AECOM

New Bedford Harbor Superfund Site Long Term Monitoring – Evaluation of Sediment Chemistry and Macroinvertebrate Community Data from 1993 to 2020
Draft Final Report

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Table of Contents

Appendices

Figures

Tables

Abbreviations and Acronyms

ACESD	Atlantic Coastal Environmental Sciences Division
ANOVA	Analysis of Variance
BI	Benthic Index
cm	Centimeter
CSO	Combined Sewer Overflow
DL	Detection Limit
DO	Dissolved Oxygen
EG	Ecological Groupings
EMAP	Environmental Monitoring and Assessment Program
EPA	United States Environmental Protection Agency
ESD	Explanations of Significant Difference
FSP	Field Sampling Plan
H'	Shannon's Diversity
IQR	Interquartile Range
J'	Evenness
LTM	Long-Term Monitoring
log10	Log Transformation
m^2	Square meter
mm	Millimeter
mg/kg	milligram per kilogram
NAE	U.S. Army Corps of Engineers, New England District
NBHSS	New Bedford Harbor Superfund Site
NOAA	National Oceanic and Atmospheric Administration
PCB	Polychlorinated Biphenyl
ppm	Parts Per Million
psu	Practical Salinity Unit
QAPP	Quality Assurance Project Plan
QC	Quality Control
R	R Statistical Software
ROD	Record of Decision
S	Number of Species
Site	New Bedford Harbor Superfund Site, New Bedford, Massachusetts
TCL	Target Cleanup Level
TOC	Total Organic Carbon
USACE	U.S. Army Corps of Engineers
USGS	U.S. Geological Survey
U.S. M-AMBI	Multivariate AZTI Marine Biotic Index
VP	Virginian Province

1. Introduction

The U.S. Environmental Protection Agency's Research Laboratory, Atlantic Ecology Division (EPA ACESD) in Narragansett, Rhode Island developed a long-term environmental monitoring (LTM) program in 1993 to assess the effectiveness of the New Bedford Harbor Superfund Site (NBHSS or "Site") remediation efforts over time. This LTM program incorporates physical, chemical. and biological sampling over all 18,000 acres of the Site to quantify and track the long-term environmental effects of Site remediation.

AECOM, on behalf of the U.S. Army Corps of Engineers New England District (USACE NAE), evaluated seven rounds of LTM data (1993 to 2020) to determine if remediation efforts to date have been effective in reducing polychlorinated biphenyl (PCB) concentrations in sediment and improving benthic community health. Normandeau Associates, Inc (Normandeau), as a subcontractor to AECOM, conducted an evaluation of the benthic infaunal taxonomy data including the calculation of the multivariate AZTI Marine Biotic Index in United States coastal waters (U.S. M-AMBI). The U.S. M-AMBI replaced the Virginian Province Benthic Index (VP BI) that was previously used by EPA for this project. The U.S. M-AMBI was developed as a nationwide macroinvertebrate index (USEPA, 2021) and is considered more reflective of pollution tolerance of the benthic community and more responsive to landscape influences than previous indices (Pelletier et al., 2018).

Seven rounds of sampling have been conducted under the LTM program including the "baseline" sampling event conducted in October 1993 (LTM I), a second event (LTM II) conducted immediately after removal of the "hot spot" sediments in October of 1995 and five subsequent events conducted in 1999, 2004, 2009, 2014, and 2020 (LTM III, IV, V, VI, and VII, respectively). Prior to the LTM VII event in 2020, subtidal dredging activities were completed in the Lower and Upper Harbors in June 2018 and March 2020, respectively. No further remediation is planned for the Outer Harbor (a sediment cap was placed over PCB-contaminated sediment near the Cornell-Dubilier plant in 2005 and 2015).

The purpose of this evaluation is to assess spatial and temporal trends in sediment chemistry and the benthic macroinvertebrate community. Similar analyses were previously conducted by the EPA ACESD for the first five LTM events between 1993 to 2009 (Nelson and Bergen, 2012) and for LTM events V and VI between 2009 and 2014 (Bergen, 2015). This evaluation followed the same approach used by EPA ACESD in 2012 and 2015 to evaluate the spatial and temporal trends of the seven LTM events from 1993 to 2020.

A description of the chemical, physical, and biological datasets included in this evaluation and the methodologies used to evaluate the spatial and temporal trends are provided in Section 2. The results are provided in Section 3. The summary and conclusions of the evaluation are presented in Section 4.

1.1 Site Description

The 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 1-1). 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 an increasing amount of offshore wind related businesses and is a densely populated manufacturing and commercial center. An increasing number of these shoreline manufacturing buildings have been converted to residential units in the last 20 years, especially in the Upper Harbor. By comparison, the eastern shore of New Bedford Harbor in Upper Harbor of Acushnet and Fairhaven is predominantly saltmarsh with residential and light commercial properties. The eastern shore of New Bedford Harbor in the Lower Harbor of Fairhaven is a mixture of residential, commercial, and boat repair facilities with small areas of saltmarsh. The Islands in the Lower Harbor have marine related businesses, marinas, and commercial properties. The area south of the New Bedford Hurricane barrier in Buzzards Bay includes the City of New Bedford and the Towns of Dartmouth and Fairhaven; with the shoreline being mostly beaches and residential properties. The New Bedford sewer plants discharge into Buzzards Bay at Fort Rodman at the most southern point of the City.

The Acushnet River's 16.5 square mile drainage basin discharges to New Bedford Harbor in the northern reaches of the Site and contributes relatively minor volumes of fresh water to the tidally influenced harbor. 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 its sediment becoming contaminated with high concentrations of many pollutants, notably PCBs and heavy metals. Contaminant gradient within Harbor sediments historically decreased from north to south. The source of the contamination has been attributed to two electrical capacitor manufacturing facilities that operated between the 1940s and 1970s. One facility, the former Aerovox Corporation site, is located near the northwestern 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.

The EPA added New Bedford Harbor to the National Priorities List in 1983. The Superfund remedy for the Upper and Lower Harbors is outlined in a 1998 Record of Decision (ROD) (EPA, 1998) and six subsequent Explanations of Significant Differences (ESDs). Lower Harbor subtidal remedial dredging was completed in June 2018. Upper Harbor subtidal remedial dredging was completed in March 2020, while the Upper Harbor intertidal remedy is still in progress. In total, over 1,000,000 cubic yards of PCB impacted sediment and shoreline soil has been removed from the harbor as part of the Superfund cleanup. Detailed information of remedial activities since 1988 are presented on the EPA NBHSS website including the Upper Harbor and Lower Harbor Dredge Data Reports.[1]

The Site has been divided into three distinct geographical areas, the Upper, Lower, and Outer Harbors (**Figure 1-1**). The Upper Harbor extends from the Main Street bridge south to the Coggeshall Street Bridge. The Lower Harbor extends from the Coggeshall Street Bridge south to the Hurricane Barrier. The Outer Harbor extends from the Hurricane Barrier south to the southern edge of the New Bedford Fishing Closure Area 3. The three geographical areas were considered in the evaluation of spatial trends.

1.2 Project Objectives

The objective of the study was to evaluate spatial and temporal trends in sediment PCB concentrations and the benthic macroinvertebrate community metrics following a taxonomic consistency check and calculation of the U.S. M-AMBI. In addition, potential relationships between sediment PCBs and benthic community metrics were explored.

[1] After Action Reports available on EPA NBHSS website at: https://www.epa.gov/new-bedford-harbor.

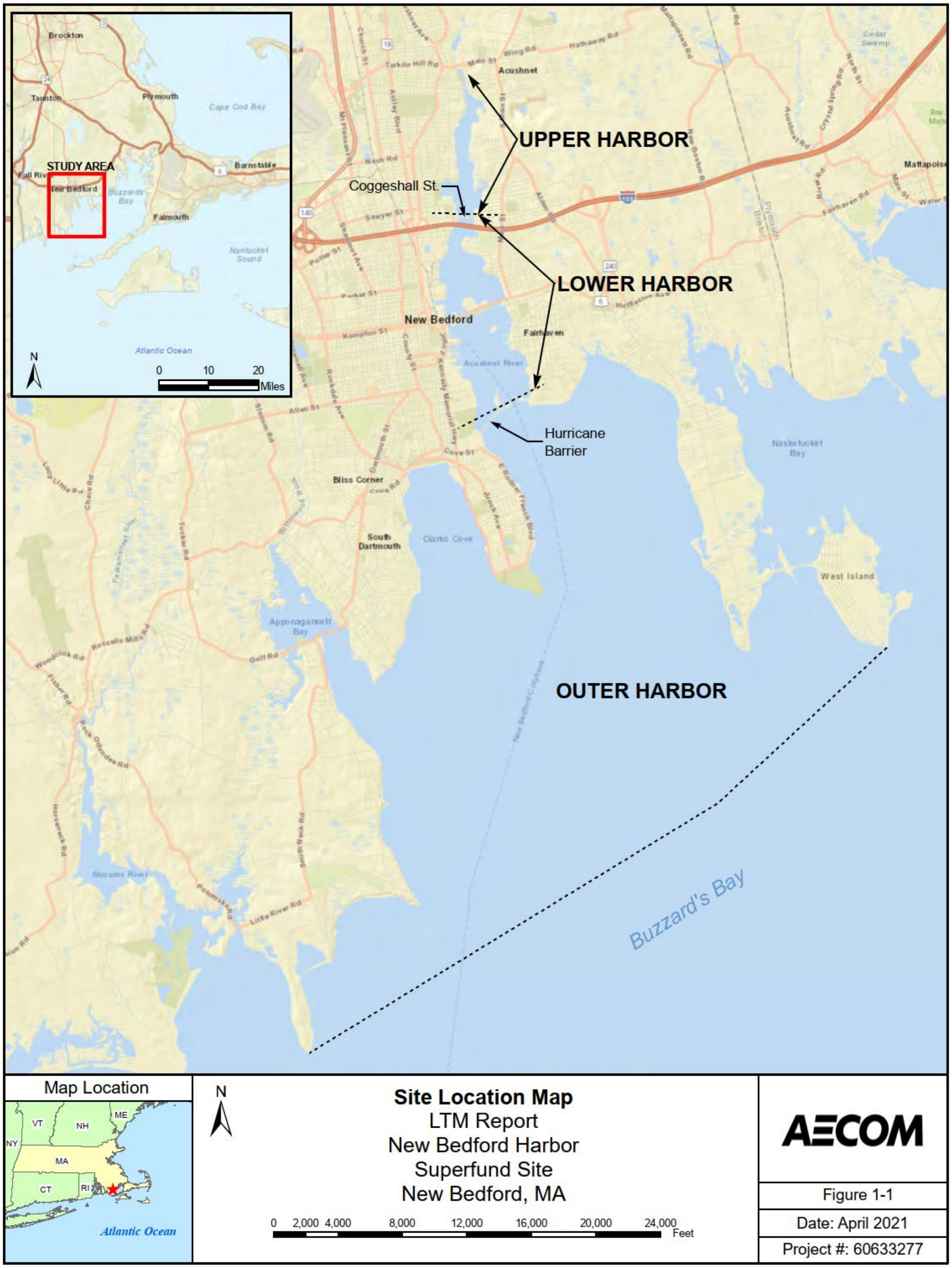

Figure 1-1 Location of the Site in Southeastern Massachusetts

2. LTM Datasets and Evaluation Methods

This section provides a summary of the sediment chemistry, physical data, and the biological data included in this evaluation. In addition, the methods used for the spatial and temporal analyses are described, including the initial data summarization steps, benthic data evaluation methodology, calculation of summary statistics, and the statistical analyses performed for the sediment and benthic infaunal datasets.

2.1 Summary of Data

Chemical, biological, and physical data collected during each of the seven LTM events were included in this evaluation. The methods for the collection and analyses of the LTM data are described in detail most recently in the LTM VII Field Sampling Plan– Draft Final (FSP; AECOM, 2020a) and in the Quality Assurance Project Plan Addendum Revision 10.2 (QAPP; AECOM, 2020b). The same data collection methods were used for the seven LTM events, and followed the methodology detailed in EPA's Environmental Monitoring and Assessment Program (EMAP) (Versar, 1991).

For each LTM event, surface (0-2 centimeters [cm]) sediment grab samples were collected using a 0.4-square meter (m^2) Ted Young modified Van Veen grab sampler at 79 stations located across the three geographical areas of New Bedford Harbor (**Figure 2-1**).

- Area 1: Upper Harbor – Wood Street to the Coggeshall Street Bridge (27 stations)
- Area 2: Lower Harbor – Coggeshall Street Bridge to Hurricane Barrier (29 stations)
- Area 3: Outer Harbor – Hurricane Barrier to edge of Fishing Closure Area 3 (23 stations)

The LTM sampling stations were determined at the outset of the LTM program and are based on a systematic, probabilistic sampling design developed by EPA/ACESD (Nelson et al., 1996). A hexagonal sampling grid was created for each harbor area and samples were collected as close as possible to the proposed location within the center of the associated hexagon. The hexagonal sampling grid was developed so that there were approximately the same number of hexagons in each harbor area. This was accomplished by adjusting the area of the hexagons in each zone. Hexagons in the Upper Harbor have a radius (center to side mid-point) of 88 meters (m), those in the Lower Harbor have a radius of 175 m, and those in the Outer Harbor have a radius of 793 m. The sampling design allows for the three harbor areas to be compared spatially and temporally to quantify any changes resulting from sediment remediation at the Site.

At each station, sediment grab samples were collected for physical (grain size) and chemical (total organic carbon [TOC] content and PCBs) analyses, as well as benthic infaunal taxonomic analysis. Sediment grain size and TOC can influence both benthic habitat quality and sediment chemistry associations. Additionally, in-situ water quality measurements (temperature, salinity, turbidity, and dissolved oxygen [DO]) were recorded at each station.

All analytical and biological results were imported into a Microsoft Access project database created by EPA ACESD. Prior to conducting the current evaluation, the PCB, TOC, grain size, and benthic taxonomy datasets were reviewed for completeness. Results for each LTM event were found to be complete with the exception of the benthic infaunal data from LTM V (2009), which were not available in the Microsoft Access project database. As described in **Appendix A**, Normandeau provided the original 2009 benthic infaunal data for this evaluation; the benthic infaunal datasets for all LTM events are presented in **Appendix A**. The complete analytical results for the PCB, TOC, and grain size are presented in **Appendix B**.

Laboratory quality control and data validation procedures were performed for all LTM sampling events as detailed in the QAPP (AECOM, 2020b). Quality control (QC) included the collection and analysis of a field duplicate sample for every 20 or fewer samples for PCB, TOC, and grain size analyses. For benthic infauna, QC measures followed the EMAP protocols and included re-sorting and re-identification of randomly selected samples, and validation of taxonomic/enumeration data entries.

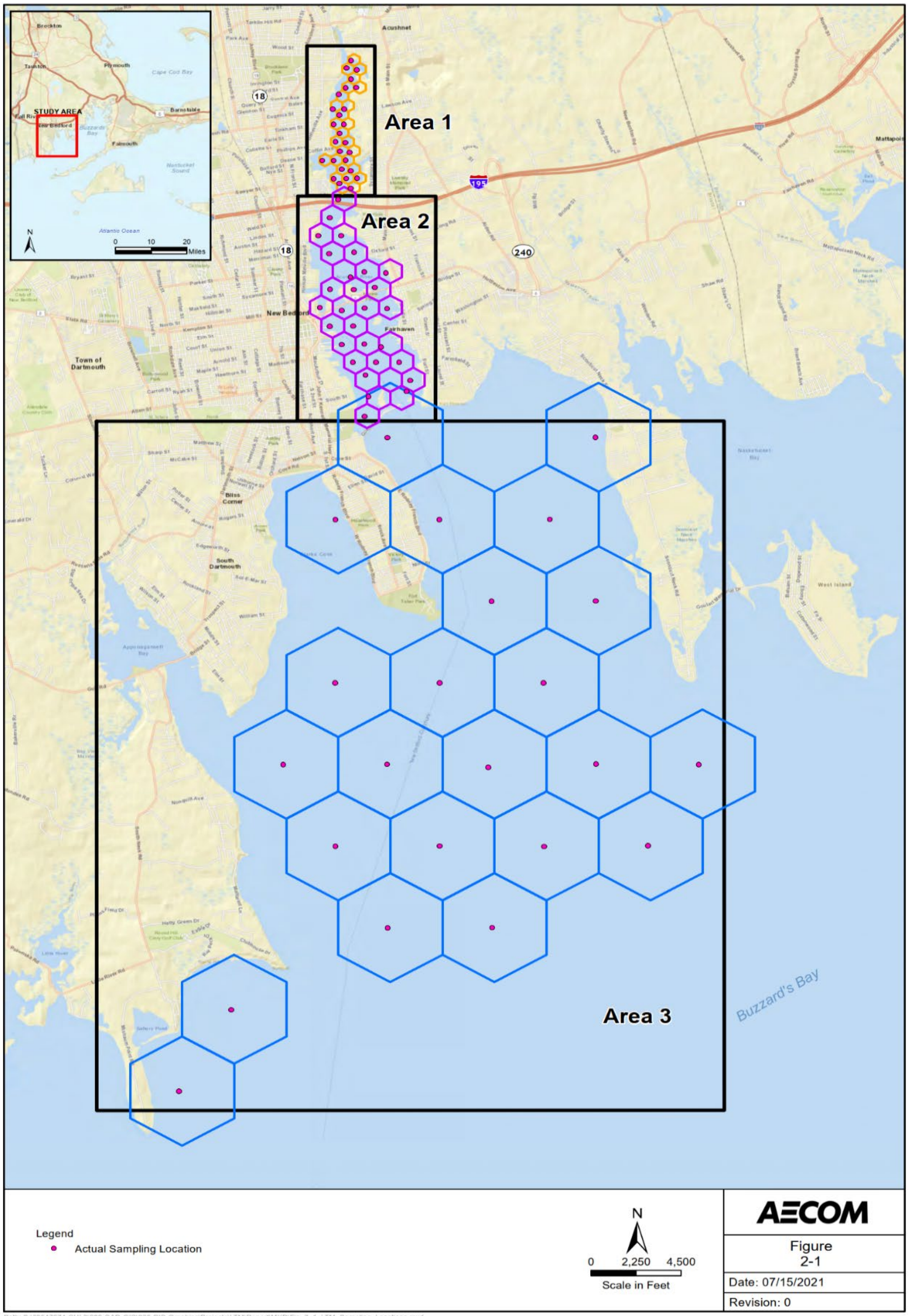

Figure 2-1 Map of the New Bedford Harbor LTM VII Sampling Area[2]

[2] The LTM VII Area 1, 2, and 3 are different than the Area 1, 2, and 3 in the MA DPH Regulation 105 CMR 260, which were used to define the NBH Site area.

2.1.1 Sediment Chemistry

As previously noted, a sediment grab sample was collected at each sampling location from the top 2 cm. Several grab samples were required at most locations to obtain a sufficient volume of sediment for the chemical and physical characteristics analyses. All grab samples per location were combined and homogenized and samples were collected from the combined grab sample sediment for the analysis of PCBs and TOC.

The methods by which PCBs were analyzed varied over the seven LTM events. For the first two LTM events in 1993 and 1995, PCBs were analyzed using Gas Chromatography/Electron Capture Detection (GC/ECD) and analytical results were reported for 18 of the 209 PCB congeners identified by the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends Program to assess marine environmental quality (i.e., NOAA 18 congeners)[3]. The LTM events III (1999), IV (2004), and VI (2014) analyzed PCBs using method 8082 (also a GC/ECD method) and also reported the NOAA 18 congeners. The LTM event V (2009) used method 8270C to analyze for the NOAA 18 congeners. The LTM event VII (2020) used method 8270D-SIM/680(M) to analyze for all the 209 PCB congeners, including the NOAA 18.

The sums of the NOAA 18 congeners were reported in the project database for some but not all of the LTM events. No NOAA 18 totals were included for LTM I (1993), II (1995), and VII (2020). For LTM VII, the sum of the full suite of 209 PCB congeners was reported in the project database, but not the sum for the NOAA 18. For consistency with the prior evaluations of LTM data (Nelson and Bergen, 2012; Bergen, 2015), total PCBs were also calculated as the sum of detected concentrations for the NOAA 18 congeners for the 2020, 1993 and 1995 events. Individual congeners that were not detected were treated as zero in the calculation of the sum.

At least one of the NOAA 18 congeners was detected in each sample per LTM event with the exception of three samples in the Outer Harbor (two samples at stations 335 and 352 collected in 1993 and one sample at station 306 in 1995). For these three samples, the maximum detection limit for PCB congeners of each sample, which ranged from 1.4 to 2.3 μg/kg, was selected to represent the PCB concentration at those locations for the statistical evaluation. In general, method detection limits for those events for which this information is available (method detection limits for 1999 are not available in the project database), are not elevated in comparison to the detected concentrations of PCBs. Given the wide range of PCB concentrations detected in the majority of samples per LTM event, the inclusion of the maximum detection limits for these three samples had little impact on the overall statistical evaluation.[4] In total, PCB results were available for a total of 550 samples (samples were not available for 2 of the 29 stations in the Lower Harbor in 1993 (LTM I) and at 1 of the 23 stations in the Outer Harbor in 1995 (LTM II)).

TOC was analyzed following EPA 9060/A methodology. Each sample was analyzed in duplicate, and the average of the results was taken per location. TOC results were available for all stations per LTM event with the exception of station 105 in 1995 (LTM II) for a total of 549 samples.

Field duplicates of sediment chemistry samples were collected at one location in each harbor area per LTM event. The average of the analytical results for the parent and duplicate samples was calculated for each location for use in summary statistics.

2.1.2 Comparison of Total PCBs Calculated as Sums of NOAA 18 and 209 Congeners

As described above in Section 2.1.1, in 2020 (LTM VII), PCBs were analyzed by method 8270D-SIM/680(M), which provides PCB concentrations for all 209 congeners. The PCB totals based on the sum of detects of the 209 congeners were higher on average than the NOAA 18 PCB totals by a factor of 3.2 in the Upper Harbor, 2.8 in the Lower Harbor, 2.4 in the Outer Harbor, and 2.8 on average across the three harbor areas. **Table 2-1** presents aggregated summary statistics (minimum, mean, standard

[3] The NOAA 18 includes the following congeners: PCB-08, PCB-18, PCB-28, PCB-44, PCB-52, PCB-66, PCB-101, PCB-105, PCB-118, PCB-128, PCB-138, PCB-153, PCB-170, PCB-180, PCB-187, PCB-195, PCB-206, PCB-209.

[4] There was no impact to the outcome of the statistical evaluation if the results for non-detected samples were replaced with zero or with the maximum detection limit.

deviation, median, maximum) for the two different PCB totals based on the 79 samples collected in the 2020 LTM VII monitoring event.

Table 2-1 Comparison of total PCB concentrations calculated as the sum of NOAA 18 congeners and the sum of 209 congeners based on the LTM VII (2020) dataset (mg/kg).

Total Calculation	n	Min	Mean	Standard Deviation	Median	Maximum
Sum of NOAA 18 congeners	79	0.0024	4.1	8.3	1.4	49
Sum of 209 congeners	79	0.0041	13	28	4.1	161

Notes:
Units are milligram per kilogram (mg/kg).

2.1.3 Physical Characteristics

Sediment grain size analysis was performed on sub-samples co-located with sediment chemistry (0 to 2 cm in depth). Grain size data were available for all stations per LTM event with the exception of three stations in LTM II (1995; stations 317, 325, and 334) for a total of 547 samples.

Fractions of gravel, sand, and silt and clay were determined based on wet sieving and hydrometer analysis. For this evaluation, the results were calculated as the percentage of sediment in the following fractions: gravel (> 2.00 millimeter [mm]), sand (0.0625 – 2 mm), and silt and clay (< 0.0625 mm). The LTM VII event (2020) used a slightly larger sieve for silt and clay (< 0.075) and therefore, the sand and silt and clay fractions were adjusted accordingly (0.075 – 2 mm and < 0.075 mm, respectively) for this event. As described above for sediment chemistry, the average of sediment grain size results for parent and duplicate samples were calculated per location.

2.1.4 Macroinvertebrate Community

Three sediment grab samples were collected at each station for benthic infaunal taxonomic enumeration and identification. While the sample depth varied somewhat among stations and LTM events, the grab samples were generally collected from the top 10 cm of sediment. Benthic biology sorting, enumeration, and identification were performed by Normandeau Associates, Inc. in Bedford, New Hampshire with the exception of LTM VI (2014) which was performed by Battelle (2015). Biological laboratory procedures were carried out according to protocols established in *EMAP Near Coastal Laboratory Procedures – Macrobenthic Community Assessment* (Versar, 1991). Two of the three replicate grab samples collected at each station were analyzed for benthic community analysis and the third sample was archived.

For this evaluation, Normandeau conducted a taxonomic consistency check on the full dataset of benthic infaunal data from all seven LTM events. **Appendix A** provides a memorandum from Normandeau describing the procedures followed for the review and update (as needed) of the taxonomic data and community metrics. In total taxonomic results are available for 552 samples. Benthic infaunal data were not available for Station 352 in 1995 (LTM II). In addition, only one specimen was identified in the sample collected at Station 221 in the lower harbor in 2020 (LTM VII). As noted in **Appendix A**, a total of 38 species were excluded from the benthic infaunal dataset because they either could not be enumerated (e.g., colonial organisms such as bryozoa, hydrozoa, and sponges) or were not benthic infaunal organisms, for example Ostracoda (seed shrimp which are zooplankton), unidentified eggs/egg cases, and Nematoda.

The benthic community parameters calculated for all LTM events included:

- Abundance - number of organisms;
- Species richness - number of species;

- Shannon's Diversity (H') - measure of diversity calculated based on the number of species and the relative abundance of each species; and,
- Evenness (J') - measure of homogeneity of species at a location relative to all locations that is calculated by dividing H' by species richness.

Shannon's Diversity (H') was calculated with log base 10-transformed data to be consistent with previous calculations for this parameter provided in Nelson and Bergen (2012). For species richness, Shannon's Diversity (H'), and evenness (J'), values close to zero indicates a community with low diversity whereas higher values indicate higher diversity.

The U.S. M-AMBI was calculated by Normandeau following the procedures of Pelletier et al. (2018) based on Ecological Groupings (EG) of taxa established for the northeast US region (**Appendix A)**. Each taxon identified is classified into a ranked EG from EG I, which is considered healthy benthic habitat, to EG V, which is considered low quality habitat. Each station is also assigned to a salinity zone: stations in the Upper Harbor (Stations 105-155) and Lower Harbor (Stations 202-253) were assigned to polyhaline (18 to <30 practical salinity unit [psu]), and stations in the Outer Harbor (Stations 304-352) were assigned to euhaline (30 to 40 psu). The U.S. M-AMBI is calculated based on a weighted percentage of taxa that fall into each EG class. The BI (described above), salinity code, number of species [S], and H' were used to determine the category of benthic health condition: Bad (<0.20), Poor (0.20 to 0.39), Moderate (>0.39 to 0.53), Good (>0.53 to 0.77), and High (>0.77).

2.2 Statistical Evaluation Methods

This section presents the methodologies used to calculate summary statistics including the treatment of field duplicate samples and non-detect results. In addition, the statistical methods used for the evaluations of spatial and temporal trends and exploratory analyses of correlations between chemistry and benthic infaunal community metrics are provided.

2.2.1 Summary Statistics

Summary statistics were calculated for sediment chemistry and grain size data for each harbor area per LTM event including the number of samples, minimum, mean, standard deviation, and maximum values (**Table 2-2**). For total PCBs, the number of samples with detected PCB congeners and the range of detection limits for individual PCB congeners were also included. As noted in **Section 2.1.1**, the maximum reported detection limit was used to represent the PCB concentration for the three sediment samples where all congeners were reported as not detected.

Table 2-2 Summary Statistics for Total PCBs Calculated as the Sum of NOAA 18 Congeners and Results of Pairwise Comparisons Between 2020 and Previous LTM Events

	Total PCBs (sum of NOAA 18)							
	Detected Concentrations (mg/kg)						Range of Detection Limits (mg/kg)	
LTM Event - Year	Minimum	Mean	Standard Deviation	Maximum	Number of Samples	Number of Samples with Detected PCB Congeners (a)	Minimum	Maximum
Upper Harbor								
I - 1993	0.34	68	75	288	27	27	0.0014	2.4
II - 1995	0.71	101	130	498	27	27	0.00088	3.1
III - 1999	1.8	102	106	350	27	27	--	--
IV - 2004	0.37	60	54	170	27	27	0.00024	0.88
V - 2009	0.59	71	83	330	27	27	0.00033	0.35
VI - 2014	0.50	82	183	940	27	27	0.0022	0.052
VII - 2020	0.32	9.9*	12	49	27	27	0.00019	0.083
Lower Harbor								
I - 1993	0.69	5.4	4.8	21	27	27	0.0011	0.43
II - 1995	0.41	5.2	5.5	24	29	29	0.00078	0.24
III - 1999	0.78	7.5	5.4	19	29	29	--	--
IV - 2004	0.38	4.9	4.5	16	29	29	0.00021	0.011
V - 2009	0.52	5.2	4.8	19	29	29	0.00033	0.0070
VI - 2014	0.22	2.8	2.3	8.7	29	29	0.00097	0.0018
VII - 2020	0.17	1.7**	1.0	4.7	29	29	0.00019	0.0041
Outer Harbor								
I - 1993	0.017	0.60	1.0	4.8	23	21	0.00069	0.053
II - 1995	0.0022	0.35	0.47	1.7	22	21	0.00059	0.0067
III - 1999	0.012	0.37	0.52	2.0	23	23	--	--
IV - 2004	0.0034	0.18	0.26	0.73	23	23	0.000020	0.0031
V - 2009	0.0028	0.24	0.32	1.1	23	23	0.00033	0.00040
VI - 2014	0.0017	0.17	0.22	0.77	23	23	0.00025	0.00027
VII - 2020	0.0024	0.11	0.14	0.45	23	23	0.00019	0.00041

Notes:
-- - Not available.
(a) The number of samples in which at least one of the NOAA 18 congeners was detected. NOAA 18 congeners were not detected in one sample in 1993 and two samples in 1995 in the Outer Harbor.
* Mean total PCBs in the Upper Harbor in 2020 (LTM VII) were significantly lower than all other LTM events for the Upper Harbor based on paired t-tests (Appendix C provides statistical test output).
** Mean total PCBs in the Lower Harbor in 2020 (LTM VII) were significantly lower than all other LTM events for the Lower Harbor except 2014 (LTM VI).
mg/kg - milligram per kilogram.

2.2.2 Spatial and Temporal Trend Evaluation

A repeated measures analysis of variance (ANOVA) was used to evaluate spatial and temporal trends for total PCB concentrations and benthic community parameters. This mixed ANOVA model evaluated differences between harbor area, within years, and a two-way interaction of harbor area and year. When differences between harbor area, within years, and a two-way interaction of harbor area and year. When the harbor area-by-year interaction was significant, one-way ANOVAs were conducted to test for significant differences within each harbor area over time and among harbor areas within each year. Multiple pairwise comparisons (paired t-tests) were conducted as post hoc tests to further evaluate differences among harbor areas and over time. The post hoc ANOVA and pairwise comparison tests were conducted with the Bonferroni multiple testing correction method. ANOVA and pairwise tests were conducted using R Statistical Software Version 4.1.0 (R Core Team, 2021; RStudio Team, 2021). The use of ANOVA to evaluate trends is consistent with the prior evaluations of the LTM data.

A Regional Kendall trend test was performed using a program available from the U.S. Geological Survey (USGS; https://pubs.er.usgs.gov/publication/70028525). This test determines whether there is a consistent temporal trend in total PCB concentrations and benthic community parameters within each harbor area. While the paired t-tests were used to compare concentrations from a single year to another single year within a harbor area, the Regional Kendall trend test was used to evaluate overall temporal trends in concentrations or community metrics for each harbor area.

The dataset for each harbor area per LTM event was evaluated with respect to the assumptions of the mixed ANOVA model, which include that the data should follow a normal distribution, have no significant outliers present, and that the differences between all combinations of data grouped by year are equal (sphericity), as summarized below:

- The Shapiro Wilk test was conducted to determine whether a dataset was normally distributed. Quantile-to-quantile plots were also created for each dataset to visually inspect the data distribution. In cases where datasets were not normally distributed, a lognormal base 10 transformation was applied, which improved the distribution of most datasets except where noted.
- Outliers were evaluated by reviewing the seven LTM reports with respect to any documentation of abnormalities during field collection or laboratory analyses that could provide a basis for excluding any samples. However, all samples collected were considered usable for project decisions based on the QAPP requirements. Therefore, no values were identified as outliers based on laboratory or field collection abnormalities, and no data were excluded from the statistical evaluations.
- The assumption of sphericity was checked automatically with the mixed ANOVA model in rstatix using Mauchly's test. The Greenhouse-Geisser sphericity correction was applied when this assumption was violated.

In addition to the above statistical tests, as with all previous LTM events, the total PCB results for each station from the 2020 event were mapped. Spatial interpolation of the PCB sediment data was conducted by kriging using the GIS software ESRI ArcGIS and consistent with the models used for each harbor areas by Nelson and Bergen (2012) and Bergen (2015). The parameters include 1) "ordinary" model type for all three harbor areas, 2) lag size (140, 302, and 937), 3) number of lags (13, 12, and 12), 4) standard search neighborhood type, and 5) circular geometry for all three harbor areas. The modeled data were clipped to the outline of each harbor area and resulting concentrations and number of cells with each concentration were used to generate contour maps.

2.2.3 Correlation Between Sediment Chemistry and Benthic Community

The relationships between PCB concentrations in sediment and the benthic community parameters were evaluated visually using scatterplots. Kendall's tau (τ) correlation test was conducted to determine if the relationships were significant. The Kendall's tau correlation coefficient was selected as the method to assess the strength of correlations because it is a non-parametric, rank-based statistical method that is not sensitive to the effect of a small number of unusual values and is suitable for a range of values that exhibit skewness or span several orders of magnitude (Helsel and Hirsch, 2002). Correlations tests were computed using the R base package, and the resulting correlation coefficients and associated p-values are provided in each pairwise scatterplot.

The Kendall's tau correlation coefficient and associated p-value were used to determine the correlation strength between two parameters. For correlations with p-values less than 0.05, the strength of the correlation was determined based on the qualitative classification available in the USACE Environmental Statistics guidance (USACE, 2013) and summarized below.

Table 2-3 Qualitative Classification of Correlation Strength for Kendall's Tau

Absolute value of correlation coefficient (Kendall's tau)	Degree of relationship
$\tau < 0.30$	Extremely Weak
$0.30 < \tau < 0.50$	Weak
$0.50 < \tau < 0.75$	Moderate
$0.75 < \tau < 0.90$	Moderately Strong
$0.90 < \tau < 0.95$	Strong
$0.95 < \tau < 1.00$	Very Strong

3. Results

This section presents the results of statistical evaluations conducted to summarize the LTM datasets and to evaluate spatial and temporal trends. Results of the correlation analysis between sediment chemistry and benthic infaunal community metrics are also discussed.

3.1 Sediment Chemistry and Physical Characteristics

A summary of the sediment chemistry, TOC and grain size data and the statistical evaluations of each dataset are provided in the following sections. The spatial interpolation of PCB concentrations throughout each harbor area is also presented. The outputs of the statistical tests are presented in **Appendix C**.

3.1.1 Total PCB Concentrations

A summary of total PCBs concentrations detected in sediment for each LTM event is presented in **Table 2-2** and in boxplots in **Figure 3-1**.

Most datasets of total PCB concentrations per harbor area per LTM event were not normally distributed based on the Shapiro Wilk test ($p<0.05$) and visual inspection of the Q-Q plots (**Appendix C**). Following log transformation (log_{10}), most of the transformed PCB datasets were normally distributed ($p>0.05$). Therefore, the statistical evaluation was conducted on the log transformed datasets of total PCB concentrations.

Based on the results of the mixed ANOVA, the interaction between harbor area and time on PCB concentrations was significant ($p<0.0001$). Post hoc tests including one-way ANOVAs and pairwise comparisons were conducted to determine if there were significant differences among harbor areas for each LTM event and within each harbor area over time. Total PCB concentrations were significantly different among harbor areas for each LTM event ($p<0.001$). A spatial gradient, which was noted previously by EPA (Bergen and Nelson, 2012; Bergen, 2015), is present where the highest concentrations of PCBs were consistently detected in the Upper Harbor followed by the Lower Harbor, and the lowest concentrations observed in the Outer Harbor. Mean and maximum concentrations differed among harbor areas per LTM event often by an order of magnitude.

Total PCBs measured in each harbor area were also significantly different over time based on the one-way ANOVA model ($p<0.001$). The results of the Regional Kendall trend test indicated that PCB concentrations in all three harbor areas had decreasing trends that were significant. The temporal trend of decreasing PCB concentrations in all three harbor areas is apparent in the boxplot comparisons (**Figure 3-1**).

Based on the results of the paired t-tests, which compared mean concentrations among LTM events in a harbor area, mean concentrations of PCBs in the Upper Harbor measured during LTM VII (2020) were significantly lower ($p<0.05$) than mean concentrations measured in all six previous LTM events. Mean concentrations of PCBs in the Lower Harbor measured in 2020 were also significantly lower ($p<0.05$) than previous LTM events except 2014. Although mean concentrations of PCBs in the Outer Harbor measured in 2020 were not significantly different than any of the six previous LTM events, the Regional Kendall trend test indicated a significant decreasing trend overall in the Outer Harbor.

Two maximum concentrations, one measured in the Upper Harbor in 2014 (940 mg/kg) and one in the Outer Harbor in 1993 (4.8 mg/kg), were over three times higher than all other concentrations detected in these harbor areas during the same LTM event. These concentrations were removed from the datasets to determine the sensitivity of the statistical test outcomes to these values. Removal of these two values did not change any of the results of the statistical tests reported above with one exception: the mean concentrations of PCBs in the Upper Harbor in 2014 and 2020 were not significantly different following the removal of the maximum value in 2014 (940 mg/kg). This indicates that the elevated value in the Upper Harbor in 2014 (940 mg/kg) significantly increased the mean concentration of total PCBs for that event relative to 2020 whereas the elevated value in the Outer Harbor in 1993 (4.8 mg/kg) did not impact mean PCB concentrations for that event relative to the subsequent LTM events.

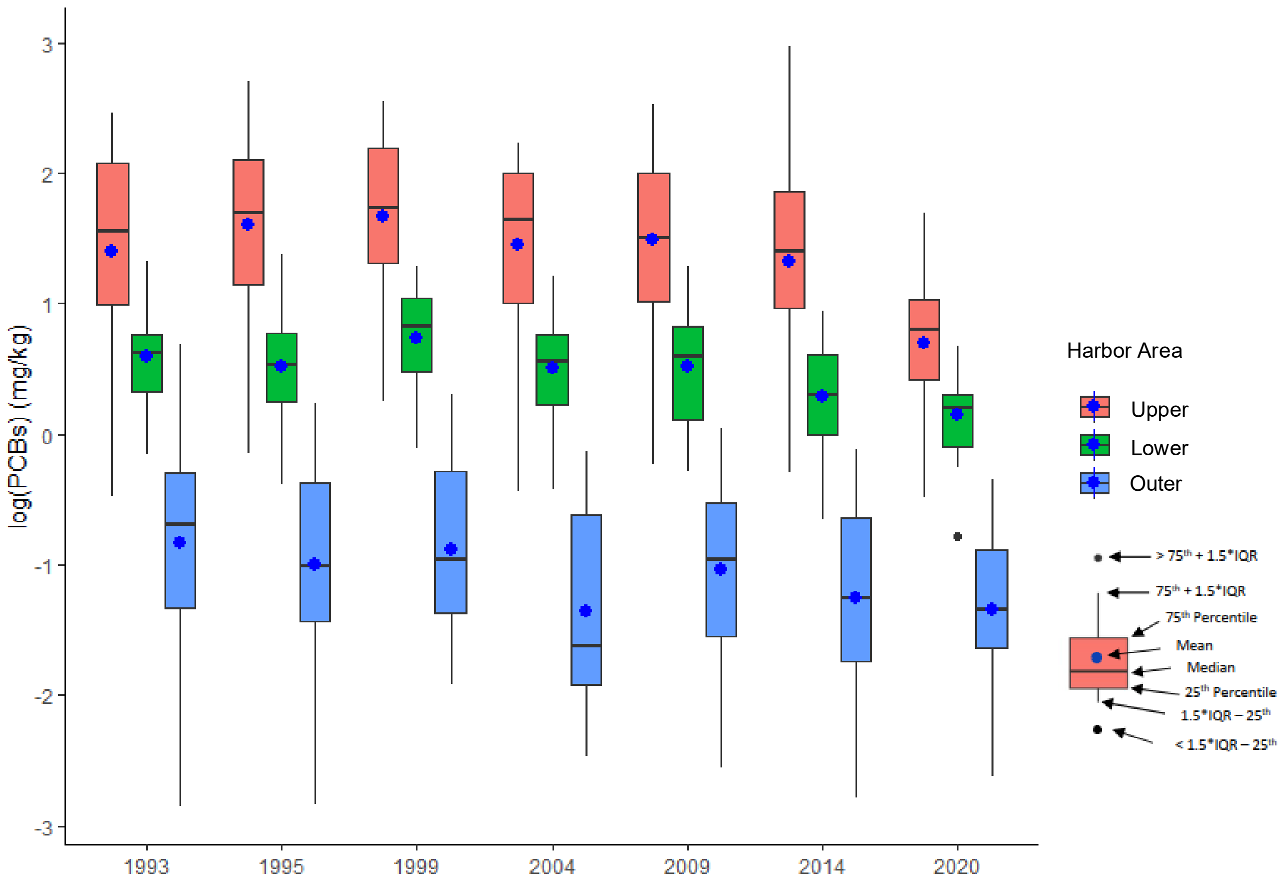

Figure 3-1 Boxplot comparisons of concentrations of total PCBs (sum of NOAA 18 congeners, log (base 10) transformed) in each harbor area for each LTM event. (Interquartile range [IQR] is the difference between the 75th and 25th percentiles)

PCB concentrations in surface sediment in 2020 were spatially interpolated based on kriging parameters that were optimized for each harbor area based on the 1993 (LTM I) dataset, as described in Nelson and Bergen (2012). The spatial distribution of PCBs in 2020 (sum of NOAA 18 congeners) are presented in five ranges of concentrations, < 1 parts per million (ppm), 1 – 10 ppm, 10 – 50 ppm, 50 – 100 ppm, and > 100 ppm, on **Figures 3-2**, **3-3**, and **3-4** for the Upper Harbor, Lower Harbor, and Outer Harbor, respectively. The spatial distribution of PCBs calculated as the sum of 209 congeners for samples collected in 2020 are presented based on the five ranges detailed above in **Appendix D**.

For subtidal sediments and mudflats, the PCB Target Cleanup Levels (TCLs) established in the 1998 ROD are 10 ppm in the Upper Harbor and 50 ppm in the Lower Harbor. The percentage of surface area in each harbor area that fell into each PCB concentration range based on the LTM VII dataset collected in 2020 in comparison to 2014 and 2009 is provided in **Table 3-1**. The percentage of surface area in the Upper Harbor below the 10 ppm TCL increased to 59% in 2020 from 19% in 2014. Likewise, the percentage of surface area in the Lower Harbor below 1 ppm increased to 22% in 2020 from 9% in 2014 and all surface area in the Outer Harbor remained below 1 ppm in 2020 consistent with 2014 (and well below the 1998 ROD cleanup level of 50 ppm). These results indicate that PCB concentrations continue to decline in all harbor areas.

Table 3-1 Comparison of sediment surface area (percent) for total PCB concentrations (sum of NOAA 18 congeners) ranges in 2009, 2014, and 2020

Total PCB Concentrations	Upper Harbor			Lower Harbor			Outer Harbor		
	2009	2014	2020	2009	2014	2020	2009	2014	2020
<1 ppm	0.1	0.3	1.4	2	9	22	99	100	100
1-10 ppm	11	19	59	88	91	78	1	--	--
10-50 ppm	46	40	39	10	--	--	--	--	--
50-100 ppm	8	18	--	--	--	--	--	--	--
>100 ppm	34	22	--	--	--	--	--	--	--

Notes:
ppm – parts per million.
Percentages for 2009 and 2014 are presented in Bergen (2015).

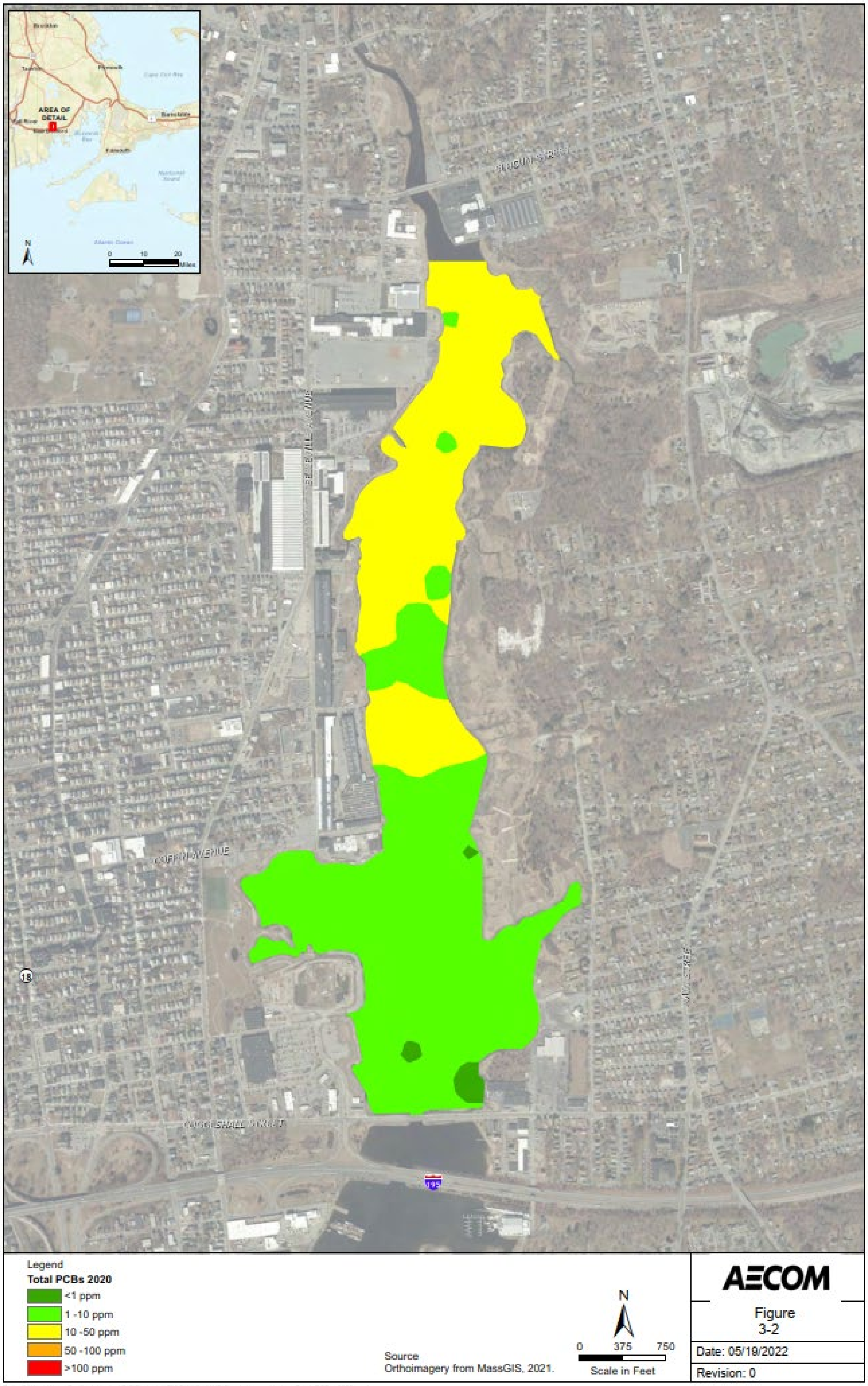

Figure 3-2 Spatial distributions of interpolated sediment PCB concentration data for the Upper Harbor in 2020. Total PCBs are the sum of the NOAA 18 congeners in the top 2 cm.

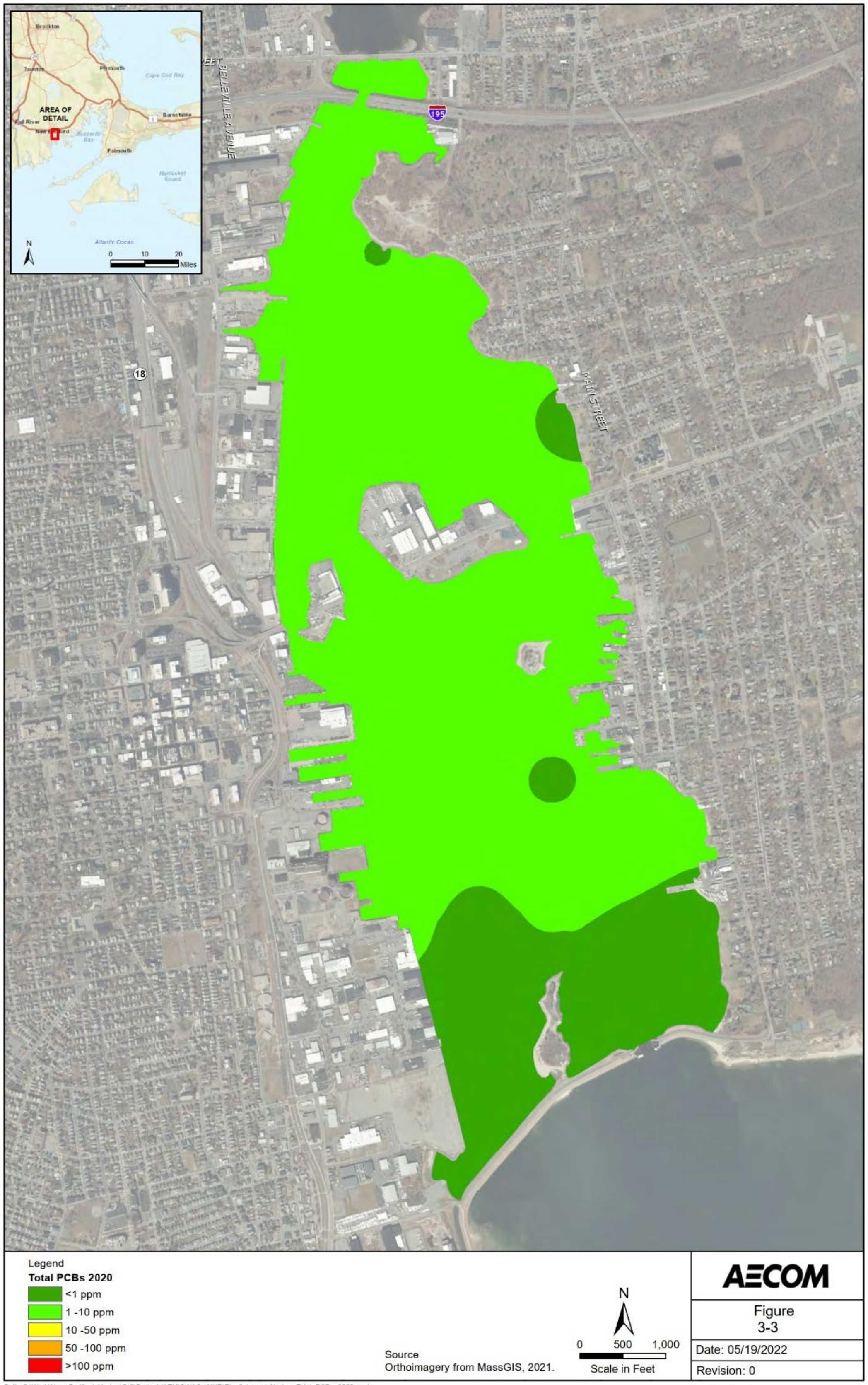

Figure 3-3 Spatial distributions of interpolated sediment PCB concentration data for the Lower Harbor in 2020. Total PCBs are the sum of the NOAA 18 congeners in the top 2 cm.

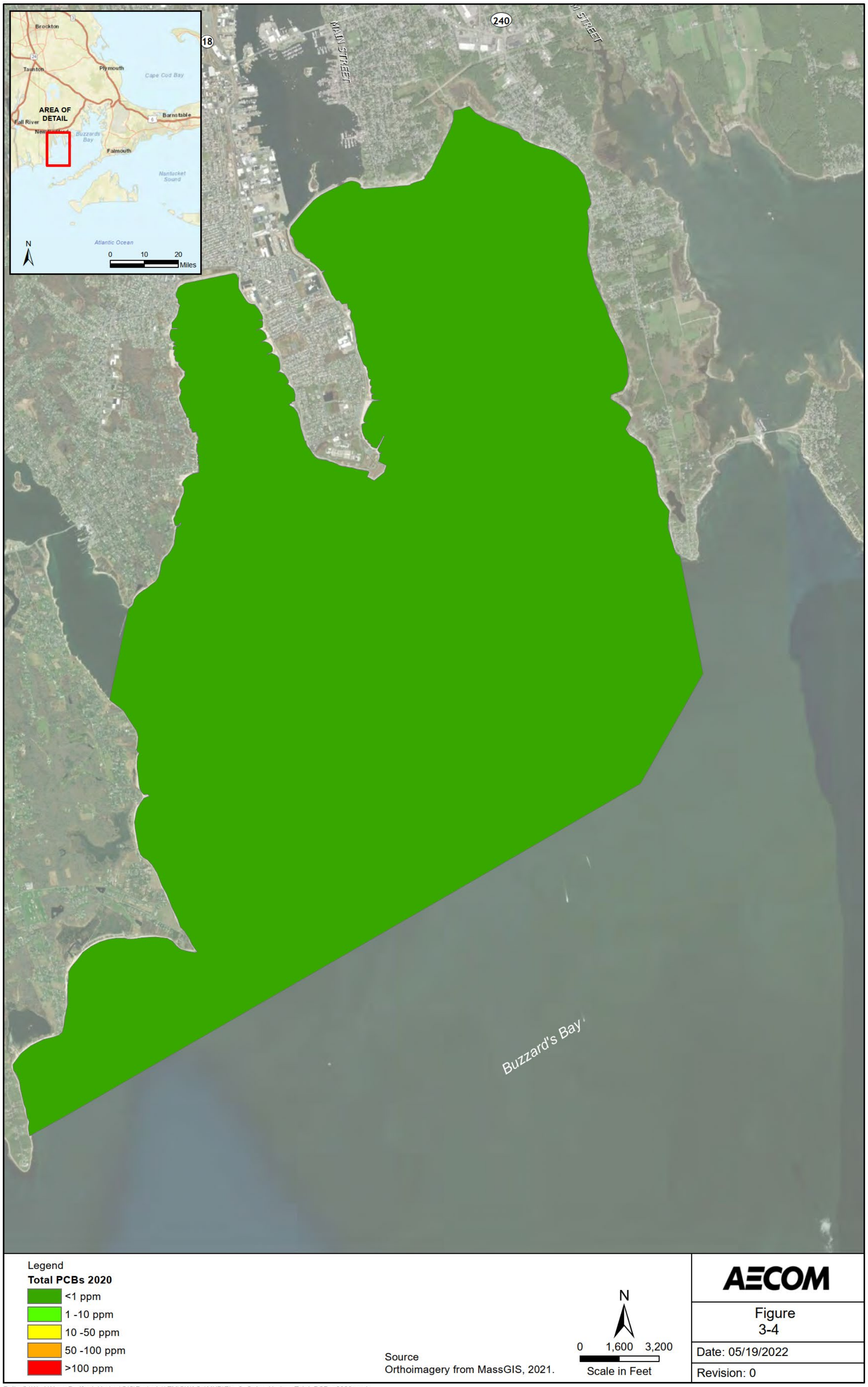

Figure 3-4 Spatial distributions of interpolated sediment PCB concentration data for the Outer Harbor in 2020. Total PCBs are the sum of the NOAA 18 congeners in the top 2 cm.

3.1.2 Sediment Total Organic Carbon

A summary of the TOC concentrations measured in the surface sediment samples for each LTM event is presented in **Table 3-2** and in boxplots in **Figure 3-5**.

The highest levels of TOC were consistently measured in surface sediment samples in the Upper Harbor during each LTM event followed by the Lower and Outer Harbors. The highest TOC (13%) was measured in the Upper Harbor in 1993 at Station 120. Prior to 2004, mean TOC ranged from 5% to 7% in the Upper Harbor and 3% to 5% in the Lower Harbor. After 2004, TOC in the Upper and Lower Harbors appear to decrease with lower mean concentrations ranging from 2% to 5% and 2% to 3%, respectively, in 2009, 2014, and 2020. TOC in the Outer Harbor is more consistent over time with mean concentrations ranging between <1% and 1.5%. Since only a small area of the Outer Harbor was capped or had dredging in the Federal Navigational Channel, the TOC should remain consistent over time.

Table 3-2 Summary Statistics of Sediment Grain Size and TOC

LTM Event - Year	Sediment Grain Size													Total Organic Carbon (%)				
		Gravel (>2.00 mm)				Sand [(a)] (<2.00 mm - >0.0625 mm)				Silt and Clay [(b)] (<0.0625 mm)								
	Number of Samples	Minimum	Mean	Standard Deviation	Maximum	Minimum	Mean	Standard Deviation	Maximum	Minimum	Mean	Standard Deviation	Maximum	Number of Samples	Minimum	Mean	Standard Deviation	Maximum
Upper Harbor																		
I - 1993	27	ND	2.8	3.6	18	14.1	51	24	93	2	47	26	86	27	0.12	7.41	4.24	13
II - 1995	27	ND	7.0	7.0	27	20.2	53	13	73	1	35	14	60	26	0.16	5.80	3.36	11
III - 1999	27	ND	3.7	3.0	10	10.3	42	23	91	4	54	24	86	27	0.52	6.39	2.78	10
IV - 2004	27	ND	6.1	12	60	2.2	35	29	81	1.3	59	35	98	27	0.20	6.32	3.28	10
V - 2009	27	ND	2.9	3.0	11	13.7	44	20	92	1	49	27	86	27	0.38	2.55	1.33	5.2
VI - 2014	27	ND	6.7	9.0	30	1.0	33	26	84	4.0	61	32	99	27	0.26	4.75	2.50	8.4
VII - 2020	27	ND	4.4	6.2	25	2.0	29	28	89	5.4	66	31	97	27	0.45	3.86	1.75	6.7
Lower Harbor																		
I - 1993	27	ND	3.8	4.4	17	18.3	57	17	95	3	39	19	82	27	0.34	4.65	2.74	9.6
II - 1995	29	ND	8.9	11	56	21.3	57	15	82	4	26	16	77	29	0.20	3.40	2.00	6.8
III - 1999	29	ND	6.0	6.1	22	16.5	51	22	91	2	43	24	84	29	0.16	4.12	2.18	9.2
IV - 2004	29	ND	9.4	18	95	0.9	42	26	97	0.6	49	30	97	29	0.27	4.64	2.60	11
V - 2009	29	ND	3.6	3.0	12	14.3	54	21	93	1	36	25	84	29	0.10	1.85	1.11	4.1
VI - 2014	29	ND	7.2	11	44	3.0	42	23	86	7.0	51	28	97	29	0.12	2.57	1.52	5.7
VII - 2020	29	ND	5.0	8.7	44	1.0	35	23	81	1.8	60	28	99	29	0.48	2.79	1.14	5.2
Outer Harbor																		
I - 1993	23	ND	5.7	9.4	35.2	13.5	53	28	98	1	42	31	86	23	0.080	1.26	1.10	3.60
II - 1995	19	ND	3.1	3.0	12.4	53.8	71	13	89	1	23	14	45	22	0.013	1.02	0.83	2.90
III - 1999	23	ND	6.5	11	41	18	53	25	95	ND	41	30	82	23	0.038	1.54	1.07	3.60
IV - 2004	23	ND	5.4	11.6	43.8	4	48	31	92	ND	46	35	96	23	0.050	1.23	0.98	3.32
V - 2009	23	ND	2.3	3.2	10.9	16.7	51	28	93	1	42	29	83	23	0.050	0.94	0.69	3.28
VI - 2014	23	ND	7.0	11.8	44.0	4.0	43	29	92	3.0	50	31	92	23	0.072	1.41	0.98	3.49
VII - 2020	23	ND	7.3	11.1	39.0	6.0	42	28	92	1.5	51	31	94	23	0.098	1.16	0.73	2.79

Notes:

ND – Not detected.

(a) The fraction for sand for LTM VII in 2020 was <2.00 - >0.075 mm.

(b) The fraction for silt and clay for LTM VII in 2020 was <0.075 mm.

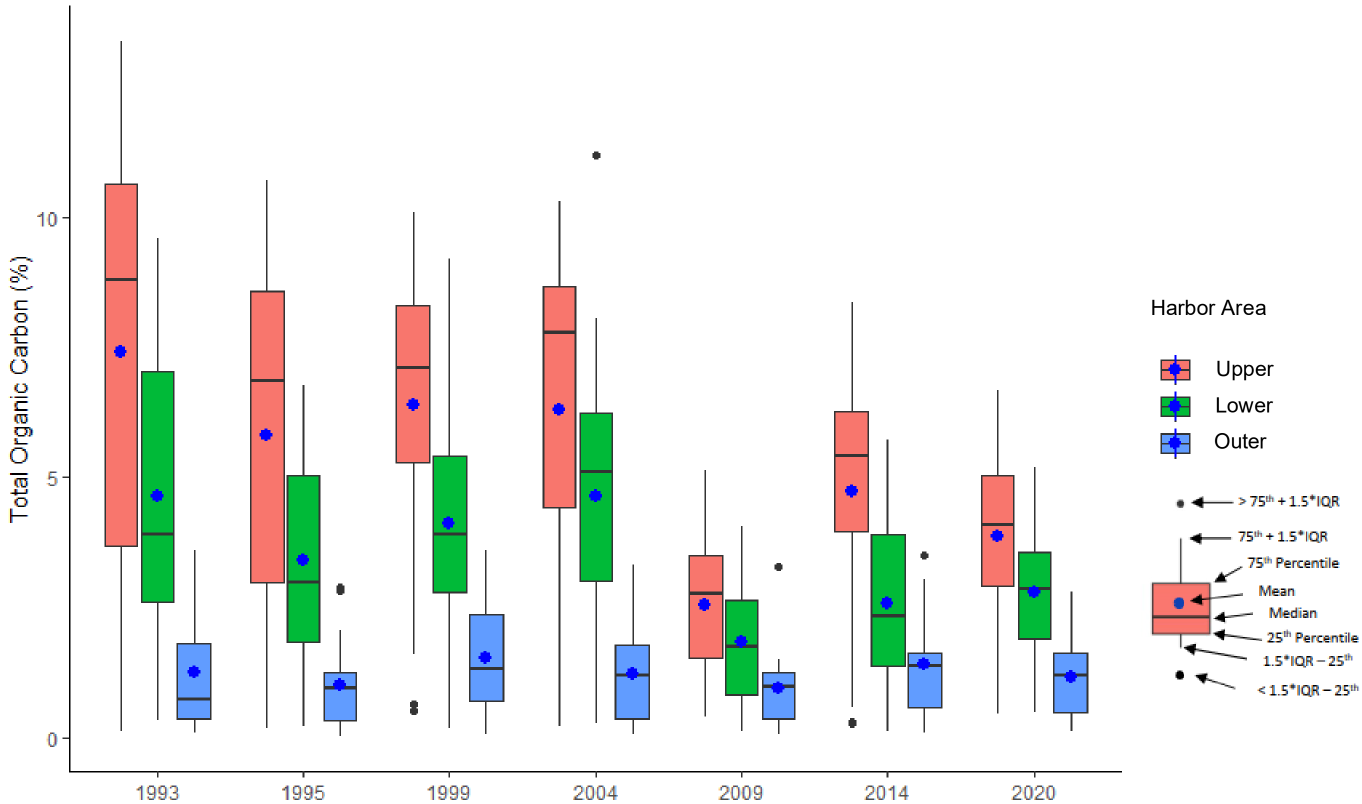

Figure 3-5 Boxplot comparisons of percent TOC in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

3.1.3 Total PCB Concentrations Normalized to TOC

Total PCB concentrations (log10-transformed) and TOC appear to be positively related in each harbor area (**Figure 3-6**). Therefore, total PCB concentrations were normalized by TOC and evaluated using the same statistical approach described in Section 3.1.1 including the mixed ANOVA and post hoc one-way ANOVAs and pairwise comparisons. The TOC-normalized PCB concentrations were not normally distributed (Shapiro Wilk test, $p<0.05$), however, following log transformation ($\log_{10}$) of these data, most of the transformed PCB/TOC datasets were normally distributed ($p>0.05$). Therefore, the statistical evaluation was conducted on the log transformed datasets of TOC-normalized total PCB concentrations.

A summary of TOC-normalized concentrations of total PCBs for each LTM event is presented in **Table 3-3**. Normalized concentrations followed the same general pattern as the not-normalized total PCB concentrations and the interaction between harbor area and time on the normalized concentrations was significant (**Figure 3-7**). The results of the Regional Kendall trend test indicated that TOC-normalized concentrations of PCBs in all three harbor areas had decreasing trends that were significant.

The pairwise comparison results indicated that normalized concentrations were significantly different among harbor areas for each LTM event. There were also significant differences in each harbor area over time. Specifically, mean TOC-normalized concentrations in the Upper Harbor measured in 2020 were lower than the six previous LTM events. Mean TOC-normalized concentrations in the Lower Harbor measured in 2020 were also significantly lower than previous LTM events except 2004. In the Outer Harbor, mean TOC-normalized concentrations measured in 2020 were significantly lower than concentrations in 1993 and 1995. Among LTM events other than 2020, TOC-normalized concentrations measured in the Upper and Lower Harbors in 2009 were significantly higher than 1993, 1995 (Lower Harbor only), 2004, and 2014 concentrations. This is likely due to the low levels of TOC measured in 2009 in these harbor areas relative to the other LTM events (**Figure 3-4**); PCB concentrations in 2009 were not significantly different from other LTM events (**Figure 3-1**, **Section 3.1.1**). Furthermore, the mean TOC-normalized PCB concentration in the Lower Harbor in 2004 was significantly lower than the mean TOC-normalized concentration in 1999. Finally, in the Outer Harbor, the mean TOC-normalized PCB concentrations in 2004, 2014, and 2020 were significantly lower than the 1993 and 1995 mean concentrations.

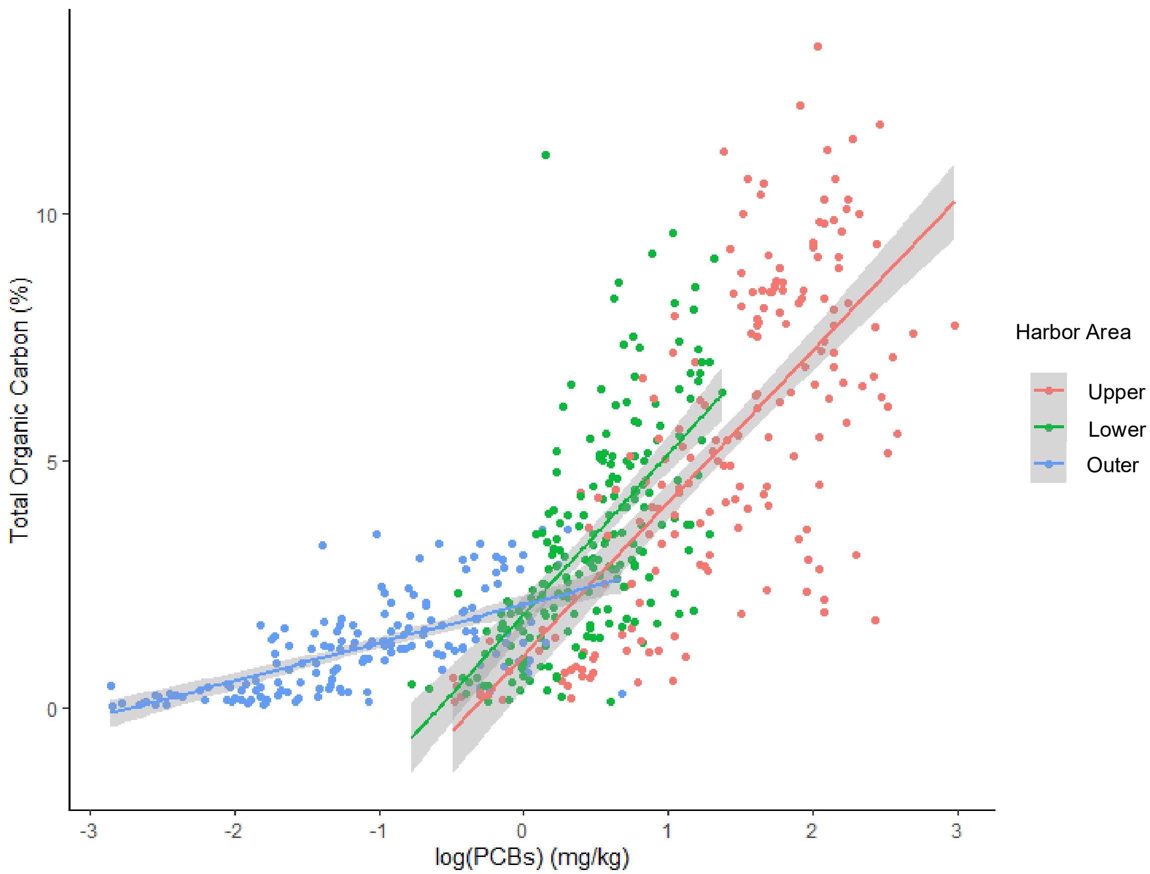

Figure 3-6 Scatterplots of total PCB concentrations (log base 10-transformed) and percent TOC in each harbor area for all LTM events. The lines represent fitted linear regression lines and the grey bands represent 95% confidence intervals of the regression lines.

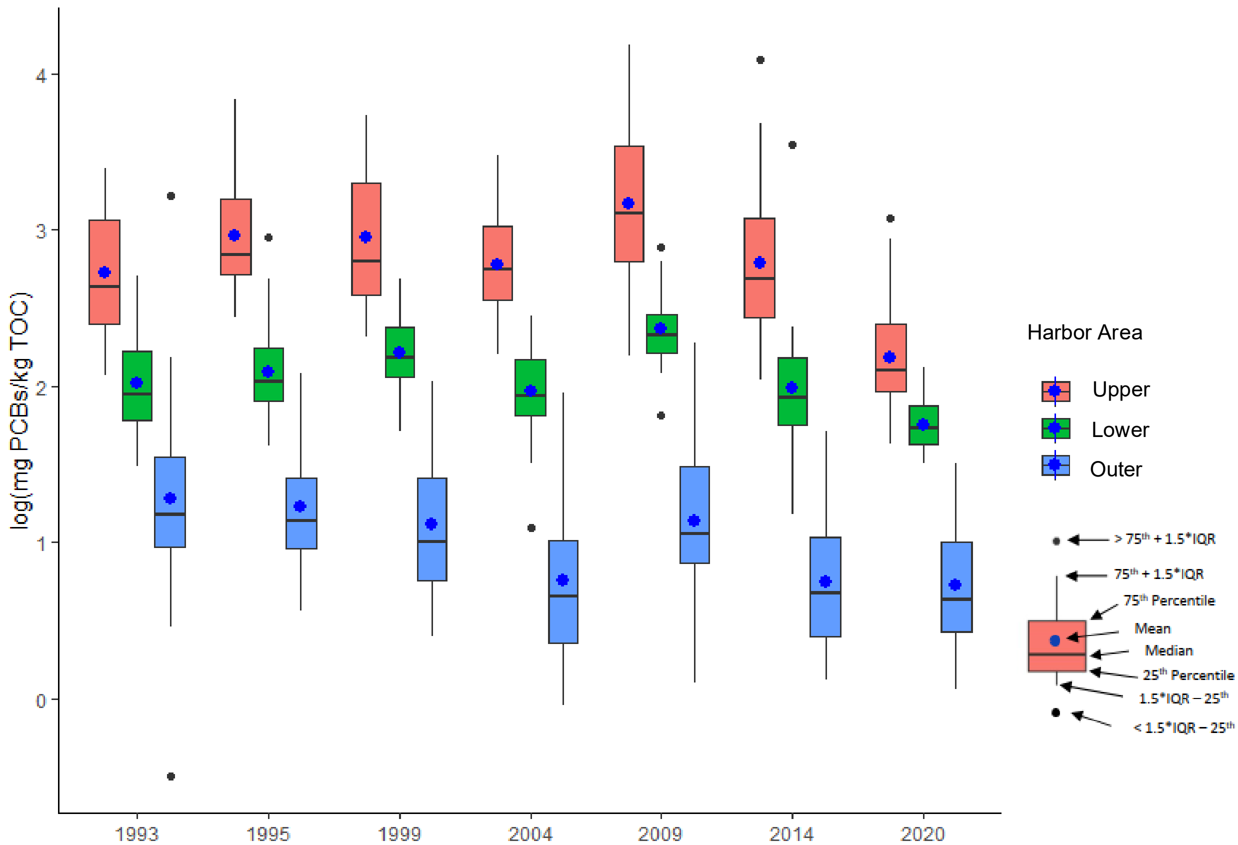

Figure 3-7 Boxplot comparisons of TOC-normalized total PCB concentrations in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

Table 3-3 Summary Statistics of Total PCBs Calculated as the Sum of NOAA 18 congeners Normalized by TOC and Results of Pairwise Comparisons Between 2020 and Previous LTM Events

LTM Event - Year	TOC-Normalized Total PCBs (sum of NOAA 18)					
	Detected Concentrations (mg PCBs/kg TOC)				Number of Samples	Number of Detected Concentrations
	Minimum	Mean	Standard Deviation	Maximum		
Upper Harbor						
I - 1993	117	775	676	2,442	27	27
II - 1995	273	1,387	1,689	6,858	26	26
III - 1999	209	1,438	1,505	5,410	27	27
IV - 2004	158	808	675	2,951	27	27
V - 2009	156	2,645	3,231	15,341	27	27
VI - 2014	109	1,284	2,383	12,168	27	27
VII - 2020	43	228	266	1,197	27	27
Lower Harbor						
I - 1993	31	136	117	507	27	27
II - 1995	42	167	175	888	29	29
III - 1999	51	192	114	488	29	29
IV - 2004	13	112	68	283	29	29
V - 2009	65	271	169	773	29	29
VI - 2014	15	220	629	3,478	29	29
VII - 2020	32	61	27	133	29	29
Outer Harbor						
I - 1993	5.3	111	357	1,658	23	21
II - 1995	3.7	27	30	120	22	21
III - 1999	2.5	22	25	108	23	23
IV - 2004	0.90	13	21	90	23	23
V - 2009	1.3	29	45	190	23	23
VI - 2014	1.3	10	12	52	23	23
VII - 2020	1.2	8.3	8.8	32	23	23

Notes:
-- - Not available.
mg/kg - milligram per kilogram.
* Mean total PCBs normalized by TOC in the Upper Harbor in 2020 were significantly lower than mean concentrations in all other LTM events.
** Mean total PCBs normalized by TOC in the Lower Harbor in 2020 were significantly lower than all other LTM events except 2004 (LTM IV).
*** Mean total PCBs normalized by TOC in the Outer Harbor in 2020 were significantly lower than 1993 and 1995 mean concentrations.

3.1.4 Sediment Grain Size Data

A summary of the fractions of gravel, sand, silt, and clay measured in the surface sediment samples (co-located with chemistry and TOC) for each LTM event is presented in **Table 3-2** and in boxplots in **Figure 3-8**.

The percentage of gravel remained relatively low over time in all harbor areas. In contrast, the percentages of silt and clay appeared to increase and sand decrease over time in the Upper and Lower Harbors. Surface sediments in the Upper Harbor were generally more fine-grained: the mean percentage of silt and clay in 1993 was 47% and increased to 66% in 2020. Sand content was higher on average in the Lower Harbor than the Upper Harbor, but silt and clay remained the highest of all fractions in the Lower Harbor in more recent events. The ranges of percentages of sand and silt and clay generally overlapped in the Outer Harbor.

The potential relationship between total PCB concentrations (log-transformed) and the fraction of silt and clay was evaluated in each harbor area (**Figure 3-9**). In general, there was a positive relationship between PCB concentrations and the percent of silt and clay; however, based on the scatter, the relationships appear weak at best. Therefore, normalization of PCB concentrations based on grain size data was not pursued.

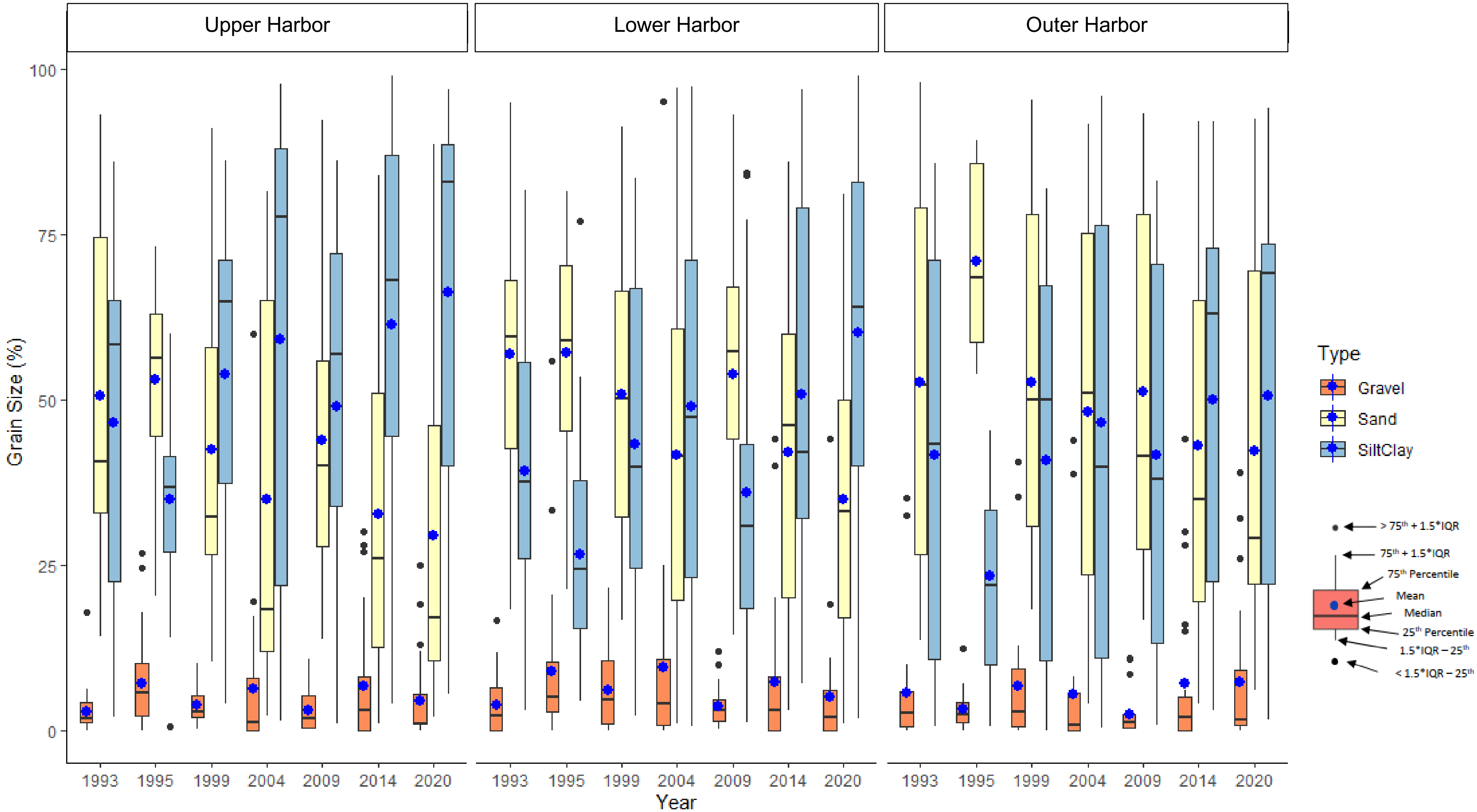

Figure 3-8 Percentages of gravel, sand, and silt and clay fractions measured in surface sediment in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

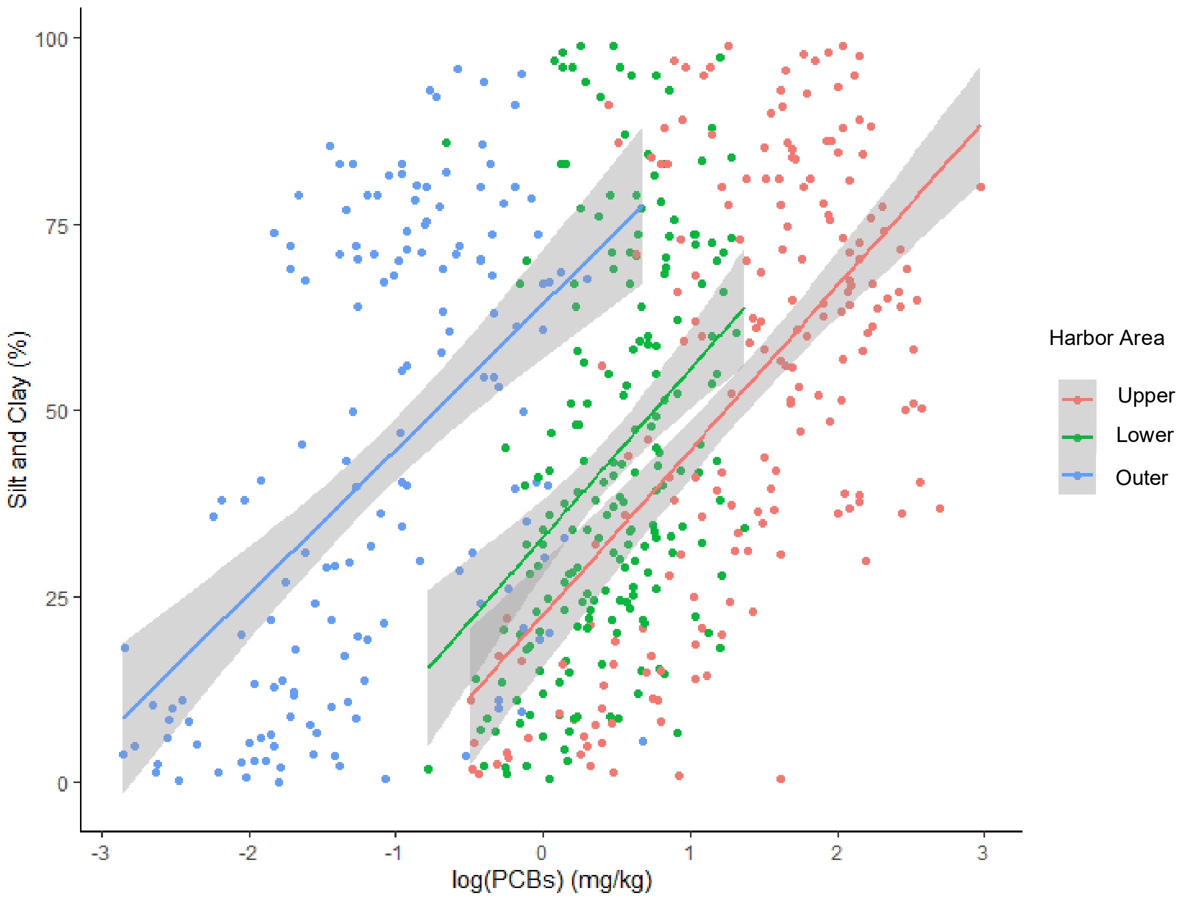

Figure 3-9 Scatterplots of total PCB concentrations (log base 10-transformed) and percent TOC in each harbor area for all LTM events. The lines represent fitted linear regression lines and the grey bands represent 95% confidence intervals.

3.2 Benthic Infaunal Community Composition

A summary of the benthic infaunal community metric data and the statistical evaluations of each dataset are provided below. Appendix A provides a memorandum prepared by Normandeau describing the calculation of the metric and presents the results of each LTM event. The outputs of the statistical tests are presented in **Appendix C**.

Mean values for the benthic infaunal community metrics calculated by Normandeau for each LTM event, including species richness (number of taxa), abundance, evenness (J'), and Shannon's Diversity (H') are presented in **Table 3-4**. The mean U.S. M-AMBI value and corresponding category of benthic health condition are also provided.

Most of the datasets for species richness, evenness, diversity, and U.S. M-AMBI were normally distributed (Shapiro Wilk test, $p>0.05$) with the exceptions of datasets for:

- Species richness in the Upper Harbor in 2009 and Lower Harbor in 2020,
- Evenness in the Upper Harbor in 1999 and 2004; Lower Harbor in 2004; and Outer Harbor in 2020,
- Diversity in the Lower Harbor in 2004 and Outer Harbor in 2020, and
- U.S. M-AMBI in the Upper Harbor in 2009; the Lower Harbor in 1993, 2004, and 2020; and the Outer Harbor in 2004.

Over half of the datasets for abundance were not normally distributed ($p<0.05$); however, a log transformation (log_{10}) did not improve the distributions and therefore, the untransformed abundance datasets were used in the statistical evaluation.

Higher species richness, evenness, diversity and U.S. M-AMBI values were measured or calculated at sampling stations in the Outer Harbor than in the Lower and Upper Harbors for all LTM events (**Figures 3-10**, **3-12**, **3-13**, and **3-14**). The ranges of these metrics generally overlapped in the Lower and Upper Harbors per LTM event and in most cases, Lower Harbor values ranged higher than Upper Harbor values. Abundance values overlapped among all three harbor areas (**Figure 3-11**).

Based on the results of the mixed ANOVAs, the interactions between harbor area and time on community metrics were significant ($p<0.05$). The post hoc test results including one-way ANOVAs and pairwise comparisons indicated significant differences ($p<0.05$) among reaches and LTM events and the Regional Kendall trend test indicated significant temporal trends as follows:

- Species richness was significantly different among harbor areas in a given LTM event, with higher values in the Outer Harbor compared to the other harbor areas and higher values in the Lower Harbor compared to the Upper Harbor for each LTM event except in 1995, 2014, and 2020 when species richness was similar in the Lower and Upper Harbors. There were also significant differences in each harbor area over time except the Lower Harbor. In the Upper Harbor mean species richness was significantly higher in 2020 in comparison to 1999, 2004, and 2009 and significantly lower in 2020 in comparison to 2014. In the Lower and Outer Harbors, mean richness in 2020 was not significantly different than any of the previous six LTM events. In the Upper Harbor, among LTM events other than 2020, richness was significantly higher in 1995 in comparison to 1999, 2004, and 2014. In the Outer Harbor, richness was significantly higher in 1993 and 2009 than 2004. The results of the Regional Kendall trend test indicated that species richness had an increasing trend in the Upper Harbor that was significant, but no temporal trends were significant in the Outer or Lower Harbors.
- There were no differences in abundance among harbor areas in 1993, 2004, 2009, and 2020. However, in 1995 and 2014 significantly higher mean abundance was measured in the Upper Harbor in comparison to the Lower and Outer Harbors and in 1999 significantly higher mean abundance was measured in the Upper Harbor in comparison to the Outer Harbor. There were also significant differences in each harbor area over time except the Upper Harbor. In the Lower and Outer Harbors mean abundance in 2020 was significantly lower than 1993 and/or 1999. Among LTM events other than 2020, mean abundance was significantly lower in 2004, 2009, and 2014 in the Lower and Outer Harbors in comparison to earlier LTM events (1993, 1995, and/or 1999). In the Lower Harbor mean abundance was also lower in 1995 in comparison with 1999. The results of the Regional Kendall trend test indicated that abundance had a decreasing trend over time in all three harbor areas that was significant.
- Evenness was significantly lower in the Upper Harbor than the Lower and Outer Harbors for most LTM events, except in 2004 and 2020 when mean evenness was similar in the Upper and Lower Harbors. In addition, mean evenness in the Lower and Outer Harbors was similar for most events except in 1993 and 2020 when mean evenness was higher in the Outer Harbor than the Lower Harbor. There were also significant differences in each harbor area over time. In the Upper Harbor, mean evenness was significantly higher in 2020 in comparison to 1993. In the Lower Harbor, mean evenness was similar in 2020 in comparison with previous LTM events. In the Outer Harbor, mean evenness was significantly higher in 2020 in comparison to 1999. Among LTM events other than 2020, mean evenness was significantly higher in 2004 in comparison to 1993 in the Upper Harbor, significantly higher in 2009 in comparison to 1993 and 1999 in the Lower Harbor, and was significantly higher in 1993, 2004, and 2014 in comparison to 1999 in the Outer Harbor. The results of the Regional Kendall trend test indicated that evenness had an increasing trend over time in all three harbor areas that was significant.
- Similar to species richness, diversity was significantly different among harbor areas with higher values in the Outer Harbor compared to the other harbor areas and higher values in the Lower Harbor compared to the Upper Harbor for all LTM events. The exception was 2020 when mean

diversity was higher in the Outer Harbor, but similar in the Upper and Lower Harbors. There were also significant differences in each harbor area over time except the Lower Harbor. In the Upper Harbor, mean diversity was significantly higher in 2020 in comparison to earlier events (1993, 1999, and 2009). In the Outer Harbor, mean diversity was significantly higher in 2020 in comparison with 1999. Among LTM events other than 2020, mean diversity was significantly higher in 2014 in comparison to earlier events (1993, 1999, and 2009) in the Upper Harbor and significantly higher in 1993 and 2009 in comparison with 1999 in the Outer Harbor. The results of the Regional Kendall trend test indicated that diversity had an increasing trend over time in the Upper and Lower Harbors that was significant, but no temporal trends were significant in the Outer Harbor.

- The U.S. M-AMBI values followed similar patterns as diversity and species richness and were significantly higher in the Outer Harbor compared to the other harbor areas and higher in the Lower Harbor compared to the Upper Harbor for all LTM events except 1995, 2014, and 2020. In 2014 mean values were similar among harbor areas and in 1995 and 2020 mean values were higher in the Outer Harbor, but similar in the Lower and Upper Harbors. There were also significant differences in each harbor area over time except the Lower Harbor. In the Upper Harbor, mean U.S. M-AMBI values were significantly higher in 2020 compared to earlier events from 1993 to 2009. In the Outer Harbor, mean values were significantly higher in 2020 in comparison with 2004. Among LTM events other than 2020, mean U.S. M-AMBI values were significantly lower in 2004 and 2014 compared to 1993 and 2009 in the Outer Harbor and significantly higher in 2014 compared to earlier events from 1993 to 2009 in the Upper Harbor. The results of the Regional Kendall trend test indicated that U.S. M-AMBI values had an increasing trend over time in the Upper Harbor that was significant, but no temporal trends were significant in the Lower or Outer Harbors.

Table 3-4 Regional Salinity Grouping and Mean Benthic Community Parameters (richness [number of taxa], abundance, evenness (J') , Shannon Diversity (H'), U.S. M-AMBI, and U.S. M-AMBI category) for Each Harbor Segment-Year Combination and Results of Pairwise Comparisons Between 2020 and Previous LTM Events

LTM Event - Year	Stations	Regional Salinity Group	Mean Richness (Number of Taxa)	Mean Abundance	Mean Evenness (J')	Mean Diversity (H')[a]	Mean U.S. M-AMBI	U.S. M-AMBI Category[b]
				Upper Harbor				
I - 1993	105-155	Polyhaline	14.1	1,200	0.40	0.45	0.27	Poor
II - 1995	105-155	Polyhaline	16.5	1,490	0.46	0.55	0.27	Poor
III - 1999	105-155	Polyhaline	12.1	1,390	0.45	0.48	0.26	Poor
IV - 2004	105-155	Polyhaline	11.1	721	0.55	0.54	0.24	Poor
V - 2009	105-155	Polyhaline	12.7	739	0.45	0.48	0.26	Poor
VI - 2014	105-155	Polyhaline	23.7	1,600	0.49	0.68	0.40	Moderate
VII - 2020	105-155	Polyhaline	17.9*	501	0.56***	0.70++	0.37^	Poor
				Lower Harbor				
I - 1993	202-253	Polyhaline	20.5	851	0.56	0.68	0.43	Moderate
II - 1995	202-253	Polyhaline	19.3	472	0.62	0.74	0.36	Poor
III - 1999	202-253	Polyhaline	22.4	928	0.56	0.72	0.46	Moderate
IV - 2004	202-253	Polyhaline	16.2	273	0.63	0.75	0.37	Poor
V - 2009	202-253	Polyhaline	20.1	405	0.68	0.81	0.44	Moderate
VI - 2014	202-253	Polyhaline	22.1	478	0.64	0.84	0.40	Moderate
VII - 2020	202-253	Polyhaline	20.5	384**	0.61	0.75	0.47	Moderate
				Outer Harbor				
I - 1993	304-352	Euhaline	46.0	786	0.72	1.2	0.69	Good
II - 1995	304-352	Euhaline	39.9	554	0.67	1.1	0.54	Good
III - 1999	304-352	Euhaline	38.0	602	0.63	0.98	0.56	Good
IV - 2004	304-352	Euhaline	29.5	226	0.72	1.0	0.47	Moderate
V - 2009	304-352	Euhaline	45.9	479	0.71	1.2	0.69	Good
VI - 2014	304-352	Euhaline	40.1	446	0.71	1.1	0.49	Moderate
VII - 2020	304-352	Euhaline	41.4	362**	0.73+	1.2+++	0.63^^	Good

Notes:
Mean benthic community parameters based on specimens collected per sample.
[a] Shannon's H' Diversity calculated with log10(x).
[b] Category of benthic health condition: Bad (<0.20), Poor (0.20 to 0.39), Moderate (>0.39 to 0.53), Good (>0.53 to 0.77), and High (>0.77).
* Mean richness in the Upper Harbor in 2020 was significantly higher in comparison to 1999, 2004, and 2009 and significantly lower in comparison to 2014.
** Mean abundance in the Lower and Outer Harbors in 2020 was significantly lower in comparison to 1993 and/or 1999.
*** Mean evenness in the Upper Harbor in 2020 was significantly higher in comparison to 1993.
+ Mean evenness in the Outer Harbor in 2020 was significantly higher in comparison to 1999.
++ Mean diversity in the Upper Harbor in 2020 was significantly higher in comparison to earlier events (1993, 1999, and 2009).
+++ Mean diversity in the Outer Harbor in 2020 was significantly higher in comparison to 1999.
^ Mean U.S. M-AMBI values in the Upper Harbor,in 2020 were significantly higher compared to earlier events from 1993 to 2009.
^^ Mean U.S. M-AMBI values in the Outer Harbor in 2020 were significantly higher in comparison to 2004.

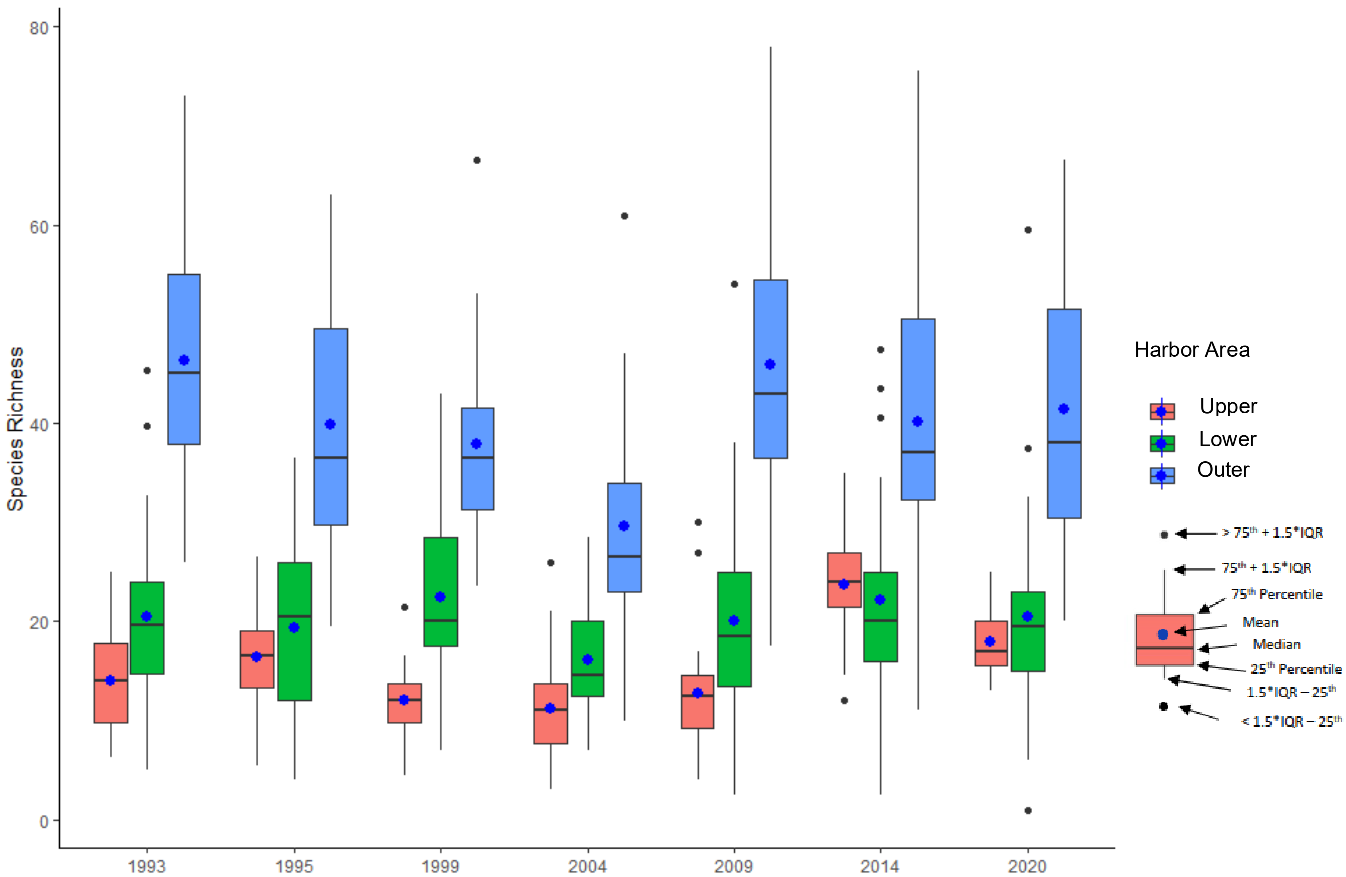

Figure 3-10 Boxplot comparisons of species richness (number of taxa) in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

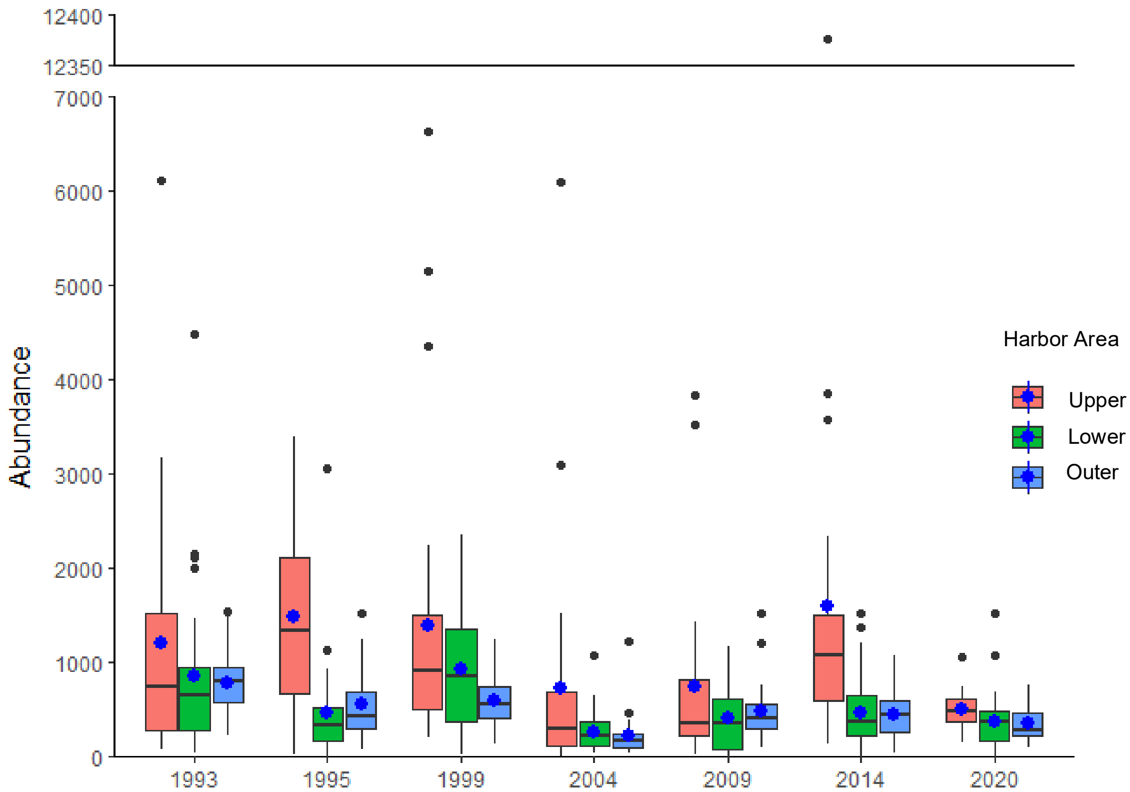

Figure 3-11 Boxplot comparisons of abundance (number of organisms) in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

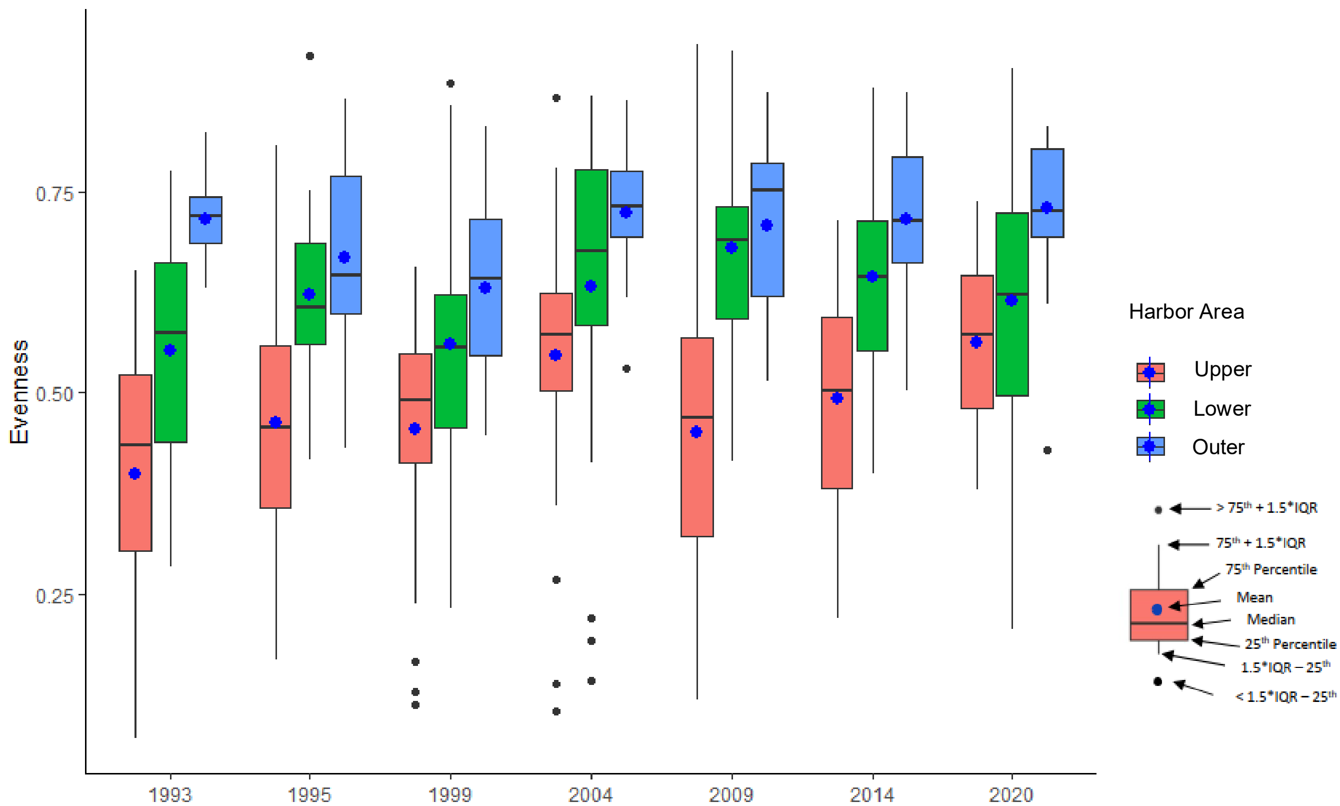

Figure 3-12 Boxplot comparisons of evenness (J') in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

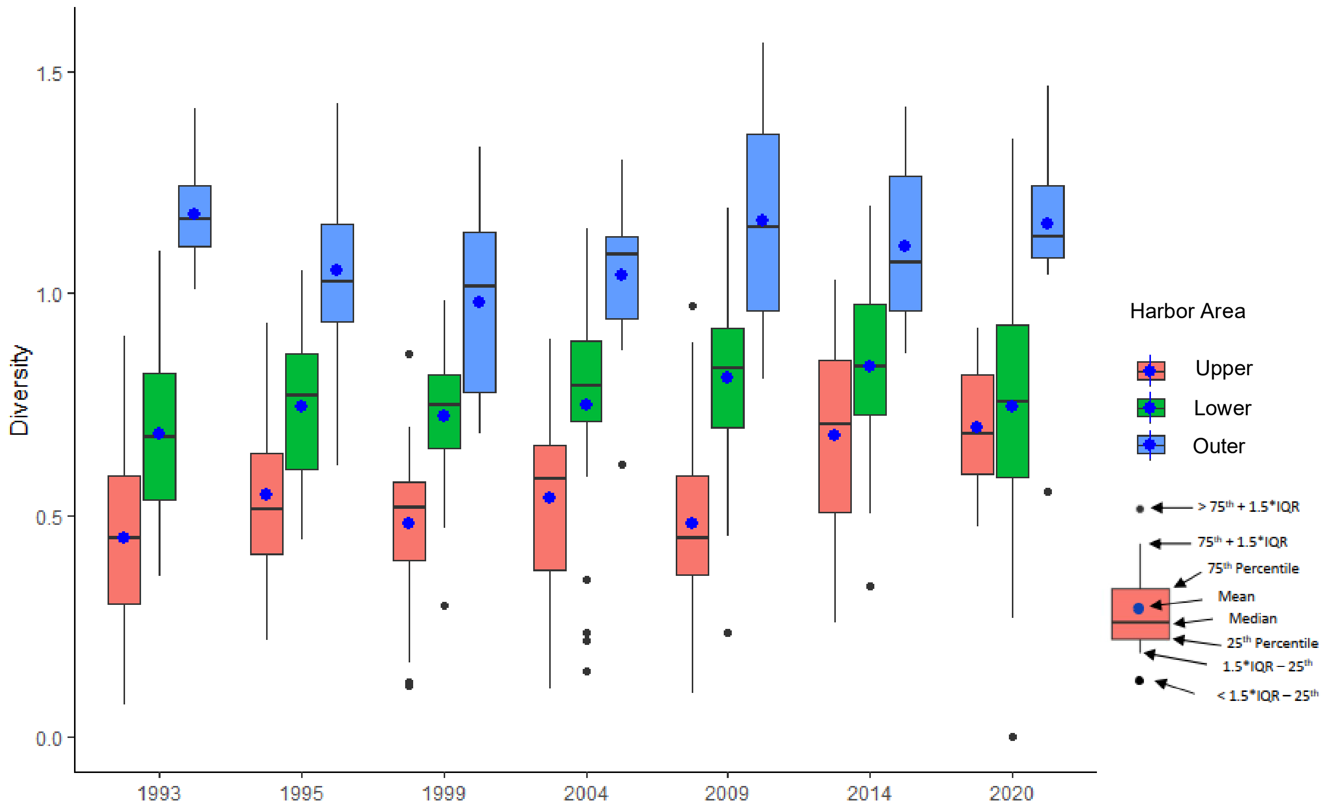

Figure 3-13 Boxplot comparisons of diversity (H') in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

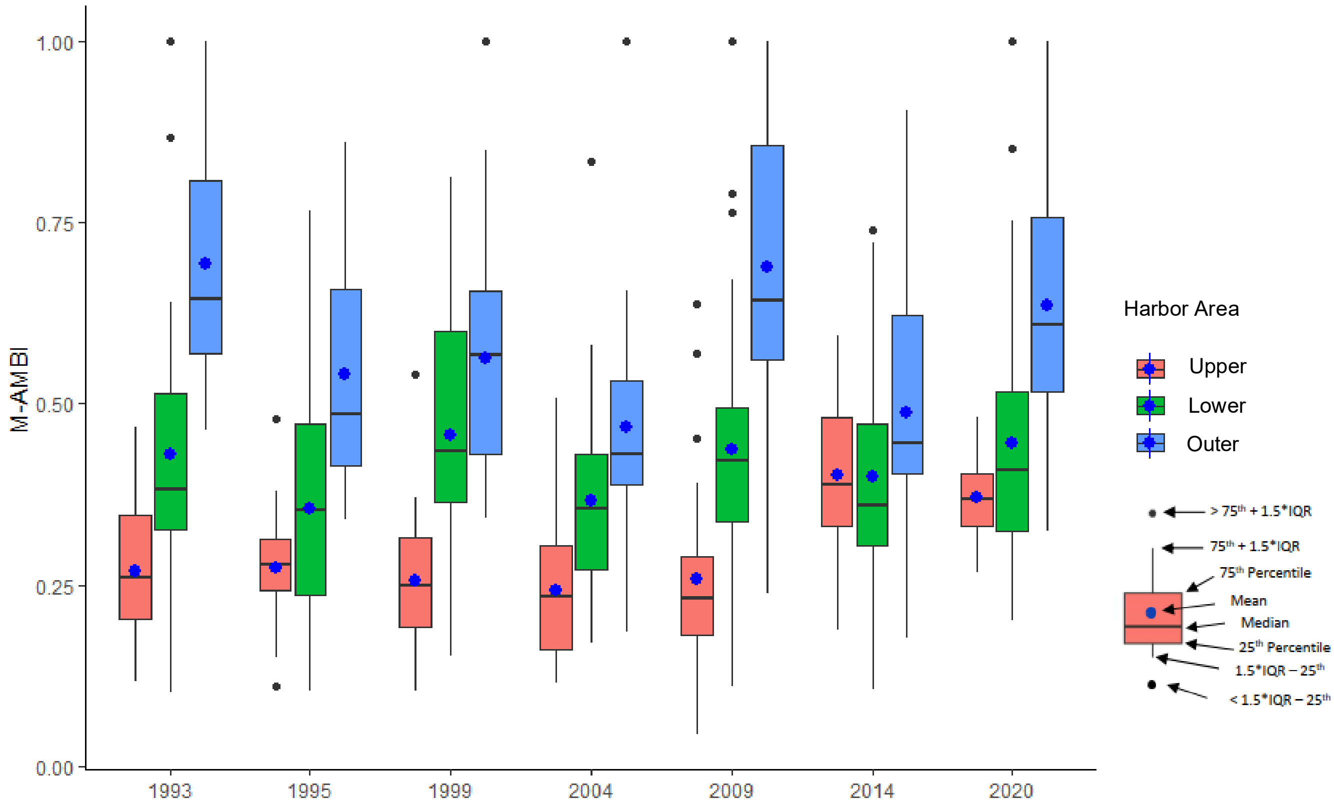

Figure 3-14 Boxplot comparisons of U.S. M-AMBI in each harbor area for each LTM event. (IQR is the difference between the 75th and 25th percentiles)

The U.S. M-AMBI values for each LTM VII station are presented on **Figures 3-15**, **3-16**, and **3-17** for the Upper Harbor, Lower Harbor, and Outer Harbor, respectively. The station symbols on these figures are colored based on the following categories: Bad (<0.20), Poor (0.20 to 0.39), Moderate (>0.39 to 0.53), Good (>0.53 to 0.77), and High (>0.77). In the Upper Harbor, the mean U.S. M-AMBI value was 0.37, which is categorized as "poor" benthic community health (but on the cusp of "moderate"). Most of the stations in the northern part of the Upper Harbor were categorized as "poor" whereas stations in the southern portion were categorized as a mix of "moderate" to "poor" (**Figure 3-15**). The U.S. M-AMBI values in the Lower Harbor were more variable ranging from "bad" to "high" with a mean value of 0.47 corresponding to "moderate" benthic community health (**Figure 3-16**). In the Outer Harbor, U.S. M-AMBI values ranged from "poor" to "high" with a mean value of 0.63 corresponding to "good" community health (**Figure 3-17**).

Overall, the benthic community health in the Upper Harbor has improved based on the change in the mean U.S. M-AMBI value from 0.27 (poor) in 1993 and 1995 to 0.40 and 0.37 (poor to moderate) in 2014 and 2020, respectively (**Table 3-4**). **Table 3-5** presents the percentage of stations in the Upper Harbor, Lower Harbor, and Outer Harbor falling into the U.S. M-AMBI based benthic health condition categories for each LTM event. In the Upper Harbor the percentage of stations categorized as having "bad" benthic community health decreased from 37% in 2004 and 2009 to 0% in 2020. Over the same period the percentage of stations categorized as having "moderate" benthic community health in the Upper Harbor increased from 7% to 33%. These changes in percentages indicate overall improvement in the benthic community health of the Upper Harbor.

In the Lower and Outer Harbors, benthic community health as indicated by the mean U.S. M-AMBI metric has remained relatively constant over the 17-year period since LTM monitoring began (**Table 3-4**). The percentage of stations in these harbor areas falling into the U.S. M-AMBI based benthic health condition categories has also remained relatively constant between LTM events (**Table 3-5**).

Table 3-5 Comparison of percent of stations in benthic health condition categories for each harbor segment-year combination

	Category of Benthic Health Condition				
LTM Event - Year	**Bad (U.S. M-AMBI <0.2)**	**Poor (U.S M-AMBI 0.20 to 0.39)**	**Moderate (U.S. M-AMBI >0.39 to 0.53)**	**Good (U.S. M-AMBI >0.53 to 0.77)**	**High (U.S. M-AMBI >0.77)**
Upper Harbor					
I - 1993	22.2%	70.4%	7.4%	0%	0%
II - 1995	14.8%	81.5%	3.7%	0%	0%
III - 1999	29.6%	66.7%	0%	3.7%	0%
IV - 2004	37.0%	55.6%	7.4%	0%	0%
V - 2009	37.0%	48.2%	7.4%	7.4%	0%
VI - 2014	3.7%	48.2%	33.3%	14.8%	0%
VII - 2020	0%	66.7%	33.3%	0%	0%
Lower Harbor					
I - 1993	6.9%	48.3%	24.1%	13.8%	6.9%
II - 1995	20.7%	41.4%	27.6%	10.3%	0%
III - 1999	6.9%	34.5%	24.1%	31.0%	3.5%
IV - 2004	6.9%	58.6%	24.1%	6.9%	3.5%
V - 2009	10.3%	31.0%	37.9%	13.8%	6.9%
VI - 2014	3.5%	51.7%	24.1%	20.7%	0%
VII - 2020	0%	42.9%	32.1%	17.9%	7.1%
Outer Harbor					
I - 1993	0%	0%	17.4%	52.2%	30.4%
II - 1995	0%	18.2%	36.4%	36.4%	9.1%
III - 1999	0%	17.4%	30.4%	39.1%	13.0%
IV - 2004	4.4%	26.1%	39.1%	26.1%	4.4%
V - 2009	0%	4.4%	4.4%	60.9%	30.4%
VI - 2014	4.4%	17.4%	34.8%	39.1%	4.4%
VII - 2020	0%	8.7%	21.7%	43.5%	26.1%

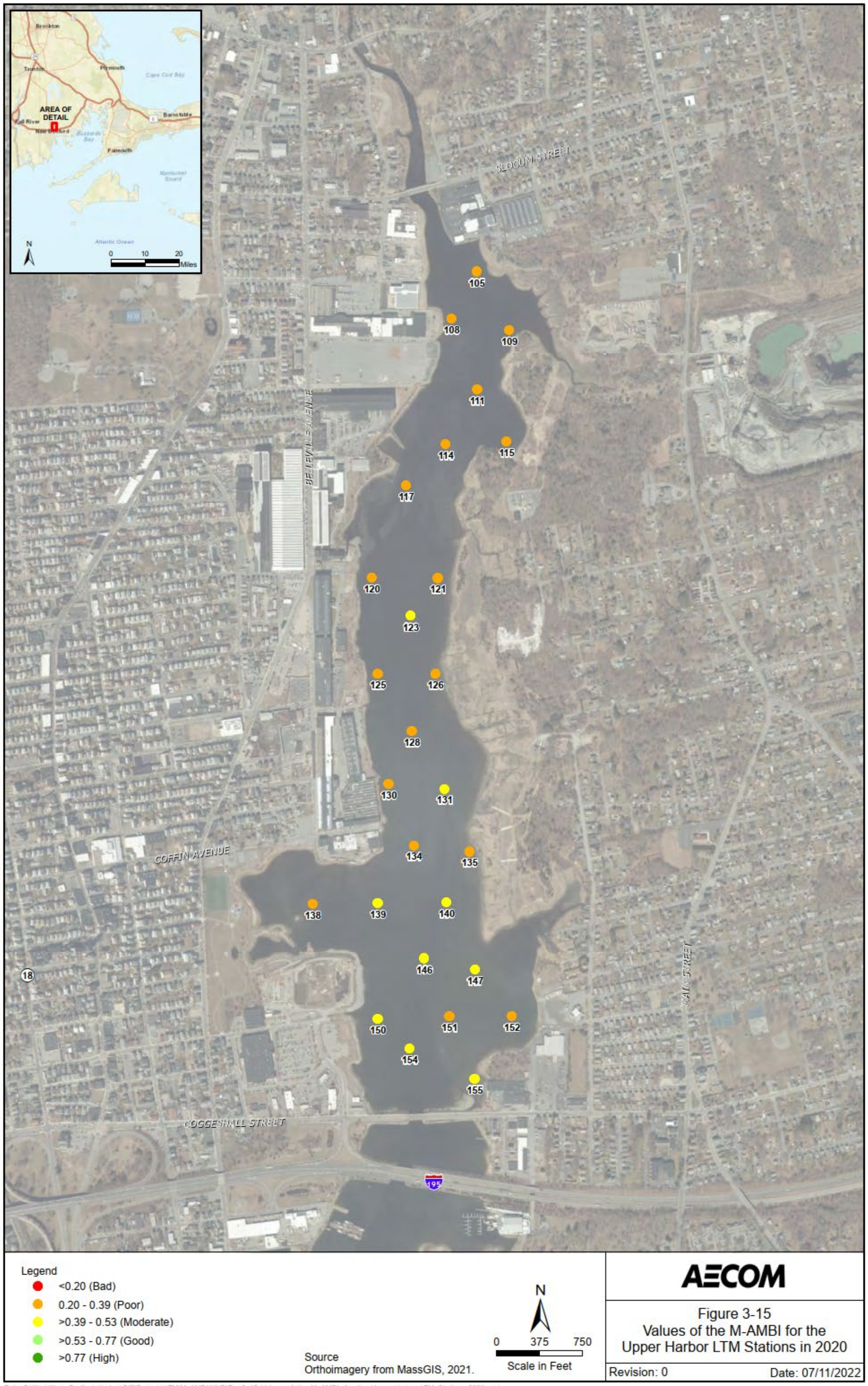

Figure 3-15 Values of the U.S. M-AMBI for the Upper Harbor LTM Stations in 2020 (LTM VII)

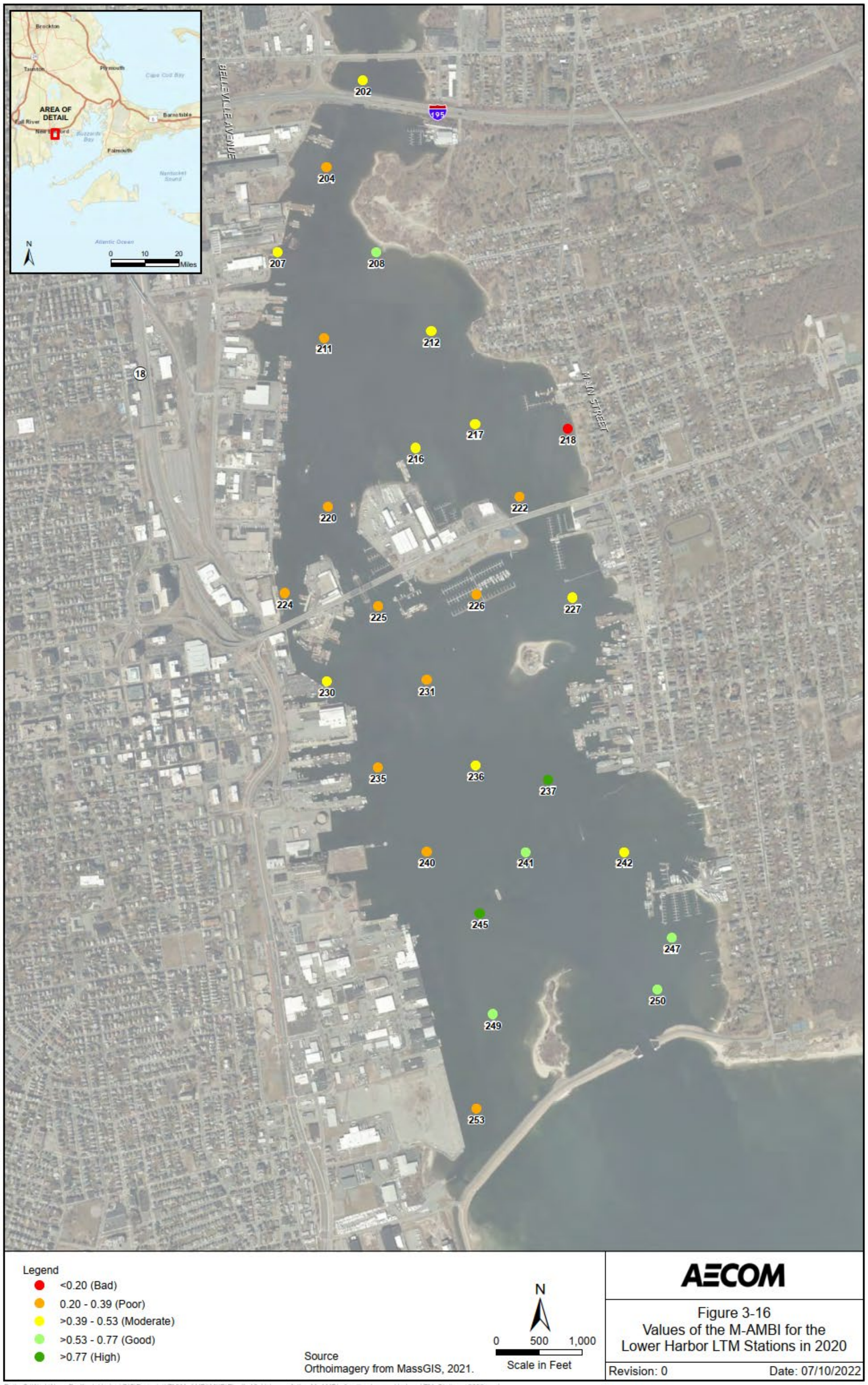

Figure 3-16 Values of the U.S. M-AMBI for the Lower Harbor LTM Stations in 2020 (LTM VII)

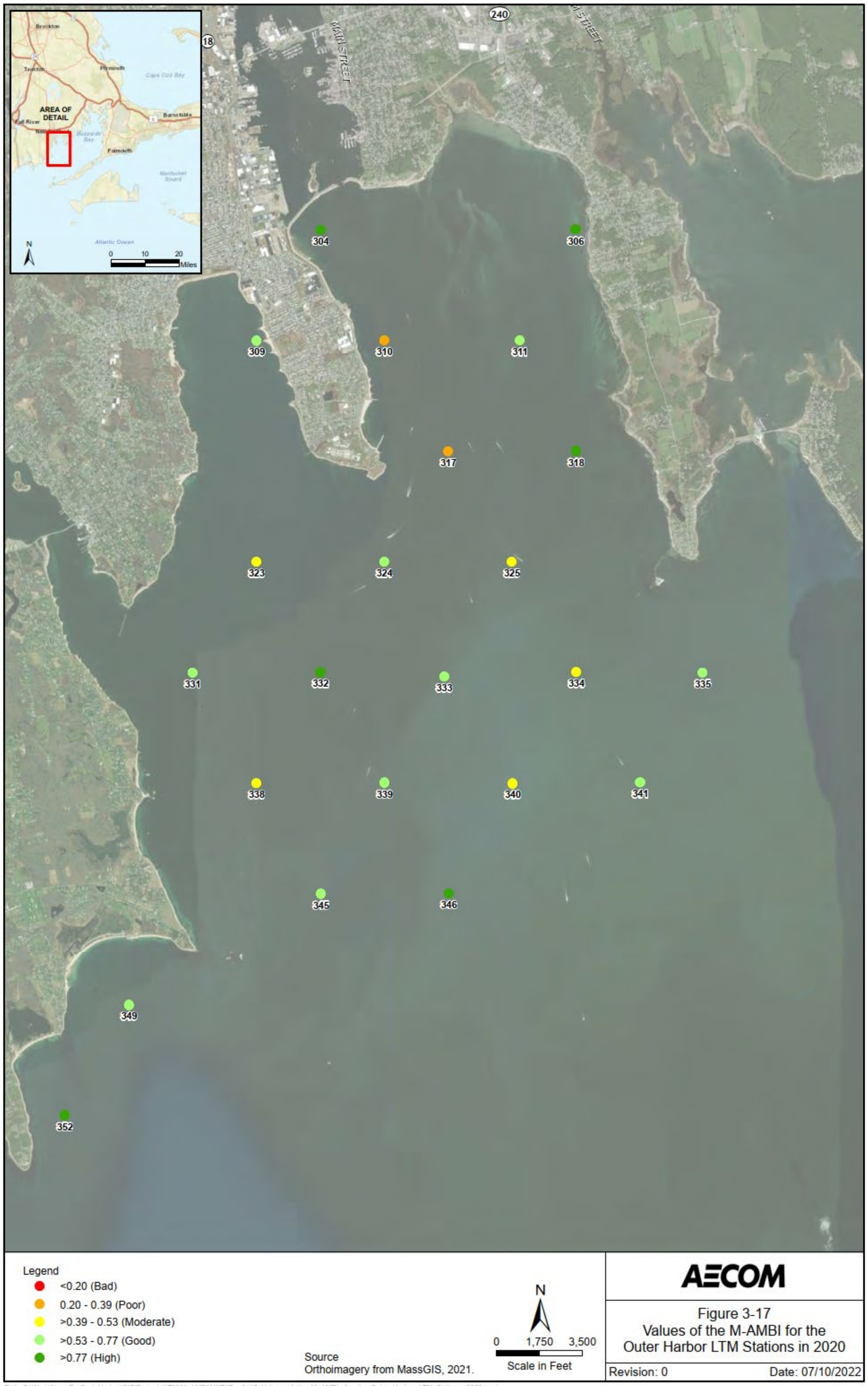

Figure 3-17 Values of the U.S. M-AMBI for the Outer Harbor LTM Stations in 2020 (LTM VII)

3.3 Relationships Between Chemistry and Macroinvertebrate Community

Potential relationships between total PCB concentrations in sediment and the benthic infaunal community metrics were explored using scatterplots and Kendall's tau correlation tests. The Kendall's tau correlation coefficient (τ) and corresponding p-value are provided on each scatterplot. There were significant negative relationships between PCB concentrations (log-transformed) and species richness, evenness, diversity and U.S. M-AMBI (**Figures 3-18**, **3-20**, **3-21**, and **3-22**). However, based on the τ values the strength of the relationships between PCBs and these metrics varied from weak for evenness (τ = -0.37) and U.S. M-AMBI (τ = -0.49) to moderate for richness (τ = 0.52) and diversity (τ = 0.55).

The relationship between total PCB concentrations and abundance had a significant positive relationship. However, the relationship was extremely weak based on the scatterplot (**Figure 3-19**) and τ of 0.13.

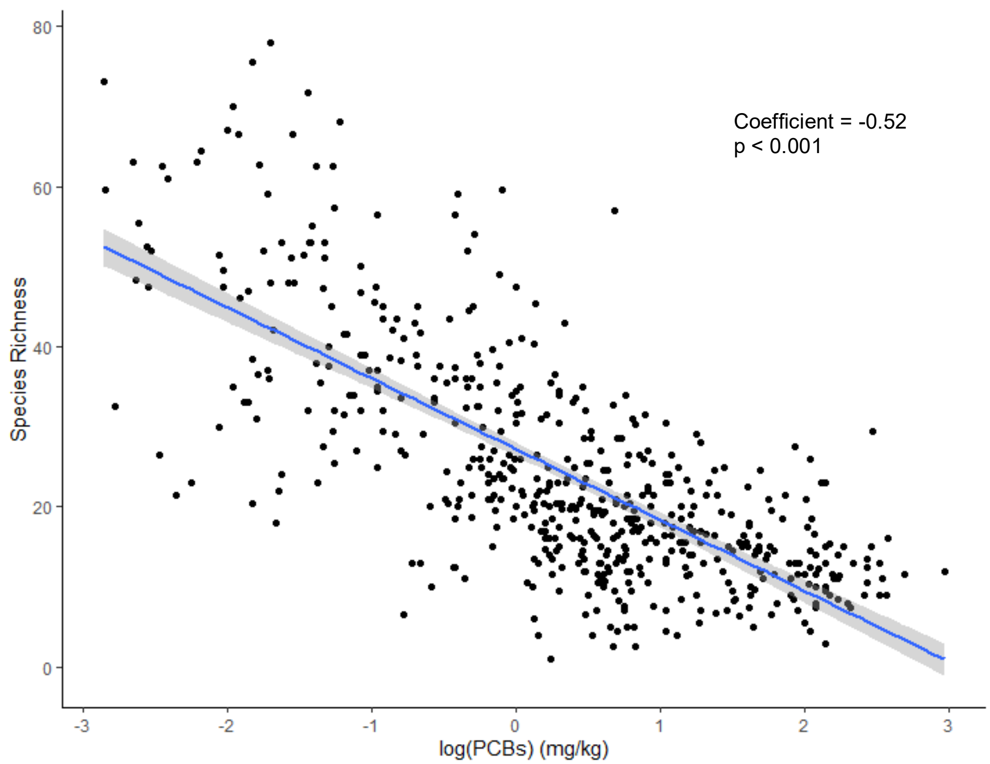

Figure 3-18 Scatterplot comparison of total PCB concentrations (log-transformed) and species richness for all three harbor areas and all LTM events. The line represents a fitted linear regression line and the grey band represents the 95% confidence interval.

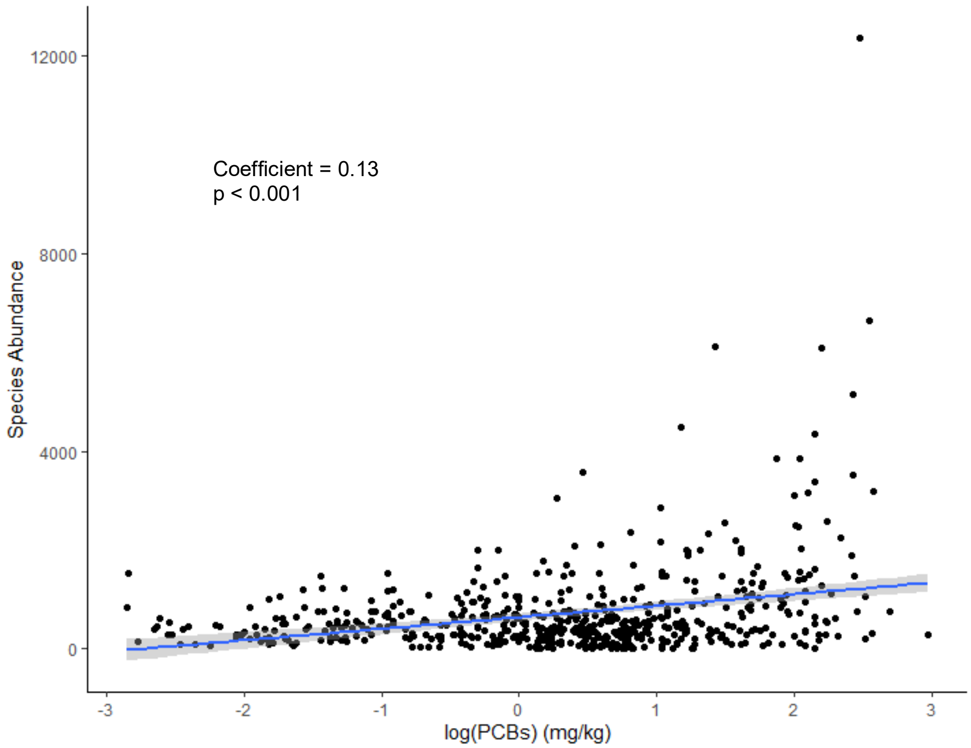

Figure 3-19 Scatterplot comparison of total PCB concentrations (log-transformed) and species abundance for all three harbor areas and all LTM events. The line represents a fitted linear regression line and the grey band represents the 95% confidence interval.

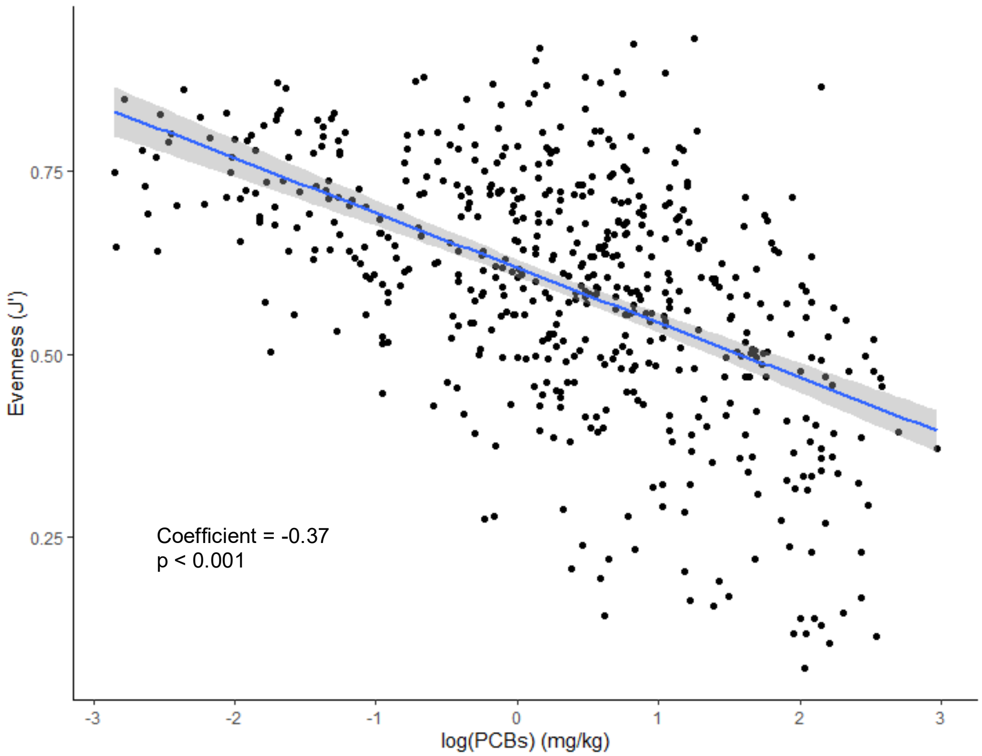

Figure 3-20 Scatterplot comparison of total PCB concentrations (log-transformed) and evenness for all three harbor areas and all LTM events. The line represents a fitted linear regression line and the grey band represents the 95% confidence interval.

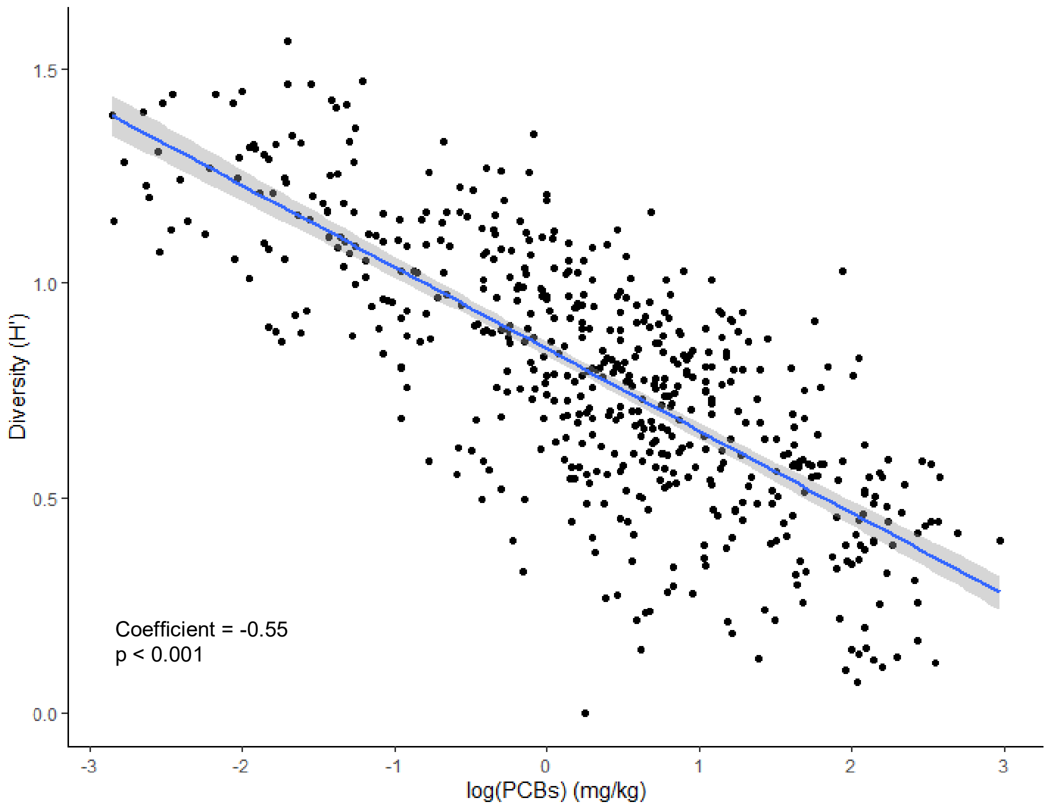

Figure 3-21 Scatterplot comparison of total PCB concentrations (log-transformed) and diversity for all three harbor areas and all LTM events. The line represents a fitted linear regression line and the grey band represents the 95% confidence interval.

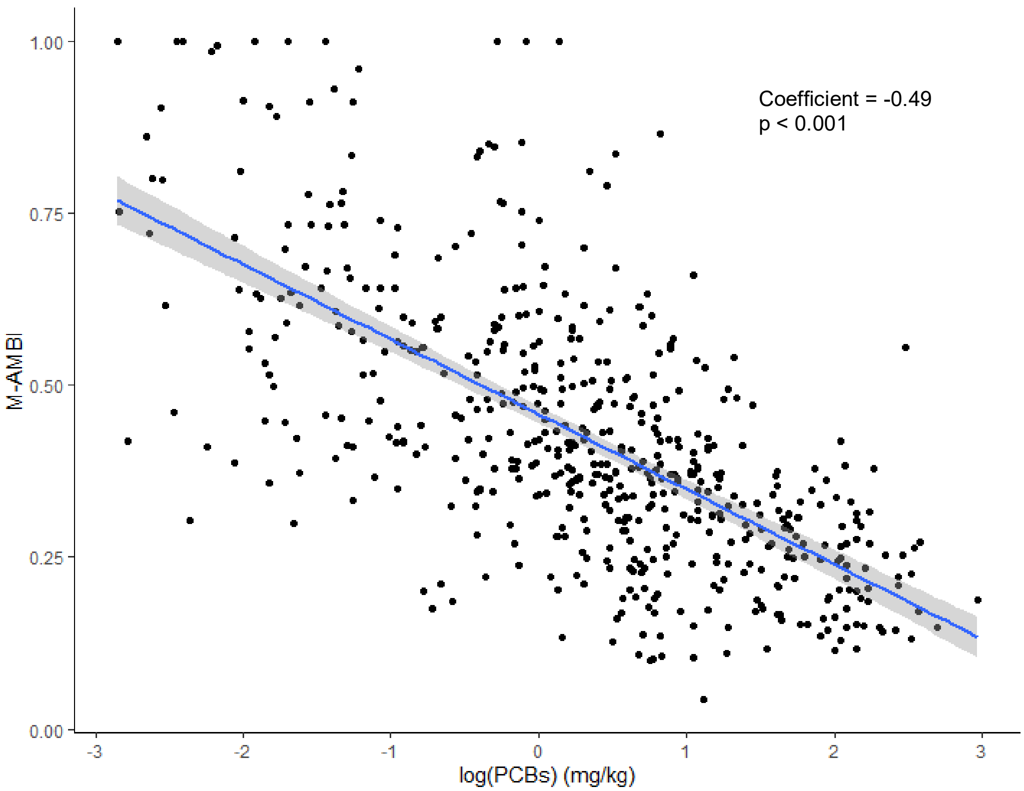

Figure 3-22 Scatterplot comparison of total PCB concentrations (log-transformed) and U.S. M-AMBI for all three harbor areas and all LTM events. The line represents a fitted linear regression line and the grey band represents the 95% confidence interval.

4. Summary and Conclusions

This section summarizes the spatial and temporal trends observed from the statistical evaluations of the sediment chemistry, biology, and physical characteristics datasets collected during seven LTM events in NBH from 1993 to 2020. In addition, the relationships between PCBs in sediment and benthic community health are summarized.

4.1 Sediment Chemistry

Surface sediment samples were collected at 550 sampling stations during seven LTM events from 1993 to 2020 including 27 stations in the Upper Harbor, 29 stations in the Lower Harbor, and 23 stations in the Outer Harbor. A spatial gradient of total PCB concentrations, evaluated as the sum of the NOAA 18 congeners, was apparent for each LTM event where concentrations were significantly higher in the Upper Harbor followed by the Lower Harbor and Outer Harbor. This spatial trend of decreasing concentrations from the Upper Harbor to the Outer Harbor is consistent with EPA's previous evaluations (Bergen and Nelson, 2012; Bergen, 2015).

The Regional Kendall trend test resulted in a significant temporal trend of decreasing PCBs in all harbor areas. This trend is most apparent in the Upper and Lower Harbors where mean PCB concentrations measured in 2020 were significantly lower than previous LTM events based on the paired t-tests. PCB concentrations also decreased over time in the Outer Harbor but with smaller differences among events, e.g., mean PCB concentrations in 2020 were not significantly different from previous events based on the paired t-tests.

In the Upper Harbor, PCB concentrations markedly decreased as a result of the remedial dredging completed in 2020. The surface area of the Upper Harbor with surface-weighted averages of PCBs less than 10 ppm increased from 19% in 2014 to 59% in 2020. Likewise in the Lower Harbor, the percentage of surface area below 1 ppm increased to 22% in 2020 from 9% in 2014. In the Outer Harbor, PCBs remained below 1 ppm in 2020 consistent with 2009 and 2014.

Nelson and Bergen (2012) and Bergen (2015) noted that at some sampling stations in the Upper Harbor, PCBs increased over time, and these localized increases were likely related to small pockets of deeper sediments with higher PCB concentrations that were exposed following dredging. For example, PCBs increased between 200 and 330 mg/kg in 2009 from concentrations less than 160 mg/kg in 2004 at three stations in the Upper Harbor (125, 117, and 105) that were close to dredging areas (**Figure 4-1**). Similarly, PCBs at station 115 in the Upper Harbor increased by a factor of 8 from 120 mg/kg in 2009 to 940 mg/kg in 2014. However, PCB concentrations at all of these locations fell below 50 mg/kg in 2020. Similar trends were noted for a few locations in the Lower Harbor but at lower concentrations (< 10 ppm). In the Outer Harbor (**Figure 4-2**), concentrations have remained at or below 1 ppm since 2004. This may be due to a change in dredge technique from hydraulic to precision mechanical dredging after LTM VI. Dredging performed since 2017 also had better defined dredge prisms and increased elevation control.

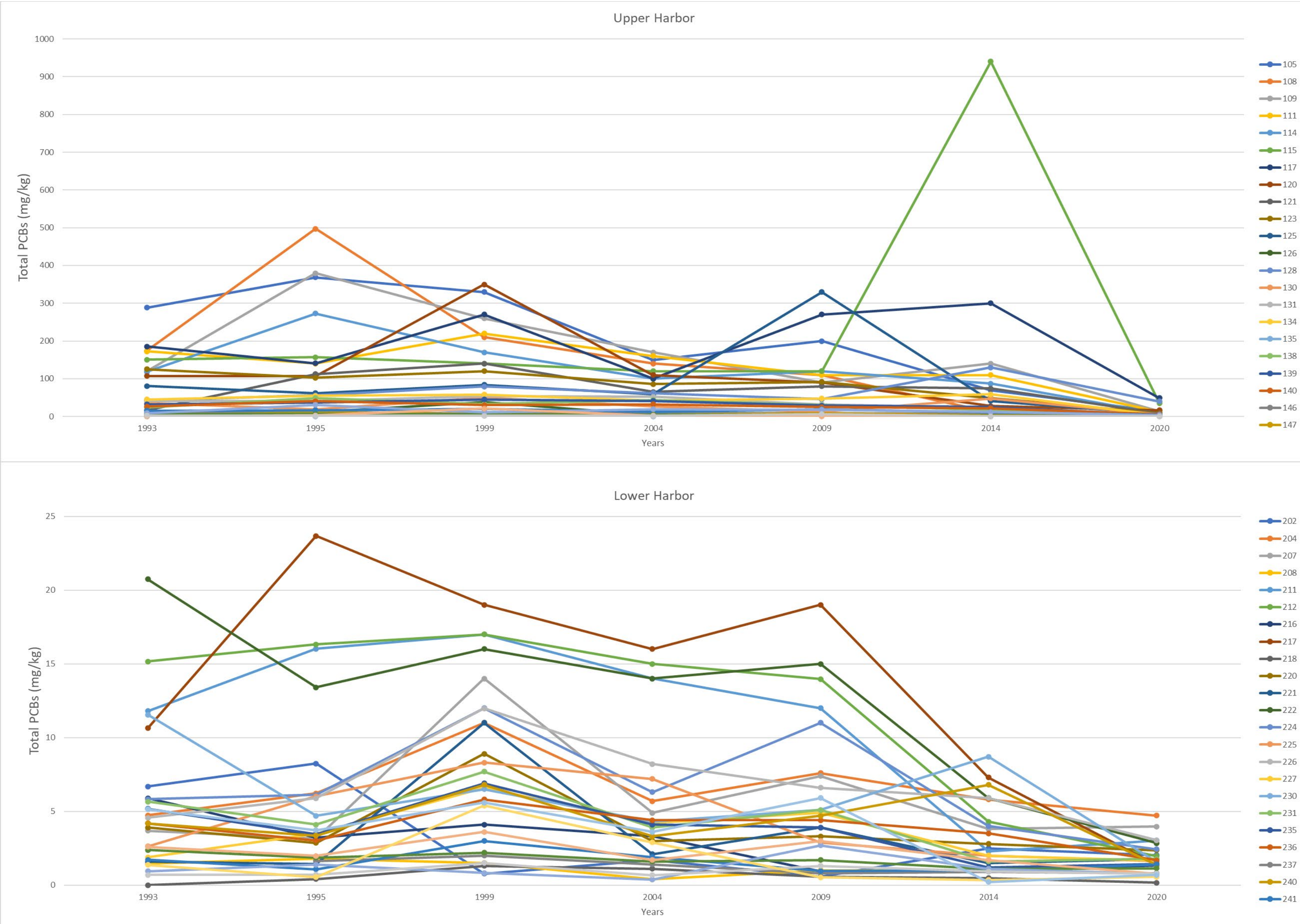

Figure 4-1 Surface sediment total PCB concentrations measured at each station per year in the Upper Harbor (top) and Lower Harbor (bottom).

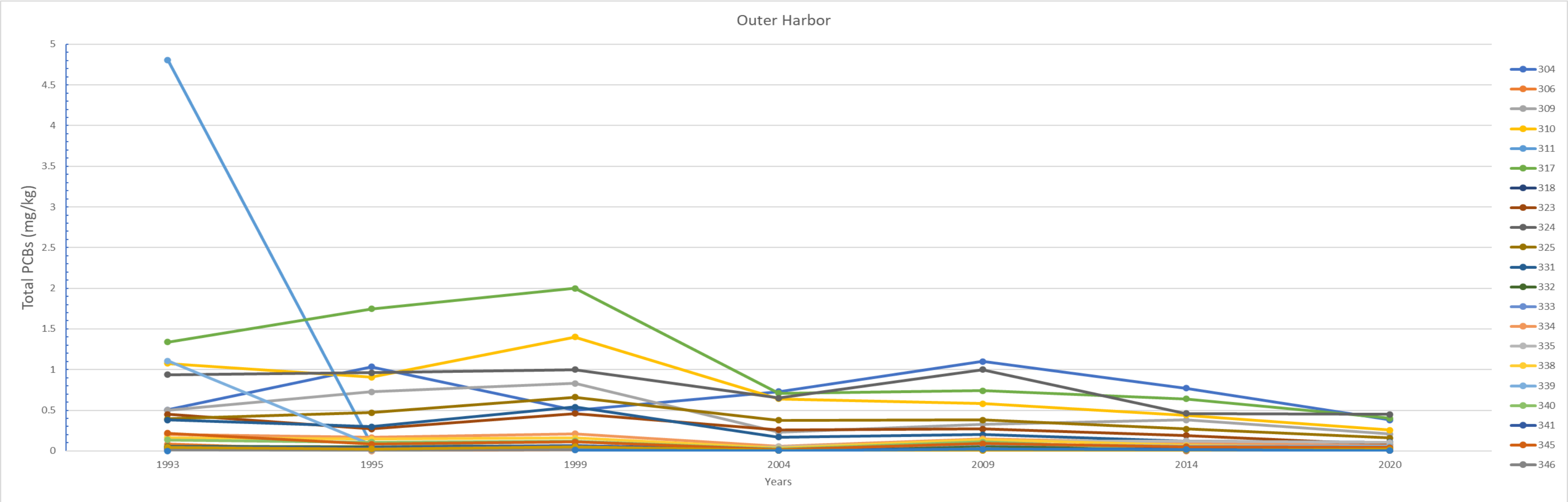

Figure 4-2 Surface sediment total PCB concentrations measured at each station per year in the Outer Harbor.

4.2 Macroinvertebrate Community

Surface sediment samples were collected for benthic infaunal taxonomic enumeration and identification at 550 sampling stations during seven LTM events from 1993 to 2020 including 27 stations in the Upper Harbor, 29 stations in the Lower Harbor, and 23 stations in the Outer Harbor. Normandeau conducted a taxonomic consistency check on the full dataset of benthic infaunal data from all seven LTM events and calculated benthic community parameters including abundance, species richness (number of taxa), Shannon's Diversity (H'), and evenness (J') and used some of these parameters (number of species and H') along with salinity and EG rankings of each taxon to calculate the U.S. M-AMBI.

Higher species richness, evenness, diversity and U.S. M-AMBI values were measured or calculated at sampling stations in the Outer Harbor compared to the Lower and Upper Harbors in all LTM events. The ranges of these metrics in the Lower and Upper Harbors generally overlapped per LTM event with Lower Harbor values ranging higher than Upper Harbor values in most cases. Abundance values overlapped among all three harbor areas per LTM event.

All of the community metrics datasets had significant differences based on the interaction between harbor area and LTM events. Many of the paired comparisons resulted in no significant differences in species richness, abundance, diversity and U.S. M-AMBI values among LTM events within a given harbor area, i.e., mean values for these metrics were similar among LTM events in the same harbor area. However, there were several significant differences for metrics such as species richness, evenness, diversity, and U.S. M-AMBI, which were higher in 2014 and/or 2020 in comparison to earlier LTM events in the Upper and/or Outer Harbors. Based on the Regional Kendall trend test, species richness, evenness, diversity, and the U.S. M-AMBI significantly increased over time in the Upper Harbor and in some cases in the Lower and/or Outer Harbors (evenness and diversity). Abundance decreased slightly over time in all three harbor areas.

The mean U.S. M-AMBI values for 2020 indicate that the Upper Harbor was categorized as having "poor" benthic community health in contrast to the Lower Harbor and Outer Harbor, which were categorized as having "moderate" and "good" benthic community health, respectively. However, the percentage of Upper Harbor stations categorized as having "bad" community health has decreased and the percentage of "moderate" stations has increased over time, in particular between earlier LTM events (1993 and 1995) in comparison to more recent events (2014 and 2020; **Table 3-5**), indicating that an overall improvement in the benthic community health of the Upper Harbor is evident. In 2020, the Upper Harbor mean value of 0.37 is only slightly below the lower end of the "moderate" category and none of the stations in the Upper Harbor were categorized as having "bad" benthic community health in contrast with 37% of stations in 2004 and 2009. It should also be noted that the benthic sampling for the 2020 LTM event was conducted only a few months following completion of the Upper Harbor sub-tidal dredging (March 2020), which may have been insufficient time for the benthic community to recover and fully recolonize.

Normandeau compared the U.S. M-AMBI results calculated for this evaluation to the VP BI results reported by EPA previously (Nelson and Bergen, 2012; Bergen, 2015) and determined that the results of the two indices were comparable, which is consistent with other comparative estuarine studies (Pelletier et al., 2018; **Appendix A**). Therefore, given that the U.S. M-AMBI metric is now widely accepted for evaluation of benthic community health, the use of U.S. M-AMBI for future LTM events is recommended.

4.3 Relationships Between PCBs and Benthic Community

The correlation evaluation indicated significant negative relationships between PCBs in surface sediment and the benthic community metrics for the study area (all three harbor areas and LTM events combined), where higher PCB concentrations were correlated with lower richness, evenness, diversity, and U.S. M-AMBI values with weak (evenness and U.S.-M-AMBI) to moderate (richness and diversity) correlations. This suggests that as PCBs continue to decline in the study area, benthic community health may continue to improve. However, abundance appeared to have the opposite relationship, where higher PCB concentrations were correlated with higher abundance, however, the relationship was extremely weak.

As detailed in the previous section, the community metrics varied widely and were often similar between LTM events within a harbor area. Temporal trends in the benthic community metrics were mainly observed in the Upper Harbor based on the Regional Kendall trend test, which is likely related to the significant decreases in PCB concentrations in this harbor area following the recent removal of contaminated sediments. Therefore, the results of benthic community observations in future LTM events will be valuable for determining if the relationship between decreasing PCB concentrations and increasing benthic community health is persistent.

The spatial and temporal gradients observed for the benthic community metrics may be related to other factors not considered in this evaluation such as other chemicals or stressors in the system. Sediment grain size, specifically percent silt and clay, was considered in this evaluation but did not appear to strongly influence benthic community metrics. Gravel content was low at all stations, but sand varied more widely. The fractions of sand and fines (silt and clay) may influence the benthic community structure. In addition, changes to the habitat such as removal of sediment by dredging likely also influence community structure.

4.4 Conclusions

The results of this evaluation identified significant spatial and temporal trends in the sediment chemistry (PCBs) and benthic community datasets collected during seven LTM events in NBH from 1993 to 2020. There is an obvious gradient of PCB concentrations in surface sediment with highest concentrations in the Upper Harbor followed by the Lower Harbor and Outer Harbor. A reverse spatial gradient was observed for most benthic community metrics (lowest to highest in the Upper to Outer Harbors) except for abundance. Weak to moderate negative relationships between PCB concentrations and benthic community metrics suggest that as PCB concentrations continue to decline, benthic community health may continue to improve.

In addition to documenting the changes in these datasets over time, this evaluation can be used to inform the effectiveness of remedial actions to date. As detailed in Section 1.1, while over 1,000,000 cubic yards of PCB impacted sediment and shoreline soil have been removed from the harbor to date, the Upper Harbor intertidal remedy is still underway. Therefore, this evaluation serves as an opportunity to evaluate the on-going remediation with respect to reducing PCB concentrations in sediment and improving benthic infaunal community health throughout the harbor.

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Appendix A Memorandum from Normandeau Regarding U.S. M-AMBI Results

May 27, 2022

Ms. Maura Surprenant
Project Manager (for AECOM)
AECOM Technical Services, Inc.
250 Apollo Drive
Chelmsford, MA 01824

Re: **Technical Support for the New Bedford Harbor Superfund Site New Bedford, Massachusetts: Comparison of U.S. M-AMBI results to the Virginian Province Benthic Index results for LTM I through LTM VII**

Dear Maura:

This letter report contains the comparison for the U.S. M-AMBI results to the Virginian Province Benthic Index (VP BI) results for LTM I through LTM VII. The Excel files[1] containing the data results discussed in this report were provided to AECOM on May 22, 2022 and were calculated as described below from the benthic infaunal data set provide by AECOM on April 7, 2022[2].

Overview

New Bedford Harbor was designated as a Superfund site in 1983 due to polychlorinated biphenyls (PCBs) contamination. Select areas within the harbor have been dredged from 1993 through 2020 to remove the contaminated sediment. A long-term monitoring program was developed by the U.S. Environmental Protection Agency (US EPA) to assess the effectiveness of the New Bedford Harbor Superfund remediation efforts. The sampling events for this program and discussed in this report include: the “baseline” sampling conducted in 1993 (LTM I), the second event (LTM II) conducted in 1995 after the removal of the “hot spot” sediments, the third event conducted in 1999 (LTM III), the fourth conducted in 2004 (LTM IV), a fifth conducted in 2009 (LTM V), the sixth conducted in 2014 (LTM VI), and the seventh and most recent event conducted in 2020 (LTM VII). The sampling for this long-term monitoring program included collection of 79 sediment samples from three harbor segments (Upper Harbor, Lower Harbor, and Outer Harbor) during each of the seven events. These sediment samples were analyzed for physical (grain size), chemical (e.g., PCBs), and biological (benthic community) measurements. The Virginian Province Benthic Index (VP BI; Paul et al. 2001) was used to assess the estuarine condition over time for LTM I through VI (1993-2014). VP BI results for LTM I through V can be found summarized in Nelson and Bergen (2012), and VP BI results for LTM V and VI can be found in Bergen (2015). VP BI was replaced by a new national benthic macroinvertebrate index, U.S. M-AMBI (Pelletier et al. 2018). The goal of this project was to compare these two benthic indices on the same data set from 1993 through 2009 (LTM I-V), and if the results were comparable, regulators could be confident in using U.S. M-AMBI to assess the 2014 (LTM VI), 2020 (LTM VII), and future data. When comparing results in this report, benthic parameters and U.S. M-AMBI results calculated by Normandeau Associates, Inc. are referred to as “Normandeau 2022” or “current assessment”.

[1] NBH LTM Benthic Community Parameters.xlsx and NBH LTM US M_AMBI Harbor Segment Summary Table.xlsx
[2] NewBedford_LTM_TaxaData.xlsx

Methods

The data set was initially reviewed and was found to be missing the data for 2009 (LTM V). As Normandeau Associates, Inc. provided the initial benthic community abundance data, we reviewed our project files, and were able to provide the original the 2009 benthic infaunal data for this current analysis. The 2009 data were verified by comparing them to the data presented in Woods Hole Group (2010) Appendix J. The 2009 data was provided to AECOM in excel format[3] on April 11, 2022 to be re-included in the official database. The data files were combined into a single formatted excel file that was used for the taxonomic consistency check and data processing.

A taxonomic consistency check was conducted on the complete data set provided for LTM I through VII prior to calculation of benthic community parameters and U.S. M-AMBI calculations. The check reviewed and updated the scientific names in the taxa list for taxonomic name changes, corrections, and inconsistencies in taxonomic nomenclature between events. Current valid scientific names and full taxonomic classifications were obtained through the World Register of Marine Species (WoRMS) database. Based on the taxonomic consistency check, 38 species were excluded from the data set because they either could not be enumerated (e.g., colonial organisms such as bryozoa, hydrozoa, and sponges) or were not benthic infaunal organisms, for example Ostracoda (seed shrimp which are zooplankton), unidentified eggs/egg cases, and Nematoda (Table 1).

Table 1. List of taxa excluded from the 2022 U.S. M-AMBI analysis.

Caulleriella sp. A	Podocopida	Bougainvilliidae	*Halecium* sp.
Caulleriella sp. B	*Raphium* sp.	*Bugulina stolonifera*	*Lovenella gracilis*
Cerapus sp. A NAI	Unidentified eggs/egg cases	Campanulariidae	*Microporella ciliata*
Cirratulus sp. 1	*Aetea sica*	*Clytia gracilis*	*Obelia bidentata*
Glycera sp. 1	*Aeverrillia armata*	*Clytia hemisphaerica*	*Obelia dichotoma*
Microphthalmus sp. A	*Aeverrillia setigera*	*Conopeum truitti*	*Pourtalesella cornuta*
Polygordius sp. A	*Amathia gracilis*	*Crisularia turrita*	*Schizoporella unicornis*
Myodocopa	*Amathia imbricata*	*Cryptosula pallasiana*	Nematoda
Myodocopina	*Amathia* sp.	*Electra pilosa*	
Podocopa	*Barentsia gracilis*	*Halecium halecinum*	

The four basic community parameters (abundance, number of taxa, Shannon's Diversity [H'], evenness [J']) for each event were calculated using PRIMER v7 (Plymouth Routines in Multivariate Ecological Research) software. Shannon's Diversity (H') was calculated with log base 10-transformed data to be consistent with previous long-term monitoring program H' calculations provided in Nelson and Bergen (2012).

U.S. M-AMBI (multivariate AZTI Marine Biotic Index in United States coastal waters) was calculated following Pelletier et al. (2018). Ecological Grouping [EG]) was assigned to taxa in the taxonomic list based on the corresponding EGs established by Gillette et al. (2015) to be specific for the northeast US region. Each taxon identified is classified as EG I, II, III, IV, or V, with I taxa being considered the least

[3] NBH_2009_02Jun10-data file_Rev.xls

tolerant taxa found in healthy benthic habitats, and V taxa considered the most tolerant taxa inhabiting low quality or heavy disturbed habitats. Only taxa included on the EG list established by Gillette et al. (2015) were used to calculate U.S. M-AMBI for LTM I through VII data. The data were prepared for U.S. M-AMBI by first coding each station for each event into the proper salinity zone. Stations in the Upper Harbor (UH; Station 105-155) and Lower Harbor (LH; Stations 202-253) were assigned to polyhaline (18 to <30 psu), and stations in the Outer Harbor (OH; Stations 304-352) were assigned to euhaline (30 to 40 psu). Salinity zones were determined based on the salinity data provided in Woods Hole Group, Inc. (2010) and Battelle (2015). Benthic grab size was confirmed to be 0.4 m^2 following the methodology detailed in US EPA Environmental Monitoring and Assessment Program.

The Biological Index (BI) was then calculated for each sample using the following formula:

BI = 0*%EG(I) + 1.5*%EG(II) + 3*%EG(III) + 4.5*%EG(IV) + 6*%EG(V)

The four parameters (salinity code, BI, number of species [S], and H') were then run through the R script for the Northeast United States provided by M. Pelletier (personal communication 2019). The output number corresponding to benthic health condition falls within the following categories: Bad (<0.20), Poor (0.20 to 0.39), Moderate (0.39 to 0.53), Good (0.53 to 0.77), and High (>0.77).

Previous number of taxa, H', and VP BI results for each harbor segment for LTM 1 though V for were reviewed from Nelson and Bergen (2012). VP BI results for each station for LTM V and VI were reviewed from Bergen (2015). The 2014 (LTM VI) results were presented as colored circles by station in map figures of the harbor segments in Bergen (2015). No tabular data or actual values are available for these stations, therefore resulting harbor segment means could not be included in this report. Normandeau compared the range of values for VP BI and U.S. M-AMBI in each harbor segment and LTM, no statistical comparisons could be made as individual station VP BI values are unavailable.

Comparison

Benthic Indices - The VP BI uses three metrics: salinity-normalized Gleason's D, salinity-normalized tubificid[4] abundance, and abundance of spionid polychaetes. The salinity normalization in this method is based on species abundance by salinity. For example, Gleason's D is higher at higher salinities and tubificids are only found at low salinities. VP BI values greater than 0 are categorized as undegraded and values less than 0 are degraded. Pelletier et al (2019) reported in an overview study of 49 estuaries sampled in MA, NY, NJ, and MD (ranging in size from 2 to 430 km^2), that VP BI for individual samples ranged from -9.05 to 9.64 and mean estuary VP BI scores ranged from -4.12 to 1.46. VP BI was used by the US EPA to assess estuarine condition from 1990 to 2010 (Pelletier et al 2019). U.S. M-AMBI also uses three metrics: the abundance-weighted tolerance index AMBI (Gillett et al. 2015), Shannon-Wiener diversity index (H'), and species richness; and is calculated separately for five salinity zones (tidal freshwater, oligohaline, polyhaline, euhaline, and hyperhaline). U.S. M-AMBI results are scaled from 0 to 1, with degraded habitats closer to 0 and more healthy habitats closer to 1. U.S. M-AMBI was used to assess estuarine condition for the US EPA National Coastal Condition Assessment from 2015 onward (Pelletier et al 2019). The overall results of both the VP BI and U.S. M-AMBI (the habitat condition score) include five categories (bad, poor, moderate, good, high) for each benthic index. Categories corresponding to the VP BI and U.S. M-AMBI index values are summarized in Table 2.

[4] Oligochaetes that are capable of living in eutrophic habitats with low dissolved oxygen or anoxic conditions.

Table 2. Habitat Condition Score Ranges for VP BI and U.S. M-AMBI index values.

Category	VP BI[1]	U.S. M-AMBI[2]
Bad	< -1.86	< 0.20
Poor	-1.86 to -0.59	0.20 to 0.39
Moderate	-0.59 to 0.33	0.39 to 0.53
Good	0.33 to 1.91	0.53 to 0.77
High	>1.91	> 0.77

[1]Bergen 2015.
[2]Pelletier et al. 2018

VP BI and U.S. M-AMBI Results

The mean benthic parameters (number of taxa and Shannon-Wiener diversity index H'), index values, and corresponding habitat condition scores for VP BI and U.S. M-AMBI for each harbor segment and event are summarized in Table 3. The mean number of taxa by harbor section in the current assessment were lower than those reported for 1993 – 2014 events in Nelson and Bergen (2012; LTM I - V) and Battelle (2015; LTM VI). This difference may be due to the exclusion of 38 taxa in the Normandeau assessment that could not be enumerated or were not benthic infaunal organisms (see Methods section, Table 1). Although mean number of taxa are generally lower in the Normandeau 2022 results compared to the values originally reported, the difference did not affect the mean Shannon-Weiner diversity indices (H'). Mean H' by harbor segment (Upper, Lower, and Outer Harbor) presented in Nelson and Bergen (2012) are remarkably similar compared to the current analysis, with a difference of 0.1 found at the Lower Harbor segment in 1995, 1999, and 2009 (Table 3).

When the mean VP BI index values are compared to U.S. M-AMBI values by harbor segment from 1993 through 2009, results indicate similar trends spatially going from the Upper Harbor south to the Outer Harbors. Index values transitioned from bad or poor in the Upper Harbor to moderate or poor in the Lower Harbor to good in the Outer Harbor (Table 3). Although the trends were spatially and temporally similar, habitat condition scores were not identical when comparing VP BI and U.S. M-AMBI results, especially in the Upper Harbor and Lower Harbor. For example, the mean Upper Harbor was categorized as "Bad" in all 5 years using the VP BI and "Poor" in all five years using the U.S. M-AMBI approach. This is not surprising as the indices use different metrics and are expected to detect certain differences. The U.S. M-AMBI index metrics includes more of the whole benthic community structure (abundance-weighted tolerance index [AMBI] that integrates the pollution tolerance of the entire community in all salinity zones) compared to the VP BI that uses two metrics to reflect pollution tolerance (percent tubificid abundance in low salinity habitats and percent spionid abundance in high salinity habitats; Pelletier et al 2019). Pelletier et al. (2019) also suggested that U.S. M-AMBI is more responsive to landscape influences, such as roads, agricultural use, and forests than the VP BI.

Overall, the results indicate that the VP BI and U.S. M-AMBI methods are comparable. This is consistent with the findings of Pelletier et al. (2019) in a wider-ranging comparison of estuaries that found U.S. M-AMBI was significantly correlated to the VP BI ($r = 0.528$, $p<0.0005$). Correspondence between index categories was good overall (76.6%) with slightly higher correspondence for "Poor" sites (85.9%) compared to "Good" sites (70.9%).

Table 3. Mean benthic community parameters, EMAP BI values, and U.S. M-AMBI BI scores for the Upper, Lower, and Outer New Bedford Harbor from 1993 – 2020.

Year	Segment	Number of Taxa (VP BI)	Number of Taxa (Normandeau 2022)	Shannon H' (VP BI)	Shannon H' (Normandeau 2022)	EMAP-BI (VP BI)	U.S. M-AMBI BI (Normandeau 2022)	EMAP Habitat Condition Score[1] (VP BI)	U.S. M-AMBI Habitat Condition Score (Normandeau 2022)[2]
1993	UH	19	14	0.5	0.5	-4.2	0.27	Bad	Poor
	LH	28	20	0.7	0.7	-0.6	0.43	Poor	Moderate
	OH	62	46	1.2	1.2	2.5	0.69	Good	Good
1995	UH	21	16	0.6	0.6	-3.7	0.27	Bad	Poor
	LH	26	19	0.8	0.7	-0.4	0.36	Poor	Poor
	OH	57	40	1.1	1.1	2.4	0.54	Good	Good
1999	UH	16	12	0.5	0.5	-2.8	0.26	Bad	Poor
	LH	30	22	0.8	0.7	-0.5	0.46	Poor	Moderate
	OH	54	38	1.0	1.0	2.2	0.56	Good	Good
2004	UH	14	11	0.6	0.5	-2.3	0.24	Bad	Poor
	LH	22	16	0.8	0.8	-0.1	0.37	Poor	Poor
	OH	42	30	1.1	1.0	2.1	0.47	Good	Moderate
2009[3]	UH	19	13	0.5	0.5	-3.7	0.26	Bad	Poor
	LH	30	20	0.9	0.8	0.2	0.44	Moderate	Moderate
	OH	64	46	1.2	1.2	3.3	0.69	Good	Good
2014[4]	UH	24	24	NA	0.7	NA	0.40	NA	Moderate
	LH	22	22	NA	0.8	NA	0.40	NA	Moderate
	OH	41	40	NA	1.1	NA	0.49	NA	Moderate
2020	UH	NA	18	NA	0.7	NA	0.37	NA	Poor
	LH	NA	21	NA	0.8	NA	0.47	NA	Moderate
	OH	NA	41	NA	1.2	NA	0.63	NA	Good

Normandeau (Normandeau Associates Inc.)
[1]Categories corresponding to VP BI scores: Bad (< -1.86), Poor (-1.86 to -0.59), Moderate (-0.59 to 0.33), Good (0.33 to 1.91), and High (>1.91; Bergen 2015).
[2]Categories corresponding to U.S. M-AMBI scores: Bad (<0.20), Poor (0.2 to 0.39), Moderate (0.39 to 0.53), Good (0.53 to 0.77), High (>0.77; Pelletier et al. 2018).
[3]Data available from 1993 – 2009 (Nelson and Bergen 2012).
[4]Bergen 2015.
UH = Upper Harbor, LH = Lower Harbor, and OH = Outer Harbor
The following colors correspond to the 5 EMAP and U.S. M-AMBI BI habitat health condition categories: Red (Bad), Orange (Poor), Yellow (Moderate), Green (Good), and Blue (High).

Discussion

As stated in Nelson and Bergen (2012), it is crucial to document the effectiveness of remedial actions due to cost and potential risks of remediation at the New Bedford Harbor Superfund site. When benthic index scores and condition results are viewed with this objective in mind, it is important to remember the context of remediation activities and the benthic infaunal communities along with other environmental factors and stressors (e.g., eutrophication, low dissolved oxygen) that may impact benthic communities. A quick review of the New Bedford Harbor benthic conditions reported from 1993 (LTM I; UH = Poor, LH = Moderate, OH = Good) to 2020 (LTM VII; UH = Poor, LH = Moderate, OH = Good; Table 4) may suggest conditions have not changed. However, it is possible that while the environment is currently less degraded from PCB contamination, it is still technically degraded from other factors including the dredging activities. It is probable that dredging activities from 1993 to 2020 have prevented natural succession and recovery of the benthic community. A dredge monitoring study for a harbor deepening project in New York and New Jersey indicated that benthic communities at a sampling station in silty sand habitat similar to New Bedford Harbor did not recover to pre-dredging conditions, and in fact were worse seven years after dredging (USACE 2013). The number of taxa actually increased from 33 to 40 from 2005 to 2012, but the diversity indices went down from 2.6 (range 1.8 – 2.2) before dredging to 1.4 (range 0.5 – 2.4) after dredging. In addition, the percentage of pollution tolerant species increased after dredging, with <1% at the site before dredging and 29% after.

In addition, there are other external factors that may also be negatively affecting the benthic community in New Bedford Harbor occurring over the same time frame. For example, increased human population density and corresponding inputs of contamination from the watershed causing eutrophication, algal blooms, low dissolved oxygen, and sedimentation may also be partly responsible for lower health condition scores for the Upper and Lower Harbor segments from 1993 to 2020 (Comeleo et al. 1996, Edgar and Barrett 2000, Dauer et al. 2000, Paul et al. 2002, Paerl et al. 2003). Water quality monitoring for this program reported very low dissolved oxygen at some stations the Upper Harbor in 2004. For example, Station 105 had a recorded dissolved oxygen value of 1.31 mg/L and Station 109 had a recorded dissolved oxygen value of 2.02 mg/L. Dissolved oxygen values less than 2.0 mg/L are considered severely hypoxic. In other words, the results from these approaches could look the same whether the cause of poor conditions scores was due to contaminated sediments or other factors (e.g., dredging or low dissolved oxygen).

Table 4. Mean VP BI and US M-AMBI condition scores for New Bedford Harbor from 1993 – 2020.

	Segment					
	UH		LH		OH	
Year	VP BI	US M-AMBI	VP BI	US M-AMBI	VP BI	US M-AMBI
1993	Bad	Poor	Poor	Moderate	Good	Good
1995	Bad	Poor	Poor	Poor	Good	Good
1999	Bad	Poor	Poor	Moderate	Good	Good
2004	Bad	Poor	Poor	Poor	Good	Moderate
2009	Bad	Poor	Moderate	Moderate	Good	Good
2014	NA	Moderate	NA	Moderate	NA	Moderate
2020	NA	Poor	NA	Moderate	NA	Good

UH = Upper Harbor, LH = Lower Harbor, and OH = Outer Harbor

More detailed discussions regarding the trends of PCB contamination levels, benthic community condition, and remediation are presented in Nelson and Bergen (2012) and Bergen (2015). These authors also point out that interpretation of results to assess remedial effects and effectiveness is challenging, and the remediation of New Bedford Harbor is still in progress.

Pelletier et al (2019) found that modeling estuarine conditions indicated that inherent landscape structure (estuarine area, watershed area, watershed: estuary ratio) was important to predicting benthic invertebrate conditions. Variability within estuaries strongly impacted model results (Pelletier et al. 2019). Larger developed watersheds had a greater potential for pollutant delivery and detrimental impacts on estuarine condition; and smaller estuaries had less potential for dilution and may be more vulnerable to impact from the surrounding area (Pelletier et al. 2019). The authors suggested that these structural variables should be considered in watershed and estuary planning and restoration.

If you have any questions or require additional information please let me know.

Sincerely,

Deborah A. Rutecki

Deborah A. Rutecki
Normandeau Associates, Inc.

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Tables

Table 1. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 1993.[*†]

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	105	15.00	747.67	0.50	0.59	0.25	Poor
1993	108	11.33	548.33	0.56	0.59	0.27	Poor
1993	109	10.00	385.00	0.63	0.63	0.18	Bad
1993	111	14.00	2569.33	0.39	0.45	0.32	Poor
1993	114	16.67	1432.00	0.38	0.46	0.38	Poor
1993	115	15.33	282.67	0.47	0.56	0.30	Poor
1993	117	15.00	1129.67	0.34	0.39	0.38	Poor
1993	120	10.33	1406.00	0.07	0.07	0.20	Poor
1993	121	14.00	1395.67	0.16	0.18	0.20	Poor
1993	123	12.33	3167.67	0.14	0.15	0.20	Poor
1993	125	9.00	100.00	0.57	0.54	0.14	Bad
1993	126	19.67	1482.33	0.29	0.37	0.29	Poor
1993	128	9.00	1199.00	0.34	0.32	0.17	Bad
1993	130	6.33	85.00	0.61	0.44	0.12	Bad
1993	131	17.67	2019.33	0.47	0.58	0.35	Poor
1993	134	9.67	290.33	0.36	0.35	0.22	Poor
1993	135	18.67	2003.67	0.54	0.69	0.35	Poor
1993	138	6.67	396.33	0.16	0.13	0.23	Poor
1993	139	8.33	164.33	0.43	0.40	0.18	Bad
1993	140	19.33	6126.67	0.19	0.24	0.29	Poor
1993	146	18.00	657.00	0.52	0.65	0.38	Poor
1993	147	22.00	1560.67	0.52	0.70	0.35	Poor
1993	150	11.33	568.67	0.20	0.21	0.21	Poor
1993	151	13.33	246.00	0.48	0.54	0.26	Poor
1993	152	7.67	167.67	0.32	0.28	0.17	Bad
1993	154	24.33	276.33	0.65	0.90	0.42	Moderate
1993	155	25.00	2095.33	0.50	0.69	0.47	Moderate
1993	202	30.33	1008.33	0.56	0.82	0.87	High
1993	204	32.67	704.67	0.63	0.96	0.61	Good
1993	207	11.67	885.33	0.39	0.41	0.29	Poor
1993	208	22.00	429.00	0.43	0.57	0.50	Moderate
1993	211	23.00	1478.00	0.40	0.54	0.38	Poor
1993	212	23.33	4480.33	0.28	0.39	0.41	Moderate
1993	216	25.33	387.67	0.67	0.93	0.51	Moderate
1993	217	18.00	2162.67	0.29	0.36	0.37	Poor
1993	218	18.00	712.00	0.48	0.60	0.31	Poor
1993	220	27.00	2113.33	0.50	0.70	0.51	Moderate
1993	221	14.67	281.67	0.59	0.68	0.38	Poor
1993	222	16.67	2005.00	0.44	0.53	0.34	Poor
1993	224	14.67	283.33	0.66	0.76	0.33	Poor
1993	225	18.33	659.00	0.65	0.82	0.39	Poor
1993	226	5.00	55.67	0.74	0.47	0.19	Bad
1993	227	16.00	627.00	0.45	0.54	0.37	Poor
1993	230	24.00	441.67	0.61	0.84	0.54	Good
1993	231	7.67	51.33	0.76	0.67	0.10	Bad
1993	235	13.67	107.33	0.68	0.78	0.20	Poor
1993	236	19.33	788.00	0.42	0.50	0.38	Poor
1993	237	25.00	442.00	0.52	0.72	0.34	Poor
1993	240	10.67	157.00	0.64	0.59	0.27	Poor
1993	241	22.67	131.33	0.78	1.05	0.54	Good
1993	242	19.67	669.33	0.38	0.49	0.46	Moderate
1993	245	22.33	703.67	0.55	0.69	0.53	Moderate
1993	247	19.67	422.33	0.57	0.70	0.48	Moderate
1993	249	39.67	1373.33	0.62	0.99	0.64	Good
1993	250	45.33	680.33	0.66	1.09	1.00	High
1993	253	8.33	59.00	0.68	0.63	0.23	Poor
1993	304	45.00	436.67	0.77	1.26	0.85	High
1993	306	46.67	773.00	0.70	1.16	0.74	Good
1993	309	26.00	237.33	0.79	1.08	0.59	Good
1993	310	35.00	224.67	0.71	1.10	0.64	Good
1993	311	57.00	914.00	0.66	1.17	0.61	Good
1993	317	40.33	1546.33	0.64	1.02	0.60	Good
1993	318	51.00	837.00	0.67	1.15	0.78	High
1993	323	32.33	956.33	0.70	1.06	0.48	Moderate
1993	324	34.00	1058.00	0.72	1.11	0.52	Moderate
1993	325	59.00	798.00	0.72	1.27	0.84	High
1993	331	37.33	932.00	0.64	1.01	0.51	Moderate
1993	332	57.33	737.67	0.78	1.36	0.91	High

Table 1. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 1993.*†							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	333	71.67	1484.33	0.63	1.17	1.00	High
1993	334	39.00	594.33	0.72	1.14	0.58	Good
1993	335	48.33	468.00	0.73	1.23	0.72	Good
1993	338	38.33	764.00	0.74	1.17	0.56	Good
1993	339	31.67	536.33	0.75	1.12	0.46	Moderate
1993	340	38.67	956.00	0.65	1.03	0.55	Good
1993	341	53.00	566.00	0.82	1.42	0.73	Good
1993	345	41.67	1082.00	0.72	1.17	0.60	Good
1993	346	62.67	614.00	0.74	1.32	0.89	High
1993	349	47.33	814.00	0.71	1.19	0.77	Good
1993	352	73.00	841.33	0.75	1.39	1.00	High

*Shannon's H' Diversity calculated with $log_{10}(x)$.

†Benthic community parameters based on specimens collected per sample.

Table 2. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 1995.*†‡							
YEAR	**STATION**	**RICHNESS**	**ABUNDANCE**	**EVENNESS (J')**	**DIVERSITY (H') (Log_{10}(x))**	**M-AMBI**	**M-AMBI CATEGORY**
1995	105	9.00	320.50	0.47	0.45	0.17	Bad
1995	108	11.50	768.00	0.39	0.42	0.15	Bad
1995	109	16.00	3201.00	0.46	0.55	0.27	Poor
1995	111	13.00	1606.50	0.36	0.40	0.28	Poor
1995	114	13.50	1488.00	0.23	0.26	0.21	Poor
1995	115	11.50	1285.00	0.52	0.55	0.15	Bad
1995	117	23.00	3392.50	0.37	0.50	0.31	Poor
1995	120	17.50	2475.50	0.33	0.42	0.25	Poor
1995	121	18.50	2038.50	0.31	0.39	0.29	Poor
1995	123	21.00	2493.00	0.59	0.78	0.34	Poor
1995	125	14.50	419.50	0.65	0.76	0.25	Poor
1995	126	16.50	2861.50	0.32	0.39	0.31	Poor
1995	128	21.00	371.00	0.69	0.91	0.31	Poor
1995	130	5.50	21.50	0.81	0.60	0.11	Bad
1995	131	18.00	1941.00	0.53	0.67	0.32	Poor
1995	134	14.00	1038.00	0.50	0.58	0.28	Poor
1995	135	21.50	2008.00	0.37	0.50	0.38	Poor
1995	138	16.50	1344.50	0.42	0.51	0.26	Poor
1995	139	15.00	2183.50	0.36	0.41	0.27	Poor
1995	140	15.00	722.00	0.39	0.46	0.21	Poor
1995	146	19.00	436.50	0.56	0.72	0.30	Poor
1995	147	13.00	628.00	0.55	0.61	0.24	Poor
1995	150	19.00	2011.50	0.32	0.41	0.31	Poor
1995	151	26.50	1232.00	0.58	0.81	0.48	Moderate
1995	152	19.00	2558.50	0.17	0.22	0.31	Poor
1995	154	23.50	601.00	0.68	0.93	0.36	Poor
1995	155	12.50	765.00	0.52	0.56	0.25	Poor
1995	202	22.00	408.50	0.59	0.79	0.37	Poor
1995	204	20.50	347.50	0.50	0.66	0.38	Poor
1995	207	9.00	269.50	0.61	0.58	0.13	Bad
1995	208	11.50	337.00	0.53	0.56	0.22	Poor
1995	211	14.00	366.00	0.56	0.64	0.25	Poor
1995	212	22.00	336.00	0.68	0.91	0.35	Poor
1995	216	25.50	447.00	0.58	0.82	0.47	Moderate
1995	217	16.50	264.00	0.60	0.73	0.33	Poor
1995	218	23.00	1142.00	0.42	0.57	0.40	Moderate
1995	220	21.00	525.00	0.62	0.81	0.38	Poor
1995	221	4.00	11.00	0.92	0.55	0.13	Bad
1995	222	25.00	294.50	0.69	0.94	0.53	Moderate
1995	224	12.00	174.00	0.55	0.60	0.19	Bad
1995	225	26.50	435.50	0.71	1.01	0.44	Moderate
1995	226	5.00	27.00	0.75	0.53	0.10	Bad
1995	227	19.50	471.00	0.61	0.79	0.34	Poor
1995	230	16.00	104.00	0.75	0.90	0.30	Poor
1995	231	10.00	60.50	0.65	0.64	0.24	Poor
1995	235	16.50	179.50	0.63	0.77	0.30	Poor
1995	236	32.00	757.00	0.58	0.87	0.49	Moderate
1995	237	31.50	930.50	0.49	0.74	0.57	Good
1995	240	4.00	12.00	0.74	0.45	0.16	Bad
1995	241	26.00	552.00	0.61	0.86	0.49	Moderate
1995	242	36.50	3061.50	0.51	0.80	0.57	Good
1995	245	26.50	363.50	0.74	1.05	0.47	Moderate
1995	247	15.00	151.50	0.70	0.80	0.26	Poor
1995	249	27.00	662.50	0.60	0.86	0.49	Moderate
1995	250	32.50	689.00	0.51	0.75	0.77	Good
1995	253	10.50	302.00	0.59	0.61	0.19	Bad
1995	304	33.00	298.00	0.62	0.94	0.49	Moderate
1995	306	59.50	1523.50	0.65	1.15	0.75	Good
1995	309	19.50	98.00	0.81	1.02	0.36	Poor
1995	310	26.50	230.50	0.43	0.61	0.38	Poor
1995	311	50.00	980.50	0.65	1.10	0.61	Good
1995	317	35.50	721.50	0.63	0.97	0.41	Moderate
1995	318	48.00	1203.50	0.55	0.94	0.67	Good
1995	323	33.00	488.50	0.63	0.95	0.46	Moderate
1995	324	24.50	624.00	0.55	0.77	0.34	Poor
1995	325	44.50	948.50	0.59	0.97	0.56	Good
1995	331	37.50	487.00	0.74	1.16	0.45	Moderate
1995	332	62.50	470.50	0.72	1.28	0.83	High

Table 2. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 1995.*†‡							
YEAR	**STATION**	**RICHNESS**	**ABUNDANCE**	**EVENNESS (J')**	**DIVERSITY (H') (Log_{10}(x))**	**M-AMBI**	**M-AMBI CATEGORY**
1995	333	53.00	1241.00	0.64	1.11	0.67	Good
1995	334	41.00	330.00	0.78	1.26	0.56	Good
1995	335	63.00	403.25	0.78	1.40	0.86	High
1995	338	29.00	234.50	0.59	0.87	0.40	Moderate
1995	339	27.00	387.00	0.62	0.89	0.37	Poor
1995	340	35.00	464.00	0.67	1.03	0.42	Moderate
1995	341	55.00	374.00	0.82	1.43	0.76	Good
1995	345	32.00	294.00	0.56	0.84	0.48	Moderate
1995	346	46.00	302.50	0.79	1.31	0.63	Good
1995	349	22.00	72.50	0.86	1.16	0.42	Moderate
1995	352	*	*	*	*	*	*

*No sample for Station 352 during 1995.

†Shannon's H' Diversity calculated with log_{10}(x).

‡Benthic community parameters based on specimens collected per sample.

Table 3. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 1999.*†							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1999	105	13.00	1053.00	0.52	0.58	0.23	Poor
1999	108	7.50	261.50	0.55	0.47	0.14	Bad
1999	109	9.00	1899.00	0.32	0.31	0.14	Bad
1999	111	13.00	2238.00	0.48	0.53	0.25	Poor
1999	114	11.00	574.00	0.46	0.48	0.19	Bad
1999	115	10.00	507.00	0.49	0.49	0.15	Bad
1999	117	10.50	5148.50	0.17	0.17	0.22	Poor
1999	120	11.00	6637.00	0.11	0.12	0.26	Poor
1999	121	9.50	4350.00	0.13	0.12	0.20	Poor
1999	123	11.50	947.00	0.50	0.52	0.24	Poor
1999	125	8.50	912.50	0.24	0.22	0.16	Bad
1999	126	16.50	1166.00	0.50	0.60	0.34	Poor
1999	128	13.00	842.50	0.41	0.46	0.33	Poor
1999	130	12.00	1532.50	0.31	0.33	0.29	Poor
1999	131	13.50	1664.50	0.49	0.55	0.22	Poor
1999	134	15.00	1266.00	0.47	0.55	0.31	Poor
1999	135	16.00	724.00	0.46	0.56	0.37	Poor
1999	138	8.50	471.00	0.55	0.50	0.18	Bad
1999	139	14.00	1054.50	0.50	0.57	0.31	Poor
1999	140	15.00	1477.50	0.42	0.49	0.33	Poor
1999	146	11.50	507.50	0.64	0.68	0.25	Poor
1999	147	15.00	512.00	0.51	0.60	0.32	Poor
1999	150	13.00	560.50	0.60	0.67	0.27	Poor
1999	151	9.50	278.50	0.56	0.53	0.20	Bad
1999	152	4.50	204.00	0.59	0.34	0.10	Bad
1999	154	21.50	505.50	0.66	0.87	0.54	Good
1999	155	13.50	339.50	0.64	0.70	0.37	Poor
1999	202	21.00	381.50	0.62	0.82	0.47	Moderate
1999	204	30.50	1553.50	0.54	0.81	0.66	Good
1999	207	20.00	792.50	0.59	0.76	0.42	Moderate
1999	208	31.00	1780.50	0.52	0.77	0.63	Good
1999	211	20.00	1888.50	0.37	0.47	0.37	Poor
1999	212	17.00	1975.50	0.39	0.47	0.31	Poor
1999	216	24.50	858.50	0.49	0.68	0.47	Moderate
1999	217	15.50	1356.00	0.41	0.49	0.24	Poor
1999	218	20.00	1018.50	0.46	0.59	0.43	Moderate
1999	220	25.50	909.00	0.56	0.78	0.49	Moderate
1999	221	7.00	21.00	0.88	0.75	0.15	Bad
1999	222	17.50	305.00	0.74	0.91	0.37	Poor
1999	224	19.00	821.50	0.42	0.53	0.33	Poor
1999	225	22.50	867.00	0.61	0.82	0.35	Poor
1999	226	14.50	149.50	0.73	0.81	0.38	Poor
1999	227	19.50	574.00	0.57	0.72	0.38	Poor
1999	230	31.00	2351.50	0.48	0.72	0.55	Good
1999	231	26.00	1252.00	0.43	0.62	0.55	Good
1999	235	18.50	355.50	0.59	0.74	0.34	Poor
1999	236	34.00	1019.00	0.55	0.84	0.60	Good
1999	237	30.50	1156.50	0.44	0.65	0.70	Good
1999	240	18.50	1706.00	0.23	0.30	0.36	Poor
1999	241	28.50	413.50	0.68	0.98	0.61	Good
1999	242	43.00	1700.50	0.49	0.80	0.81	High
1999	245	25.50	813.00	0.63	0.87	0.60	Good
1999	247	16.00	331.00	0.58	0.70	0.41	Moderate
1999	249	17.00	185.50	0.80	0.94	0.44	Moderate
1999	250	28.50	374.00	0.62	0.90	0.63	Good
1999	253	7.00	16.00	0.86	0.72	0.18	Bad
1999	304	36.00	468.50	0.57	0.89	0.58	Good
1999	306	31.00	129.00	0.81	1.21	0.50	Moderate
1999	309	23.50	372.50	0.56	0.75	0.41	Moderate
1999	310	23.50	153.50	0.76	1.03	0.37	Poor
1999	311	53.00	752.50	0.73	1.25	0.73	Good
1999	317	34.00	981.00	0.45	0.68	0.50	Moderate
1999	318	36.50	363.50	0.57	0.89	0.57	Good
1999	323	52.00	658.00	0.71	1.16	0.85	High
1999	324	31.50	1049.50	0.50	0.74	0.34	Poor
1999	325	26.00	658.00	0.53	0.75	0.38	Poor
1999	331	39.00	1255.00	0.50	0.79	0.58	Good
1999	332	41.50	558.00	0.64	1.02	0.57	Good

Table 3. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 1999.*†							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1999	333	48.00	463.00	0.72	1.21	0.73	Good
1999	334	37.50	570.00	0.66	1.03	0.58	Good
1999	335	51.00	520.00	0.64	1.10	0.78	High
1999	338	33.50	749.00	0.61	0.93	0.44	Moderate
1999	339	34.50	1180.50	0.45	0.69	0.44	Moderate
1999	340	29.50	863.50	0.52	0.76	0.42	Moderate
1999	341	41.50	528.50	0.71	1.12	0.64	Good
1999	345	25.00	728.00	0.60	0.80	0.35	Poor
1999	346	38.50	222.00	0.68	1.08	0.51	Moderate
1999	349	40.00	168.50	0.83	1.33	0.67	Good
1999	352	66.50	452.00	0.72	1.32	1.00	High

*Shannon's H' Diversity calculated with $log_{10}(x)$.

†Benthic community parameters based on specimens collected per sample.

Table 4. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2004.*†							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2004	105	9.00	176.50	0.27	0.26	0.19	Bad
2004	108	3.00	5.50	0.87	0.40	0.12	Bad
2004	109	8.50	276.00	0.36	0.33	0.21	Poor
2004	111	11.00	6098.50	0.10	0.11	0.23	Poor
2004	114	5.50	270.50	0.48	0.35	0.11	Bad
2004	115	8.00	67.00	0.57	0.51	0.22	Poor
2004	117	11.50	3098.00	0.14	0.15	0.16	Bad
2004	120	4.50	110.00	0.55	0.36	0.13	Bad
2004	121	8.00	118.00	0.64	0.58	0.15	Bad
2004	123	13.00	1527.00	0.53	0.59	0.27	Poor
2004	125	6.50	62.50	0.68	0.55	0.15	Bad
2004	126	15.50	715.00	0.59	0.69	0.35	Poor
2004	128	11.50	879.50	0.55	0.58	0.27	Poor
2004	130	12.00	374.00	0.59	0.64	0.24	Poor
2004	131	11.00	393.00	0.57	0.58	0.25	Poor
2004	134	10.00	653.50	0.58	0.58	0.21	Poor
2004	135	12.50	415.00	0.45	0.50	0.32	Poor
2004	138	5.00	127.50	0.47	0.30	0.16	Bad
2004	139	7.50	88.00	0.71	0.62	0.17	Bad
2004	140	14.50	844.00	0.55	0.64	0.29	Poor
2004	146	18.00	310.00	0.67	0.83	0.37	Poor
2004	147	9.50	117.50	0.71	0.68	0.24	Poor
2004	150	16.50	677.00	0.60	0.73	0.32	Poor
2004	151	21.00	659.50	0.58	0.76	0.45	Moderate
2004	152	7.00	83.50	0.53	0.45	0.15	Bad
2004	154	26.00	1196.00	0.61	0.84	0.51	Moderate
2004	155	14.50	123.50	0.78	0.89	0.34	Poor
2004	202	20.00	205.50	0.76	0.91	0.58	Good
2004	204	20.00	239.00	0.68	0.88	0.36	Poor
2004	207	13.00	331.00	0.56	0.63	0.23	Poor
2004	208	20.00	299.50	0.69	0.89	0.35	Poor
2004	211	8.50	122.50	0.67	0.61	0.17	Bad
2004	212	12.50	207.50	0.78	0.84	0.31	Poor
2004	216	17.00	63.50	0.79	0.97	0.37	Poor
2004	217	11.50	479.50	0.73	0.77	0.24	Poor
2004	218	22.00	378.50	0.59	0.79	0.43	Moderate
2004	220	12.00	56.00	0.84	0.89	0.32	Poor
2004	221	20.50	388.50	0.61	0.80	0.43	Moderate
2004	222	15.50	93.50	0.78	0.93	0.41	Moderate
2004	224	18.50	403.50	0.58	0.74	0.43	Moderate
2004	225	12.50	225.50	0.69	0.76	0.26	Poor
2004	226	10.50	50.00	0.78	0.79	0.27	Poor
2004	227	14.00	138.00	0.64	0.73	0.41	Moderate
2004	230	14.50	134.50	0.67	0.77	0.34	Poor
2004	231	13.00	506.50	0.19	0.22	0.29	Poor
2004	235	11.50	1086.00	0.14	0.15	0.20	Poor
2004	236	12.00	659.00	0.22	0.23	0.25	Poor
2004	237	26.50	331.50	0.68	0.97	0.51	Moderate
2004	240	28.50	350.25	0.63	0.77	0.84	High
2004	241	20.50	404.50	0.54	0.71	0.37	Poor
2004	242	17.00	239.00	0.78	0.95	0.36	Poor
2004	245	12.50	126.50	0.54	0.59	0.35	Poor
2004	247	14.00	115.00	0.78	0.89	0.38	Poor
2004	249	21.00	87.50	0.87	1.14	0.48	Moderate
2004	250	22.50	126.50	0.72	0.97	0.53	Good
2004	253	7.00	68.50	0.41	0.36	0.17	Bad
2004	304	35.50	297.50	0.72	1.12	0.60	Good
2004	306	26.50	84.00	0.79	1.12	0.46	Moderate
2004	309	29.00	202.50	0.74	1.09	0.52	Moderate
2004	310	21.00	71.50	0.73	0.96	0.43	Moderate
2004	311	33.00	146.50	0.80	1.21	0.63	Good
2004	317	23.50	180.50	0.76	1.04	0.39	Poor
2004	318	30.00	222.00	0.71	1.06	0.39	Poor
2004	323	10.00	37.00	0.62	0.62	0.19	Bad
2004	324	23.00	145.50	0.73	1.00	0.39	Moderate
2004	325	36.00	264.50	0.73	1.13	0.53	Good
2004	331	26.50	256.50	0.62	0.87	0.41	Moderate
2004	332	35.00	202.00	0.65	1.01	0.58	Good

Table 4. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2004.*†

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2004	333	47.00	388.50	0.78	1.30	0.53	Good
2004	334	25.50	154.50	0.77	1.09	0.41	Moderate
2004	335	45.00	1233.50	0.53	0.88	0.66	Good
2004	338	32.00	175.00	0.78	1.17	0.46	Moderate
2004	339	24.00	115.50	0.64	0.88	0.37	Poor
2004	340	18.00	95.50	0.74	0.92	0.30	Poor
2004	341	33.00	198.50	0.72	1.10	0.45	Moderate
2004	345	20.50	103.00	0.69	0.90	0.36	Poor
2004	346	61.00	461.50	0.70	1.24	1.00	High
2004	349	23.00	61.00	0.82	1.12	0.41	Moderate
2004	352	21.50	92.00	0.86	1.15	0.30	Poor

*Shannon's H' Diversity calculated with $log_{10}(x)$.

†Benthic community parameters based on specimens collected per sample.

Table 5. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2009.*†							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2009	105	8.00	622.00	0.15	0.13	0.15	Bad
2009	108	14.50	3842.00	0.12	0.14	0.27	Poor
2009	109	7.00	1440.00	0.12	0.10	0.14	Bad
2009	111	12.50	726.00	0.41	0.45	0.25	Poor
2009	114	14.00	1168.00	0.33	0.38	0.27	Poor
2009	115	7.50	354.50	0.23	0.20	0.15	Bad
2009	117	12.50	3530.00	0.39	0.42	0.22	Poor
2009	120	11.50	750.50	0.37	0.39	0.19	Bad
2009	121	11.00	1020.00	0.33	0.34	0.25	Poor
2009	123	13.00	708.00	0.32	0.35	0.19	Bad
2009	125	9.00	197.50	0.48	0.45	0.13	Bad
2009	126	10.50	328.00	0.28	0.28	0.17	Bad
2009	128	14.50	844.50	0.51	0.59	0.29	Poor
2009	130	4.00	24.00	0.76	0.46	0.04	Bad
2009	131	9.50	186.00	0.58	0.56	0.23	Poor
2009	134	15.00	784.00	0.50	0.59	0.30	Poor
2009	135	9.50	116.50	0.43	0.41	0.21	Poor
2009	138	10.50	280.00	0.50	0.52	0.19	Bad
2009	139	7.00	246.00	0.47	0.39	0.17	Bad
2009	140	13.50	316.00	0.60	0.68	0.28	Poor
2009	146	27.00	528.50	0.56	0.80	0.57	Good
2009	147	13.50	363.00	0.49	0.55	0.28	Poor
2009	150	17.00	218.50	0.65	0.80	0.32	Poor
2009	151	16.50	277.00	0.64	0.76	0.39	Moderate
2009	152	9.00	18.50	0.93	0.89	0.22	Poor
2009	154	30.00	988.00	0.27	0.40	0.64	Good
2009	155	17.00	62.50	0.80	0.97	0.45	Moderate
2009	202	38.00	692.00	0.64	1.01	0.76	Good
2009	204	21.50	272.25	0.68	0.88	0.42	Moderate
2009	207	11.50	496.50	0.57	0.61	0.23	Poor
2009	208	20.00	828.50	0.60	0.79	0.42	Moderate
2009	211	16.50	766.50	0.57	0.70	0.35	Poor
2009	212	18.50	451.50	0.69	0.87	0.41	Moderate
2009	216	25.00	710.00	0.70	0.98	0.42	Moderate
2009	217	28.00	1163.50	0.64	0.93	0.49	Moderate
2009	218	26.00	866.00	0.63	0.89	0.49	Moderate
2009	220	29.50	464.00	0.72	1.06	0.67	Good
2009	221	15.00	78.00	0.80	0.95	0.34	Poor
2009	222	15.50	430.00	0.70	0.83	0.31	Poor
2009	224	13.50	58.00	0.70	0.77	0.37	Poor
2009	225	35.00	358.50	0.73	1.12	0.79	High
2009	226	5.00	11.50	0.92	0.65	0.14	Bad
2009	227	20.50	347.00	0.50	0.66	0.46	Moderate
2009	230	28.50	612.50	0.59	0.86	0.59	Good
2009	231	4.50	11.50	0.89	0.57	0.14	Bad
2009	235	11.00	37.00	0.87	0.91	0.31	Poor
2009	236	23.00	233.50	0.79	0.92	0.48	Moderate
2009	237	23.50	380.25	0.58	0.80	0.52	Moderate
2009	240	2.50	5.50	0.79	0.24	0.11	Bad
2009	241	18.50	260.00	0.66	0.83	0.39	Poor
2009	242	23.00	277.00	0.58	0.79	0.58	Good
2009	245	13.00	69.00	0.73	0.79	0.43	Moderate
2009	247	13.50	216.00	0.41	0.45	0.43	Moderate
2009	249	10.00	37.50	0.86	0.86	0.28	Poor
2009	250	54.00	1046.00	0.69	1.19	1.00	High
2009	253	18.50	552.50	0.45	0.57	0.34	Poor
2009	304	41.00	473.00	0.64	1.04	0.67	Good
2009	306	52.50	288.25	0.77	1.31	0.90	High
2009	309	35.50	299.00	0.79	1.22	0.54	Good
2009	310	27.50	94.50	0.75	1.08	0.56	Good
2009	311	62.50	502.00	0.78	1.41	0.93	High
2009	317	17.50	132.50	0.72	0.90	0.24	Poor
2009	318	49.50	301.50	0.77	1.29	0.81	High
2009	323	36.00	176.00	0.76	1.17	0.70	Good
2009	324	34.50	162.50	0.78	1.21	0.61	Good
2009	325	30.50	355.00	0.60	0.89	0.47	Moderate
2009	331	43.00	534.00	0.67	1.10	0.59	Good
2009	332	68.00	418.00	0.80	1.47	0.96	High

Table 5. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2009. [*†]

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2009	333	56.50	1524.50	0.52	0.92	0.73	Good
2009	334	43.50	404.00	0.70	1.15	0.55	Good
2009	335	43.50	1209.50	0.57	0.93	0.60	Good
2009	338	42.00	668.50	0.63	1.03	0.59	Good
2009	339	39.00	573.25	0.61	0.96	0.64	Good
2009	340	37.00	636.50	0.51	0.81	0.56	Good
2009	341	48.00	197.00	0.87	1.46	0.73	Good
2009	345	39.00	759.50	0.60	0.96	0.55	Good
2009	346	67.00	334.50	0.79	1.45	0.91	High
2009	349	64.50	450.00	0.80	1.44	0.99	High
2009	352	78.00	524.25	0.83	1.57	1.00	High

*Shannon's H' Diversity calculated with $log_{10}(x)$.

†Benthic community parameters based on specimens collected per sample.

Table 6. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2014.*†

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2014	105	18.50	293.00	0.64	0.81	0.35	Poor
2014	108	23.00	1471.00	0.66	0.90	0.39	Poor
2014	109	15.00	650.00	0.34	0.40	0.30	Poor
2014	111	26.00	1561.50	0.59	0.83	0.42	Moderate
2014	114	27.50	1097.00	0.71	1.03	0.36	Poor
2014	115	12.00	293.50	0.37	0.40	0.19	Bad
2014	117	29.50	12375.00	0.29	0.44	0.55	Good
2014	120	25.00	1076.00	0.62	0.87	0.47	Moderate
2014	121	21.50	3863.50	0.27	0.36	0.38	Poor
2014	123	24.50	1123.00	0.50	0.69	0.31	Poor
2014	125	22.50	1375.50	0.52	0.70	0.38	Poor
2014	126	14.50	3577.00	0.24	0.27	0.24	Poor
2014	128	23.00	1514.00	0.40	0.55	0.33	Poor
2014	130	14.50	910.00	0.22	0.26	0.25	Poor
2014	131	24.50	2348.00	0.35	0.49	0.41	Moderate
2014	134	19.50	1337.00	0.50	0.65	0.33	Poor
2014	135	21.50	1654.00	0.39	0.52	0.38	Poor
2014	138	29.00	858.00	0.48	0.70	0.48	Moderate
2014	139	21.50	139.00	0.60	0.80	0.30	Poor
2014	140	23.00	929.50	0.40	0.55	0.48	Moderate
2014	146	31.50	294.50	0.69	1.03	0.56	Good
2014	147	25.50	383.00	0.57	0.80	0.51	Moderate
2014	150	24.00	933.00	0.54	0.75	0.40	Moderate
2014	151	33.50	584.50	0.58	0.89	0.59	Good
2014	152	26.50	437.50	0.71	1.01	0.43	Moderate
2014	154	35.00	600.50	0.58	0.90	0.55	Good
2014	155	29.50	1480.50	0.50	0.73	0.50	Moderate
2014	202	33.00	351.00	0.72	1.09	0.53	Good
2014	204	14.00	506.50	0.53	0.60	0.36	Poor
2014	207	19.50	1527.50	0.64	0.83	0.34	Poor
2014	208	30.50	983.50	0.65	0.97	0.56	Good
2014	211	23.50	787.00	0.57	0.78	0.36	Poor
2014	212	12.50	256.00	0.61	0.66	0.23	Poor
2014	216	47.50	653.00	0.71	1.19	0.74	Good
2014	217	17.50	242.50	0.72	0.89	0.29	Poor
2014	218	25.00	1379.00	0.54	0.76	0.46	Moderate
2014	220	20.50	281.00	0.62	0.81	0.37	Poor
2014	221	17.00	657.50	0.44	0.55	0.28	Poor
2014	222	12.00	130.50	0.68	0.74	0.25	Poor
2014	224	19.00	1218.50	0.40	0.50	0.31	Poor
2014	225	34.50	310.50	0.71	1.08	0.62	Good
2014	226	21.50	383.50	0.59	0.78	0.47	Moderate
2014	227	17.50	89.00	0.81	1.01	0.31	Poor
2014	230	20.00	561.50	0.54	0.71	0.42	Moderate
2014	231	16.00	53.50	0.87	1.03	0.41	Moderate
2014	235	10.50	38.50	0.84	0.84	0.22	Poor
2014	236	19.00	117.00	0.81	1.01	0.35	Poor
2014	237	40.50	506.00	0.61	0.99	0.56	Good
2014	240	2.50	3.00	0.48	0.34	0.11	Bad
2014	241	26.00	233.00	0.68	0.96	0.47	Moderate
2014	242	21.50	368.50	0.55	0.73	0.34	Poor
2014	245	22.00	471.00	0.69	0.92	0.45	Moderate
2014	247	16.00	419.00	0.53	0.63	0.36	Poor
2014	249	25.00	255.50	0.69	0.97	0.50	Moderate
2014	250	43.50	1039.00	0.55	0.90	0.72	Good
2014	253	13.00	35.50	0.88	0.97	0.21	Poor
2014	304	49.00	731.00	0.55	0.93	0.70	Good
2014	306	32.50	141.00	0.85	1.28	0.42	Moderate
2014	309	18.50	120.50	0.78	0.99	0.28	Poor
2014	310	11.00	36.50	0.85	0.88	0.22	Poor
2014	311	75.50	1006.50	0.69	1.29	0.91	High
2014	317	24.00	274.50	0.72	0.99	0.30	Poor
2014	318	70.00	842.00	0.71	1.32	0.55	Good
2014	323	13.00	34.00	0.87	0.97	0.18	Bad
2014	324	35.00	245.50	0.72	1.11	0.42	Moderate
2014	325	33.50	266.50	0.80	1.22	0.39	Moderate
2014	331	45.00	482.50	0.66	1.09	0.56	Good
2014	332	42.00	165.50	0.83	1.35	0.63	Good

Table 6. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2014.*†							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2014	333	59.00	614.00	0.70	1.24	0.70	Good
2014	334	37.00	448.50	0.61	0.96	0.42	Moderate
2014	335	32.00	570.00	0.58	0.88	0.42	Moderate
2014	338	34.00	490.00	0.63	0.95	0.45	Moderate
2014	339	32.00	537.00	0.66	1.00	0.33	Poor
2014	340	37.00	518.50	0.68	1.06	0.45	Moderate
2014	341	53.00	650.00	0.77	1.33	0.62	Good
2014	345	37.50	430.00	0.68	1.07	0.41	Moderate
2014	346	52.00	282.50	0.83	1.42	0.62	Good
2014	349	47.50	294.50	0.75	1.24	0.64	Good
2014	352	52.00	1073.00	0.50	0.86	0.63	Good

*Shannon's H' Diversity calculated with $log_{10}(x)$.

†Benthic community parameters based on specimens collected per sample.

Table 7. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2020.*†‡							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2020	105	14.50	504.50	0.51	0.59	0.29	Poor
2020	108	15.50	629.50	0.48	0.57	0.31	Poor
2020	109	15.50	500.00	0.48	0.57	0.35	Poor
2020	111	17.50	437.00	0.38	0.47	0.36	Poor
2020	114	17.00	599.50	0.44	0.54	0.32	Poor
2020	115	15.50	460.00	0.50	0.60	0.27	Poor
2020	117	16.50	369.50	0.62	0.75	0.31	Poor
2020	120	17.00	406.50	0.65	0.80	0.36	Poor
2020	121	16.00	737.50	0.52	0.62	0.36	Poor
2020	123	21.50	492.00	0.63	0.84	0.41	Moderate
2020	125	15.50	195.00	0.70	0.83	0.37	Poor
2020	126	17.50	724.00	0.57	0.69	0.37	Poor
2020	128	15.50	365.50	0.67	0.80	0.37	Poor
2020	130	17.00	321.50	0.71	0.86	0.37	Poor
2020	131	18.00	277.00	0.74	0.92	0.40	Moderate
2020	134	20.00	1069.50	0.40	0.52	0.38	Poor
2020	135	21.00	715.00	0.46	0.61	0.36	Poor
2020	138	16.00	466.50	0.50	0.60	0.34	Poor
2020	139	19.50	690.00	0.59	0.76	0.40	Moderate
2020	140	17.50	426.50	0.45	0.56	0.42	Moderate
2020	146	20.00	378.00	0.64	0.83	0.47	Moderate
2020	147	23.00	579.50	0.46	0.62	0.40	Moderate
2020	150	24.50	569.50	0.66	0.91	0.48	Moderate
2020	151	13.50	148.00	0.65	0.73	0.28	Poor
2020	152	13.00	239.50	0.65	0.67	0.30	Poor
2020	154	25.00	611.50	0.62	0.86	0.47	Moderate
2020	155	20.50	617.50	0.52	0.68	0.48	Moderate
2020	202	20.50	576.00	0.72	0.95	0.42	Moderate
2020	204	18.00	574.00	0.49	0.61	0.38	Poor
2020	207	21.00	563.00	0.64	0.85	0.51	Moderate
2020	208	37.50	1081.00	0.59	0.93	0.64	Good
2020	211	12.00	171.00	0.52	0.56	0.23	Poor
2020	212	23.00	454.00	0.56	0.76	0.44	Moderate
2020	216	19.50	479.00	0.50	0.64	0.40	Moderate
2020	217	20.50	421.50	0.60	0.79	0.41	Moderate
2020	218	6.50	40.00	0.80	0.59	0.20	Poor
2020	220	16.50	114.50	0.67	0.82	0.39	Poor
2020	221	1.00	1.00	*	0.00	*	*
2020	222	14.00	398.50	0.59	0.68	0.33	Poor
2020	224	20.00	1528.00	0.21	0.27	0.37	Poor
2020	225	18.00	381.50	0.46	0.57	0.32	Poor
2020	226	6.50	14.50	0.88	0.71	0.26	Poor
2020	227	25.00	397.00	0.68	0.95	0.50	Moderate
2020	230	20.50	180.50	0.72	0.94	0.42	Moderate
2020	231	18.50	451.00	0.39	0.49	0.36	Poor
2020	235	13.00	292.00	0.40	0.45	0.29	Poor
2020	236	16.00	119.50	0.72	0.87	0.42	Moderate
2020	237	59.50	587.50	0.78	1.35	1.00	High
2020	240	6.00	11.50	0.90	0.69	0.20	Poor
2020	241	21.50	210.50	0.69	0.92	0.53	Good
2020	242	19.00	203.50	0.49	0.63	0.41	Moderate
2020	245	37.50	483.00	0.72	1.10	0.85	High
2020	247	32.00	163.50	0.84	1.26	0.75	Good
2020	249	24.00	163.50	0.77	1.07	0.55	Good
2020	250	32.50	383.50	0.58	0.88	0.60	Good
2020	253	15.00	684.50	0.28	0.33	0.27	Poor
2020	304	56.50	670.00	0.61	1.07	0.83	High
2020	306	55.50	623.00	0.69	1.20	0.80	High
2020	309	45.00	298.50	0.80	1.33	0.69	Good
2020	310	20.00	263.50	0.43	0.55	0.33	Poor
2020	311	35.50	429.00	0.73	1.11	0.59	Good
2020	317	21.00	93.50	0.81	1.07	0.35	Poor
2020	318	63.00	496.00	0.70	1.27	0.99	High
2020	323	34.00	169.50	0.73	1.11	0.52	Moderate
2020	324	36.00	265.50	0.73	1.13	0.55	Good
2020	325	27.00	194.00	0.76	1.09	0.44	Moderate
2020	331	47.50	380.50	0.68	1.15	0.69	Good
2020	332	66.50	413.00	0.80	1.47	0.91	High

Table 7. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during 2020.*†‡

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2020	333	51.50	767.50	0.69	1.19	0.64	Good
2020	334	31.50	259.00	0.70	1.05	0.51	Moderate
2020	335	45.50	670.50	0.67	1.10	0.64	Good
2020	338	27.50	223.50	0.74	1.04	0.45	Moderate
2020	339	29.50	243.50	0.79	1.16	0.58	Good
2020	340	23.00	164.50	0.80	1.09	0.39	Moderate
2020	341	51.50	280.00	0.83	1.42	0.72	Good
2020	345	38.00	221.00	0.81	1.26	0.61	Good
2020	346	62.50	397.00	0.80	1.44	1.00	High
2020	349	36.00	267.50	0.82	1.23	0.59	Good
2020	352	47.50	543.00	0.64	1.07	0.80	High

*Only one specimen present at Station 221 during 2020 sampling.

†Shannon's H' Diversity calculated with $\log_{10}(x)$.

‡Benthic community parameters based on specimens collected per sample.

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	105	15.00	747.67	0.50	0.59	0.25	Poor
1993	108	11.33	548.33	0.56	0.59	0.27	Poor
1993	109	10.00	385.00	0.63	0.63	0.18	Bad
1993	111	14.00	2569.33	0.39	0.45	0.32	Poor
1993	114	16.67	1432.00	0.38	0.46	0.38	Poor
1993	115	15.33	282.67	0.47	0.56	0.30	Poor
1993	117	15.00	1129.67	0.34	0.39	0.38	Poor
1993	120	10.33	1406.00	0.07	0.07	0.20	Poor
1993	121	14.00	1395.67	0.16	0.18	0.20	Poor
1993	123	12.33	3167.67	0.14	0.15	0.20	Poor
1993	125	9.00	100.00	0.57	0.54	0.14	Bad
1993	126	19.67	1482.33	0.29	0.37	0.29	Poor
1993	128	9.00	1199.00	0.34	0.32	0.17	Bad
1993	130	6.33	85.00	0.61	0.44	0.12	Bad
1993	131	17.67	2019.33	0.47	0.58	0.35	Poor
1993	134	9.67	290.33	0.36	0.35	0.22	Poor
1993	135	18.67	2003.67	0.54	0.69	0.35	Poor
1993	138	6.67	396.33	0.16	0.13	0.23	Poor
1993	139	8.33	164.33	0.43	0.40	0.18	Bad
1993	140	19.33	6126.67	0.19	0.24	0.29	Poor
1993	146	18.00	657.00	0.52	0.65	0.38	Poor
1993	147	22.00	1560.67	0.52	0.70	0.35	Poor
1993	150	11.33	568.67	0.20	0.21	0.21	Poor
1993	151	13.33	246.00	0.48	0.54	0.26	Poor
1993	152	7.67	167.67	0.32	0.28	0.17	Bad
1993	154	24.33	276.33	0.65	0.90	0.42	Moderate
1993	155	25.00	2095.33	0.50	0.69	0.47	Moderate
1993	202	30.33	1008.33	0.56	0.82	0.87	High
1993	204	32.67	704.67	0.63	0.96	0.61	Good
1993	207	11.67	885.33	0.39	0.41	0.29	Poor
1993	208	22.00	429.00	0.43	0.57	0.50	Moderate
1993	211	23.00	1478.00	0.40	0.54	0.38	Poor
1993	212	23.33	4480.33	0.28	0.39	0.41	Moderate
1993	216	25.33	387.67	0.67	0.93	0.51	Moderate
1993	217	18.00	2162.67	0.29	0.36	0.37	Poor
1993	218	18.00	712.00	0.48	0.60	0.31	Poor
1993	220	27.00	2113.33	0.50	0.70	0.51	Moderate
1993	221	14.67	281.67	0.59	0.68	0.38	Poor
1993	222	16.67	2005.00	0.44	0.53	0.34	Poor
1993	224	14.67	283.33	0.66	0.76	0.33	Poor
1993	225	18.33	659.00	0.65	0.82	0.39	Poor
1993	226	5.00	55.67	0.74	0.47	0.19	Bad
1993	227	16.00	627.00	0.45	0.54	0.37	Poor
1993	230	24.00	441.67	0.61	0.84	0.54	Good
1993	231	7.67	51.33	0.76	0.67	0.10	Bad
1993	235	13.67	107.33	0.68	0.78	0.20	Poor
1993	236	19.33	788.00	0.42	0.50	0.38	Poor
1993	237	25.00	442.00	0.52	0.72	0.34	Poor
1993	240	10.67	157.00	0.64	0.59	0.27	Poor
1993	241	22.67	131.33	0.78	1.05	0.54	Good
1993	242	19.67	669.33	0.38	0.49	0.46	Moderate
1993	245	22.33	703.67	0.55	0.69	0.53	Moderate
1993	247	19.67	422.33	0.57	0.70	0.48	Moderate
1993	249	39.67	1373.33	0.62	0.99	0.64	Good
1993	250	45.33	680.33	0.66	1.09	1.00	High
1993	253	8.33	59.00	0.68	0.63	0.23	Poor
1993	304	45.00	436.67	0.77	1.26	0.85	High
1993	306	46.67	773.00	0.70	1.16	0.74	Good
1993	309	26.00	237.33	0.79	1.08	0.59	Good
1993	310	35.00	224.67	0.71	1.10	0.64	Good
1993	311	57.00	914.00	0.66	1.17	0.61	Good
1993	317	40.33	1546.33	0.64	1.02	0.60	Good
1993	318	51.00	837.00	0.67	1.15	0.78	High
1993	323	32.33	956.33	0.70	1.06	0.48	Moderate
1993	324	34.00	1058.00	0.72	1.11	0.52	Moderate
1993	325	59.00	798.00	0.72	1.27	0.84	High
1993	331	37.33	932.00	0.64	1.01	0.51	Moderate
1993	332	57.33	737.67	0.78	1.36	0.91	High

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	**STATION**	**RICHNESS**	**ABUNDANCE**	**EVENNESS (J')**	**DIVERSITY (H') ($Log_{10}(x)$)**	**M-AMBI**	**M-AMBI CATEGORY**
1993	333	71.67	1484.33	0.63	1.17	1.00	High
1993	334	39.00	594.33	0.72	1.14	0.58	Good
1993	335	48.33	468.00	0.73	1.23	0.72	Good
1993	338	38.33	764.00	0.74	1.17	0.56	Good
1993	339	31.67	536.33	0.75	1.12	0.46	Moderate
1993	340	38.67	956.00	0.65	1.03	0.55	Good
1993	341	53.00	566.00	0.82	1.42	0.73	Good
1993	345	41.67	1082.00	0.72	1.17	0.60	Good
1993	346	62.67	614.00	0.74	1.32	0.89	High
1993	349	47.33	814.00	0.71	1.19	0.77	Good
1993	352	73.00	841.33	0.75	1.39	1.00	High
1995	105	9.00	320.50	0.47	0.45	0.17	Bad
1995	108	11.50	768.00	0.39	0.42	0.15	Bad
1995	109	16.00	3201.00	0.46	0.55	0.27	Poor
1995	111	13.00	1606.50	0.36	0.40	0.28	Poor
1995	114	13.50	1488.00	0.23	0.26	0.21	Poor
1995	115	11.50	1285.00	0.52	0.55	0.15	Bad
1995	117	23.00	3392.50	0.37	0.50	0.31	Poor
1995	120	17.50	2475.50	0.33	0.42	0.25	Poor
1995	121	18.50	2038.50	0.31	0.39	0.29	Poor
1995	123	21.00	2493.00	0.59	0.78	0.34	Poor
1995	125	14.50	419.50	0.65	0.76	0.25	Poor
1995	126	16.50	2861.50	0.32	0.39	0.31	Poor
1995	128	21.00	371.00	0.69	0.91	0.31	Poor
1995	130	5.50	21.50	0.81	0.60	0.11	Bad
1995	131	18.00	1941.00	0.53	0.67	0.32	Poor
1995	134	14.00	1038.00	0.50	0.58	0.28	Poor
1995	135	21.50	2008.00	0.37	0.50	0.38	Poor
1995	138	16.50	1344.50	0.42	0.51	0.26	Poor
1995	139	15.00	2183.50	0.36	0.41	0.27	Poor
1995	140	15.00	722.00	0.39	0.46	0.21	Poor
1995	146	19.00	436.50	0.56	0.72	0.30	Poor
1995	147	13.00	628.00	0.55	0.61	0.24	Poor
1995	150	19.00	2011.50	0.32	0.41	0.31	Poor
1995	151	26.50	1232.00	0.58	0.81	0.48	Moderate
1995	152	19.00	2558.50	0.17	0.22	0.31	Poor
1995	154	23.50	601.00	0.68	0.93	0.36	Poor
1995	155	12.50	765.00	0.52	0.56	0.25	Poor
1995	202	22.00	408.50	0.59	0.79	0.37	Poor
1995	204	20.50	347.50	0.50	0.66	0.38	Poor
1995	207	9.00	269.50	0.61	0.58	0.13	Bad
1995	208	11.50	337.00	0.53	0.56	0.22	Poor
1995	211	14.00	366.00	0.56	0.64	0.25	Poor
1995	212	22.00	336.00	0.68	0.91	0.35	Poor
1995	216	25.50	447.00	0.58	0.82	0.47	Moderate
1995	217	16.50	264.00	0.60	0.73	0.33	Poor
1995	218	23.00	1142.00	0.42	0.57	0.40	Moderate
1995	220	21.00	525.00	0.62	0.81	0.38	Poor
1995	221	4.00	11.00	0.92	0.55	0.13	Bad
1995	222	25.00	294.50	0.69	0.94	0.53	Moderate
1995	224	12.00	174.00	0.55	0.60	0.19	Bad
1995	225	26.50	435.50	0.71	1.01	0.44	Moderate
1995	226	5.00	27.00	0.75	0.53	0.10	Bad
1995	227	19.50	471.00	0.61	0.79	0.34	Poor
1995	230	16.00	104.00	0.75	0.90	0.30	Poor
1995	231	10.00	60.50	0.65	0.64	0.24	Poor
1995	235	16.50	179.50	0.63	0.77	0.30	Poor
1995	236	32.00	757.00	0.58	0.87	0.49	Moderate
1995	237	31.50	930.50	0.49	0.74	0.57	Good
1995	240	4.00	12.00	0.74	0.45	0.16	Bad
1995	241	26.00	552.00	0.61	0.86	0.49	Moderate
1995	242	36.50	3061.50	0.51	0.80	0.57	Good
1995	245	26.50	363.50	0.74	1.05	0.47	Moderate
1995	247	15.00	151.50	0.70	0.80	0.26	Poor
1995	249	27.00	662.50	0.60	0.86	0.49	Moderate
1995	250	32.50	689.00	0.51	0.75	0.77	Good
1995	253	10.50	302.00	0.59	0.61	0.19	Bad
1995	304	33.00	298.00	0.62	0.94	0.49	Moderate

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1995	306	59.50	1523.50	0.65	1.15	0.75	Good
1995	309	19.50	98.00	0.81	1.02	0.36	Poor
1995	310	26.50	230.50	0.43	0.61	0.38	Poor
1995	311	50.00	980.50	0.65	1.10	0.61	Good
1995	317	35.50	721.50	0.63	0.97	0.41	Moderate
1995	318	48.00	1203.50	0.55	0.94	0.67	Good
1995	323	33.00	488.50	0.63	0.95	0.46	Moderate
1995	324	24.50	624.00	0.55	0.77	0.34	Poor
1995	325	44.50	948.50	0.59	0.97	0.56	Good
1995	331	37.50	487.00	0.74	1.16	0.45	Moderate
1995	332	62.50	470.50	0.72	1.28	0.83	High
1995	333	53.00	1241.00	0.64	1.11	0.67	Good
1995	334	41.00	330.00	0.78	1.26	0.56	Good
1995	335	63.00	403.25	0.78	1.40	0.86	High
1995	338	29.00	234.50	0.59	0.87	0.40	Moderate
1995	339	27.00	387.00	0.62	0.89	0.37	Poor
1995	340	35.00	464.00	0.67	1.03	0.42	Moderate
1995	341	55.00	374.00	0.82	1.43	0.76	Good
1995	345	32.00	294.00	0.56	0.84	0.48	Moderate
1995	346	46.00	302.50	0.79	1.31	0.63	Good
1995	349	22.00	72.50	0.86	1.16	0.42	Moderate
1995	352	*	*	*	*	*	*
1999	105	13.00	1053.00	0.52	0.58	0.23	Poor
1999	108	7.50	261.50	0.55	0.47	0.14	Bad
1999	109	9.00	1899.00	0.32	0.31	0.14	Bad
1999	111	13.00	2238.00	0.48	0.53	0.25	Poor
1999	114	11.00	574.00	0.46	0.48	0.19	Bad
1999	115	10.00	507.00	0.49	0.49	0.15	Bad
1999	117	10.50	5148.50	0.17	0.17	0.22	Poor
1999	120	11.00	6637.00	0.11	0.12	0.26	Poor
1999	121	9.50	4350.00	0.13	0.12	0.20	Poor
1999	123	11.50	947.00	0.50	0.52	0.24	Poor
1999	125	8.50	912.50	0.24	0.22	0.16	Bad
1999	126	16.50	1166.00	0.50	0.60	0.34	Poor
1999	128	13.00	842.50	0.41	0.46	0.33	Poor
1999	130	12.00	1532.50	0.31	0.33	0.29	Poor
1999	131	13.50	1664.50	0.49	0.55	0.22	Poor
1999	134	15.00	1266.00	0.47	0.55	0.31	Poor
1999	135	16.00	724.00	0.46	0.56	0.37	Poor
1999	138	8.50	471.00	0.55	0.50	0.18	Bad
1999	139	14.00	1054.50	0.50	0.57	0.31	Poor
1999	140	15.00	1477.50	0.42	0.49	0.33	Poor
1999	146	11.50	507.50	0.64	0.68	0.25	Poor
1999	147	15.00	512.00	0.51	0.60	0.32	Poor
1999	150	13.00	560.50	0.60	0.67	0.27	Poor
1999	151	9.50	278.50	0.56	0.53	0.20	Bad
1999	152	4.50	204.00	0.59	0.34	0.10	Bad
1999	154	21.50	505.50	0.66	0.87	0.54	Good
1999	155	13.50	339.50	0.64	0.70	0.37	Poor
1999	202	21.00	381.50	0.62	0.82	0.47	Moderate
1999	204	30.50	1553.50	0.54	0.81	0.66	Good
1999	207	20.00	792.50	0.59	0.76	0.42	Moderate
1999	208	31.00	1780.50	0.52	0.77	0.63	Good
1999	211	20.00	1888.50	0.37	0.47	0.37	Poor
1999	212	17.00	1975.50	0.39	0.47	0.31	Poor
1999	216	24.50	858.50	0.49	0.68	0.47	Moderate
1999	217	15.50	1356.00	0.41	0.49	0.24	Poor
1999	218	20.00	1018.50	0.46	0.59	0.43	Moderate
1999	220	25.50	909.00	0.56	0.78	0.49	Moderate
1999	221	7.00	21.00	0.88	0.75	0.15	Bad
1999	222	17.50	305.00	0.74	0.91	0.37	Poor
1999	224	19.00	821.50	0.42	0.53	0.33	Poor
1999	225	22.50	867.00	0.61	0.82	0.35	Poor
1999	226	14.50	149.50	0.73	0.81	0.38	Poor
1999	227	19.50	574.00	0.57	0.72	0.38	Poor
1999	230	31.00	2351.50	0.48	0.72	0.55	Good
1999	231	26.00	1252.00	0.43	0.62	0.55	Good
1999	235	18.50	355.50	0.59	0.74	0.34	Poor

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	**STATION**	**RICHNESS**	**ABUNDANCE**	**EVENNESS (J')**	**DIVERSITY (H') ($Log_{10}(x)$)**	**M-AMBI**	**M-AMBI CATEGORY**
1999	236	34.00	1019.00	0.55	0.84	0.60	Good
1999	237	30.50	1156.50	0.44	0.65	0.70	Good
1999	240	18.50	1706.00	0.23	0.30	0.36	Poor
1999	241	28.50	413.50	0.68	0.98	0.61	Good
1999	242	43.00	1700.50	0.49	0.80	0.81	High
1999	245	25.50	813.00	0.63	0.87	0.60	Good
1999	247	16.00	331.00	0.58	0.70	0.41	Moderate
1999	249	17.00	185.50	0.80	0.94	0.44	Moderate
1999	250	28.50	374.00	0.62	0.90	0.63	Good
1999	253	7.00	16.00	0.86	0.72	0.18	Bad
1999	304	36.00	468.50	0.57	0.89	0.58	Good
1999	306	31.00	129.00	0.81	1.21	0.50	Moderate
1999	309	23.50	372.50	0.56	0.75	0.41	Moderate
1999	310	23.50	153.50	0.76	1.03	0.37	Poor
1999	311	53.00	752.50	0.73	1.25	0.73	Good
1999	317	34.00	981.00	0.45	0.68	0.50	Moderate
1999	318	36.50	363.50	0.57	0.89	0.57	Good
1999	323	52.00	658.00	0.71	1.16	0.85	High
1999	324	31.50	1049.50	0.50	0.74	0.34	Poor
1999	325	26.00	658.00	0.53	0.75	0.38	Poor
1999	331	39.00	1255.00	0.50	0.79	0.58	Good
1999	332	41.50	558.00	0.64	1.02	0.57	Good
1999	333	48.00	463.00	0.72	1.21	0.73	Good
1999	334	37.50	570.00	0.66	1.03	0.58	Good
1999	335	51.00	520.00	0.64	1.10	0.78	High
1999	338	33.50	749.00	0.61	0.93	0.44	Moderate
1999	339	34.50	1180.50	0.45	0.69	0.44	Moderate
1999	340	29.50	863.50	0.52	0.76	0.42	Moderate
1999	341	41.50	528.50	0.71	1.12	0.64	Good
1999	345	25.00	728.00	0.60	0.80	0.35	Poor
1999	346	38.50	222.00	0.68	1.08	0.51	Moderate
1999	349	40.00	168.50	0.83	1.33	0.67	Good
1999	352	66.50	452.00	0.72	1.32	1.00	High
2004	105	9.00	176.50	0.27	0.26	0.19	Bad
2004	108	3.00	5.50	0.87	0.40	0.12	Bad
2004	109	8.50	276.00	0.36	0.33	0.21	Poor
2004	111	11.00	6098.50	0.10	0.11	0.23	Poor
2004	114	5.50	270.50	0.48	0.35	0.11	Bad
2004	115	8.00	67.00	0.57	0.51	0.22	Poor
2004	117	11.50	3098.00	0.14	0.15	0.16	Bad
2004	120	4.50	110.00	0.55	0.36	0.13	Bad
2004	121	8.00	118.00	0.64	0.58	0.15	Bad
2004	123	13.00	1527.00	0.53	0.59	0.27	Poor
2004	125	6.50	62.50	0.68	0.55	0.15	Bad
2004	126	15.50	715.00	0.59	0.69	0.35	Poor
2004	128	11.50	879.50	0.55	0.58	0.27	Poor
2004	130	12.00	374.00	0.59	0.64	0.24	Poor
2004	131	11.00	393.00	0.57	0.58	0.25	Poor
2004	134	10.00	653.50	0.58	0.58	0.21	Poor
2004	135	12.50	415.00	0.45	0.50	0.32	Poor
2004	138	5.00	127.50	0.47	0.30	0.16	Bad
2004	139	7.50	88.00	0.71	0.62	0.17	Bad
2004	140	14.50	844.00	0.55	0.64	0.29	Poor
2004	146	18.00	310.00	0.67	0.83	0.37	Poor
2004	147	9.50	117.50	0.71	0.68	0.24	Poor
2004	150	16.50	677.00	0.60	0.73	0.32	Poor
2004	151	21.00	659.50	0.58	0.76	0.45	Moderate
2004	152	7.00	83.50	0.53	0.45	0.15	Bad
2004	154	26.00	1196.00	0.61	0.84	0.51	Moderate
2004	155	14.50	123.50	0.78	0.89	0.34	Poor
2004	202	20.00	205.50	0.76	0.91	0.58	Good
2004	204	20.00	239.00	0.68	0.88	0.36	Poor
2004	207	13.00	331.00	0.56	0.63	0.23	Poor
2004	208	20.00	299.50	0.69	0.89	0.35	Poor
2004	211	8.50	122.50	0.67	0.61	0.17	Bad
2004	212	12.50	207.50	0.78	0.84	0.31	Poor
2004	216	17.00	63.50	0.79	0.97	0.37	Poor
2004	217	11.50	479.50	0.73	0.77	0.24	Poor

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.[*†‡§]

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2004	218	22.00	378.50	0.59	0.79	0.43	Moderate
2004	220	12.00	56.00	0.84	0.89	0.32	Poor
2004	221	20.50	388.50	0.61	0.80	0.43	Moderate
2004	222	15.50	93.50	0.78	0.93	0.41	Moderate
2004	224	18.50	403.50	0.58	0.74	0.43	Moderate
2004	225	12.50	225.50	0.69	0.76	0.26	Poor
2004	226	10.50	50.00	0.78	0.79	0.27	Poor
2004	227	14.00	138.00	0.64	0.73	0.41	Moderate
2004	230	14.50	134.50	0.67	0.77	0.34	Poor
2004	231	13.00	506.50	0.19	0.22	0.29	Poor
2004	235	11.50	1086.00	0.14	0.15	0.20	Poor
2004	236	12.00	659.00	0.22	0.23	0.25	Poor
2004	237	26.50	331.50	0.68	0.97	0.51	Moderate
2004	240	28.50	350.25	0.63	0.77	0.84	High
2004	241	20.50	404.50	0.54	0.71	0.37	Poor
2004	242	17.00	239.00	0.78	0.95	0.36	Poor
2004	245	12.50	126.50	0.54	0.59	0.35	Poor
2004	247	14.00	115.00	0.78	0.89	0.38	Poor
2004	249	21.00	87.50	0.87	1.14	0.48	Moderate
2004	250	22.50	126.50	0.72	0.97	0.53	Good
2004	253	7.00	68.50	0.41	0.36	0.17	Bad
2004	304	35.50	297.50	0.72	1.12	0.60	Good
2004	306	26.50	84.00	0.79	1.12	0.46	Moderate
2004	309	29.00	202.50	0.74	1.09	0.52	Moderate
2004	310	21.00	71.50	0.73	0.96	0.43	Moderate
2004	311	33.00	146.50	0.80	1.21	0.63	Good
2004	317	23.50	180.50	0.76	1.04	0.39	Poor
2004	318	30.00	222.00	0.71	1.06	0.39	Poor
2004	323	10.00	37.00	0.62	0.62	0.19	Bad
2004	324	23.00	145.50	0.73	1.00	0.39	Moderate
2004	325	36.00	264.50	0.73	1.13	0.53	Good
2004	331	26.50	256.50	0.62	0.87	0.41	Moderate
2004	332	35.00	202.00	0.65	1.01	0.58	Good
2004	333	47.00	388.50	0.78	1.30	0.53	Good
2004	334	25.50	154.50	0.77	1.09	0.41	Moderate
2004	335	45.00	1233.50	0.53	0.88	0.66	Good
2004	338	32.00	175.00	0.78	1.17	0.46	Moderate
2004	339	24.00	115.50	0.64	0.88	0.37	Poor
2004	340	18.00	95.50	0.74	0.92	0.30	Poor
2004	341	33.00	198.50	0.72	1.10	0.45	Moderate
2004	345	20.50	103.00	0.69	0.90	0.36	Poor
2004	346	61.00	461.50	0.70	1.24	1.00	High
2004	349	23.00	61.00	0.82	1.12	0.41	Moderate
2004	352	21.50	92.00	0.86	1.15	0.30	Poor
2009	105	8.00	622.00	0.15	0.13	0.15	Bad
2009	108	14.50	3842.00	0.12	0.14	0.27	Poor
2009	109	7.00	1440.00	0.12	0.10	0.14	Bad
2009	111	12.50	726.00	0.41	0.45	0.25	Poor
2009	114	14.00	1168.00	0.33	0.38	0.27	Poor
2009	115	7.50	354.50	0.23	0.20	0.15	Bad
2009	117	12.50	3530.00	0.39	0.42	0.22	Poor
2009	120	11.50	750.50	0.37	0.39	0.19	Bad
2009	121	11.00	1020.00	0.33	0.34	0.25	Poor
2009	123	13.00	708.00	0.32	0.35	0.19	Bad
2009	125	9.00	197.50	0.48	0.45	0.13	Bad
2009	126	10.50	328.00	0.28	0.28	0.17	Bad
2009	128	14.50	844.50	0.51	0.59	0.29	Poor
2009	130	4.00	24.00	0.76	0.46	0.04	Bad
2009	131	9.50	186.00	0.58	0.56	0.23	Poor
2009	134	15.00	784.00	0.50	0.59	0.30	Poor
2009	135	9.50	116.50	0.43	0.41	0.21	Poor
2009	138	10.50	280.00	0.50	0.52	0.19	Bad
2009	139	7.00	246.00	0.47	0.39	0.17	Bad
2009	140	13.50	316.00	0.60	0.68	0.28	Poor
2009	146	27.00	528.50	0.56	0.80	0.57	Good
2009	147	13.50	363.00	0.49	0.55	0.28	Poor
2009	150	17.00	218.50	0.65	0.80	0.32	Poor
2009	151	16.50	277.00	0.64	0.76	0.39	Moderate

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2009	152	9.00	18.50	0.93	0.89	0.22	Poor
2009	154	30.00	988.00	0.27	0.40	0.64	Good
2009	155	17.00	62.50	0.80	0.97	0.45	Moderate
2009	202	38.00	692.00	0.64	1.01	0.76	Good
2009	204	21.50	272.25	0.68	0.88	0.42	Moderate
2009	207	11.50	496.50	0.57	0.61	0.23	Poor
2009	208	20.00	828.50	0.60	0.79	0.42	Moderate
2009	211	16.50	766.50	0.57	0.70	0.35	Poor
2009	212	18.50	451.50	0.69	0.87	0.41	Moderate
2009	216	25.00	710.00	0.70	0.98	0.42	Moderate
2009	217	28.00	1163.50	0.64	0.93	0.49	Moderate
2009	218	26.00	866.00	0.63	0.89	0.49	Moderate
2009	220	29.50	464.00	0.72	1.06	0.67	Good
2009	221	15.00	78.00	0.80	0.95	0.34	Poor
2009	222	15.50	430.00	0.70	0.83	0.31	Poor
2009	224	13.50	58.00	0.70	0.77	0.37	Poor
2009	225	35.00	358.50	0.73	1.12	0.79	High
2009	226	5.00	11.50	0.92	0.65	0.14	Bad
2009	227	20.50	347.00	0.50	0.66	0.46	Moderate
2009	230	28.50	612.50	0.59	0.86	0.59	Good
2009	231	4.50	11.50	0.89	0.57	0.14	Bad
2009	235	11.00	37.00	0.87	0.91	0.31	Poor
2009	236	23.00	233.50	0.79	0.92	0.48	Moderate
2009	237	23.50	380.25	0.58	0.80	0.52	Moderate
2009	240	2.50	5.50	0.79	0.24	0.11	Bad
2009	241	18.50	260.00	0.66	0.83	0.39	Poor
2009	242	23.00	277.00	0.58	0.79	0.58	Good
2009	245	13.00	69.00	0.73	0.79	0.43	Moderate
2009	247	13.50	216.00	0.41	0.45	0.43	Moderate
2009	249	10.00	37.50	0.86	0.86	0.28	Poor
2009	250	54.00	1046.00	0.69	1.19	1.00	High
2009	253	18.50	552.50	0.45	0.57	0.34	Poor
2009	304	41.00	473.00	0.64	1.04	0.67	Good
2009	306	52.50	288.25	0.77	1.31	0.90	High
2009	309	35.50	299.00	0.79	1.22	0.54	Good
2009	310	27.50	94.50	0.75	1.08	0.56	Good
2009	311	62.50	502.00	0.78	1.41	0.93	High
2009	317	17.50	132.50	0.72	0.90	0.24	Poor
2009	318	49.50	301.50	0.77	1.29	0.81	High
2009	323	36.00	176.00	0.76	1.17	0.70	Good
2009	324	34.50	162.50	0.78	1.21	0.61	Good
2009	325	30.50	355.00	0.60	0.89	0.47	Moderate
2009	331	43.00	534.00	0.67	1.10	0.59	Good
2009	332	68.00	418.00	0.80	1.47	0.96	High
2009	333	56.50	1524.50	0.52	0.92	0.73	Good
2009	334	43.50	404.00	0.70	1.15	0.55	Good
2009	335	43.50	1209.50	0.57	0.93	0.60	Good
2009	338	42.00	668.50	0.63	1.03	0.59	Good
2009	339	39.00	573.25	0.61	0.96	0.64	Good
2009	340	37.00	636.50	0.51	0.81	0.56	Good
2009	341	48.00	197.00	0.87	1.46	0.73	Good
2009	345	39.00	759.50	0.60	0.96	0.55	Good
2009	346	67.00	334.50	0.79	1.45	0.91	High
2009	349	64.50	450.00	0.80	1.44	0.99	High
2009	352	78.00	524.25	0.83	1.57	1.00	High
2014	105	18.50	293.00	0.64	0.81	0.35	Poor
2014	108	23.00	1471.00	0.66	0.90	0.39	Poor
2014	109	15.00	650.00	0.34	0.40	0.30	Poor
2014	111	26.00	1561.50	0.59	0.83	0.42	Moderate
2014	114	27.50	1097.00	0.71	1.03	0.36	Poor
2014	115	12.00	293.50	0.37	0.40	0.19	Bad
2014	117	29.50	12375.00	0.29	0.44	0.55	Good
2014	120	25.00	1076.00	0.62	0.87	0.47	Moderate
2014	121	21.50	3863.50	0.27	0.36	0.38	Poor
2014	123	24.50	1123.00	0.50	0.69	0.31	Poor
2014	125	22.50	1375.50	0.52	0.70	0.38	Poor
2014	126	14.50	3577.00	0.24	0.27	0.24	Poor
2014	128	23.00	1514.00	0.40	0.55	0.33	Poor

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2014	130	14.50	910.00	0.22	0.26	0.25	Poor
2014	131	24.50	2348.00	0.35	0.49	0.41	Moderate
2014	134	19.50	1337.00	0.50	0.65	0.33	Poor
2014	135	21.50	1654.00	0.39	0.52	0.38	Poor
2014	138	29.00	858.00	0.48	0.70	0.48	Moderate
2014	139	21.50	139.00	0.60	0.80	0.30	Poor
2014	140	23.00	929.50	0.40	0.55	0.48	Moderate
2014	146	31.50	294.50	0.69	1.03	0.56	Good
2014	147	25.50	383.00	0.57	0.80	0.51	Moderate
2014	150	24.00	933.00	0.54	0.75	0.40	Moderate
2014	151	33.50	584.50	0.58	0.89	0.59	Good
2014	152	26.50	437.50	0.71	1.01	0.43	Moderate
2014	154	35.00	600.50	0.58	0.90	0.55	Good
2014	155	29.50	1480.50	0.50	0.73	0.50	Moderate
2014	202	33.00	351.00	0.72	1.09	0.53	Good
2014	204	14.00	506.50	0.53	0.60	0.36	Poor
2014	207	19.50	1527.50	0.64	0.83	0.34	Poor
2014	208	30.50	983.50	0.65	0.97	0.56	Good
2014	211	23.50	787.00	0.57	0.78	0.36	Poor
2014	212	12.50	256.00	0.61	0.66	0.23	Poor
2014	216	47.50	653.00	0.71	1.19	0.74	Good
2014	217	17.50	242.50	0.72	0.89	0.29	Poor
2014	218	25.00	1379.00	0.54	0.76	0.46	Moderate
2014	220	20.50	281.00	0.62	0.81	0.37	Poor
2014	221	17.00	657.50	0.44	0.55	0.28	Poor
2014	222	12.00	130.50	0.68	0.74	0.25	Poor
2014	224	19.00	1218.50	0.40	0.50	0.31	Poor
2014	225	34.50	310.50	0.71	1.08	0.62	Good
2014	226	21.50	383.50	0.59	0.78	0.47	Moderate
2014	227	17.50	89.00	0.81	1.01	0.31	Poor
2014	230	20.00	561.50	0.54	0.71	0.42	Moderate
2014	231	16.00	53.50	0.87	1.03	0.41	Moderate
2014	235	10.50	38.50	0.84	0.84	0.22	Poor
2014	236	19.00	117.00	0.81	1.01	0.35	Poor
2014	237	40.50	506.00	0.61	0.99	0.56	Good
2014	240	2.50	3.00	0.48	0.34	0.11	Bad
2014	241	26.00	233.00	0.68	0.96	0.47	Moderate
2014	242	21.50	368.50	0.55	0.73	0.34	Poor
2014	245	22.00	471.00	0.69	0.92	0.45	Moderate
2014	247	16.00	419.00	0.53	0.63	0.36	Poor
2014	249	25.00	255.50	0.69	0.97	0.50	Moderate
2014	250	43.50	1039.00	0.55	0.90	0.72	Good
2014	253	13.00	35.50	0.88	0.97	0.21	Poor
2014	304	49.00	731.00	0.55	0.93	0.70	Good
2014	306	32.50	141.00	0.85	1.28	0.42	Moderate
2014	309	18.50	120.50	0.78	0.99	0.28	Poor
2014	310	11.00	36.50	0.85	0.88	0.22	Poor
2014	311	75.50	1006.50	0.69	1.29	0.91	High
2014	317	24.00	274.50	0.72	0.99	0.30	Poor
2014	318	70.00	842.00	0.71	1.32	0.55	Good
2014	323	13.00	34.00	0.87	0.97	0.18	Bad
2014	324	35.00	245.50	0.72	1.11	0.42	Moderate
2014	325	33.50	266.50	0.80	1.22	0.39	Moderate
2014	331	45.00	482.50	0.66	1.09	0.56	Good
2014	332	42.00	165.50	0.83	1.35	0.63	Good
2014	333	59.00	614.00	0.70	1.24	0.70	Good
2014	334	37.00	448.50	0.61	0.96	0.42	Moderate
2014	335	32.00	570.00	0.58	0.88	0.42	Moderate
2014	338	34.00	490.00	0.63	0.95	0.45	Moderate
2014	339	32.00	537.00	0.66	1.00	0.33	Poor
2014	340	37.00	518.50	0.68	1.06	0.45	Moderate
2014	341	53.00	650.00	0.77	1.33	0.62	Good
2014	345	37.50	430.00	0.68	1.07	0.41	Moderate
2014	346	52.00	282.50	0.83	1.42	0.62	Good
2014	349	47.50	294.50	0.75	1.24	0.64	Good
2014	352	52.00	1073.00	0.50	0.86	0.63	Good

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.[*†‡§]

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2020	105	14.50	504.50	0.51	0.59	0.29	Poor
2020	108	15.50	629.50	0.48	0.57	0.31	Poor
2020	109	15.50	500.00	0.48	0.57	0.35	Poor
2020	111	17.50	437.00	0.38	0.47	0.36	Poor
2020	114	17.00	599.50	0.44	0.54	0.32	Poor
2020	115	15.50	460.00	0.50	0.60	0.27	Poor
2020	117	16.50	369.50	0.62	0.75	0.31	Poor
2020	120	17.00	406.50	0.65	0.80	0.36	Poor
2020	121	16.00	737.50	0.52	0.62	0.36	Poor
2020	123	21.50	492.00	0.63	0.84	0.41	Moderate
2020	125	15.50	195.00	0.70	0.83	0.37	Poor
2020	126	17.50	724.00	0.57	0.69	0.37	Poor
2020	128	15.50	365.50	0.67	0.80	0.37	Poor
2020	130	17.00	321.50	0.71	0.86	0.37	Poor
2020	131	18.00	277.00	0.74	0.92	0.40	Moderate
2020	134	20.00	1069.50	0.40	0.52	0.38	Poor
2020	135	21.00	715.00	0.46	0.61	0.36	Poor
2020	138	16.00	466.50	0.50	0.60	0.34	Poor
2020	139	19.50	690.00	0.59	0.76	0.40	Moderate
2020	140	17.50	426.50	0.45	0.56	0.42	Moderate
2020	146	20.00	378.00	0.64	0.83	0.47	Moderate
2020	147	23.00	579.50	0.46	0.62	0.40	Moderate
2020	150	24.50	569.50	0.66	0.91	0.48	Moderate
2020	151	13.50	148.00	0.65	0.73	0.28	Poor
2020	152	13.00	239.50	0.65	0.67	0.30	Poor
2020	154	25.00	611.50	0.62	0.86	0.47	Moderate
2020	155	20.50	617.50	0.52	0.68	0.48	Moderate
2020	202	20.50	576.00	0.72	0.95	0.42	Moderate
2020	204	18.00	574.00	0.49	0.61	0.38	Poor
2020	207	21.00	563.00	0.64	0.85	0.51	Moderate
2020	208	37.50	1081.00	0.59	0.93	0.64	Good
2020	211	12.00	171.00	0.52	0.56	0.23	Poor
2020	212	23.00	454.00	0.56	0.76	0.44	Moderate
2020	216	19.50	479.00	0.50	0.64	0.40	Moderate
2020	217	20.50	421.50	0.60	0.79	0.41	Moderate
2020	218	6.50	40.00	0.80	0.59	0.20	Poor
2020	220	16.50	114.50	0.67	0.82	0.39	Poor
2020	221	1.00	1.00	†	0.00	†	†
2020	222	14.00	398.50	0.59	0.68	0.33	Poor
2020	224	20.00	1528.00	0.21	0.27	0.37	Poor
2020	225	18.00	381.50	0.46	0.57	0.32	Poor
2020	226	6.50	14.50	0.88	0.71	0.26	Poor
2020	227	25.00	397.00	0.68	0.95	0.50	Moderate
2020	230	20.50	180.50	0.72	0.94	0.42	Moderate
2020	231	18.50	451.00	0.39	0.49	0.36	Poor
2020	235	13.00	292.00	0.40	0.45	0.29	Poor
2020	236	16.00	119.50	0.72	0.87	0.42	Moderate
2020	237	59.50	587.50	0.78	1.35	1.00	High
2020	240	6.00	11.50	0.90	0.69	0.20	Poor
2020	241	21.50	210.50	0.69	0.92	0.53	Good
2020	242	19.00	203.50	0.49	0.63	0.41	Moderate
2020	245	37.50	483.00	0.72	1.10	0.85	High
2020	247	32.00	163.50	0.84	1.26	0.75	Good
2020	249	24.00	163.50	0.77	1.07	0.55	Good
2020	250	32.50	383.50	0.58	0.88	0.60	Good
2020	253	15.00	684.50	0.28	0.33	0.27	Poor
2020	304	56.50	670.00	0.61	1.07	0.83	High
2020	306	55.50	623.00	0.69	1.20	0.80	High
2020	309	45.00	298.50	0.80	1.33	0.69	Good
2020	310	20.00	263.50	0.43	0.55	0.33	Poor
2020	311	35.50	429.00	0.73	1.11	0.59	Good
2020	317	21.00	93.50	0.81	1.07	0.35	Poor
2020	318	63.00	496.00	0.70	1.27	0.99	High
2020	323	34.00	169.50	0.73	1.11	0.52	Moderate
2020	324	36.00	265.50	0.73	1.13	0.55	Good
2020	325	27.00	194.00	0.76	1.09	0.44	Moderate
2020	331	47.50	380.50	0.68	1.15	0.69	Good
2020	332	66.50	413.00	0.80	1.47	0.91	High

Table 8. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
2020	333	51.50	767.50	0.69	1.19	0.64	Good
2020	334	31.50	259.00	0.70	1.05	0.51	Moderate
2020	335	45.50	670.50	0.67	1.10	0.64	Good
2020	338	27.50	223.50	0.74	1.04	0.45	Moderate
2020	339	29.50	243.50	0.79	1.16	0.58	Good
2020	340	23.00	164.50	0.80	1.09	0.39	Moderate
2020	341	51.50	280.00	0.83	1.42	0.72	Good
2020	345	38.00	221.00	0.81	1.26	0.61	Good
2020	346	62.50	397.00	0.80	1.44	1.00	High
2020	349	36.00	267.50	0.82	1.23	0.59	Good
2020	352	47.50	543.00	0.64	1.07	0.80	High

*No sample for Station 352 during 1995.

†Only one specimen present at Station 221 during 2020 sampling.

‡Shannon's H' Diversity calculated with $log_{10}(x)$.

§Benthic community parameters based on specimens collected per sample.

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.[*†‡§]

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	105	15.00	747.67	0.50	0.59	0.25	Poor
1995	105	9.00	320.50	0.47	0.45	0.17	Bad
1999	105	13.00	1053.00	0.52	0.58	0.23	Poor
2004	105	9.00	176.50	0.27	0.26	0.19	Bad
2009	105	8.00	622.00	0.15	0.13	0.15	Bad
2014	105	18.50	293.00	0.64	0.81	0.35	Poor
2020	105	14.50	504.50	0.51	0.59	0.29	Poor
1993	108	11.33	548.33	0.56	0.59	0.27	Poor
1995	108	11.50	768.00	0.39	0.42	0.15	Bad
1999	108	7.50	261.50	0.55	0.47	0.14	Bad
2004	108	3.00	5.50	0.87	0.40	0.12	Bad
2009	108	14.50	3842.00	0.12	0.14	0.27	Poor
2014	108	23.00	1471.00	0.66	0.90	0.39	Poor
2020	108	15.50	629.50	0.48	0.57	0.31	Poor
1993	109	10.00	385.00	0.63	0.63	0.18	Bad
1995	109	16.00	3201.00	0.46	0.55	0.27	Poor
1999	109	9.00	1899.00	0.32	0.31	0.14	Bad
2004	109	8.50	276.00	0.36	0.33	0.21	Poor
2009	109	7.00	1440.00	0.12	0.10	0.14	Bad
2014	109	15.00	650.00	0.34	0.40	0.30	Poor
2020	109	15.50	500.00	0.48	0.57	0.35	Poor
1993	111	14.00	2569.33	0.39	0.45	0.32	Poor
1995	111	13.00	1606.50	0.36	0.40	0.28	Poor
1999	111	13.00	2238.00	0.48	0.53	0.25	Poor
2004	111	11.00	6098.50	0.10	0.11	0.23	Poor
2009	111	12.50	726.00	0.41	0.45	0.25	Poor
2014	111	26.00	1561.50	0.59	0.83	0.42	Moderate
2020	111	17.50	437.00	0.38	0.47	0.36	Poor
1993	114	16.67	1432.00	0.38	0.46	0.38	Poor
1995	114	13.50	1488.00	0.23	0.26	0.21	Poor
1999	114	11.00	574.00	0.46	0.48	0.19	Bad
2004	114	5.50	270.50	0.48	0.35	0.11	Bad
2009	114	14.00	1168.00	0.33	0.38	0.27	Poor
2014	114	27.50	1097.00	0.71	1.03	0.36	Poor
2020	114	17.00	599.50	0.44	0.54	0.32	Poor
1993	115	15.33	282.67	0.47	0.56	0.30	Poor
1995	115	11.50	1285.00	0.52	0.55	0.15	Bad
1999	115	10.00	507.00	0.49	0.49	0.15	Bad
2004	115	8.00	67.00	0.57	0.51	0.22	Poor
2009	115	7.50	354.50	0.23	0.20	0.15	Bad
2014	115	12.00	293.50	0.37	0.40	0.19	Bad
2020	115	15.50	460.00	0.50	0.60	0.27	Poor
1993	117	15.00	1129.67	0.34	0.39	0.38	Poor
1995	117	23.00	3392.50	0.37	0.50	0.31	Poor
1999	117	10.50	5148.50	0.17	0.17	0.22	Poor
2004	117	11.50	3098.00	0.14	0.15	0.16	Bad
2009	117	12.50	3530.00	0.39	0.42	0.22	Poor
2014	117	29.50	12375.00	0.29	0.44	0.55	Good
2020	117	16.50	369.50	0.62	0.75	0.31	Poor
1993	120	10.33	1406.00	0.07	0.07	0.20	Poor
1995	120	17.50	2475.50	0.33	0.42	0.25	Poor
1999	120	11.00	6637.00	0.11	0.12	0.26	Poor
2004	120	4.50	110.00	0.55	0.36	0.13	Bad
2009	120	11.50	750.50	0.37	0.39	0.19	Bad
2014	120	25.00	1076.00	0.62	0.87	0.47	Moderate
2020	120	17.00	406.50	0.65	0.80	0.36	Poor
1993	121	14.00	1395.67	0.16	0.18	0.20	Poor
1995	121	18.50	2038.50	0.31	0.39	0.29	Poor
1999	121	9.50	4350.00	0.13	0.12	0.20	Poor
2004	121	8.00	118.00	0.64	0.58	0.15	Bad
2009	121	11.00	1020.00	0.33	0.34	0.25	Poor
2014	121	21.50	3863.50	0.27	0.36	0.38	Poor
2020	121	16.00	737.50	0.52	0.62	0.36	Poor

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	123	12.33	3167.67	0.14	0.15	0.20	Poor
1995	123	21.00	2493.00	0.59	0.78	0.34	Poor
1999	123	11.50	947.00	0.50	0.52	0.24	Poor
2004	123	13.00	1527.00	0.53	0.59	0.27	Poor
2009	123	13.00	708.00	0.32	0.35	0.19	Bad
2014	123	24.50	1123.00	0.50	0.69	0.31	Poor
2020	123	21.50	492.00	0.63	0.84	0.41	Moderate
1993	125	9.00	100.00	0.57	0.54	0.14	Bad
1995	125	14.50	419.50	0.65	0.76	0.25	Poor
1999	125	8.50	912.50	0.24	0.22	0.16	Bad
2004	125	6.50	62.50	0.68	0.55	0.15	Bad
2009	125	9.00	197.50	0.48	0.45	0.13	Bad
2014	125	22.50	1375.50	0.52	0.70	0.38	Poor
2020	125	15.50	195.00	0.70	0.83	0.37	Poor
1993	126	19.67	1482.33	0.29	0.37	0.29	Poor
1995	126	16.50	2861.50	0.32	0.39	0.31	Poor
1999	126	16.50	1166.00	0.50	0.60	0.34	Poor
2004	126	15.50	715.00	0.59	0.69	0.35	Poor
2009	126	10.50	328.00	0.28	0.28	0.17	Bad
2014	126	14.50	3577.00	0.24	0.27	0.24	Poor
2020	126	17.50	724.00	0.57	0.69	0.37	Poor
1993	128	9.00	1199.00	0.34	0.32	0.17	Bad
1995	128	21.00	371.00	0.69	0.91	0.31	Poor
1999	128	13.00	842.50	0.41	0.46	0.33	Poor
2004	128	11.50	879.50	0.55	0.58	0.27	Poor
2009	128	14.50	844.50	0.51	0.59	0.29	Poor
2014	128	23.00	1514.00	0.40	0.55	0.33	Poor
2020	128	15.50	365.50	0.67	0.80	0.37	Poor
1993	130	6.33	85.00	0.61	0.44	0.12	Bad
1995	130	5.50	21.50	0.81	0.60	0.11	Bad
1999	130	12.00	1532.50	0.31	0.33	0.29	Poor
2004	130	12.00	374.00	0.59	0.64	0.24	Poor
2009	130	4.00	24.00	0.76	0.46	0.04	Bad
2014	130	14.50	910.00	0.22	0.26	0.25	Poor
2020	130	17.00	321.50	0.71	0.86	0.37	Poor
1993	131	17.67	2019.33	0.47	0.58	0.35	Poor
1995	131	18.00	1941.00	0.53	0.67	0.32	Poor
1999	131	13.50	1664.50	0.49	0.55	0.22	Poor
2004	131	11.00	393.00	0.57	0.58	0.25	Poor
2009	131	9.50	186.00	0.58	0.56	0.23	Poor
2014	131	24.50	2348.00	0.35	0.49	0.41	Moderate
2020	131	18.00	277.00	0.74	0.92	0.40	Moderate
1993	134	9.67	290.33	0.36	0.35	0.22	Poor
1995	134	14.00	1038.00	0.50	0.58	0.28	Poor
1999	134	15.00	1266.00	0.47	0.55	0.31	Poor
2004	134	10.00	653.50	0.58	0.58	0.21	Poor
2009	134	15.00	784.00	0.50	0.59	0.30	Poor
2014	134	19.50	1337.00	0.50	0.65	0.33	Poor
2020	134	20.00	1069.50	0.40	0.52	0.38	Poor
1993	135	18.67	2003.67	0.54	0.69	0.35	Poor
1995	135	21.50	2008.00	0.37	0.50	0.38	Poor
1999	135	16.00	724.00	0.46	0.56	0.37	Poor
2004	135	12.50	415.00	0.45	0.50	0.32	Poor
2009	135	9.50	116.50	0.43	0.41	0.21	Poor
2014	135	21.50	1654.00	0.39	0.52	0.38	Poor
2020	135	21.00	715.00	0.46	0.61	0.36	Poor
1993	138	6.67	396.33	0.16	0.13	0.23	Poor
1995	138	16.50	1344.50	0.42	0.51	0.26	Poor
1999	138	8.50	471.00	0.55	0.50	0.18	Bad
2004	138	5.00	127.50	0.47	0.30	0.16	Bad
2009	138	10.50	280.00	0.50	0.52	0.19	Bad
2014	138	29.00	858.00	0.48	0.70	0.48	Moderate
2020	138	16.00	466.50	0.50	0.60	0.34	Poor

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	**STATION**	**RICHNESS**	**ABUNDANCE**	**EVENNESS (J')**	**DIVERSITY (H') ($Log_{10}(x)$)**	**M-AMBI**	**M-AMBI CATEGORY**
1993	139	8.33	164.33	0.43	0.40	0.18	Bad
1995	139	15.00	2183.50	0.36	0.41	0.27	Poor
1999	139	14.00	1054.50	0.50	0.57	0.31	Poor
2004	139	7.50	88.00	0.71	0.62	0.17	Bad
2009	139	7.00	246.00	0.47	0.39	0.17	Bad
2014	139	21.50	139.00	0.60	0.80	0.30	Poor
2020	139	19.50	690.00	0.59	0.76	0.40	Moderate
1993	140	19.33	6126.67	0.19	0.24	0.29	Poor
1995	140	15.00	722.00	0.39	0.46	0.21	Poor
1999	140	15.00	1477.50	0.42	0.49	0.33	Poor
2004	140	14.50	844.00	0.55	0.64	0.29	Poor
2009	140	13.50	316.00	0.60	0.68	0.28	Poor
2014	140	23.00	929.50	0.40	0.55	0.48	Moderate
2020	140	17.50	426.50	0.45	0.56	0.42	Moderate
1993	146	18.00	657.00	0.52	0.65	0.38	Poor
1995	146	19.00	436.50	0.56	0.72	0.30	Poor
1999	146	11.50	507.50	0.64	0.68	0.25	Poor
2004	146	18.00	310.00	0.67	0.83	0.37	Poor
2009	146	27.00	528.50	0.56	0.80	0.57	Good
2014	146	31.50	294.50	0.69	1.03	0.56	Good
2020	146	20.00	378.00	0.64	0.83	0.47	Moderate
1993	147	22.00	1560.67	0.52	0.70	0.35	Poor
1995	147	13.00	628.00	0.55	0.61	0.24	Poor
1999	147	15.00	512.00	0.51	0.60	0.32	Poor
2004	147	9.50	117.50	0.71	0.68	0.24	Poor
2009	147	13.50	363.00	0.49	0.55	0.28	Poor
2014	147	25.50	383.00	0.57	0.80	0.51	Moderate
2020	147	23.00	579.50	0.46	0.62	0.40	Moderate
1993	150	11.33	568.67	0.20	0.21	0.21	Poor
1995	150	19.00	2011.50	0.32	0.41	0.31	Poor
1999	150	13.00	560.50	0.60	0.67	0.27	Poor
2004	150	16.50	677.00	0.60	0.73	0.32	Poor
2009	150	17.00	218.50	0.65	0.80	0.32	Poor
2014	150	24.00	933.00	0.54	0.75	0.40	Moderate
2020	150	24.50	569.50	0.66	0.91	0.48	Moderate
1993	151	13.33	246.00	0.48	0.54	0.26	Poor
1995	151	26.50	1232.00	0.58	0.81	0.48	Moderate
1999	151	9.50	278.50	0.56	0.53	0.20	Bad
2004	151	21.00	659.50	0.58	0.76	0.45	Moderate
2009	151	16.50	277.00	0.64	0.76	0.39	Moderate
2014	151	33.50	584.50	0.58	0.89	0.59	Good
2020	151	13.50	148.00	0.65	0.73	0.28	Poor
1993	152	7.67	167.67	0.32	0.28	0.17	Bad
1995	152	19.00	2558.50	0.17	0.22	0.31	Poor
1999	152	4.50	204.00	0.59	0.34	0.10	Bad
2004	152	7.00	83.50	0.53	0.45	0.15	Bad
2009	152	9.00	18.50	0.93	0.89	0.22	Poor
2014	152	26.50	437.50	0.71	1.01	0.43	Moderate
2020	152	13.00	239.50	0.65	0.67	0.30	Poor
1993	154	24.33	276.33	0.65	0.90	0.42	Moderate
1995	154	23.50	601.00	0.68	0.93	0.36	Poor
1999	154	21.50	505.50	0.66	0.87	0.54	Good
2004	154	26.00	1196.00	0.61	0.84	0.51	Moderate
2009	154	30.00	988.00	0.27	0.40	0.64	Good
2014	154	35.00	600.50	0.58	0.90	0.55	Good
2020	154	25.00	611.50	0.62	0.86	0.47	Moderate
1993	155	25.00	2095.33	0.50	0.69	0.47	Moderate
1995	155	12.50	765.00	0.52	0.56	0.25	Poor
1999	155	13.50	339.50	0.64	0.70	0.37	Poor
2004	155	14.50	123.50	0.78	0.89	0.34	Poor
2009	155	17.00	62.50	0.80	0.97	0.45	Moderate
2014	155	29.50	1480.50	0.50	0.73	0.50	Moderate
2020	155	20.50	617.50	0.52	0.68	0.48	Moderate

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.[*†‡§]							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	202	30.33	1008.33	0.56	0.82	0.87	High
1995	202	22.00	408.50	0.59	0.79	0.37	Poor
1999	202	21.00	381.50	0.62	0.82	0.47	Moderate
2004	202	20.00	205.50	0.76	0.91	0.58	Good
2009	202	38.00	692.00	0.64	1.01	0.76	Good
2014	202	33.00	351.00	0.72	1.09	0.53	Good
2020	202	20.50	576.00	0.72	0.95	0.42	Moderate
1993	204	32.67	704.67	0.63	0.96	0.61	Good
1995	204	20.50	347.50	0.50	0.66	0.38	Poor
1999	204	30.50	1553.50	0.54	0.81	0.66	Good
2004	204	20.00	239.00	0.68	0.88	0.36	Poor
2009	204	21.50	272.25	0.68	0.88	0.42	Moderate
2014	204	14.00	506.50	0.53	0.60	0.36	Poor
2020	204	18.00	574.00	0.49	0.61	0.38	Poor
1993	207	11.67	885.33	0.39	0.41	0.29	Poor
1995	207	9.00	269.50	0.61	0.58	0.13	Bad
1999	207	20.00	792.50	0.59	0.76	0.42	Moderate
2004	207	13.00	331.00	0.56	0.63	0.23	Poor
2009	207	11.50	496.50	0.57	0.61	0.23	Poor
2014	207	19.50	1527.50	0.64	0.83	0.34	Poor
2020	207	21.00	563.00	0.64	0.85	0.51	Moderate
1993	208	22.00	429.00	0.43	0.57	0.50	Moderate
1995	208	11.50	337.00	0.53	0.56	0.22	Poor
1999	208	31.00	1780.50	0.52	0.77	0.63	Good
2004	208	20.00	299.50	0.69	0.89	0.35	Poor
2009	208	20.00	828.50	0.60	0.79	0.42	Moderate
2014	208	30.50	983.50	0.65	0.97	0.56	Good
2020	208	37.50	1081.00	0.59	0.93	0.64	Good
1993	211	23.00	1478.00	0.40	0.54	0.38	Poor
1995	211	14.00	366.00	0.56	0.64	0.25	Poor
1999	211	20.00	1888.50	0.37	0.47	0.37	Poor
2004	211	8.50	122.50	0.67	0.61	0.17	Bad
2009	211	16.50	766.50	0.57	0.70	0.35	Poor
2014	211	23.50	787.00	0.57	0.78	0.36	Poor
2020	211	12.00	171.00	0.52	0.56	0.23	Poor
1993	212	23.33	4480.33	0.28	0.39	0.41	Moderate
1995	212	22.00	336.00	0.68	0.91	0.35	Poor
1999	212	17.00	1975.50	0.39	0.47	0.31	Poor
2004	212	12.50	207.50	0.78	0.84	0.31	Poor
2009	212	18.50	451.50	0.69	0.87	0.41	Moderate
2014	212	12.50	256.00	0.61	0.66	0.23	Poor
2020	212	23.00	454.00	0.56	0.76	0.44	Moderate
1993	216	25.33	387.67	0.67	0.93	0.51	Moderate
1995	216	25.50	447.00	0.58	0.82	0.47	Moderate
1999	216	24.50	858.50	0.49	0.68	0.47	Moderate
2004	216	17.00	63.50	0.79	0.97	0.37	Poor
2009	216	25.00	710.00	0.70	0.98	0.42	Moderate
2014	216	47.50	653.00	0.71	1.19	0.74	Good
2020	216	19.50	479.00	0.50	0.64	0.40	Moderate
1993	217	18.00	2162.67	0.29	0.36	0.37	Poor
1995	217	16.50	264.00	0.60	0.73	0.33	Poor
1999	217	15.50	1356.00	0.41	0.49	0.24	Poor
2004	217	11.50	479.50	0.73	0.77	0.24	Poor
2009	217	28.00	1163.50	0.64	0.93	0.49	Moderate
2014	217	17.50	242.50	0.72	0.89	0.29	Poor
2020	217	20.50	421.50	0.60	0.79	0.41	Moderate
1993	218	18.00	712.00	0.48	0.60	0.31	Poor
1995	218	23.00	1142.00	0.42	0.57	0.40	Moderate
1999	218	20.00	1018.50	0.46	0.59	0.43	Moderate
2004	218	22.00	378.50	0.59	0.79	0.43	Moderate
2009	218	26.00	866.00	0.63	0.89	0.49	Moderate
2014	218	25.00	1379.00	0.54	0.76	0.46	Moderate
2020	218	6.50	40.00	0.80	0.59	0.20	Poor

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	220	27.00	2113.33	0.50	0.70	0.51	Moderate
1995	220	21.00	525.00	0.62	0.81	0.38	Poor
1999	220	25.50	909.00	0.56	0.78	0.49	Moderate
2004	220	12.00	56.00	0.84	0.89	0.32	Poor
2009	220	29.50	464.00	0.72	1.06	0.67	Good
2014	220	20.50	281.00	0.62	0.81	0.37	Poor
2020	220	16.50	114.50	0.67	0.82	0.39	Poor
1993	221	14.67	281.67	0.59	0.68	0.38	Poor
1995	221	4.00	11.00	0.92	0.55	0.13	Bad
1999	221	7.00	21.00	0.88	0.75	0.15	Bad
2004	221	20.50	388.50	0.61	0.80	0.43	Moderate
2009	221	15.00	78.00	0.80	0.95	0.34	Poor
2014	221	17.00	657.50	0.44	0.55	0.28	Poor
2020	221	1.00	1.00	*	0.00	*	*
1993	222	16.67	2005.00	0.44	0.53	0.34	Poor
1995	222	25.00	294.50	0.69	0.94	0.53	Moderate
1999	222	17.50	305.00	0.74	0.91	0.37	Poor
2004	222	15.50	93.50	0.78	0.93	0.41	Moderate
2009	222	15.50	430.00	0.70	0.83	0.31	Poor
2014	222	12.00	130.50	0.68	0.74	0.25	Poor
2020	222	14.00	398.50	0.59	0.68	0.33	Poor
1993	224	14.67	283.33	0.66	0.76	0.33	Poor
1995	224	12.00	174.00	0.55	0.60	0.19	Bad
1999	224	19.00	821.50	0.42	0.53	0.33	Poor
2004	224	18.50	403.50	0.58	0.74	0.43	Moderate
2009	224	13.50	58.00	0.70	0.77	0.37	Poor
2014	224	19.00	1218.50	0.40	0.50	0.31	Poor
2020	224	20.00	1528.00	0.21	0.27	0.37	Poor
1993	225	18.33	659.00	0.65	0.82	0.39	Poor
1995	225	26.50	435.50	0.71	1.01	0.44	Moderate
1999	225	22.50	867.00	0.61	0.82	0.35	Poor
2004	225	12.50	225.50	0.69	0.76	0.26	Poor
2009	225	35.00	358.50	0.73	1.12	0.79	High
2014	225	34.50	310.50	0.71	1.08	0.62	Good
2020	225	18.00	381.50	0.46	0.57	0.32	Poor
1993	226	5.00	55.67	0.74	0.47	0.19	Bad
1995	226	5.00	27.00	0.75	0.53	0.10	Bad
1999	226	14.50	149.50	0.73	0.81	0.38	Poor
2004	226	10.50	50.00	0.78	0.79	0.27	Poor
2009	226	5.00	11.50	0.92	0.65	0.14	Bad
2014	226	21.50	383.50	0.59	0.78	0.47	Moderate
2020	226	6.50	14.50	0.88	0.71	0.26	Poor
1993	227	16.00	627.00	0.45	0.54	0.37	Poor
1995	227	19.50	471.00	0.61	0.79	0.34	Poor
1999	227	19.50	574.00	0.57	0.72	0.38	Poor
2004	227	14.00	138.00	0.64	0.73	0.41	Moderate
2009	227	20.50	347.00	0.50	0.66	0.46	Moderate
2014	227	17.50	89.00	0.81	1.01	0.31	Poor
2020	227	25.00	397.00	0.68	0.95	0.50	Moderate
1993	230	24.00	441.67	0.61	0.84	0.54	Good
1995	230	16.00	104.00	0.75	0.90	0.30	Poor
1999	230	31.00	2351.50	0.48	0.72	0.55	Good
2004	230	14.50	134.50	0.67	0.77	0.34	Poor
2009	230	28.50	612.50	0.59	0.86	0.59	Good
2014	230	20.00	561.50	0.54	0.71	0.42	Moderate
2020	230	20.50	180.50	0.72	0.94	0.42	Moderate
1993	231	7.67	51.33	0.76	0.67	0.10	Bad
1995	231	10.00	60.50	0.65	0.64	0.24	Poor
1999	231	26.00	1252.00	0.43	0.62	0.55	Good
2004	231	13.00	506.50	0.19	0.22	0.29	Poor
2009	231	4.50	11.50	0.89	0.57	0.14	Bad
2014	231	16.00	53.50	0.87	1.03	0.41	Moderate
2020	231	18.50	451.00	0.39	0.49	0.36	Poor

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	235	13.67	107.33	0.68	0.78	0.20	Poor
1995	235	16.50	179.50	0.63	0.77	0.30	Poor
1999	235	18.50	355.50	0.59	0.74	0.34	Poor
2004	235	11.50	1086.00	0.14	0.15	0.20	Poor
2009	235	11.00	37.00	0.87	0.91	0.31	Poor
2014	235	10.50	38.50	0.84	0.84	0.22	Poor
2020	235	13.00	292.00	0.40	0.45	0.29	Poor
1993	236	19.33	788.00	0.42	0.50	0.38	Poor
1995	236	32.00	757.00	0.58	0.87	0.49	Moderate
1999	236	34.00	1019.00	0.55	0.84	0.60	Good
2004	236	12.00	659.00	0.22	0.23	0.25	Poor
2009	236	23.00	233.50	0.79	0.92	0.48	Moderate
2014	236	19.00	117.00	0.81	1.01	0.35	Poor
2020	236	16.00	119.50	0.72	0.87	0.42	Moderate
1993	237	25.00	442.00	0.52	0.72	0.34	Poor
1995	237	31.50	930.50	0.49	0.74	0.57	Good
1999	237	30.50	1156.50	0.44	0.65	0.70	Good
2004	237	26.50	331.50	0.68	0.97	0.51	Moderate
2009	237	23.50	380.25	0.58	0.80	0.52	Moderate
2014	237	40.50	506.00	0.61	0.99	0.56	Good
2020	237	59.50	587.50	0.78	1.35	1.00	High
1993	240	10.67	157.00	0.64	0.59	0.27	Poor
1995	240	4.00	12.00	0.74	0.45	0.16	Bad
1999	240	18.50	1706.00	0.23	0.30	0.36	Poor
2004	240	28.50	350.25	0.63	0.77	0.84	High
2009	240	2.50	5.50	0.79	0.24	0.11	Bad
2014	240	2.50	3.00	0.48	0.34	0.11	Bad
2020	240	6.00	11.50	0.90	0.69	0.20	Poor
1993	241	22.67	131.33	0.78	1.05	0.54	Good
1995	241	26.00	552.00	0.61	0.86	0.49	Moderate
1999	241	28.50	413.50	0.68	0.98	0.61	Good
2004	241	20.50	404.50	0.54	0.71	0.37	Poor
2009	241	18.50	260.00	0.66	0.83	0.39	Poor
2014	241	26.00	233.00	0.68	0.96	0.47	Moderate
2020	241	21.50	210.50	0.69	0.92	0.53	Good
1993	242	19.67	669.33	0.38	0.49	0.46	Moderate
1995	242	36.50	3061.50	0.51	0.80	0.57	Good
1999	242	43.00	1700.50	0.49	0.80	0.81	High
2004	242	17.00	239.00	0.78	0.95	0.36	Poor
2009	242	23.00	277.00	0.58	0.79	0.58	Good
2014	242	21.50	368.50	0.55	0.73	0.34	Poor
2020	242	19.00	203.50	0.49	0.63	0.41	Moderate
1993	245	22.33	703.67	0.55	0.69	0.53	Moderate
1995	245	26.50	363.50	0.74	1.05	0.47	Moderate
1999	245	25.50	813.00	0.63	0.87	0.60	Good
2004	245	12.50	126.50	0.54	0.59	0.35	Poor
2009	245	13.00	69.00	0.73	0.79	0.43	Moderate
2014	245	22.00	471.00	0.69	0.92	0.45	Moderate
2020	245	37.50	483.00	0.72	1.10	0.85	High
1993	247	19.67	422.33	0.57	0.70	0.48	Moderate
1995	247	15.00	151.50	0.70	0.80	0.26	Poor
1999	247	16.00	331.00	0.58	0.70	0.41	Moderate
2004	247	14.00	115.00	0.78	0.89	0.38	Poor
2009	247	13.50	216.00	0.41	0.45	0.43	Moderate
2014	247	16.00	419.00	0.53	0.63	0.36	Poor
2020	247	32.00	163.50	0.84	1.26	0.75	Good
1993	249	39.67	1373.33	0.62	0.99	0.64	Good
1995	249	27.00	662.50	0.60	0.86	0.49	Moderate
1999	249	17.00	185.50	0.80	0.94	0.44	Moderate
2004	249	21.00	87.50	0.87	1.14	0.48	Moderate
2009	249	10.00	37.50	0.86	0.86	0.28	Poor
2014	249	25.00	255.50	0.69	0.97	0.50	Moderate
2020	249	24.00	163.50	0.77	1.07	0.55	Good

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§

YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	250	45.33	680.33	0.66	1.09	1.00	High
1995	250	32.50	689.00	0.51	0.75	0.77	Good
1999	250	28.50	374.00	0.62	0.90	0.63	Good
2004	250	22.50	126.50	0.72	0.97	0.53	Good
2009	250	54.00	1046.00	0.69	1.19	1.00	High
2014	250	43.50	1039.00	0.55	0.90	0.72	Good
2020	250	32.50	383.50	0.58	0.88	0.60	Good
1993	253	8.33	59.00	0.68	0.63	0.23	Poor
1995	253	10.50	302.00	0.59	0.61	0.19	Bad
1999	253	7.00	16.00	0.86	0.72	0.18	Bad
2004	253	7.00	68.50	0.41	0.36	0.17	Bad
2009	253	18.50	552.50	0.45	0.57	0.34	Poor
2014	253	13.00	35.50	0.88	0.97	0.21	Poor
2020	253	15.00	684.50	0.28	0.33	0.27	Poor
1993	304	45.00	436.67	0.77	1.26	0.85	High
1995	304	33.00	298.00	0.62	0.94	0.49	Moderate
1999	304	36.00	468.50	0.57	0.89	0.58	Good
2004	304	35.50	297.50	0.72	1.12	0.60	Good
2009	304	41.00	473.00	0.64	1.04	0.67	Good
2014	304	49.00	731.00	0.55	0.93	0.70	Good
2020	304	56.50	670.00	0.61	1.07	0.83	High
1993	306	46.67	773.00	0.70	1.16	0.74	Good
1995	306	59.50	1523.50	0.65	1.15	0.75	Good
1999	306	31.00	129.00	0.81	1.21	0.50	Moderate
2004	306	26.50	84.00	0.79	1.12	0.46	Moderate
2009	306	52.50	288.25	0.77	1.31	0.90	High
2014	306	32.50	141.00	0.85	1.28	0.42	Moderate
2020	306	55.50	623.00	0.69	1.20	0.80	High
1993	309	26.00	237.33	0.79	1.08	0.59	Good
1995	309	19.50	98.00	0.81	1.02	0.36	Poor
1999	309	23.50	372.50	0.56	0.75	0.41	Moderate
2004	309	29.00	202.50	0.74	1.09	0.52	Moderate
2009	309	35.50	299.00	0.79	1.22	0.54	Good
2014	309	18.50	120.50	0.78	0.99	0.28	Poor
2020	309	45.00	298.50	0.80	1.33	0.69	Good
1993	310	35.00	224.67	0.71	1.10	0.64	Good
1995	310	26.50	230.50	0.43	0.61	0.38	Poor
1999	310	23.50	153.50	0.76	1.03	0.37	Poor
2004	310	21.00	71.50	0.73	0.96	0.43	Moderate
2009	310	27.50	94.50	0.75	1.08	0.56	Good
2014	310	11.00	36.50	0.85	0.88	0.22	Poor
2020	310	20.00	263.50	0.43	0.55	0.33	Poor
1993	311	57.00	914.00	0.66	1.17	0.61	Good
1995	311	50.00	980.50	0.65	1.10	0.61	Good
1999	311	53.00	752.50	0.73	1.25	0.73	Good
2004	311	33.00	146.50	0.80	1.21	0.63	Good
2009	311	62.50	502.00	0.78	1.41	0.93	High
2014	311	75.50	1006.50	0.69	1.29	0.91	High
2020	311	35.50	429.00	0.73	1.11	0.59	Good
1993	317	40.33	1546.33	0.64	1.02	0.60	Good
1995	317	35.50	721.50	0.63	0.97	0.41	Moderate
1999	317	34.00	981.00	0.45	0.68	0.50	Moderate
2004	317	23.50	180.50	0.76	1.04	0.39	Poor
2009	317	17.50	132.50	0.72	0.90	0.24	Poor
2014	317	24.00	274.50	0.72	0.99	0.30	Poor
2020	317	21.00	93.50	0.81	1.07	0.35	Poor
1993	318	51.00	837.00	0.67	1.15	0.78	High
1995	318	48.00	1203.50	0.55	0.94	0.67	Good
1999	318	36.50	363.50	0.57	0.89	0.57	Good
2004	318	30.00	222.00	0.71	1.06	0.39	Poor
2009	318	49.50	301.50	0.77	1.29	0.81	High
2014	318	70.00	842.00	0.71	1.32	0.55	Good
2020	318	63.00	496.00	0.70	1.27	0.99	High

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	STATION	RICHNESS	ABUNDANCE	EVENNESS (J')	DIVERSITY (H') ($Log_{10}(x)$)	M-AMBI	M-AMBI CATEGORY
1993	323	32.33	956.33	0.70	1.06	0.48	Moderate
1995	323	33.00	488.50	0.63	0.95	0.46	Moderate
1999	323	52.00	658.00	0.71	1.16	0.85	High
2004	323	10.00	37.00	0.62	0.62	0.19	Bad
2009	323	36.00	176.00	0.76	1.17	0.70	Good
2014	323	13.00	34.00	0.87	0.97	0.18	Bad
2020	323	34.00	169.50	0.73	1.11	0.52	Moderate
1993	324	34.00	1058.00	0.72	1.11	0.52	Moderate
1995	324	24.50	624.00	0.55	0.77	0.34	Poor
1999	324	31.50	1049.50	0.50	0.74	0.34	Poor
2004	324	23.00	145.50	0.73	1.00	0.39	Moderate
2009	324	34.50	162.50	0.78	1.21	0.61	Good
2014	324	35.00	245.50	0.72	1.11	0.42	Moderate
2020	324	36.00	265.50	0.73	1.13	0.55	Good
1993	325	59.00	798.00	0.72	1.27	0.84	High
1995	325	44.50	948.50	0.59	0.97	0.56	Good
1999	325	26.00	658.00	0.53	0.75	0.38	Poor
2004	325	36.00	264.50	0.73	1.13	0.53	Good
2009	325	30.50	355.00	0.60	0.89	0.47	Moderate
2014	325	33.50	266.50	0.80	1.22	0.39	Moderate
2020	325	27.00	194.00	0.76	1.09	0.44	Moderate
1993	331	37.33	932.00	0.64	1.01	0.51	Moderate
1995	331	37.50	487.00	0.74	1.16	0.45	Moderate
1999	331	39.00	1255.00	0.50	0.79	0.58	Good
2004	331	26.50	256.50	0.62	0.87	0.41	Moderate
2009	331	43.00	534.00	0.67	1.10	0.59	Good
2014	331	45.00	482.50	0.66	1.09	0.56	Good
2020	331	47.50	380.50	0.68	1.15	0.69	Good
1993	332	57.33	737.67	0.78	1.36	0.91	High
1995	332	62.50	470.50	0.72	1.28	0.83	High
1999	332	41.50	558.00	0.64	1.02	0.57	Good
2004	332	35.00	202.00	0.65	1.01	0.58	Good
2009	332	68.00	418.00	0.80	1.47	0.96	High
2014	332	42.00	165.50	0.83	1.35	0.63	Good
2020	332	66.50	413.00	0.80	1.47	0.91	High
1993	333	71.67	1484.33	0.63	1.17	1.00	High
1995	333	53.00	1241.00	0.64	1.11	0.67	Good
1999	333	48.00	463.00	0.72	1.21	0.73	Good
2004	333	47.00	388.50	0.78	1.30	0.53	Good
2009	333	56.50	1524.50	0.52	0.92	0.73	Good
2014	333	59.00	614.00	0.70	1.24	0.70	Good
2020	333	51.50	767.50	0.69	1.19	0.64	Good
1993	334	39.00	594.33	0.72	1.14	0.58	Good
1995	334	41.00	330.00	0.78	1.26	0.56	Good
1999	334	37.50	570.00	0.66	1.03	0.58	Good
2004	334	25.50	154.50	0.77	1.09	0.41	Moderate
2009	334	43.50	404.00	0.70	1.15	0.55	Good
2014	334	37.00	448.50	0.61	0.96	0.42	Moderate
2020	334	31.50	259.00	0.70	1.05	0.51	Moderate
1993	335	48.33	468.00	0.73	1.23	0.72	Good
1995	335	63.00	403.25	0.78	1.40	0.86	High
1999	335	51.00	520.00	0.64	1.10	0.78	High
2004	335	45.00	1233.50	0.53	0.88	0.66	Good
2009	335	43.50	1209.50	0.57	0.93	0.60	Good
2014	335	32.00	570.00	0.58	0.88	0.42	Moderate
2020	335	45.50	670.50	0.67	1.10	0.64	Good
1993	338	38.33	764.00	0.74	1.17	0.56	Good
1995	338	29.00	234.50	0.59	0.87	0.40	Moderate
1999	338	33.50	749.00	0.61	0.93	0.44	Moderate
2004	338	32.00	175.00	0.78	1.17	0.46	Moderate
2009	338	42.00	668.50	0.63	1.03	0.59	Good
2014	338	34.00	490.00	0.63	0.95	0.45	Moderate
2020	338	27.50	223.50	0.74	1.04	0.45	Moderate

Table 9. Benthic community parameters for Upper Harbor, Lower Harbor, and Outer Harbor stations during years 1993, 1995, 1999, 2004, 2009, 2014, and 2020.*†‡§							
YEAR	**STATION**	**RICHNESS**	**ABUNDANCE**	**EVENNESS (J')**	**DIVERSITY (H') ($Log_{10}(x)$)**	**M-AMBI**	**M-AMBI CATEGORY**
1993	339	31.67	536.33	0.75	1.12	0.46	Moderate
1995	339	27.00	387.00	0.62	0.89	0.37	Poor
1999	339	34.50	1180.50	0.45	0.69	0.44	Moderate
2004	339	24.00	115.50	0.64	0.88	0.37	Poor
2009	339	39.00	573.25	0.61	0.96	0.64	Good
2014	339	32.00	537.00	0.66	1.00	0.33	Poor
2020	339	29.50	243.50	0.79	1.16	0.58	Good
1993	340	38.67	956.00	0.65	1.03	0.55	Good
1995	340	35.00	464.00	0.67	1.03	0.42	Moderate
1999	340	29.50	863.50	0.52	0.76	0.42	Moderate
2004	340	18.00	95.50	0.74	0.92	0.30	Poor
2009	340	37.00	636.50	0.51	0.81	0.56	Good
2014	340	37.00	518.50	0.68	1.06	0.45	Moderate
2020	340	23.00	164.50	0.80	1.09	0.39	Moderate
1993	341	53.00	566.00	0.82	1.42	0.73	Good
1995	341	55.00	374.00	0.82	1.43	0.76	Good
1999	341	41.50	528.50	0.71	1.12	0.64	Good
2004	341	33.00	198.50	0.72	1.10	0.45	Moderate
2009	341	48.00	197.00	0.87	1.46	0.73	Good
2014	341	53.00	650.00	0.77	1.33	0.62	Good
2020	341	51.50	280.00	0.83	1.42	0.72	Good
1993	345	41.67	1082.00	0.72	1.17	0.60	Good
1995	345	32.00	294.00	0.56	0.84	0.48	Moderate
1999	345	25.00	728.00	0.60	0.80	0.35	Poor
2004	345	20.50	103.00	0.69	0.90	0.36	Poor
2009	345	39.00	759.50	0.60	0.96	0.55	Good
2014	345	37.50	430.00	0.68	1.07	0.41	Moderate
2020	345	38.00	221.00	0.81	1.26	0.61	Good
1993	346	62.67	614.00	0.74	1.32	0.89	High
1995	346	46.00	302.50	0.79	1.31	0.63	Good
1999	346	38.50	222.00	0.68	1.08	0.51	Moderate
2004	346	61.00	461.50	0.70	1.24	1.00	High
2009	346	67.00	334.50	0.79	1.45	0.91	High
2014	346	52.00	282.50	0.83	1.42	0.62	Good
2020	346	62.50	397.00	0.80	1.44	1.00	High
1993	349	47.33	814.00	0.71	1.19	0.77	Good
1995	349	22.00	72.50	0.86	1.16	0.42	Moderate
1999	349	40.00	168.50	0.83	1.33	0.67	Good
2004	349	23.00	61.00	0.82	1.12	0.41	Moderate
2009	349	64.50	450.00	0.80	1.44	0.99	High
2014	349	47.50	294.50	0.75	1.24	0.64	Good
2020	349	36.00	267.50	0.82	1.23	0.59	Good
1993	352	73.00	841.33	0.75	1.39	1.00	High
1995	352	†	†	†	†	†	†
1999	352	66.50	452.00	0.72	1.32	1.00	High
2004	352	21.50	92.00	0.86	1.15	0.30	Poor
2009	352	78.00	524.25	0.83	1.57	1.00	High
2014	352	52.00	1073.00	0.50	0.86	0.63	Good
2020	352	47.50	543.00	0.64	1.07	0.80	High

*Only one specimen present at Station 221 during 2020 sampling.

†No sample for Station 352 during 1995.

‡Shannon's H' Diversity calculated with $log_{10}(x)$.

§Benthic community parameters based on specimens collected per sample.

Appendix B Sediment Chemistry and Grain Size Data

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTM1993_202	regular	Lower Harbor	202	27-Oct-93	1993	UG/KG	6692.6	1.32	6.1	79.3	14.6
NBHLTM1993_204	regular	Lower Harbor	204	22-Oct-93	1993	UG/KG	4723.8	1.64	10.2	67.8	21.8
NBHLTM1993_207	regular	Lower Harbor	207	22-Oct-93	1993	UG/KG	3693.46	3.4	6.7	69	24.3
NBHLTM1993_208	regular	Lower Harbor	208	27-Oct-93	1993	UG/KG	1451.9	0.34	2.2	94.9	3
NBHLTM1993_211	regular	Lower Harbor	211	22-Oct-93	1993	UG/KG	11798	7.4	1.3	53.4	45.4
NBHLTM1993_212	regular	Lower Harbor	212	27-Oct-93	1993	UG/KG	15154	8.5	2.3	42.6	55
NBHLTM1993_216	regular	Lower Harbor	216	27-Oct-93	1993	UG/KG	5888	2.9	11.7	62.3	26
NBHLTM1993_220	regular	Lower Harbor	220	28-Oct-93	1993	UG/KG	3903.9	3.9	4.9	61.4	33.7
NBHLTM1993_221	regular	Lower Harbor	221	28-Oct-93	1993	UG/KG	1583.5	3.2	8.2	63.5	28.3
NBHLTM1993_222	regular	Lower Harbor	222	28-Oct-93	1993	UG/KG	20742	9.1	0	39.5	60.5
NBHLTM1993_224	regular	Lower Harbor	224	22-Oct-93	1993	UG/KG	5816.2	6.7	0	50.8	49.2
NBHLTM1993_225	regular	Lower Harbor	225	21-Oct-93	1993	UG/KG	2627.13	3	5.7	68.2	25.9
NBHLTM1993_226	regular	Lower Harbor	226	21-Oct-93	1993	UG/KG	4572	8.6	0	40.6	59.4
NBHLTM1993_227	regular	Lower Harbor	227	21-Oct-93	1993	UG/KG	1881.3	6.1	1	42.5	56.4
NBHLTM1993_230	regular	Lower Harbor	230	18-Oct-93	1993	UG/KG	11559	4.6	2.5	55.7	41.8
NBHLTM1993_231	regular	Lower Harbor	231	21-Oct-93	1993	UG/KG	5651.6	7.5	0	18.3	81.6
NBHLTM1993_235	regular	Lower Harbor	235	18-Oct-93	1993	UG/KG	5180	5	1.6	38.3	60
NBHLTM1993_236	regular	Lower Harbor	236	18-Oct-93	1993	UG/KG	4190	3.5	2.7	55.6	41.6
NBHLTM1993_240	regular	Lower Harbor	240	18-Oct-93	1993	UG/KG	4179.9	8.3	0	70.3	29.7
NBHLTM1993_241	regular	Lower Harbor	241	17-Oct-93	1993	UG/KG	1717.5	2.3	16.7	54.3	29
NBHLTM1993_242	regular	Lower Harbor	242	17-Oct-93	1993	UG/KG	2374.8	2.7	0.8	66.3	32.8
NBHLTM1993_245	regular	Lower Harbor	245	17-Oct-93	1993	UG/KG	942.18	1.74	6.8	72.8	20.3
NBHLTM1993_247	regular	Lower Harbor	247	17-Oct-93	1993	UG/KG	2601	3.9	0	59.6	40.4
NBHLTM1993_249	regular	Lower Harbor	249	28-Oct-93	1993	UG/KG	694.12	1.6	9.2	82.6	8.1
NBHLTM1993_250	regular	Lower Harbor	250	17-Oct-93	1993	UG/KG	1378.77	2.5	2.1	60.4	37.6
NBHLTM1993_253	regular	Lower Harbor	253	17-Oct-93	1993	UG/KG	5145.2	6.2	0	41.2	58.8
NBHLTM1993_217	Dup treated	Lower Harbor	217	22-Oct-93	1993	UG/KG	10647.2	9.6	0	26.3	73.6
NBHLTM1995_202	regular	Lower Harbor	202	19-Oct-95	1995	UG/KG	8234.3	1.68	2.38	81.5	6.788
NBHLTM1995_204	regular	Lower Harbor	204	20-Oct-95	1995	UG/KG	6215.6	3.19	4.91	70.29	15.3
NBHLTM1995_207	regular	Lower Harbor	207	20-Oct-95	1995	UG/KG	3158.04	1.97	5.85	72.25	20.1
NBHLTM1995_208	regular	Lower Harbor	208	19-Oct-95	1995	UG/KG	1802	0.203	0.733	21.25	77.1
NBHLTM1995_212	regular	Lower Harbor	212	20-Oct-95	1995	UG/KG	16317	6.76	2.76	44.55	27.9
NBHLTM1995_216	regular	Lower Harbor	216	20-Oct-95	1995	UG/KG	3230.02	2.98	5.04	75.68	8.71
NBHLTM1995_217	regular	Lower Harbor	217	24-Oct-95	1995	UG/KG	23672	6.39	5.6	58.83	34.2
NBHLTM1995_218	regular	Lower Harbor	218	20-Oct-95	1995	UG/KG	414.16	0.514	12.8	76.39	8.58
NBHLTM1995_220	regular	Lower Harbor	220	20-Oct-95	1995	UG/KG	2867.3	1.65	11.3	70.8	8.91
NBHLTM1995_221	regular	Lower Harbor	221	24-Oct-95	1995	UG/KG	1424.81	1.24	2.73	80.3	16.3
NBHLTM1995_222	regular	Lower Harbor	222	24-Oct-95	1995	UG/KG	13407	3.71	9.425	59.115	20.05
NBHLTM1995_224	regular	Lower Harbor	224	23-Oct-95	1995	UG/KG	6128.8	5.78	5.51	45.33	44.3
NBHLTM1995_225	regular	Lower Harbor	225	19-Oct-95	1995	UG/KG	6020.4	4.38	10.3	32.41	42.5
NBHLTM1995_226	regular	Lower Harbor	226	19-Oct-95	1995	UG/KG	5887.5	5.79	3.19	55.59	39.3
NBHLTM1995_227	regular	Lower Harbor	227	19-Oct-95	1995	UG/KG	3484.6	4.23	1.62	60.56	37.8
NBHLTM1995_230	regular	Lower Harbor	230	19-Oct-95	1995	UG/KG	4703.6	4.04	20.4	52.97	15.1
NBHLTM1995_231	regular	Lower Harbor	231	19-Oct-95	1995	UG/KG	4101.7	4.68	33.2	38.26	26.3
NBHLTM1995_235	regular	Lower Harbor	235	18-Oct-95	1995	UG/KG	3449.2	6.44	0	57.05	42.9
NBHLTM1995_236	regular	Lower Harbor	236	18-Oct-95	1995	UG/KG	3033.6	2.83	2.91	44.28	37.1
NBHLTM1995_237	regular	Lower Harbor	237	18-Oct-95	1995	UG/KG	1640.6	1.83	12.5	39.614	8.79
NBHLTM1995_240	regular	Lower Harbor	240	17-Oct-95	1995	UG/KG	3364.9	5.05	1.81	59.66	38.5
NBHLTM1995_241	regular	Lower Harbor	241	17-Oct-95	1995	UG/KG	1071.34	1.87	7.78	60.33	24.8
NBHLTM1995_242	regular	Lower Harbor	242	18-Oct-95	1995	UG/KG	1868.58	2.26	2.54	68.973	24.3
NBHLTM1995_245	regular	Lower Harbor	245	16-Oct-95	1995	UG/KG	1391.96	1.93	55.9	37.8	4.49
NBHLTM1995_247	regular	Lower Harbor	247	16-Oct-95	1995	UG/KG	1991.27	2.21	3.26	65.2	25.5
NBHLTM1995_249	regular	Lower Harbor	249	23-Oct-95	1995	UG/KG	705.71	1.7	4.49	72.06	19.8

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTM1995_250	regular	Lower Harbor	250	17-Oct-95	1995	UG/KG	542.73	1.08	10.2	57.98	20.6
NBHLTM1995_253	regular	Lower Harbor	253	16-Oct-95	1995	UG/KG	3714.44	5.55	1.35	45.27	53.4
NBHLTM1995_211	Dup treated	Lower Harbor	211	20-Oct-95	1995	UG/KG	16028.1	6.61	16.3	50.411	18.2
NBHLTM1999_202	regular	Lower Harbor	202	06-Oct-99	1999	UG/KG	780	0.16	11.7	86.1	2.2
NBHLTM1999_204	regular	Lower Harbor	204	22-Sep-99	1999	UG/KG	11000	2.3	11.3	66.4	22.4
NBHLTM1999_207	regular	Lower Harbor	207	22-Sep-99	1999	UG/KG	14000	3.7	0.1	46.3	53.6
NBHLTM1999_208	regular	Lower Harbor	208	23-Sep-99	1999	UG/KG	1500	0.83	1.8	91.3	7.0
NBHLTM1999_211	regular	Lower Harbor	211	22-Sep-99	1999	UG/KG	17000	5.4	2.76	26.1	71.2
NBHLTM1999_212	regular	Lower Harbor	212	24-Sep-99	1999	UG/KG	17000	7	1.37	32.8	65.9
NBHLTM1999_216	regular	Lower Harbor	216	22-Sep-99	1999	UG/KG	4100	2.8	11.2	63.7	25.1
NBHLTM1999_217	regular	Lower Harbor	217	23-Sep-99	1999	UG/KG	19000	7	1.33	25.5	73.2
NBHLTM1999_218	regular	Lower Harbor	218	27-Oct-99	1999	UG/KG	1300	1.4	7.1	83.8	9.1
NBHLTM1999_220	regular	Lower Harbor	220	22-Sep-99	1999	UG/KG	8900	3.7	5.92	59.7	34.5
NBHLTM1999_221	regular	Lower Harbor	221	24-Sep-99	1999	UG/KG	11000	8.2	0.2	26.3	73.5
NBHLTM1999_222	regular	Lower Harbor	222	23-Sep-99	1999	UG/KG	16000	4.7	18.5	43.5	38
NBHLTM1999_224	regular	Lower Harbor	224	22-Sep-99	1999	UG/KG	12000	5.5	0.84	32.3	66.9
NBHLTM1999_225	regular	Lower Harbor	225	21-Sep-99	1999	UG/KG	8300	5.4	3.73	43.9	52.3
NBHLTM1999_227	regular	Lower Harbor	227	21-Sep-99	1999	UG/KG	6600	4.5	0.95	48	51
NBHLTM1999_230	regular	Lower Harbor	230	21-Sep-99	1999	UG/KG	6500	3.7	2.9	57	40
NBHLTM1999_231	regular	Lower Harbor	231	21-Sep-99	1999	UG/KG	7700	9.2	1.03	23.4	75.6
NBHLTM1999_235	regular	Lower Harbor	235	20-Sep-99	1999	UG/KG	6900	4.6	5.15	24.4	70.5
NBHLTM1999_236	regular	Lower Harbor	236	20-Sep-99	1999	UG/KG	5800	4.2	6.45	35	58.6
NBHLTM1999_237	regular	Lower Harbor	237	24-Sep-99	1999	UG/KG	2000	3.9	21.5	57.8	20.7
NBHLTM1999_240	regular	Lower Harbor	240	20-Sep-99	1999	UG/KG	6800	5	5.91	24.8	69.3
NBHLTM1999_241	regular	Lower Harbor	241	20-Sep-99	1999	UG/KG	3000	3.5	18.9	50.2	30.9
NBHLTM1999_242	regular	Lower Harbor	242	20-Sep-99	1999	UG/KG	2200	1.9	8.37	67	24.6
NBHLTM1999_245	regular	Lower Harbor	245	19-Sep-99	1999	UG/KG	820	0.51	10.8	80	9.2
NBHLTM1999_247	regular	Lower Harbor	247	19-Sep-99	1999	UG/KG	3600	3.3	0.24	70.9	28.9
NBHLTM1999_249	regular	Lower Harbor	249	19-Sep-99	1999	UG/KG	1500	2.8	4.67	80.4	14.8
NBHLTM1999_250	regular	Lower Harbor	250	19-Sep-99	1999	UG/KG	5400	4.9	0.2	51.9	47.9
NBHLTM1999_253	regular	Lower Harbor	253	20-Sep-99	1999	UG/KG	5600	3	10.4	55	34.6
NBHLTM1999_226	Dup treated	Lower Harbor	226	21-Sep-99	1999	UG/KG	11975.25	6.45	0	16.5	83.5
NBHLTM2004_202	regular	Lower Harbor	202	22-Aug-04	2004	UG/KG	1700	0.6	16.2	74.89	8.83
NBHLTM2004_204	regular	Lower Harbor	204	22-Aug-04	2004	UG/KG	5700	3.3	10	56.14	33.8
NBHLTM2004_207	regular	Lower Harbor	207	22-Aug-04	2004	UG/KG	4900	7.35	10.8	67.76	21.4
NBHLTM2004_211	regular	Lower Harbor	211	23-Aug-04	2004	UG/KG	14000	6.25	3.89	36.07	60
NBHLTM2004_212	regular	Lower Harbor	212	22-Aug-04	2004	UG/KG	15000	8.06	13.6	16.31	70.1
NBHLTM2004_216	regular	Lower Harbor	216	23-Aug-04	2004	UG/KG	3300	2.67	7.09	68.45	24.5
NBHLTM2004_217	regular	Lower Harbor	217	23-Aug-04	2004	UG/KG	16000	7.26	1.67	0.9	97.4
NBHLTM2004_218	regular	Lower Harbor	218	22-Aug-04	2004	UG/KG	1100	0.52	95.2	4.17	0.63
NBHLTM2004_220	regular	Lower Harbor	220	23-Aug-04	2004	UG/KG	3000	3.02	4.77	52.24	43
NBHLTM2004_221	regular	Lower Harbor	221	21-Aug-04	2004	UG/KG	2100	6.55	18	58.97	23.1
NBHLTM2004_222	regular	Lower Harbor	222	16-Aug-04	2004	UG/KG	14000	6.76	1.95	10.13	87.9
NBHLTM2004_224	regular	Lower Harbor	224	16-Aug-04	2004	UG/KG	6300	7.27	2.39	19.59	78
NBHLTM2004_225	regular	Lower Harbor	225	16-Aug-04	2004	UG/KG	7200	5.14	0.41	26.35	73.3
NBHLTM2004_226	regular	Lower Harbor	226	16-Aug-04	2004	UG/KG	8200	6.15	3.98	33.86	62.2
NBHLTM2004_227	regular	Lower Harbor	227	16-Aug-04	2004	UG/KG	4200	4.29	9.49	43.13	47.4
NBHLTM2004_230	regular	Lower Harbor	230	21-Aug-04	2004	UG/KG	4300	6.11	0.37	28.86	70.8
NBHLTM2004_231	regular	Lower Harbor	231	16-Aug-04	2004	UG/KG	3900	4.53	2.23	26.6	71.2
NBHLTM2004_235	regular	Lower Harbor	235	16-Aug-04	2004	UG/KG	4100	5.09	0.26	41.45	58.3
NBHLTM2004_236	regular	Lower Harbor	236	16-Aug-04	2004	UG/KG	4400	4.65	0.34	25.94	73.7
NBHLTM2004_237	regular	Lower Harbor	237	21-Aug-04	2004	UG/KG	1400	11.2	14.7	62.07	23.2
NBHLTM2004_240	regular	Lower Harbor	240	21-Aug-04	2004	UG/KG	3300	5.12	0	4.04	96

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTM2004_241	regular	Lower Harbor	241	21-Aug-04	2004	UG/KG	1900	3.06	6.32	50.41	43.2
NBHLTM2004_242	regular	Lower Harbor	242	21-Aug-04	2004	UG/KG	1600	2.03	5.6	60.46	33.9
NBHLTM2004_245	regular	Lower Harbor	245	21-Aug-04	2004	UG/KG	380	0.61	25	67.93	7.04
NBHLTM2004_247	regular	Lower Harbor	247	19-Aug-04	2004	UG/KG	1700	4.78	0.23	60.76	39
NBHLTM2004_249	regular	Lower Harbor	249	20-Aug-04	2004	UG/KG	670	1.4	2.67	86.17	11.1
NBHLTM2004_250	regular	Lower Harbor	250	19-Aug-04	2004	UG/KG	2900	5.45	15.5	13.4	71.1
NBHLTM2004_253	regular	Lower Harbor	253	19-Aug-04	2004	UG/KG	3600	5.14	0.34	12.69	87
NBHLTM2004_208	Dup Treated	Lower Harbor	208	22-Aug-04	2004	UG/KG	399.84	0.27	0.66	97.125	2.225
NBHLTMV2009+SEDIMENT GRABS_202	regular	Lower Harbor	202	25-Sep-09	2009	UG/KG	570	0.1025	7.7	88.1	1.1
NBHLTMV2009+SEDIMENT GRABS_204	regular	Lower Harbor	204	25-Sep-09	2009	UG/KG	7600	2.115	2.2	57	30.9
NBHLTMV2009+SEDIMENT GRABS_207	regular	Lower Harbor	207	25-Sep-09	2009	UG/KG	7400	2.64	4.2	55.4	33.1
NBHLTMV2009+SEDIMENT GRABS_208	regular	Lower Harbor	208	25-Sep-09	2009	UG/KG	1000	0.615	0.4	93.1	6.3
NBHLTMV2009+SEDIMENT GRABS_211	regular	Lower Harbor	211	25-Sep-09	2009	UG/KG	12000	1.9	6.9	51.4	32.2
NBHLTMV2009+SEDIMENT GRABS_216	regular	Lower Harbor	216	25-Sep-09	2009	UG/KG	930	0.3305	0.3	70.4	29.1
NBHLTMV2009+SEDIMENT GRABS_217	regular	Lower Harbor	217	25-Sep-09	2009	UG/KG	19000	3.515	1.3	14.3	84
NBHLTMV2009+SEDIMENT GRABS_218	regular	Lower Harbor	218	25-Sep-09	2009	UG/KG	560	0.426	6.4	60.5	2.1
NBHLTMV2009+SEDIMENT GRABS_220	regular	Lower Harbor	220	25-Sep-09	2009	UG/KG	3300	1.39	3.2	62	30.1
NBHLTMV2009+SEDIMENT GRABS_221	regular	Lower Harbor	221	25-Sep-09	2009	UG/KG	3900	1.68	4.5	61.6	23.5
NBHLTMV2009+SEDIMENT GRABS_222	regular	Lower Harbor	222	25-Sep-09	2009	UG/KG	15000	1.94	4.4	44.1	43.3
NBHLTMV2009+SEDIMENT GRABS_224	regular	Lower Harbor	224	25-Sep-09	2009	UG/KG	11000	3.82	0.7	26.7	72.3
NBHLTMV2009+SEDIMENT GRABS_225	regular	Lower Harbor	225	25-Sep-09	2009	UG/KG	2900	1.605	3.6	70.9	21.8
NBHLTMV2009+SEDIMENT GRABS_226	regular	Lower Harbor	226	25-Sep-09	2009	UG/KG	6600	3.145	2.9	26.4	68.3
NBHLTMV2009+SEDIMENT GRABS_227	regular	Lower Harbor	227	25-Sep-09	2009	UG/KG	4900	2.445	2.6	57.3	31.7
NBHLTMV2009+SEDIMENT GRABS_230	regular	Lower Harbor	230	25-Sep-09	2009	UG/KG	5100	4.06	2.8	63.4	28.2
NBHLTMV2009+SEDIMENT GRABS_231	regular	Lower Harbor	231	25-Sep-09	2009	UG/KG	5100	1.805	0.2	15.3	84.4
NBHLTMV2009+SEDIMENT GRABS_235	regular	Lower Harbor	235	25-Sep-09	2009	UG/KG	3900	2.845	0.3	32.4	67.1
NBHLTMV2009+SEDIMENT GRABS_236	regular	Lower Harbor	236	25-Sep-09	2009	UG/KG	4400	2.595	11.9	47.7	11.9
NBHLTMV2009+SEDIMENT GRABS_237	regular	Lower Harbor	237	25-Sep-09	2009	UG/KG	810	1.245	9.9	48.4	18.4
NBHLTMV2009+SEDIMENT GRABS_240	regular	Lower Harbor	240	25-Sep-09	2009	UG/KG	4700	2.885	0.4	22.3	77.2
NBHLTMV2009+SEDIMENT GRABS_241	regular	Lower Harbor	241	25-Sep-09	2009	UG/KG	960	0.8045	4.5	72.4	15.1
NBHLTMV2009+SEDIMENT GRABS_242	regular	Lower Harbor	242	25-Sep-09	2009	UG/KG	1700	0.631	2.4	67.1	21
NBHLTMV2009+SEDIMENT GRABS_245	regular	Lower Harbor	245	25-Sep-09	2009	UG/KG	2700	1.45	1.6	61.1	35.9
NBHLTMV2009+SEDIMENT GRABS_247	regular	Lower Harbor	247	25-Sep-09	2009	UG/KG	3000	1.41	0.2	55.9	41.2
NBHLTMV2009+SEDIMENT GRABS_249	regular	Lower Harbor	249	25-Sep-09	2009	UG/KG	1300	0.834	4.5	77.6	13.5
NBHLTMV2009+SEDIMENT GRABS_250	regular	Lower Harbor	250	25-Sep-09	2009	UG/KG	520	0.437	6.2	75.1	13.5
NBHLTMV2009+SEDIMENT GRABS_253	regular	Lower Harbor	253	25-Sep-09	2009	UG/KG	5900	1.735	4.8	60.5	32.8
NBHLTMV2009+SEDIMENT GRABS_212	Dup treated	Lower Harbor	212	25-Sep-09	2009	UG/KG	13964	3.19	2.6	22.1	72.6
NBHLTM2014_202	regular	Lower Harbor	202	23-Sep-14	2014	UG/KG	2500	1.037	14	70	16
NBHLTM2014_204	regular	Lower Harbor	204	30-Sep-14	2014	UG/KG	5800	2.87	3	52	45
NBHLTM2014_207	regular	Lower Harbor	207	29-Sep-14	2014	UG/KG	3800	1.995	8	60	32
NBHLTM2014_208	regular	Lower Harbor	208	29-Sep-14	2014	UG/KG	1000	0.9745	2	86	12
NBHLTM2014_211	regular	Lower Harbor	211	30-Sep-14	2014	UG/KG	2300	1.205	0	62	38
NBHLTM2014_212	regular	Lower Harbor	212	30-Sep-14	2014	UG/KG	4300	2.795	1	20	79
NBHLTM2014_216	regular	Lower Harbor	216	22-Sep-14	2014	UG/KG	1000	0.8795	0	66	34
NBHLTM2014_217	regular	Lower Harbor	217	30-Sep-14	2014	UG/KG	7300	4.33	2	5	93
NBHLTM2014_218	regular	Lower Harbor	218	29-Sep-14	2014	UG/KG	470	0.589	44	49	7
NBHLTM2014_220	regular	Lower Harbor	220	22-Sep-14	2014	UG/KG	2800	2.34	4	41	55
NBHLTM2014_221	regular	Lower Harbor	221	25-Sep-14	2014	UG/KG	1500	3.915	7	65	28
NBHLTM2014_222	regular	Lower Harbor	222	29-Sep-14	2014	UG/KG	5900	4.405	3	42	55
NBHLTM2014_224	regular	Lower Harbor	224	29-Sep-14	2014	UG/KG	4000	0.115	0	5	95
NBHLTM2014_225	regular	Lower Harbor	225	30-Sep-14	2014	UG/KG	2000	2.345	20	46	34
NBHLTM2014_226	regular	Lower Harbor	226	30-Sep-14	2014	UG/KG	5900	5.085	0	5	95
NBHLTM2014_227	regular	Lower Harbor	227	30-Sep-14	2014	UG/KG	2000	2.535	6	43	51

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTM2014_230	regular	Lower Harbor	230	26-Sep-14	2014	UG/KG	8700	5.71	6	52	42
NBHLTM2014_231	regular	Lower Harbor	231	26-Sep-14	2014	UG/KG	1600	3.995	0	4	96
NBHLTM2014_235	regular	Lower Harbor	235	22-Sep-14	2014	UG/KG	1200	3.49	0	3	97
NBHLTM2014_236	regular	Lower Harbor	236	26-Sep-14	2014	UG/KG	3500	5.005	7	41	52
NBHLTM2014_237	regular	Lower Harbor	237	26-Sep-14	2014	UG/KG	910	1.62	40	37	23
NBHLTM2014_240	regular	Lower Harbor	240	22-Sep-14	2014	UG/KG	6800	4.05	0	17	83
NBHLTM2014_241	regular	Lower Harbor	241	26-Sep-14	2014	UG/KG	990	1.545	10	58	32
NBHLTM2014_245	regular	Lower Harbor	245	22-Sep-14	2014	UG/KG	1100	1.39	0	58	42
NBHLTM2014_247	regular	Lower Harbor	247	26-Sep-14	2014	UG/KG	1700	3.42	0	42	58
NBHLTM2014_249	regular	Lower Harbor	249	25-Sep-14	2014	UG/KG	920	1.965	10	49	41
NBHLTM2014_250	regular	Lower Harbor	250	25-Sep-14	2014	UG/KG	350	2.305	19	65	14
NBHLTM2014_253	regular	Lower Harbor	253	22-Sep-14	2014	UG/KG	220	0.3735	1	13	86
NBHLTM2014_242	Dup treated	Lower Harbor	242	26-Sep-14	2014	UG/KG	1111.85	2.2	2	62	36
20FSP20_LTM_202	regular	Lower Harbor	202	23-Sep-20	2020	UG/KG	2032.7	1.55	5	73	22
20FSP20_LTM_204	regular	Lower Harbor	204	29-Sep-20	2020	UG/KG	4711.96	3.55	2	34	64
20FSP20_LTM_207	regular	Lower Harbor	207	29-Sep-20	2020	UG/KG	3971.68	4.92	7	59	34
20FSP20_LTM_208	regular	Lower Harbor	208	29-Sep-20	2020	UG/KG	779.439	0.926	1	81	18
20FSP20_LTM_211	regular	Lower Harbor	211	29-Sep-20	2020	UG/KG	3027.97	3.27	3	28	69
20FSP20_LTM_212	regular	Lower Harbor	212	29-Sep-20	2020	UG/KG	1967.69	2.63	0	6	94
20FSP20_LTM_216	regular	Lower Harbor	216	29-Sep-20	2020	UG/KG	1332.69	2.29	0	17	83
20FSP20_LTM_217	regular	Lower Harbor	217	29-Sep-20	2020	UG/KG	1352.643	2.51	0	2	98
20FSP20_LTM_218	regular	Lower Harbor	218	01-Oct-20	2020	UG/KG	167.51	0.482	44	54.2	1.8
20FSP20_LTM_220	regular	Lower Harbor	220	02-Oct-20	2020	UG/KG	2371.12	3.66	1	23	76
20FSP20_LTM_221	regular	Lower Harbor	221	02-Oct-20	2020	UG/KG	1760.41	3.18	2	50	48
20FSP20_LTM_222	regular	Lower Harbor	222	02-Oct-20	2020	UG/KG	2851.66	2.92	2	19	79
20FSP20_LTM_224	regular	Lower Harbor	224	02-Oct-20	2020	UG/KG	2438.03	4.29	0	8	92
20FSP20_LTM_225	regular	Lower Harbor	225	02-Oct-20	2020	UG/KG	1611.64	3.21	6	27	67
20FSP20_LTM_226	regular	Lower Harbor	226	01-Oct-20	2020	UG/KG	3041.61	4.46	0	1	99
20FSP20_LTM_227	regular	Lower Harbor	227	01-Oct-20	2020	UG/KG	1676.64	5.2	11	25	64
20FSP20_LTM_230	regular	Lower Harbor	230	01-Oct-20	2020	UG/KG	1565.77	3.09	7	42	51
20FSP20_LTM_231	regular	Lower Harbor	231	01-Oct-20	2020	UG/KG	1792.56	3.73	0	1	99
20FSP20_LTM_235	regular	Lower Harbor	235	01-Oct-20	2020	UG/KG	1439.95	3.34	1	16	83
20FSP20_LTM_236	regular	Lower Harbor	236	01-Oct-20	2020	UG/KG	1685.2	2.85	3	49	48
20FSP20_LTM_240	regular	Lower Harbor	240	29-Sep-20	2020	UG/KG	1346.63	3.55	0	4	96
20FSP20_LTM_241	regular	Lower Harbor	241	29-Sep-20	2020	UG/KG	1406.84	1.86	11	62	27
20FSP20_LTM_242	regular	Lower Harbor	242	29-Sep-20	2020	UG/KG	1141.57	2.36	3	50	47
20FSP20_LTM_245	regular	Lower Harbor	245	29-Sep-20	2020	UG/KG	769.181	1.58	19	49	32
20FSP20_LTM_247	regular	Lower Harbor	247	28-Sep-20	2020	UG/KG	759.378	2.16	1	59	40
20FSP20_LTM_249	regular	Lower Harbor	249	29-Sep-20	2020	UG/KG	779.333	2.11	2	28	70
20FSP20_LTM_250	regular	Lower Harbor	250	28-Sep-20	2020	UG/KG	558.14	1.55	9	46	45
20FSP20_LTM_253	regular	Lower Harbor	253	29-Sep-20	2020	UG/KG	691.24	1.89	0	33	67
20FSP20_LTM_237	Dup treated	Lower Harbor	237	01-Oct-20	2020	UG/KG	813.2675	1.905	6	66	28
NBHLTM1993_105	regular	Upper Harbor	105	26-Oct-93	1993	UG/KG	288100	11.8	3.7	46.3	50
NBHLTM1993_108	regular	Upper Harbor	108	18-Oct-93	1993	UG/KG	173930	10.3	1	37.9	61.2
NBHLTM1993_109	regular	Upper Harbor	109	19-Oct-93	1993	UG/KG	120310	7.4	0	32.6	67.4
NBHLTM1993_111	regular	Upper Harbor	111	19-Oct-93	1993	UG/KG	172710	8.2	1.2	31.9	66.9
NBHLTM1993_114	regular	Upper Harbor	114	19-Oct-93	1993	UG/KG	117930	9.8	1.8	32.4	65.8
NBHLTM1993_115	regular	Upper Harbor	115	26-Oct-93	1993	UG/KG	150360	8.9	0	42.1	57.9
NBHLTM1993_117	regular	Upper Harbor	117	20-Oct-93	1993	UG/KG	185600	11.5	1.7	34.4	63.8
NBHLTM1993_120	regular	Upper Harbor	120	20-Oct-93	1993	UG/KG	107490	13.4	0	36.8	63.2
NBHLTM1993_121	regular	Upper Harbor	121	26-Oct-93	1993	UG/KG	16555	2.9	1.4	78.6	20
NBHLTM1993_123	regular	Upper Harbor	123	20-Oct-93	1993	UG/KG	125340	11.3	2.4	30.8	66.8
NBHLTM1993_125	regular	Upper Harbor	125	20-Oct-93	1993	UG/KG	81045	12.2	0	35.6	64.4

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples											
Sample ID	**Sample Type**	**Reach**	**LTM Station**	**Sample Date**	**Year**	**PCB units**	**Total PCBs (NOAA 18)**	**TOC (%)**	**Grain Size - Gravel**	**Grain Size - Sand**	**Grain Size - Silt and Clay**
NBHLTM1993_126	regular	Upper Harbor	126	26-Oct-93	1993	UG/KG	2090.24	0.19	17.9	79.8	2.2
NBHLTM1993_128	regular	Upper Harbor	128	21-Oct-93	1993	UG/KG	42764	10.4	1.8	26.5	71.6
NBHLTM1993_130	regular	Upper Harbor	130	21-Oct-93	1993	UG/KG	35318	10.7	6	54.6	39.5
NBHLTM1993_131	regular	Upper Harbor	131	21-Oct-93	1993	UG/KG	41047	7.5	1.8	41.4	56.7
NBHLTM1993_134	regular	Upper Harbor	134	21-Oct-93	1993	UG/KG	45488	10.6	0.1	14.1	85.9
NBHLTM1993_135	regular	Upper Harbor	135	26-Oct-93	1993	UG/KG	493.57	0.25	6.2	91.3	2.5
NBHLTM1993_139	regular	Upper Harbor	139	22-Oct-93	1993	UG/KG	32238.1	8.8	1.2	40.6	58.3
NBHLTM1993_140	regular	Upper Harbor	140	22-Oct-93	1993	UG/KG	26653.4	9.3	4.5	33.1	62.3
NBHLTM1993_146	regular	Upper Harbor	146	19-Oct-93	1993	UG/KG	10718	7.2	4.6	70.5	25
NBHLTM1993_147	regular	Upper Harbor	147	25-Oct-93	1993	UG/KG	1633.92	1.4	2	89.5	8.4
NBHLTM1993_150	regular	Upper Harbor	150	18-Oct-93	1993	UG/KG	15346	7	1.3	59.6	39.2
NBHLTM1993_151	regular	Upper Harbor	151	19-Oct-93	1993	UG/KG	5476.5	2.5	4.2	79	17
NBHLTM1993_152	regular	Upper Harbor	152	25-Oct-93	1993	UG/KG	9044	4.5	0.7	40.1	59.2
NBHLTM1993_154	regular	Upper Harbor	154	21-Oct-93	1993	UG/KG	335.36	0.12	5	93.1	1.9
NBHLTM1993_155	regular	Upper Harbor	155	25-Oct-93	1993	UG/KG	2547.4	0.77	4	86.1	9.9
NBHLTM1993_138	Dup treated	Upper Harbor	138	22-Oct-93	1993	UG/KG	24300.15	11.25	1.1	28.9	70
NBHLTM1995_105	regular	Upper Harbor	105	10-Oct-95	1995	UG/KG	368300	--	3.49	56.16	40.3
NBHLTM1995_108	regular	Upper Harbor	108	10-Oct-95	1995	UG/KG	497520	7.59	17.8	45.35	36.9
NBHLTM1995_109	regular	Upper Harbor	109	10-Oct-95	1995	UG/KG	379230	5.53	2.41	45.267	50.2
NBHLTM1995_111	regular	Upper Harbor	111	11-Oct-95	1995	UG/KG	140170	8.05	0	62.31	37.7
NBHLTM1995_114	regular	Upper Harbor	114	11-Oct-95	1995	UG/KG	272540	9.38	0.536	63.32	36.2
NBHLTM1995_115	regular	Upper Harbor	115	11-Oct-95	1995	UG/KG	157090	9.63	0.546	69.71	29.8
NBHLTM1995_117	regular	Upper Harbor	117	11-Oct-95	1995	UG/KG	141160	10.7	11.1	48.25	38.7
NBHLTM1995_120	regular	Upper Harbor	120	26-Sep-95	1995	UG/KG	106340	9.13	2.34	46.42	51.3
NBHLTM1995_121	regular	Upper Harbor	121	12-Oct-95	1995	UG/KG	112473	7.21	4.46	56.76	38.8
NBHLTM1995_123	regular	Upper Harbor	123	12-Oct-95	1995	UG/KG	102479	6.54	24.6	20.163	36.2
NBHLTM1995_126	regular	Upper Harbor	126	13-Oct-95	1995	UG/KG	10750.2	0.535	4.98	67.025	14
NBHLTM1995_128	regular	Upper Harbor	128	13-Oct-95	1995	UG/KG	56337	8.65	10	36.45	47.2
NBHLTM1995_130	regular	Upper Harbor	130	13-Oct-95	1995	UG/KG	18580	2.75	10.7	47.62	24.2
NBHLTM1995_131	regular	Upper Harbor	131	16-Oct-95	1995	UG/KG	41514	6.35	5.65	56.29	30.7
NBHLTM1995_134	regular	Upper Harbor	134	16-Oct-95	1995	UG/KG	54733	8.54	9.24	29.87	53.1
NBHLTM1995_135	regular	Upper Harbor	135	13-Oct-95	1995	UG/KG	707.14	0.159	6.83	65.39	16.4
NBHLTM1995_138	regular	Upper Harbor	138	16-Oct-95	1995	UG/KG	48831	9.16	0	43.44	55.7
NBHLTM1995_139	regular	Upper Harbor	139	17-Oct-95	1995	UG/KG	37296	7.57	0.464	62.77	36.7
NBHLTM1995_140	regular	Upper Harbor	140	17-Oct-95	1995	UG/KG	40939	7.88	26.8	59.66	0.583
NBHLTM1995_146	regular	Upper Harbor	146	18-Oct-95	1995	UG/KG	11908	4.36	10.1	40.44	35.7
NBHLTM1995_147	regular	Upper Harbor	147	17-Oct-95	1995	UG/KG	10996	1.44	7.76	73.15	18.6
NBHLTM1995_150	regular	Upper Harbor	150	18-Oct-95	1995	UG/KG	16544	3.72	11.4	43.52	41.8
NBHLTM1995_151	regular	Upper Harbor	151	18-Oct-95	1995	UG/KG	7256.9	1.13	1.83	56.81	41
NBHLTM1995_152	regular	Upper Harbor	152	17-Oct-95	1995	UG/KG	31265	4.47	3.08	59.285	34.95
NBHLTM1995_154	regular	Upper Harbor	154	19-Oct-95	1995	UG/KG	3049.7	0.986	6.5	68.87	15.9
NBHLTM1995_155	regular	Upper Harbor	155	17-Oct-95	1995	UG/KG	2098.15	0.76	5.525	71.24	21.3
NBHLTM1995_125	Dup treated	Upper Harbor	125	12-Oct-95	1995	UG/KG	62215	8.61	0.655	37.68	60
NBHLTM1999_105	regular	Upper Harbor	105	05-Oct-99	1999	UG/KG	330000	6.1	2.05	46.9	51
NBHLTM1999_108	regular	Upper Harbor	108	06-Oct-99	1999	UG/KG	210000	10	0.25	25.7	74
NBHLTM1999_109	regular	Upper Harbor	109	06-Oct-99	1999	UG/KG	260000	6.7	2.27	31.7	66
NBHLTM1999_111	regular	Upper Harbor	111	05-Oct-99	1999	UG/KG	220000	6.5	2.41	32.6	65
NBHLTM1999_114	regular	Upper Harbor	114	01-Oct-99	1999	UG/KG	170000	10.1	2.61	21.6	75.8
NBHLTM1999_115	regular	Upper Harbor	115	05-Oct-99	1999	UG/KG	140000	7.2	0.3	27.1	72.6
NBHLTM1999_117	regular	Upper Harbor	117	18-Nov-99	1999	UG/KG	270000	7.7	5.36	22.9	71.7
NBHLTM1999_120	regular	Upper Harbor	120	18-Nov-99	1999	UG/KG	350000	7.1	9.21	26.2	64.7
NBHLTM1999_121	regular	Upper Harbor	121	18-Nov-99	1999	UG/KG	140000	6.9	2.71	27.2	70.2
NBHLTM1999_123	regular	Upper Harbor	123	29-Sep-99	1999	UG/KG	120000	8.3	3.50	32.3	64.2

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTM1999_125	regular	Upper Harbor	125	29-Sep-99	1999	UG/KG	84000	8.3	3.49	10.3	86.2
NBHLTM1999_126	regular	Upper Harbor	126	29-Sep-99	1999	UG/KG	38000	8.4	3.03	55.1	41.9
NBHLTM1999_130	regular	Upper Harbor	130	01-Oct-99	1999	UG/KG	50000	8.4	0.92	34.2	64.9
NBHLTM1999_131	regular	Upper Harbor	131	29-Sep-99	1999	UG/KG	54000	8.5	7.06	32.1	60.8
NBHLTM1999_134	regular	Upper Harbor	134	01-Oct-99	1999	UG/KG	58000	8	1.85	27.8	70.3
NBHLTM1999_135	regular	Upper Harbor	135	01-Oct-99	1999	UG/KG	2500	0.64	8.24	86.4	5.4
NBHLTM1999_138	regular	Upper Harbor	138	05-Oct-99	1999	UG/KG	33000	10	0.54	18.4	81
NBHLTM1999_139	regular	Upper Harbor	139	29-Sep-99	1999	UG/KG	45000	8.1	9.88	34.2	56
NBHLTM1999_140	regular	Upper Harbor	140	01-Oct-99	1999	UG/KG	30000	5.5	1.33	30.2	68.5
NBHLTM1999_146	regular	Upper Harbor	146	01-Oct-99	1999	UG/KG	7300	3.5	5.23	66.9	27.9
NBHLTM1999_147	regular	Upper Harbor	147	28-Sep-99	1999	UG/KG	5600	1.6	3.34	85.3	11.3
NBHLTM1999_150	regular	Upper Harbor	150	28-Sep-99	1999	UG/KG	20000	5.2	10.1	58.8	31.1
NBHLTM1999_151	regular	Upper Harbor	151	28-Sep-99	1999	UG/KG	6300	2.1	2.39	82.6	15.0
NBHLTM1999_152	regular	Upper Harbor	152	28-Sep-99	1999	UG/KG	11000	3.5	2.11	56.8	41.1
NBHLTM1999_154	regular	Upper Harbor	154	28-Sep-99	1999	UG/KG	21000	5.4	5.63	60.9	33.5
NBHLTM1999_155	regular	Upper Harbor	155	28-Sep-99	1999	UG/KG	1800	0.52	5.12	91	3.9
NBHLTM1999_128	Dup treated	Upper Harbor	128	29-Sep-99	1999	UG/KG	79624.5	8.2	0.11	22.1	77.7
NBHLTM2004_105	regular	Upper Harbor	105	17-Aug-04	2004	UG/KG	150000	9.11	0.68	14.89	84.4
NBHLTM2004_108	regular	Upper Harbor	108	17-Aug-04	2004	UG/KG	140000	9.87	0	2.54	97.5
NBHLTM2004_109	regular	Upper Harbor	109	17-Aug-04	2004	UG/KG	170000	5.76	0	11.88	88.1
NBHLTM2004_111	regular	Upper Harbor	111	17-Aug-04	2004	UG/KG	160000	6.56	2.28	37.28	60.5
NBHLTM2004_114	regular	Upper Harbor	114	17-Aug-04	2004	UG/KG	100000	9.41	0	6.52	93.5
NBHLTM2004_115	regular	Upper Harbor	115	18-Aug-04	2004	UG/KG	120000	10.3	4.88	58.29	36.8
NBHLTM2004_117	regular	Upper Harbor	117	17-Aug-04	2004	UG/KG	100000	9.32	1.21	14.04	84.7
NBHLTM2004_120	regular	Upper Harbor	120	18-Aug-04	2004	UG/KG	110000	9.85	0.09	11.98	87.9
NBHLTM2004_121	regular	Upper Harbor	121	18-Aug-04	2004	UG/KG	65000	7.78	0.64	18.32	81
NBHLTM2004_123	regular	Upper Harbor	123	18-Aug-04	2004	UG/KG	86000	8.46	11.1	12.55	76.3
NBHLTM2004_125	regular	Upper Harbor	125	18-Aug-04	2004	UG/KG	59000	8.89	0	2.2	97.8
NBHLTM2004_126	regular	Upper Harbor	126	19-Aug-04	2004	UG/KG	3000	0.7	60	38.51	1.49
NBHLTM2004_128	regular	Upper Harbor	128	18-Aug-04	2004	UG/KG	62000	8.46	0	7.4	92.6
NBHLTM2004_130	regular	Upper Harbor	130	19-Aug-04	2004	UG/KG	27000	4.88	7.16	69.9	23
NBHLTM2004_131	regular	Upper Harbor	131	18-Aug-04	2004	UG/KG	52000	8.43	0	16.23	83.8
NBHLTM2004_134	regular	Upper Harbor	134	19-Aug-04	2004	UG/KG	42000	7.8	0	9.3	90.7
NBHLTM2004_135	regular	Upper Harbor	135	19-Aug-04	2004	UG/KG	370	0.2	17.3	81.47	1.28
NBHLTM2004_138	regular	Upper Harbor	138	20-Aug-04	2004	UG/KG	44000	8.46	0	4.39	95.6
NBHLTM2004_140	regular	Upper Harbor	140	20-Aug-04	2004	UG/KG	32000	8.11	0.39	14.27	85.3
NBHLTM2004_146	regular	Upper Harbor	146	20-Aug-04	2004	UG/KG	8600	5.43	9.46	59.95	30.6
NBHLTM2004_147	regular	Upper Harbor	147	20-Aug-04	2004	UG/KG	4800	1.47	1.44	77.75	20.8
NBHLTM2004_150	regular	Upper Harbor	150	21-Aug-04	2004	UG/KG	12000	5.63	3.63	75.58	20.8
NBHLTM2004_151	regular	Upper Harbor	151	21-Aug-04	2004	UG/KG	5000	2.43	8.35	76.92	14.9
NBHLTM2004_152	regular	Upper Harbor	152	20-Aug-04	2004	UG/KG	19000	3.96	4.16	43.71	52.2
NBHLTM2004_154	regular	Upper Harbor	154	21-Aug-04	2004	UG/KG	2300	0.84	19.4	72.87	7.74
NBHLTM2004_155	regular	Upper Harbor	155	20-Aug-04	2004	UG/KG	1900	0.7	13.5	80.2	6.29
NBHLTM2004_139	Dup treated	Upper Harbor	139	19-Aug-04	2004	UG/KG	41272.2	7.74	0.27	22.15	77.6
NBHLTMV2009+SEDIMENT GRABS_105	regular	Upper Harbor	105	24-Sep-09	2009	UG/KG	200000	3.08	0.1	22.6	77.3
NBHLTMV2009+SEDIMENT GRABS_108	regular	Upper Harbor	108	24-Sep-09	2009	UG/KG	110000	4.49	0.4	41.8	56.8
NBHLTMV2009+SEDIMENT GRABS_109	regular	Upper Harbor	109	24-Sep-09	2009	UG/KG	90000	2.335	0.9	45.9	48.6
NBHLTMV2009+SEDIMENT GRABS_111	regular	Upper Harbor	111	24-Sep-09	2009	UG/KG	110000	2.78	0.1	26.8	73.1
NBHLTMV2009+SEDIMENT GRABS_114	regular	Upper Harbor	114	24-Sep-09	2009	UG/KG	120000	1.935	0.1	28.9	71.1
NBHLTMV2009+SEDIMENT GRABS_115	regular	Upper Harbor	115	24-Sep-09	2009	UG/KG	120000	2.165	0.4	18.6	80.8
NBHLTMV2009+SEDIMENT GRABS_117	regular	Upper Harbor	117	25-Sep-09	2009	UG/KG	270000	1.76	2.8	32.1	63.9
NBHLTMV2009+SEDIMENT GRABS_120	regular	Upper Harbor	120	25-Sep-09	2009	UG/KG	90000	3.615	0.3	24	75.6
NBHLTMV2009+SEDIMENT GRABS_121	regular	Upper Harbor	121	25-Sep-09	2009	UG/KG	80000	3.42	1.1	35.9	62.7

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTMV2009+SEDIMENT GRABS_123	regular	Upper Harbor	123	25-Sep-09	2009	UG/KG	92000	2.995	0.1	13.7	86.2
NBHLTMV2009+SEDIMENT GRABS_125	regular	Upper Harbor	125	23-Sep-09	2009	UG/KG	330000	5.15	0.9	38.3	58.1
NBHLTMV2009+SEDIMENT GRABS_126	regular	Upper Harbor	126	23-Sep-09	2009	UG/KG	6100	0.4895	6.9	71.7	11
NBHLTMV2009+SEDIMENT GRABS_128	regular	Upper Harbor	128	23-Sep-09	2009	UG/KG	46000	4.325	2.1	22.3	74.6
NBHLTMV2009+SEDIMENT GRABS_130	regular	Upper Harbor	130	22-Sep-09	2009	UG/KG	13000	1.0125	10.8	54.7	14.4
NBHLTMV2009+SEDIMENT GRABS_131	regular	Upper Harbor	131	23-Sep-09	2009	UG/KG	32000	1.895	5.3	44.6	43.7
NBHLTMV2009+SEDIMENT GRABS_134	regular	Upper Harbor	134	23-Sep-09	2009	UG/KG	48000	2.36	2.4	45.4	51.3
NBHLTMV2009+SEDIMENT GRABS_135	regular	Upper Harbor	135	23-Sep-09	2009	UG/KG	2000	0.4425	9	73.2	4.9
NBHLTMV2009+SEDIMENT GRABS_138	regular	Upper Harbor	138	22-Sep-09	2009	UG/KG	30000	3.65	0.1	38	62
NBHLTMV2009+SEDIMENT GRABS_139	regular	Upper Harbor	139	24-Sep-09	2009	UG/KG	29000	4.21	5.3	55.9	36.4
NBHLTMV2009+SEDIMENT GRABS_140	regular	Upper Harbor	140	24-Sep-09	2009	UG/KG	25000	4.135	5.2	61.7	31.2
NBHLTMV2009+SEDIMENT GRABS_147	regular	Upper Harbor	147	22-Sep-09	2009	UG/KG	8500	1.14	1.8	92.3	1
NBHLTMV2009+SEDIMENT GRABS_150	regular	Upper Harbor	150	23-Sep-09	2009	UG/KG	19000	3.08	5.3	56	37.4
NBHLTMV2009+SEDIMENT GRABS_151	regular	Upper Harbor	151	22-Sep-09	2009	UG/KG	5100	1.145	5.6	39.9	46.1
NBHLTMV2009+SEDIMENT GRABS_152	regular	Upper Harbor	152	22-Sep-09	2009	UG/KG	18000	2.865	0.3	22	77.6
NBHLTMV2009+SEDIMENT GRABS_154	regular	Upper Harbor	154	25-Sep-09	2009	UG/KG	590	0.378	6.7	73.5	3.4
NBHLTMV2009+SEDIMENT GRABS_155	regular	Upper Harbor	155	22-Sep-09	2009	UG/KG	6400	1.325	1.5	72.6	8.2
NBHLTMV2009+SEDIMENT GRABS_146	Dup treated	Upper Harbor	146	24-Sep-09	2009	UG/KG	8187.05	2.7525	3.9	28.9	66
NBHLTM2014_105	regular	Upper Harbor	105	25-Sep-14	2014	UG/KG	70000	6.39	0	3	97
NBHLTM2014_108	regular	Upper Harbor	108	26-Sep-14	2014	UG/KG	11000	7.925	28	20	62
NBHLTM2014_109	regular	Upper Harbor	109	25-Sep-14	2014	UG/KG	140000	7.725	0	11	89
NBHLTM2014_111	regular	Upper Harbor	111	26-Sep-14	2014	UG/KG	110000	5.47	0	1	99
NBHLTM2014_114	regular	Upper Harbor	114	26-Sep-14	2014	UG/KG	87000	6.89	0	2	98
NBHLTM2014_115	regular	Upper Harbor	115	25-Sep-14	2014	UG/KG	940000	7.725	0	20	80
NBHLTM2014_117	regular	Upper Harbor	117	26-Sep-14	2014	UG/KG	300000	6.295	5	26	69
NBHLTM2014_120	regular	Upper Harbor	120	22-Sep-14	2014	UG/KG	28000	8.375	8	31	61
NBHLTM2014_121	regular	Upper Harbor	121	29-Sep-14	2014	UG/KG	74000	5.08	7	41	52
NBHLTM2014_123	regular	Upper Harbor	123	29-Sep-14	2014	UG/KG	49000	5.49	1	14	85
NBHLTM2014_125	regular	Upper Harbor	125	22-Sep-14	2014	UG/KG	41000	6.045	2	5	93
NBHLTM2014_126	regular	Upper Harbor	126	26-Sep-14	2014	UG/KG	2900	0.5895	9	83	8
NBHLTM2014_128	regular	Upper Harbor	128	29-Sep-14	2014	UG/KG	130000	6.265	0	15	95
NBHLTM2014_130	regular	Upper Harbor	130	22-Sep-14	2014	UG/KG	48000	4.48	1	48	51
NBHLTM2014_131	regular	Upper Harbor	131	25-Sep-14	2014	UG/KG	24000	4.905	0	19	81
NBHLTM2014_134	regular	Upper Harbor	134	22-Sep-14	2014	UG/KG	59000	6.2	10	10	80
NBHLTM2014_135	regular	Upper Harbor	135	23-Sep-14	2014	UG/KG	500	0.292	20	63	17
NBHLTM2014_138	regular	Upper Harbor	138	26-Sep-14	2014	UG/KG	18000	6.13	0	1	99
NBHLTM2014_140	regular	Upper Harbor	140	23-Sep-14	2014	UG/KG	22000	4.99	3	24	73
NBHLTM2014_146	regular	Upper Harbor	146	23-Sep-14	2014	UG/KG	7800	4.055	8	54	38
NBHLTM2014_147	regular	Upper Harbor	147	23-Sep-14	2014	UG/KG	3100	1.06	4	77	19
NBHLTM2014_150	regular	Upper Harbor	150	22-Sep-14	2014	UG/KG	11000	3.895	5	27	68
NBHLTM2014_151	regular	Upper Harbor	151	30-Sep-14	2014	UG/KG	2600	1.1	3	84	13
NBHLTM2014_154	regular	Upper Harbor	154	25-Sep-14	2014	UG/KG	570	0.2575	30	66	4
NBHLTM2014_155	regular	Upper Harbor	155	30-Sep-14	2014	UG/KG	790	0.7245	27	67	6
NBHLTM2014_139	Dup treated	Upper Harbor	139	25-Sep-14	2014	UG/KG	25127.9	5.425	1	40	59
NBHLTM2014_152	Dup treated	Upper Harbor	152	25-Sep-14	2014	UG/KG	11968.22	4.44	8	32	60
20FSP20_LTM_105	regular	Upper Harbor	105	21-Sep-20	2020	UG/KG	14184.4	5.066666667	2	11	87
20FSP20_LTM_108	regular	Upper Harbor	108	21-Sep-20	2020	UG/KG	9433.12	5.03	0	4	96
20FSP20_LTM_109	regular	Upper Harbor	109	21-Sep-20	2020	UG/KG	13829.17	4.553333333	0	4	96
20FSP20_LTM_111	regular	Upper Harbor	111	21-Sep-20	2020	UG/KG	12332.53	5.296666667	1	4	95
20FSP20_LTM_114	regular	Upper Harbor	114	21-Sep-20	2020	UG/KG	7026.51	4.576666667	1	16	83
20FSP20_LTM_115	regular	Upper Harbor	115	21-Sep-20	2020	UG/KG	35546.5	4.033333333	0	10	90
20FSP20_LTM_117	regular	Upper Harbor	117	21-Sep-20	2020	UG/KG	48942.8	4.09	4	12	84
20FSP20_LTM_120	regular	Upper Harbor	120	21-Sep-20	2020	UG/KG	16586.42	6.213333333	2	18	80

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples											
Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
20FSP20_LTM_121	regular	Upper Harbor	121	21-Sep-20	2020	UG/KG	8626.48	4.023333333	1	26	73
20FSP20_LTM_125	regular	Upper Harbor	125	22-Sep-20	2020	UG/KG	7818.35	6.25	1	2	97
20FSP20_LTM_126	regular	Upper Harbor	126	22-Sep-20	2020	UG/KG	1282.422	1.16	5	85.6	9.4
20FSP20_LTM_128	regular	Upper Harbor	128	22-Sep-20	2020	UG/KG	39923.4	6.32	1	18	81
20FSP20_LTM_130	regular	Upper Harbor	130	23-Sep-20	2020	UG/KG	5430.07	5.08	1	15	84
20FSP20_LTM_131	regular	Upper Harbor	131	22-Sep-20	2020	UG/KG	6288.45	3.76	0	17	83
20FSP20_LTM_134	regular	Upper Harbor	134	22-Sep-20	2020	UG/KG	3272.6	4.26	5	9	86
20FSP20_LTM_135	regular	Upper Harbor	135	22-Sep-20	2020	UG/KG	321.682	0.588	19	70	11
20FSP20_LTM_138	regular	Upper Harbor	138	22-Sep-20	2020	UG/KG	2780.04	3.64	1	8	91
20FSP20_LTM_139	regular	Upper Harbor	139	23-Sep-20	2020	UG/KG	3591.8	2.5	1	63	36
20FSP20_LTM_140	regular	Upper Harbor	140	22-Sep-20	2020	UG/KG	6695.96	6.67	1	11	88
20FSP20_LTM_146	regular	Upper Harbor	146	23-Sep-20	2020	UG/KG	2485.89	4.36	13	31	56
20FSP20_LTM_147	regular	Upper Harbor	147	23-Sep-20	2020	UG/KG	2249.81	2.2	7	61	32
20FSP20_LTM_150	regular	Upper Harbor	150	23-Sep-20	2020	UG/KG	4352.26	4.4	12	17	71
20FSP20_LTM_151	regular	Upper Harbor	151	23-Sep-20	2020	UG/KG	1350.718	1.56	3	81	16
20FSP20_LTM_152	regular	Upper Harbor	152	23-Sep-20	2020	UG/KG	3811.52	3.46	25	31	44
20FSP20_LTM_154	regular	Upper Harbor	154	23-Sep-20	2020	UG/KG	575.535	1.35	8	70	22
20FSP20_LTM_155	regular	Upper Harbor	155	23-Sep-20	2020	UG/KG	340.086	0.446	6	88.6	5.4
20FSP20_LTM_123	Dup treated	Upper Harbor	123	22-Sep-20	2020	UG/KG	8924.33	3.32	0	11	89
NBHLTM1993_304	regular	Outer Harbor	304	11-Oct-93	1993	UG/KG	503.9	0.42	9.9	78.9	11.1
NBHLTM1993_306	regular	Outer Harbor	306	19-Oct-93	1993	UG/KG	84.7	0.11	2.6	96.9	0.5
NBHLTM1993_309	regular	Outer Harbor	309	19-Oct-93	1993	UG/KG	500.95	3.3	2.6	44.4	53.1
NBHLTM1993_310	regular	Outer Harbor	310	12-Oct-93	1993	UG/KG	1075.2	0.71	8	52.2	39.9
NBHLTM1993_311	regular	Outer Harbor	311	19-Oct-93	1993	UG/KG	4807.6	0.29	9	85.5	5.5
NBHLTM1993_317	regular	Outer Harbor	317	13-Oct-93	1993	UG/KG	1337.74	3.6	0.2	31.2	68.6
NBHLTM1993_318	regular	Outer Harbor	318	19-Oct-93	1993	UG/KG	27.61	0.19	4.8	91.3	3.9
NBHLTM1993_324	regular	Outer Harbor	324	13-Oct-93	1993	UG/KG	937.1	2.8	2.3	24.2	73.6
NBHLTM1993_325	regular	Outer Harbor	325	16-Oct-93	1993	UG/KG	395.7	1.55	3.3	42.2	54.5
NBHLTM1993_331	regular	Outer Harbor	331	16-Oct-93	1993	UG/KG	382.25	1.95	0.5	13.5	85.8
NBHLTM1993_332	regular	Outer Harbor	332	16-Oct-93	1993	UG/KG	55.46	0.32	1.2	79	19.7
NBHLTM1993_333	regular	Outer Harbor	333	16-Oct-93	1993	UG/KG	36.28	0.68	35.2	54.6	10.2
NBHLTM1993_334	regular	Outer Harbor	334	15-Oct-93	1993	UG/KG	204.22	1.57	6.1	36.2	57.7
NBHLTM1993_335	regular	Outer Harbor	335	16-Oct-93	1993	UG/KG	2.32	0.08	0.8	97.9	1.4
NBHLTM1993_338	regular	Outer Harbor	338	15-Oct-93	1993	UG/KG	161.66	1.86	0.2	19.9	79.9
NBHLTM1993_339	regular	Outer Harbor	339	15-Oct-93	1993	UG/KG	1108.5	1.74	4	28.9	67.2
NBHLTM1993_340	regular	Outer Harbor	340	15-Oct-93	1993	UG/KG	134.25	1.67	0.4	21.3	78.3
NBHLTM1993_341	regular	Outer Harbor	341	15-Oct-93	1993	UG/KG	47.82	0.74	0.6	69.7	29.6
NBHLTM1993_345	regular	Outer Harbor	345	14-Oct-93	1993	UG/KG	219.38	1.28	0	18.1	81.9
NBHLTM1993_346	regular	Outer Harbor	346	14-Oct-93	1993	UG/KG	16.74	0.16	0	86.1	13.8
NBHLTM1993_349	regular	Outer Harbor	349	14-Oct-93	1993	UG/KG	46.34	0.45	1.3	55.5	43.3
NBHLTM1993_352	regular	Outer Harbor	352	14-Oct-93	1993	UG/KG	1.41	0.44	32.4	63.6	3.9
NBHLTM1993_323	Dup treated	Outer Harbor	323	19-Oct-93	1993	UG/KG	450.505	3.05	5.6	20.8	73.7
NBHLTM1995_304	regular	Outer Harbor	304	09-Oct-95	1995	UG/KG	1033.3	0.862	3.77	60	30.3
NBHLTM1995_306	regular	Outer Harbor	306	17-Oct-95	1995	UG/KG	1.44	0.0127	1.02	80.89	18.1
NBHLTM1995_309	regular	Outer Harbor	309	12-Oct-95	1995	UG/KG	725.25	2.82	3.25	84.25	9.47
NBHLTM1995_310	regular	Outer Harbor	310	09-Oct-95	1995	UG/KG	905.3	0.924	1.42	57.566	40.3
NBHLTM1995_311	regular	Outer Harbor	311	17-Oct-95	1995	UG/KG	83.4	0.303	4.34	57.37	21.4
NBHLTM1995_317	regular	Outer Harbor	317	26-Sep-95	1995	UG/KG	1747.79	2.9	--	--	--
NBHLTM1995_318	regular	Outer Harbor	318	13-Oct-95	1995	UG/KG	26.448	0.11	2.29	87.68	7.82
NBHLTM1995_323	regular	Outer Harbor	323	12-Oct-95	1995	UG/KG	271.07	1.05	0.959	68.42	28.4
NBHLTM1995_324	regular	Outer Harbor	324	12-Oct-95	1995	UG/KG	961.87	2.06	7.07	70.96	19.2
NBHLTM1995_325	regular	Outer Harbor	325	26-Sep-95	1995	UG/KG	470.02	1.8	--	--	--
NBHLTM1995_331	regular	Outer Harbor	331	11-Oct-95	1995	UG/KG	297.91	1.26	6.31	87.45	3.65

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples											
Sample ID	**Sample Type**	**Reach**	**LTM Station**	**Sample Date**	**Year**	**PCB units**	**Total PCBs (NOAA 18)**	**TOC (%)**	**Grain Size - Gravel**	**Grain Size - Sand**	**Grain Size - Silt and Clay**
NBHLTM1995_333	regular	Outer Harbor	333	13-Oct-95	1995	UG/KG	36.91	0.894	12.4	57.84	21.8
NBHLTM1995_334	regular	Outer Harbor	334	26-Sep-95	1995	UG/KG	166.49	1.26	--	--	--
NBHLTM1995_335	regular	Outer Harbor	335	13-Oct-95	1995	UG/KG	2.22	0.0604	1.23	87.175	10.4
NBHLTM1995_338	regular	Outer Harbor	338	10-Oct-95	1995	UG/KG	147.1	1.47	2.36	67.8	29.9
NBHLTM1995_339	regular	Outer Harbor	339	11-Oct-95	1995	UG/KG	78.02	0.981	4.05	59.78	36.2
NBHLTM1995_340	regular	Outer Harbor	340	11-Oct-95	1995	UG/KG	109.02	1.24	0	59.43	40.4
NBHLTM1995_341	regular	Outer Harbor	341	11-Oct-95	1995	UG/KG	38.71	0.373	1.15	69.69	29.1
NBHLTM1995_345	regular	Outer Harbor	345	10-Oct-95	1995	UG/KG	84.73	1.24	4.82	89.12	0.536
NBHLTM1995_346	regular	Outer Harbor	346	10-Oct-95	1995	UG/KG	12.2	0.0902	0.848	57.21	40.6
NBHLTM1995_349	regular	Outer Harbor	349	10-Oct-95	1995	UG/KG	22.93	0.315	0.7835	53.821	45.35
NBHLTM1995_332	Dup treated	Outer Harbor	332	12-Oct-95	1995	UG/KG	53.785	0.386	1.19	89.27	8.6
NBHLTM1999_304	regular	Outer Harbor	304	14-Sep-99	1999	UG/KG	500	0.85	8.31	81.7	10
NBHLTM1999_306	regular	Outer Harbor	306	14-Sep-99	1999	UG/KG	16	0.038	4.77	95.27	0
NBHLTM1999_309	regular	Outer Harbor	309	07-Oct-99	1999	UG/KG	830	3.3	0	21.6	78.4
NBHLTM1999_310	regular	Outer Harbor	310	14-Sep-99	1999	UG/KG	1400	1.3	12.7	54.4	32.9
NBHLTM1999_311	regular	Outer Harbor	311	14-Sep-99	1999	UG/KG	38	0.22	10.07	86.3	3.6
NBHLTM1999_317	regular	Outer Harbor	317	07-Oct-99	1999	UG/KG	2000	3.6	2.95	29.4	67.6
NBHLTM1999_323	regular	Outer Harbor	323	07-Oct-99	1999	UG/KG	460	1.8	3.57	42	54.5
NBHLTM1999_324	regular	Outer Harbor	324	07-Oct-99	1999	UG/KG	1000	3.1	0.95	32.1	67
NBHLTM1999_325	regular	Outer Harbor	325	10-Oct-99	1999	UG/KG	660	2.5	0.11	38.6	61.2
NBHLTM1999_331	regular	Outer Harbor	331	15-Sep-99	1999	UG/KG	540	2.4	0	22.3	77.7
NBHLTM1999_332	regular	Outer Harbor	332	07-Oct-99	1999	UG/KG	65	1.2	2.73	77.9	19.3
NBHLTM1999_333	regular	Outer Harbor	333	08-Oct-99	1999	UG/KG	29	0.88	35.23	58.2	6.6
NBHLTM1999_334	regular	Outer Harbor	334	08-Oct-99	1999	UG/KG	210	2.1	2.92	33.9	63.2
NBHLTM1999_335	regular	Outer Harbor	335	08-Oct-99	1999	UG/KG	47	0.58	10.9	78.2	10.9
NBHLTM1999_338	regular	Outer Harbor	338	07-Oct-99	1999	UG/KG	160	2.4	1.06	23.7	75.3
NBHLTM1999_339	regular	Outer Harbor	339	07-Oct-99	1999	UG/KG	110	1.9	0.38	44.3	55.3
NBHLTM1999_340	regular	Outer Harbor	340	08-Oct-99	1999	UG/KG	120	2.1	0.5	27.9	71.7
NBHLTM1999_341	regular	Outer Harbor	341	08-Oct-99	1999	UG/KG	67	1.3	0.53	67.8	31.7
NBHLTM1999_345	regular	Outer Harbor	345	07-Oct-99	1999	UG/KG	110	2.3	0	18.2	81.8
NBHLTM1999_346	regular	Outer Harbor	346	08-Oct-99	1999	UG/KG	15	0.21	0.6	86.5	12.8
NBHLTM1999_349	regular	Outer Harbor	349	15-Sep-99	1999	UG/KG	51	0.8	0.16	49.9	49.9
NBHLTM1999_352	regular	Outer Harbor	352	15-Sep-99	1999	UG/KG	12	0.48	40.7	53.3	6
NBHLTM1999_318	Dup treated	Outer Harbor	318	10-Oct-99	1999	UG/KG	16.463	0.091	11.4	86.6	2
NBHLTM2004_304	regular	Outer Harbor	304	19-Aug-04	2004	UG/KG	730	0.81	5.57	73.64	20.8
NBHLTM2004_306	regular	Outer Harbor	306	19-Aug-04	2004	UG/KG	3.4	0.05	8.13	91.65	0.3
NBHLTM2004_309	regular	Outer Harbor	309	18-Aug-04	2004	UG/KG	230	1.76	0.81	38.49	60.7
NBHLTM2004_310	regular	Outer Harbor	310	17-Aug-04	2004	UG/KG	640	1.09	5.08	55.28	39.6
NBHLTM2004_311	regular	Outer Harbor	311	17-Aug-04	2004	UG/KG	13	0.16	6.37	90.62	3.04
NBHLTM2004_317	regular	Outer Harbor	317	17-Aug-04	2004	UG/KG	710	2.98	0	4.91	95.1
NBHLTM2004_318	regular	Outer Harbor	318	17-Aug-04	2004	UG/KG	8.8	0.14	6.33	90.78	2.81
NBHLTM2004_323	regular	Outer Harbor	323	18-Aug-04	2004	UG/KG	260	3.32	0	4.07	95.9
NBHLTM2004_324	regular	Outer Harbor	324	18-Aug-04	2004	UG/KG	650	2.74	1	19.11	79.9
NBHLTM2004_331	regular	Outer Harbor	331	18-Aug-04	2004	UG/KG	170	2.29	0	7.08	92.9
NBHLTM2004_332	regular	Outer Harbor	332	18-Aug-04	2004	UG/KG	11	0.34	0.4	86.13	13.4
NBHLTM2004_333	regular	Outer Harbor	333	18-Aug-04	2004	UG/KG	14	0.35	38.7	54.88	6.46
NBHLTM2004_334	regular	Outer Harbor	334	22-Aug-04	2004	UG/KG	55	1.79	0.97	28.59	70.4
NBHLTM2004_335	regular	Outer Harbor	335	22-Aug-04	2004	UG/KG	53	1.18	5.76	54.42	39.8
NBHLTM2004_338	regular	Outer Harbor	338	18-Aug-04	2004	UG/KG	36	1.5	0	14.37	85.6
NBHLTM2004_339	regular	Outer Harbor	339	22-Aug-04	2004	UG/KG	24	1.26	0	32.61	67.4
NBHLTM2004_340	regular	Outer Harbor	340	22-Aug-04	2004	UG/KG	22	1.59	0	21	79
NBHLTM2004_341	regular	Outer Harbor	341	22-Aug-04	2004	UG/KG	14	0.53	1.22	76.89	21.9
NBHLTM2004_345	regular	Outer Harbor	345	20-Aug-04	2004	UG/KG	15	1.67	0	26.18	73.8

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
NBHLTM2004_346	regular	Outer Harbor	346	20-Aug-04	2004	UG/KG	3.9	0.23	0.15	91.49	8.33
NBHLTM2004_349	regular	Outer Harbor	349	20-Aug-04	2004	UG/KG	5.7	0.35	0.26	64.03	35.8
NBHLTM2004_352	regular	Outer Harbor	352	20-Aug-04	2004	UG/KG	4.4	0.2	43.8	51.02	5.17
NBHLTM2004_325	Dup treated	Outer Harbor	325	17-Aug-04	2004	UG/KG	376.9	1.915	0.565	29.21	70.25
NBHLTMV2009+SEDIMENT GRABS_304	regular	Outer Harbor	304	25-Sep-09	2009	UG/KG	1100	0.94	2.3	72.9	20.2
NBHLTMV2009+SEDIMENT GRABS_306	regular	Outer Harbor	306	28-Sep-09	2009	UG/KG	2.8	0.05	0.6	92.3	6
NBHLTMV2009+SEDIMENT GRABS_309	regular	Outer Harbor	309	25-Sep-09	2009	UG/KG	330	1.135	1.1	41.5	31
NBHLTMV2009+SEDIMENT GRABS_310	regular	Outer Harbor	310	28-Sep-09	2009	UG/KG	580	0.3055	2.3	64.7	26
NBHLTMV2009+SEDIMENT GRABS_311	regular	Outer Harbor	311	25-Sep-09	2009	UG/KG	41	3.275	3.2	89.4	2.3
NBHLTMV2009+SEDIMENT GRABS_317	regular	Outer Harbor	317	28-Sep-09	2009	UG/KG	740	1.3	2.4	47	49.8
NBHLTMV2009+SEDIMENT GRABS_318	regular	Outer Harbor	318	25-Sep-09	2009	UG/KG	9.5	0.1005	2.3	93.1	0.8
NBHLTMV2009+SEDIMENT GRABS_324	regular	Outer Harbor	324	25-Sep-09	2009	UG/KG	1000	1.305	2.2	36.2	60.9
NBHLTMV2009+SEDIMENT GRABS_325	regular	Outer Harbor	325	25-Sep-09	2009	UG/KG	380	1.19	0.2	29.7	70
NBHLTMV2009+SEDIMENT GRABS_331	regular	Outer Harbor	331	24-Sep-09	2009	UG/KG	200	1.485	0.3	22.2	77.4
NBHLTMV2009+SEDIMENT GRABS_332	regular	Outer Harbor	332	24-Sep-09	2009	UG/KG	61	0.3005	1.2	83.3	13.8
NBHLTMV2009+SEDIMENT GRABS_333	regular	Outer Harbor	333	24-Sep-09	2009	UG/KG	110	1.335	10.8	25.5	34.4
NBHLTMV2009+SEDIMENT GRABS_334	regular	Outer Harbor	334	24-Sep-09	2009	UG/KG	150	1.185	0.8	27.8	71.1
NBHLTMV2009+SEDIMENT GRABS_335	regular	Outer Harbor	335	24-Sep-09	2009	UG/KG	120	1.1	8.4	36.6	39.9
NBHLTMV2009+SEDIMENT GRABS_338	regular	Outer Harbor	338	23-Sep-09	2009	UG/KG	140	1.17	0.1	19.8	80.2
NBHLTMV2009+SEDIMENT GRABS_339	regular	Outer Harbor	339	23-Sep-09	2009	UG/KG	84	0.987	0.4	29.9	67.3
NBHLTMV2009+SEDIMENT GRABS_340	regular	Outer Harbor	340	23-Sep-09	2009	UG/KG	110	0.961	0.2	16.7	83.1
NBHLTMV2009+SEDIMENT GRABS_341	regular	Outer Harbor	341	23-Sep-09	2009	UG/KG	20	0.2385	0.4	87.3	11.8
NBHLTMV2009+SEDIMENT GRABS_345	regular	Outer Harbor	345	23-Sep-09	2009	UG/KG	90	1.33	0.1	18.4	81.6
NBHLTMV2009+SEDIMENT GRABS_346	regular	Outer Harbor	346	22-Sep-09	2009	UG/KG	10	0.1755	1.2	93.2	5.3
NBHLTMV2009+SEDIMENT GRABS_349	regular	Outer Harbor	349	22-Sep-09	2009	UG/KG	6.6	0.39	0.2	61.8	37.9
NBHLTMV2009+SEDIMENT GRABS_352	regular	Outer Harbor	352	22-Sep-09	2009	UG/KG	20	0.509	10.9	61.8	12.3
NBHLTMV2009+SEDIMENT GRABS_323	Dup treated	Outer Harbor	323	25-Sep-09	2009	UG/KG	269.80	0.75	0.7	26.9	72
NBHLTM2014_304	regular	Outer Harbor	304	25-Sep-14	2014	UG/KG	770	1.49	16	49	35
NBHLTM2014_309	regular	Outer Harbor	309	25-Sep-14	2014	UG/KG	380	3	1	19	80
NBHLTM2014_310	regular	Outer Harbor	310	25-Sep-14	2014	UG/KG	440	2.01	1	16	83
NBHLTM2014_311	regular	Outer Harbor	311	24-Sep-14	2014	UG/KG	15	0.411	3	92	5
NBHLTM2014_317	regular	Outer Harbor	317	25-Sep-14	2014	UG/KG	640	3.05	0	9	91
NBHLTM2014_318	regular	Outer Harbor	318	24-Sep-14	2014	UG/KG	11	0.149	15	83	3
NBHLTM2014_323	regular	Outer Harbor	323	29-Sep-14	2014	UG/KG	190	3.02	4	4	92
NBHLTM2014_324	regular	Outer Harbor	324	29-Sep-14	2014	UG/KG	460	1.38	2	35	63
NBHLTM2014_325	regular	Outer Harbor	325	29-Sep-14	2014	UG/KG	270	1.675	2	26	72
NBHLTM2014_331	regular	Outer Harbor	331	29-Sep-14	2014	UG/KG	120	1.285	6	20	74
NBHLTM2014_332	regular	Outer Harbor	332	29-Sep-14	2014	UG/KG	21	0.346	2	80	18
NBHLTM2014_333	regular	Outer Harbor	333	23-Sep-14	2014	UG/KG	19	1.08	44	47	9
NBHLTM2014_334	regular	Outer Harbor	334	23-Sep-14	2014	UG/KG	96	3.49	2	30	68
NBHLTM2014_335	regular	Outer Harbor	335	23-Sep-14	2014	UG/KG	120	1.53	28	16	56
NBHLTM2014_338	regular	Outer Harbor	338	29-Sep-14	2014	UG/KG	71	1.49	0	29	71
NBHLTM2014_339	regular	Outer Harbor	339	23-Sep-14	2014	UG/KG	55	1.34	0	36	64
NBHLTM2014_340	regular	Outer Harbor	340	23-Sep-14	2014	UG/KG	19	1.43	0	28	72
NBHLTM2014_341	regular	Outer Harbor	341	23-Sep-14	2014	UG/KG	24	0.7435	1	68	31
NBHLTM2014_345	regular	Outer Harbor	345	24-Sep-14	2014	UG/KG	51	1.54	0	17	83
NBHLTM2014_346	regular	Outer Harbor	346	23-Sep-14	2014	UG/KG	3	0.2125	0	90	10
NBHLTM2014_349	regular	Outer Harbor	349	24-Sep-14	2014	UG/KG	9.4	0.4095	0	62	38
NBHLTM2014_352	regular	Outer Harbor	352	24-Sep-14	2014	UG/KG	18	1.37	30	43	27
NBHLTM2014_306	Dup treated	Outer Harbor	306	24-Sep-14	2014	UG/KG	1.6602	0.0717	3	92	5
20FSP20_LTM_304	regular	Outer Harbor	304	28-Sep-20	2020	UG/KG	380.98	1.2	11	65	24
20FSP20_LTM_306	regular	Outer Harbor	306	28-Sep-20	2020	UG/KG	2.423	0.098	5	92.4	2.6
20FSP20_LTM_309	regular	Outer Harbor	309	28-Sep-20	2020	UG/KG	209.464	2.05	7	24	69

Table 1. Summary of NOAA 18 Total PCBs and Grain Size Data in LTM Sediment Samples

Sample ID	Sample Type	Reach	LTM Station	Sample Date	Year	PCB units	Total PCBs (NOAA 18)	TOC (%)	Grain Size - Gravel	Grain Size - Sand	Grain Size - Silt and Clay
20FSP20_LTM_311	regular	Outer Harbor	311	28-Sep-20	2020	UG/KG	44.353	0.363	5	78	17
20FSP20_LTM_317	regular	Outer Harbor	317	28-Sep-20	2020	UG/KG	401.287	2.79	0	6	94
20FSP20_LTM_318	regular	Outer Harbor	318	28-Sep-20	2020	UG/KG	6.142	0.142	11	87.5	1.5
20FSP20_LTM_323	regular	Outer Harbor	323	25-Sep-20	2020	UG/KG	75.49	0.933	5	16	79
20FSP20_LTM_324	regular	Outer Harbor	324	25-Sep-20	2020	UG/KG	448.871	1.53	1	31	68
20FSP20_LTM_331	regular	Outer Harbor	331	25-Sep-20	2020	UG/KG	106.954	1.34	32	21	47
20FSP20_LTM_332	regular	Outer Harbor	332	25-Sep-20	2020	UG/KG	28.166	0.506	2	74	24
20FSP20_LTM_333	regular	Outer Harbor	333	25-Sep-20	2020	UG/KG	33.97	1.17	26	45	29
20FSP20_LTM_334	regular	Outer Harbor	334	25-Sep-20	2020	UG/KG	64.82	1.67	1	20	79
20FSP20_LTM_335	regular	Outer Harbor	335	24-Sep-20	2020	UG/KG	104.8	2.44	18	12	70
20FSP20_LTM_338	regular	Outer Harbor	338	24-Sep-20	2020	UG/KG	45.94	1.23	0	23	77
20FSP20_LTM_339	regular	Outer Harbor	339	24-Sep-20	2020	UG/KG	54.067	1.66	0	28	72
20FSP20_LTM_340	regular	Outer Harbor	340	25-Sep-20	2020	UG/KG	41.959	1.73	0	29	71
20FSP20_LTM_341	regular	Outer Harbor	341	24-Sep-20	2020	UG/KG	8.796	0.474	1	79	20
20FSP20_LTM_345	regular	Outer Harbor	345	24-Sep-20	2020	UG/KG	41.834	1.257	0	17	83
20FSP20_LTM_346	regular	Outer Harbor	346	24-Sep-20	2020	UG/KG	3.533	0.279	1	88	11
20FSP20_LTM_349	regular	Outer Harbor	349	24-Sep-20	2020	UG/KG	19.436	0.898	1	30	69
20FSP20_LTM_352	regular	Outer Harbor	352	24-Sep-20	2020	UG/KG	2.852	0.246	39	52.6	8.4
20FSP20_LTM_310	Dup treated	Outer Harbor	310	28-Sep-20	2020	UG/KG	254.579	1.075	0.5	28.5	71
20FSP20_LTM_325	Dup treated	Outer Harbor	325	25-Sep-20	2020	UG/KG	159.503	1.6	1.5	23.5	75

Notes:

-- - Not available / Not listed.

ug/kg - microgram per kilogram.

Gravel = >2.00 mm.

Sand = <2.00 mm - >0.0625 mm.

Silt and Clay = <0.0625 mm.

Dup treated = Data presented is the average of the parent and duplicate sample.

(a) The fraction for silt and clay for LTM VII was <0.075 mm.

(b) The fraction for LTM VII was <2.00 - >0.075 mm.

Appendix C Statistical Output

Mixed ANOVA: PCBs

ANOVA Table (type III tests): logPCBs between reach and over time

Effect	DFn	DFd	F	P	p<0.05	ges
Reach	2	73	112.09	5.57e-23	*	0.72
Year	4.28	312.64	49.217	1.12e-33	*	0.099
Reach:Year	8.57	312.64	7.289	2.59e-09	*	0.032

One-way ANOVA: Effect of Reach on logPCBs at every year

Year	**Effect**	**DFn**	**DFd**	**F**	**p**	**p<0.05**	**ges**	**p. adj**
1993	Reach	2	74	62.6	1.24e-16	*	0.628	<0.001
1995	Reach	2	75	94.6	3.14e-21	*	0.716	<0.001
1999	Reach	2	76	120	3.34e-24	*	0.759	<0.001
2004	Reach	2	76	118	4.74e-24	*	0.757	<0.001
2009	Reach	2	76	106	1.13e-22	*	0.736	<0.001
2014	Reach	2	76	92.9	3.88e-21	*	0.71	<0.001
2020	Reach	2	76	99.2	6.53e-22	*	0.723	<0.001

One-way ANOVA: Effect of year on logPCBs in reach

Reach	**Effect**	**DFn**	**DFd**	**F**	**p**	**p<0.05**	**ges**	**p. adj**
Lower	Year	3.96	103	18.5	P<0.001	*	0.177	P<0.001
Outer	Year	2.23	46.8	10.1	P<0.001	*	0.077	P<0.001
Upper	Year	4.08	106	41.6	P<0.001	*	0.154	P<0.001

Mixed ANOVA: Log-transformed PCBs normalized by TOC

Mixed ANOVA Table (type III tests)

	Effect	DFn	DFd	F	p	p<0.05	ges
1	REACH	2	72	168.519	6.93E-28	*	0.767
2	YEAR	3.67	264.13	69.427	6.64E-38	*	0.224
3	REACH:YEAR	7.34	264.13	10.457	5.58E-12	*	0.08

One-way ANOVA: Effect of Reach on log(PCB/TOCs) at every year

Year	**Effect**	**DFn**	**DFd**	**F**	**P**	**p<0.05**	**ges**	**p. adj**
1993	REACH	2	74	55.7	1.76E-15	*	0.601	1.23E-14
1995	REACH	2	74	136	1.59E-25	*	0.786	1.11E-24
1999	REACH	2	76	147	7.25E-27	*	0.795	5.08E-26
2004	REACH	2	76	168	1.17E-28	*	0.816	8.19E-28
2009	REACH	2	76	138	4.83E-26	*	0.784	3.38E-25
2014	REACH	2	76	128	4.94E-25	*	0.771	3.46E-24
2020	REACH	2	76	134	1.12E-25	*	0.78	7.84E-25

One-way ANOVA: Effect of year on log(PCBs/TOC) in reach

Reach	**Effect**	**DFn**	**DFd**	**F**	**p**	**p<0.05**	**ges**	**p. adj**
Lower	YEAR	3.1	80.5	28.5	7.11E-13	*	0.308	2.13E-12
Outer	YEAR	2.04	42.8	17.6	2.34E-06	*	0.2	7.02E-06
Upper	YEAR	3.3	82.5	51.3	1.02E-19	*	0.333	3.06E-19

Mixed ANOVA: Community Metrics Between Reaches and Within Years

Richness

Mixed ANOVA Table (type III tests)

Effect	DFn	DFd	F	p	p<0.05	ges
Reach	2	75	82.44	1.16e-19	*	0.545
Year	5.25	393.91	15.25	3.2e-14	*	0.085
Reach:Year	10.5	393.91	6.24	3.35e-09	*	0.070

One-way ANOVA: Effect of Reach on Species Richness at every year

Year	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
1993	Reach	2	76	83.667	6.24e-20	*	0.688	4.368e-19
1995	Reach	2	75	44.43	1.87e-13	*	0.542	1.309e-12
1999	Reach	2	76	70.447	4.94e-18	*	0.65	3.458e-17
2004	Reach	2	76	41.324	7.15e-13	*	0.521	5.005e-12
2009	Reach	2	76	64.072	4.93e-17	*	0.628	3.451e-16
2014	Reach	2	76	19.522	1.44e-07	*	0.339	1.008e-06
2020	Reach	2	76	37.399	4.92e-12	*	0.496	3.444e-11

One-way ANOVA: Effect of year on Richness in reach

Reach	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
Lower	Year	6	168	2.447	0.027	*	0.042	0.081
Outer	Year	6	126	7.382	8.8e-07	*	0.127	2.64e-06
Upper	Year	3.82	99.2	38.818	4.87e-19	*	0.424	1.461e-18

Abundance

Mixed ANOVA Table (type III tests)

Effect	DFn	DFd	F	p	p<0.05	ges
Reach	2	75	11.906	3.23e-04	*	0.092
Year	3.98	298.74	7.607	7.83e-06	*	0.065
Reach:Year	7.97	298.74	2.124	3.4e-02	*	0.037

One-way ANOVA: Effect of Reach on Species Abundance at every year

Comp	Year	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
1	1993	REACH	2	76	1.478	0.235		0.037	1
2	1995	REACH	2	75	17.933	4.31e-07	*	0.324	3.017e-06
3	1999	REACH	2	76	3.93	0.024	*	0.094	0.168
4	2004	REACH	2	76	3.452	0.037	*	0.083	0.259
5	2009	REACH	2	76	2.299	0.107		0.057	0.749
6	2014	REACH	2	76	5.876	0.004	*	0.134	0.028
7	2020	REACH	2	76	2.323	0.105		0.058	0.735

One-way ANOVA: Effect of year (within factor) on Abundance in reach (between factor)

Reach	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
Lower	Year	3.36	94.1	6.57	0.000258	*	0.157	0.00077
Outer	Year	3.81	80.1	9.62	0.00000304	*	0.242	0.000009
Upper	Year	3.47	90.3	3.57	0.013	*	0.083	0.039

Evenness

Mixed ANOVA Table (type III tests)

Effect	DFn	DFd	F	p	p<0.05	ges
Reach	2	74	68.865	1.28e-17	*	0.302
Year	4.95	366.4	6.627	6.92e-06	*	0.064
Reach:Year	9.90	366.4	2.112	2.30e-02	*	0.042

One-way ANOVA: Effect of Reach on Evenness at every year

Comp	Year	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
1	1993	REACH	2	76	36.859	6.46e-12	*	0.492	4.522e-11
2	1995	REACH	2	75	19.808	1.24e-07	*	0.346	8.68e-07
3	1999	REACH	2	76	10.172	0.000122	*	0.211	0.000854
4	2004	REACH	2	76	8.167	0.000613	*	0.177	0.004291
5	2009	REACH	2	76	22.881	1.67e-08	*	0.376	1.169e-07
6	2014	REACH	2	76	20.892	5.88e-08	*	0.355	4.116e-07
7	2020	REACH	2	75	10.515	9.43e-05	*	0.219	0.0006601

One-way ANOVA: Effect of Year on Evenness at every Reach

Reach	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
Lower	Year	3.63	98	3.27	0.017	*	0.091	0.051
Outer	Year	6	126	4.77	0.0002	*	0.137	0.000618
Upper	Year	6	156	4.12	0.0007	*	0.104	0.00216

Diversity

Mixed ANOVA Table (type III tests)

Effect	DFn	DFd	F	p	p<0.05	ges
Reach	2	75.0	118.722	5.76e-24	*	0.548
Year	5.10	382.2	8.575	8.17e-08	*	0.066
Reach:Year	10.19	382.2	3.950	3.33e-05	*	0.061

One-way ANOVA: Effect of Reach on Diversity at every year

Comp	Year	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
1	1993	REACH	2	76	103.606	1.95e-22	*	0.732	1.365e-21
2	1995	REACH	2	75	48.337	3.26e-14	*	0.563	2.282e-13
3	1999	REACH	2	76	46.65	6.05e-14	*	0.551	4.235e-13
4	2004	REACH	2	76	37.371	4.99e-12	*	0.496	3.493e-11
5	2009	REACH	2	76	61.065	1.54e-16	*	0.616	1.078e-15
6	2014	REACH	2	76	28.001	7.74e-10	*	0.424	5.418e-09
7	2020	REACH	2	76	33.441	3.82e-11	*	0.468	2.674e-10

One-way ANOVA: Effect of Year on Diversity at every Reach

Reach	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
Lower	Year	3.84	107.39	2.31	0.065		0.051	0.195
Outer	Year	6	126	6.717	3.43e-06	*	0.139	1.029e-05
Upper	Year	4.13	107.51	8.8	2.66e-06	*	0.181	7.98e-06

M-AMBI

Mixed ANOVA Table (type III tests)

Effect	DFn	DFd	F	p	p<0.05	ges
Reach	2	74	42.901	4.26e-13	*	0.370
Year	6	444	10.644	4.64e-11	*	0.066
Reach:Year	12	444	7.672	5.45e-13	*	0.093

One-way ANOVA: Effect of Reach on M-AMBI at every year

Comp	Year	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
1	1993	REACH	2	76	47.316	4.49e-14	*	0.555	3.143e-13
2	1995	REACH	2	75	24.05	8.51e-09	*	0.391	5.957e-08
3	1999	REACH	2	76	30.229	2.19e-10	*	0.443	1.533e-09
4	2004	REACH	2	76	17.759	4.7e-07	*	0.318	3.29e-06
5	2009	REACH	2	76	37.495	4.69e-12	*	0.497	3.283e-11
6	2014	REACH	2	76	3.021	0.055		0.074	0.385
7	2020	REACH	2	75	18.489	2.97e-07	*	0.33	2.079e-06

One-way ANOVA: Effect of Year on M-AMBI at every reach

Reach	Effect	DFn	DFd	F	p	p<0.05	ges	p. adj
Lower	Year	6	162	2.667	0.017	*	0.049	0.051
Outer	Year	6	126	10.65	1.5e-09	*	0.19	4.5e-09
Upper	Year	6	156	20.774	8.24e-18	*	0.278	2.472e-17

Shapiro Wilk Test - LogPCB/TOC normalized

	REACH	Year	W	p-value	Normal?
1	Upper	1993	0.941837	0.135247	Yes
2	Lower	1993	0.958503	0.341503	Yes
3	Outer	1993	0.928284	0.100422	Yes
4	Upper	1995	0.919008	0.042621	No
5	Lower	1995	0.927173	0.046501	No
6	Outer	1995	0.961233	0.514606	Yes
7	Upper	1999	0.917312	0.034028	No
8	Lower	1999	0.978166	0.789825	Yes
9	Outer	1999	0.949768	0.289404	Yes
10	Upper	2004	0.97894	0.837641	Yes
11	Lower	2004	0.954524	0.239429	Yes
12	Outer	2004	0.948997	0.278909	Yes
13	Upper	2009	0.978061	0.816168	Yes
14	Lower	2009	0.976476	0.742777	Yes
15	Outer	2009	0.969577	0.678879	Yes
16	Upper	2014	0.95309	0.25455	Yes
17	Lower	2014	0.856392	0.001032	No
18	Outer	2014	0.956961	0.404833	Yes
19	Upper	2020	0.936122	0.097757	Yes
20	Lower	2020	0.946669	0.149893	Yes
21	Outer	2020	0.958402	0.431874	Yes

Shapiro Wilk Test - PCB/TOC normalized

	REACH	Year	W	p-value	Normal?
1	Upper	1993	0.836	6.09E-04	No
2	Lower	1993	0.759	2.92E-05	No
3	Outer	1993	0.290	1.41E-09	No
4	Upper	1995	0.607	3.54E-07	No
5	Lower	1995	0.639	3.13E-07	No
6	Outer	1995	0.699	1.88E-05	No
7	Upper	1999	0.768	4.06E-05	No
8	Lower	1999	0.871	2.09E-03	No
9	Outer	1999	0.735	4.12E-05	No
10	Upper	2004	0.809	1.94E-04	No
11	Lower	2004	0.917	2.53E-02	No
12	Outer	2004	0.578	5.25E-07	No
13	Upper	2009	0.702	4.10E-06	No
14	Lower	2009	0.841	5.09E-04	No
15	Outer	2009	0.621	1.56E-06	No
16	Upper	2014	0.474	9.30E-09	No
17	Lower	2014	0.258	4.92E-11	No
18	Outer	2014	0.699	1.38E-05	No
19	Upper	2020	0.628	4.48E-07	No
20	Lower	2020	0.855	9.50E-04	No
21	Outer	2020	0.744	5.50E-05	No

Shapiro Wilk Test - %Silt and Clay

Reach	Year	W	P-value	Normal?
Lower	1993	0.979414	0.848	Yes
Lower	1995	0.918961	0.028	No
Lower	1999	0.943809	0.126	Yes
Lower	2004	0.947231	0.155	Yes
Lower	2009	0.897603	0.008	No
Lower	2014	0.914729	0.022	No
Lower	2020	0.955236	0.249	Yes
Upper	1993	0.861248	0.001	No
Upper	1995	0.964505	0.465	Yes
Upper	1999	0.885772	0.006	No
Upper	2004	0.838771	0	No
Upper	2009	0.909886	0.022	No
Upper	2014	0.89412	0.009	No
Upper	2020	0.812864	0	No
Outer	1993	0.885195	0.012	No
Outer	1995	0.947219	0.354	Yes
Outer	1999	0.876019	0.008	No
Outer	2004	0.888383	0.014	No
Outer	2009	0.899101	0.024	No
Outer	2014	0.894399	0.019	No
Outer	2020	0.860075	0.004	No

Shapiro Wilk Test - TOC

Reach	Year	W	P-value	Normal?
Lower	1993	0.931313	0.074	Yes
Lower	1995	0.931603	0.06	Yes
Lower	1999	0.982033	0.886	Yes
Lower	2004	0.961601	0.359	Yes
Lower	2009	0.964262	0.416	Yes
Lower	2014	0.96573	0.45	Yes
Lower	2020	0.986381	0.962	Yes
Upper	1993	0.889016	0.007	No
Upper	1995	0.901503	0.016	No
Upper	1999	0.90408	0.016	No
Upper	2004	0.870325	0.002	No
Upper	2009	0.971622	0.645	Yes
Upper	2014	0.892101	0.008	No
Upper	2020	0.947829	0.189	Yes
Outer	1993	0.879498	0.009	No
Outer	1995	0.906598	0.04	No
Outer	1999	0.948855	0.277	Yes
Outer	2004	0.916932	0.057	Yes
Outer	2009	0.833673	0.001	No
Outer	2014	0.907795	0.036	No
Outer	2020	0.957177	0.408	Yes

Log(10)-transformed PCBs

Pairwise Comparison Test: to determine if there are differences between reaches per year.

Comp	Year	y	group1	group2	n1	n2	p	p.signif	p.adj	p.adj.signif
1	1993	LogPCBs	Lower Harbor	Outer Harbor	27	23	6.21E-10	****	1.86E-09	****
2	1993	LogPCBs	Lower Harbor	Upper Harbor	27	27	8.12E-05	****	0.000244	***
3	1993	LogPCBs	Outer Harbor	Upper Harbor	23	27	1.98E-17	****	5.95E-17	****
4	1995	LogPCBs	Lower Harbor	Outer Harbor	29	22	7.03E-12	****	2.11E-11	****
5	1995	LogPCBs	Lower Harbor	Upper Harbor	29	27	3.13E-08	****	9.40E-08	****
6	1995	LogPCBs	Outer Harbor	Upper Harbor	22	27	3.52E-22	****	1.06E-21	****
7	1999	LogPCBs	Lower Harbor	Outer Harbor	29	23	2.99E-15	****	8.98E-15	****
8	1999	LogPCBs	Lower Harbor	Upper Harbor	29	27	5.98E-08	****	1.79E-07	****
9	1999	LogPCBs	Outer Harbor	Upper Harbor	23	27	4.97E-25	****	1.49E-24	****
10	2004	LogPCBs	Lower Harbor	Outer Harbor	29	23	4.85E-16	****	1.46E-15	****
11	2004	LogPCBs	Lower Harbor	Upper Harbor	29	27	7.74E-07	****	2.32E-06	****
12	2004	LogPCBs	Outer Harbor	Upper Harbor	23	27	9.67E-25	****	2.90E-24	****
13	2009	LogPCBs	Lower Harbor	Outer Harbor	29	23	1.13E-13	****	3.39E-13	****
14	2009	LogPCBs	Lower Harbor	Upper Harbor	29	27	8.49E-08	****	2.55E-07	****
15	2009	LogPCBs	Outer Harbor	Upper Harbor	23	27	1.50E-23	****	4.49E-23	****
16	2014	LogPCBs	Lower Harbor	Outer Harbor	29	23	3.38E-12	****	1.02E-11	****
17	2014	LogPCBs	Lower Harbor	Upper Harbor	29	27	1.47E-07	****	4.42E-07	****
18	2014	LogPCBs	Outer Harbor	Upper Harbor	23	27	4.79E-22	****	1.44E-21	****
19	2020	LogPCBs	Lower Harbor	Outer Harbor	29	23	7.09E-16	****	2.13E-15	****
20	2020	LogPCBs	Lower Harbor	Upper Harbor	29	27	0.000199	***	0.000598	***
21	2020	LogPCBs	Outer Harbor	Upper Harbor	23	27	2.96E-22	****	8.87E-22	****

Log(10)-transformed PCBs

Pairwise Comparison Test: to determine if there are differences between years per reach.

Comparison	y	Reach	group1	group2	n1	n2	p	p.signif	p.adj	p.adj.signif
1	LogPCBs	Lower Harbor	1993	1995	27	29	0.479	ns	1	ns
2	LogPCBs	Lower Harbor	1993	1999	27	29	0.196	ns	1	ns
3	LogPCBs	Lower Harbor	1995	1999	29	29	0.0425	*	0.893	ns
4	LogPCBs	Lower Harbor	1993	2004	27	29	0.449	ns	1	ns
5	LogPCBs	Lower Harbor	1995	2004	29	29	0.959	ns	1	ns
6	LogPCBs	Lower Harbor	1999	2004	29	29	0.0376	*	0.79	ns
7	LogPCBs	Lower Harbor	1993	2009	27	29	0.486	ns	1	ns
8	LogPCBs	Lower Harbor	1995	2009	29	29	0.992	ns	1	ns
9	LogPCBs	Lower Harbor	1999	2009	29	29	0.0436	*	0.916	ns
10	LogPCBs	Lower Harbor	2004	2009	29	29	0.951	ns	1	ns
11	LogPCBs	Lower Harbor	1993	2014	27	29	0.00531	**	0.111	ns
12	LogPCBs	Lower Harbor	1995	2014	29	29	0.0328	*	0.689	ns
13	LogPCBs	Lower Harbor	**1999**	**2014**	**29**	**29**	**4.21E-05**	****	**0.000883**	***
14	LogPCBs	Lower Harbor	2004	2014	29	29	0.0372	*	0.78	ns
15	LogPCBs	Lower Harbor	2009	2014	29	29	0.032	*	0.671	ns
16	LogPCBs	Lower Harbor	**1993**	**2020**	**27**	**29**	**6.52E-05**	****	**0.00137**	**
17	LogPCBs	Lower Harbor	**1995**	**2020**	**29**	**29**	**0.000723**	***	**0.0152**	*
18	LogPCBs	Lower Harbor	**1999**	**2020**	**29**	**29**	**1.33E-07**	****	**2.79E-06**	****
19	LogPCBs	Lower Harbor	**2004**	**2020**	**29**	**29**	**0.000864**	***	**0.0181**	*
20	LogPCBs	Lower Harbor	**2009**	**2020**	**29**	**29**	**0.000697**	***	**0.0146**	*
21	LogPCBs	Lower Harbor	2014	2020	29	29	0.2	ns	1	ns
22	LogPCBs	Outer Harbor	1993	1995	23	22	0.472	ns	1	ns
23	LogPCBs	Outer Harbor	1993	1999	23	23	0.827	ns	1	ns
24	LogPCBs	Outer Harbor	1995	1999	22	23	0.614	ns	1	ns
25	LogPCBs	Outer Harbor	1993	2004	23	23	0.0207	*	0.434	ns
26	LogPCBs	Outer Harbor	1995	2004	22	23	0.114	ns	1	ns
27	LogPCBs	Outer Harbor	1999	2004	23	23	0.0357	*	0.749	ns
28	LogPCBs	Outer Harbor	1993	2009	23	23	0.362	ns	1	ns
29	LogPCBs	Outer Harbor	1995	2009	22	23	0.855	ns	1	ns
30	LogPCBs	Outer Harbor	1999	2009	23	23	0.488	ns	1	ns
31	LogPCBs	Outer Harbor	2004	2009	23	23	0.156	ns	1	ns
32	LogPCBs	Outer Harbor	1993	2014	23	23	0.0623	ns	1	ns
33	LogPCBs	Outer Harbor	1995	2014	22	23	0.258	ns	1	ns
34	LogPCBs	Outer Harbor	1999	2014	23	23	0.0992	ns	1	ns
35	LogPCBs	Outer Harbor	2004	2014	23	23	0.646	ns	1	ns
36	LogPCBs	Outer Harbor	2009	2014	23	23	0.337	ns	1	ns
37	LogPCBs	Outer Harbor	1993	2020	23	23	0.0256	*	0.537	ns
38	LogPCBs	Outer Harbor	1995	2020	22	23	0.133	ns	1	ns
39	LogPCBs	Outer Harbor	1999	2020	23	23	0.0435	*	0.913	ns
40	LogPCBs	Outer Harbor	2004	2020	23	23	0.934	ns	1	ns
41	LogPCBs	Outer Harbor	2009	2020	23	23	0.182	ns	1	ns
42	LogPCBs	Outer Harbor	2014	2020	23	23	0.706	ns	1	ns
43	LogPCBs	Upper Harbor	1993	1995	27	27	0.279	ns	1	ns
44	LogPCBs	Upper Harbor	1993	1999	27	27	0.15	ns	1	ns
45	LogPCBs	Upper Harbor	1995	1999	27	27	0.719	ns	1	ns
46	LogPCBs	Upper Harbor	1993	2004	27	27	0.781	ns	1	ns
47	LogPCBs	Upper Harbor	1995	2004	27	27	0.421	ns	1	ns
48	LogPCBs	Upper Harbor	1999	2004	27	27	0.245	ns	1	ns
49	LogPCBs	Upper Harbor	1993	2009	27	27	0.607	ns	1	ns
50	LogPCBs	Upper Harbor	1995	2009	27	27	0.57	ns	1	ns
51	LogPCBs	Upper Harbor	1999	2009	27	27	0.354	ns	1	ns
52	LogPCBs	Upper Harbor	2004	2009	27	27	0.813	ns	1	ns
53	LogPCBs	Upper Harbor	1993	2014	27	27	0.72	ns	1	ns
54	LogPCBs	Upper Harbor	1995	2014	27	27	0.15	ns	1	ns
55	LogPCBs	Upper Harbor	1999	2014	27	27	0.0727	ns	1	ns
56	LogPCBs	Upper Harbor	2004	2014	27	27	0.524	ns	1	ns
57	LogPCBs	Upper Harbor	2009	2014	27	27	0.383	ns	1	ns
58	LogPCBs	Upper Harbor	**1993**	**2020**	**27**	**27**	**0.000418**	***	**0.00878**	**
59	LogPCBs	Upper Harbor	**1995**	**2020**	**27**	**27**	**5.58E-06**	****	**0.000117**	***
60	LogPCBs	Upper Harbor	**1999**	**2020**	**27**	**27**	**1.12E-06**	****	**2.35E-05**	****
61	LogPCBs	Upper Harbor	**2004**	**2020**	**27**	**27**	**0.00015**	***	**0.00314**	**
62	LogPCBs	Upper Harbor	**2009**	**2020**	**27**	**27**	**5.97E-05**	****	**0.00125**	**
63	LogPCBs	Upper Harbor	**2014**	**2020**	**27**	**27**	**0.00144**	**	**0.0303**	*

Shapiro Wilk Test - LogPCBs

Reach	Year	W	P-value	Normal?
Lower	1993	0.981577	0.896	**Yes**
Lower	1995	0.980016	0.838	**Yes**
Lower	1999	0.928833	0.051	**Yes**
Lower	2004	0.960319	0.334	**Yes**
Lower	2009	0.948423	0.166	**Yes**
Lower	2014	0.964477	0.421	**Yes**
Lower	2020	0.939576	0.097	**Yes**
Upper	1993	0.918488	0.036	No
Upper	1995	0.962747	0.425	**Yes**
Upper	1999	0.941194	0.13	**Yes**
Upper	2004	0.889466	0.007	No
Upper	2009	0.956039	0.299	**Yes**
Upper	2014	0.966156	0.504	**Yes**
Upper	2020	0.964784	0.471	**Yes**
Outer	1993	0.972802	0.793	**Yes**
Outer	1995	0.968981	0.71	**Yes**
Outer	1999	0.948564	0.273	**Yes**
Outer	2004	0.904565	0.031	No
Outer	2009	0.961028	0.484	**Yes**
Outer	2014	0.961569	0.495	**Yes**
Outer	2020	0.944055	0.219	**Yes**

Log-transformed PCBs/TOC normalized

Pairwise Comparison Test: to determine if there are differences between reaches per year.

Comp	Year	y	group1	group2	n1	n2	p	p.signif	p.adj	p.adj.signif
1	1993	logPCBTOC	Lower Harbor	Outer Harbor	27	23	7.82E-07	****	2.35E-06	****
2	1993	logPCBTOC	Lower Harbor	Upper Harbor	27	27	8.75E-07	****	2.63E-06	****
3	1993	logPCBTOC	Outer Harbor	Upper Harbor	23	27	2.13E-16	****	6.39E-16	****
4	1995	logPCBTOC	Lower Harbor	Outer Harbor	29	22	2.74E-12	****	8.23E-12	****
5	1995	logPCBTOC	Lower Harbor	Upper Harbor	29	27	2.34E-13	****	7.01E-13	****
6	1995	logPCBTOC	Outer Harbor	Upper Harbor	22	27	1.82E-26	****	5.47E-26	****
7	1999	logPCBTOC	Lower Harbor	Outer Harbor	29	23	2.56E-16	****	7.68E-16	****
8	1999	logPCBTOC	Lower Harbor	Upper Harbor	29	27	2.74E-10	****	8.21E-10	****
9	1999	logPCBTOC	Outer Harbor	Upper Harbor	23	27	8.67E-28	****	2.60E-27	****
10	2004	logPCBTOC	Lower Harbor	Outer Harbor	29	23	1.51E-17	****	4.54E-17	****
11	2004	logPCBTOC	Lower Harbor	Upper Harbor	29	27	2.08E-11	****	6.25E-11	****
12	2004	logPCBTOC	Outer Harbor	Upper Harbor	23	27	1.35E-29	****	4.06E-29	****
13	2009	logPCBTOC	Lower Harbor	Outer Harbor	29	23	8.71E-16	****	2.61E-15	****
14	2009	logPCBTOC	Lower Harbor	Upper Harbor	29	27	9.02E-10	****	2.71E-09	****
15	2009	logPCBTOC	Outer Harbor	Upper Harbor	23	27	5.88E-27	****	1.77E-26	****
16	2014	logPCBTOC	Lower Harbor	Outer Harbor	29	23	2.90E-15	****	8.70E-15	****
17	2014	logPCBTOC	Lower Harbor	Upper Harbor	29	27	5.13E-09	****	1.54E-08	****
18	2014	logPCBTOC	Outer Harbor	Upper Harbor	23	27	6.32E-26	****	1.90E-25	****
19	2020	logPCBTOC	Lower Harbor	Outer Harbor	29	23	3.01E-18	****	9.02E-18	****
20	2020	logPCBTOC	Lower Harbor	Upper Harbor	29	27	2.51E-06	****	7.52E-06	****
21	2020	logPCBTOC	Outer Harbor	Upper Harbor	23	27	3.54E-26	****	1.06E-25	****

Log-transformed PCBs/TOC normalized

Pairwise Comparison Test: to determine if there are differences between years per reach.

Comparison	y	Reach	group1	group2	n1	n2	p	p.signif	p.adj	p.adj.signif
1	Lower Harbor	logPCBTOC	1993	1995	27	29	0.388	ns	1	ns
2	Lower Harbor	logPCBTOC	1993	1999	27	29	0.0129	*	0.271	ns
3	Lower Harbor	logPCBTOC	1995	1999	29	29	0.0956	ns	1	ns
4	Lower Harbor	logPCBTOC	1993	2004	27	29	0.474	ns	1	ns
5	Lower Harbor	logPCBTOC	1995	2004	29	29	0.109	ns	1	ns
6	Lower Harbor	logPCBTOC	1999	2004	29	29	0.0012	**	0.0253	*
7	Lower Harbor	logPCBTOC	1993	2009	27	29	1.91E-05	****	0.000402	***
8	Lower Harbor	logPCBTOC	1995	2009	29	29	0.000429	***	0.00901	**
9	Lower Harbor	logPCBTOC	1999	2009	29	29	0.0578	ns	1	ns
10	Lower Harbor	logPCBTOC	2004	2009	29	29	5.15E-07	****	1.08E-05	****
11	Lower Harbor	logPCBTOC	1993	2014	27	29	0.709	ns	1	ns
12	Lower Harbor	logPCBTOC	1995	2014	29	29	0.209	ns	1	ns
13	Lower Harbor	logPCBTOC	1999	2014	29	29	0.00372	**	0.0782	ns
14	Lower Harbor	logPCBTOC	2004	2014	29	29	0.727	ns	1	ns
15	Lower Harbor	logPCBTOC	2009	2014	29	29	2.59E-06	****	5.43E-05	****
16	Lower Harbor	logPCBTOC	1993	2020	27	29	0.000728	***	0.0153	*
17	Lower Harbor	logPCBTOC	1995	2020	29	29	1.96E-05	****	0.000413	***
18	Lower Harbor	logPCBTOC	1999	2020	29	29	7.27E-09	****	1.53E-07	****
19	Lower Harbor	logPCBTOC	2004	2020	29	29	0.00624	**	0.131	ns
20	Lower Harbor	logPCBTOC	2009	2020	29	29	1.41E-13	****	2.96E-12	****
21	Lower Harbor	logPCBTOC	2014	2020	29	29	0.00212	**	0.0444	*
22	Outer Harbor	logPCBTOC	1993	1995	23	22	0.759	ns	1	ns
23	Outer Harbor	logPCBTOC	1993	1999	23	23	0.279	ns	1	ns
24	Outer Harbor	logPCBTOC	1995	1999	22	23	0.445	ns	1	ns
25	Outer Harbor	logPCBTOC	1993	2004	23	23	0.000613	***	0.0129	*
26	Outer Harbor	logPCBTOC	1995	2004	22	23	0.00195	**	0.041	*
27	Outer Harbor	logPCBTOC	1999	2004	23	23	0.017	*	0.357	ns
28	Outer Harbor	logPCBTOC	1993	2009	23	23	0.35	ns	1	ns
29	Outer Harbor	logPCBTOC	1995	2009	22	23	0.537	ns	1	ns
30	Outer Harbor	logPCBTOC	1999	2009	23	23	0.882	ns	1	ns
31	Outer Harbor	logPCBTOC	2004	2009	23	23	0.0114	*	0.239	ns
32	Outer Harbor	logPCBTOC	1993	2014	23	23	0.000505	***	0.0106	*
33	Outer Harbor	logPCBTOC	1995	2014	22	23	0.00163	**	0.0343	*
34	Outer Harbor	logPCBTOC	1999	2014	23	23	0.0147	*	0.308	ns
35	Outer Harbor	logPCBTOC	2004	2014	23	23	0.956	ns	1	ns
36	Outer Harbor	logPCBTOC	2009	2014	23	23	0.00974	**	0.205	ns
37	Outer Harbor	logPCBTOC	1993	2020	23	23	0.000276	***	0.00581	**
38	Outer Harbor	logPCBTOC	1995	2020	22	23	0.000939	***	0.0197	*
39	Outer Harbor	logPCBTOC	1999	2020	23	23	0.00923	**	0.194	ns
40	Outer Harbor	logPCBTOC	2004	2020	23	23	0.823	ns	1	ns
41	Outer Harbor	logPCBTOC	2009	2020	23	23	0.00601	**	0.126	ns
42	Outer Harbor	logPCBTOC	2014	2020	23	23	0.866	ns	1	ns
43	Upper Harbor	logPCBTOC	1993	1995	27	27	0.041	*	0.861	ns
44	Upper Harbor	logPCBTOC	1993	1999	27	27	0.0472	*	0.991	ns
45	Upper Harbor	logPCBTOC	1995	1999	27	27	0.937	ns	1	ns
46	Upper Harbor	logPCBTOC	1993	2004	27	27	0.611	ns	1	ns
47	Upper Harbor	logPCBTOC	1995	2004	27	27	0.122	ns	1	ns
48	Upper Harbor	logPCBTOC	1999	2004	27	27	0.138	ns	1	ns
49	Upper Harbor	logPCBTOC	1993	2009	27	27	0.000104	***	0.00218	**
50	Upper Harbor	logPCBTOC	1995	2009	27	27	0.0627	ns	1	ns
51	Upper Harbor	logPCBTOC	1999	2009	27	27	0.0503	ns	1	ns
52	Upper Harbor	logPCBTOC	2004	2009	27	27	0.000677	***	0.0142	*
53	Upper Harbor	logPCBTOC	1993	2014	27	27	0.597	ns	1	ns
54	Upper Harbor	logPCBTOC	1995	2014	27	27	0.127	ns	1	ns

Log-transformed PCBs/TOC normalized

Pairwise Comparison Test: to determine if there are differences between years per reach.

Comparison	y	Reach	group1	group2	n1	n2	p	p.signif	p.adj	p.adj.signif
55	Upper Harbor	logPCBTOC	1999	2014	27	27	0.144	ns	1	ns
56	Upper Harbor	logPCBTOC	2004	2014	27	27	0.984	ns	1	ns
57	Upper Harbor	logPCBTOC	2009	2014	27	27	0.000726	***	0.0152	*
58	Upper Harbor	logPCBTOC	1993	2020	27	27	3.38E-06	****	7.09E-05	****
59	Upper Harbor	logPCBTOC	1995	2020	27	27	1.41E-10	****	2.95E-09	****
60	Upper Harbor	logPCBTOC	1999	2020	27	27	1.52E-10	****	3.20E-09	****
61	Upper Harbor	logPCBTOC	2004	2020	27	27	3.25E-07	****	6.83E-06	****
62	Upper Harbor	logPCBTOC	2009	2020	27	27	1.34E-15	****	2.81E-14	****
63	Upper Harbor	logPCBTOC	2014	2020	27	27	2.96E-07	****	6.21E-06	****

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:    Total PCBs - Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is -0.441
    S =   -250.
    z =  -7.206
    p =  0.0000

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -600.0     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:    Total PCBs - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is -0.335
    S =   -200.
    z =  -5.632
    p =  0.0000

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -59.33     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:     Total PCBs - Outer Harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is -0.421
    S =    -201.
    z =  -6.319
    p =  0.0000

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -2.000     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:   PCB/TOC Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is -0.194
    S =   -109.
    z =  -3.143
    p =  0.0017

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -7005.     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:  PCB/TOC - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is -0.203
    S =    -121.
    z =  -3.389
    p =  0.0007

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -1466.     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set: PCB/TOC - Outer Harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is -0.438
    S =    -209.
    z =  -6.566
    p =  0.0000

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -347.3     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:      Species Richness - Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is  0.240
    S =    136.
    z =   3.920
    p =  0.0001

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.1842     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:      Species Richness - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is -0.040
    S =     -24.
    z =  -0.653
    p =  0.5137

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y = -0.2062E-01 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:         Species Richness - Outer Harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is -0.031
    S =    -15.
    z =  -0.442
    p =  0.6582

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y = -0.6250E-01 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:        Abundance - Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is -0.164
    S =    -93.
    z =  -2.659
    p =  0.0078

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -13.68     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:        Abundance - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is -0.159
    S =    -95.
    z =  -2.655
    p =  0.0079

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -6.579     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:        Abundance - Outer Harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is -0.233
    S =   -111.
    z =  -3.472
    p =  0.0005

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  -10.40     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:        Evenness - Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is  0.217
    S =    123.
    z =   3.549
    p =  0.0004

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.3571E-02 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:       Evenness - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is  0.173
    S =    102.
    z =   2.881
    p =  0.0040

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.3636E-02 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:    Evenness - Outer Harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is  0.168
    S =     80.
    z =   2.512
    p =  0.0120

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.1875E-02 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:       Diversity - Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is  0.268
    S =    152.
    z =   4.381
    p =  0.0000

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.6000E-02 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:      Diversity - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is  0.127
    S =     76.
    z =   2.128
    p =  0.0334

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.3684E-02 per year.
```

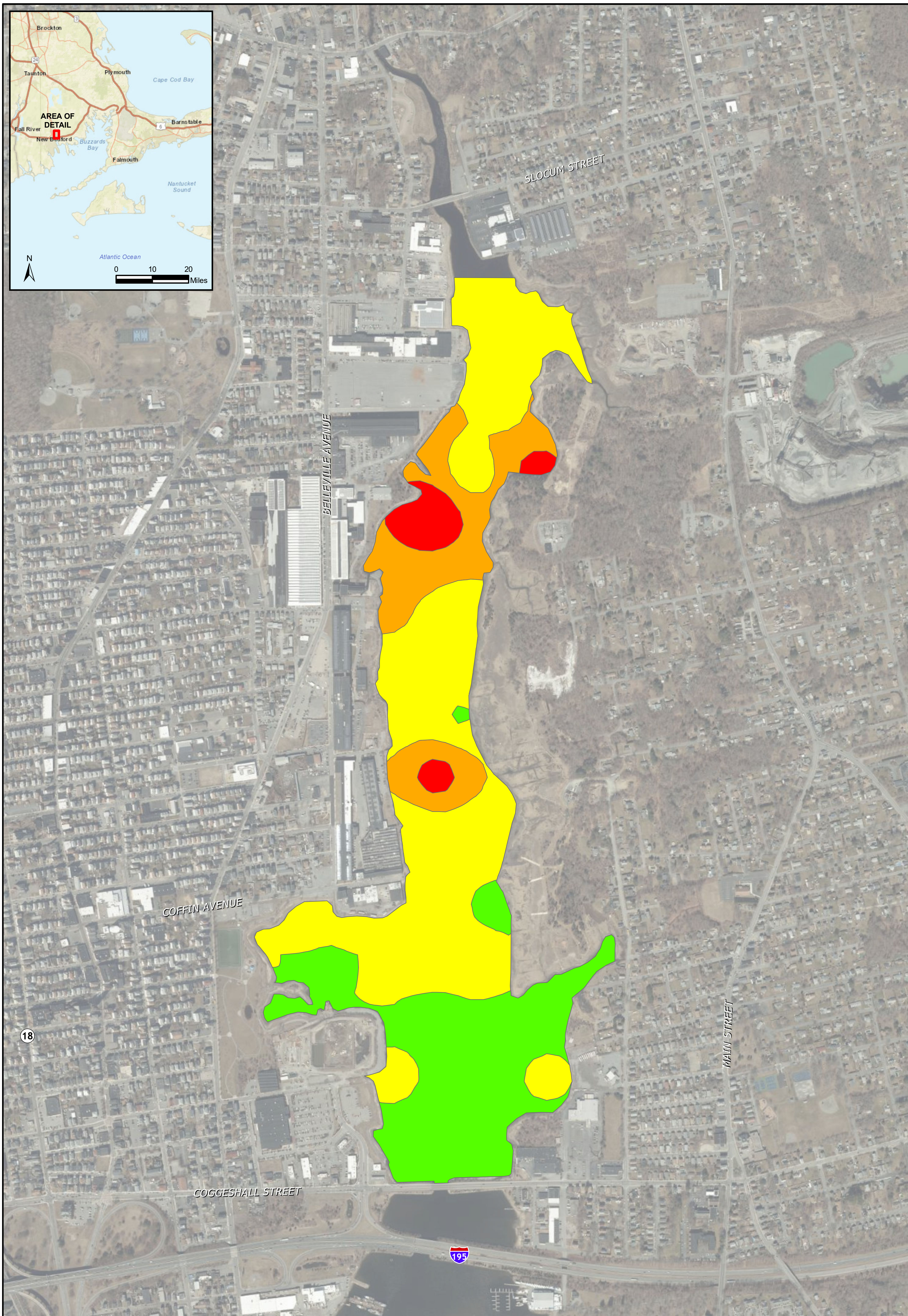
```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:      Diversity - Outer Harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is  0.109
    S =     52.
    z =   1.615
    p =  0.1062

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.2143E-02 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:     M-AMBI - Upper Harbor


The record is 28 years at  27 locations
   beginning in year  1993.

The tau correlation coefficient is  0.286
    S =    162.
    z =   4.684
    p =  0.0000

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =  0.4545E-02 per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:   M-AMBI - Lower Harbor


The record is 28 years at  29 locations
   beginning in year  1993.

The tau correlation coefficient is  0.015
    S =      9.
    z =   0.229
    p =  0.8191

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y =   0.000     per year.
```

```
    Regional Kendall Test for Trend
      US Geological Survey, 2009

Data set:   M-AMBI - Outer harbor


The record is 28 years at  23 locations
   beginning in year  1993.

The tau correlation coefficient is -0.084
    S =    -40.
    z =  -1.240
    p =  0.2152

The estimated median trend throughout the region
   during years 1993 through 2020 is:

   Change in Y = -0.1250E-02 per year.
```

Appendix D Additional Figures for Total PCBs in Shallow Sediment



Legend

Total PCBs (Sum of 209 Congeners) ppm

- <1 ppm
- 1-10 ppm
- 10 -50 ppm
- 50 -100 ppm
- >100 ppm

Source
Orthoimagery from MassGIS, 2021.

N
0 375 750
Scale in Feet

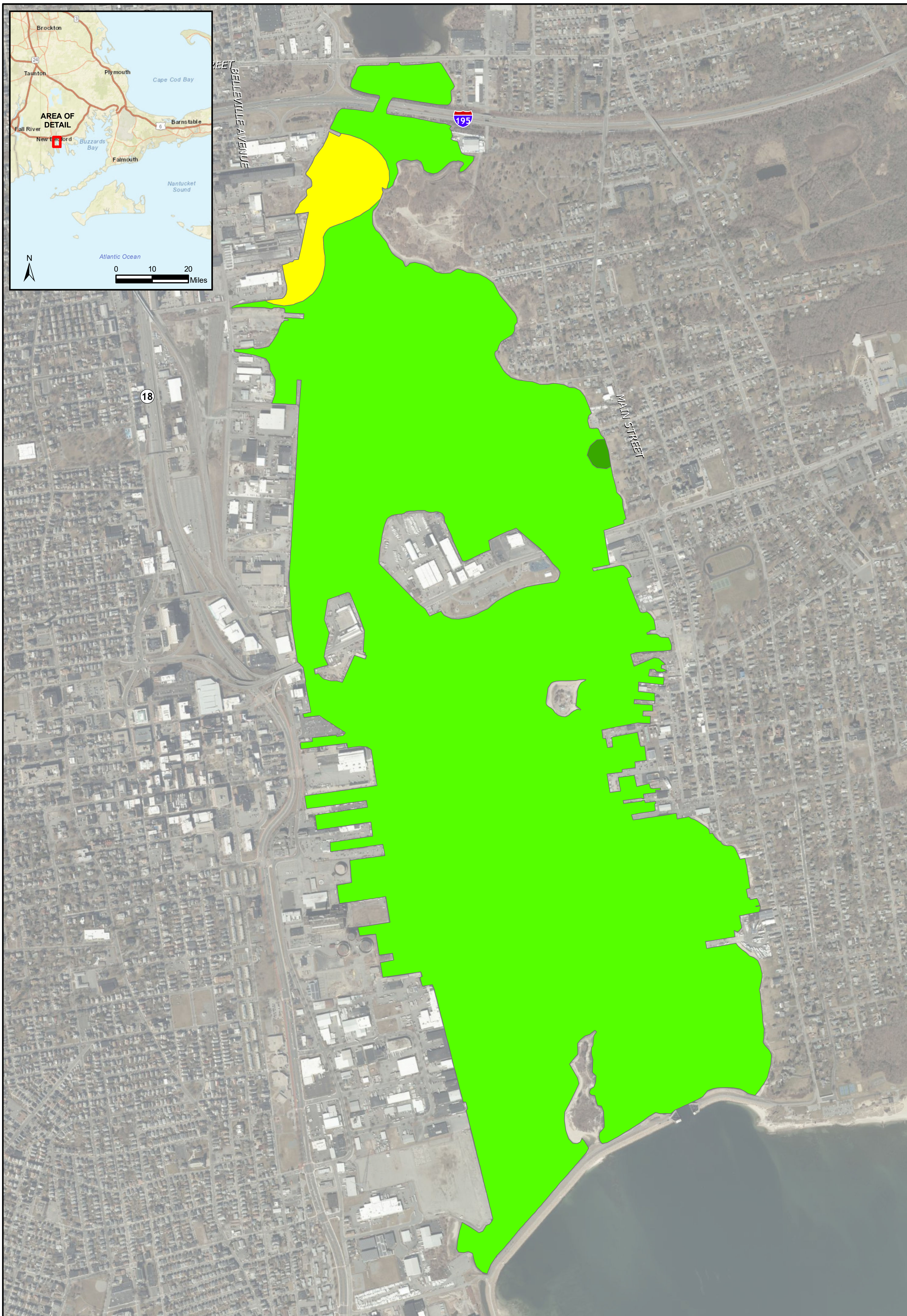
AECOM

Figure
1

Date: 07/28/2022

Revision: 0

Path: C:\Work\New_Bedford_Harbor\GIS\Projects\LTM\SWACs_Total_PCBs_Sum_209_Congeners\MXD\Fig_1_Upper_Harbor_Total_PCBs_Sum_209_Congeners_2020.mxd



Legend

Total PCBs (Sum of 209 Congeners) ppm

- <1 ppm
- 1-10 ppm
- 10-50 ppm
- 50-100 ppm
- >100 ppm

Source
Orthoimagery from MassGIS, 2021.

N

0 500 1,000

Scale in Feet

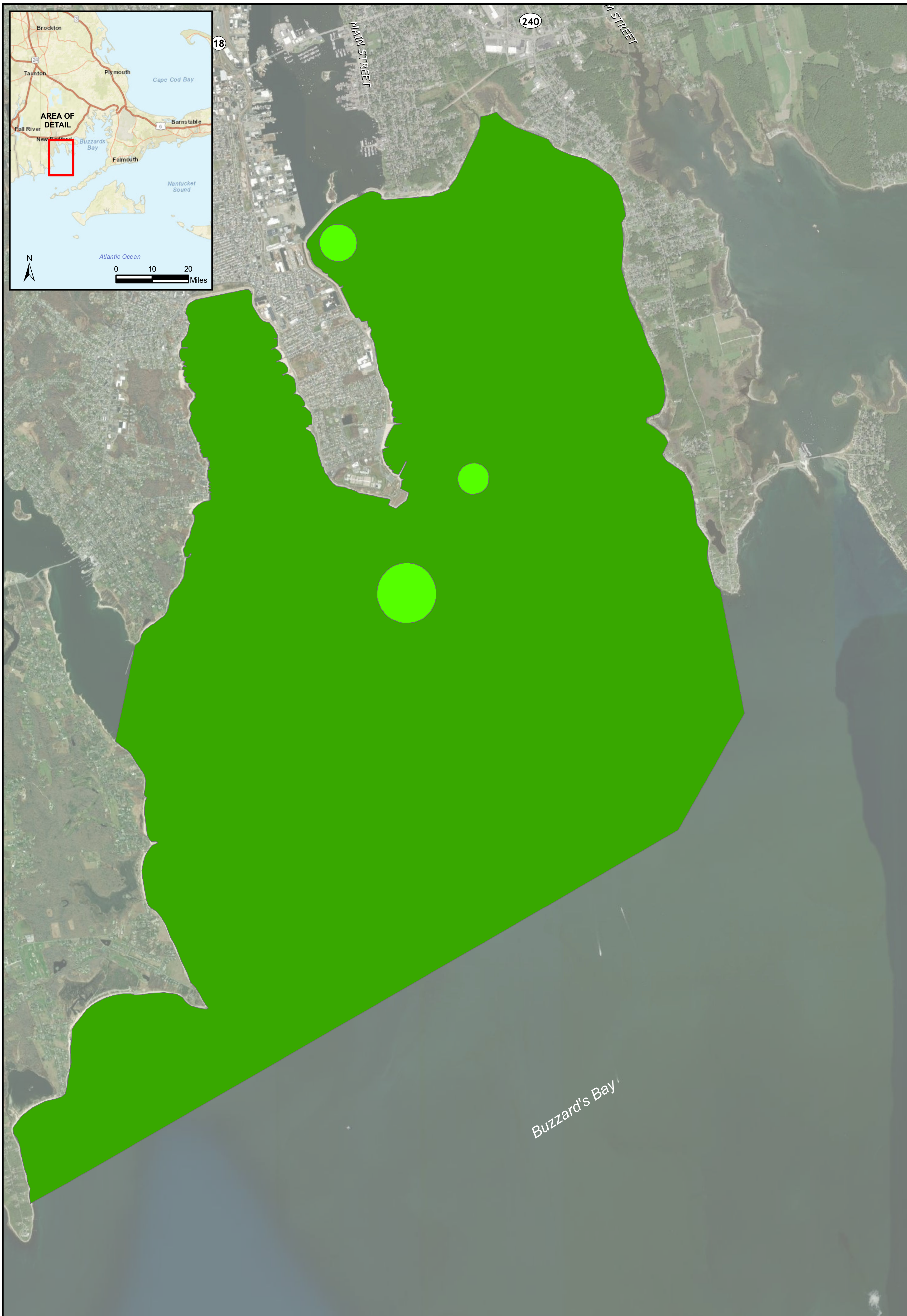
AECOM

Figure 2

Date: 07/28/2022

Revision: 0

Path: C:\Work\New_Bedford_Harbor\GIS\Projects\LTM\SWACs_Total_PCBs_Sum_209_Congeners\MXD\Fig_2_Lower_Harbor_Total_PCBs_Sum_209_Congeners_2020.mxd



Legend

Total PCBs (Sum of 209 Congeners) ppm

- <1 ppm
- 1-10 ppm
- 10 -50 ppm
- 50 -100 ppm
- >100 ppm

Source
Orthoimagery from MassGIS, 2021.

N

0 1,600 3,200
Scale in Feet

AECOM

Figure 3

Date: 07/28/2022

Revision: 0

Path: C:\Work\New_Bedford_Harbor\GIS\Projects\LTM\SWACs_Total_PCBs_Sum_209_Congeners\MXD\Fig_3_Outer_Harbor_Total_PCBs_Sum_209_Congeners_2020.mxd