SEDIMENT TRAP STUDY SUMMARY REPORT
2009 REMEDIAL DREDGING
NEW BEDFORD HARBOR SUPERFUND SITE, OU #1

Contract No. W912WJ-09-D-0001-0010

Prepared For:
United States Army Corps of Engineers
New England District
696 Virginia Road
Concord, MA 01742

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June 2010

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EXECUTIVE SUMMARY

Suspended sediment monitoring was performed for six months during the 2009 dredge season as part of the Environmental Monitoring, Sampling and Analysis for the New Bedford Harbor Superfund Site. Sediment trap samplers were positioned in three locations within the upper harbor with the goal of characterizing the chemical and physical properties of sediments that are actively transported. The study area reached from the previously remediated area north of Wood Street (NWS), south to the Coggeshall Street and Interstate-195 bridges, and spanned four active remediation dredge locations.

The sediment trap study was performed during active dredging periods and demobilization of dredge-related equipment. Two sediment trap samplers were deployed at each of three stations within the study area. The northernmost station, ST-001 was located 100 feet north of the Wood Street Bridge. The centralized station, ST-002, was located 300 feet south of Dredge Area J. The southernmost station, ST-003 was located 100 feet south of the I-195 Bridge, adjacent to a sediment trap maintained by the City of New Bedford. The sediment traps were serviced every 35 days. Co-located surface sediments were collected each time the sediment traps were recovered and deployed to represent an integrated measurement of newly deposited sediment characteristics and PCB concentration. The sediment trap samples and co-located surface samples were analyzed for polychlorinated biphenyl (PCB) concentrations, total organic carbon (TOC), and sediment grain size.

All sediment trap samples were processed to determine the particulate mass accumulated and to calculate sediment deposition rates. The mass of sediment accumulated in the sediment traps varied by location and deployment period. Sedimentation rates ranged across the study area from approximately 75 g/m2/day at ST-001 during October-November, to almost 340 g/m2/day at ST-003 during July-August. Results from previous years indicate that sediment deposition rates vary seasonally, increasing from late spring to summer, reaching a maximum during July and August, and decreasing from late fall to winter.

Sediment trap samples were generally comprised of fine-grained sediments (clay and silt) and contained minimal gravel (<2%). Co-located surface sediments were highly variable. Surface samples were comprised of more sand and gravel than their sediment trap sample counterparts. The content of TOC in sediment trap samples exhibited a seasonal trend in concentration similar to sedimentation rates, decreasing between summer and winter.

The accumulated sediment from the trap samplers was analyzed for PCB content to determine the PCB flux for each location. Concentrations of PCBs in the sediment trap samples ranged from 29.91 to 378.70 mg/kg (ppm) over the 2009 season. Substantial variability in PCB concentrations was observed between the stations and deployment periods. In general, surface sediments contained higher concentrations of PCBs than the co-located trap samples for stations ST-001 and ST-002. Conversely, surface grab samples at station ST-003 contained lower concentrations of PCBs than the ST-003 sediment trap samples.

Daily flux of PCBs is defined as the deposition rate of PCB contaminated sediments from the water column to the bottom sediments. Flux of PCBs at the northernmost (ST-001) and southernmost (ST-003) locations remained relatively constant throughout the dredge season, averaging 8.22 ± 3.95 and 11.84 ± 3.31 mg/m2/day, respectively. At the central trap, however, daily flux of PCBs ranged from 24.34 to 104.06 mg/m2/day.

The general relationships between stations and among the two sample types suggests that the suspended sediments transported out of the upper harbor have a higher concentration of PCBs than the sediments already present in the lower harbor. All three stations confirm that sediment associated PCB transport is active in the system. The variation in the relationships between sediment trap and surface sediment contaminant levels indicates the possible existence of two or more sediment sources in the study area: the resuspension of contaminated sediments into the water column, and at least one other source of "clean" sediments. Overall, the study showed that the estuary is a highly variable system, with both natural and anthropogenic influences that affect resuspension and, likely, sediment transport. Continued suspended sediment monitoring will be valuable in providing additional data regarding the potential redistribution of contaminated sediments within the estuary.

1.0 INTRODUCTION

1.1 SITE LOCATION AND DESCRIPTION

The New Bedford Harbor Superfund Site, located in Bristol County, Massachusetts, extends from the shallow northern reaches of the Acushnet River estuary south through the commercial harbors of New Bedford and Fairhaven and into 17,000 adjacent acres of Buzzards Bay (Figure 1). The City of New Bedford, located along the western shore of the Site, is approximately 55 miles south of Boston. New Bedford is currently home port to a large offshore fishing fleet and is a densely populated manufacturing and commercial center. By comparison, the eastern shore of New Bedford Harbor is predominantly residential, light commercial, or salt marsh.

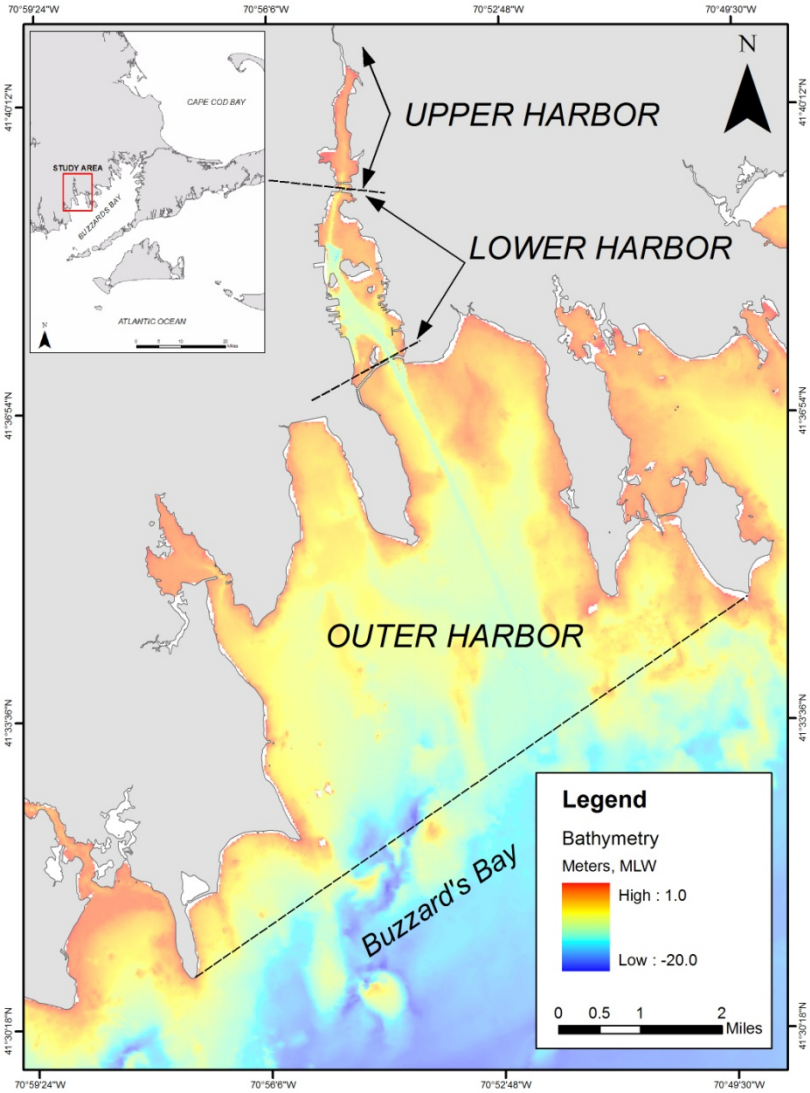

Figure 1. Basemap of New Bedford Harbor Superfund Site in southeastern, MA

The Acushnet River's 16.5 square mile drainage basin discharges to New Bedford Harbor in the northern reaches of the Site, contributing relatively minor volumes of fresh water to the tidally influenced harbor (VHB, 1996). Numerous storm drains, combined sewer overflows (CSOs), industrial discharges, as well as smaller brooks and creeks also discharge directly to the Site. The upper and lower harbors are believed to be areas of net groundwater discharge. The estuary can be characterized as a shallow, well-mixed system.

Industrial and urban development surrounding the harbor has resulted in sediments becoming contaminated with high concentrations of many pollutants, notably polychlorinated biphenyls (PCBs) and heavy metals. Contaminant gradients within harbor sediments decrease from north to south. The source of the contamination has been attributed to two electrical capacitor manufacturing facilities that operated between the 1940s and the 1970s. One facility, Aerovox Corporation, is located near the northern boundary of the Site, and the other, Cornell-Dubilier Electronics, Inc. is located just south of the New Bedford Harbor hurricane barrier. The two facilities are known to have discharged PCB-laden wastes either directly into the harbor or indirectly via discharges to the City's sewerage system.

Based on human health concerns and ecological risk assessments, the United States Environmental Protection Agency (USEPA) added New Bedford Harbor to the National Priorities List in 1983 as a designated Superfund Site. Through an Interagency Agreement between the USEPA and the United States Army Corps of Engineers, New England District (USACE NAE), the USACE is responsible for carrying out the design and implementation of remedial measures at the Site.

The Site has been divided into three geographic areas: the upper, lower and outer harbors, consistent with geographic features, basin morphology and gradients of contamination (Figure 1). The Site is also defined by three state-sanctioned fishing closure areas extending approximately 6.8 miles north to south and encompassing approximately 18,000 acres in total. The upper harbor comprises approximately 187 acres, with current sediment PCB levels ranging from below detection to approximately 4,000 parts per million (ppm). Prior to the removal of the most contaminated hot spot sediments in 1994 and 1995 as part of EPA's first cleanup phase, sediment PCB levels were reported higher than 100,000 ppm in the upper harbor. The boundary between the upper and lower harbor is the Coggeshall Street Bridge; at this point the harbor is constricted to a width of approximately 100 feet. The lower harbor comprises approximately 750 acres, with current sediment PCB levels ranging from below detection to over 100 ppm. The boundary between the lower and outer harbor is the 150 foot wide opening of the New Bedford hurricane barrier. The hurricane barrier was constructed in the mid-1960s. Sediment PCB levels in the outer harbor are generally low, with only localized areas of PCBs in the 50 – 100 ppm range near the Cornell-Dubilier plant and the New Bedford sewage treatment plant's outfall pipes. The southern extent of the outer harbor is a line mapped from Rock Point (the southern tip of West Island in Fairhaven), southwesterly to Negro Ledge, and then southwesterly to Mishaum Point in Dartmouth (Figure 1).

1.2 PROJECT OBJECTIVES AND SCOPE

The remediation of the Site involves the excavation and dredging of approximately 900,000 cubic yards of PCB-contaminated sediment. The majority of the contaminated material is being removed by a hydraulic dredge that pumps a spoils-slurry to the project's Sawyer Street facility where it is mechanically processed to remove all sand, gravel, and debris. The remaining silt and clay slurry is then pumped to the Area D Dewatering Facility located on Herman Melville Boulevard where it is mechanically dewatered and transported off-site for disposal.

The Site is divided into a series of Dredge Management Units (DMU) based primarily on contamination levels, contamination sources, and topography. In 2009, remediation activities at the Site included hydraulic dredging in four areas, M, G, J and L (Figure 2). Three of the four areas (Areas M, G and J) dredged during the 2009 season were in the vicinity of the Aerovox facility. These three areas comprised the majority of the estuary between the Wood Street Bridge and the Aerovox facility. The fourth area, Area L, is located south of the submerged cable crossing.

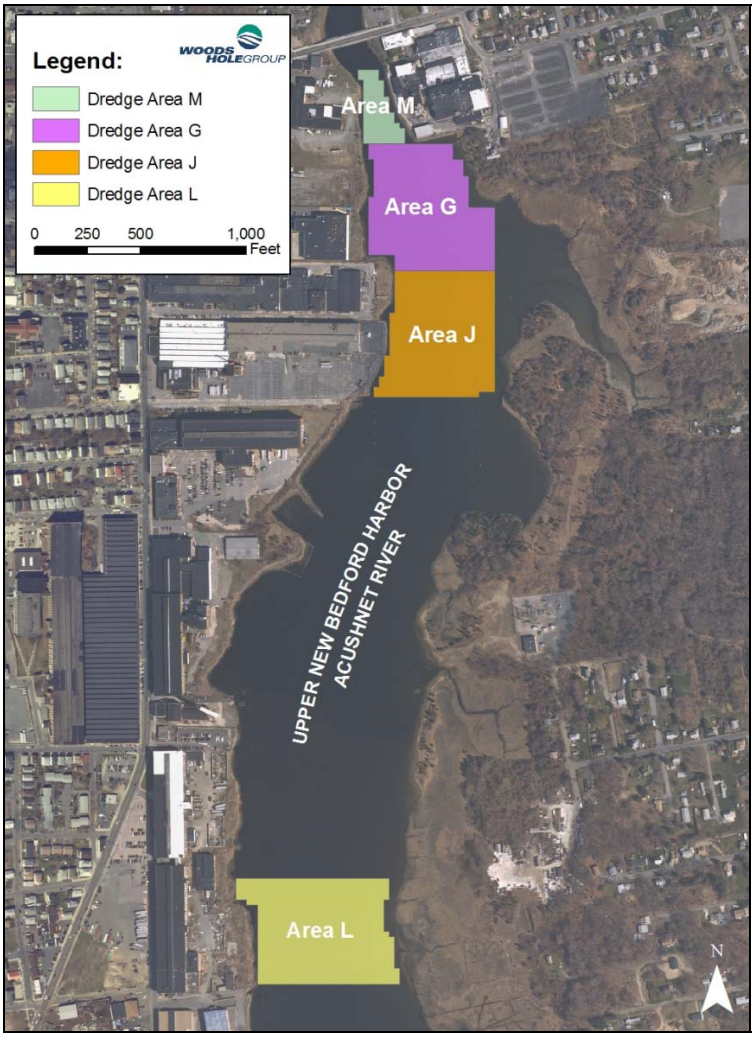

Figure 2. Basemap of 2009 remediation dredging areas

The re-suspension of sediments during dredging, and dredging related activities, can transport contaminated sediments away from the dredge area. Additionally, contaminated sediments suspended in the water column present a concern for toxicity to aquatic organisms in the area.

The primary objective of the 2009 sediment trap study was to assess sedimentation rates throughout the Upper Harbor and evaluate the potential for redistribution or transport of contaminated sediments through re-suspension caused by dredging. The ultimate goal of this program was to monitor PCB concentrations in suspended sediments captured in the traps in order to evaluate whether contamination is occurring in areas of lower PCB concentrations, such as south of the Coggeshall Street Bridge, as well as previously remediated areas, such as north of Wood Street (NWS).

Changes in sedimentation rates and contaminant concentrations observed within the various sediment stations could be associated with a number of processes. These processes include, but are not limited to: 1) the re-suspension of contaminated material by remedial dredging activities, 2) naturally occurring movement of suspended sediments in the harbor, and 3) upland sources such as combined sewer overflows (CSOs). Analytical data collected to support the study objectives included: sediment grain size, total organic carbon (TOC) concentration, and polychlorinated biphenyls (PCBs) concentrations of both sediment trap samples and surface sediments collected at each trap location. In-situ water quality measurements (e.g., turbidity) were recorded during sediment trap deployment and recovery to establish typical baseline water quality standards at each site.

2.0 METHODS

The study design and methods used to collect and analyze sediment trap and surface sediment samples are summarized in this section and described in detail in the project Field Sampling Plan (Woods Hole Group 2009A) and Quality Assurance Project Plan (Woods Hole Group 2009B).

2.1 STUDY AREA AND DESIGN

The 2009 sediment trap study area reached from the previously remediated area north of Wood Street (NWS) through the upper New Bedford Harbor, south to the Coggeshall Street and Interstate-195 bridges. This area included the entire active remediation dredge locations and combined sewer overflows (CSOs). North of the Wood Street Bridge, the estuary is shallow and the narrow channel is flanked with steep marsh banks. As the estuary widens to the south, the western shoreline becomes more industrialized. This portion of the upper harbor contained the highest concentrations of PCB contamination, and is the active remediation site. South of the Coggeshall Street and I-195 bridges, the river opens into the lower harbor, where harbor sediment PCB concentrations are generally much lower, typically below 100 ppm.

The sediment trap study was performed over a 6 month period in 2009, with individual deployments occurring during active dredging periods and demobilization of dredge-related equipment. An additional deployment is scheduled for the spring of 2010 to assess natural movement of sediment in the harbor, independent of remediation activities. Sediment trap samplers were deployed at three stations within the study area (Figure 3).

The northernmost station, ST-001 was located 100 feet north of the Wood Street Bridge. The centralized station, ST-002, was located 300 feet south of Dredge Area J. The southernmost station, ST-003 was located 100 feet south of the I-195 Bridge, adjacent to a sediment trap maintained by the City of New Bedford. Sediment traps were recovered once a sufficient quantity of suspended sediment material had accumulated (usually five weeks) to meet mass requirements for physical and chemical testing. Co-located surface sediments were collected each time the sediment traps were recovered and deployed to represent an integrated measurement of newly deposited sediment characteristics and PCB concentration.

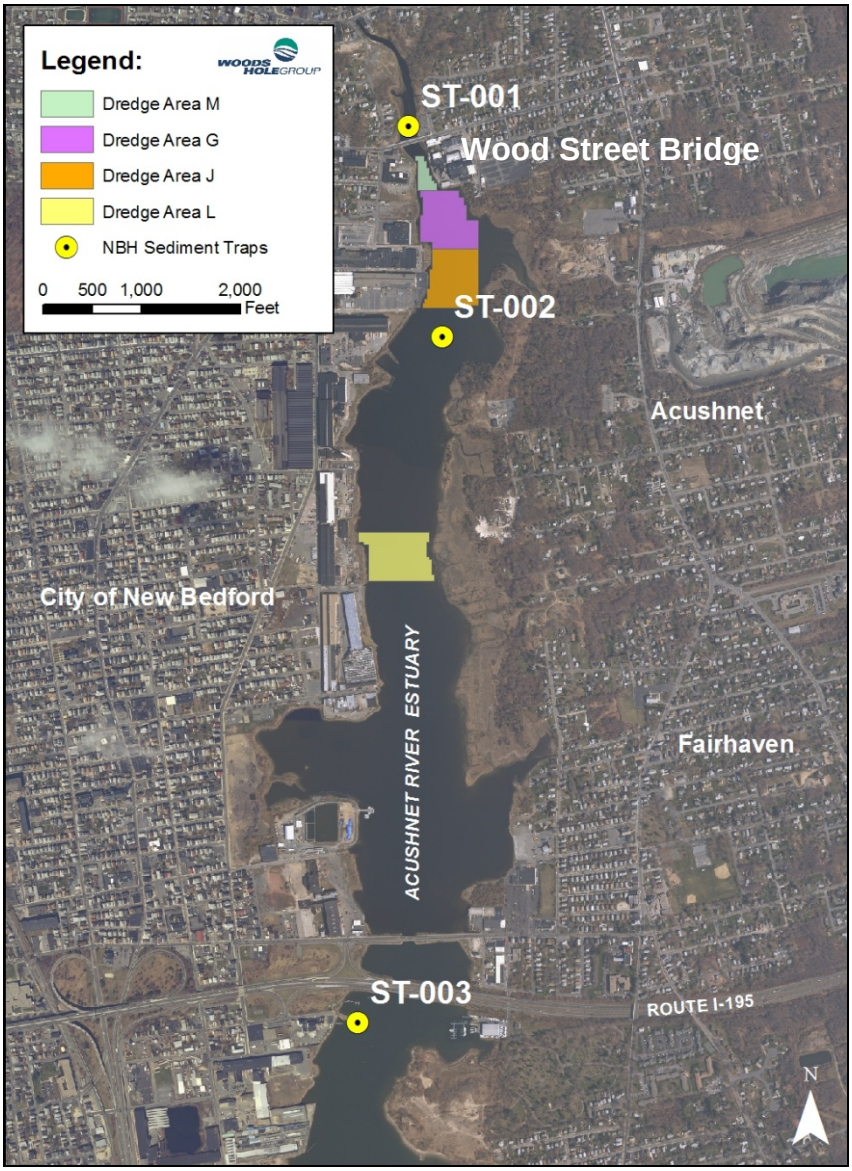

Figure 3. 2009 Sediment trap stations

All sediment samples (traps and surface sediment grabs) were analyzed for grain size, TOC, and PCB congeners, which were reported using the NOAA 18 PCB congener list (WHG 2009B). As part of a separate project monitoring task, continuous in-situ water

quality monitoring was performed at two of the three stations using co-located moored instruments to collect temperature, salinity, dissolved oxygen (DO) and turbidity data. During deployment and recovery, in-situ water quality measurements were also manually recorded at all stations. Other field data including sampling location, sample deployment and collection date, and sample depth were recorded on the field logs.

2.2 FIELD METHODS

2.2.1 Sediment Trap Deployment and Retrieval

Two sediment traps were deployed at each location to ensure the collection of adequate material volume for analysis. All information pertaining to the deployment and retrieval of sediment traps was recorded in the WHG field log book. Following sediment trap deployment at each station, an in-situ profile of turbidity, temperature, dissolved oxygen, and salinity measurements was recorded on the water quality monitoring data log sheets (Appendix A). In addition to these profiles, a moored fixed-station YSI data sonde was stationed at ST-001 and ST-002. These moored units provided a continuous record of the pertinent water quality parameters during deployment periods for the traps positioned closest to dredge activities (Appendix B). The third sediment trap station was not co-located with a fixed-station water quality mooring, but was co-located with the sediment trap maintained by the City of New Bedford. A Garmin GPS Map 76CSx was used to record the geographic positions of the stations.

Each sediment trap sampler consisted of a one gallon, wide mouth plastic jar with a funnel affixed to the mouth. The outer diameter of the funnel was 8 inches. The jar/funnel assembly was secured inside a weighted plastic bucket. This configuration placed the opening of the trap (mouth of the funnel) approximately 1.5 feet above the sediment water interface. Figure 4 depicts the sediment trap assembly following recovery. A line from the weighted bucket was used to lower the assembly to the bottom under control and ensure an upright deployment. During deployment, clean sediment traps were lowered slowly through the water column and placed gently on the bottom. This process was important to minimize re-suspension of sediments during deployment of the trap. A small float secured to the line kept the line buoyant to prevent it from fouling the trap. This line was attached to a surface marker buoy.

Sediment traps were retrieved after a deployment period of five-weeks, provided that a sufficient quantity of material had accumulated in the traps. Based on visual observation of traps, approximately 20 grams of wet material was required to meet mass requirements for physical and chemical testing. During sediment trap retrieval, the traps were pulled to the surface in a slow, controlled manner using the surface buoy line. Every effort was made to minimize disturbance of sediments within the trap. After the traps were secured aboard the vessel, the funnel was gently removed, and a cap was placed on the 1-gallon jar. The caps were secured with tape to ensure that no sediment or water was lost from the jars. Samples were kept cold (4°C) and transported under chain of custody to EnviroSystems Inc. (ESI) for dewatering and processing. At ESI, the two sample containers from each station were composited into one sediment sample. Following sample processing at ESI, samples were transported by courier to Alpha Analytical Labs for chemical and physical analysis.

Figure 4. Sediment traps after recovery from ST-002 (left) and ST-003 (right)

2.2.2 Surface Sediment Sampling

Surface sediments were collected at each of the three sediment trap locations to represent an integrated measurement of actual surface sediment characteristics and PCB concentrations before and after sediment trap sample collection. Co-located surface sediment samples were compared to sediment trap samples to determine if sediments deposited in the trap samplers are representative of the material that has accumulated on the estuary floor. Figure 5 contains a series of photographs that depict this process. Sediment was collected using a stainless-steel petite PONAR grab sampler. Each grab sample was inspected to ensure the sample surface was undisturbed and representative of the sediment-water interface (Figure 5-A). Sediment was sampled using a pre-cleaned stainless steel spoon to scoop the top 0–2 cm of the sediment in the grab (Figure 5-B). Often times, more than one grab was necessary to collect enough material for all chemical and physical analyses. The PONAR grab and sub-sampling process was repeated multiple times to ensure enough sediment was collected for all required samples (Figure 5-C). Sediment was homogenized prior to sample collection by stirring with a stainless steel spoon in a clean stainless steel container (Figure 5-D). Samples were spooned into the appropriate sample containers, stored on ice (4°C), and transported to Alpha Analytical Labs (AAL) under chain of custody. At AAL, samples were analyzed for grain size, TOC, and PCB congeners (NOAA 18).

Figure 5. Process of collecting and sampling co-located surface sediment grabs (shown August 5, 2009, ST-001, North of Wood Street location)

2.3 QUALITY ASSURANCE/QUALITY CONTROL

2.3.1 Decontamination

All of the sampling equipment was decontaminated prior to use in the field and between stations to prevent cross-contamination. The decontamination procedure specified in EPA Region II, CERCLA Quality Assurance Manual from October 1989, Revision 1 (WHG 2009B) was implemented prior to each station for sampling equipment that came into direct contact with the media to be sampled (e.g., PONAR grab sampler, stainless steel bowls, spoons, etc.). The EPA Region II procedures used for decontamination are summarized below (solvents used during decontamination activities were collected and stored for disposal at the laboratory):

1) Rinse with tap water (or site water on board)
2) Clean with non-phosphate soap (Liquinox) and tap water (or site water)
3) Rinse with Milli-Q or deionized water
4) Rinse with Acetone a
5) Rinse with dichloromethane (DCM) a, b
6) Let air-dry

[a] Solvent waste created during decontamination activities was collected for disposal at the laboratory.

[b] Used if oily contamination is apparent and only on metal/stainless steel surfaces.

2.3.2 Field-Based Quality Control Samples

Replicate or field duplicate samples of the surface grabs were collected at one of the three stations during each sampling event. The purpose of these samples was to ensure that field procedures did not affect the quality of the data. Field duplicates samples were used to evaluate the sampling procedure and analytical precision. The replicate samples were collected using two methods. The replicate samples were collected using the same techniques, and were handled, containerized, preserved, stored and transported in the same manner as field samples. All samples were analyzed by the same laboratory.

The reason for the two methods was due to miscommunication by field sampling teams and project manager. Replicate samples were collected as: A) a sub-sample of the multiple grab composite that was used for the field sample, or B) a completely different set of grabs that were composited and sub-sampled for the field duplicate samples only. Method A has since been approved for use as the method for field duplicate sample collection. It is thought that Method B introduces too much variability due to the spatial heterogeneity of PCB concentration in harbor sediments. Method A was used during the sampling events that occurred on August 5th, October 14th and November 11th, 2009. Method B was used for the events occurring on September 9th and December 28th, 2009.

2.3.3 Laboratory-Based Quality Control Samples

A routine suite of laboratory-based quality control (QC) samples were prepared with each set of field samples to evaluate data quality in terms of accuracy and precision. Grain size QC samples consisted of one laboratory duplicate sample for each batch of 20 or fewer samples. Quality control samples for TOC consisted of one method blank, and one laboratory duplicate sample for each batch of 20 or fewer samples. Quality control samples for PCB analysis included one procedural blank (also called a method blank or procedural method blank), one laboratory control sample (LCS), one matrix spike (MS) and one matrix spike duplicate (MSD) for each batch of 20 or fewer samples.

3.0 RESULTS

This section summarizes results from the sediment trap study. Complete analytical results are provided in Appendix C of this report.

3.1 FIELD SAMPLING SUMMARY

A total of five deployments were performed at each of the three sample locations during the six month study. Sediment traps were recovered for analysis after approximately five weeks (35 days). The traps were initially deployed on July 1st, 2009, and routine sample collection and redeployments occurred on August 5th, September 9th, October 14th, and November 18th. The final recovery of the sediment traps occurred on December 28th, 2009. All sediment trap stations remained constant over the season except ST-003. After the first deployment of ST-003, the USEPA requested that the station be repositioned in closer proximity to the City of New Bedford's sediment trap. WHG repositioned the ST-003 traps on August 5th; the station remained at this position for the remainder of the 2009 season.

During the final deployment period (November 18th to December 28th, 2009), the two traps located at ST-002 were fouled, compromising the data quality of the samples and rendering them unusable. These traps had been tipped over and dragged away from their locations, which apparently occurred during the demobilization activities of dredge equipment. Also during this deployment period, one of the traps at ST-001 was dragged off station, likely by ice flow. However, since the trap was recovered upright and appeared un-fouled, the sample was deemed uncompromised. Due to heavy icing conditions on the harbor, no sediment traps were deployed after December 28th. Table 1 summarizes the location and duration of the sediment trap deployment periods, as well as sample IDs and the general dredge activity during each deployment period.

Table 1. Summary of sediment trap sampler deployments

Deployment Period	Deployment Duration (days)	Station ID	Station Location	Remediation Activities	Sample ID
07/01/09 - 08/05/09	36	ST-001	41° 40.726' N 70° 55.020' W	Debris Removal and Dredging in Areas G, J, L	S-09G-T001-0-0
		ST-002	41° 40.373' N 70° 54.949' W		S-09G-T002-0-0
		ST-003	41° 39.197' N 70° 55.126' W		S-09G-T003-0-0
08/05/09- 09/09/09	36	ST-002	41° 40.726' N 70° 55.020' W	Debris Removal and Dredging in Areas G, J, L	S-09S-T001-0-0
		ST-003	41° 40.373' N 70° 54.949' W		S-09S-T002-0-0
		ST-003	41° 39.225' N 70° 55.153' W		S-09S-T003-0-0
09/09/09 - 10/14/09	36	ST-001	41° 40.726' N 70° 55.020' W	Debris Removal and Dredging in Areas G, L Dredging in J	S-09O-T001-0-0
		ST-002	41° 40.373' N 70° 54.949' W		S-09O-T002-0-0
		ST-003	41° 39.225' N 70° 55.153' W		S-09O-T003-0-0
10/14/09 - 11/18/09	36	ST-001	41° 40.726' N 70° 55.020' W	Debris Removal and Dredging in Areas M, L, J Debris Removal in G	S-09N-T001-0-0
		ST-002	41° 40.373' N 70° 54.949' W		S-09N-T002-0-0
		ST-003	41° 39.225' N 70° 55.153' W		S-09N-T003-0-0
11/18/09 - 12/28/09	40	ST-001	41° 40.717' N 70° 55.020' W	Debris Removal and Dredging in Areas G, M Dredging in J, L	S-09D-T001-0-0
			41° 40.692' N 70° 55.017' W		
		ST-002	41° 40.373' N 70° 54.949' W		No Sample Submitted for Analysis
		ST-003	41° 39.225' N 70° 55.153' W		S-09D-T003-0-0

Co-located surface sediment samples were collected from the top 0 – 2 cm of sediment of a petite PONAR grab sample at each of the three trap locations before each sediment trap deployment. A final set of surface grab samples was collected on December 28th, although no new trap samplers were deployed at that time. No surface samples were collected in the central location on December 28th, 2009 due to the lack of trap samples for analysis from that location. The initial set of surface sediment samples collected on July 1, 2009 was not analyzed, but instead archived.

All sediment trap samples were processed to determine the particulate mass accumulated and to calculate sediment deposition rates. The accumulated sediment was analyzed for PCB content to determine the PCB flux for each location. Samples collected in the sediment traps were also analyzed for total organic carbon (TOC) content and grain size. All co-located surface sediment samples were analyzed in the same manner.

Upon deployment and recovery of each set of sediment trap samplers, a water quality profile was recorded. The profile was collected adjacent to or at the site of the sediment traps. During collection of the profile, water quality parameters were recorded at various depths to characterize the water column in the vicinity of the sample location. The water quality parameters recorded include: depth, turbidity, dissolved oxygen (DO), salinity, and temperature. If the water was particularly shallow, only surface and bottom readings were recorded. Field log sheets of this water quality data are provided in Appendix A and summarized in Table 2.

In general, the water quality data from ST-001 exhibited a well stratified salt-wedge structure, where fresh water from the Acushnet River flowed in the top 0.0 – 0.5 feet, atop more dense brackish or saline water from Buzzard's Bay. At station ST-002, the estuary appeared less stratified, but retained the salt-wedge structure. The water column in the lower harbor was well mixed, with a slight halocline observed on occasion.

Turbidity values at ST-001 ranged from 1 – 15 NTU, and averaged 6.3 NTU. Turbidity at ST-002 was occasionally elevated, possibly due to dredge operations in Area J, or potentially due to weather, tide, or anthropogenic sources such as CSOs. During water column profiles, turbidity ranged from 1.5 – 21.8 NTU, and averaged 6.8 NTU. South of the I-195 and Coggeshall bridges at ST-003, turbidity appeared to be characteristic of background conditions for the harbor and ranged from 0 – 5 NTU, with an average of 2.0 NTU.

The general characterization of the salinity and turbidity at these three sites is typical of a funnel shaped estuary in New England. Moored YSI data sondes were located at the northern ST-001 and central ST-002 stations to collect continuous in-situ water quality data. These data are presented in Appendix B.

Table 2. Summary of in-situ water quality data

Station	Water Depth (ft)	Sample Depth (ft)	Turbidity (NTU)	DO (mg/L)	Salinity (ppt)	Temperature (°C)
July 1, 2009						
ST-001	4.0	0.96	5.0	7.13	1.37	20.91
		3.02	13.2	3.32	27.18	21.37
ST-002	7.3	1.01	6.3	7.81	17.62	22.67
		3.00	8.8	5.84	25.49	21.80
		6.02	21.8	4.31	28.24	21.34
ST-003	>20	1.03	2.6	6.85	28.83	20.71
		5.01	3.2	6.49	28.99	20.57
		10.12	3.5	6.21	29.56	20.21
		15.00	2.4	5.93	30.26	19.88
		20.02	4.9	6.01	31.07	19.04
August 5, 2009						
ST-001	5.6	0.56	3.0	4.87	2.32	23.40
		2.02	5.8	2.96	15.75	25.34
		3.03	7.4	1.86	20.90	25.54
		4.52	7.1	1.61	23.65	25.54
ST-002	8.3	0.76	8.5	10.18	6.24	25.55
		2.59	7.6	2.42	25.20	25.53
		4.60	5.3	3.32	26.31	25.39
		7.00	5.4	3.36	26.50	25.25
ST-003	18.0	0.58	4.4	9.91	25.87	25.89
		3.01	4.4	9.61	25.95	25.84
		8.16	1.8	6.73	27.21	25.13
		12.14	1.6	4.92	27.84	24.79
		16.95	2.2	2.27	30.05	23.90
Station	**Water Depth (ft)**	**Sample Depth (ft)**	**Turbidity (NTU)**	**DO (mg/L)**	**Salinity (ppt)**	**Temperature (°C)**
September 9,2009						
ST-001	6.0	0.52	8.2	5.75	26.98	22.71
		2.55	7.8	4.89	27.60	22.74
		5.02	11.1	4.47	27.71	22.70
ST-002	8.8	0.51	3.6	7.29	24.76	22.43
		4.12	3.1	6.36	27.66	22.09
		6.47	4.6	5.36	28.59	21.99
ST-003	21.2	1.01	0.9	6.13	29.35	22.00
		10.23	0.9	5.77	29.59	21.97
		18.79	3.1	4.57	30.49	21.70
October 14,2009						
ST-001	4	0.33	1.8	8.1	5.68	10.85
		1.68	8.6	6.25	24.51	13.50
		3.02	5.9	5.5	25.04	13.52
ST-002	4.4	0.66	12	8.1	23.34	13.17
		1.68	7.1	7.26	25.45	13.73
		3.55	5.7	6.72	26.80	14.28

ST-003	17.5	0.68	0.6	7.89	27.22	14.14
		5.56	0.9	7.48	27.79	14.58
		11.24	1.0	7.36	28.18	14.96
		16.75	3.5	7.31	28.27	15.05
November 18, 2009						
ST-001	6.7	1.73	2.0	7.43	20.70	10.78
		4.16	3.6	6.93	26.40	11.24
		6.33	4.4	6.89	26.67	11.32
ST-002	7.3	1.68	4.4	8.07	26.2	10.97
		3.30	3.3	7.9	27.22	10.95
		6.76	1.5	7.89	27.84	10.98
ST-003	21.7	18.23	0.0	8.41	28.00	10.86
		11.79	0.5	8.37	27.82	10.78
		7.33	0.0	8.35	27.83	10.79
		1.56	0.2	8.35	27.76	10.79

3.2 LABORATORY TESTING SUMMARY

The mass of sediment that accumulated in the sediment traps varied by location and deployment period. The wet mass of sediment in the traps ranged from 176.1 g at station ST-001 during the fourth deployment (October 14 – November 18, 2009) to 986.7 g at station ST-003 during the first deployment (July 1 – August 8, 2009). Total solid percentages ranged from 70.8% at station ST-001 during the first deployment to 97.2% at the same station during the final deployment.

For all of the six deployments, the sediment trap located south of the I-195 bridge (ST-003) accumulated the most sediment. The station north of Wood Street (ST-001) accumulated the lowest mass of sediment during four of the five deployments. Dry sediment mass data was calculated by multiplying the wet mass of sediment, reported by ESI, times the total percentage of solids, reported by AAL (Table 3).

Table 3. Summary of sediment trap sample accumulation

Deployment Period	Activity	Sample ID	Sediment Wet Weight (g)	Total Solids (%)	Sediment Dry Weight (g)
Deployment 1					
07/01/09 - 08/05/09	Debris Removal and Dredging in Area G, J, L	S-09G-T001-0-0	375.70	70.80	266.00
		S-09G-T002-0-0	730.10	85.30	622.78
		S-09G-T003-0-0	986.70	77.80	767.65
Deployment 2					
08/05/09- 09/09/09	Debris Removal and Dredging in Area G, J, L	S-09S-T001-0-0	523.80	94.10	492.90
		S-09S-T002-0-0	348.00	94.80	329.90
		S-09S-T003-0-0	678.10	95.40	646.91
Deployment 3					
09/09/09 -	Debris Removal and	S-09O-T001-0-0	201.30	92.70	186.61

10/14/09	Dredging in Area G, L Dredging in J	S-09O-T002-0-0	239.30	82.10	196.47
		S-09O-T003-0-0	425.60	93.10	396.23
Deployment 4					
10/14/09 - 11/18/09	Debris Removal and Dredging in Area M, L, J Debris Removal in G	S-09N-T001-0-0	176.10	96.10	169.23
		S-09N-T002-0-0	270.10	94.10	254.16
		S-09N-T003-0-0	592.80	95.10	563.75
Deployment 5					
11/18/09 - 12/28/09	Debris Removal and Dredging in Area G, M Dredging in J, L	S-09D-T001-0-0	253.70	97.20	246.60
		S-09D-T002-0-0	N/A	N/A	N/A
		S-09D-T003-0-0	336.10	95.40	320.64

Sediment trap samples and co-located surface grab samples were analyzed for the NOAA 18 PCB congeners. Total PCB congener content was calculated by multiplying the sum of the NOAA 18 congeners by a site-specific regression factor of 2.6. In the case of a non-detect for a particular congener, a value of zero was used during the summation.

Concentrations of PCBs in the sediment trap samples ranged from 29.91 mg/kg (ppm) to 378.70 mg/kg (ppm) over the 2009 season. These minimum and maximum concentrations were analyzed in samples collected during the July-August deployment. Substantial variability in PCB concentrations was observed between the stations and deployment periods. A summary of the dry weight, total concentration of PCBs and TOC results for each sediment trap station over the five deployments is provided in Table 4.

Table 4. Summary of sediment trap analytical results

Deployment Period	Remediation Activities	Sample ID	Sediment Dry Weight (g)	Total PCBs (µg/kg)	Total Organic Carbon (%)
Deployment 1					
07/01/09 - 08/05/09	Debris Removal and Dredging in Area G, J, L	S-09G-T001-0-0	266.00	29,910.40	6.87
		S-09G-T002-0-0	622.78	378,697.80	5.01
		S-09G-T003-0-0	767.65	41,714.40	4.45
Deployment 2					
08/05/09- 09/09/09	Debris Removal and Dredging in Area G, J, L	S-09S-T001-0-0	492.90	53,815.32	8.09
		S-09S-T002-0-0	329.90	221,683.54	5.17
		S-09S-T003-0-0	646.91	37,866.40	3.75
Deployment 3					
09/09/09 - 10/14/09	Debris Removal and Dredging in Area G, L Dredging in J	S-09O-T001-0-0	186.61	79,812.20	5.88
		S-09O-T002-0-0	196.47	280,961.20	3.84
		S-09O-T003-0-0	396.23	38,911.60	2.11
Deployment 4					
10/14/09 - 11/18/09	Debris Removal and Dredging in Area M, L, J Debris Removal in G	S-09N-T001-0-0	169.23	173,170.40	4.12
		S-09N-T002-0-0	254.16	248,903.20	4.17
		S-09N-T003-0-0	563.75	48,755.20	3.89

Deployment 5					
11/18/09 - 12/28/09	Debris Removal and Dredging in Area G, M Dredging in J, L	S-09D-T001-0-0	246.60	67,106.00	4.97
		S-09D-T002-0-0	N/A	N/A	N/A
		S-09D-T003-0-0	320.64	124,209.80	8.80

Similarly, surface sediment grab samples were analyzed for PCB and TOC content. In general, surface sediments contained higher concentrations of PCBs than the co-located trap samples for stations ST-001 and ST-002. Conversely, surface grab samples at station ST-003 contained lower concentrations of PCBs than the ST-003 sediment trap samples. This difference is discussed further in Section 4.0. Table 5 summarizes the PCB and TOC analytical results for the surface sediment grabs.

Table 5. Summary of surface sediment grab analytical results

Sampling Date	Remediation Activities	Station ID	Total PCBs (mg/kg)	Total Organic Carbon (%)
8/5/09	Debris Removal and Dredging in Areas G, J, L	ST-001	153.075	6.54
		ST-002	488.030	5.35
		ST-002 REP*	471.658	5.13
		ST-003	32.367	2.95
9/9/09	Debris Removal and Dredging in Areas G, J, L	ST-001	110.107	7.84
		ST-002	312.606	5.69
		ST-002 REP	439.665	5.78
		ST-003	30.316	3.25
10/14/09	Debris Removal and Dredging in Areas G, J, L	ST-001	91.034	2.22
		ST-002	477.685	4.15
		ST-002 REP	489.739	3.47
		ST-003	31.226	3.44
11/18/09	Debris Removal and Dredging in Areas G, J, L	ST-001	143.299	5.86
		ST-002	564.951	2.59
		ST-002 REP	525.736	3.75
		ST-003	32.640	2.62
12/28/09	Debris Removal and Dredging in Areas G and M	ST-001	211.380	5.66
		ST-001 REP	167.830	5.79
		ST-003	70.990	2.40

*REP designates a replicate sample (field duplicate)

Results of grain size analysis for the sediment trap and surface grab samples are presented in Table 6. Grain size was determined by a standard sieve method. This method utilizes a series of sieves and later differentiates size fractions into categories using the Wentworth scale. Due to very low sample volume, hydrometer analysis was

performed on only the trap samples recovered in September and October. The hydrometer method can quantify the distinction between clay, silt, and very fine sand, although very fine sand is difficult to quantify due to the rapid settling rate of the hydrometer. For all samples that were not analyzed using hydrometer methods, the clay and silt fractions are combined in Table 6 as "% silt," and the very fine sand fraction is included in the percentage of "fine sand." TOC results are also presented in Table 6. Sediment trap samples generally resulted in higher concentrations of organic carbon than surface sediment samples. Grain size varied between the locations of the sampling stations. For example, sediment samples from south of I-195 (ST-003) were generally composed of coarser material than samples from the upper harbor (ST-002). The trap stationed at ST-001 during the third deployment did not collect sufficient material for grain size analysis. Likewise, the fourth and fifth deployments resulted in insufficient volume for grain size analysis of trap samples from all three locations.

Table 6. Summary of physical results for sediment trap and surface sediment grab samples

Type of Sample	Sample ID	TOC (%)	% Clay (<1.95um)	% Silt (1.95-62.5um)	% Very Fine Sand (0.063-0.125mm)	% Fine Sand (0.125-0.25mm)	% Medium Sand (0.25-0.5mm)	% Coarse Sand (0.5-1.0mm)	% Very Coarse Sand (1.0-2.0mm)	% Gravel (>2.0mm)
Deployment 1 (07/01/09 - 08/05/09)										
Sediment Trap	ST-09G-T001-0-0	6.87	N/A	88.8	N/A	2.4	2.7	3.0	3.0	0.1
	ST-09G-T002-0-0	5.005	N/A	82.8	N/A	5.2	4.8	3.6	3.5	0.1
	ST-09G-T003-0-0	4.445	N/A	73.7	N/A	6.1	6.2	6.9	6.8	0.2
Surface Grab	S-09G-G001-0-0	6.54	N/A	84.8	N/A	5.4	4.7	2.5	2.6	0.0
	S-09G-G002-0-0	5.35	N/A	69.7	N/A	5.3	6.2	9.0	9.0	0.4
	S-09G-G002-0-0REP	5.13	N/A	88.6	N/A	3.4	3.3	2.3	2.3	0.1
	S-09G-G003-0-0	2.95	N/A	73.8	N/A	9.6	8.4	3.9	4.0	0.2
Deployment 2 (08/05/09-09/09/09)										
Sediment Trap	ST-09S-T001-0-0	8.09	17.9	36.3	17.1	8.3	6.4	6.4	5.3	1.6
	ST-09S-T002-0-0	5.17	38.3	48.9	10.0	0.8	1.0	0.7	0.3	ND
	ST-09S-T003-0-0	3.745	18.4	58.1	15.8	2.1	2.6	2.2	0.7	0.1
Surface Grab	S-09S-G001-0-0	7.84	45.2	27.4	12.4	7.6	3.7	2.3	1.2	0.2
	S-09S-G002-0-0	5.685	36.3	48.8	9.2	1.8	1.6	1.5	0.5	0.2
	S-09S-G002-0-0REP	5.775	33.3	43.0	8.0	3.1	3.7	3.8	2.3	0.5
	S-09S-G003-0-0	3.25	14.1	43.3	14.9	13.0	5.1	2.9	4.0	2.2
Deployment 3 (09/09/09-10/14/09)										
Sediment Trap	ST-09O-T001-0-0	5.88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	ST-09O-T002-0-0	3.84	38.4	47.7	10.8	0.8	1.7	0.5	0.1	ND
	ST-09O-T003-0-0	2.11	21.2	48.9	14.9	3.2	5.0	4.9	1.9	ND
Surface Grab	S-09O-G001-0-0	2.22	N/A	50.2	N/A	16.0	14.3	8.8	8.8	0.6
	S-09O-G002-0-0	4.145	N/A	40.8	N/A	12.2	13.0	16.0	15.9	1.7
	S-09O-G002-0-0REP	3.465	N/A	41.7	N/A	12.9	13.4	15.1	15.1	0.9
	S-09O-G003-0-0	3.435	N/A	53.8	N/A	20.0	16.2	4.0	3.9	0.2
Deployment 4 (10/14/09-11/18/09)										
Sediment	ST-09N-T001-0-0	4.12	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Trap	ST-09N-T002-0-0	4.17	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	ST-09N-T003-0-0	3.89	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Surface Grab	S-09N-G001-0-0	5.855	N/A	68.9	N/A	11.8	9.9	3.8	3.8	1.3
	S-09N-G002-0-0	2.59	N/A	84.6	N/A	3.8	3.7	3.1	3.1	1.1
	S-09N-G002-0-0REP	3.75	N/A	85.4	N/A	3.2	3.1	2.6	2.7	0.9
	S-09N-G003-0-0	2.62	N/A	69.5	N/A	12.7	10.1	1.5	1.6	1.3
Deployment 5 (11/18/09-12/28/09)										
Sediment Trap	ST-09D-T001-0-0	4.965	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	ST-09D-T003-0-0	8.795	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Surface Grab	S-09D-G001-0-0	5.66	N/A	74.2	N/A	10.0	8.5	3.4	3.3	0.4
	S-09D-G001-0-0REP	5.785	N/A	74.5	N/A	10.0	8.3	3.2	3.1	0.4
	S-09D-G003-0-0	2.395	N/A	62.4	N/A	15.9	13.1	3.9	4.0	0.6

*REP designates a replicate sample (field duplicate)

3.3 QUALITY ASSURANCE/ QUALITY CONTROL

3.3.1 Field-Based Quality Control Samples

Replicate samples, or field duplicates, were collected in the field throughout the study to evaluate reproducibility of sampling and analytical techniques. These samples were tested and compared with their field sample counterparts for consistency in the following parameters: grain size, TOC and concentration of NOAA 18 PCB congeners. Replicates were collected from surface sediments only. Previously, replicate sediment traps were positioned at each location in order to evaluate sediment accumulation accuracy and reproducibility. This year, however, it was determined that the two sediment trap samplers at each location would need to be composited and treated as one sample in order to ensure enough material had accumulated for all desired analyses. Replicate surface sediment samples were collected once per field sampling event and analyzed for grain size, TOC and PCB concentrations. Results are displayed in Tables 5 and 6. When collected using replicate collection Method A (the accepted method), PCB congener concentrations of the replicates were comparable to the field samples. However, the replicates collected using Method B differ more in comparison to the field samples.

3.3.2 Laboratory-Based Quality Control Samples

Laboratory-based QC results are reported with the sample data as appendices to this report (Appendix C). Results from the analysis of laboratory-based QC samples for PCBs were evaluated against the project measurement quality objectives for accuracy and precision, as defined in the project QAPP (WHG 2009B). The evaluation is summarized in the QA/QC narrative of the Alpha Lab reports (Appendix C). Overall, results from the laboratory-based QC samples for all tests parameters indicate that the laboratory methods were in control and the data is usable. Sediment grab data were validated by a third party to Tier I+ standards for entry into the New Bedford Harbor Superfund Site Database; however, sediment trap data were not validated.

4.0 DISCUSSION

This section presents the analytical results, discusses sediment accumulation at the harbor sampling locations, and addresses trends in PCB concentrations at those sites. These data were collected to assess whether contaminated sediment particles are actively transported in the water column, and to quantify the rates at which deposition of that sediment occurs. The data were reviewed for the presence of statistically significant trends using the analysis of variance (ANOVA) exercise.

4.1 SEDIMENT DEPOSITION AND PHYSICAL CHARACTERISTICS

Sediment deposition rates were calculated by dividing the total mass of dry sediment collected in the trap over the total time the trap was deployed. The calculation is represented per unit area to take into account the size of the funnel mouth, and expanded over a one square meter. Trends in sediment deposition rate (g/m2/day) over the five deployment periods are presented in Figure 6.

Sediment deposition rates and the physical properties of accumulated suspended sediments varied greatly between sediment trap stations and deployment periods. The sediment traps located in the lower harbor (ST-003) accumulated more sediment than the traps in the upper harbor during all five deployments. This is evident in Figure 6. This result was surprising considering ST-003 is located over one-half mile south of any dredge-related activity, and ST-001 and ST-002 were located just 300 feet north and south of active dredging and debris removal occurring in Areas M, G and J, respectively. A possible explanation for this trend may be that the higher salinity of the lower harbor caused suspended fine grained material to flocculate and fall out of suspension. However, other explanations may include a change in physical hydraulic environment or a sediment source that is proximal to the ST-003 location. Additionally, the ST-003 station was down gradient of a CSO located near major construction activity, including the demolition and excavation of a large river-side building. Increased sediment deposition at the ST-003 location may have been the result of increased run-off from this construction site.

Sedimentation rates ranged across the study area from approximately 75 g/m2/day at ST-001 during October-November, to almost 340 g/m2/day at ST-003 during July-August. The first two deployment periods resulted in the greatest amounts of accumulated sediments in the traps at all three locations. Results from previous years indicate that sediment deposition rates vary seasonally, increasing from late spring to summer, reach a maximum during July and August, and decrease from late fall to winter. Results from the five deployments from the 2009 season are consistent with this seasonal trend. Maximum sedimentation rates occurred during the first deployment (mid-summer), and decreased thereafter (Figure 6). Table 7 presents the calculated daily sedimentation rate.

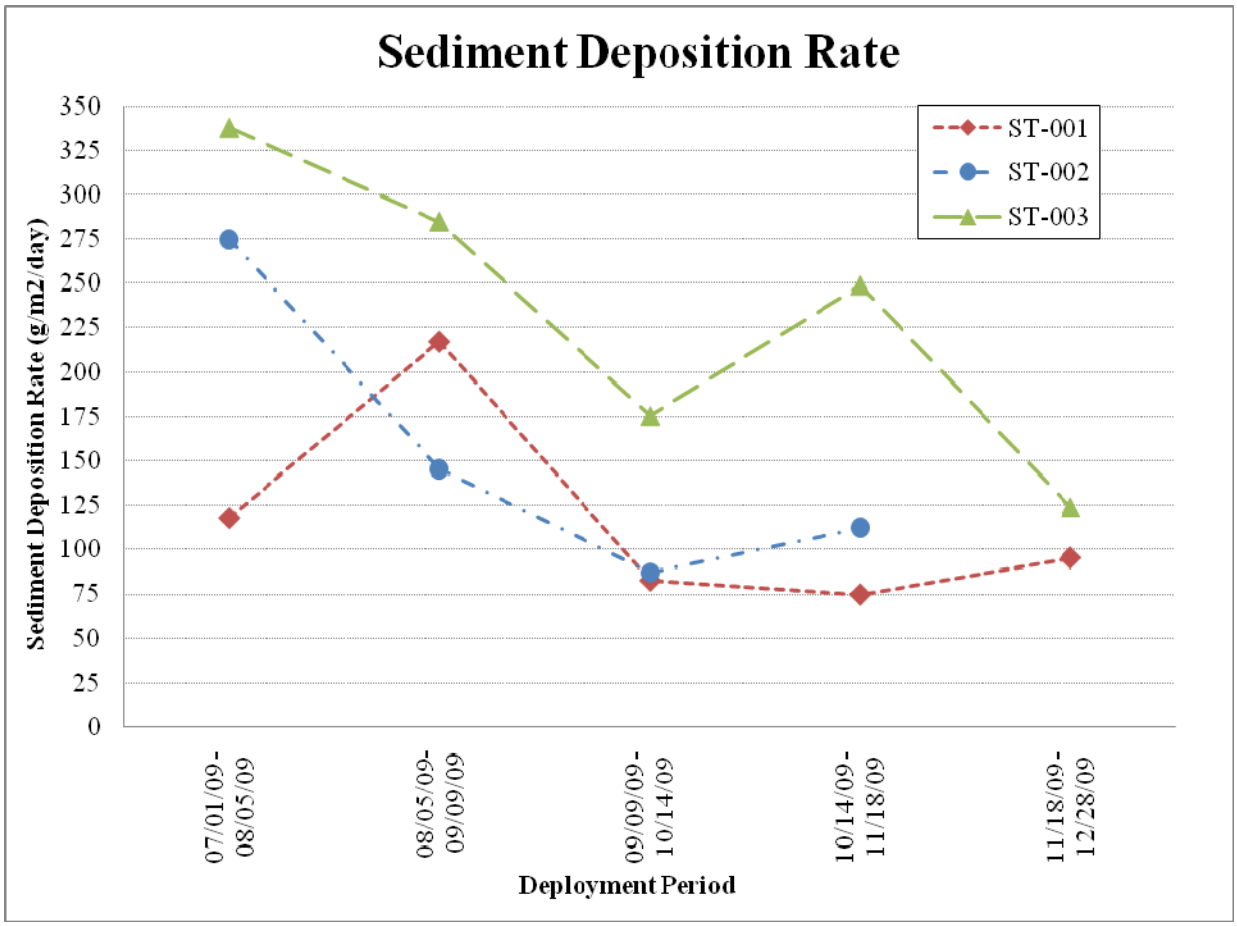

Figure 6. Sediment deposition rate by deployment period

Sediment trap samples were generally comprised of fine-grained sediments (clay and silt) and contained minimal gravel (<2%). Co-located surface sediments were highly variable. These were comprised of more sand and gravel than their sediment trap sample counterparts. Due to insufficient sample volume, grain size data are only available for three of the five sediment trap deployments. Sediment analysis was prioritized to ensure proper volume for PCB analysis, followed by TOC and grain size. Concentrations of organic carbon in the samples from the southernmost trap (ST-003) were lower than in the northern traps for all but one of the five deployments. Surface sediment samples from ST-003 also typically contained lower percent TOC, with the exception of the final sampling event on December 28, 2009. Organic carbon content was consistently under 10%, and averaged 4.7%. The content of TOC in sediment trap samples exhibited a seasonal trend in concentration similar to sedimentation rates, decreasing between summer and winter.

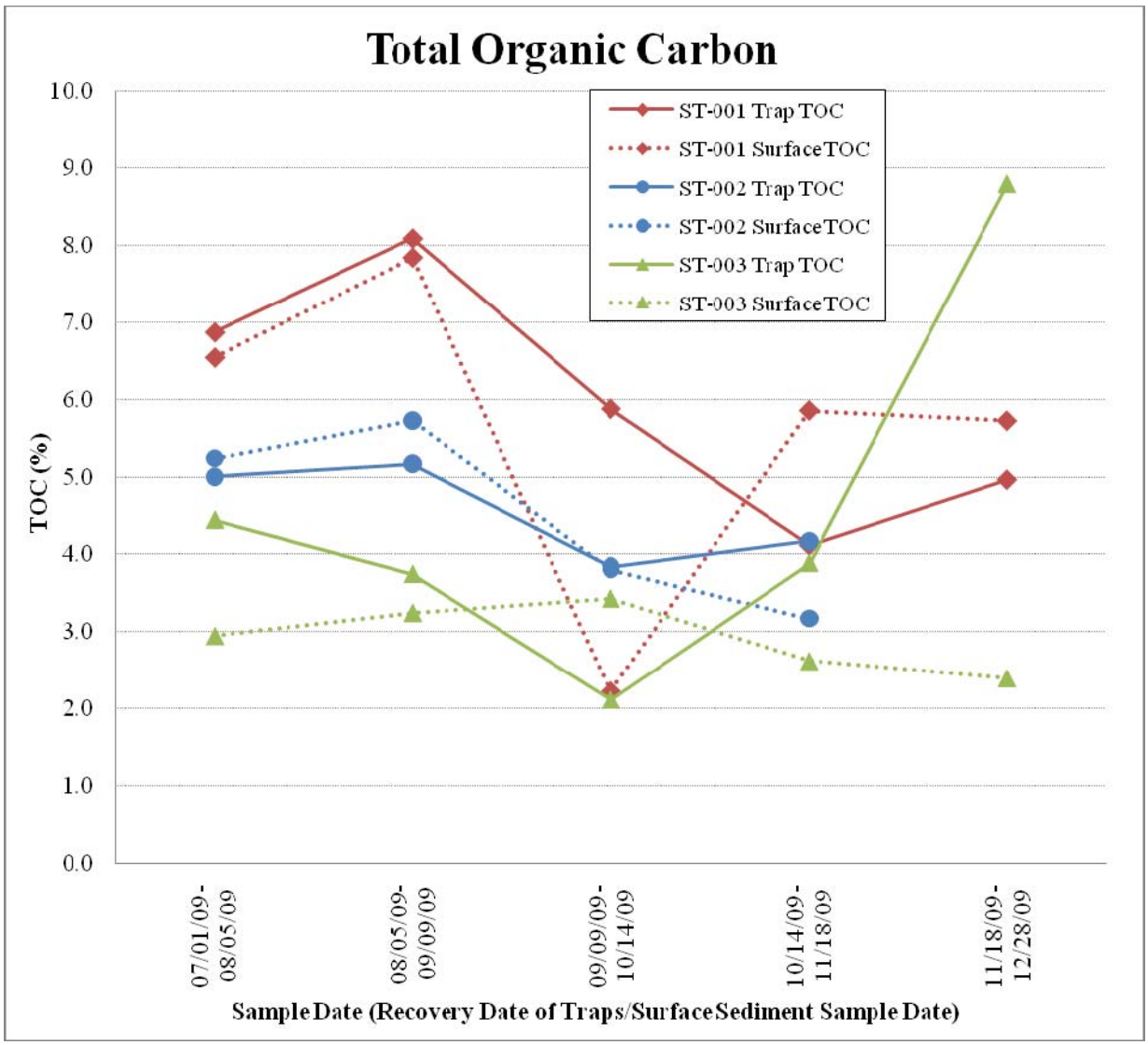

Figure 7. Total organic carbon concentrations for traps and surface grabs

4.2 POLYCHLORINATED BIPHENYLS

Daily flux of PCBs is defined as the deposition rate of PCB contaminated sediments from the water column to the bottom sediments. PCB flux was quantified using the calculated sediment deposition rate (g/m2/day) and the total PCB concentration of the sediment trap sample. The PCB flux is representative of the period during which the sediment trap was deployed. A summary of sediment deposition rate and PCB flux results for the 2009 season is provided in Table 7.

Table 7. Summary of sediment and PCB deposition rates (PCB Flux)

Deployment Period	Activity	Sample ID	Sediment Deposition Rate ($g/m^2/day$)	Total PCB Flux ($mg/m^2/day$)
Deployment 1				
07/01/09 - 08/05/09	Debris Removal and Dredging in Area G, J, L	S-09G-T001-0-0	117.67	3.52
		S-09G-T002-0-0	310.13	117.45
		S-09G-T003-0-0	337.80	14.09
Deployment 2				
08/05/09- 09/09/09	Debris Removal and Dredging in Area G, J, L	S-09S-T001-0-0	217.28	11.69
		S-09S-T002-0-0	145.36	32.22
		S-09S-T003-0-0	284.94	10.79
Deployment 3				
09/09/09 - 10/14/09	Debris Removal and Dredging in Area G, L Dredging in J	S-09O-T001-0-0	82.53	6.59
		S-09O-T002-0-0	86.95	24.43
		S-09O-T003-0-0	175.35	6.82
Deployment 4				
10/14/09 - 11/18/09	Debris Removal and Dredging in Area M, L, J Debris Removal in G	S-09N-T001-0-0	74.65	12.93
		S-09N-T002-0-0	112.20	27.93
		S-09N-T003-0-0	248.86	12.13
Deployment 5				
11/18/09 - 12/28/09	Debris Removal and Dredging in Area G, M Dredging in J, L	S-09D-T001-0-0	95.24	6.39
		S-09D-T002-0-0	N/A	N/A
		S-09D-T003-0-0	123.82	15.38

Flux of PCBs at the northernmost (ST-001) and southernmost (ST-003) locations remained relatively constant throughout the dredge season, averaging 8.22 ± 3.95 and 11.84 ± 3.31 mg/m2/day, respectively. At the central trap, however, daily flux of PCBs ranged from 24.34 to 104.06 mg/m2/day. The average rate of PCB deposition at ST-002 was 50.51 ± 44.74; removing the initial spike in July – August, the remaining three deployments (115 days) averaged 28.19 ± 3.90 mg/m2/day. Statistically, this average rate is significantly greater than the traps at ST-001 and ST-003, over the same three month deployment period. Despite less total sediment deposition compared to ST-003, the greater PCB deposition at ST-002 may be attributed to the station's close proximity to remediation activities and to the Aerovox facility, where sediment PCB concentrations are exceptionally high. In other words, although ST-002 accumulated less sediment than ST-003, the sediments contained higher concentrations of PCBs. Figure 8 depicts the total daily PCB flux for each location and deployment period.

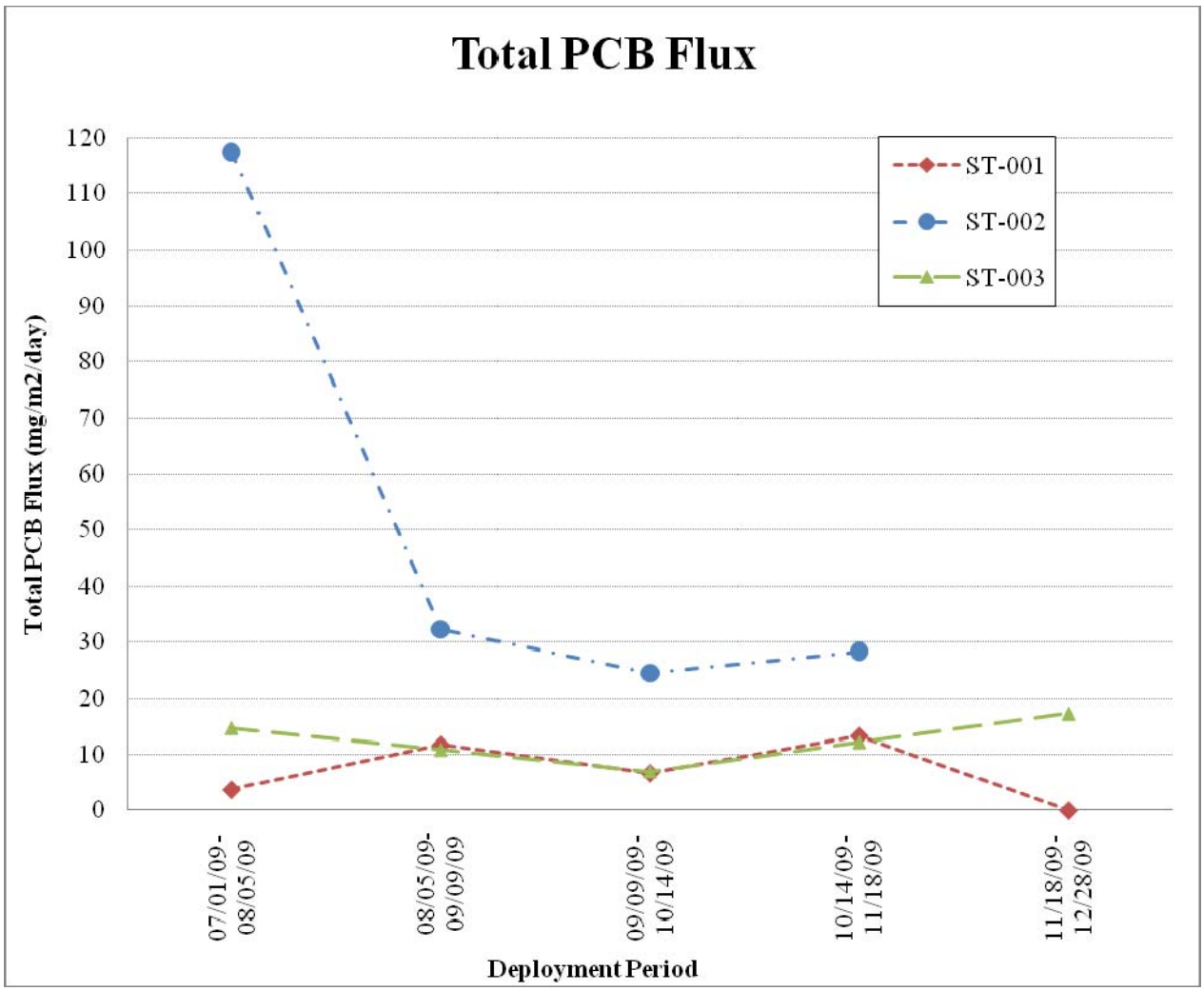

Figure 8. PCB deposition rate (PCB Flux)

A review of the analytical data reveals two distinct patterns, one between PCB concentrations and station location, and the other between sediment traps and surface sediments. Figure 9 depicts PCB concentration in sediment traps and surface grabs over the course of the 2009 season. The figure highlights the significantly (ANOVA quantified) greater concentrations of ST-002 versus the other stations in both sediment traps and surface sediment samples. This relationship was alluded to in Figure 8, but it is clear from Figure 9 that the positioning of ST-002 in a "hot spot" of contaminants has influenced the concentrations of PCB contaminants in the traps and surface sediment samples. Furthermore, ST-002 was located in closest proximity to remediation activities, whereas ST-001 is situated in a previously remediated area, and ST-003 is in a far field position known to have lower contaminant levels. Analysis of variance reveals that PCB concentrations in sediment trap samples from ST-002 were significantly different than those from ST-001 and ST-003. Differences between PCB concentrations in ST-001 and ST-003 sediment traps were statistically insignificant.

A comparison of PCB concentration between sediment traps and surface samples demonstrates varying relationships between the three sites. At ST-002, surface sediments

consistently contained a greater concentration of PCBs over the sediment trap samples (Figure 9.) In this location, the difference in PCB concentration between the two sample types is statistically significant. This may be due to the positioning of the trap in a location of high contamination that has yet to be remediated. Suspended sediments in the vicinity of ST-002, while of high PCB content, are not as contaminated as the surface sediments in that location. Differences in contaminant concentrations between trap and surface sediment at ST-001 were variable and insignificant. At ST-003, the sediment traps contained a consistently higher concentration of PCBs than their surface sample counterparts, although the difference is statistically insignificant.

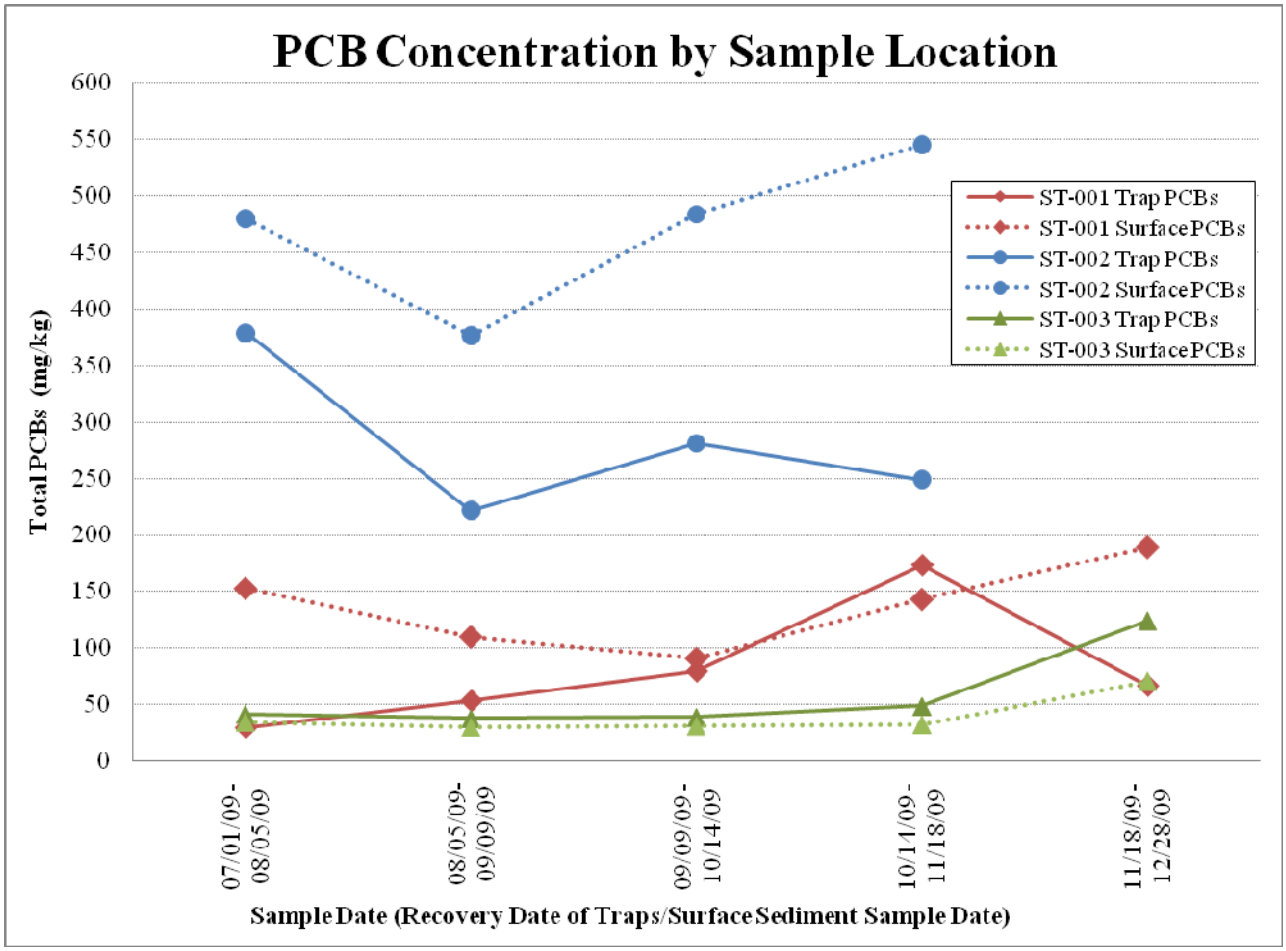

Figure 9. Correlation of PCB concentrations between sediment trap samples and co-located surface sediment grab samples

The general relationships between stations and among the two sample types suggests that the suspended sediments transported out of the upper harbor have a higher concentration of PCBs than the sediments already deposited in the lower harbor. All three stations confirm that sediment associated PCB transport is active in the system. The variation in the relationships between sediment trap and surface sediment contaminant levels indicates the possible existence of two or more sediment sources in the study area: the resuspension of contaminated sediments into the water column, and at least one other

source of "clean" sediments. "Clean" sources could be fluvial, CSOs, biological or lower harbor sediments being transported into the estuary.

Sediment trap samples and surface sediments samples were comparable in terms of the PCB distribution patterns and indicate that sediments deposited in the trap samplers are representative of the material that has accumulated on the estuary floor.

4.3 DISCUSSION SUMMARY

The 2009 sediment trap study has confirmed that PCB-contaminated sediments are actively deposited at all monitored locations in the study area. Contaminant transport may be contributing to short-term changes in surface sediment PCB levels in the lower harbor and north of Wood Street. Pre-dredge and post-dredge period monitoring data were not available from 2009 as data were collected only during periods of active remediation activities; this hindered any assessment of whether the active remediation had an impact on the ambient sedimentation patterns of the harbor. The absence of samples for months of inactivity prevents the establishment of conclusions regarding sources of suspended sediments and potential for recontamination. Collection of post-dredge period data was attempted, however due to the extension of the dredge season into winter ice buildup prevented the ability for successful collection of samples using the established methodology. Continued monitoring during the pre- and post-dredge period in 2010 would be valuable in the assessment of site conditions and to better understand potential impacts that ongoing remediation activities may have on the estuarine system.

5.0 REFERENCES

Woods Hole Group. 2009A. Environmental Monitoring, Sampling and Analysis Water Quality Monitoring Field Sampling Plan. New Bedford Harbor Superfund Site, New Bedford, MA. Prepared under Contract W912WJ-09-D-0001 Task Order No 0010 for the U.S. Army Corps of Engineers New England District, Concord, MA.

Woods Hole Group. 2009B. Environmental Monitoring, Sampling and Analysis Quality Assurance Project Plan Addendum. New Bedford Harbor Superfund Site, New Bedford, Massachusetts. Prepared under Contract W912WJ-09-D-0001 Task Order No 0010 for the U.S. Army Corps of Engineers New England District, Concord, MA.

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APPENDIX A. *IN-SITU* WATER QUALITY DATA FIELD LOGS

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APPENDIX B. CONTINUOUS *IN-SITU* FIXED STATION WATER QUALITY DATA

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APPENDIX C. ALPHA ANALYTICAL LABORATORIES REPORTS AND ANALYTICAL DATA

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APPENDIX D. ENVIROSYSTEMS, INC. REPORTS AND ANALYTICAL DATA

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