US Army Corps of Engineers
New England District

NEW BEDFORD HARBOR PCB FLUX STUDY

Contract No. W912WJ-09-D-0001-0005-02

Prepared For:
United States Army Corps of Engineers
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August 2010

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List of Acronyms

ADCP – Acoustic Doppler Current Profiler
COC – Chain–Of-Custody
CSM – Conceptual Site Model
EMC – Event Mean Concentration
HADCP – Horizontal Acoustic Doppler Current Profiler
NOAA – National Oceanic and Atmospheric Administration
OU#3 – Operable Unit # 3, New Bedford Harbor Superfund Site
PCB – Polychlorinated Biphenyls
QAPP – Quality Assurance Project Plan
RI/FS – Remedial Investigation/Feasibility Study
SNR – Signal-to-Noise Ratio
SOW – Statement of Work
TRDI – Teledyne RD Instruments
USGS – US Geological Survey
USACE – US Army Corps of Engineers
WHG – Woods Hole Group Inc.

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EXECUTIVE SUMMARY

This report summarizes the results from a flux study completed to quantify the transport of PCBs through the hurricane barrier at New Bedford Harbor. Flow-proportioned, composite water samples were collected and analyzed for PCBs in total and dissolved fractions. Samples were collected every half-hour at two stations, over three depths, throughout six separate tidal cycles. The six events included spring, neap, and abnormal weather conditions in April and May, 2010. The net rate of the total PCB mass flux ranged from -24.7g[1] per tidal cycle (neap tide on April 21) to -82.8g per tidal cycle (weather event on April 28 coinciding with spring tide). The mean net PCB mass flux for the six (6) sampling events was approximately -61g per tidal cycle, which translates to approximately -118g per day.

These results indicate that the New Bedford Harbor area serves as an ongoing source of PCBs to Operable Unit #3, the 17,000 acre area outside of the hurricane barrier. The methods established herein provide the basis for ongoing investigation of OU#3, and provide the basis for future surveys if appropriate.

[1] The negative value indicates flux outward from the harbor to Upper Buzzard's Bay.

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1.0 INTRODUCTION

The New Bedford Harbor Superfund Site (Site), located in Bristol County, Massachusetts, extends from the shallow northern reaches of the Acushnet river estuary south through the commercial harbor of New Bedford and into 17,000 adjacent acres of Buzzards Bay. See the Statement of Work for RI/FS Report Field Work, Operable Unit No. 3 (OU3), New Bedford Harbor Superfund Site, New Bedford, MA, 14 August 2009 (SOW) for further information on site background and history. This report describes results from the sub-set of activities for Task 3 – Harbor Flux Study taken in Operable Unit III (OU#3) located at, inside, and outside of the hurricane barrier. The study area is shown in Figure 1.

Figure 1. New Bedford OU#3 Harbor Flux Study area.

The purpose of Task 3, Harbor Flux Study of OU#3 is to quantify the transport of PCBs through the hurricane barrier. The Conceptual Site Model (CSM) and Data Gaps Analysis Report (Woods Hole Group, 2009a) recognized that although there may be multiple potential ongoing sources of PCBs to OU#3, it is anticipated based on consultations with EPA and the project team that the primary ongoing source is from New Bedford Harbor via net flux of PCBs out through the hurricane barrier. PCB flux may be either in aqueous phase or attached to sediments, primarily suspended fine sediments. The ongoing remediation of New Bedford Harbor is intended to substantially reduce the PCB contamination within the Harbor, which also has the intended effect of reducing the export of PCBs throughout the system over time, including into OU#3. Extensive ongoing studies and models by the EPA and USACE are being conducted to quantify the anticipated long-term, time-varying reduction in pollutant loading and health risk reduction (i.e., reduction of contaminant of concern (COC) concentrations in fish tissue and resultant health risk reduction).

The current export of PCBs from the Harbor to OU#3 poses a potential ecological risk (yet to be estimated). However, the estimates of the magnitude of this export are not well-understood. The objective of the Harbor Flux Study is to improve the estimates of present-day PCB flux from the Harbor to OU#3, and establish a methodology that could be repeated in the future, if required, to evaluate the efficacy of remediation.

The approach to quantifying this export of PCBs through the hurricane barrier includes a combination of:

- long-term velocity measurements to capture the time variations of water flow
- short-term current measurements over six (6) tidal cycles to capture the spatial variations in flow as well as water fluxes through the barrier, and
- short-term water sampling and analysis over six (6) tidal cycles to measure the water- and sediment-borne PCB concentrations under various tidal and weather conditions.

This report focuses on developing estimates of the net export of PCBs through the hurricane barrier from the Harbor to OU#3 using these three data sets.

The Harbor Flux Study was performed in consecutive sub-tasks, as outlined below. Water current data were collected from December 09 through March 10 to help select locations for water column sampling and analysis.

The sequence of the Harbor Flux Study sub-tasks for the 2009-2010 sampling is listed in Table 1 below.

Table 1. Sampling tasks/events for OU#3 Harbor Flux Study field reconnaissance

Event	Time
Mobilization	November 2009
Sub-Task 1. Installation of HADCP	December 2009
Sub-Task 2. Perform Real Time ADCP surveys – Qty 2	January - February 2010
Sub-Task 3. Interim Service and Data Retrieval from HADCP	February 2010
Sub-Task 4. Data Analysis to Determine Water Column Sample locations	February - March 2010
Sub-Task 5. Water Column Sampling – Qty 6	April-May 2010
Sub-Task 6. Final Retrieval of HADCP	June 2010
Sub-Task 7. Data Analysis and Reporting	July 2010

This report is organized as follows. Section 2 of the report describes sampling methods used during this study. The results are discussed in Section 3 and summarized in Section 4.

2.0 FIELD SAMPLING METHODS

The flow rate through the Hurricane Barrier Gate varies widely; therefore, water sampling was scheduled to characterize major conditions that contribute to flow variability. These conditions are associated with the fortnightly spring/neap tidal cycle, as well as weather patterns, including abnormal freshwater runoff and/or strong winds that can block or accelerate water exchange through the Hurricane Barrier. Therefore, six sampling events were planned to cover this range of conditions: two (2) surveys during neap tide, two (2) surveys during spring tide, and two (2) surveys during wet weather conditions. One of the wet weather sampling events took place on a windy day when the outflow from the inner harbor was accelerated due to strong northwesterly winds.

Two types of current data were collected during each sampling event. The horizontal ADCP (TRDI 300kHz Workhorse Horizontal ADCP) deployed on the western wall of the Gate continuously recorded two-minute averages of long-channel and cross-channel velocities from 2-m horizontal bins across the channel at a depth of about 7m+/-1m or 4m above the bottom. Current velocity data also were collected during each sampling event from the survey boat using a broadband 1200kHz ADCP (TRDI 1200kHz Workhorse Sentinel ADCP). This ADCP was configured to collect data from 1m vertical bins every second to accurately describe the vertical velocity shear, if present. Bottom tracking was used to correct for boat movements in the raw velocity data.

Post-survey data processing and interpretation of the ADCP data collected on the survey boat revealed frequent occurrence of a sheared velocity profile (i.e., current speed and direction varied considerably over depth). The data revealed that the velocity shears developed as the density stratification of the water column increased in spring due to heating at the surface and increased freshwater runoff. Therefore, while data from the HADCP (mounted on the Hurricane Barrier) were valuable to select measurement locations and understand longer-term flow variability at the Hurricane Barrier, the HADCP data were not used for water flux calculations. Data from the vessel-based ADCP data collected during each survey event were used instead.

The mean current profile, $U(z)$, was calculated for each round of water sampling within the Gate. These discrete current profiles were used to calculate integrated volumes of water transported through the Gate during ebb and flood for each sampling event:

$$Vol_{tide} = S * \sum_{i=1}^{i=n}(\bar{U}_i * \Delta t_i), \qquad (1)$$

where S is the channel cross-section area The estimates of the water (volume) flux for ebb and flood were then multiplied by the mean concentrations of PCBs for each tidal phase to calculate fluxes of PCBs for each tidal phase. Total net PCB flux through the Gate was then calculated as the sum of: 1) the net flow PCB flux (i.e., estimated freshwater inflow rate times the ebb tidal PCB concentration), and; 2) the tide-corrected tidal pumping flux (i.e., mean tidal volume times the difference between the ebb and flood PCB concentration):

$$Total_{flux} = Vol_{fresh} * C_{ebb} + \overline{Vol_{tide}} * (C_{ebb} - C_{flood}), \qquad (2)$$

where $C_{ebb} and\ C_{flood}$ are the concentrations of PCBs during ebb and flood tidal phases.

This method is consistent with that of a previous PCB flux study performed for New Bedford Harbor (see Teeter, 1988, page 25, section 53). Note that estimating the net-flow flux and tide-corrected tidal pumping flux would not be necessary if there were symmetry in the ebb and flood flows. In reality, although the mass flux of PCBs estimated for each tidal phase may be quite accurate, the estimate of the net flux of PCBs calculated as the difference between the ebb and flood fluxes contains an uncertainty related to tidal asymmetry and other factors. This uncertainty cannot be averaged out using data from just six surveys. A more extended sampling program would be required.

Each survey was conducted throughout a full tidal cycle to estimate the flux in and out of the harbor, during flood and ebb tide, respectively. Two sets of water samples were collected during each sampling round, which typically lasted somewhere between 7 and 20 minutes. Each set included water samples taken from near the surface (approximately 1m deep), mid-water column (approximately 5m deep), and from near the bottom (approximately 10m deep). The samples were taken using a Niskin bottle lowered on a rope using a small davit. The first sample was collected from the near-bottom layer. This sampling depth was determined using a lead weight hanging approximately 1m below the Niskin bottle. At the time the Niskin bottle was lowered, a slack in the rope indicated when the weight hit the seabed. The rope was then pulled back to eliminate the slack and the messenger was sent to close the bottle about 10 seconds later to assure that any sediment suspended when the weight hit the seabed had cleared before the bottom sample was collected. After the first sample was drained into a measuring glass, the bottle was lowered to half of the total depth and the mid-water sample was collected. The depth of the bottle was evaluated visually when the surface sample was collected.

2.1 SAMPLING LOCATIONS

Two (2) preliminary full-tidal-cycle ADCP surveys of the area were conducted to select appropriate sampling locations for the subsequent six (6) flux sampling events. The two (2) preliminary (or reconnaissance) surveys provided data to guide the decision on the locations at which water samples had to be taken during the flux sampling events to exclude possible bias if quasi-stationary circulation patterns were observed in the OU#3 area (e.g., eddies or other turbulence). The data from the two (2) preliminary events were analyzed together with data from the horizontal ADCP. The purpose of this analysis was to determine the extent of horizontal flow variability within (across or at depth) the channel.

Both types of current data revealed a rather homogeneous long-channel flow (Figures 2 and 3). The upper panel of Figure 2 shows a time series of the along-channel flow velocity (i.e., parallel to the Hurricane Barrier walls) during the time of the second reconnaissance survey. Time is represented along the horizontal axis and distance across the Hurricane Barrier is represented on the vertical axis (the 0 point is on the west side of the channel). The color bar represents the current speed (in cm/s) and direction (red represents flow out of New Bedford Harbor and blue represents flow into the Harbor). Moving from left to right across the top panel of Figure 2, each "stripe" represents a snapshot in time of the along channel currents. Although the data show the expected ebb and flood of the tidal currents over the 12 hour period, there is little evidence of cross-channel variation in the along-channel currents.

The lower panel of Figure 2 illustrates a slightly different perspective, however. It represents the small component of the current directed across the channel (i.e., perpendicular to the Hurricane

Barrier walls). At certain times (e.g., after 06:00 on February 2), the data show the cross-channel currents can be directed in different directions depending upon location across the channel. Although these cross-channel currents (0-10cm/s) are small as compared to the along-channel currents (0-100cm/s), these observations were used to select the sampling locations for the flux sampling events. The initial plan was to sample near each wall and in the middle of the channel. Based on reviewing the reconnaissance velocity data with the project team, samples were not collected in the near vicinity of the Hurricane Barrier walls. Instead, the flux event sampling scheme was refined to include one set of samples approximately one-third of the channel width distance off of each wall to avoid possible bias.

Figure 3 shows a plan view of the depth-averaged velocity vectors during ebb tide on the same day. The direction of the vector represents the flow direction, and the vector length is proportional to current speed. This plot is typical, and shows a relatively organized flow field draining from New Bedford Harbor out through the Hurricane Barrier.

The actual practice of holding the boat on-station during each round of sample collection at a fixed position was challenging due to currents, wind and vessel traffic, but a good faith effort was devoted to occupying the intended sampling stations. The boat drift introduced an element of randomness to the sampling location rather sampling strictly at two fixed locations. In view of the conclusion about the homogeneity of the long-channel flow, this random sampling did not compromise the quality of the composite sample. Two sets of samples were collected every 30 minutes.

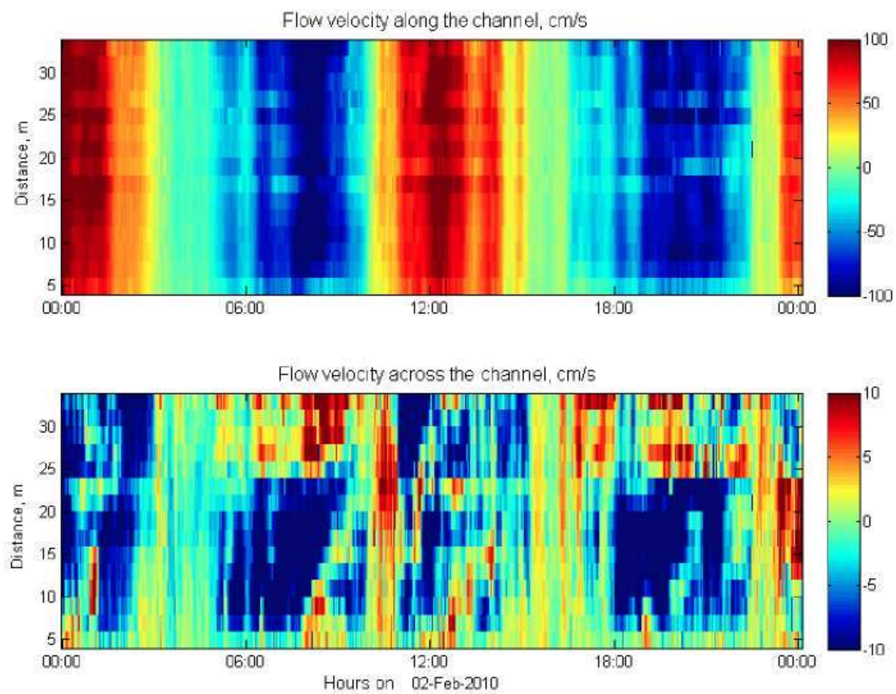

Figure 2. Color-coded time series of long-channel and cross-channel current velocities from the HADCP during the spring tide reconnaissance survey (y-axis shows distance from the instrument, deployed on the western wall, across the channel).

Figure 3. Depth-averaged flow vectors: ebb tide

2.2 WATER SAMPLE COLLECTION AND PROCESSING

All samples collected during a certain tidal phase (ebb or flood) were mixed together to form a composite sample for the particular tidal phase. A flow-proportional sampling scheme was implemented. A flow-proportional composite is comprised of multiple water samples each representative of an equal flow volume through the Hurricane Barrier. During neap tide, a 100ml sample of water was collected per 10cm/s flow velocity and a 50ml water sample was collected per 10cm/s flow velocity during spring tide (to ensure appropriate water volume in the sample). Appendix A shows the volume of water collected during each sampling event. The principal advantage of flow-proportional composites is that flow-proportional composites are not biased by over- or under-sampling any part of the tidal cycle. Flow-proportional sampling allows for direct estimation of Event Mean Concentration (EMC) without making assumptions about the relationship between pollutant concentrations and flow rates. By collecting greater sample volumes at higher flow rates (and smaller volume at low flow rates), a flow-proportional composite water sample allows direct analysis of the composite sample to estimate the EMC, which is defined as the arithmetic average concentration of the pollutant in the total volume. This flow-proportional sampling was implemented in a manner consistent with other EPA and USACE studies (Teeter, 1988).

The method applied to sample surface water using a discrete sampler (Niskin bottle) onboard a boat to obtain a composite surface water sample is described below. More details are provided in the Field Sampling Plan.

- Have a set of six pre-cleaned intermediate sampling containers (clean, inert graduated cylinder).
- Approach the western side of the entrance to the Hurricane Barrier Gate, and start the ADCP.

- Lower Niskin bottle to the appropriate depth and trigger discrete bottom sample.
- Raise Niskin bottle using winch and davit.
- Open Niskin bottle and drain sample in a clean inert graduated cylinder.
- Repeat sampling for mid-water depth.
- Repeat sampling for surface water sample.
- Repeat sampling on the eastern side of the channel.
- End ADCP data collection.
- Open ADCP data file and evaluate the ADCP data to determine the appropriate flow-proportioned sample volume.
- Decant the graduated cylinder for each sample to the appropriate flow-proportioned sample volume.
- Dump the sample(s) into the clean compositing container.
- Repeat above steps until a composite sample from all the depths, locations, and times are obtained.
- Mechanically mix the composite sample and remove a sub-sample using the appropriate new, labeled, pre-cleaned container with screw top provided by the laboratory – specific for each chemical analysis. Transfer the sample into a cooler with ice.
- Decontaminate sampling device and compositing basins between sampling rounds.

2.3 SAMPLE HANDLING AND CUSTODY

The following provides a brief description of sample handling and custody procedures. For details, please refer to the Woods Hole Group QAPP (Woods Hole Group, 2009b).

Samples were placed in coolers with the appropriate documentation and picked-up daily by a courier for Alpha Analytical. The temperature in the cooler was measured and recorded upon receipt at the laboratory.

Additional details regarding sample handling and custody include:

- Sample labels were hand-written at the time of sample collection and were affixed to the individual samples. Chain–Of-Custody (COC) forms were initiated in the field.
- Samples were in the custody of the survey Chief Scientist until relinquished to the laboratory.
- Custody forms accompanied the samples when transferred from the field to the laboratory.
- Each shipment included the original, signed custody forms. Copies of the custody forms were kept in the project files at WHG.
- When the samples arrived at the laboratory, custody was relinquished to the receiving Laboratory Sample Custodian. The Laboratory Sample Custodian examined the samples, verified that the COC forms were accurate and that the samples were intact, logged the samples into the laboratory tracking system, and completed and signed the custody forms.
- Copies of the original COC forms along with the comments and signature of the receiving Laboratory Sample Custodian were transferred to the WHG Task Manager.

2.4 ANCILLARY DATA

Multiple other sources of data were utilized for the flux study, including:

- Current data from the HADCP were used in post-processing to evaluate the accuracy of decisions made in the field regarding volumes of individual samples.
- Data from the USGS Paskamanset River flow gage were used to evaluate freshwater discharge into the upper harbor since direct freshwater discharge measurements are not available for New Bedford Harbor.
- Weather forecasts from NOAA were used to guide decisions on the timing of sampling events.
- Wind data from the Hurricane Barrier meteorological station were used to help interpret study results on inflow and outflow volumes.

3.0 RESULTS

This section reviews flow and sea level variability in the OU#3 study area (Section 3.1) and provides estimates of water and PCB fluxes through the Hurricane Barrier during the six sampling events (Section 3.2).

3.1 FLOW AND SEA LEVEL VARIABILITY AT THE GATE OF THE HURRICANE BARRIER

The data recorded by the pressure sensor of the HADCP were used to calculate parameters of major tidal constituents that describe about 92% of the total energy associated with tidal-driven sea level variability at the location of the sensor; that is, at the western wall of the Gate. A portion of the total record was selected for tidal harmonic analysis that did not have gaps that sometimes occurred due to gate closing. There were no gate closings after April 27th 2010, so the 51.5-day time series beginning on April 27th was used to calculate the water surface tidal constituents, as well as tidal constituents derived from current time series. The results are presented in Tables 2 and 3.

The tables list the names of tidal harmonics that were reliably resolved by the tidal harmonic analysis; that is, the harmonics for which the signal-to-noise ratio (SNR), shown in the last column, is greater than 2. All tidal harmonics characterized by a lower SNR had negligible amplitudes. Other parameters listed in the tables are the period of a harmonic, its amplitude and phase. Both amplitude and phase are shown with 95% confidence limits (indicated as Amplitude error and Phase error in Table 2). The superposition of these harmonics describes tidal oscillation of the water level and of the flow at any time. Thus, the parameters shown in the tables do not only reveal the range of tidal variability but also they can be used for prediction of water level and current at the Gate at any time. The 95% confidence intervals provided in the table for the amplitude and phase of each harmonic indicate how accurate such a prediction may be.

The major harmonics have amplitudes that exceed the noise level by an order of two or three, as for M2 harmonic, for example, indicating the results are accurate. As expected, the major tidal harmonic is M2, which is the primary semi-diurnal (twice daily) tidal constituent resulting from the interaction between the moon and the earth's oceans. Its amplitude is 52cm. The amplitude of the primary semi-diurnal solar constituent, S2, is only 8cm. Since M2 (12.42 hrs) and S2 (12 hrs) have slightly different periods, the spring/neap tidal cycle is typically a result of the interaction between M2 and S2. Because S2 is only a minor contributor at this site, tidal variations within the usual spring/neap tide cycle are relatively small. The amplitude of N2 harmonic, which is due to the non-circularity of the moon's orbit, is 12cm. The combination of M2 and N2 harmonics causes variations of the tide with a 27.5-day period. The role of the diurnal (once-daily) harmonics (which take into account the earth's equatorial plane with respect to the plane of the moon's orbit) is relatively small at this site. The amplitude of K1 is 8cm and the amplitude of O1 is 5cm. Among high-frequency harmonics, M4 (created primarily by non-linear interactions of the tide within the system) is the most energetic with an amplitude about 8cm.

Table 2. Amplitudes and phases of major tidal constituents: Water Level

Tidal harmonic	Period (hours)	Amplitude (m)	Amplitude error* (m)	Phase (degrees)	Phase error* (degrees)	SNR**
*O_1	25.82	0.05	0.009	135	10	33
*NO_1	24.83	0.01	0.007	173	30	4
*K_1	23.94	0.08	0.009	78	7	67
*N_2	12.66	0.12	0.010	214	4	150
*M_2	12.42	0.52	0.009	223	1	3700
*S_2	12.00	0.08	0.010	236	6	75
*MO_3	8.39	0.02	0.006	144	18	7
*MK_3	8.18	0.02	0.005	153	18	11
*MN_4	6.27	0.03	0.007	65	14	16
*M_4	6.21	0.08	0.008	111	5	100
*MS_4	6.10	0.01	0.007	166	31	4
*$2MK_5$	4.93	0.01	0.005	289	28	4

* 95% confidence interval

** Signal-to-Noise Ratio (only constituents with SNR > 2 are shown)

Current data from the HADCP were used to examine tidal variations of the mid-depth through-channel flow, which describe about 80-85% of the total flow variability, depending on the time period used to calculated tidal constituents. The major tidal harmonic of the current regime at the Hurricane Barrier is M2. Its amplitude is 50cm/s, and it accounts for approximately 50% of the total flow variability. The amplitude of S2 is 8cm/s, and the amplitude of N2 is 11cm/s. The amplitude of M4 is 15cm/s. The role of diurnal harmonics in the currents is small. The combined amplitude of O1 and K1 is 7cm/s only. It is common for currents to have a different tidal constituent variability than the water surface.

In addition to tidal-driven circulation, there can be substantial non-tidal, residual motions resulting from climatological conditions, interaction of flow within the system, and other forcings and responses. At the New Bedford Hurricane Barrier, there are occasional unique residual events. Analysis of the residual variations of the flow revealed the occurrence of transient high-amplitude (up to 150cm/s) oscillations with a period of about 80 minutes. The most significant events resulted in currents through the Barrier that were swifter than the tidal currents. With a period of 80 minutes, there were occasions when these residual currents actually caused a reversal in the tidal current direction – a unique circumstance. An example of such variations in the long-channel flow is shown in Figure 4. The alternating red and blue stripes around 1800 hrs on January 25 and after 0600 hrs on January 26 show reversing current directions with speeds approaching 150 cm/sec (~3 kts).

Using current data from the HADCP and meteorological data from the Hurricane Barrier, Woods Hole Group conducted a process-oriented analysis to better understand the importance of these observed residual motions. The analysis was focused on the following questions:

- Can these strong transient currents play a role in transport of PCBs?
- Can the occurrence of such an event be predicted using meteorological data?

The analysis of the data did not reveal any meaningful correlation between the occurrence of such high-frequency high-amplitude current oscillations and specific wind events. For example, these transient flow oscillations were observed to occur over a wide range of wind conditions. However, the residual motions did not consistently occur during any particular wind direction or speed. Wind conditions during the observed residual events occur quite frequently at other times, but the occurrence of high-amplitude flow oscillations was rare. Furthermore, the amplitude of this non-tidal motion exceeded 50cm/s approximately only 1% of the time (Figure 5). Therefore, it is logical to suggest that the role of such flow oscillations in the total flux of PCBs through the Hurricane Barrier is episodic, and small as compared to the ongoing tidal circulation. Based on the lack of a correlation with specific wind conditions, the events also could not be readily predicted based on the available information. Thus, the field sampling scheme was not modified. It was assumed that the major contributors to the flux of PCBs through the Hurricane Barrier may be semi-diurnal tidal oscillations, wind-driven flows, and freshwater runoff.

Table 3. Amplitudes and phases of major tidal constituents: Currents

Tidal harmonic	Period (hours)	Amplitude, cm/s	Amplitude error* (cm/s)	Phase, deg	Phase error* (deg)	SNR**
*O_1	25.82	3	0.6	221	15	16
*K_1	23.94	4	0.7	172	10	32
*N_2	12.66	11	1.1	300	6	100
*M_2	12.42	50	1.1	315	1	2100
*L_2	12.19	3	1.2	279	28	5
*S_2	12.00	8	1.0	326	7	62
*MO_3	8.39	2	0.8	228	25	6
*MK_3	8.18	2	0.9	226	30	3
*MN_4	6.27	6	1.8	15	17	9
*M_4	6.21	15	1.3	207	6	130
*MS_4	6.10	3	1.5	267	31	3
*$2MK_5$	4.93	3	1.6	14	35	3

* 95% confidence interval

** Signal-to-Noise Ratio (only constituents with SNR > 2 are shown)

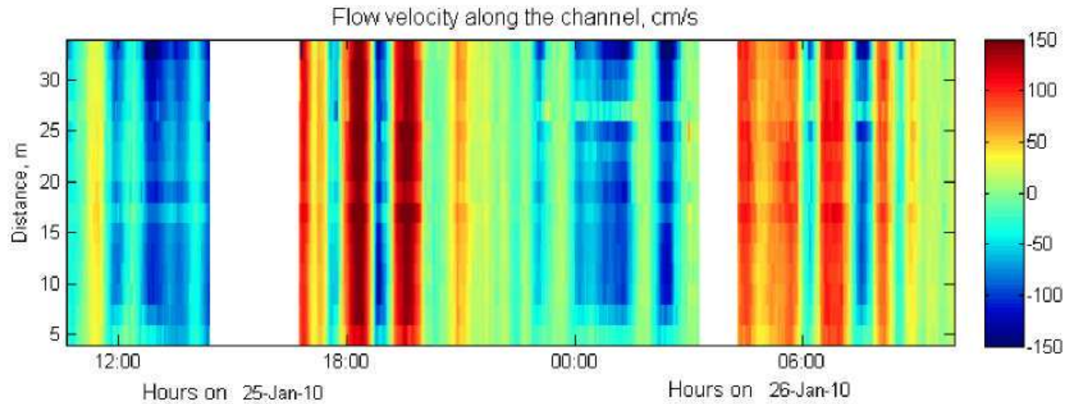

Figure 4. **Color-coded time series of long-channel velocity for January 25th and 26th 2010 (y-axis shows distance from the instrument, deployed on the western wall, across the channel).**

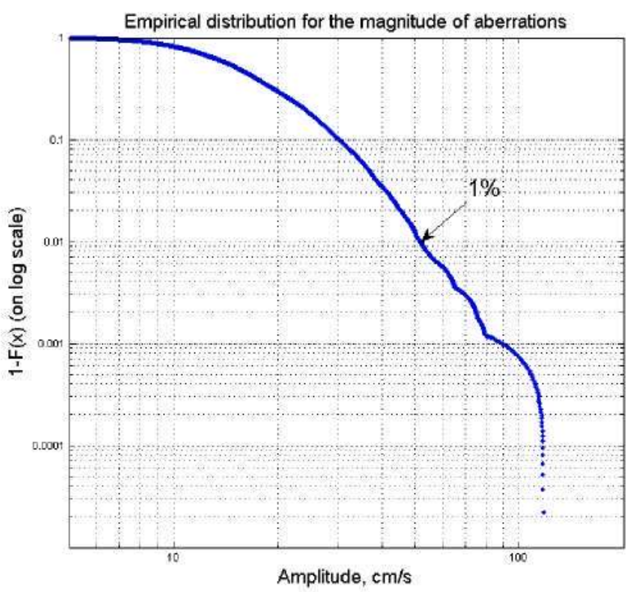

Figure 5. **Empirical distribution of the magnitude of high-frequency current oscillations. The amplitude of such oscillations exceeds 50cm/s 1% of the time.**

3.2 WATER AND PCB FLUXES DURING SAMPLING EVENTS

This section focuses on the discussion of tidal volumes (Table 4) and PCB fluxes (Table 5) through the Hurricane Barrier during each sampling event. Table 4 shows tidal volumes and water flux for the six sampling events. Table 5 summarizes measured PCB flux for each ebb and flood tide during each survey. All PCB data (209 congeners and homologues) are provided in Appendix B.

Measured flux was calculated based upon the measured PCB concentration and the measured flow volume for the particular tide based on the ADCP data. The difference between the measured flood and ebb PCB flux is not representative of the net flux, however, because of the tidal asymmetry (i.e., there are higher high and lower low tides each day). Therefore, Table 5 also lists estimated net PCB flux for each event due to tidal pumping and net freshwater inflow, as described in Section 2.0 [total net PCB flux (last column of Table 5) is the sum of these two parameters]. PCB concentrations measured in the flow-proportional composite samples for ebb and flood tides for the six sampling events are shown in Figure 6. Sections 3.2.1 through 3.2.6 describe conditions and detailed results for each sampling event.

Table 4. Tidal volumes and water fluxes for the six sampling events.

Event	Flood volume, 10^6 m^3	Ebb volume, 10^6 m^3	Mean tidal volume, 10^6 m^3	Freshwater flux, m^3/s
001-weather (04/02)	3.27	3.97	3.3	14
002-neap (04/21)	3.02	2.73	2.8	0.8
003-weather (04/28)	3.66	4.98	4.3	0.8
004-neap (05/07)	2.48	2.08	2.3	0.5
005-spring (05/13)	3.39	3.74	3.6	0.4
006-spring (05/26)	4.97	3.71	4.3	0.5

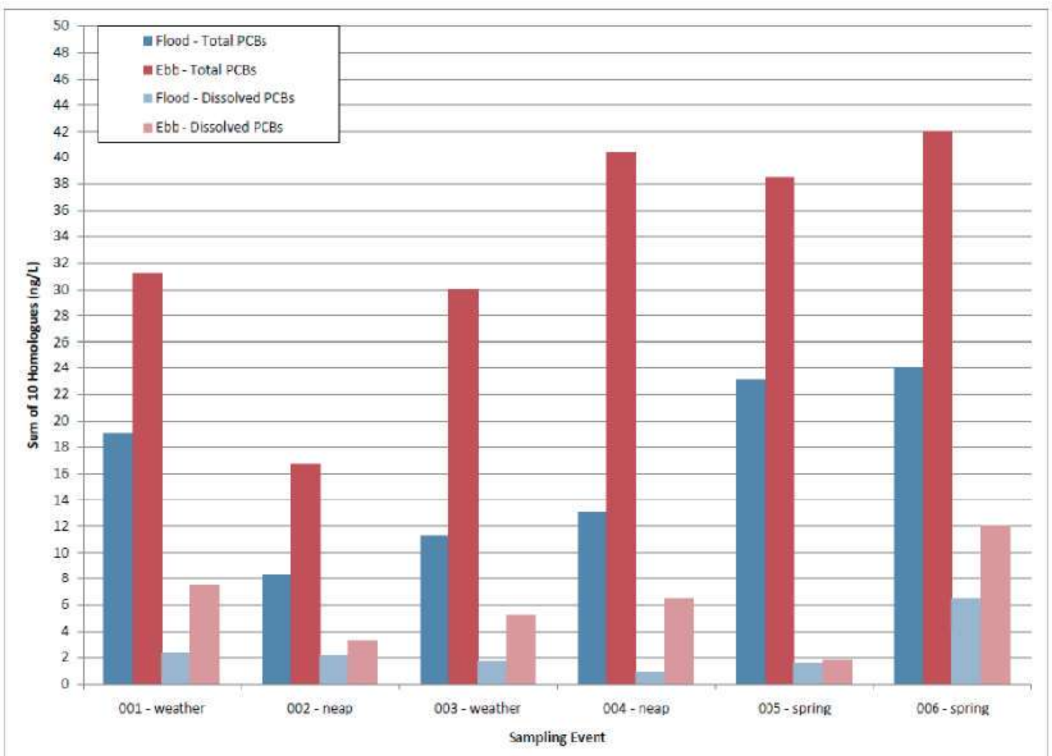

Figure 6. PCB concentration in composite samples for ebb and flood for the six sampling events.

Table 5. PCB fluxes

Event	Measured PCB Mass Flux		Estimated Net PCB Mass Flux		
	Total mass flux of PCBs: flood, g	Total mass flux of PCBs: ebb, g	Tidal-pumping PCB mass flux, g per tidal cycle	Net-flow PCB mass flux, g per tidal cycle	Total PCB mass flux, g per tidal cycle
001-weather	62.1	-123.1	-39.6	-19.4	-59.0
002-neap	25.4	-46.4	-24.1	-0.6	-24.7
003-weather	39.6	-149.4	-81.7	-1.1	-82.8
004-neap	32.2	-83.2	-62.1	-0.9	-63.0
005-spring	78.0	-145.9	-57.6	-0.8	-58.4
006-spring	119.3	-155.8	-77.4	-0.9	-78.3

3.2.1 Sampling event #1: April 2nd 2010 (wet weather event)

Sampling on April 2nd 2010 was conducted after a prolonged period of torrential rains and was selected to represent a wet weather event. The sampling started at low water, approximately at 05:30, and ended around 16:20 when the tide turned to flood again (Figure 7). High water was observed at about 11:00 this day. The range of tidal variability was about 110cm. Wind conditions (Figure 8) were characterized by weak northerly winds during the first half of the day (flood) followed by a persistent southwesterly breeze, with wind speeds around 4m/s, during the ebb. Figure 9 compares long-channel current velocities recorded by the HADCP mounted on the Hurricane Barrier with the velocity estimates measured using the ADCP on the boat to determine the volume of each individual sample. This comparison shows good agreement between these data, which helps confirm the validity of the flow-proportional sampling for this sampling event.

Freshwater discharge data are not available for the Acushnet River, which flows into New Bedford Harbor. To estimate the volume of freshwater runoff for the period of the sampling, flow data from the USGS Paskamanset River gage were used. This is the nearest watershed basin to the Acushnet River basin, located to the west from the Aushnet River. The approach was dependent upon the major assumption that inflow from the Acushnet River could be scaled in proportion to inflow in the Paskamanset River given their close proximity. The Acushnet River and Paskamanset River watersheds cover areas approximately of the same size and shape, though land use may be slightly different in these areas since the Acushnet River includes the city of New Bedford while the Paskamanset River area includes the smaller city of Dartmouth.

The daily data for the Paskamanset River reveal that, in the beginning of April, the discharge of that river was approximately 14 times the mean annual discharge. Based on work by Jason M. Cortell and Associates (Jason M. Cortell and Associates 1982, in Teeter et al. 1988), the mean annual Acushnet River discharge can be estimated as approximately $1m^3/s$. Assuming linear proportionality between the flow in the two rivers, the freshwater discharge of the Acushnet River in the beginning of April was estimated to be $14m^3/s$. This value of freshwater inflow and the mean concentration of PCBs during the ebb were used to calculate net-flow PCB flux [per methods outlined in Section 2.0, equations (1), (2)] through the Hurricane Barrier on April 2nd 2010. This net-flow PCB flux was equal to -19.4g per tidal cycle, or approximately -37g per day. The minus sign defines a flux out of the harbor. At the same time, the difference in the PCB concentrations reported by the laboratory for the ebb and flood (12ng/l) resulted in the outflow of PCBs due to tidal pumping at a rate of -39.6g per tidal cycle. The total flux of PCBs was about -59g per tidal cycle during this period.

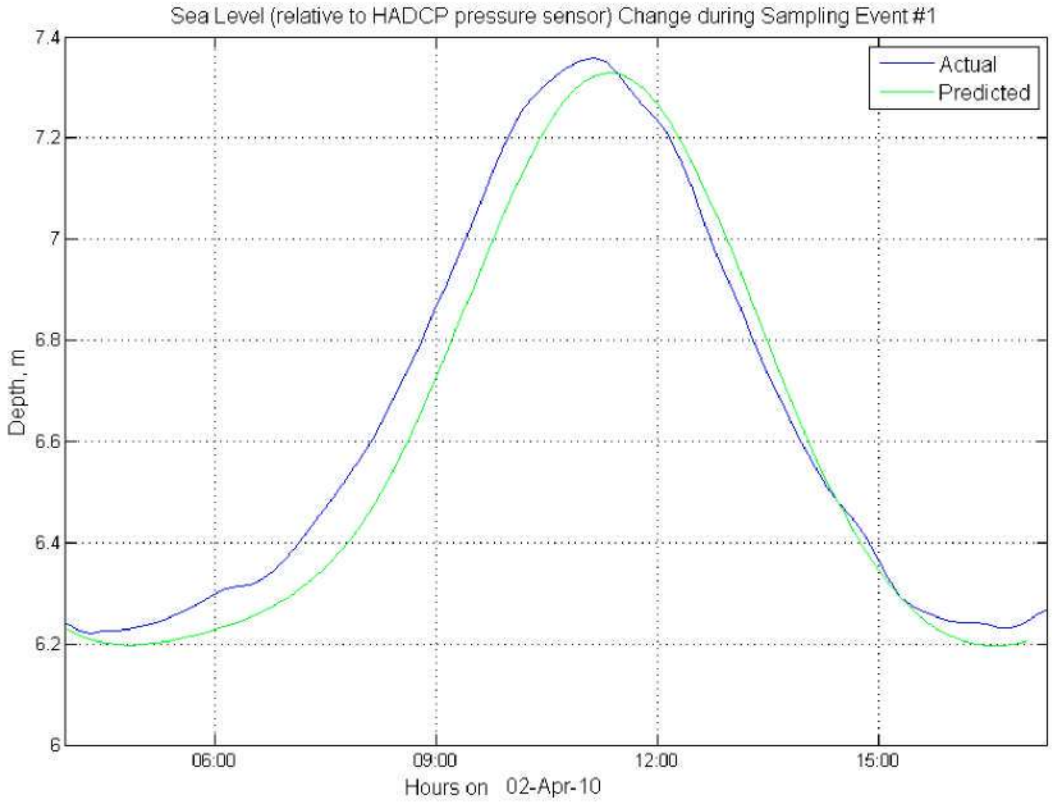

Figure 7. Time series of the actual water level (blue) and predicted water level (green) during the first sampling event (02-Apr-10).

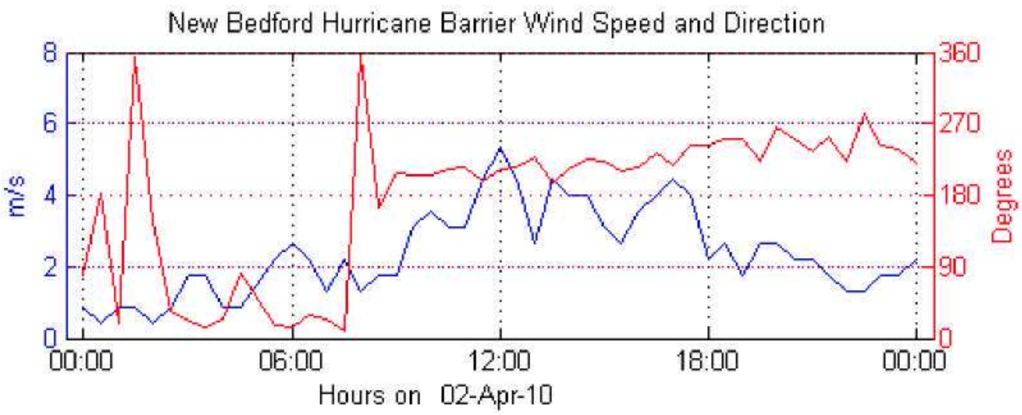

Figure 8. Time series of wind speed and direction at the Hurricane Barrier for 02-Apr-10.

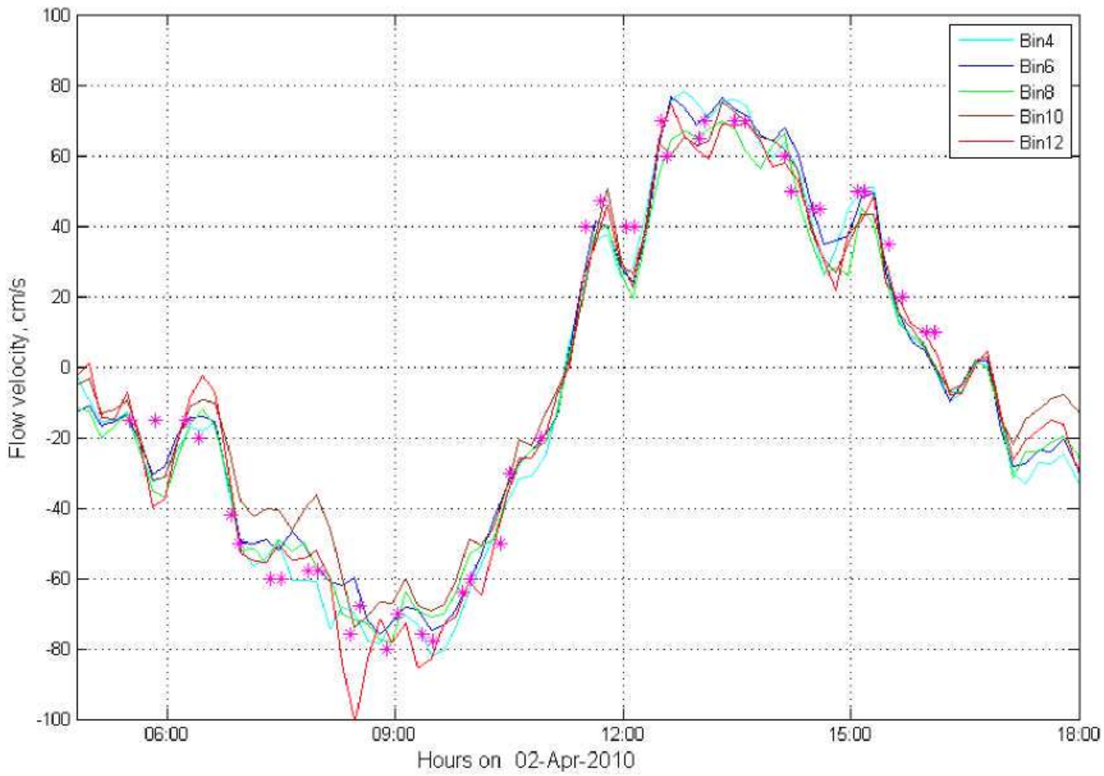

Figure 9. Long-channel flow velocity from selected HADCP bins for 02-Apr-10. Magenta stars (*) show flow velocities (measured from the ADCP on the boat) used for estimation of sample volumes in the field during April 2nd sampling.

3.2.2 Sampling event #2: April 21st 2010 (neap tide)

Sampling on April 21 2010, which was a neap tide sampling event, started at low water, approximately at 09:00, and ended around 19:15 when the tide turned to flood (Figure 10). High water was observed at about 14:00. The range of tidal variability was equal to 90cm. The sea level change during ebb was slightly less than sea level change during flood. This tidal asymmetry may offer an explanation to why the flood tidal volume was slightly greater than the ebb tidal volume during this sampling period. Wind conditions (Figure 11) were characterized by weak northerly winds in the morning, and a persistent southwesterly breeze (wind speeds around 5m/s) during most of the day. The comparison between long-channel current velocities with the velocity estimates made in the field to determine the volume of each individual sample (Figure 12) shows good agreement between these data, which is a confirmation of the validity of flow-proportional sampling for this sampling event.

Freshwater discharge into the harbor for April 21st was estimated under the assumption of similarity between the hydrographs of the Acushnet River and Paskamanset River. The discharge for the Acushnet River was estimated to be around 0.8m^3/s, which is small compared with the tidal flow rates. This value of freshwater runoff was used to calculate net-flow PCB flux through the

Hurricane Barrier on April 21st 2010. This net-flow PCB flux was equal to -0.6g per tidal cycle. The difference in the PCB concentrations during ebb and flood (8.6ng/l) resulted in the tide-corrected outflow of PCBs at a rate of -24.1g per tidal cycle. The total flux of PCBs was about -24.7g per tidal cycle during this period.

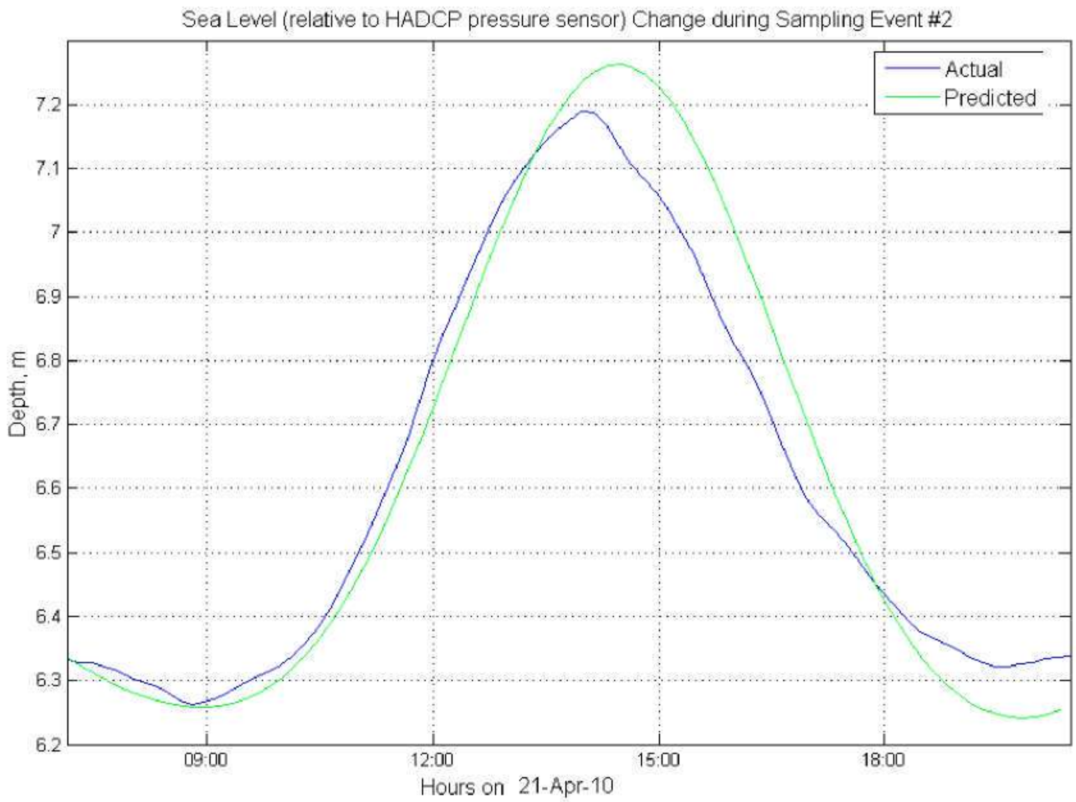

Figure 10. **Time series of the actual water level (blue) and predicted water level (green) during the second sampling event (21-Apr-10).**

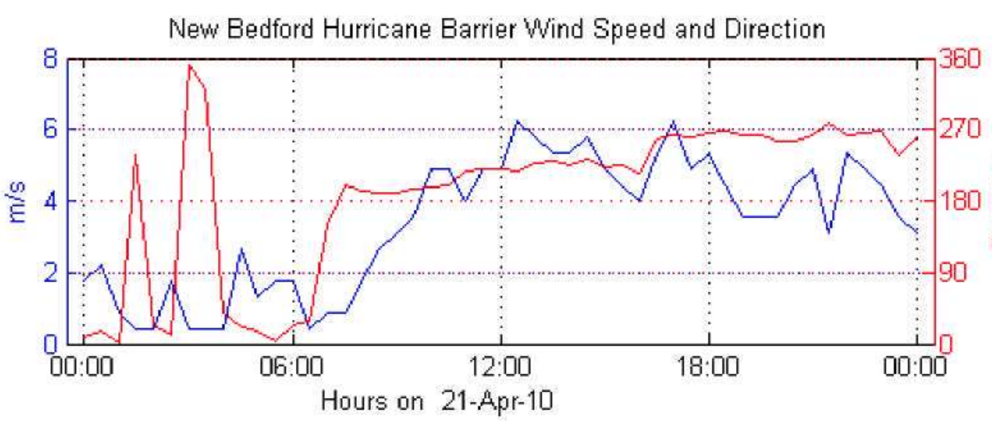

Figure 11. **Time series of wind speed and direction at the Hurricane Barrier for 21-Apr-10.**

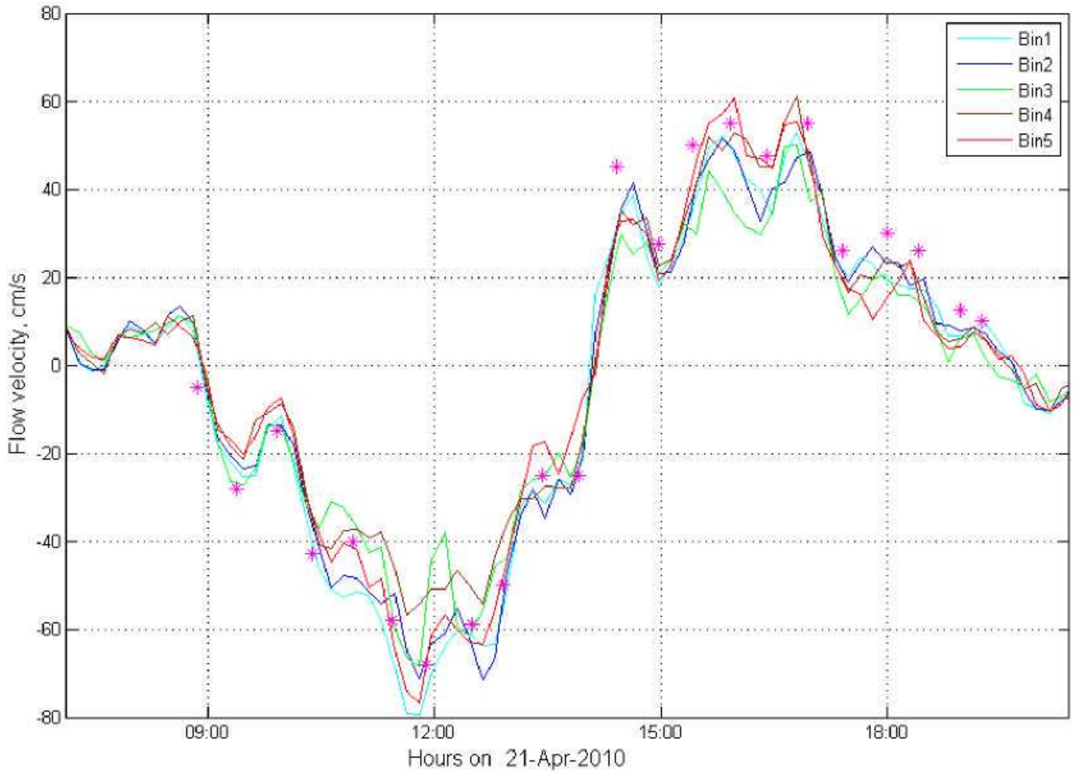

Figure 12. Long-channel flow velocity from selected HADCP bins for 21-Apr-10. Magenta stars (*) show flow velocities (measured from the ADCP on the boat) used for estimation of sample volumes in the field during April 21st sampling.

3.2.3 Sampling event #3: April 28th 2010 (weather event)

Sampling on April 28th 2010 was conducted after a day of heavy rainfall, so it was planned as a wet weather sampling event. However, the discharge of the Paskamanset River did not show any notable increase during this time, but the sampling period was characterized by strong northwesterly winds, so this sampling event was characteristic of an abnormal weather condition. The sampling started at high water, approximately at 09:00, and ended around 20:15 when the tide turned to ebb (Figure 13). Low water was observed at about 14:00. The range of tidal variability was equal to 150cm, which is characteristic of spring tide. The sea level change during ebb was approximately the same as sea level change during flood. However, even without a notable tidal asymmetry, the volume of the outflow exceeded the volume of the inflow by about 26% during the sampling period. This asymmetry in the volumes of the inflow and outflow that day may be attributed to the strong northwesterly winds that were driving the water out of the harbor during ebb tide and blocking the inflow during flood. Wind conditions (Figure 14) were characterized by strong, up to 15m/s, gusty northwesterly winds. The comparison between long-channel current velocities with the velocity estimates made in the field to determine the volume of each individual sample (Figure 15) shows good agreement between these data, which is a confirmation of the validity of flow-proportional sampling for this sampling event.

Freshwater discharge into the harbor for April 28st was estimated under the assumption of similarity between the hydrographs of the Acushnet River and Paskamanset River. The discharge for the Acushnet River was estimated to be around $0.8 m^3/s$, which is small compared with the tidal flow rates. This value of freshwater runoff was used to calculate net-flow PCB flux through the Hurricane Barrier on April 28th 2010. This net-flow PCB flux was equal to -1.1g per tidal cycle. The difference in the PCB concentrations during ebb and flood (19ng/l) resulted in the tide-corrected outflow of PCBs at a rate of -81.7g per tidal cycle. The total flux of PCBs was about -82.8g per tidal cycle during this period.

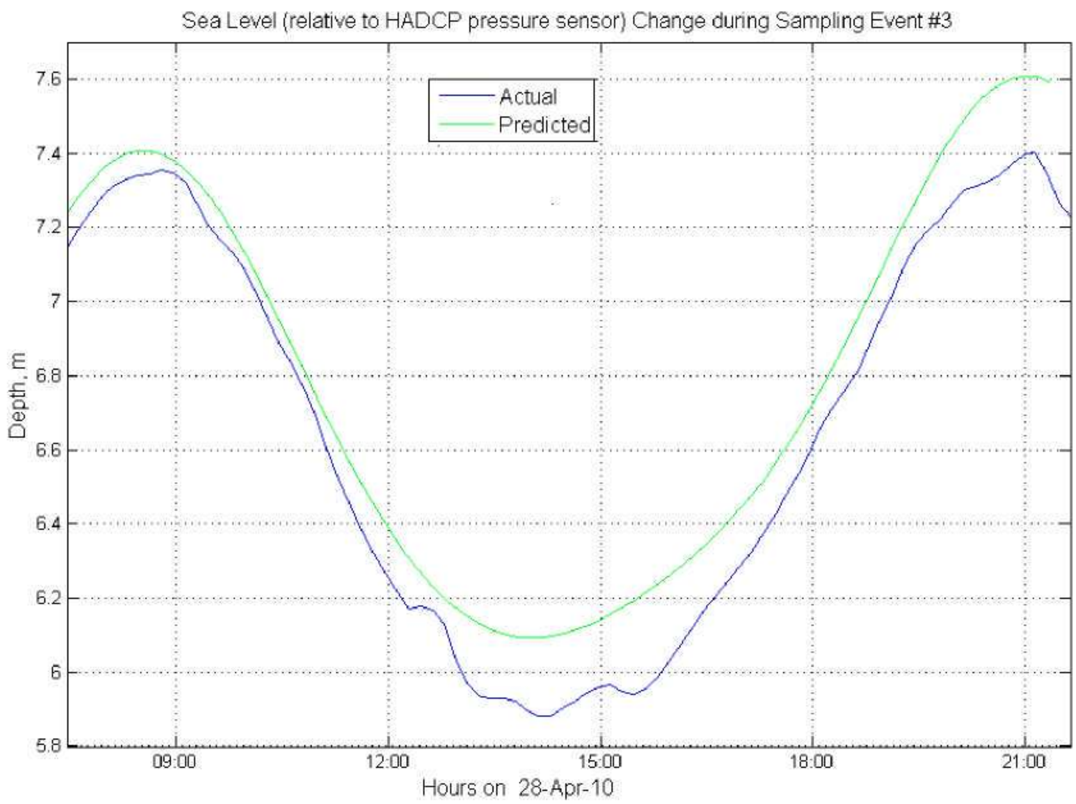

Figure 13. Time series of the actual water level (blue) and predicted water level (green) during the first sampling event (28-Apr-10).

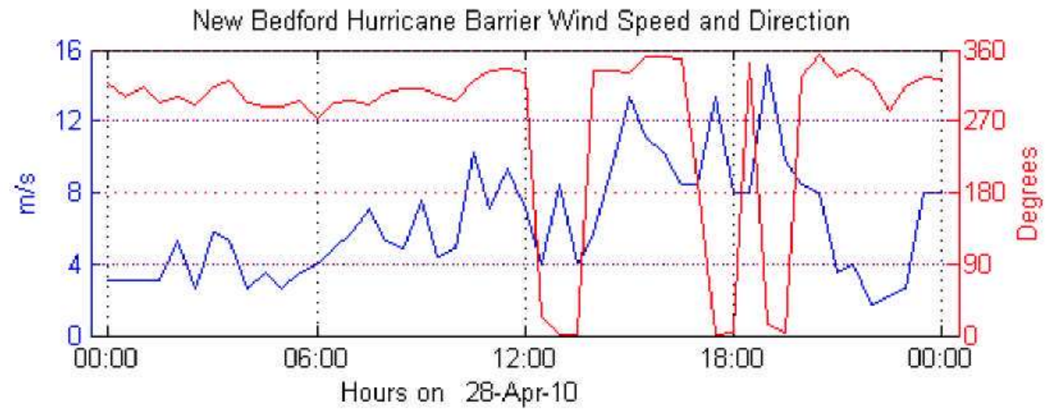

Figure 14. Time series of wind speed and direction at the Hurricane Barrier for 28-Apr-10.

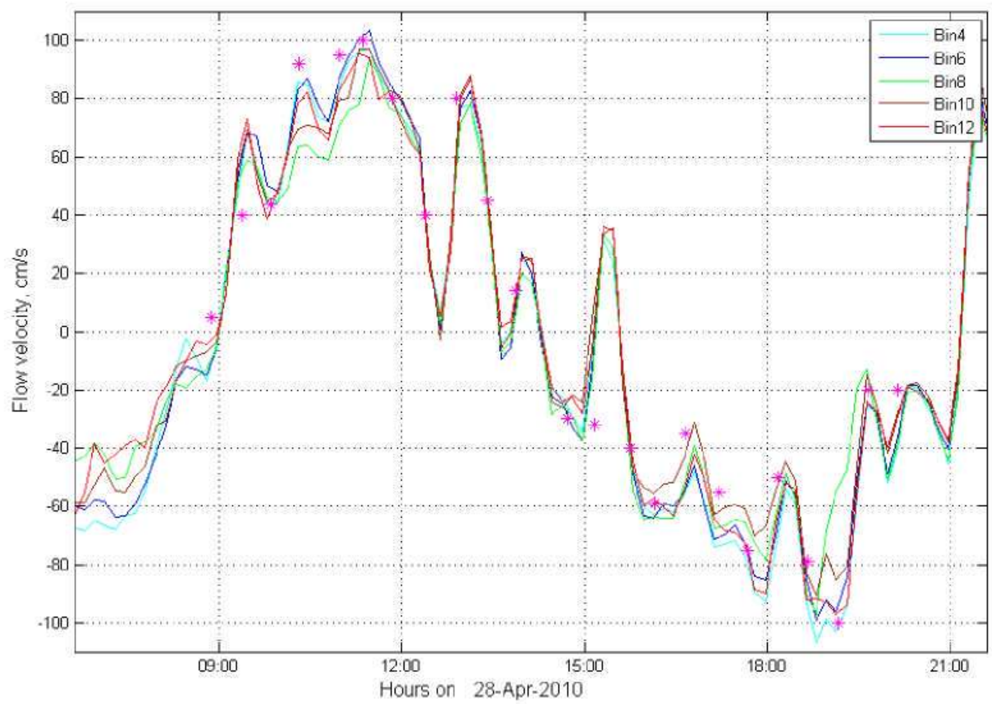

Figure 15. Long-channel flow velocity from selected HADCP bins for 28-Apr-10. Magenta stars (*) show flow velocities (measured from the ADCP on the boat) used for estimation of sample volumes in the field during April 28th sampling.

3.2.4 Sampling event #4: May 7th 2010 (neap tide)

Sampling on May 7th 2010, which was a neap tide sampling event, started at low water, approximately at 09:15, and ended around 21:15 when the tide turned to flood (Figure 16). High water was observed at about 15:50. The range of tidal variability was equal to 80cm. The sea level change during ebb was slightly less than sea level change during flood. This tidal asymmetry may explain why the flood tidal volume was slightly greater than the ebb tidal volume. Wind conditions (Figure 17) were characterized by northwesterly winds during flood. The wind direction changed at about 14:00. During ebb, the wind was from the west. The comparison between long-channel current velocities with the velocity estimates made in the field to determine the volume of each individual sample (Figure 18) shows good agreement between these data, which is a confirmation of the validity of flow-proportional sampling for this sampling event.

The freshwater discharge into the harbor for May 7th was estimated under the assumption of similarity between the hydrographs of the Acushnet River and Paskamanset River. The discharge for the Acushnet River was estimated to be around $0.5m^3/s$, which is small compared with the tidal flow rates. This value of freshwater runoff was used to calculate net-flow PCB flux through the Hurricane Barrier on May 7th 2010. This net-flow PCB flux was equal to -0.9g per tidal cycle. The difference in the PCB concentrations during ebb and flood (27ng/l) resulted in the tide-corrected outflow of PCBs at a rate of -62.1g per tidal cycle. The total flux of PCBs was about -63g per tidal cycle during this period.

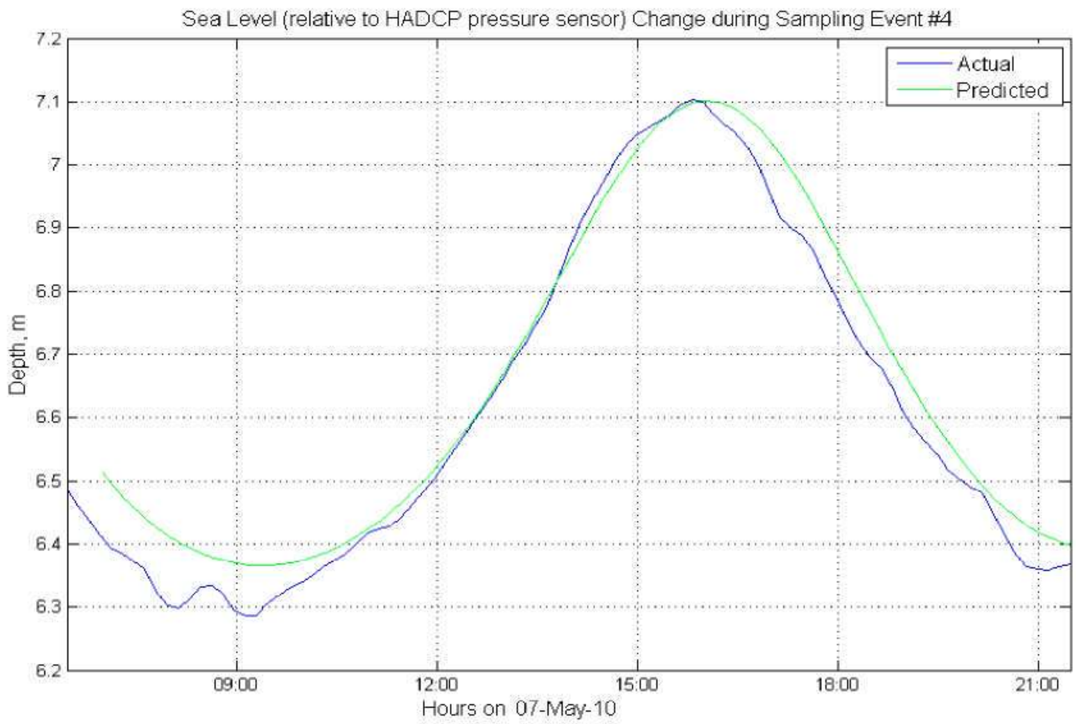

Figure 16. Time series of the actual water level (blue) and predicted water level (green) during the first sampling event (07-May-10).

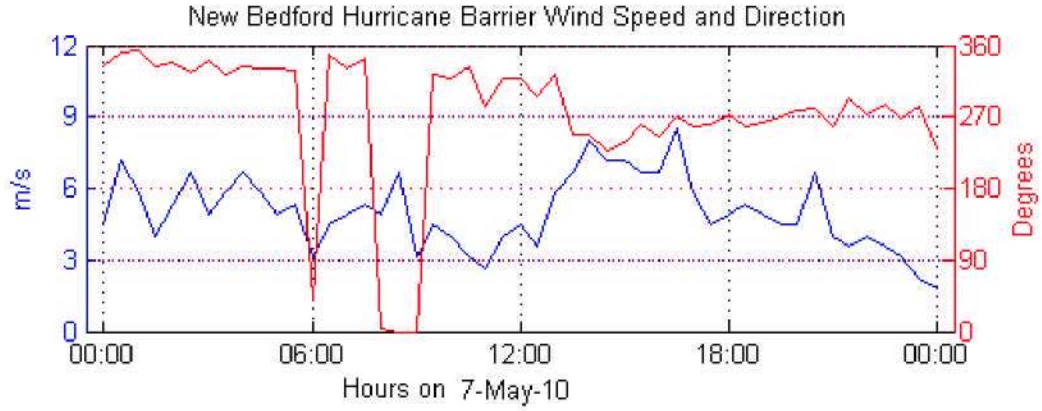

Figure 17. Time series of wind speed and direction at the Hurricane Barrier for 07-May-10.

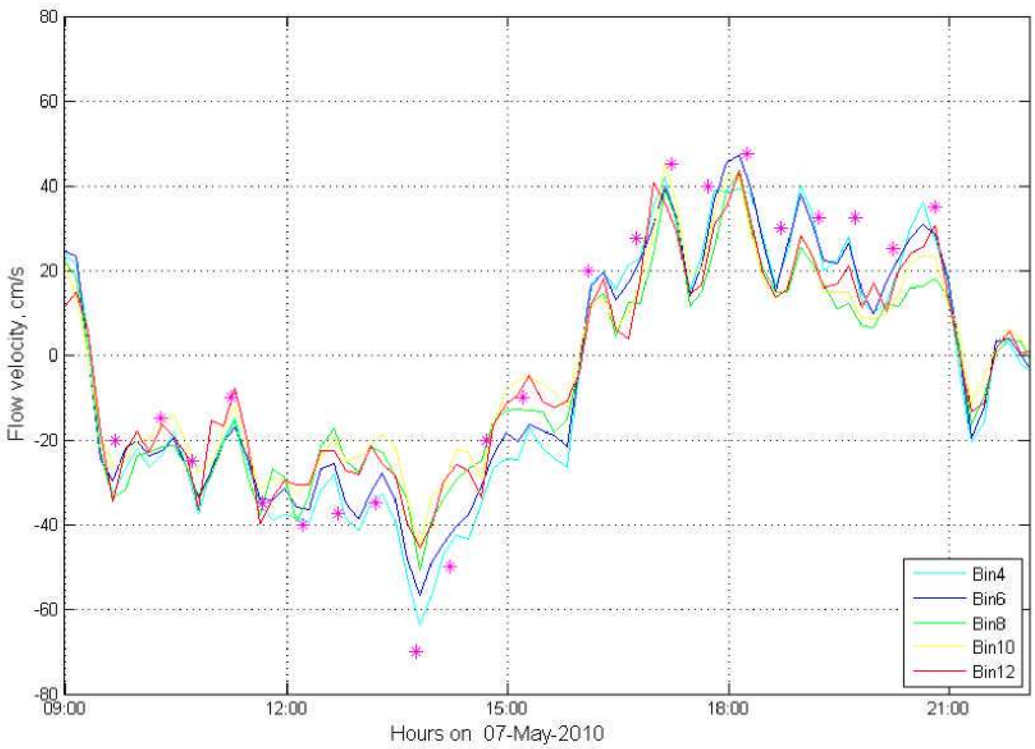

Figure 18. Long-channel flow velocity from selected HADCP bins for 07-May-10. Magenta stars show flow velocities (measured from the ADCP on the boat) used for estimation of sample volumes in the field May 7th sampling.

3.2.5 *Sampling event #5: May 13th 2010 (spring tide)*

Sampling on May 13th 2010, which was a spring tide sampling event, started at high water, approximately at 08:15, and ended around 19:30 (Figure 19). Low water was observed at about 13:00. The range of tidal variability was equal to 110cm during ebb and 130cm during flood. The tidal asymmetry suggested that the flood tidal volume would be greater than the ebb tidal volume. This was not the case however, perhaps due to northwesterly winds that were driving surface water out of the harbor during ebb. Wind conditions (Figure 20) were characterized by northerly winds during the ebb and southwesterly and westerly winds during the flood. The comparison between long-channel current velocities with the velocity estimates made in the field to determine the volume of each individual sample (Figure 21) shows good agreement between these data, which is a confirmation of the validity of flow-proportional sampling for this sampling event.

Freshwater discharge into the harbor for May 13th was estimated under the assumption of similarity between the hydrographs of the Acushnet River and Paskamanset River. The discharge for the Acushnet River was estimated to be around $0.4m^3/s$, which is small compared with the tidal flow rates. The net-flow PCB flux was equal to -0.8g per tidal cycle. The difference in the PCB concentrations during ebb and flood (16ng/l) resulted in the tide-corrected outflow of PCBs at a rate of -57.6g per tidal cycle. The total flux of PCBs was about -58.4g per tidal cycle during this period.

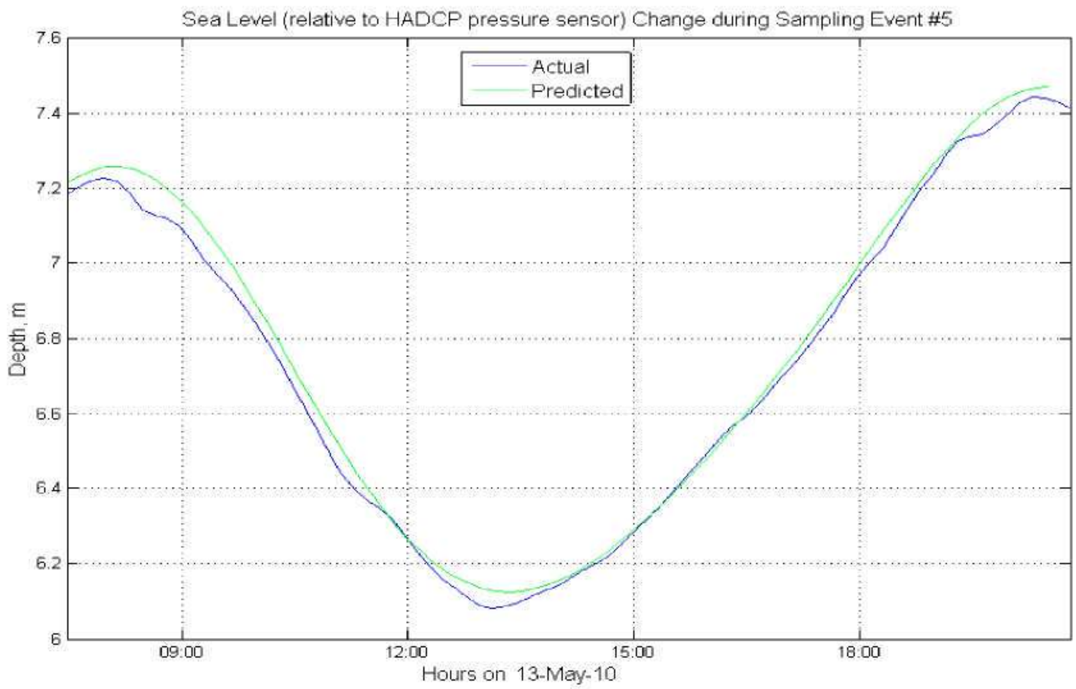

Figure 19. Time series of the actual water level (blue) and predicted water level (green) during the first sampling event (13-May-10).

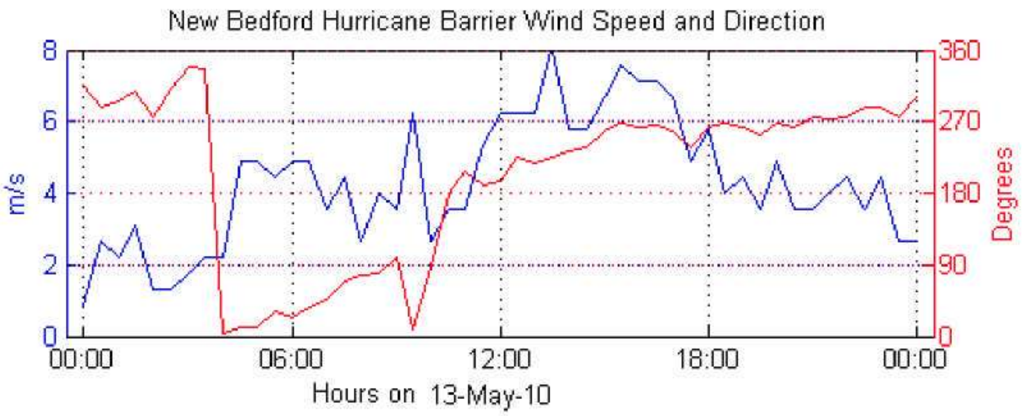

Figure 20. Time series of wind speed and direction at the Hurricane Barrier for 13-May-10.

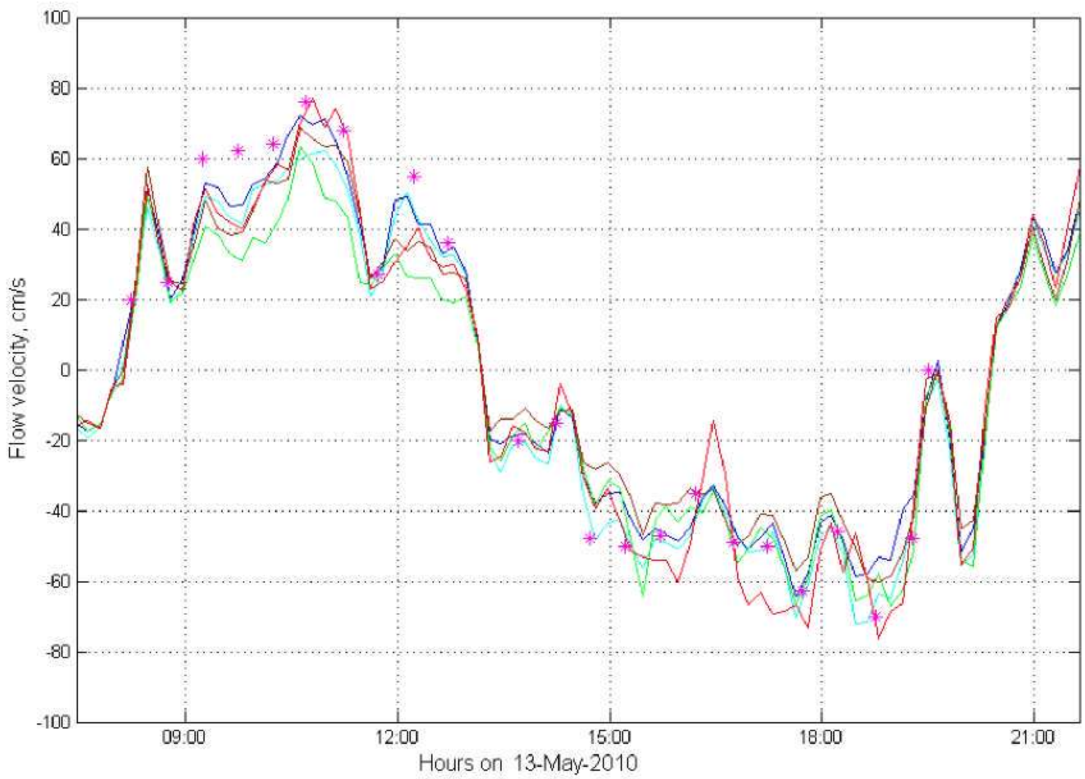

Figure 21. Long-channel flow velocity from selected HADCP bins for 13-May-10. Magenta stars show flow velocities (measured from the ADCP on the boat) used for estimation of sample volumes in the field May 13 sampling.

3.2.6 Sampling event #6: May 26th 2010 (spring tide)

Sampling on May 16th 2010, which was a spring tide sampling event, started at high water, approximately at 07:30, and ended around 19:15. Low water was observed at about 13:15 (Figure 22). The range of tidal variability was equal to 120cm during ebb and 150cm during flood. The tidal asymmetry suggested that the flood volume would be greater than the ebb volume. Indeed, the flood volume exceeded ebb volume by about 25%. Wind conditions (Figure 23) were characterized variable and light winds during the ebb and mostly southerly winds, with speeds around 4m/s, during the flood. The comparison between long-channel current velocities with the velocity estimates made in the field to determine the volume of each individual sample (Figure 24) shows good agreement between these data, which is a confirmation of the validity of flow-proportional sampling for this sampling event.

The freshwater discharge into the harbor for May 26th was estimated under the assumption of similarity between the hydrographs of the Acushnet River and Paskamanset River. The discharge for the Acushnet River was estimated to be around 0.5m^3/s, which is small compared with the tidal flow rates. The net-flow PCB flux was equal to -0.9g per tidal cycle. The difference in the PCB concentrations during ebb and flood (18ng/l) resulted in the tide-corrected outflow of PCBs at a rate of -77.4g per tidal cycle. The total flux of PCBs was about -78.3g per tidal cycle during this period.

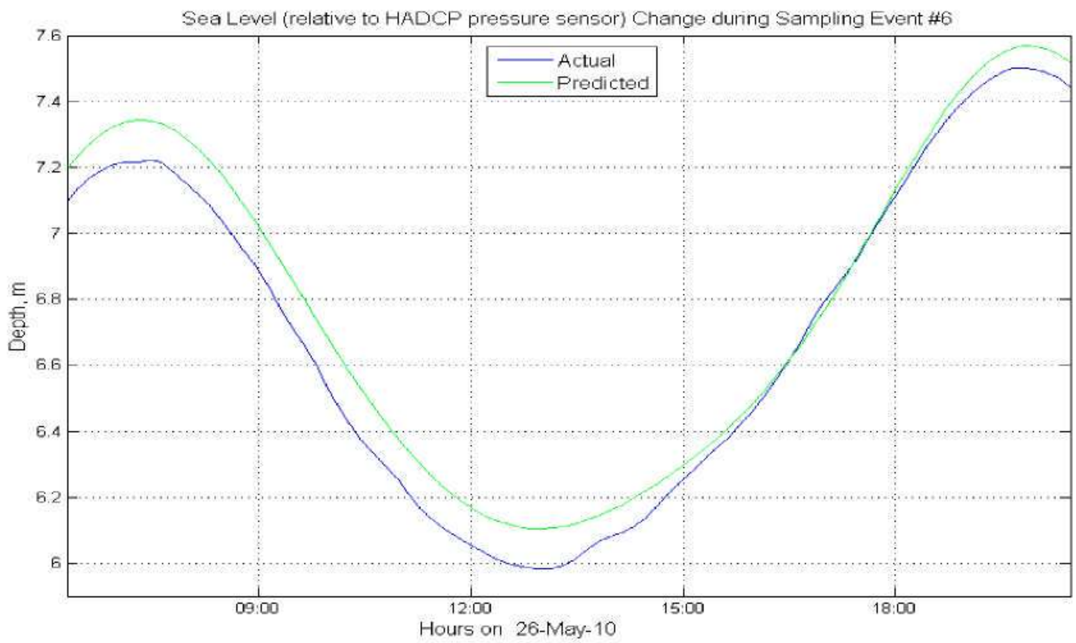

Figure 22. Time series of the actual water level (blue) and predicted water level (green) during the first sampling event (26-May-10).

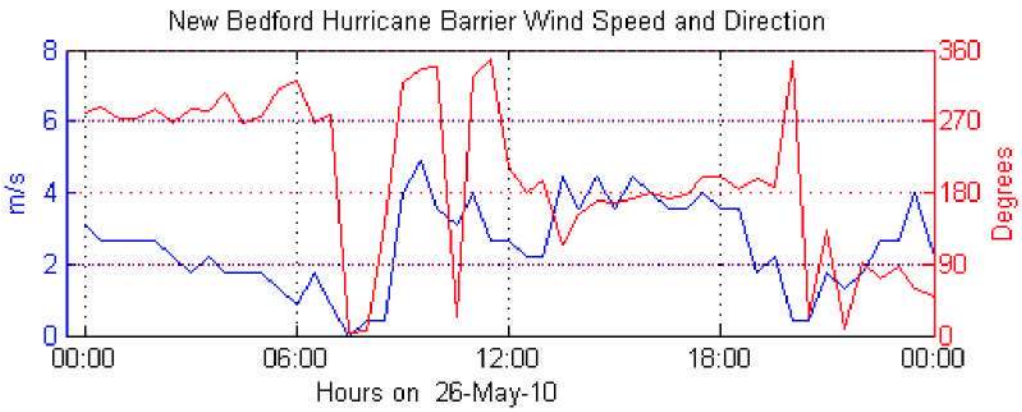

Figure 23. Time series of wind speed and direction at the Hurricane Barrier for 26-May-10.

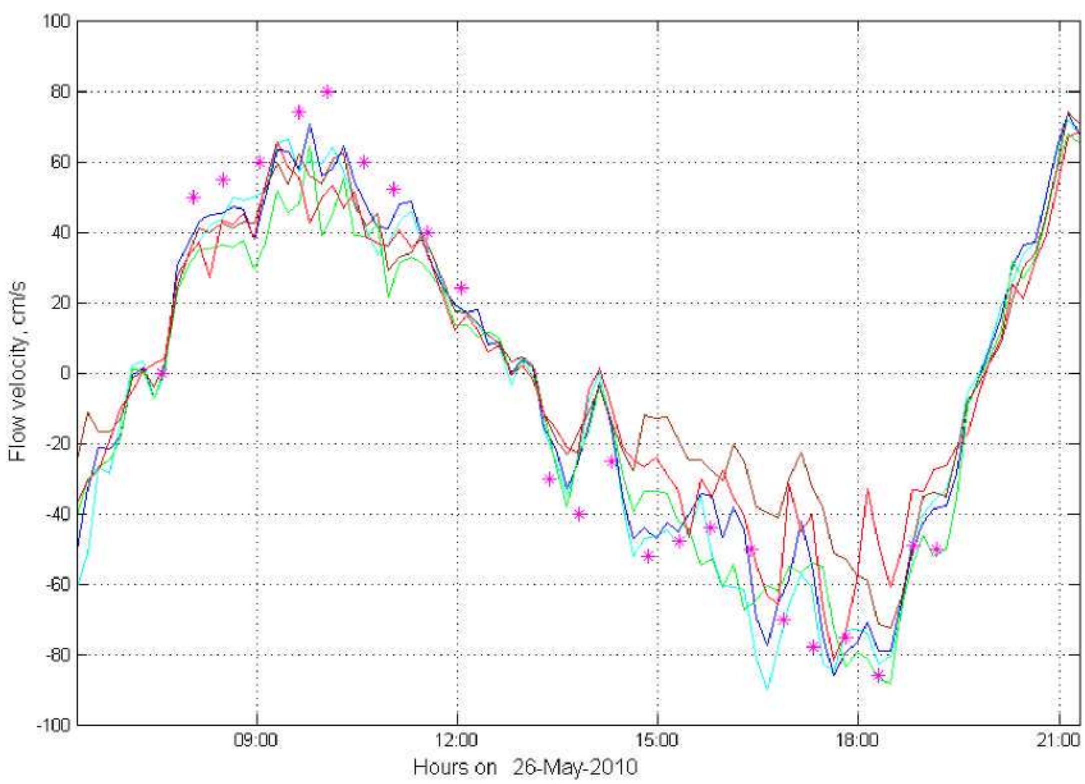

Figure 24. Long-channel flow velocity from selected HADCP bins for 26-May-10. Magenta stars show flow velocities (measured from the ADCP on the boat) used for estimation of sample volumes in the field during May 26th sampling.

4.0 SUMMARY

The results of the six sampling surveys intended to estimate the PCB flux to the OU#3 area show a persistent flux of PCBs through the Hurricane Barrier out from New Bedford Harbor. In the spring of 2010, the net rate of the total PCB mass flux ranged from -24.7g per tidal cycle (neap tide on April 21) to -82.8g per tidal cycle (weather event on April 28 coinciding with spring tide). The mean net PCB mass flux for the six (6) sampling events was approximately -61g per tidal cycle, which translates to approximately -118g per day.

The prevailing mechanism for PCB net flux through the Hurricane Barrier is tidal pumping, with net freshwater discharge providing small contributions during five (5) of the six (6) events. PCB concentrations were always lower on the flood tide than on the ebb tide, and it is the magnitude of this concentration difference that contributed most to the rate of the net PCB outflow from New Bedford Harbor to OU#3. Average tidal pumping PCB net mass flux was 57.1g per tidal cycle (range: -24.1 to -81.7), whereas average net PCB mass flux due to freshwater inflow [for the five (5) events when freshwater inflow was low] was -0.9g per tidal cycle (range: -0.6 to -1.1). The estimated net PCB mass flux for the high freshwater inflow event (April 2 flood) was -19.4g per tidal cycle, which was less than half of the tidal pumping PCB mass flux for that particularly rare event. No meaningful correlation was established between PCB concentrations in the flood and ebb composite samples and such parameters as flow velocities, sea conditions, and freshwater runoff.

PCB flux varied considerably over the six sampling events. On the flood tides, flux varied by a factor of almost 5 (range 25.4 to 119.3g). On ebb tides, flux varied by a factor of about 3 (range 46.4 to 155.8g). Similarly, the fraction of dissolved to total (dissolved plus particulate) PCBs varied by approximately a factor of more than 3. The total PCB concentration, as well as partitioning in the dissolved vs. particulate phase in the water at any given time are affected by a number of variables. These include the amount of particulate and dissolved organic carbon in water, differences in solubility of various PCB compounds (Adzeel et al. 1997; Garton et al. 1996), and suspended sediment concentrations in water column. These in turn depend on a variety of physical, biological, and chemical processes including seawater mixing, sediment scour, microbial and other biological activity, input of dissolved organic matter from surface- or groundwater inflow; and other factors. These issues, as they relate to fate, transport, and bioavailability of PCBs will be further investigated as part of the Remedial Investigation/Feasibility Study for OU#3.

This study indicates that the New Bedford Harbor sediments and water serve as a source of PCBs to OU#3, the 17,000 acre area outside the hurricane barrier. The measured flux rate compares with earlier modeled estimates of PCB flux through the barrier (Battelle, 1990), which estimated an out-flux of PCBs through the barrier of 150g per tidal cycle in 1990 and forecasted an out flux of 110g per tidal cycle for simulation year 10 (this would have been 2000, as the model was completed in 1990). The net PCB mass flux export values from the 2010 campaign outlined in this report are in a similar range, but lower on average. The average calculated net PCB mass flux in 2010 is slightly more than half (55%) of the Battelle modeled value for year 2000. Note that the PCB flux estimates from (Battelle, 1990) were based on field and laboratory studies that provided input to a physical/chemical model interfaced with a food chain model, while the estimates of the fluxes provided in this report are entirely empirical.

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APPENDIX A. TABLES SHOWING SAMPLE VOLUME FOR EACH COMPOSITE SAMPLE (6 TABLES)

Results: Ultra Study 209 PCB Congeners and Total PCBs (Sum of Congeners, non-detects considered 0)

PCB Congener	Sample ID	SW-LDH-03ED-D-0-40 D			SW-LDH-01ET-0-0-40 0			SW-LDH-01FD-D-0-40 D			SW-LDH-03FT-D-0-40 D		
	CAS Code	Result	Unit	RvO	Result	Unit	RvO	Result	Unit	RvO	Result	Unit	RvO
2-Monochlorobiphenyl	2051-60-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
3-Monochlorobiphenyl	2051-61-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
4-Monochlorobiphenyl	2051-62-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2'-Dichlorobiphenyl	13029-08-8	0	NG/L	CLD	0	NG/L	CLD	0	NG/L	CLD	0	NG/L	C30
2,3-Dichlorobiphenyl	16605-91-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3'-Dichlorobiphenyl	25569-80-6	0.706	NG/L		1.29	NG/L		0.306	NG/L	J	0.804	NG/L	
2,4-Dichlorobiphenyl	33284-50-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,4'-Dichlorobiphenyl	34883-43-7	0.595	NG/L		1.31	NG/L		0	NG/L	U	0.765	NG/L	
2,5-Dichlorobiphenyl	34883-39-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,6-Dichlorobiphenyl	33146-45-1	1.01	NG/L	U	1.2	NG/L	C	0.552	NG/L	U	0.732	NG/L	U
3,3'-Dichlorobiphenyl	2050-67-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
3,4-Dichlorobiphenyl	2974-92-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
3,4'-Dichlorobiphenyl	2974-90-5	0	NG/L	U	0.505	NG/L	J	0	NG/L	U	0.268	NG/L	J
3,5-Dichlorobiphenyl	34883-41-5	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
4,4'-Dichlorobiphenyl	2050-68-2	0	NG/L	U	0.413	NG/L	J	0	NG/L	U	0.279	NG/L	J
2,2',3-Trichlorobiphenyl	38444-78-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',4-Trichlorobiphenyl	37680-66-3	0.533	NG/L	J	1.01	NG/L		0	NG/L	U	0.638	NG/L	
2,2',5-Trichlorobiphenyl	37680-65-2	1.46	NG/L		2.66	NG/L		0.7	NG/L		1.57	NG/L	
[illegible]	[illegible]	[illegible]			[illegible]			[illegible]			[illegible]		

PCB Congener	Sample ID	SW-10H-01EC-0.0-30.0			SW-10H-01ET-0.0-30.0			SW-10H-01FD-0.0-40.0			SW-10H-01FT-0.0-40.0			SW-10H-02EC-0.0-30.0			SW-10H-02ET-0.0-30.0		
	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
2,2',3,3',5,6,6'-Heptachlorobiphenyl	52663-64-6	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6-Heptachlorobiphenyl	74472-47-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6'-Heptachlorobiphenyl	60145-23-5	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',6,6'-Heptachlorobiphenyl	74472-48-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,5',6-Heptachlorobiphenyl	52712-05-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,6,6'-Heptachlorobiphenyl	74472-49-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,5',6-Heptachlorobiphenyl	52663-68-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,6,6'-Heptachlorobiphenyl	74487-85-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5',6-Heptachlorobiphenyl	74472-50-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,5,5',6-Heptachlorobiphenyl	74472-51-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4',5,5',6-Heptachlorobiphenyl	69782-91-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5'-Octachlorobiphenyl	35694-08-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6-Octachlorobiphenyl	52663-78-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',6,6'-Octachlorobiphenyl	33091-17-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6-Octachlorobiphenyl	68194-17-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6'-Octachlorobiphenyl	52663-75-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,6,6'-Octachlorobiphenyl	52663-73-7	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',5,5',6,6'-Octachlorobiphenyl	2136-99-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6,6'-Octachlorobiphenyl	74472-52-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5',6-Octachlorobiphenyl	74472-53-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	40186-72-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	52663-79-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
Total PCBs (sum of congeners, non-detects are considered 0, J values included as reported value)		7.492			33.211			3			19.113			3.369			16.723		

PCB Congener	Sample ID	SW-10H-02FC-0.0-30.0			SW-10H-02FT-0.0-30.0			SW-10H-03ED-0.0-40.0			SW-10H-03ET-0.0-30.0			SW-10H-03FC-0.0-30.0			SW-10H-03FT-0.0-30.0		
	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
2,2',3,3',5,6,6'-Heptachlorobiphenyl	52663-64-6	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6-Heptachlorobiphenyl	74472-47-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6'-Heptachlorobiphenyl	60145-23-5	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',6,6'-Heptachlorobiphenyl	74472-48-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,5',6-Heptachlorobiphenyl	52712-05-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,6,6'-Heptachlorobiphenyl	74472-49-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,5',6-Heptachlorobiphenyl	52663-68-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,6,6'-Heptachlorobiphenyl	74487-85-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5',6-Heptachlorobiphenyl	74472-50-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,5,5',6-Heptachlorobiphenyl	74472-51-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4',5,5',6-Heptachlorobiphenyl	69782-91-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5'-Octachlorobiphenyl	35694-08-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6-Octachlorobiphenyl	52663-78-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',6,6'-Octachlorobiphenyl	33091-17-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6-Octachlorobiphenyl	68194-17-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6'-Octachlorobiphenyl	52663-75-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,6,6'-Octachlorobiphenyl	52663-73-7	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',5,5',6,6'-Octachlorobiphenyl	2136-99-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6,6'-Octachlorobiphenyl	74472-52-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5',6-Octachlorobiphenyl	74472-53-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	40186-72-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	52663-79-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
Total PCBs (sum of congeners, non-detects are considered 0, J values included as reported value)		2.324			7.947			5.72			33.388			1.24			33.83		

PCB Congener	Sample ID	SW-10H-04ED-0.0-40.0			SW-10H-04ET-0.0-30.0			SW-10H-04FC-0.0-30.0			SW-10H-04FT-0.0-30.0			SW-10H-05ED-0.0-40.0			SW-10H-05ET-0.0-30.0		
	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
2,2',3,3',5,6,6'-Heptachlorobiphenyl	52663-64-6	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6-Heptachlorobiphenyl	74472-47-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6'-Heptachlorobiphenyl	60145-23-5	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',6,6'-Heptachlorobiphenyl	74472-48-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,5',6-Heptachlorobiphenyl	52712-05-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,6,6'-Heptachlorobiphenyl	74472-49-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,5',6-Heptachlorobiphenyl	52663-68-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,6,6'-Heptachlorobiphenyl	74487-85-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5',6-Heptachlorobiphenyl	74472-50-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,5,5',6-Heptachlorobiphenyl	74472-51-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4',5,5',6-Heptachlorobiphenyl	69782-91-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5'-Octachlorobiphenyl	35694-08-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6-Octachlorobiphenyl	52663-78-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',6,6'-Octachlorobiphenyl	33091-17-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6-Octachlorobiphenyl	68194-17-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6'-Octachlorobiphenyl	52663-75-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,6,6'-Octachlorobiphenyl	52663-73-7	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',5,5',6,6'-Octachlorobiphenyl	2136-99-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6,6'-Octachlorobiphenyl	74472-52-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5',6-Octachlorobiphenyl	74472-53-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	40186-72-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	52663-79-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
Total PCBs (sum of congeners, non-detects are considered 0, J values included as reported value)		8.494			40.437			0.55			15			1.73			38.45		

PCB Congener	Sample ID	SW-10H-05FC-0.0-30.0			SW-10H-05FT-0.0-30.0			SW-10H-06ED-0.0-40.0			SW-10H-06ET-0.0-30.0			SW-10H-06FC-0.0-30.0			SW-10H-06FT-0.0-30.0		
	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
2,2',3,3',5,6,6'-Heptachlorobiphenyl	52663-64-6	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5'-Heptachlorobiphenyl	35065-29-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6-Heptachlorobiphenyl	74472-47-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6'-Heptachlorobiphenyl	60145-23-5	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5',6-Heptachlorobiphenyl	52663-69-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',6,6'-Heptachlorobiphenyl	74472-48-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,5',6-Heptachlorobiphenyl	52712-05-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,5,6,6'-Heptachlorobiphenyl	74472-49-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,5',6-Heptachlorobiphenyl	52663-68-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4',5,6,6'-Heptachlorobiphenyl	74487-85-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5'-Heptachlorobiphenyl	39635-31-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,6-Heptachlorobiphenyl	41411-64-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5',6-Heptachlorobiphenyl	74472-50-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,5,5',6-Heptachlorobiphenyl	74472-51-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4',5,5',6-Heptachlorobiphenyl	69782-91-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5'-Octachlorobiphenyl	35694-08-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6-Octachlorobiphenyl	52663-78-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6'-Octachlorobiphenyl	42740-50-1	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',6,6'-Octachlorobiphenyl	33091-17-7	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6-Octachlorobiphenyl	68194-17-2	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,5',6'-Octachlorobiphenyl	52663-75-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,5,6,6'-Octachlorobiphenyl	52663-73-7	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204	0	NG/L	C204
2,2',3,3',4,5',6,6'-Octachlorobiphenyl	40186-71-8	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',5,5',6,6'-Octachlorobiphenyl	2136-99-4	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,5',6-Octachlorobiphenyl	52663-76-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,4,4',5,6,6'-Octachlorobiphenyl	74472-52-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,3,3',4,4',5,5',6-Octachlorobiphenyl	74472-53-0	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	40186-72-9	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
2,2',3,3',4,4',5,6,6'-Nonachlorobiphenyl	52663-79-3	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U	0	NG/L	U
Total PCBs (sum of congeners, non-detects are considered 0, J values included as reported value)		1.59			23.1			11.955			43.551			8.54			34		

NEW BEDFORD SUPERFUND
Data View: nbh_basic_results_view
Username: Fields
Created: 01-Jul-2010 11:36:49
Results for

STUDY_ID IN ('NBH OU3 2010')
CLASS IN ('HOM')

	Station ID	Ebb-1			Ebb-1			Flood-1			Flood-1			Ebb-1			Ebb-1		
	Collected	4/2/2010			4/2/2010			4/2/2010			4/2/2010			4/21/2010			4/21/2010		
	Fraction	DISS			TOTAL			DISS			TOTAL			DISS			TOTAL		
	Sample ID	SW-10H-01ED-0.0-40.0			SW-10H-01ET-0.0-40.0			SW-10H-01FD-0.0-40.0			SW-10H-01FT-0.0-40.0			SW-10H-02ED-0.0-40.0			SW-10H-02ET-0.0-40.0		
Param Name	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
Total MonoCB	27323-18-8	0.543	NG/L	U	0.515	NG/L	U	0.521	NG/L	U	0.515	NG/L	U	0.588	NG/L	U	0.51	NG/L	U
Total DiCB	25512-42-9	2.31	NG/L		4.66	NG/L		0.958	NG/L		2.85	NG/L		0.318	NG/L	J	0.898	NG/L	
Total TriCB	25323-68-6	4.29	NG/L		13.2	NG/L		1	NG/L		8.28	NG/L		2.42	NG/L		7.52	NG/L	
Total TetraCB	26914-33-0	0.945	NG/L		8.69	NG/L		0.302	NG/L	J	5.45	NG/L		0.588	NG/L	U	5.2	NG/L	
Total PentaCB	25429-29-2	0.543	NG/L	U	3.01	NG/L		0.521	NG/L	U	1.74	NG/L		0.588	NG/L	U	2.65	NG/L	
Total HexaCB	26601-64-9	0.543	NG/L	U	1.66	NG/L		0.521	NG/L	U	0.794	NG/L		0.588	NG/L	U	0.449	NG/L	J
Total HeptaCB	28655-71-2	0.543	NG/L	U	0.515	NG/L	U	0.521	NG/L	U	0.515	NG/L	U	0.588	NG/L	U	0.51	NG/L	U
Total OctaCB	55722-26-4	0.543	NG/L	U	0.515	NG/L	U	0.521	NG/L	U	0.515	NG/L	U	0.588	NG/L	U	0.51	NG/L	U
Total NonaCB	53742-07-7	0.543	NG/L	U	0.515	NG/L	U	0.521	NG/L	U	0.515	NG/L	U	0.588	NG/L	U	0.51	NG/L	U
Total DecaCB, Concentration	H-2051-24-3_CONC	0.543	NG/L	U	0.515	NG/L	U	0.521	NG/L	U	0.515	NG/L	U	0.588	NG/L	U	0.51	NG/L	U
Total Sum Homologues		7.485			31.22			2.26			19.114			2.738			16.717		
Total Sum Homologues (2 sig figs)		7.5			31			2.3			19			2.7			17		
Calculations for Total of Homologues																			
Param Name	CAS Code	0			0			0			0			0			0		
Total MonoCB	27323-18-8	2.31			4.66			0.958			2.85			0.318			0.898		
Total DiCB	25512-42-9	4.29			13.2			1			8.28			2.42			7.52		
Total TriCB	25323-68-6	0.945			8.69			0.302			5.45			0			5.2		
Total TetraCB	26914-33-0	0			3.01			0			1.74			0			2.65		
Total PentaCB	25429-29-2	0			1.66			0			0.794			0			0.449		
Total HexaCB	26601-64-9	0			0			0			0			0			0		
Total HeptaCB	28655-71-2	0			0			0			0			0			0		
Total OctaCB	55722-26-4	0			0			0			0			0			0		
Total NonaCB	53742-07-7	0			0			0			0			0			0		
Total DecaCB, Concentration	H-2051-24-3_CONC	0			0			0			0			0			0		
Sum of Homologues	SUM	7.485			31.22			2.26			19.114			2.738			16.717		
	SIG DIGITS	7.5			31			2.3			19			2.7			17		

	Station ID	Flood-1			Flood-1			Ebb-1			Ebb-1			Flood-1			Flood-1		
	Collected	4/21/2010			4/21/2010			4/28/2010			4/28/2010			4/28/2010			4/28/2010		
	Fraction	DISS			TOTAL			DISS			TOTAL			DISS			TOTAL		
	Sample ID	SW-10H-02FD-0.0-40.0			SW-10H-02FT-0.0-40.0			SW-10H-03ED-0.0-40.0			SW-10H-03ET-0.0-40.0			SW-10H-03FD-0.0-40.0			SW-10H-03FT-0.0-40.0		
Param Name	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
Total MonoCB	27323-18-8	0.565	NG/L	U	0.521	NG/L	U	0.5	NG/L	U	0.526	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total DiCB	25512-42-9	0.565	NG/L	U	0.271	NG/L	J	1.2	NG/L		2.54	NG/L		0.5	NG/L	U	0.58	NG/L	
Total TriCB	25323-68-6	1.71	NG/L		3.89	NG/L		3.13	NG/L		12.2	NG/L		0.47	NG/L	J	4.62	NG/L	
Total TetraCB	26914-33-0	0.418	NG/L	J	2.14	NG/L		0.89	NG/L		8.99	NG/L		0.27	NG/L	J	3.14	NG/L	
Total PentaCB	25429-29-2	0.565	NG/L	U	1.3	NG/L		0.5	NG/L	U	4.34	NG/L		0.5	NG/L	U	2.05	NG/L	
Total HexaCB	26601-64-9	0.565	NG/L	U	0.344	NG/L	J	0.5	NG/L	U	1.88	NG/L		0.5	NG/L	U	0.93	NG/L	
Total HeptaCB	28655-71-2	0.565	NG/L	U	0.521	NG/L	U	0.5	NG/L	U	0.526	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total OctaCB	55722-26-4	0.565	NG/L	U	0.521	NG/L	U	0.5	NG/L	U	0.526	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total NonaCB	53742-07-7	0.565	NG/L	U	0.521	NG/L	U	0.5	NG/L	U	0.526	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total DecaCB, Concentration	H-2051-24-3_CONC	0.565	NG/L	U	0.417	NG/L	J	0.5	NG/L	U	0.526	NG/L	U	0.97	NG/L		0.5	NG/L	U
Total Sum Homologues		2.128			8.362			5.22			29.95			1.71			11.32		
Total Sum Homologues (2 sig figs)		2.1			8.4			5.2			30			1.7			11		
Calculations for Total of Homologues																			
Param Name	CAS Code	0			0			0			0			0			0		
Total MonoCB	27323-18-8	0			0.271			1.2			2.54			0			0.58		
Total DiCB	25512-42-9	1.71			3.89			3.13			12.2			0.47			4.62		
Total TriCB	25323-68-6	0.418			2.14			0.89			8.99			0.27			3.14		
Total TetraCB	26914-33-0	0			1.3			0			4.34			0			2.05		
Total PentaCB	25429-29-2	0			0.344			0			1.88			0			0.93		
Total HexaCB	26601-64-9	0			0			0			0			0			0		
Total HeptaCB	28655-71-2	0			0			0			0			0			0		
Total OctaCB	55722-26-4	0			0			0			0			0			0		
Total NonaCB	53742-07-7	0			0.417			0			0			0.97			0		
Total DecaCB, Concentration	H-2051-24-3_CONC	0			0			0			0			0			0		
Sum of Homologues	SUM	2.128			8.362			5.22			29.95			1.71			11.32		
	SIG DIGITS	2.1			8.4			5.2			30			1.7			11		

	Station ID	Ebb-1			Ebb-1			Flood-1			Flood-1			Ebb-1			Ebb-1		
	Collected	5/7/2010			5/7/2010			5/7/2010			5/7/2010			5/13/2010			5/13/2010		
	Fraction	DISS			TOTAL			DISS			TOTAL			DISS			TOTAL		
	Sample ID	SW-10H-04ED-0.0-40.0			SW-10H-04ET-0.0-40.0			SW-10H-04FD-0.0-40.0			SW-10H-04FT-0.0-40.0			SW-10H-05ED-0.0-40.0			SW-10H-05ET-0.0-40.0		
Param Name	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
Total MonoCB	27323-18-8	0.549	NG/L	U	0.524	NG/L	U	0.549	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total DiCB	25512-42-9	0.934	NG/L		2.46	NG/L		0.549	NG/L	U	0.25	NG/L	J	0.66	NG/L		3.59	NG/L	
Total TriCB	25323-68-6	4.27	NG/L		13.7	NG/L		0.484	NG/L	J	4.49	NG/L		1.12	NG/L		15.4	NG/L	
Total TetraCB	26914-33-0	1.29	NG/L		12	NG/L		0.396	NG/L	J	3.83	NG/L		0.5	NG/L	U	10.9	NG/L	
Total PentaCB	25429-29-2	0.549	NG/L	U	8.52	NG/L		0.549	NG/L	U	3.03	NG/L		0.5	NG/L	U	6.53	NG/L	
Total HexaCB	26601-64-9	0.549	NG/L	U	3.7	NG/L		0.549	NG/L	U	1.4	NG/L		0.5	NG/L	U	2.08	NG/L	
Total HeptaCB	28655-71-2	0.549	NG/L	U	0.524	NG/L	U	0.549	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total OctaCB	55722-26-4	0.549	NG/L	U	0.524	NG/L	U	0.549	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total NonaCB	53742-07-7	0.549	NG/L	U	0.524	NG/L	U	0.549	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total DecaCB, Concentration	H-2051-24-3_CONC	0.549	NG/L	U	0.524	NG/L	U	0.549	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total Sum Homologues		6.494			40.38			0.88			13			1.78			38.5		
Total Sum Homologues (2 sig figs)		6.5			40			0.88			13			1.8			39		
Calculations for Total of Homologues																			
Param Name	CAS Code	0			0			0			0			0			0		
Total MonoCB	27323-18-8	0.934			2.46			0			0.25			0.66			3.59		
Total DiCB	25512-42-9	4.27			13.7			0.484			4.49			1.12			15.4		
Total TriCB	25323-68-6	1.29			12			0.396			3.83			0			10.9		
Total TetraCB	26914-33-0	0			8.52			0			3.03			0			6.53		
Total PentaCB	25429-29-2	0			3.7			0			1.4			0			2.08		
Total HexaCB	26601-64-9	0			0			0			0			0			0		
Total HeptaCB	28655-71-2	0			0			0			0			0			0		
Total OctaCB	55722-26-4	0			0			0			0			0			0		
Total NonaCB	53742-07-7	0			0			0			0			0			0		
Total DecaCB, Concentration	H-2051-24-3_CONC	0			0			0			0			0			0		
Sum of Homologues	SUM	6.494			40.38			0.88			13			1.78			38.5		
	SIG DIGITS	6.5			40			0.88			13			1.8			39		

	Station ID	Flood-1			Flood-1			Ebb-1			Ebb-1			Flood-1			Flood-1		
	Collected	5/13/2010			5/13/2010			5/26/2010			5/26/2010			5/26/2010			5/26/2010		
	Fraction	DISS			TOTAL			DISS			TOTAL			DISS			TOTAL		
	Sample ID	SW-10H-05FD-0.0-40.0			SW-10H-05FT-0.0-40.0			SW-10H-06ED-0.0-40.0			SW-10H-06ET-0.0-40.0			SW-10H-06FD-0.0-40.0			SW-10H-06FT-0.0-40.0		
Param Name	CAS Code	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ	Result	Unit	FinQ
Total MonoCB	27323-18-8	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total DiCB	25512-42-9	0.53	NG/L		2.16	NG/L		3.31	NG/L		4.65	NG/L		1.37	NG/L		3	NG/L	
Total TriCB	25323-68-6	0.76	NG/L		9.16	NG/L		6.34	NG/L		17.7	NG/L		2.38	NG/L		9.38	NG/L	
Total TetraCB	26914-33-0	0.3	NG/L	J	6.59	NG/L		1.81	NG/L		11.7	NG/L		0.76	NG/L		6.99	NG/L	
Total PentaCB	25429-29-2	0.5	NG/L	U	3.66	NG/L		0.394	NG/L	J	5.36	NG/L		0.99	NG/L		3.13	NG/L	
Total HexaCB	26601-64-9	0.5	NG/L	U	1.53	NG/L		0.5	NG/L	U	2.23	NG/L		1.04	NG/L		1.5	NG/L	
Total HeptaCB	28655-71-2	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total OctaCB	55722-26-4	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total NonaCB	53742-07-7	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total DecaCB, Concentration	H-2051-24-3_CONC	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U	0.5	NG/L	U
Total Sum Homologues		1.59			23.1			11.854			41.64			6.54			24		
Total Sum Homologues (2 sig figs)		1.6			23			12			42			6.5			24		
Calculations for Total of Homologues																			
Param Name	CAS Code	0			0			0			0			0			0		
Total MonoCB	27323-18-8	0.53			2.16			3.31			4.65			1.37			3		
Total DiCB	25512-42-9	0.76			9.16			6.34			17.7			2.38			9.38		
Total TriCB	25323-68-6	0.3			6.59			1.81			11.7			0.76			6.99		
Total TetraCB	26914-33-0	0			3.66			0.394			5.36			0.99			3.13		
Total PentaCB	25429-29-2	0			1.53			0			2.23			1.04			1.5		
Total HexaCB	26601-64-9	0			0			0			0			0			0		
Total HeptaCB	28655-71-2	0			0			0			0			0			0		
Total OctaCB	55722-26-4	0			0			0			0			0			0		
Total NonaCB	53742-07-7	0			0			0			0			0			0		
Total DecaCB, Concentration	H-2051-24-3_CONC	0			0			0			0			0			0		
Sum of Homologues	SUM	1.59			23.1			11.854			41.64			6.54			24		
	SIG DIGITS	1.6			23			12			42			6.5			24		

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APPENDIX B. SPREADSHEETS SHOWING VALUES FOR TOTAL PCB (SUM OF 209 CONGENERS AND SUM OF HOMOLOGUES)

Location: Hurricane Barrier in New Bedford Harbor

Date: 02-Apr-2010

Sample volume = 50ml per 10cm/s velocity

	Sample Volume (ml) - Flood				Sample Volume (ml) - Ebb		
Time	Surface	Midwater	Bottom	Time	Surface	Midwater	Bottom
5:30	0	75	75	11:30	200	200	200
5:50	0	75	75	11:42	200	250	200
6:15	0	75	100	12:02	225	200	200
6:25	0	100	100	12:09	200	200	200
6:50	0	200	250	12:30	350	350	350
6:57	0	250	250	12:35	300	300	300
7:21	50	300	300	13:00	325	325	325
7:30	100	300	300	13:05	300	350	350
7:51	50	300	250	13:28	350	350	350
7:59	50	300	250	13:36	350	350	350
8:24	100	400	350	14:08	300	300	300
8:32	100	350	300	14:13	300	250	250
8:53	100	400	400	14:30	225	225	225
9:02	50	350	350	14:35	225	225	225
9:21	300	400	350	15:05	250	250	250
9:30	400	400	350	15:11	250	250	250
9:53	250	350	250	15:30	175	175	175
10:00	200	300	300	15:40	100	100	100
10:23	150	250	250	16:00	100	50	50
10:31	150	150	150	16:06	75	50	50
10:55	100	100	100				

Location: Hurricane Barrier in New Bedford Harbor

Date: 21-Apr-2010

Sample volume = 100ml per 10cm/s velocity

		Sample Volume (ml) - Flood					Sample Volume (ml) - Ebb		
	Time	Surface	Midwater	Bottom		Time	Surface	Midwater	Bottom
	8:47	0	50	50		14:21	400	400	400
	8:52	0	50	50		14:25	500	500	500
	9:20	50	300	250		14:55	275	275	275
	9:23	50	300	250		14:58	275	275	275
	9:52	50	150	150		15:20	500	500	500
	9:55	50	150	150		15:25	500	500	500
	10:20	350	450	350		15:50	550	550	550
	10:23	350	450	350		15:55	550	550	550
	10:50	500	400	300		16:20	475	475	475
	10:55	500	400	300		16:24	475	475	475
	11:22	650	600	500		16:52	550	550	550
	11:26	650	600	500		16:56	550	550	550
	11:50	800	700	600		17:20	260	260	260
	11:53	800	700	600		17:24	260	260	260
	12:23	600	600	550		17:52	300	300	300
	12:34	600	600	550		18:00	300	300	300
	12:50	500	500	500		18:20	260	260	260
	12:54	500	500	500		18:24	260	260	260
	13:22	250	250	250		18:55	125	125	125
	13:26	250	250	250		18:58	125	125	125
	13:50	250	250	250		19:12	100	100	100
	13:55	250	250	250		19:15	100	100	100

Location: Hurricane Barrier in New Bedford Harbor

Date: 28-Apr-2010

Sample volume = 50ml per 10cm/s velocity, double size sample beginning 16:10 (due to rough weather)

	Sample Volume (ml) - Ebb				Sample Volume (ml) - Flood		
Time	Surface	Midwater	Bottom	Time	Surface	Midwater	Bottom
8:50	50	0	0	14:40	150	150	150
8:53	50	50	0	14:43	150	150	150
9:20	200	200	200	15:12	175	175	125
9:23	200	200	200	15:15	175	175	125
9:48	250	250	150	15:40	200	200	200
9:51	250	250	150	15:45	200	200	200
10:19	475	475	425	16:10	600	600	550
10:22	475	475	425	16:40	350	350	350
10:49	475	475	475	17:12	550	550	550
11:00	475	475	475	17:40	750	750	750
11:18	500	500	500	18:10	500	500	500
11:22	500	500	500	18:40	800	800	750
11:49	400	400	400	19:10	1000	1000	1000
11:51	400	400	400	19:39	200	200	200
12:20	200	200	200	20:08	200	200	200
12:24	200	200	200				
12:50	375	375	375				
12:54	425	425	425				
13:20	225	225	225				
13:24	225	225	225				
13:50	100	75	50				
13:53	100	75	50				

Location: Hurricane Barrier in New Bedford Harbor									
Date: 07-May-2010									
Sample volume = 100ml per 10cm/s velocity									
		Sample Volume (ml) - Flood					Sample Volume (ml) - Ebb		
	Time	Surface	Midwater	Bottom		Time	Surface	Midwater	Bottom
	9:37	200	200	200		16:02	250	200	100
	9:40	200	200	200		16:05	350	200	100
	10:13	0	150	150		16:38	275	275	275
	10:17	0	150	150		16:45	275	275	275
	10:40	50	250	300		17:10	450	450	450
	10:43	50	250	300		17:13	450	450	450
	11:11	0	100	100		17:40	400	400	400
	11:14	0	100	100		17:43	400	400	400
	11:36	200	350	350		18:10	475	475	475
	11:40	200	350	350		18:15	475	475	475
	12:10	300	400	350		18:40	300	300	300
	12:13	300	400	350		18:43	300	300	300
	12:40	250	375	375		19:11	325	325	325
	12:42	250	375	375		19:13	325	325	325
	13:10	325	350	325		19:40	325	325	325
	13:12	325	350	325		19:43	325	325	325
	13:41	700	750	650		20:10	250	250	250
	13:49	700	750	650		20:14	250	250	250
	14:09	500	500	500		20:41	325	325	325
	14:13	500	500	500		20:48	375	375	375
	14:40	200	200	200					
	14:43	200	200	200					
	15:10	100	100	100					
	15:12	100	100	100					

Location: Hurricane Barrier in New Bedford Harbor

Date: 13-May-2010

Sample volume = 50ml per 10cm/s velocity

Sample Volume (ml) - Ebb				Sample Volume (ml) - Flood			
Time	Surface	Midwater	Bottom	Time	Surface	Midwater	Bottom
8:10	100	100	50	13:40	100	100	100
8:15	150	100	50	13:43	100	100	100
8:40	125	125	125	14:11	75	75	75
8:45	125	125	125	14:15	75	75	75
9:10	300	300	300	14:40	250	250	220
9:15	300	300	300	14:43	250	250	220
9:40	310	310	310	15:10	250	250	250
9:45	310	310	310	15:13	250	250	250
10:10	300	300	300	15:40	260	240	200
10:15	340	340	340	15:43	260	240	200
10:40	380	380	380	16:10	200	180	150
10:43	380	380	380	16:13	200	180	150
11:11	325	325	325	16:40	250	250	230
11:15	350	350	350	16:45	250	250	230
11:40	125	125	140	17:12	260	260	230
11:43	140	140	140	17:15	260	260	230
12:10	275	275	275	17:40	360	320	270
12:14	275	275	275	17:43	360	320	270
12:40	180	180	180	18:10	250	250	170
12:43	180	180	180	18:13	250	250	170
				18:40	375	375	275
				18:45	375	375	275
				19:12	300	300	200
				19:16	250	250	150

Location: Hurricane Barrier in New Bedford Harbor

Date: 26-May-2010

Sample volume = 50ml per 10cm/s velocity

Sample Volume (ml) - Ebb				Sample Volume (ml) - Flood			
Time	Surface	Midwater	Bottom	Time	Surface	Midwater	Bottom
7:30	50	0	0	13:20	150	150	150
7:35	50	0	0	13:22	150	150	150
8:00	250	250	300	13:44	200	200	200
8:03	250	250	300	13:49	200	200	200
8:29	250	275	300	14:16	125	125	125
8:32	250	275	300	14:18	125	125	125
9:00	300	300	300	14:45	260	260	260
9:03	300	300	300	14:51	260	260	260
9:31	370	370	370	15:15	240	240	240
9:38	370	370	370	15:19	240	240	240
10:00	375	375	375	15:44	240	220	220
10:03	420	420	420	15:47	240	220	220
10:30	300	300	300	16:16	250	250	240
10:36	300	300	300	16:23	250	250	240
11:00	250	250	250	16:46	350	350	350
11:03	275	275	275	16:53	350	350	350
11:30	200	200	200	17:15	390	390	390
11:33	200	200	200	17:19	390	390	390
12:00	120	120	120	17:44	390	390	390
12:04	120	120	120	17:49	360	360	360
				18:14	420	420	420
				18:18	440	440	440
				18:45	270	270	240
				18:49	240	240	200
				19:07	250	250	200
				19:10	250	250	200

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