	0.10
Comp IHC-2	50	1	7	3	0.70		
Comp IHC-2	50	2	7	3	0.70		
Comp IHC-2	50	3	8	2	0.80	0.73	0.06
Comp IHC-2	100	1	7	3	0.70		
Comp IHC-2	100	2	6	4	0.60		
Comp IHC-2	100	3	6	4	0.60	0.63	0.06
Comp IHC-3	0	1	10	0	1.00		
Comp IHC-3	0	2	10	0	1.00		
Comp IHC-3	0	3	9	1	0.90	0.97	0.06
Comp IHC-3	10	1	9	1	0.90		
Comp IHC-3	10	2	8	2	0.80		
Comp IHC-3	10	3	9	1	0.90	0.87	0.06
Comp IHC-3	50	1	7	3	0.70		
Comp IHC-3	50	2	8	2	0.80		
Comp IHC-3	50	3	8	2	0.80	0.77	0.06
Comp IHC-3	100	1	5	5	0.50		
Comp IHC-3	100	2	5	5	0.50		
Comp IHC-3	100	3	6	4	0.60	0.53	0.06

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- (a) Test of Comp LC-5 elutriate at lower concentrations.
(b) UF Unfiltered.
(c) F Filtered through granular activated carbon.

TABLE H.4. Water Quality Summary for 96-h *H. costata* Elutriate Test, United Heckathorn Remedial Investigation

Sediment Treatment	Elutriate Concentration (Percent)	Temperature (°C)		pH ^(a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
		Min ^(b)	Max ^(b)	Min	Max	Min	Max	Min	Max
Acceptable Range		13.0	17.0	7.45	8.45	4.0	NA	30.0	34.0
Comp LC	0	16.5	16.8	7.42 ^(c)	7.99	6.0	8.3	30.0	30.0
Comp LC	10	16.6	16.8	7.88	8.03	6.9	8.0	30.0	30.5
Comp LC	50	16.6	16.7	8.02	8.28	7.1	7.9	30.0	30.5
Comp LC	100	16.6	16.8	7.92	8.47 ^(c)	6.4	7.4	30.0	30.5
Comp LC-5	0	16.4	16.7	7.74	7.99	6.8	8.1	28.0 ^(d)	30.0
Comp LC-5	10	16.6	16.9	7.86	8.12	7.1	8.1	29.0 ^(d)	30.0
Comp LC-5	50	16.7	16.9	7.99	8.60 ^(c)	6.2	8.0	29.0 ^(d)	30.0
Comp LC-5	100	16.6	16.9	8.04	8.97 ^(c)	6.0	7.6	29.5 ^(d)	30.5
Comp LC-5	0	16.1	16.5	7.73	7.96	7.0	8.7	30.0	30.5
Comp LC-5	0.01	16.2	16.5	7.65	7.97	6.6	8.8	30.0	30.5
Comp LC-5	0.1	16.1	16.5	7.66	7.94	6.5	8.9	30.0	30.5
Comp LC-5	1	16.1	16.5	7.76	7.90	6.9	8.7	29.5 ^(d)	30.5
Comp LC-5	0	16.0	16.3	7.72	7.91	6.8	8.2	29.0 ^(d)	30.0
Comp LC-5 UF ^(e)	100	16.1	16.4	8.26	8.92 ^(c)	7.1	8.0	29.0 ^(d)	29.5 ^(d)
Comp LC-5 F ^(f)	100	16.1	16.4	8.05	8.65 ^(c)	7.1	8.0	28.5 ^(d)	30.0
Comp LC-6	0	16.5	16.7	7.74	7.93	7.0	7.9	29.5 ^(d)	30.0
Comp LC-6	10	16.5	16.8	7.95	8.02	7.6	7.9	29.0 ^(d)	30.0
Comp LC-6	50	16.5	16.6	7.97	8.42 ^(c)	7.6	7.7	29.0 ^(d)	30.0
Comp LC-6	100	16.5	16.7	8.04	8.70 ^(c)	7.1	7.5	29.5 ^(d)	30.0
Comp FSFC	0	15.9	16.4	7.63	7.91	6.6	8.7	30.0	30.0
Comp FSFC	10	16.0	16.4	7.78	7.94	6.7	8.6	30.0	30.0
Comp FSFC	50	15.9	16.4	7.79	8.00	7.0	8.3	30.0	30.0
Comp FSFC	100	15.9	16.5	7.86	8.17	6.9	8.1	30.0	30.0
Comp USFC	0	16.5	16.7	7.85	8.02	7.1	8.2	29.5 ^(d)	30.0
Comp USFC	10	16.4	16.8	7.75	8.01	6.9	8.0	30.0 ^(d)	30.5
Comp USFC	50	16.3	16.8	7.99	8.14	6.9	7.8	29.5 ^(d)	31.0
Comp USFC	100	16.4	16.8	8.00	8.28	6.7	7.8	30.0	30.5
Comp IHC-1	0	16.0	16.3	7.62	7.86	6.7	8.6	30.0	30.0
Comp IHC-1	10	16.0	16.3	7.82	7.92	6.9	8.6	30.0	30.0
Comp IHC-1	50	16.0	16.4	7.85	8.09	7.0	8.3	30.0	30.0
Comp IHC-1	100	16.0	16.4	7.88	8.23	6.9	7.9	30.0	30.0
Comp IHC-2	0	15.9	16.4	7.61	7.88	6.7	8.3	30.0	30.0
Comp IHC-2	10	15.9	16.4	7.55	7.93	6.0	8.3	30.0	30.0
Comp IHC-2	50	16.0	16.4	7.75	8.01	6.5	8.1	30.0	30.0
Comp IHC-2	100	16.0	16.5	7.66	8.06	6.7	7.9	30.0	30.0
Comp IHC-3	0	15.7	16.4	7.73	7.90	6.9	8.4	30.0	30.5
Comp IHC-3	10	15.8	16.5	7.55	7.86	6.3	8.4	30.0	30.0
Comp IHC-3	50	15.9	16.5	7.75	8.09	6.0	8.1	30.0	30.0
Comp IHC-3	100	15.9	16.4	7.76	8.28	6.7	7.7	29.0 ^(d)	30.0

(a) Acceptable pH range is based on mean pH in all test chambers in 10-day test.

(b) Minimum and maximum values are derived from all replicates for each treatment.

(c) Value exceeds acceptable range.

(d) The 96-h test was conducted at a salinity of 30 ± 2% instead of the 32 ± 2% specified in the Quality Assurance Plan.

(e) UF Unfiltered.

(f) F Filtered.

TABLE H.5. Results for all Replicates in 96-h *H. costata* Reference Toxicant Tests, United Heckathorn Remedial Investigation

Copper Concentration (mg/L)	Replicate	Number Alive	Number Dead	Proportion Surviving	Mean Proportion Surviving	Standard Deviation
<u>Test 1:</u> <i>H. costata</i> used for testing Comps LC, LC-5, LC-6, and USFC SPP and Elutriate						
0.00	1	10	0	1.00	0.97	0.06
0.00	2	9	1	0.90		
0.00	3	10	0	1.00		
0.05	1	7	3	0.70	0.73	0.06
0.05	2	8	2	0.80		
0.05	3	7	3	0.70		
0.10	1	3	7	0.30	0.47	0.15
0.10	2	6	4	0.60		
0.10	3	5	5	0.50		
0.20	1	0	10	0.00	0.00	0.00
0.20	2	0	10	0.00		
0.20	3	0	10	0.00		
0.40	1	0	10	0.00	0.00	0.00
0.40	2	0	10	0.00		
0.40	3	0	10	0.00		
<u>Test 2:</u> <i>H. costata</i> used for testing Comps FSFC, IHC-1, IHC-2, IHC-3 SPP and Elutriate; Comp LC-5 SPP and Elutriate at Lower Concentrations and Comp LC-5 Elutriate Filtered and Unfiltered						
0.00	1	9	1	0.90	0.93	0.06
0.00	2	10	0	1.00		
0.00	3	9	1	0.90		
0.05	1	9	1	0.90	0.83	0.06
0.05	2	8	2	0.80		
0.05	3	8	2	0.80		
0.10	1	5	5	0.50	0.57	0.12
0.10	2	7	3	0.70		
0.10	3	5	5	0.50		
0.20	1	0	10	0.00	0.00	0.00
0.20	2	0	10	0.00		
0.20	3	0	10	0.00		
0.40	1	0	10	0.00	0.00	0.00
0.40	2	0	10	0.00		
0.40	3	0	10	0.00		

TABLE H.6. Water Quality Summary for 96-h *H. costata* Reference Toxicant Tests, United Heckathorn Remedial Investigation

Copper Concentration (mg/L)	Temperature (°C)		pH ^(a)		Dissolved Oxygen (mg/L)		Salinity o/oo	
	Min ^(b)	Max ^(b)	Min	Max	Min	Max	Min	Max
Acceptable Range	13.0	17.0	7.32	8.32	4.0	NA	30.0	34.0
Test 1: <i>H. Costata</i> used for testing Comps LC, LC-5, LC-6, and USFC SPP and Elutriate								
0.00	16.0	16.7	7.73	7.95	7.2	8.6	30.0	31.5
0.05	16.1	16.6	7.71	7.99	7.2	8.2	30.0	31.5
0.1	16.2	16.5	7.75	8.01	7.2	8.2	30.0	31.0
0.2	16.2	16.5	7.74	8.02	7.5	8.2	30.0	31.0
0.4	16.2	16.5	7.74	8.04	7.7	8.2	30.0	30.5
Test 2: <i>H. costata</i> used for testing Comps FSFC, IHC-1, IHC-2, IHC-3 SPP and Elutriate; Comp LC-5 SPP and Elutriate at Lower Concentrations and Comp LC-5 Elutriate Filtered and Unfiltered								
0.00	16.1	16.5	7.44	7.82	6.2	8.2	30.5	31.0
0.05	16.0	16.4	7.54	7.83	6.6	8.3	30.5	31.0
0.1	16.1	16.5	7.66	7.95	7.1	8.2	30.5	31.0
0.2	16.2	16.6	7.77	7.96	7.2	8.3	30.0	31.0
0.4	16.3	16.6	7.80	7.89	7.8	8.2	30.0	31.0

(a) Acceptable pH range is based on mean pH in all test chambers in 96-h test.

(b) Minimum and maximum values are derived from all replicates for each concentration.

APPENDIX I

BIOASSAY RESULTS FOR 48-HOUR SUSPENDED-PARTICULATE-PHASE TEST
AND 48-HOUR REFERENCE TOXICANT TEST FOR *Mytilus galloprovincialis*

TABLE I.1. Results for all Replicates in 48-h *M. galloprovincialis* Suspended-Particulate-Phase Test, United Heckathorn Remedial Investigation

<i>M. galloprovincialis</i>												
Sediment Treatment	SPP Concentration (Percent)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Proportion Normal		Number Surviving	Proportion Surviving	Proportion Surviving		
						Mean	Standard Deviation			Mean	Standard Deviation	
I 1	Comp LC	0%	1	249	249	1.00	0.948	0.05	250	1.00 ^(a)	0.961	0.03
	Comp LC	0%	2	249	229	0.92			233	0.94		
	Comp LC	0%	3	249	230	0.92			236	0.95		
	Comp LC	10%	1	249	251	1.00 ^(a)	0.937	0.06	256	1.00 ^(a)	0.957	0.04
	Comp LC	10%	2	249	218	0.88			227	0.91		
	Comp LC	10%	3	249	233	0.94			239	0.96		
	Comp LC	50%	1	249	237	0.95	0.924	0.03	238	0.96	0.937	0.02
	Comp LC	50%	2	249	225	0.90			232	0.93		
	Comp LC	50%	3	249	228	0.92			230	0.92		
	Comp LC	100%	1	249	0	0.00	0.003	0.00	190	0.76 ^(a)	0.884	0.12
	Comp LC	100%	2	249	0	0.00			265	1.00 ^(a)		
	Comp LC	100%	3	249	2	0.01			221	0.89		
	Comp LC-5	0%	1	249	253	1.00 ^(a)	0.995	0.01	255	1.00 ^(a)	0.997	0.02
	Comp LC-5	0%	2	249	245	0.98			247	0.99		
	Comp LC-5	0%	3	249	266	1.00 ^(a)			268	1.00 ^(a)		
	Comp LC-5	10%	1	249	230	0.92	0.938	0.06	234	0.94	0.946	0.05
	Comp LC-5	10%	2	249	222	0.89			224	0.90		
	Comp LC-5	10%	3	249	254	1.00 ^(a)			255	1.00 ^(a)		
	Comp LC-5	50%	1	249	1	0.00	0.003	0.00	129	0.52	0.627	0.21
	Comp LC-5	50%	2	249	1	0.00			123	0.49		
	Comp LC-5	50%	3	249	0	0.00			216	0.87		
	Comp LC-5	100%	1	249	0	0.00	0.000	0.00	196	0.79	0.819	0.03
	Comp LC-5	100%	2	249	0	0.00			206	0.83		
	Comp LC-5	100%	3	249	0	0.00			210	0.84		
	Comp LC-6	0%	1	236	ND	NA	0.972	0.56	ND	NA ^(a)	0.975	0.03
	Comp LC-6	0%	2	236	240	1.00 ^(a)			242	1.00 ^(a)		
	Comp LC-6	0%	3	236	223	0.94			224	0.95		
	Comp LC-6	10%	1	236	236	1.00	0.984	0.03	237	1.00 ^(a)	0.992	0.01
	Comp LC-6	10%	2	236	240	1.00 ^(a)			242	1.00 ^(a)		
	Comp LC-6	10%	3	236	225	0.95			230	0.97		
	Comp LC-6	50%	1	236	0	0.00	0.000	0.00	204	0.86	0.825	0.20
	Comp LC-6	50%	2	236	0	0.00			144	0.61		
	Comp LC-6	50%	3	236	0	0.00			254	1.00 ^(a)		
	Comp LC-6	100%	1	236	0	0.00	0.004	0.01	135	0.57	0.668	0.12
	Comp LC-6	100%	2	236	3	0.01			188	0.80		
	Comp LC-6	100%	3	236	0	0.00			150	0.64		

TABLE 1.1. (contd)

<i>M. galloprovincialis</i>												
Sediment Treatment	SPP Concentration (Percent)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Proportion Normal		Number Surviving	Proportion Surviving	Proportion Surviving		
						Mean	Standard Deviation			Mean	Standard Deviation	
I 2	Comp FSFC	0%	1	236	227	0.96	0.969	0.03	230	0.97	0.977	0.02
	Comp FSFC	0%	2	236	223	0.94	0.866	0.07	226	0.96	0.890	0.05
	Comp FSFC	0%	3	236	239	1.00 ^(a)			244	1.00 ^(a)		
	Comp FSFC	10%	1	236	222	0.94			223	0.94		
	Comp FSFC	10%	2	236	192	0.81	0.935	0.07	206	0.87	0.953	0.06
	Comp FSFC	10%	3	236	199	0.84			201	0.85		
	Comp FSFC	50%	1	236	221	0.94			229	0.97		
	Comp FSFC	50%	2	236	205	0.87	0.136	0.01	210	0.89	0.887	0.10
	Comp FSFC	50%	3	236	243	1.00 ^(a)			248	1.00 ^(a)		
	Comp FSFC	100%	1	236	34	0.14			200	0.85		
	Comp FSFC	100%	2	236	33	0.14	0.12		246	1.00 ^(a)		
	Comp FSFC	100%	3	236	29	0.12			190	0.81		
	Comp USFC	0%	1	236	261	1.00 ^(a)			0.989	0.01		
	Comp USFC	0%	2	236	231	0.98	0.955	0.03	231	0.98	0.963	0.04
	Comp USFC	0%	3	236	233	0.99			237	1.00 ^(a)		
	Comp USFC	10%	1	236	229	0.97			229	0.97		
	Comp USFC	10%	2	236	216	0.92	0.999	0.00	217	0.92	1.000	0.00
	Comp USFC	10%	3	236	231	0.98			238	1.00 ^(a)		
	Comp USFC	50%	1	236	266	1.00 ^(a)			266	1.00 ^(a)		
	Comp USFC	50%	2	236	235	1.00	0.839	0.14	245	1.00 ^(a)	1.000	0.00
	Comp USFC	50%	3	236	241	1.00 ^(a)			244	1.00 ^(a)		
	Comp USFC	100%	1	236	210	0.89			247	1.00 ^(a)		
	Comp USFC	100%	2	236	223	0.94	0.68		255	1.00 ^(a)	1.000	0.00
	Comp USFC	100%	3	236	161	0.68			242	1.00 ^(a)		
	Comp IHC-1	0%	1	236	241	1.00 ^(a)			0.989	0.01		
	Comp IHC-1	0%	2	236	234	0.99	0.932	0.04	236	1.00	0.945	0.04
	Comp IHC-1	0%	3	236	230	0.97			231	0.98		
	Comp IHC-1	10%	1	236	218	0.92			223	0.94		
	Comp IHC-1	10%	2	236	230	0.97	0.751	0.10	232	0.98	0.845	0.08
	Comp IHC-1	10%	3	236	212	0.90			214	0.91		
	Comp IHC-1	50%	1	236	202	0.86			221	0.94		
	Comp IHC-1	50%	2	236	174	0.74	0.001	0.00	192	0.81	0.959	0.03
	Comp IHC-1	50%	3	236	156	0.66			185	0.78		
	Comp IHC-1	100%	1	236	1	0.00			219	0.93		
	Comp IHC-1	100%	2	236	0	0.00	0.00		230	0.97		
	Comp IHC-1	100%	3	236	0	0.00			230	0.97		

TABLE 1.1. (contd)

<i>M. galloprovincialis</i>											
Sediment Treatment	SPP Concentration (Percent)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Proportion Normal		Number Surviving	Proportion Surviving	Proportion Surviving	
						Mean	Standard Deviation			Mean	Standard Deviation
Comp IHC-2	0%	1	279	298	1.00 ^(a)	0.975	0.04	301	1.00 ^(a)	0.980	0.04
Comp IHC-2	0%	2	279	293	1.00 ^(a)			297	1.00 ^(a)		
Comp IHC-2	0%	3	279	258	0.92			262	0.94		
Comp IHC-2	10%	1	279	220	0.79	0.901	0.11	223	0.80	0.909	0.10
Comp IHC-2	10%	2	279	255	0.91			259	0.93		
Comp IHC-2	10%	3	279	288	1.00 ^(a)			294	1.00 ^(a)		
Comp IHC-2	50%	1	279	239	0.86	0.805	0.13	258	0.92	0.841	0.14
Comp IHC-2	50%	2	279	184	0.66			191	0.68		
Comp IHC-2	50%	3	279	251	0.90			255	0.91		
Comp IHC-2	100%	1	279	0	0.00	0.002	0.00	253	0.91	0.940	0.05
Comp IHC-2	100%	2	279	0	0.00			283	1.00 ^(a)		
Comp IHC-2	100%	3	279	2	0.01			255	0.91		
Comp IHC-3	0%	1	279	271	0.97	0.940	0.08	274	0.98	0.953	0.07
Comp IHC-3	0%	2	279	298	1.00 ^(a)			299	1.00 ^(a)		
Comp IHC-3	0%	3	279	237	0.85			245	0.88		
Comp IHC-3	10%	1	279	336	1.00 ^(a)	0.908	0.11	342	1.00 ^(a)	0.919	0.11
Comp IHC-3	10%	2	279	263	0.94			269	0.96		
Comp IHC-3	10%	3	279	218	0.78			221	0.79		
Comp IHC-3	50%	1	279	0	0.00	0.001	0.00	288	1.00 ^(a)	0.953	0.07
Comp IHC-3	50%	2	279	0	0.00			276	0.99		
Comp IHC-3	50%	3	279	1	0.00			243	0.87		
Comp IHC-3	100%	1	279	0	0.00	0.000	0.00	200	0.72	0.849	0.12
Comp IHC-3	100%	2	279	0	0.00			261	0.94		
Comp IHC-3	100%	3	279	0	0.00			250	0.90		

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

TABLE I.2. Water Quality Summary for 48-h *M. galloprovincialis* Suspended-Particulate-Phase Test, United Heckathorn Remedial Investigation

Sediment Treatment	SPP Concentration (Percent)	Temperature (°C)		pH (a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
		Min (b)	Max (b)	Min	Max	Min	Max	Min	Max
Acceptable Range		14.0	18.0	7.63	8.63	4.0	NA	28.0	32.0
Comp LC	0	15.7	16.0	8.03	8.07	7.5	7.9	29.5	30.0
Comp LC	10	15.8	16.0	8.04	8.09	7.5	7.9	29.0	30.5
Comp LC	50	15.8	16.0	8.14	8.28	7.6	7.9	29.5	30.5
Comp LC	100	15.8	16.0	8.23	8.46	7.5	7.9	29.5	31.0
Comp LC-5	0	15.8	16.0	7.97	8.12	7.5	7.9	29.0	30.0
Comp LC-5	10	15.8	16.1	8.04	8.11	7.4	8.0	29.5	30.0
Comp LC-5	50	15.7	16.0	8.08	8.58	7.5	7.9	29.0	30.0
Comp LC-5	100	15.8	16.1	8.14	8.97 (c)	7.5	7.9	29.5	30.5
Comp LC-6	0	16.2	16.4	7.88	8.08	7.4	8.0	30.0	30.0
Comp LC-6	10	16.2	16.4	7.99	8.10	7.6	8.3	29.5	30.0
Comp LC-6	50	16.2	16.4	8.04	8.41 (c)	7.4	8.2	29.0	30.0
Comp LC-6	100	16.2	16.4	8.12	8.74 (c)	7.3	8.1	28.5	30.0
Comp USFC	0	16.2	16.3	7.95	8.06	7.5	8.2	30.0	30.0
Comp USFC	10	16.2	16.3	7.93	8.06	7.5	8.2	30.0	30.0
Comp USFC	50	16.2	16.4	8.12	8.16	7.4	8.1	30.0	30.5
Comp USFC	100	16.2	16.3	8.20	8.27	7.2	8.3	30.0	31.0
Comp FSFC	0	15.5	15.8	7.95	8.05	7.5	8.1	30.0	30.0
Comp FSFC	10	15.5	15.8	7.93	8.15	7.5	8.2	30.0	30.0
Comp FSFC	50	15.5	15.9	8.05	8.23	7.6	8.2	30.0	30.0
Comp FSFC	100	15.6	15.8	8.16	8.33	7.4	8.4	30.0	30.0
Comp IHC-1	0	15.6	15.8	7.96	8.13	7.5	8.3	30.0	30.0
Comp IHC-1	10	15.5	15.8	7.80	8.16	7.6	8.3	30.0	30.0
Comp IHC-1	50	15.5	15.8	7.91	8.29	7.6	8.3	30.0	30.0
Comp IHC-1	100	15.6	15.8	7.96	8.44	7.6	8.1	30.0	30.0
Comp IHC-2	0	16.1	16.2	7.96	8.09	7.6	7.9	30.0	30.0
Comp IHC-2	10	16.1	16.2	7.96	8.11	7.7	8.0	30.0	30.0
Comp IHC-2	50	16.1	16.2	7.85	8.25	7.7	8.0	30.0	30.0
Comp IHC-2	100	16.1	16.2	7.69	8.38	7.1	8.0	30.0	30.0
Comp IHC-3	0	16.1	16.2	7.95	8.07	7.6	8.3	30.0	30.5
Comp IHC-3	10	16.1	16.3	7.93	8.15	7.5	8.0	30.0	30.5
Comp IHC-3	50	16.1	16.2	7.90	8.34	7.7	8.0	30.0	30.0
Comp IHC-3	100	16.1	16.3	7.77	8.48	7.0	8.1	30.0	30.0

(a) Acceptable pH range is based on mean pH in all test chambers in 48-h test.

(b) Minimum and maximum values are derived from all replicates for each treatment.

(c) Value exceeds acceptable range.

TABLE 1.3. Results for all Replicates in 48-h *M. galloprovincialis* Elutriate Test, United Heckathorn Remedial Investigation

M. galloprovincialis												
Sediment Treatment	Elutriate Concentration (Percent)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Proportion Normal		Number Surviving	Proportion Surviving	Proportion Surviving		
			Mean			Standard Deviation	Mean			Standard Deviation		
15	Comp LC	0%	1	236	242	1.00 ^(a)	0.976	0.04	245	1.00 ^(a)	0.979	0.04
	Comp LC	0%	2	236	219	0.93			221	0.94		
	Comp LC	0%	3	236	250	1.00 ^(a)			251	1.00 ^(a)		
	Comp LC	10%	1	236	228	0.97	0.918	0.10	235	1.00	0.939	0.10
	Comp LC	10%	2	236	189	0.80			194	0.82		
	Comp LC	10%	3	236	233	0.99			238	1.00 ^(a)		
	Comp LC	50%	1	236	211	0.89	0.929	0.05	214	0.91	0.945	0.05
	Comp LC	50%	2	236	214	0.91			219	0.93		
	Comp LC	50%	3	236	233	0.99			239	1.00 ^(a)		
	Comp LC	100%	1	236	1	0.00	0.007	0.00	186	0.79	0.736	0.05
	Comp LC	100%	2	236	2	0.01			161	0.68		
	Comp LC	100%	3	236	2	0.01			174	0.74		
	Comp LC-5	0%	1	236	229	0.97	0.986	0.01	231	0.98	0.990	0.01
	Comp LC-5	0%	2	236	259	1.00 ^(a)			263	1.00 ^(a)		
	Comp LC-5	0%	3	236	233	0.99			234	0.99		
	Comp LC-5	10%	1	236	198	0.84	0.936	0.09	206	0.87	0.958	0.07
	Comp LC-5	10%	2	236	229	0.97			241	1.00 ^(a)		
	Comp LC-5	10%	3	236	261	1.00 ^(a)			268	1.00 ^(a)		
	Comp LC-5	50%	1	236	0	0.00	0.004	0.00	231	0.98	0.674	0.27
	Comp LC-5	50%	2	236	1	0.00			113	0.48		
	Comp LC-5	50%	3	236	2	0.01			133	0.56		
	Comp LC-5	100%	1	236	0	0.00	0.000	0.00	190	0.81	0.573	0.22
	Comp LC-5	100%	2	236	0	0.00			87	0.37		
	Comp LC-5	100%	3	236	0	0.00			129	0.55		
	Comp LC-6	0%	1	270	289	1.00 ^(a)	1.000	0.00	291	1.00 ^(a)	1.000	0.00
	Comp LC-6	0%	2	270	286	1.00 ^(a)			288	1.00 ^(a)		
	Comp LC-6	0%	3	270	275	1.00 ^(a)			279	1.00 ^(a)		
	Comp LC-6	10%	1	270	241	0.89	0.867	0.07	264	0.98	0.943	0.08
	Comp LC-6	10%	2	270	212	0.79			230	0.85		
	Comp LC-6	10%	3	270	249	0.92			275	1.00 ^(a)		
	Comp LC-6	50%	1	270	1	0.00	0.001	0.00	242	0.90	0.704	0.17
	Comp LC-6	50%	2	270	0	0.00			151	0.56		
	Comp LC-6	50%	3	270	0	0.00			177	0.66		
	Comp LC-6	100%	1	270	0	0.00	0.000	0.00	243	0.90	0.679	0.19
	Comp LC-6	100%	2	270	0	0.00			159	0.59		
	Comp LC-6	100%	3	270	0	0.00			148	0.55		

TABLE 1.3. (contd)

<i>M. galloprovincialis</i>											
Sediment Treatment	Elutriate Concentration (Percent)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Proportion Normal		Number Surviving	Proportion Surviving	Proportion Surviving	
						Mean	Standard Deviation			Mean	Standard Deviation
9 I	Comp FSFC	0%	1	236	0.96	0.915	0.04	234	0.99	0.938	0.05
	Comp FSFC	0%	2	236	0.91			220	0.93		
	Comp FSFC	0%	3	236	0.88			210	0.89		
	Comp FSFC	10%	1	236	0.95	0.941	0.06	228	0.97	0.952	0.06
	Comp FSFC	10%	2	236	0.87			210	0.89 ^(a)		
	Comp FSFC	10%	3	236	1.00 ^(a)			255	1.00 ^(a)		
	Comp FSFC	50%	1	236	1.00 ^(a)	0.922	0.07	238	1.00 ^(a)	0.928	0.06
	Comp FSFC	50%	2	236	0.87			209	0.89		
	Comp FSFC	50%	3	236	0.89			212	0.90		
	Comp FSFC	100%	1	236	0.00	0.001	0.00	226	0.96	0.590	0.40
	Comp FSFC	100%	2	236	0.00			154	0.65		
	Comp FSFC	100%	3	236	0.00			38	0.16		
	Comp USFC	0%	1	270	0.88	0.879	0.01	242	0.90	0.893	0.02
	Comp USFC	0%	2	270	0.87			236	0.87		
	Comp USFC	0%	3	270	0.89 ^(a)			245	0.91 ^(a)		
	Comp USFC	10%	1	270	1.00 ^(a)	0.986	0.02	279	1.00 ^(a)	0.986	0.02
	Comp USFC	10%	2	170	1.00 ^(a)			176	1.00 ^(a)		
	Comp USFC	10%	3	270	0.96			259	0.96		
	Comp USFC	50%	1	270	0.78 ^(a)	0.890	0.11	217	0.80 ^(a)	0.920	0.10
	Comp USFC	50%	2	270	1.00 ^(a)			280	1.00 ^(a)		
	Comp USFC	50%	3	270	0.89			258	0.96		
	Comp USFC	100%	1	270	0.09	0.143	0.13	220	0.81 ^(a)	0.805	0.20
	Comp USFC	100%	2	270	0.30			292	1.00 ^(a)		
	Comp USFC	100%	3	270	0.05			162	0.60		
	Comp IHC-1	0%	1	236	0.94	0.955	0.04	225	0.95	0.969	0.03
	Comp IHC-1	0%	2	236	0.92 ^(a)			225	0.95 ^(a)		
	Comp IHC-1	0%	3	236	1.00 ^(a)			264	1.00 ^(a)		
	Comp IHC-1	10%	1	236	0.87	0.895	0.09	207	0.88	0.901	0.09
	Comp IHC-1	10%	2	236	0.82 ^(a)			195	0.83 ^(a)		
	Comp IHC-1	10%	3	236	1.00 ^(a)			303	1.00 ^(a)		
	Comp IHC-1	50%	1	236	0.72	0.750	0.03	197	0.83	0.884	0.05
	Comp IHC-1	50%	2	236	0.78			218	0.92		
	Comp IHC-1	50%	3	236	0.75			211	0.89		
	Comp IHC-1	100%	1	236	0.00	0.000	0.00	121	0.51	0.811	0.26
	Comp IHC-1	100%	2	236	0.00			217	0.92 ^(a)		
	Comp IHC-1	100%	3	236	0.00			246	1.00 ^(a)		

TABLE I.3. (contd)

<i>M. galloprovincialis</i>											
Sediment Treatment	Elutriate Concentration (Percent)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Proportion Normal		Number Surviving	Proportion Surviving	Proportion Surviving	
						Mean	Standard Deviation			Mean	Standard Deviation
Comp IHC-2	0%	1	250	288	1.00 ^(a)	1.000	0.00	295	1.00 ^(a)	1.000	0.00
Comp IHC-2	0%	2	250	258	1.00 ^(a)			271	1.00 ^(a)		
Comp IHC-2	0%	3	250	300	1.00 ^(a)			302	1.00 ^(a)		
Comp IHC-2	10%	1	250	267	1.00 ^(a)	1.000	0.00	270	1.00 ^(a)	1.000	0.00
Comp IHC-2	10%	2	250	261	1.00 ^(a)			264	1.00 ^(a)		
Comp IHC-2	10%	3	250	300	1.00 ^(a)			304	1.00 ^(a)		
Comp IHC-2	50%	1	250	313	1.00 ^(a)	1.000	0.00	333	1.00 ^(a)	1.000	0.00
Comp IHC-2	50%	2	250	290	1.00 ^(a)			298	1.00 ^(a)		
Comp IHC-2	50%	3	250	288	1.00 ^(a)			303	1.00 ^(a)		
Comp IHC-2	100%	1	250	0	0.00	0.003	0.00	279	1.00 ^(a)	1.000	0.00
Comp IHC-2	100%	2	250	0	0.00			287	1.00 ^(a)		
Comp IHC-2	100%	3	250	2	0.01			268	1.00 ^(a)		
Comp IHC-3	0%	1	548	536	0.98	0.971	0.03	550	1.00 ^(a)	0.984	0.03
Comp IHC-3	0%	2	250	234	0.94			238	0.95		
Comp IHC-3	0%	3	250	265	1.00 ^(a)			265	1.00 ^(a)		
Comp IHC-3	10%	1	250	306	1.00 ^(a)	1.000	0.00	308	1.00 ^(a)	1.000	0.00
Comp IHC-3	10%	2	250	279	1.00 ^(a)			281	1.00 ^(a)		
Comp IHC-3	10%	3	250	360	1.00 ^(a)			364	1.00 ^(a)		
Comp IHC-3	50%	1	250	0	0.00	0.001	0.00	201	0.80	0.916	0.10
Comp IHC-3	50%	2	250	0	0.00			236	0.94		
Comp IHC-3	50%	3	250	1	0.00			262	1.00 ^(a)		
Comp IHC-3	100%	1	250	0	0.00	0.000	0.00	303	1.00 ^(a)	0.952	0.08
Comp IHC-3	100%	2	250	0	0.00			289	1.00 ^(a)		
Comp IHC-3	100%	3	250	0	0.00			214	0.86		

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

TABLE 1.4. Water Quality Summary for 48-h *M. galloprovincialis* Elutriate Test, United Heckathorn Remedial Investigation

Sediment Treatment	Elutriate Concentration (Percent)	Temperature (°C)		pH ^(a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
		Min ^(b)	Max ^(b)	Min	Max	Min	Max	Min	Max
Acceptable Range		14.0	18.0	7.63	8.63	4.0	NA	28.0	32.0
Comp LC	0	15.8	16.0	8.03	8.08	7.6	8.0	28.5	30.0
Comp LC	10	15.8	16.1	8.00	8.09	7.5	8.5	28.5	30.5
Comp LC	50	15.8	16.0	8.13	8.29	7.6	8.0	29.0	30.5
Comp LC	100	15.8	16.0	8.21	8.45	7.6	7.9	29.5	30.0
Comp LC-5	0	15.8	16.0	8.02	8.09	7.6	7.9	29.0	30.0
Comp LC-5	10	15.8	16.0	8.03	8.12	7.6	7.8	29.0	30.0
Comp LC-5	50	15.8	16.0	8.08	8.53	7.6	7.9	29.0	30.5
Comp LC-5	100	15.8	16.0	8.06	8.94	7.5	7.8	29.0	30.5
Comp LC-6	0	16.2	16.3	7.77	8.06	7.4	8.1	30.0	30.5
Comp LC-6	10	16.2	16.4	8.02	8.09	7.5	8.1	30.0	30.5
Comp LC-6	50	16.3	16.4	8.07	8.39	7.4	8.2	29.5	30.0
Comp LC-6	100	16.2	16.4	8.12	8.73	7.5	8.1	29.0	30.5
Comp USFC	0	16.2	16.4	8.00	8.05	7.4	7.9	30.0	30.5
Comp USFC	10	16.2	16.4	8.02	8.10	7.5	7.9	30.0	30.5
Comp USFC	50	16.2	16.3	8.11	8.21	7.5	8.4	30.0	30.5
Comp USFC	100	16.3	16.3	8.23	8.34	7.5	8.1	30.0	30.5
Comp FSFC	0	15.6	15.8	7.94	8.10	7.6	8.2	30.0	30.0
Comp FSFC	10	15.6	15.8	7.96	8.13	7.8	8.2	30.0	30.0
Comp FSFC	50	15.5	15.8	8.04	8.24	7.3	8.2	30.0	30.0
Comp FSFC	100	15.5	15.8	8.10	8.35	7.5	8.2	30.0	30.0
Comp IHC-1	0	15.6	15.7	7.80	8.06	7.6	8.2	29.5	30.0
Comp IHC-1	10	15.6	15.8	7.94	8.09	7.5	8.2	29.5	30.0
Comp IHC-1	50	15.6	15.8	7.96	8.25	7.5	8.4	29.5	30.0
Comp IHC-1	100	15.6	15.8	7.96	8.37	7.4	8.2	29.5	30.0
Comp IHC-2	0	16.1	16.3	7.99	8.10	7.8	8.4	30.0	30.0
Comp IHC-2	10	16.1	16.3	7.97	8.15	7.7	8.2	30.0	30.0
Comp IHC-2	50	16.1	16.2	7.87	8.26	7.7	8.2	30.0	30.0
Comp IHC-2	100	16.1	16.3	7.91	8.40	7.7	8.1	30.0	30.0
Comp IHC-3	0	16.1	16.3	7.94	8.09	7.7	8.2	30.0	30.0
Comp IHC-3	10	16.1	16.3	7.97	8.17	7.6	8.1	30.0	30.0
Comp IHC-3	50	16.1	16.2	7.94	8.35	7.7	8.1	30.0	30.0
Comp IHC-3	100	16.1	16.3	7.91	8.48	7.6	8.1	30.0	30.0

(a) Acceptable pH range is based on mean pH in all test chambers in 48-h test.

(b) Minimum and maximum values are derived from all replicates for each concentration.

TABLE 1.5. Results for all Replicates in 48-h *M. galloprovincialis* Reference Toxicant Test, United Heckathorn Remedial Investigation

<i>M. galloprovincialis</i>								
Copper Concentration ($\mu\text{g/L}$)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Number Surviving	Proportion Surviving	Mean Proportion Normal	Mean Proportion Surviving
Batch 1: Organisms for Comp LC and Comp LC-5, SPP and Elutriate Testing								
6.1	0	1	249	248	1.00	251	1.00 ^(a)	1.00
	0	2	249	268	1.00 ^(a)	278	1.00 ^(a)	1.00
	0	3	249	263	1.00 ^(a)	267	1.00 ^(a)	1.00
	1	1	249	236	0.95	237	0.95	0.95
	1	2	249	244	0.98	244	0.98	0.95
	1	3	249	228	0.92	232	0.93	0.95
	4	1	249	261	1.00 ^(a)	267	1.00 ^(a)	0.99
	4	2	249	237	0.95	239	0.96	0.99
	4	3	249	250	1.00	254	1.00 ^(a)	0.99
	16	1	249	0	0.00	98	0.39	0.00
	16	2	249	0	0.00	50	0.20	0.24
	16	3	249	0	0.00	34	0.14	0.24
	64	1	249	0	0.00	0	0.00	0.00
	64	2	249	0	0.00	10	0.04	0.03
	64	3	249	0	0.00	14	0.06	0.03
	256	1	249	0	0.00	0	0.00	0.00
	256	2	249	0	0.00	0	0.00	0.00
	256	3	249	0	0.00	0	0.00	0.00
	Brine	1	249	317	1.00 ^(a)	324	1.00 ^(a)	1.00
	Brine	2	249	287	1.00 ^(a)	290	1.00 ^(a)	1.00
	Brine	3	249	278	1.00 ^(a)	281	1.00 ^(a)	1.00

TABLE I.5. (contd)

<i>M. galloprovincialis</i>								
Copper Concentration ($\mu\text{g/L}$)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Number Surviving	Proportion Surviving	Mean Proportion Normal	Mean Proportion Surviving
Batch 2: Organisms for Comp LC-6 and Comp USFC, SPP and Elutriate Testing								
I.10	0	1	335	277	0.83	280	0.84	0.86
	0	2	335	299	0.89	292	0.87	0.87
	0	3	335	285	0.85	299	0.89	
	1	1	335	278	0.83	282	0.84	0.88
	1	2	335	317	0.95	322	0.96	0.89
	1	3	335	291	0.87	293	0.87	
	4	1	335	322	0.96	326	0.97	0.90
	4	2	335	313	0.93	323	0.96	0.91
	4	3	335	265	0.79	268	0.80	
	16	1	335	0	0.00	97	0.29	0.00
	16	2	335	0	0.00	182	0.54	0.41
	16	3	335	1	0.00	138	0.41	
	64	1	335	0	0.00	0	0.00	0.00
	64	2	335	0	0.00	0	0.00	0.01
	64	3	335	0	0.00	6	0.02	
	256	1	335	0	0.00	0	0.00	0.00
	256	2	335	0	0.00	0	0.00	0.00
	256	3	335	0	0.00	1	0.00	
	Brine	1	335	314	0.94	322	0.96	0.95
	Brine	2	335	304	0.91	310	0.93	0.96
	Brine	3	335	342	1.00 ^(a)	348	1.00 ^(a)	

TABLE 1.5. (contd)

<i>M. galloprovincialis</i>								
Copper Concentration ($\mu\text{g/L}$)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Number Surviving	Proportion Surviving	Mean Proportion Normal	Mean Proportion Surviving
Batch 3: Organisms for Comp FSFC and Comp IHC-1, SPP and Elutriate Testing								
0	1	230	260	1.00 ^(a)	262	1.00 ^(a)	1.00	1.00
0	2	230	237	1.00 ^(a)	245	1.00 ^(a)		
0	3	230	285	1.00 ^(a)	299	1.00 ^(a)		
1	1	230	217	0.94 ^(a)	220	0.96 ^(a)	0.98	0.99
1	2	230	317	1.00 ^(a)	322	1.00 ^(a)		
1	3	230	237	1.00 ^(a)	248	1.00 ^(a)		
4	1	230	235	1.00 ^(a)	248	1.00 ^(a)	1.00	1.00
4	2	230	247	1.00 ^(a)	257	1.00 ^(a)		
4	3	230	265	1.00 ^(a)	268	1.00 ^(a)		
16	1	230	0	0.00	143	0.62	0.00	0.77
16	2	230	0	0.00	182	0.79		
16	3	230	0	0.00	205	0.89		
64	1	230	0	0.00	50	0.22	0.00	0.09
64	2	230	0	0.00	4	0.02		
64	3	230	0	0.00	6	0.03		
256	1	230	0	0.00	0	0.00	0.00	0.01
256	2	230	0	0.00	5	0.02		
256	3	230	0	0.00	0	0.00		
Brine	1	230	243	1.00 ^(a)	248	1.00 ^(a)	1.00	1.00
Brine	2	230	242	1.00 ^(a)	250	1.00 ^(a)		
Brine	3	230	245	1.00 ^(a)	249	1.00 ^(a)		

TABLE I.5. (contd)

<i>M. galloprovincialis</i>								
Copper Concentration ($\mu\text{g/L}$)	Replicate	Mean Stocking Density (embryos/10 mL)	Number Normal	Proportion Normal	Number Surviving	Proportion Surviving	Mean Proportion Normal	Mean Proportion Surviving
Batch 4: Organisms for Comp IHC-2 and Comp IHC-3, SPP and Elutriate Testing								
0	1	286	256	0.90	257	0.90	0.95	0.96
0	2	286	282	0.99	285	1.00		
0	3	286	280	0.98	282	0.99		
1	1	286	278	0.97	285	1.00	0.91	0.93
1	2	286	243	0.85	251	0.88		
1	3	286	262	0.92	264	0.92		
4	1	286	222	0.78	236	0.83	0.90	0.93
4	2	286	277	0.97	283	0.99		
4	3	286	271	0.95	276	0.97		
16	1	286	0	0.00	208	0.73	0.00	0.60
16	2	286	0	0.00	58	0.20		
16	3	286	0	0.00	253	0.88		
64	1	286	0	0.00	93	0.33	0.00	0.17
64	2	286	0	0.00	0	0.00		
64	3	286	0	0.00	56	0.20		
256	1	286	0	0.00	0	0.00	0.00	0.00
256	2	286	0	0.00	0	0.00		
256	3	286	0	0.00	0	0.00		
Brine	1	286	296	1.00 ^(a)	302	1.00 ^(a)	0.95	0.96
Brine	2	286	304	1.00 ^(a)	310	1.00 ^(a)		
Brine	3	286	244	0.85	250	0.87		

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

TABLE 1.6. Water Quality Summary for 48-h *M. galloprovincialis* Reference Toxicant Test. United Heckathorn Remedial Investigation

Copper Concentration ($\mu\text{g/L}$)	Temperature ($^{\circ}\text{C}$)		pH ^(a)		Dissolved Oxygen (mg/L)		Salinity (o/oo)	
	Min ^(b)	Max ^(b)	Min	Max	Min	Max	Min	Max
Acceptable Range	14.0	18.0	7.48	8.48	4.0	NA	28.0	32.0
Batch 1: Organisms for Comp LC and Comp LC-5, SPP and Elutriate Testing								
0	15.8	16.0	7.93	8.01	7.5	7.9	30.0	31.5
1	15.8	16.1	7.95	8.00	7.6	7.9	30.0	31.5
4	15.8	16.1	7.95	8.00	7.5	7.9	30.0	31.5
16	15.9	16.1	8.00	8.02	7.6	7.9	30.0	31.5
64	15.8	16.1	8.00	8.02	7.5	7.9	30.0	31.5
256	15.8	16.0	7.99	8.02	7.7	7.9	30.0	31.5
Brine	15.8	16.0	8.01	8.11	7.6	7.9	30.0	31.0
Batch 2: Organisms for Comp LC-6 and Comp USFC, SPP and Elutriate Testing								
0	16.3	16.3	7.88	8.03	7.4	7.7	30.0	31.0
1	16.2	16.4	7.84	8.05	7.5	7.7	30.0	31.0
4	16.2	16.4	7.90	7.98	7.6	7.7	30.0	31.0
16	16.2	16.4	7.97	8.06	7.4	7.7	30.0	31.5
64	16.3	16.4	7.93	8.04	7.5	7.8	30.0	31.5
256	16.2	16.3	7.90	8.02	7.4	7.8	30.0	30.5
Brine	16.3	16.4	7.95	8.06	7.4	7.9	30.5	31.5
Batch 3: Organisms for Comp FSFC and Comp IHC-1, SPP and Elutriate Testing								
0	15.6	15.9	7.92	8.11	7.5	8.1	30.0	30.5
1	15.5	15.8	7.85	8.10	7.5	8.1	30.0	30.5
4	15.5	15.9	7.89	8.11	7.5	8.2	30.0	30.5
16	15.5	15.9	7.88	8.11	7.6	8.1	30.0	30.5
64	15.6	15.9	7.84	8.11	7.7	8.1	30.0	30.5
256	15.5	15.8	7.85	8.11	7.6	8.1	30.0	30.0
Brine	15.6	15.9	7.86	8.10	7.7	8.2	29.5	30.0
Batch 4: Organisms for Comp IHC-2 and Comp IHC-3, SPP and Elutriate Testing								
0	16.1	16.3	7.92	8.09	7.7	8.0	30.0	30.0
1	16.1	16.3	7.97	8.07	7.5	8.0	30.0	30.5
4	16.1	16.3	7.99	8.07	7.6	8.0	30.0	30.5
16	16.0	16.4	7.92	8.02	7.7	8.0	30.0	30.0
64	16.0	16.3	7.94	8.04	7.6	8.0	30.0	30.0
256	16.0	16.3	7.94	8.03	7.5	8.1	30.0	30.0
Brine	15.9	16.4	7.96	8.09	7.6	8.0	30.0	31.0

(a) Acceptable pH range is based on mean pH in all test chambers in 48-h test.

(b) Minimum and maximum values are derived from all replicates for each treatment.

APPENDIX J

FISH TISSUE CHEMISTRY AND QUALITY ASSURANCE DATA

TABLE J.1. Lipids in Tissues of *C. aggregata*, United Heckathorn
Remedial Investigation

<u>Sample</u>	<u>Percent Dry Weight</u>	<u>Lipid Weight (percent wet)</u>
S1CHT-206/11	26.44	5.89
S1CHT-206/12	26.98	6.63
S1CHT-206/13	27.32	6.83
S1CHT-206/14	26.44	4.36
S1CHT-206/15	28.72	10.13
S1CHT-206/16	30.44	12.63
S1CHT-206/17	29.36	8.30
S1CHT-206/18	26.35	8.78
S1CHT-206/19	30.39	10.54
S1CHT-206/20	30.13	10.14
<u>Analytical Duplicate</u>		
S1CHT-206/20	30.13	10.14
S1CHT-206/20 Duplicate	29.62	10.75
RPD	2%	6%
I-Stat	0.01	0.03

TABLE J.2. Chlorinated Pesticides (elution order, Alpha-BHC to cis-Chlordane) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Pesticides ($\mu\text{g/kg}$ wet weight)									
	Alpha BHC	Beta BHC	Lindane	Delta BHC	Hepta-chlor	Aldrin	Heptachlor Epoxide	trans-Chlordane	Endo-sulfan I	cis-Chlordane
Target DL (a)	2	2	2	2	2	2	2	2	2	2
Achieved DL High	16.03	16.03	16.03	16.03	17.04	10.39	15.14	31.49	31.49	18.31
Achieved DL Low	5.50 U	5.50 U	5.50 U	5.50 U	5.85 U	3.57 U	5.20 U	10.81 U	10.81 U	6.29 U
S1CHT-206/11	7.65 U ^(b)	7.65 U	7.65 U	7.65 U	8.13 U	4.96 U	7.22 U	15.02 U	15.02 U	8.74 U
S1CHT-206/12	9.07 U	9.07 U	9.07 U	9.07 U	9.65 U	5.88 U	8.57 U	17.83 U	17.83 U	10.37 U
S1CHT-206/13	6.17 U	6.17 U	6.17 U	6.17 U	6.56 U	4.00 U	5.83 U	12.12 U	12.12 U	7.05 U
S1CHT-206/14	6.82 U	6.82 U	6.82 U	6.82 U	7.25 U	4.42 U	6.44 U	13.39 U	13.39 U	7.79 U
S1CHT-206/15	12.38 U	12.38 U	12.38 U	12.38 U	13.16 U	8.03 U	11.70 U	24.32 U	24.32 U	14.14 U
S1CHT-206/16	5.90 U	5.90 U	5.90 U	5.90 U	6.27 U	3.82 U	5.57 U	11.58 U	11.58 U	6.73 U
S1CHT-206/17	5.50 U	5.50 U	5.50 U	5.50 U	5.85 U	3.57 U	5.20 U	10.81 U	10.81 U	6.29 U
S1CHT-206/18	10.27 U	10.27 U	10.27 U	10.27 U	10.92 U	6.65 U	9.70 U	20.17 U	20.17 U	11.73 U
S1CHT-206/19	16.03 U	16.03 U	16.03 U	16.03 U	17.04 U	10.39 U	15.14 U	31.49 U	31.49 U	18.31 U
S1CHT-206/20	12.55 U	12.55 U	12.55 U	12.55 U	13.34 U	8.13 U	11.86 U	24.65 U	24.65 U	14.34 U

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

TABLE J.3. Chlorinated Pesticides (elution order, Dieldrin to Toxaphene) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Pesticides ($\mu\text{g/kg}$ wet weight)								
	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin aldehyde	Endosulfan sulfate	4,4'-DDT	Toxaphene
Target DL (a)	2	2	2	2	2	2	2	2	2
Achieved DL High	12.86	163.83	13.18 U	31.49 U	73.99	31.49 U	31.49 U	32.94	314.56 U
Achieved DL Low	4.41	15.03	4.52 U	10.81 U	9.04	10.81 U	10.81 U	11.31	107.98 U
S1CHT-206/11	172.47	401.84	6.29 U (b)	15.02 U	1365.46	15.02 U	15.02 U	1123.41	150.09 U
S1CHT-206/12	270.95	829.11	7.46 U	17.83 U	1170.11	17.83 U	17.83 U	459.02	178.08 U
S1CHT-206/13	132.85	355.05	5.07 U	12.12 U	1371.57	12.12 U	12.12 U	207.86	121.06 U
S1CHT-206/14	99.70	597.54	5.60 U	13.39 U	952.42	13.39 U	13.39 U	374.84	133.76 U
S1CHT-206/15	311.85	2220.06	10.18 U	24.32 U	3128.46	24.32 U	24.32 U	1624.77	242.95 U
S1CHT-206/16	155.46	396.75	4.85 U	11.58 U	711.35	11.58 U	11.58 U	190.18	115.69 U
S1CHT-206/17	137.53	342.69	4.52 U	10.81 U	1682.63	10.81 U	10.81 U	275.54	107.98 U
S1CHT-206/18	156.97	761.73	8.44 U	20.17 U	1807.78	20.17 U	20.17 U	410.60	201.47 U
S1CHT-206/19	180.14	1170.42	13.18 U	31.49 U	2177.06	31.49 U	31.49 U	515.18	314.56 U
S1CHT-206/20	175.88	957.71	10.32 U	24.65 U	2007.63	24.65 U	24.65 U	301.13	246.28 U

(a) DL Detection limit.

(b) U Analyte was not present above the associated value.

TABLE J.4. Quality Control Summary for Chlorinated Pesticides (elution order, Alpha-BHC to cis-Chlordane) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Pesticides ($\mu\text{g}/\text{kg}$ wet weight)									
	Alpha-BHC	Beta-BHC	Lindane	Delta-BHC	Hepta-chlor	Aldrin	Hepta-chlor epoxide	trans-Chlordane	Endo-sulfan I	cis-Chlordane
<u>Method Blank</u>										
Blank	4.10 U ^(a)	4.10 U	4.10 U	4.10 U	4.35 U	2.65 U	3.87 U	8.05 U	8.05 U	4.68 U
<u>Matrix Spikes</u>										
S1CHT-206/19	16.03 U	16.03 U	16.03 U	16.03 U	17.04 U	10.39 U	15.14 U	31.49 U	31.49 U	18.31 U
S1CHT-206/19 MS	10.47	7.76	7.15	8.65	7.06	7.36	6.80	M ^(b)	M	M
Concentration Recovered	10.47	7.76	7.15	8.65	7.06	7.36	6.80	NA ^(c)	NA	NA
Amount Spiked	10.39	9.78	9.78	9.78	9.78	9.78	9.78	10.60	9.78	NS ^(d)
Percent Recovery	101%	79%	73%	88%	72%	75%	70%	NA	NA	NA
S1CHT-206/19	16.03 U	16.03 U	16.03 U	16.03 U	17.04 U	10.39 U	15.14 U	31.49 U	31.49 U	18.31 U
S1CHT-206/19 MSD	15.83	13.57	13.00	14.13	12.46	12.40	12.53	M	M	M
Concentration Recovered	15.83	13.57	13.00	14.13	12.46	12.40	12.53	NA	NA	NA
Amount Spiked	18.61	17.52	17.52	17.52	17.52	17.52	17.52	18.98	17.52	NS
Percent Recovery	85%	77%	74%	81%	71%	71%	72%	NA	NA	NA
RPD	17%	2%	1%	9%	2%	6%	3%	NA	NA	NA
I-Stat	0.08	0.01	0.01	0.05	0.01	0.03	0.02	NA	NA	NA
<u>Analytical Duplicate</u>										
S1CHT-206/20	12.55 U	12.55 U	12.55 U	12.55 U	13.34 U	8.13 U	11.86 U	24.65 U	24.65 U	14.34 U
S1CHT-206/20 Duplicate	9.14 U	9.14 U	9.14 U	9.14 U	9.72 U	5.93 U	8.64 U	17.96 U	17.96 U	10.44 U
RPD	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
I-Stat	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

- (a) U Analyte was not present above the associated value.
(b) M Matrix interference. Recovery could not be calculated.
(c) NA Not applicable.
(d) NS Not spiked.

TABLE J.5. Quality Control Summary for Chlorinated Pesticides (elution order, Dieldrin to Toxaphene) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Pesticides ($\mu\text{g}/\text{kg}$ wet weight)								
	Dieldrin	4,4'-DDE	Endrin	Endo-sulfan II	4,4'-DDD	Endrin aldehyde	Endo-sulfan sulfate	4,4'-DDT	Toxaphene
<u>Method Blank</u>									
Blank	3.29 U ^(a)	9.03 U	3.37 U	8.05 U	4.08 U	8.05 U	8.05 U	8.42 U	80.37 U
<u>Matrix Spikes</u>									
S1CHT-206/19	180.14	1170.42	13.18 U	31.49 U	2177.06	31.49 U	31.49 U	515.18	314.56 U
S1CHT-206/19 MS		D	M ^(c)	10.21	D	M	M	D	NA ^(d)
Concentration Recovered	NA	NA	NA	10.21	NA	NA	NA	NA	NA
Amount Spiked	9.78	9.78	9.99	9.78	9.78	9.78	9.78	9.78	NS ^(e)
Percent Recovery	NA	NA	NA	104%	NA	NA	NA	NA	NA
S1CHT-206/19	180.14	1170.42	13.18 U	31.49 U	2177.06	31.49 U	31.49 U	515.18	314.56 U
S1CHT-206/19 MSD		D	M	17.97	D	M	M	D	NA
Concentration Recovered	NA	NA	NA	17.97	NA	NA	NA	NA	NA
Amount Spiked	17.52	17.52	17.88	17.52	17.52	17.52	17.52	17.52	NS
Percent Recovery	NA	NA	NA	103%	NA	NA	NA	NA	NA
RPD	NA	NA	NA	2%	NA	NA	NA	NA	NA
I-Stat	NA	NA	NA	0.01	NA	NA	NA	NA	NA
<u>Analytical Duplicate</u>									
S1CHT-206/20	175.88	957.71	10.32 U	24.65 U	2007.63	24.65 U	24.65 U	301.13	246.28 U
S1CHT-206/20 Duplicate	184.98	569.44	NS	NS	2349.02	NS	NS	323.69	NS
RPD	5%	51% ^(f)	NA	NA	16%	NA	NA	7%	NA
I-Stat	0.03	0.25	NA	NA	0.08	NA	NA	0.04	NA

- (a) U Analyte was not present above the associated value.
(b) D Diluted out.
(c) M Matrix interference. Recovery could not be calculated.
(d) NA Not applicable.
(e) NS Not spiked.
(f) Value exceeds relative precision goal of $\leq 30\%$.

TABLE 5.6. Surrogate Recoveries for Chlorinated Pesticides in Tissues of *C. aggregata*, United Heckathorn Remedial Investigation

<u>Sample</u>	<u>Surrogate Percent Recoveries</u>		
	<u>DBOFB</u>	<u>CL5(112)</u>	<u>CL5(103)</u>
S1CHT-206/11	74.99	74.52	76.87
S1CHT-206/12	77.44	67.95	89.08
S1CHT-206/13	78.91	70.63	77.64
S1CHT-206/14	80.27	68.90	74.86
S1CHT-206/15	71.68	78.63	93.20
S1CHT-206/16	69.18	80.68	85.11
S1CHT-206/17	66.04	81.72	57.15
S1CHT-206/18	73.94	77.21	68.09
S1CHT-206/19	77.42	72.42	73.51
S1CHT-206/20	76.11	74.83	71.51
<u>Quality Control Data</u>			
<u>Method Blank</u>			
Blank	78.59	77.76	71.24
<u>Matrix Spikes</u>			
S1CHT-206/19 MS	72.37	69.19	76.69
S1CHT-206/19 MSD	71.69	74.62	76.14
<u>Analytical Duplicate</u>			
S1CHT-206/20 Duplicate	73.41	77.11	70.64

TABLE 5.7. Polychlorinated Biphenyls (PCBs) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Surrogate Percent Recoveries			PCBs ($\mu\text{g/kg}$ wet weight)			
	DBOFB	CL5(112)	CL5(103)	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
Target DL (a)	NA ^(b)	NA	NA	20	20	20	20
Achieved DL High	NA	NA	NA	246.28 U	246.28 U	242.97	246.28 U
Achieved DL Low	NA	NA	NA	107.98 U	107.98 U	4.84	107.98 U
S1CHT-206/11	74.99	74.52	76.87	150.09 U ^(c)	150.09 U	657.50	150.09 U
S1CHT-206/12	77.44	67.95	89.08	178.08 U	178.08 U	602.56 J ^(d)	178.08 U
S1CHT-206/13	78.91	70.63	77.64	121.06 U	121.06 U	740.01	121.06 U
S1CHT-206/14	80.27	68.90	74.86	133.76 U	133.76 U	497.23 J	133.76 U
S1CHT-206/15	71.68	78.63	93.20	242.95 U	242.95 U	787.71	242.95 U
S1CHT-206/16	69.18	80.68	85.11	115.69 U	115.69 U	349.63	115.69 U
S1CHT-206/17	66.04	81.72	57.15	107.98 U	107.98 U	224.16	107.98 U
S1CHT-206/18	73.94	77.21	68.09	201.47 U	201.47 U	458.23	201.47 U
S1CHT-206/19	77.42	72.42	73.51	314.56 U	314.56 U	419.34 J	314.56 U
S1CHT-206/20	76.11	74.83	71.51	246.28 U	246.28 U	332.07 J	246.28 U

(a) DL Detection limit.

(b) NA Not applicable.

(c) U Analyte not detected above the level of the associated value.

(d) J Analyte detected below detection limit (MDL), but above instrument detection limit (IDL).

TABLE J.8. Quality Control Summary for Polychlorinated Biphenyls (PCBs) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Surrogate Percent Recoveries			PCBs ($\mu\text{g/kg}$ wet weight)			
	DBOFB	C15(112)	C15(103)	Aroclor 1242	Aroclor 1248	Aroclor 1254	Aroclor 1260
<u>Method Blank</u>							
Blank	78.59	77.76	71.24	80.37 U ^(a)	80.37 U	80.37 U	80.37 U
<u>Matrix Spikes</u>							
S1CHT-206/19	77.42	72.42	73.51	314.56 U	314.56 U	419.34 J ^(b)	314.56 U
S1CHT-206/19 MS	72.37	69.19	76.69	NA ^(c)	NA	678.92	NA
Concentration Recovered				NA	NA	259.58	NA
Amount Spiked				NS ^(d)	NS	163.04	NS
Percent Recovery				NA	NA	159% ^(e)	NA
S1CHT-206/19	77.42	72.42	73.51	314.56 U	314.56 U	419.34 J	314.56 U
S1CHT-206/19 MSD	71.69	74.62	76.14	NA	NA	777.03	NA
Concentration Recovered				NA	NA	357.69	NA
Amount Spiked				NS	NS	291.97	NS
Percent Recovery				NA	NA	123% ^(e)	NA
RPD				NA	NA	26%	NA
I-Stat				NA	NA	0.13	NA
<u>Analytical Duplicate</u>							
S1CHT-206/20	76.11	74.83	71.51	246.28 U	246.28 U	332.07 J	246.28 U
S1CHT-206/20 Duplicate	73.41	77.11	70.64	179.42 U	179.42 U	345.19 J	179.42 U
RPD				NA	NA	4%	NA
I-Stat				NA	NA	0.02	NA

(a) U Analyte not detected above the level of the associated value.

(b) J Analyte detected below detection limit (MDL), but above instrument detection limit (IDL).

(c) NA Not applicable.

(d) NS Not spiked.

(e) Recovery outside of quality control range (40%-120%).

Table J.9. Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in the Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	LPAHs ($\mu\text{g/kg}$ wet weight)							
	Naph- thalene	2-methyl Naph- thalene	1-methyl Naph- thalene	Acenaph- thylene	Acenaph- thene	Fluorene	Phenan- threne	Anthra- cene
Target DL (~)	20	20	20	20	20	20	20	20
Achieved DL High	6.84	3.48	3.59	6.31	2.39	4.03	4.47	3.43
Achieved DL Low	2.35	1.19	1.23	2.17	0.82	1.38	1.54	1.18
S1CHT-206/11	21.70	4.23	2.80	3.25	42.83	17.19	15.33	7.66
S1CHT-206/12	25.25	5.76	4.52	2.92 J ^(b)	63.85	23.38	15.94	7.27
S1CHT-206/13	34.44	5.60	3.58	4.16	47.07	18.89	16.56	10.79
S1CHT-206/14	37.74	5.45	4.03	4.55 J	34.61	11.39	12.77	7.75
S1CHT-206/15	25.12	5.33	3.88	6.40	46.38	17.31	11.15	11.88
S1CHT-206/16	33.62	7.70	5.84	3.91	100.08	45.97	28.89	11.09
S1CHT-206/17	21.65	3.54	2.58	5.18	44.07	17.22	13.58	12.26
S1CHT-206/18	35.78	4.24	2.78	3.24 J	40.23	14.07	10.60	6.82
S1CHT-206/19	31.48	4.08	2.99 J	3.86 J	45.89	17.83	17.27	9.70
S1CHT-206/20	28.07	3.94	2.73 J	4.49 J	41.35	15.31	12.39	9.68

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE J.10. High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	HPAH ($\mu\text{g/kg}$ wet weight)									
	Fluor-anthene	Pyrene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluor-anthene	Benzo(k)-fluor-anthene	Benzo(a)-pyrene	Indeno(1,2,3,-c,d)pyrene	Dibenzo-(a,h)anthracene	Benzo-(g,h,i)perylene
Target DL ^(a)	20	20	20	20	20	20	20	20	20	20
Achieved DL High	5.95	4.28	5.44	6.22	6.14	2.87	2.29	5.01	4.51	4.21
Achieved DL Low	2.05	1.47	1.87	2.14	2.11	0.99	0.79	1.72	1.55	1.45
S1CHT-206/11	24.77	7.04	2.83	7.53	4.87	2.15	2.66	2.46	0.90 J ^(b)	2.54
S1CHT-206/12	20.89	4.40	0.63 J	2.28 J	0.67 J	0.24 J	0.31 J	0.39 J	0.15 J	0.65 J
S1CHT-206/13	34.01	11.25	4.66	10.97	6.31	2.80	2.84	2.39	0.78 J	2.36
S1CHT-206/14	14.59	4.10	2.37 J	4.29 J	3.02 J	1.55 J	1.76 J	1.74 J	0.89 J	2.00 J
S1CHT-206/15	22.74	7.36	2.39	4.15	2.54	1.13	1.67	1.41 J	0.38 J	1.80
S1CHT-206/16	35.92	8.08	1.86 J	4.92	2.00 J	1.10	1.41	1.13 J	0.45 J	1.46 J
S1CHT-206/17	26.87	7.97	2.79	6.74	4.18	1.61	2.22	1.83	0.48 J	1.69
S1CHT-206/18	16.03	3.66	0.76 J	2.49 J	0.92 J	0.36 J	0.40 J	0.45 J	0.23 J	0.73 J
S1CHT-206/19	24.43	6.14	1.66 J	4.27 J	1.91 J	0.76 J	0.94 J	1.03 J	0.39 J	1.57 J
S1CHT-206/20	22.71	6.70	2.25 J	4.90	2.75 J	0.94 J	1.67 J	1.56 J	0.36 J	1.83 J

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE J.11. Quality Control Summary for Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs) in the Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	LPAHs ($\mu\text{g/kg}$ wet weight)							
	Naph-thalene	2-methyl Naph-thalene	1-methyl Naph-thalene	Acenaph-thylene	Acenaph-thene	Fluorene	Phenan-threne	Anthra-cene
<u>Method Blank</u>								
Blank	9.15	0.45 J ^(a)	0.23 J	3.23 U ^(b)	1.22 U	0.11 J	2.11 J	1.76 U
<u>Matrix Spike</u>								
S1CHT-206/19	31.48	4.08	2.99 J	3.86 J	45.89	17.83	17.27	9.70
S1CHT-206/19 MS	165.74	NA ^(c)	NA	155.55	194.08	164.57	159.19	148.31
Concentration Recovered	134.26	NA	NA	151.69	148.19	146.74	141.92	138.61
Amount Spiked	203.80	NS ^(d)	NS	203.80	203.80	203.80	203.80	203.80
Percent Recovery	66%	NA	NA	74%	73%	72%	70%	68%
S1CHT-206/19	31.48	4.08	2.99 J	3.86 J	45.89	17.83	17.27	9.70
S1CHT-206/19 MSD	305.67	NA	NA	287.08	317.48	290.90	285.98	275.86
Concentration Recovered	274.19	NA	NA	283.22	271.59	273.07	268.71	266.17
Amount Spiked	364.96	NS	NS	364.96	364.96	364.96	364.96	364.96
Percent Recovery	75%	NA	NA	78%	74%	75%	74%	73%
RPD	13%	NA	NA	4%	2%	4%	6%	7%
I-Stat	0.07	NA	NA	0.02	0.01	0.02	0.03	0.03
<u>Analytical Duplicate</u>								
S1CHT-206/20	28.07	3.94	2.73 J	4.49 J	41.35	15.31	12.39	9.68
S1CHT-206/20 Duplicate	22.64	3.47	2.54	4.72	43.72	16.58	12.81	9.88
RPD	21%	13%	7%	5%	6%	8%	3%	2%
I-Stat	0.11	0.06	0.04	0.02	0.03	0.04	0.02	0.01

(a) J Analyte detected below detection limit (MDL), but above instrument detection limit (IDL).

(b) U Analyte was not present above the level of the associated value.

(c) NA Not applicable.

(d) NS Not spiked.

TABLE 5.12. Quality Control Summary for High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs) in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	HPAH ($\mu\text{g/kg}$ wet weight)									
	Fluor-anthene	Pyrene	Benzo(a)-anthracene	Chrysene	Benzo(b)-fluor-anthene	Benzo(k)-fluor-anthene	Benzo(a)-pyrene	Indeno-(1,2,3-c,d)pyrene	Dibenzo-(a,h)anthracene	Benzo-(g,h,i)perylene
<u>Method Blank</u>										
Blank	0.25 J ^(a)	0.14 J	0.32 J	0.28 J	0.26 J	0.07 J	0.31 J	0.18 J	0.10 J	0.25 J
<u>Matrix Spikes</u>										
S1CHT-206/19	24.43	6.14	1.66 J	4.27 J	1.91 J	0.76 J	0.94 J	1.03 J	0.39 J	1.57 J
S1CHT-206/19 MS	179.42	160.33	150.54	154.95	129.78	148.80	130.54	134.98	133.12	123.49
Concentration Recovered	154.99	154.19	148.88	150.67	127.87	148.04	129.60	133.95	132.73	121.93
Amount Spiked	203.80	203.80	203.80	203.80	203.80	203.80	203.80	203.80	203.80	203.80
Percent Recovery	76%	76%	73%	74%	63%	73%	64%	66%	65%	60%
S1CHT-206/19	24.43	6.14	1.66 J	4.27 J	1.91 J	0.76 J	0.94 J	1.03 J	0.39 J	1.57 J
S1CHT-206/19 MSD	318.48	300.26	282.01	297.71	252.48	281.53	262.59	282.06	285.02	272.57
Concentration Recovered	294.06	294.12	280.35	293.44	250.57	280.77	261.65	281.03	284.63	271.00
Amount Spiked	364.96	364.96	364.96	364.96	364.96	364.96	364.96	364.96	364.96	364.96
Percent Recovery	81%	81%	77%	80%	69%	77%	72%	77%	78%	74%
RPD	6%	6%	5%	8%	9%	6%	12%	16%	18%	22%
I-Stat	0.03	0.03	0.03	0.04	0.05	0.03	0.06	0.08	0.09	0.11
<u>Analytical Duplicate</u>										
S1CHT-206/20	22.71	6.70	2.25 J	4.90	2.75 J	0.94 J	1.67 J	1.56 J	0.36 J	1.83 J
S1CHT-206/20 Duplicate	23.83	6.97	2.05 J	5.10	2.78 J	1.19 J	1.64	1.57 J	0.41 J	1.91 J
RPD	5%	4%	9%	4%	1%	24%	2%	1%	13%	4%
I-Stat	0.02	0.02	0.05	0.02	0.00	0.12	0.01	0.00	0.07	0.02

(a) J Analyte detected below detection limit (MDL), but above instrument detection limit (IDL).

TABLE 5.13. Surrogate Recoveries for Analysis of Polynuclear Aromatic Hydrocarbons (PAHs) in Tissues of *C. aggregata*, United Heckathorn Remedial Investigation

Sample	Surrogate Percent Recoveries		
	Naphthalene-d8	Acenaphthene-d10	Benzo[a]pyrene-d12
S1CHT-206/11	73.36	72.99	57.83
S1CHT-206/12	69.20	70.67	60.26
S1CHT-206/13	69.87	71.19	54.76
S1CHT-206/14	73.77	73.80	64.98
S1CHT-206/15	67.85	70.77	51.86
S1CHT-206/16	65.98	68.21	47.88
S1CHT-206/17	63.79	67.30	49.41
S1CHT-206/18	69.59	69.66	53.38
S1CHT-206/19	72.45	72.66	60.58
S1CHT-206/20	71.85	72.68	60.64
<u>Quality Control Data</u>			
<u>Method Blank</u>			
Blank	84.40	84.11	71.86
<u>Matrix Spikes</u>			
S1CHT-206/19	72.45	72.66	60.58
S1CHT-206/19 MS	68.68	71.24	62.38
S1CHT-206/19 MSD	74.22	74.78	68.14

TABLE 5.14. Phthalate Esters in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Phthalate Esters ($\mu\text{g/kg}$ wet weight)					
	Dimethyl-phthalate	Diethyl-phthalate	Di-n-butyl-phthalate	Di-n-octyl-phthalate	Butyl benzyl-phthalate	Bis (2-ethylhexyl)-phthalate
Target DL (a)	75	75	75	75	75	75
Achieved DL High	189.87	189.87	189.87	189.87	189.87	189.87
Achieved DL Low	65.22	65.22	65.22	65.22	65.22	65.22
S1CHT-206/11	1.52 J ^(b)	17.19 J	24.88 J	28.55 J	334.90	478.42
S1CHT-206/12	1.53 J	22.67 J	17.73 J	0.69 J	4.26 J	7.53 J
S1CHT-206/13	1.94 J	59.22 J	11.93 J	0.82 J	3.37 J	9.92 J
S1CHT-206/14	2.02 J	68.77 J	30.88 J	1.29 J	5.09 J	31.04 J
S1CHT-206/15	1.61 J	15.22 J	15.89 J	1.77 J	25.73 J	14.32 J
S1CHT-206/16	1.52 J	18.97 J	125.68	1.59 J	29.55 J	19.38 J
S1CHT-206/17	0.63 J	9.53 J	12.07 J	1.87 J	23.01 J	11.01 J
S1CHT-206/18	2.52 J	25.20 J	76.20 J	15.17 J	262.95	1438.23
S1CHT-206/19	1.08 J	24.32 J	34.19 J	6.44 J	291.13	25.57 J
S1CHT-206/20	1.35 J	30.66 J	24.36 J	1.17 J	6.84 J	16.22 J

(a) DL Detection limit.

(b) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

TABLE 5.15. Quality Control Summary for Phthalate Esters in Tissues of *C. aggregata*, Wet Weight, United Heckathorn Remedial Investigation

Sample	Phthalate Esters ($\mu\text{g/kg}$ wet weight)					
	Dimethyl-phthalate	Diethyl-phthalate	Di-n-butyl-phthalate	Di-n-octyl-phthalate	Butyl benzyl-phthalate	Bis (2-ethylhexyl)-phthalate
<u>Method Blank</u>						
Blank	0.29 J ^(a)	3.80 J	19.98 J	0.26 J	4.27 J	6.96 J
<u>Blank Spike</u>						
Blank Spike	2660.79	2954.84	3291.89	956.99	3085.05	2427.20
Amount Spiked	3750.00	3846.00	3750.00	3750.00	3750.00	3750.00
Percent Recovery	71%	77%	88%	26% ^(b)	82%	65%
<u>Analytical Duplicate</u>						
S1CHT-206/20	1.35 J	30.66 J	24.36 J	1.17 J	6.84 J	16.22 J
S1CHT-206/20 Duplicate	1.23 J	18.48 J	23.15 J	1.07 J	5.17 J	9.07 J
RPD	9%	50%	5%	9%	28%	57%
I-Stat	0.04	0.25	0.03	0.04	0.14	0.28

(a) J Analyte detected below method detection limit (MDL), but above instrument detection limit (IDL).

(b) Recovery outside of quality control range (40%-120%).

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Total Lipids
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *C. aggregata* tissue
SAMPLE NUMBER: 10

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
	NA	±30%	0.1% wet weight

HOLDING TIMES

The holding time for lipid analysis has not been specified.

MATRIX SPIKES

Matrix spikes are not applicable to lipid analyses.

SURROGATES

Surrogates are not applicable to lipid analyses.

DUPLICATES

The precision of duplicate measurements was within QC criteria.

DETECTION LIMITS

Target detection limits were met for lipid analyses.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Chlorinated Pesticides
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *C. aggregata* tissue
SAMPLE NUMBER: 10

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8080	40%-120%	±30%	2 µg/kg wet weight (30 µg/kg for toxaphene)

HOLDING TIMES

The following is a list of extraction and analysis dates for the tissue samples:

<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
10/10/91	5/25/93	6/11/93	6/19-22/93, 6/25-26/93, 7/1/93

Holding times for extractions were exceeded; however, samples were stored in frozen state from the time of collection to extraction. The holding time from extraction to analysis was met.

METHOD BLANKS

Pesticides were not detected in the method blank.

MATRIX SPIKES

The recoveries of target pesticides in the MS and MSD samples were acceptable for all compounds.

SURROGATES

Surrogate recoveries for all samples were acceptable.

DUPLICATES

Duplicate precision between the MS and MSD samples was good for all compounds. Precision of laboratory duplicates was acceptable for all compounds except 4,4'-DDE, with a RPD of 51%.

DETECTION LIMITS

Achieved detection limits were higher than the target detection limits because sample dilution was required.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polychlorinated Biphenyls (PCB)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *C. aggregata* tissue
SAMPLE NUMBER: 10

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8080	40%-120%	±30%	20 µg/kg wet weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the tissue samples:

<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/ECD Analysis</u>
10/10/91	5/25/93	6/11/93	6/19-22/93, 6/25-26/93, 7/1/93

Holding times for extractions were exceeded; however, samples were stored in frozen state from the time of collection to extraction. The holding time from extraction to analysis was met.

METHOD BLANKS

No PCB compounds were detected in the method blank.

MATRIX SPIKES

The recoveries of Aroclor 1254 in the MS and MSD samples exceeded the quality control limits of 40% - 120%.

SURROGATES

The recoveries of all three surrogate compounds were acceptable in the samples.

DUPLICATES

Duplicate precision between the MS and MSD samples was acceptable. Precision of analytical duplicate measurements was also acceptable.

DETECTION LIMITS

Achieved detection limits for PCBs in tissues were higher than target detection limits because sample dilution was required.

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Polynuclear Aromatic Hydrocarbons (PAH)
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *C. aggregata* tissue
SAMPLE NUMBER: 10

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recovery?</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8270	40%-120%	±30%	20 µg/kg wet weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the tissue samples:

<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/MS Analysis</u>
10/10/91	5/25/93	6/11/93	6/21-22/93, 6/24-25/93

Holding times for extractions were exceeded; however, samples were stored in frozen state from the time of collection to extraction. The holding time from extraction to analysis was met.

METHOD BLANKS

Naphthalene was detected in the method blank at a concentration greater than the method detection limit (MDL) but lower than the quality control criteria of five times the MDL. Fourteen PAHs were detected at concentrations below the MDL.

MATRIX SPIKES

The recoveries of target PAHs in the MS and MSD were acceptable.

SURROGATES

All tissue PAH surrogate recoveries were acceptable.

DUPLICATES

The RPDs between MS and MSD samples and analytical duplicates were acceptable.

DETECTION LIMITS

Achieved detection limits were acceptable ($<20 \mu\text{g/kg}$ wet weight).

QA/QC SUMMARY

PROGRAM: United Heckathorn Remedial Investigation
PARAMETER: Phthalate Esters
LABORATORY: Battelle Ocean Sciences Laboratory
MATRIX: *C. aggregata* tissue
SAMPLE NUMBER: 10

QA/QC REQUIREMENTS

<u>Reference Method</u>	<u>Range of Recover?</u>	<u>Relative Precision</u>	<u>Detection Limit</u>
Modified 8270	40%-120%	±30%	75 µg/kg wet weight

HOLDING TIMES

The following is a list of extraction and analysis dates for the tissue samples:

<u>Date Collected</u>	<u>Date Received</u>	<u>Date Extracted</u>	<u>GC/MS Analysis</u>
10/10/91	5/25/93	6/11/93	6/21-22/93, 6/24-25/93

Holding times for extractions were exceeded; however, samples were stored in frozen state from the time of collection to extraction. The holding time from extraction to analysis was met.

METHOD BLANKS

Phthalate esters were detected at concentrations below the MDL in the method blank.

BLANK SPIKES

One blank spike sample was analyzed. The recovery of di-n-octyl phthalate was less than the minimum QC requirement of 40%. All other recoveries were acceptable.

SURROGATES

Surrogate recoveries (reported in Table J.13) were acceptable.

DUPLICATES

The concentrations of phthalate esters in the duplicate samples were less than the method detection limit; therefore, QC criteria do not apply.

DETECTION LIMITS

Achieved detection limits for some analyses exceeded the target detection limit of 75 µg/kg wet weight because of sample dilution.

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