Sediment Contaminants near Combined Sewer Overflows in Dorchester Bay and at other areas in Boston Harbor: 1990−2006

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EXECUTIVE SUMMARY

Combined sewer systems were designed to collect sewage, as well as storm water runoff, and to transport both to treatment facilities. During heavy rains, overflows from these combined systems—called combined sewer overflows (CSOs)—discharge a mixture of sewage and storm runoff directly into local waters, potentially affecting public health. In 1987, the Massachusetts Water Resources Authority (MWRA) agreed to plan and build projects to control CSOs hydraulically connected to the Deer Island Treatment Plant. As of March 2006, just before the sampling described in this report, MWRA had completed 14 of the 35 projects proposed under the CSO Control Plan. These completed projects include, among others, the upgrading of five CSO treatment facilities (Fox Point, Commercial Point, Cottage Farm, Prison Point, and Somerville Marginal), sewer separations, the closing of 27 of 84 permitted CSO outfalls, the installation of floatables controls, and hydraulic relief projects. These projects have decreased CSO discharges and activations. Several other projects are currently in the construction or design phases. The overall effect of the improvements to date has been the decrease of CSO discharges in a typical rainfall year from 3.3 billion gallons per year in 1988 to 0.76 billion gallons in 2006, with 68% of the remaining overflow receiving treatment at MWRA's five CSO facilities (MWRA, 2007).

The main goals of this study were to assess the effects of specific CSOs on the concentrations of pollutants in the sediments potentially impacted by the CSOs, and to determine if sediment concentrations of these pollutants at specific stations in Dorchester Bay have declined across the sampling years 1990, 1994, 1998, 2002, and 2006; data from the 1997 Harbor sediment survey were also included in some of the data analyses. Two areas of Dorchester Bay were studied: (1) the Old Harbor area, which historically may have received direct discharge from seven untreated CSOs (BOS-81 through BOS-87), and (2) the area near Fox Point (BOS-89) and Commercial Point (BOS-90) CSOs, which may have received direct discharge from these two CSO treatment facilities and from BOS-88. Some of these CSOs have been altered or significantly improved since 1990. More distant Harbor and river (e.g., Neponset River) sources may also impact these general locations. The Fox Point/Commercial Point area at one time received indirect discharges from two CSO outfalls located in the Neponset River; however, these CSOs were closed as of June 2000. Several other Boston Harbor stations, outside the Dorchester Bay area, were included in the 2006 study to compare sediment quality at locations not directly impacted by CSO, as was a station in the Inner Harbor (C019) which may be impacted by CSOs in Fort Point Channel and other local and upstream locations.

Because there are many sources of contaminants to Boston Harbor, it is usually difficult to measure the relative impact from each source. To help differentiate the pollution due to treatment plants and CSO discharges from other confounding point and nonpoint contamination sources (including stormwater and direct deposition from the air), the microbial indicator *Clostridium perfringens* was included in the monitoring. Organic and metal contaminants were measured to help associate contaminated sediments with specific CSOs, and determine the near-CSO sediment quality with respect to these important environmental contaminants.

The data generated by this study were compared to data generated by similar studies performed in 1990, 1994, 1998, and 2002 to assess if contaminant concentrations have changed in recent years. In all surveys, sediments were collected near to ("Near" stations) and far from ("Far" stations) known CSO outfalls to determine if the CSOs are likely to significantly impact the local sediment quality. Statistical analyses were used to determine if there were significant differences in contaminant levels among "Near" and "Far" stations, and to determine if contaminant concentrations had changed since the previous CSO sediment investigations (1990, 1994, 1998, and 2002).

Percent Fines and Total Organic Carbon (TOC)

Percent fines in 2006 were highest at "Near" Station CO19 and "Far" Station T02, while TOC concentrations were found to be highest at "Far" Station T07 and "Near" Station DB14. Conclusive temporal trends are difficult to discern for both percent fines and percent TOC, because of large fluctuations in the data, and lack of consistency among all stations. In addition, short-term factors, such as major weather events, can confound any trends analysis. However, there appears to be a subtle trend of generally increasing percent fines and decreasing TOC with time for the five sampling years (1990, 1994, 1998, 2002, and 2006); a possible change that is visually observable in the graphical data presentations but not statistically significant. The TOC and percent fines have, on average, been higher at the "Near" stations than the "Far" stations.

Organic Contaminants

The PAH concentrations have, on average, been higher at the "Near" stations (the stations likely more impacted by CSO discharge and stormwater runoff) than the "Far" stations. The analyses of the PAH data from 1994, 1998, 2002 and 2006 did not consistently exhibit distinct decreasing or increasing trends for the data set as a whole. A general decline from 1990 was observed at some locations, but year-to-year variability that cannot be attributed to contaminant loadings was observed at most locations. The PAH concentrations were actually higher in 2006 than in some of the earlier sampling years at most locations. Increased PAH concentrations at DB10, DB14, and T04 were observed in 1998 and/or 2006 that possibly can be attributed to storm events that occurred earlier in those summers. Based on the composition of the PAH compounds (e.g., HMW vs LMW PAH) it appears that the Commercial Point and Fox Point CSOs may have contributed to the elevated PAH at DB14 and T04 observed in 1998, while sources upstream of DB10 likely contributed PAH in the summer of 2006. Stormwater runoff, rather than sewage in CSO discharge, is generally the primary source of PAH in urban sediments, and the lack of a consistent decline in PAH sediment concentrations is therefore not surprising.

PCB and pesticide (e.g., DDT and chlordane) concentrations were variable among the '"Near" and "Far" stations sampled, with, for the most part, the lowest concentrations found in the "Far" stations. The exception was that "Far" station DB12 had higher PCB concentrations than "Near" stations DB01 and DB04, "Far" stations DB12 and SWEX3 had higher or similar DDT concentrations as DB01 and DB04, and the chlordane concentrations at DB12 were comparable to those measure at "Near" stations DB01, DB04, and C019, in most years. PCB, DDT, and chlordane concentrations have generally been declining since the early 1990's, with a "leveling out" in the decline and relatively comparable concentrations in 2002 and 2006; the 2002 concentrations were actually lower than the 2006 concentrations for several of the chlorinated contaminants and at several stations. These general decreases in chlorinated contaminants may be attributed to the national controls set for these compounds in the early 1970s as well as recent Harbor-wide decreases in discharges.

Metal Contaminants

Sediment samples were analyzed for silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn). The concentrations of the contaminant metals have, on average, been higher at the "Near" stations than the "Far" stations. The concentrations of several metals have clearly been declining since the early 1990's, which is well illustrated by Cd, Hg, and Ag. In general, Cd, Cr, Cu, Pb, Hg, Ni, Ag, and Zn concentrations in 2006 were similar to or lower than those measured in earlier years at most "Near" and "Far" stations. The Al concentrations show a weak trend of increasing in concentration, consistent with the slight increase in sediment grain size.

Sewage Tracers

Clostridium levels have dropped considerably at "Near" stations and most "Far" stations since 1990. The greatest decline was in the early 1990's. Since 1998, however, *Clostridium* levels have not significantly changed at any "Near" stations; declines at T03, T05A, T06, and T07 have been observed from the levels

measured in 1997. The *Clostridium* concentrations have been higher at the "Near" stations than the "Far" stations, although the difference between the "Far" and "Near" stations has been smaller in recent years, and occasionally some of the "Far" stations (e.g., DB12, T02, and T07 in 2006) have had higher *Clostridium* concentrations than some of the "Near" stations (e.g., DB01).These observations are primarily a reflection of a significant decrease in the *Clostridium* concentration at "Near" stations as a result of CSO management.

CSO Influence on Sediment Quality

Many factors can control the quality of sediments, especially in an urban setting where both anthropogenic and naturally-occurring contaminant sources are present. CSOs are just one anthropogenic influence on sediment quality in Boston Harbor. Correlation of measured contaminants to TOC and fines in stations adjacent ("Near") to CSOs and stations removed ("Far") from CSOs showed that, as is typically observed in marine sediments, increases in total organic carbon concentration were positively correlated with increases in percent fines at the "Far" stations. The relationship of percent fines to TOC at the "Near" stations is not as well defined and appears to be negatively correlated for several contaminants (particularly relative to percent fines). The proximity of some sampling stations to CSO outfalls may help to explain the variations in percent fines and TOC over the years, and lack of relationship between anthropogenic contaminant loadings from CSOs and storm water and fine particles and organic matter in many situations. Comparison of contaminants at "Near" and "Far" stations by study year, including using two sub-groups of "Far" stations, using the Student *t*-test, show that the concentrations of most parameters were significantly different at "Near" and "Far" stations ($p < 0.05$), and therefore support the grouping of sampling stations into "Near" and "Far" classifications. These results also lend themselves to the conclusion that there has been some level of impact from CSOs related to sediment quality in the vicinity of the CSOs. The difference between "Near" and "Far" concentrations has decreased over the years (i.e., concentrations have been declining more rapidly at the "Near" stations) for several contaminants (e.g., *Clostridium).*

One way ANOVA statistical analyses were performed to evaluate parameter trends over time at "Near" and "Far" stations. Most contaminants have declined in concentration at most CSO impacted locations since the early 1990s, and several have also experienced a decline at the "Far" locations. The concentrations have been declining less, or not to any noticeable degree, since the late 1990's. Contaminants such as *Clostridium*, Cd, Hg, Ag, and DDT have been declining significantly at the "Near" stations, while Cd, DDT, Chlordane, and *Clostridium* have experienced a noticeable decline at the "Far" stations, for example. These declines can be attributed to the implementation of secondary treatment of sewage at Deer Island in 1998, cessation of effluent from Nut Island, the relocation of the Deer Island Outfall in 2000, and CSO projects.

CSO Outfall Discharge and Potential Impacts Due to Precipitation Events

Impacts to sediment quality are variable and cannot necessarily be attributed directly to CSOs. Few parameters showed statistically significant temporal trends, though slightly more parameters show a significant temporal decrease at "Near" stations compared to "Far" stations. Most parameters showed variable or possibly decreasing concentrations from the early 1990s to 2006 and some showed declining concentrations since 1998. However, a number of notable spikes in contaminant concentrations were observed in 1998 and 2006 relative to other years, illustrating the significant effects storm events had on contaminant loadings in those particular years. It will be important to carefully monitor the response of the Boston Harbor sediments to future storm events, as additional CSO projects are completed.

Conclusions

The overall general decrease in contaminant concentrations observed since 1990 may in part be an indication of a Harbor-wide source reduction, including wastewater treatment upgrades (removal of sludge, implementation of secondary treatment, and the relocation of the Deer Harbor outfall to

Massachusetts Bay in 2000) and a variety of other legislative actions. However, some of the observed declines in the Dorchester Bay sediment contamination (e.g., *Clostridium*, DDT, and several metals) can in part be attributed to the CSO Program. *Clostridium* and silver, for instance, are reliable indicators of sewage sources. The significant decline in the concentration of these contaminants in sediment near CSOs indicates improvements that can be attributed to CSO management actions. The data clearly demonstrate that the CSO Control Plan is having a positive long-term impact on the sediment quality of Dorchester Bay and the Inner Harbor.

As CSO improvements continue, the results presented in this report will be most useful in combination with past and future results so that temporal trends can be identified and causal connections between sediment quality and CSO system improvements can be better understood. Improvements to the study sampling design may also aid in drawing direct links to CSO improvements and the potential for relatively short-term effects from major storm events. Changes to the sampling design and sampling frequency, including a design that potentially includes targeted sampling following individual storms, or other modifications may allow for more direct comparisons between CSO discharge and sediment quality. In addition, incorporating Deer Island Treatment Plant influent data as a surrogate for CSO discharge data during storm event, may allow for effectively estimating CSO loadings.

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1.0 INTRODUCTION

Combined sewer and stormwater systems collect sewage and storm water for transport to treatment facilities. During heavy rains, relief points, called combined sewer overflows (CSOs), are designed to discharge the sewage and stormwater into local waters if the capacity of the system is exceeded. This provides a "safety valve" that prevents back-ups of wastewater into homes and businesses and flooding in city streets. CSOs can affect public and ecological health through the introduction of pathogens, chemicals, and organic matter into the local waters.

Parts of the metropolitan Boston area are served by combined sewer systems that connect to the Massachusetts Water Resources Authority (MWRA) wastewater treatment system. In the past as many as 84 CSOs were active; 27 have been closed. As a result, Boston Harbor and the major rivers that flow into it (i.e., the Charles, Mystic, and Neponset Rivers) were subject to overflows of combined rainwater and sewage. To address the issue of CSO discharges, the MWRA is implementing a regional CSO control plan to reduce CSO releases and an environmental monitoring program to document the recovery of Boston Harbor in response to decreases in wastewater discharges.

The Boston Harbor sediments are sinks for contaminants originating with CSO sources, and are useful for monitoring these contaminants. MWRA has conducted periodic surveys to assess the potential impact of CSOs on sediment quality in Dorchester Bay (Durell *et al*., 1991; Durell, 1995; Lefkovitz *et al*., 2000, 2006). These surveys targeted toxic contaminants, pathogens, and other indicators of CSO discharge. Previous surveys were conducted in November 1990, August 1994, August 1998, and August 2002. The new data presented in this report were generated with samples collected in August 2006.

1.1 MWRA Combined Sewer Overflow (CSO) Program

The MWRA was created in 1985, in response to both the United States Environmental Protection Agency (EPA) mandate to institute secondary treatment and a Federal Court order to improve the condition of Boston Harbor. The MWRA instituted a multifaceted approach to improving the wastewater treatment system, including a new secondary treatment facility and construction of a 9.5-mile-long outfall pipe to carry the treated effluent to a deepwater diffuser system in Massachusetts Bay. In 1987, MWRA also assumed responsibility for developing and implementing a regional CSO control plan and agreed to plan and build small-scale projects to control CSOs in its combined sewer communities. These improvements have included blocking off rarely used CSOs, increasing the storage capacity of the sewer system, constructing treatment facilities, and installing tide gates to keep seawater out. The goal of the CSO program is to protect swimming beaches, shell fishing beds and other sensitive waters from overflows due to heavy rains.

In 1994, MWRA developed a long-term, three-phase CSO control plan, which includes Early CSO Related Improvements (Phase 1); Full Deer Island Pumping Capacity, SOPs and Minimum Controls (Phase 2); and Implementation of CSO Plan Projects (Phase 3) (MWRA, 2007). This plan was recommended in the Final CSO Facilities Plan and Environmental Impact Report (the "1997 Facilities Plan/EIR"), which received state and federal regulatory approvals in late 1997 and early 1998, respectively. Since 1997, several changes to the plan and schedule have been incorporated, and together with these modifications, the CSO control plan now comprises 35 wastewater system improvement projects, most of which are now in design, in construction, or complete. These projects are designed to bring CSO discharges in the metropolitan Boston area into compliance with the federal Clean Water Act (CWA) and state Water Quality Standards. The projects and their locations are shown in Figure 1-1. The design and construction phase of the CSO Control plan is anticipated to last until 2015, followed by a five-year period of assessment (2015−2020) to verify the attainment of CSO control goals.

Source: MWRA, 2008

Figure 1-1. MWRA Recommended CSO Control Plan and Status of Implementation

As part of this waste discharge improvement effort, MWRA has conducted periodic sediment surveys to 1) assess the potential impact of CSOs on sediment quality in Dorchester Bay (Durell *et al.,* 1991; Durell, 1995; Lefkovitz *et al.,* 2000, 2006), and 2) to document long-term improvement of sediment quality after CSO upgrades. New data will provide information to support the multi-year assessment due in 2020. The CSO sediment surveys to date have targeted sediment characteristics [grain size, total organic carbon (TOC)], toxic contaminants, and sewage tracers. The surveys were conducted every four years, in November 1990, August 1994, August 1998, August 2002, and most recently in August 2006. The 2006 study is described in more detail in Section 2.0 (Technical Approach).

1.1.1 Progress Since 1990

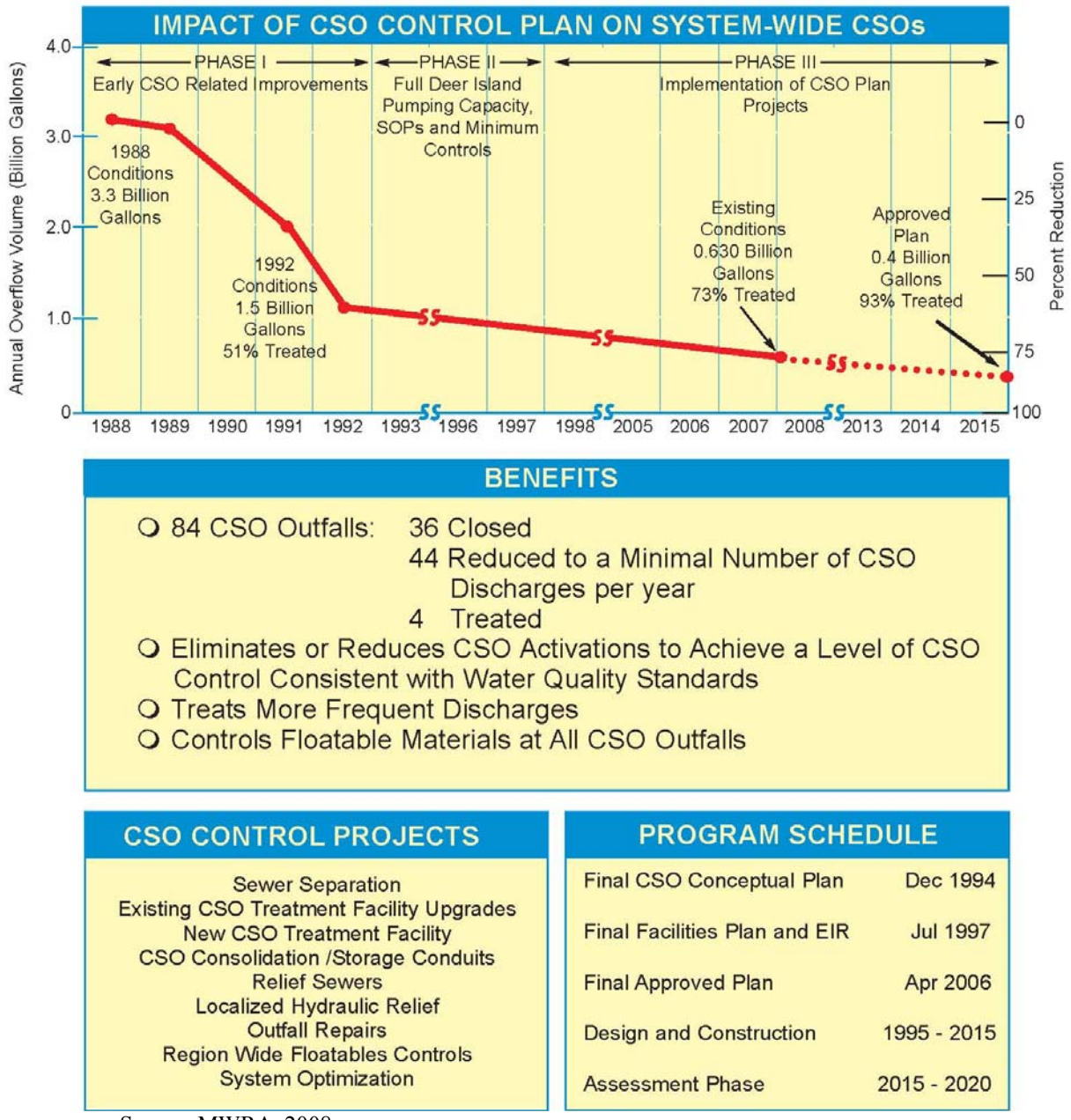
Ongoing MWRA pollution abatement projects for Boston Harbor involve reducing the number and discharge volumes from CSOs, and since 1987, these improvements have greatly reduced CSO impacts to water quality in Boston Harbor and its tributaries (MWRA, 2008). In 1988, the annual overflow volume from CSOs was about 3.3 billion gallons per year (BGY) (Figure 1-2). As of 2006 the wastewater system improvement projects, including completed CSO projects, have decreased the average annual volume of CSO discharge in a typical rainfall year to 0.76 billion gallons and have enabled more sewage to be pumped to the Deer Island treatment plant during rainy weather. Improvements and increased capacity at the Deer Island Treatment Plant have also contributed to decreased flows to the CSOs since 1989. Receiving water quality results (Coughlin, 2006, 2007; Morrison and Coughlin, 2005; Rex, 1991, 993; BWSC, 1990a, b) have shown substantial decreases in bacteria in Boston Harbor and its tributary rivers. For example, a decrease in wet-weather bacteria counts harbor-wide since the late 1980s shows the cumulative effect of the Boston Harbor Project and CSO control projects (Figure 1-3). The CSO Control Plan goal is to close 34 outfalls, to reduce to a minimal number the annual discharges at 46 outfalls, and to treat the discharges at another 4 outfalls.

MWRA has completed 21 of 35 scheduled CSO projects to date. Completed CSO projects include, but are not limited to, the upgrading of five CSO treatment facilities (Fox Point, Commercial Point, Cottage Farm, Prison Point, and Somerville Marginal), one facility optimization project, one new CSO treatment facility, one new CSO storage facility, six sewer separations [including one along the Neponset River, which empties into the study area (Figure 1-1)], the closing of 27 CSO outfalls, the installation of floatables controls, and four hydraulic relief projects. Several other projects are currently in the construction, design, and implementation phases.

1.1.2 Combined Sewer Overflow Progress Since 2002 Study

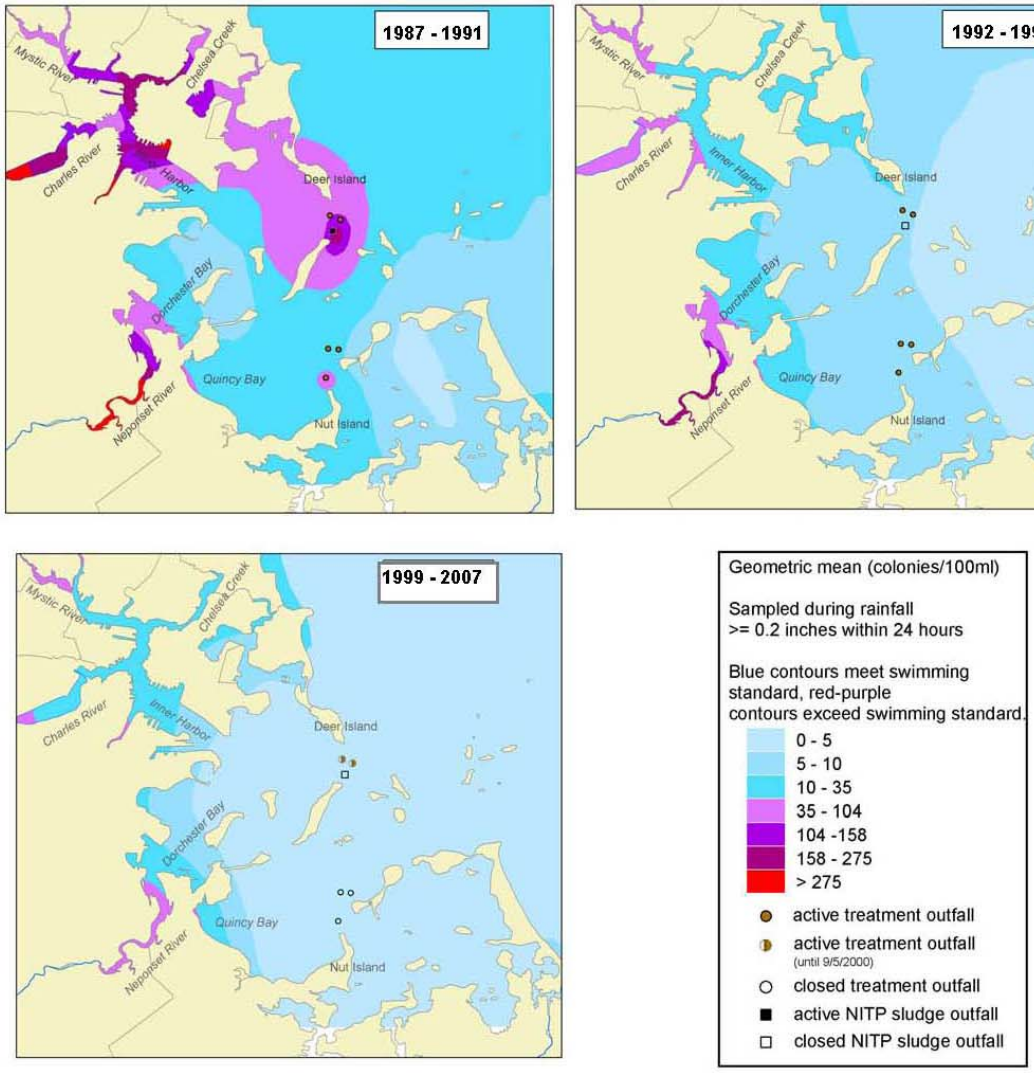
Since the last Boston Harbor CSO sediment study was conducted in 2002, major progress has been made in completing important projects around Boston Harbor, including new storage and treatment facilities, optimization of existing facilities, and sewer separation projects. Table 1-1 shows progress as of June on the CSO outfalls and CSO treatment facilities located in the vicinity of the MWRA CSO sediment study area. Figure 1-1 shows the locations of these outfalls and facilities. Table 1-2 presents the various CSO control projects in the vicinity of the MWRA CSO sediment study area and their completion dates. Five additional CSOs were closed in 2007 (two of which were outside the Dorchester Bay study area in the Charles River), after the August 2006 CSO sampling occurred (Table 1-1), with an additional seven CSOs to be eliminated in 2009.

Union Park Detention/Treatment Facility: The Union Park Pump Station provides flood control for the South End neighborhood of Boston, and the new detention and treatment facility was constructed to store up to 2.2 million gallons of CSO entering the pumping station, thereby lowering the frequency and volume of discharges from the pumping station to Fort Point Channel. The new facility includes finer screens for solids removal, chlorination with sodium hypochlorite, dechlorination with sodium bisulfite, and below-ground detention tanks. The goal of this project is to improve water quality in the Fort Point Channel by reducing the average annual number of pumping station discharges from 25 to 17 times per year and providing treatment of the remaining CSO flows (an estimated 71.4 million gallons per year) that are discharged through the Union Park pump station. The new treatment facility was brought into partial beneficial use on December 31, 2006, and construction was competed and full operation commenced in April 2007.



Source: MWRA, 2008

Figure 1-2. Impact of CSO Control Plan on System-Wide CSO Flow Volume, and Other Benefits



Contours show the geometric means of *Enterococcus* data collected when more than 0.2 inches of rain fell in the previous 24 hours. Blue areas meet the EPA geometric mean standard and red-purple areas exceed the standard.

1987 - 1991 This period shows data collected prior to the Boston Harbor project and CSO plans began, through the last year that sludge was discharged (1991). In wet weather, areas affected by the discharge of sewage and sludge from the Deer Island Treatment Plant and Nut Island Treatment plant and most of the Inner Harbor and tributary rivers failed to meet the standard.

1992 - 1998 Data from these years reflects the affects of CSO upgrades, the ending of sludge discharge, full pumping at DITP, improved primary and beginning secondary treatment at DITP. Most of the harbor meets standards except for the tributary rivers, Fort Point Channel and along Wollaston Beach.

1999 - 2007 The current period shows continued improvement due to the closure of 27 CSO outfalls, upgrades of CSO facilities, ending of harbor treatment plant effluent discharges as the new outfall began operating in 2000, and local efforts to abate stormwater pollution.

Source: MWRA, 2008

Figure 1-3. Changes in Boston Harbor *Enterococcus* Counts in Wet Weather

Table 1-1. CSO Status as of June 2008

Project	Location	Activity
CSO Outfalls		
BOS-49	Charles River	Active but schedule to be closed 2013
BOS-57	Inner Harbor	Active
BOS-60	Inner Harbor	Active
BOS-62	Fort Point Channel	Active
BOS-64	Fort Point Channel	Active
BOS-72	Fort Point Channel	Typically inactive, as of March 2007 with completion of the BOS72-73 Sewer Separation and System Optimization project (may discharge in large, 2-year, storms)
BOS-73	Fort Point Channel	
BOS-65	Fort Point Channel	Active
BOS-68	Fort Point Channel	Active
BOS-70	Fort Point Channel	Active
BOS-81	Old Harbor/North Dorchester Bay	Active but scheduled to be closed in May 2011 with completion of the N. Dorchester Bay Storage Tunnel
BOS-82	Old Harbor/North Dorchester Bay	
BOS-83	Old Harbor/North Dorchester Bay	
BOS-84	Old Harbor/North Dorchester Bay	
BOS-85	Old Harbor/North Dorchester Bay	
BOS-86	Old Harbor/North Dorchester Bay	
BOS-87	Old Harbor/North Dorchester Bay	Only stormwater (no CSO) since 2003
BOS-88	South Dorchester Bay	Closed to CSO in 2003; discharge stormwater
BOS-89	South Dorchester Bay	Closed as of June 2007, with completion of the South Dorchester Bay Sewer Separation project.
BOS-90	South Dorchester Bay	
BOS-93	Neponset River	Closed to CSO in February 1998; discharge stormwater
BOS-95	Neponset River	Closed to CSO in June 2000; discharge stormwater
CAM004	Alewife Brook	Active but schedule to be closed 2015
CAM400	Alewife Brook	Active but schedule to be closed 2015
CSO Treatment Facilities		
Fox Point	South Dorchester Bay; adjacent to BOS-88	Upgraded in mid-2002; were decommissioned and CSO discharge ceased with completion of the South Dorchester Bay Sewer Separation project in fall, 2007. Discharge stormwater.
Commercial Point	South Dorchester Bay; adjacent to BOS-90	

Table 1-2 . Long-term CSO Control Plan Projects in the CSO Sediment Study Area

Projects	Description	Estimated Construction Completion Date
Fort Point Channel		
Union Park Treatment Facility	• Construction of a new facility to provide 2.2 million gallons of storage and treatment of remaining CSO discharges.	04/2007
BOS072-073 Sewer Separation and System Optimization	• Construction of ~ 4,550 linear feet of new storm drains and appurtenant structures, relocation of storm runoff connections from the existing combined sewer to the new storm drains, and rehabilitation of the existing combined sewers for use as sanitary sewers.	03/2007
North Dorchester Bay		
N. Dorchester Bay Storage Tunnel	• 10,832-ft. long, 17-ft. diameter softground tunnel with mining shaft and equipment removal shaft • Drop shafts, diversion structures and associated piping at CSO outfalls BOS081 to BOS086, including gates to control stormwater	Operational 05/2011 (Notice to Proceed issued 8/31/2006)
N. Dorchester Bay Related Facilities	• 15 mgd dewatering pump station at Conley Terminal and 24-inch force main • Odor control facility at upstream end of tunnel, near State Police building	Operational 05/2011 (In design phase)
Pleasure Bay Storm Drain Improvements	• Stormwater piping and appurtenances to relocate stormwater discharges from Pleasure Bay to the Reserved Channel	03/2006
Morrissey Blvd Storm Drain	• 2,900-foot long, 12 x 12 foot box conduit for stormwater conveyance to Savin Hill Cove/South Dorchester Bay • Gated connection to CSO Storage tunnel	06/2009 (Notice to Proceed issued 12/2006)
South Dorchester Bay		
Fox Point Facility Upgrade	• Interim improvement with upgraded screening, chlorination, and dechlorination facilities	6/2002
Commercial Pt. Facility Upgrade	• Interim improvement with upgraded screening, chlorination, and dechlorination facilities	6/2002
South Dorchester Bay Sewer Separation	• Construction of ~ 136,000 linear feet of new storm drains and appurtenant structures, relocation of stormwater runoff connections from the existing combined sewer to the new storm drains, and rehabilitation of the existing combined sewers for use as sanitary sewers.	6/2007
Neponset River		
Neponset River Sewer Separation	• Sewer separation to eliminate CSO discharges to the Neponset River at outfalls BOS093 and BOS095. • Construction of approximately 10,000 feet of new storm drain. • Downspout disconnection work	6/2000
Regional		
Floatables Controls and Outfall Closings	• Floatables controls and regulator or outfall closings that are independent of the larger projects	2002

BOS 072-073 Sewer Separation and System Optimization: The Fort Point Channel Sewer Separation project, which was completed in March 2007, removed stormwater runoff from local sewers by installing 4,550 feet of new storm drains serving 55 acres in the Fort Point Channel area. As a result, the CSO discharges at outfalls BOS-72 and BOS-73 were reduced from 9 activations and 3.0 million gallons per year to zero discharges in a typical year.

Pleasure Bay Storm Drain Improvements: The Pleasure Bay storm drain improvements, completed on March 28, 2006, eliminate wet weather discharges to Pleasure Bay Beach by diverting storm flows to outfall BOS-80 (to the north) and outfall BOS-81 (to the south), which will eventually be tied into the North Dorchester Bay CSO storage tunnel. The inactive storm drain outfalls have been removed from the beach, and its surface has been restored.

South Dorchester Bay Sewer Separation: The South Dorchester Bay Sewer Separation project, completed in June 2007, removed stormwater runoff from local sewers by installing 136,000 feet (over 25 miles) of new storm drains serving 1,750 acres of Dorchester. As a result, the CSO discharges from outfalls BOS-88, BOS-89, and BOS-90 were reduced from 20 activations and 30 million gallons per year to zero discharges in a typical year, currently only discharging stormwater. After flow monitoring to close CSO regulators, MWRA decommissioned the Fox Point and Commercial Point CSO treatment facilities in December 2007. Downspout disconnection and other work continue to remove additional stormwater inflow from the sewer system, in order to minimize the risk of surcharging and flooding. In 2004, substantial work was completed to remove inflow sources from sewer systems in the Neponset area. This work further reduced the amount of stormwater in the sewer system by removing nonresidential, private drainage connections, such as connections from private parking lots.

Floatables Controls and Outfall Closings: Floatables control included in this project involved the installation of underflow baffles in ten existing CSO regulator structures associated with outfalls along Boston Inner Harbor and Fort Point Channel. The last of the ten installations was completed in 2002.

1.2 Objectives of CSO Monitoring and Report

The primary objectives for the 2006 CSO sediment study were to:

- Evaluate the extent to which sediment contamination in Dorchester Bay may result from CSO discharges, and how contaminant levels in that area have changed since the original 1990 study;
- Evaluate the extent to which changes may be occurring in concentrations of contaminants in Boston Harbor sediments, based on the data from the 1990–2006 CSO sediment surveys, and, if possible, gain an understanding of the response of the sediments to reduced CSO discharge;
- Evaluate how observed changes in sediment contamination may be related to MWRA's sewage treatment and CSO improvement program, and/or gain a better understanding of any lack of changes in contaminant concentrations.

These objectives were met by measuring concentrations of selected contaminants (toxic metals, organic pollutants, and sewage tracer compounds) in sediments at sites that were expected to be affected by CSOs ("Near" stations) and at sites that are in the same general area but were expected to be relatively free of CSO-related impacts ("Far" stations). Comparisons of 2006 survey results to results from the four previous studies were made to determine if sediment contaminant concentrations have changed in the past sixteen years and whether any observed changes can be attributed to the presence of CSOs or to CSO improvements. This report is not intended to be an exhaustive contaminant impact assessment study; rather, it provides a summary of the sediment quality in Dorchester Bay at the sites near CSOs relative to the sites farther away, as well as providing updates to previously reported Harbor sediment quality information (Hunt *et. al*., 2006).

2.0 TECHNICAL APPROACH

Pathogen contamination is generally considered the primary water quality impact from untreated CSO discharges. However, CSO discharges also contribute toxic chemicals, biological oxygen demand (BOD), and nutrients to receiving waters. Toxic chemical pollutants (selected organic and metal contaminants) in sediments were measured in relation to specific CSOs. To help discriminate the impact from sewage discharges from other sources of contamination to Boston Harbor, the microbial indicator *Clostridium perfringens* was included in the monitoring study; *Clostridium perfringens* counts are substantially higher in sewage effluents than in stormwater.

In August 2006, sediment samples were collected from 17 stations (Figure 2-1, Table 2-1) in Boston Harbor, most of which are located in Dorchester Bay. The field and laboratory procedures used in 2006 are the same as those used to conduct the 1990, 1994, 1998, and 2002 CSO sediment surveys (Durell *et al*., 1991; Durell, 1995; Lefkovitz *et al*., 2000, 2006). The technical procedures are briefly summarized in this report; detailed technical descriptions regarding sample collection, transport, and storage can be found in the survey report (Williams, 2006) and the combined work/quality assurance project plan (CW/QAPP) for benthic monitoring (Williams *et al*., 2006). Samples were analyzed according to the Quality Assurance Project Plan for Sediment Chemistry Analyses for Harbor and Outfall Monitoring (Prasse *et al.,* 2007), and referenced standard operating procedures (SOPs).

Sediment samples were analyzed for grain size, total organic carbon (TOC), organic contaminants (including a large suite of PAH compounds, PCB congeners, and chlorinated pesticides), sewage tracers (i.e., *Clostridium perfringens*), and selected major and toxic metals [silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn)]. The data were reviewed to determine the differences in sediment contaminant concentrations among sites expected to be significantly influenced by CSOs ("Near" stations) and sites remote from CSO sources ("Far" stations and "Harbor" stations). Additionally, the data were compared with data from the earlier surveys (Durell *et al.,* 1991; Durell, 1995; Lefkovitz *et al*., 2000, 2006) to determine if contaminant concentrations have changed.

2.1 Station Selection and Sample Analyses – Rationale and Objectives

The locations of the 17 sampling stations selected for this study are presented in Figure 2-1 and Table 2-1. The descriptions and rationale for the selection of these stations are provided in detail in the 1994 CSO sediment report (Durell, 1995) and also in the 2002 report (Lefkovitz *et al*., 2006). The Dorchester Bay stations have been sampled for each of the CSO studies since 1990 (Table 2-1). Stations outside Dorchester Bay were added to the CSO studies in 1994 (stations T01, T02, T08, C019, and SWEX3), 1998 (station T07), and 2002 (stations T03, T05A, and T06). What was originally called Station DB13 was surveyed in 1998, is located 0.01"W of Station T04, and those are considered equivalent; that sampling location is now called Station T04, including in this report. Data on these study sites that were generated from 1997 Boston Harbor sediment survey have also been included in this report.

The sampling stations are referred to as "Near" CSO discharges (n=6) or "Far" from CSO discharges (n=11), based on their physical proximity to CSO and/or SWO outfall. These stations represent areas likely to be influenced by CSO discharges, as well as areas primarily unaffected by CSO. These "Near" and "Far" station groupings are generally consistent with the earlier CSO sediment reports (Durell, 1995; Lefkovitz *et al*., 2000, 2006), except that station DB10 is now considered a "Near" station because of likely runoff contamination due to its near-shore location, and because it is downstream of some historical CSOs on the Neponset River. Also, the Boston Harbor stations from outside Dorchester Bay are considered "Far" stations for the purposes of most data analyses and discussions in this report, and are not treated as a third "Harbor" group, thus providing more power to the "Near" vs. "Far" data assessment.

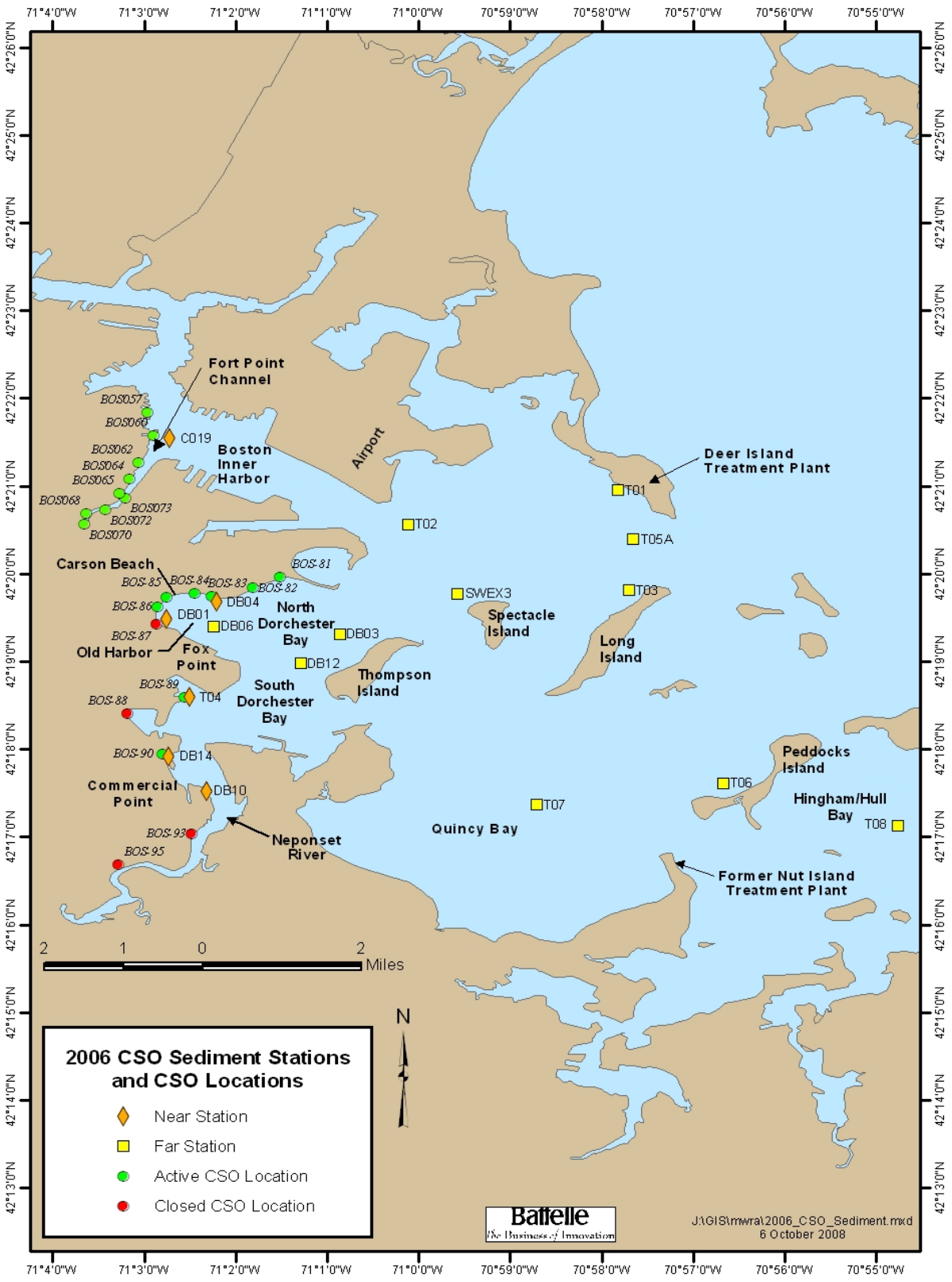


Figure 2-1 . Station Locations for 2006 Survey and Locations of CSOs

Table 2-1. Sampling Locations for CSO Sediment Contaminant Survey

Station	"Near" (N) or "Far" (F)	Station Description	Potential CSO Impact	Years Sampled	Latitude	Longitude	Mean Water Depth (m)
Old Harbor/ North Dorchester Bay							
DB01	N	Carson Beach, near BOS-087	BOS-86, BOS-87, BOS-82, BOS-84, BOS-81, BOS-85, BOS-83	'90, '94, '98, '02, '06	42°19.48'N	71°02.75'W	3.0
DB03	F	Off Thompson Island	No direct CSO input	'90, '94, '98, '02, '06	42°19.30'N	71°00.86'W	5.0
DB04	N	Carson Beach, near BOS-083	BOS-86, BOS-87, BOS-82, BOS-84, BOS-81, BOS-85, BOS-83	'90, '94, '98, '02, '06	42°19.68'N	71°02.22'W	4.0
DB06	F	Off Carson Beach	No direct CSO input	'90, '94, '98, '02, '06	42°19.39'N	71°02.25'W	2.0
South Dorchester Bay							
DB10	N	Mouth of Neponset River	No direct CSO input (near-shore with nearby CSOs, potential runoff)	'90, '94, '98, '02, '06	42°17.50'N	71°02.33'W	2.0
DB12	F	Off Thompson Island	No direct CSO input	'90, '94, '98, '02, '06	42°18.97'N	71°01.29'W	5.0
DB14	N	Commercial Point, near BOS-090	BOS-90	'90, '94, '98, '02, '06	42°17.92'N	71°02.73'W	2.0
T04	N	Fox Point, near BOS-089	BOS-89	'90, '94, '97, '98, '02, '06	42°18.60'N	71°02.49'W	3.2
Outside Dorchester Bay							
T01	F	Deer Island	No direct CSO input	'94, '97, '98, '02, '06	42°20.95'N	70°57.81'W	4.0
T02	F	Inner Harbor, off Logan Airport	No direct CSO input	'94, '97, '98, '02, '06	42°20.57'N	71°00.12'W	6.8
T03	F	Long Island	No direct CSO input	'97, '02, '06	42°19.81'N	70°57.72'W	8.7
T05A	F	President Roads	No direct CSO input	'97, '02, '06	42°20.38'N	70°57.64'W	17.5
T06	F	Peddocks Island	No direct CSO input	'97, '02, '06	42°17.61'N	70°56.66'W	6.6
T07	F	Quincy Bay	No direct CSO input	'97, '98, '02, '06	42°17.36'N	70°58.71'W	5.9
T08	F	Hull Bay	No direct CSO input	'94, '97, '98, '02, '06	42°17.12'N	70°54.75'W	11.3
C019	N	Fort Point Channel	CSOs in Fort Point Channel	'94, '98, '02, '06	42°21.55'N	71°02.71'W	7.9
SWEX3	F	Spectacle Island	No direct CSO input	'94, '98, '02, '06	42°19.76'N	70°59.56'W	8.0

2.2 Sample Collection and Field Procedures

2.2.1 Vessel/Navigation

The 2006 CSO sediment survey was conducted onboard the Battelle-owned *R/V Aquamonitor.* Navigation procedures followed those described in the Water Column CW/QAPP (Libby *et al.,* 2006a). Station positioning within 30 m of the target location was considered acceptable for sediment sampling (Williams *et al.,* 2006).

2.2.2 Sediment Sampling

At each station, three replicate samples were collected with a Kynar-coated 0.1-m^2 Ted Young-modified van Veen grab sampler. The top two centimeters of the grab were removed and processed for sedimentological, chemical, and microbiological parameters. Samples were analyzed for sediment grain size, total organic carbon (TOC), and *Clostridium perfringens*, as well as the organic and metal contaminants summarized in Table 2-2. Samples for grain size analysis were placed on ice in coolers, whereas the samples for TOC, organics, metals, and *Clostridium perfringens* analysis were frozen. A total of 51 samples were collected for analysis as part of the CSO sediment survey in 2006.

Table 2-2. Sediment Chemistry Analytes and Target Method Detection Limits (MDL)

Analyte	MDL[1,2]	Analyte	MDL[1,2]
Metals		**Polynuclear Aromatic Hydrocarbons[3]**	
Al Aluminum	4.5	Naphthalene*	0.190
Fe Iron	0.04	C_1-naphthalenes*	0.190
Ag Silver	0.0045	C_2-naphthalenes*	0.190
Cd Cadmium	0.005	C_3-naphthalenes*	0.190
Cr Chromium	0.20	C_4-naphthalenes	0.190
Cu Copper	0.525	Biphenyl*	0.050
Hg Mercury	0.001	Acenaphthylene*	0.067
Ni Nickel	0.15	Acenaphthene*	0.046
Pb Lead	0.60	Fluorene*	0.073
Zn Zinc	0.285	C_1-fluorenes*	0.073
Polychlorinated Biphenyls		C_2-fluorenes*	0.073
2,4-Cl_2(8)	0.0299	C_3-fluorenes*	0.073
2,2'5-Cl_3(18)	0.0280	Anthracene*	0.060
2,4,4'-Cl_3(28)	0.0288	Phenanthrene*	0.079
2,2'3,5'-Cl_4(44)	0.0233	C_1-phenanthrenes/anthracene*	0.079
2,2',5,5'-Cl_4(52)	0.0278	C_2-phenanthrenes/anthracene*	0.079
2,3',4,4'-Cl_4(66)	0.0301	C_3-phenanthrenes/anthracene*	0.079
3,3',4,4'-Cl_4(77)	0.0404	C_4-phenanthrenes/anthracene*	0.079
2,2'4,5,5'-Cl_5(101)	0.0189	Dibenzothiophene*	0.097
2,3,3',4,4'-Cl_5(105)	0.0280	C_1-dibenzothiophenes*	0.097
2,3',4,4'5-Cl_5(118)	0.0335	C_2-dibenzothiophenes*	0.097
3,3',4,4',5-Cl_5(126)	0.0362	C_3-dibenzothiophenes*	0.097
2,2',3,3,4,4'-Cl_6(128)	0.0303	Fluoranthene*	0.055
2,2',3,4,4',5-Cl_6(138)	0.0248	Pyrene*	0.044
2,2'4,4',5,5'-Cl_6(153)	0.0269	C_1-fluoranthenes/pyrenes*	0.044
2,2'3,3,4,4',5-Cl_7(170)	0.0253	C_2-fluoranthenes/pyrenes	0.044
2,2',3,4,4',5,5'-Cl_7(180)	0.0275	C_3-fluoranthenes/pyrenes	0.044
2,2',3,4,5,5',6-Cl_7(187)	0.0270	Benzo(a)anthracene*	0.062
2,2',3,3',4,4',5,6-Cl_8(195)	0.0431	Chrysene*	0.055
2,2',3,3'4,4',5,5',6-Cl_9(206)	0.0394	C_1-chrysene*	0.055
Decachlorobiphenyl-Cl_{10}(209)	0.0347	C_2-chrysene*	0.055

Table 2-2. Sediment Chemistry Analytes and Target Method Detection Limits (MDL), continued

Analyte	MDL[1,2]	Analyte	MDL[1,2]
Pesticides		C_3-chrysene*	0.055
Aldrin	0.0803	C_4-chrysene*	0.055
Dieldrin	0.1845	Benzo(b)fluoranthene*	0.029
Endrin	0.0612	Benzo(k)fluoranthene*	0.083
Hexachlorobenzene	0.0929	Benzo(a)pyrene*	0.033
Lindane (gamma-BHC)	0.0839	Benzo(e)pyrene*	0.072
Mirex	0.0226	Perylene*	0.037
Heptachlor	0.1631	Indeno(1,2,3-c,d)pyrene*	0.044
Heptachlorepoxide	0.0366	Dibenzo(a,h)anthracene*	0.074
alpha-Chlordane	0.0158	Benzo(g,h,i)perylene*	0.061
gamma-Chlordane	0.0325	Benzthiazole	0.129
Cis-Nonachlor	0.0131	1-Methylnaphthalene	
trans-Nonachlor	0.0213	2-Methylnaphthalene	
Oxychlordane	0.0790	2,6-Dimethylnaphthalene	
2,4'-DDD	0.0322	2,3,5-Trimethylnaphthalene	
4,4'-DDD	0.0266	1-Methylphenanthrene	
2,4'-DDE	0.0253	**Sewage Tracers**	
4,4'-DDE	0.0294	*Clostridium perfringens*	NA
2,4'-DDT	0.0303	**Physical Sediment Parameters**	
4,4'-DDT	0.0277	Total organic carbon	0.0065%
DDMU	0.0250	Grain size	2%

[1] MDL: method detection limit. Actual MDL is updated periodically. Contact the MWRA Central Laboratory for the most current MDL information. Units = μg/g dry weight for metals; ng/g dry weight for organics.
[2] Metals MDLs are based on 1 g sample weight, 100% solids, and 50 mL final volume (except mercury, which has a final volume of 100 mL). Organics MDLs are based on a 20g weight and 100% solids. TOC MDLs are based on 0.25g weight, 100% solids, and 5 mL final volume.
[3] MDL concentrations for alkyl homologues are based on the MDL of the unsubstituted, parent compound.
* Compounds are included in the calculation of Total PAH.

Grain size and *C. perfringens* samples were shipped to MWRA subcontractors for subsequent analysis. Azimuth Geo Services in Austin, Texas performed the grain size analysis. *C. perfringens* analysis was performed by BAL Laboratory in Cranston, Rhode Island. At the end of each survey day, the samples for TOC, organic contaminants, and metals analyses were transferred to personnel from MWRA's Department of Laboratory Services (DLS) for storage and analysis.

2.3 Laboratory Sample Analysis Procedures

Sediment samples were analyzed for organic contaminants (PAHs, PCBs, and chlorinated pesticides), selected metals (Ag, Al, Cd, Cr, Cu, Fe, Hg, Ni, Pb, and Zn), grain size, TOC, and a sewage tracer bacterium (*Clostridium perfringens*). Table 2-2 presents the list of analytical parameters, as well as the approximate method detection limits. Laboratory procedures followed those outlined in the Sediment Chemistry CW/QAPP (Prasse *et al.*, 2007). Concise summaries of the procedures are provided below.

2.3.1 Organic Contaminant Analysis

Analyses of sediments for organic contaminants were performed by the MWRA Central Laboratory according to methods listed in Table 2-3. Detailed information is provided in Prasse *et al.* (2007). Analytical methods for organic contaminants used in the 2006 study are comparable to those used in the historical CSO studies (Durell *et al.,* 1991; Durell, 1995; Lefkovitz *et al.,* 2000, 2006), with the exception that the PCB and pesticide analyses are now being conducted using GC/MS (rather than GC/ECD); GC/MS typically provides higher quality data, as it is generally less susceptible to sample matrix interference issues.

2.3.1.1 Contaminant Classes, Summations, and Definitions

The sediment samples were not analyzed for exactly the same parameters in each of the survey years from 1990 to 2006. Although the majority of the contaminants were consistent, and can be reliably compared, some differences limited the ability to compare the contaminants across sampling years. The details of the analyses are described for each study in each CSO sediment report (Durell *et al.,* 1991; Durell, 1995; Lefkovitz *et al*., 2000, 2006). The contaminants measured in 2006 are presented in Table 2-2, and the data for each individual parameter and each individual station replicate sample is presented in Appendix A. Appendix A also includes the mean and standard deviation in the concentration at each station.

Table 2-3. Sediment Organic Contaminant Analysis Methods

Parameter	Analysis Lab	Unit of Measurement	Method	Reference
Polycyclic Aromatic Hydrocarbons (PAHs)	DLS	µg/kg dry weight	GC/MS	DLS SOP DCN #1188/ #1030
Polychlorinated Biphenyls (PCBs)	DLS	µg/kg dry weight	GC/MS	DLS SOP DCN #1188/#1173
Chlorinated Pesticides	DLS	µg/kg dry weight	GC/MS	DLS SOP DCN #1188/#1173

GC/MS = gas chromatography/mass spectrometry
SOP = standard operating procedure. DCN = document control number. The SOP revision number is not included in the DCN. Contact the MWRA Central Laboratory for the most current revision number.

Reporting Polynuclear Aromatic Hydrocarbons (PAHs). Consistent with the earlier CSO studies, polynuclear aromatic hydrocarbon (PAH) data are primarily presented as total PAHs, low molecular weight (LMW) or petrogenic PAHs, and high molecular weight (HMW) or pyrogenic PAHs. Individual PAH compound data for the 2006 samples are presented in Appendix A. Total PAHs are for this report defined as the sum of majority of the target PAH compounds in Table 2-2; see asterix and footnote. A few relatively minor PAH compounds that were quantified are excluded from the Total PAH summation because they are recent additions to the PAH analyte list, and therefore cannot be compared across years, or to avoid double-counting (i.e., the five individual alkylated PAH compounds which are a component of their respective alkyl homolog). The set of asterixed PAH used to estimate the Total PAH has consistently been measured since 1994. In 1990, the PAH analyte list consisted of a set of 24 compounds commonly referred to as the 24 NOAA PAH (Durell *et al.,* 1991). The 24 NOAA PAH compounds have been measured in each year, and are a sub-set of the current more extensive PAH analyte list. Therefore, for the purposes of this report, the Total PAH for the 1990 data was determined by multiplying the Sum of 24 NOAA PAH by a station-specific PAH adjustment factor. The PAH adjustment factor was obtained from the ratio of Total PAH to Sum 24 NOAA PAH using the 2006 data; the adjustment factor was quite consistent, ranging from 1.27 to 1.47 for the different stations.

The total petrogenic PAH (LMW PAH) is the sum of petroleum-related PAHs, whereas the total pyrogenic PAH (HMW PAH) represent the sum of pyrogenic (combustion and creosote, coal-tar related) PAHs. The petrogenic PAH are mostly found in refined and unrefined petroleum products and are primarily the lighter-molecular-weight PAHs (i.e., LMW PAH). For this report, the LMW PAHs are defined as the asterixed PAHs in Table 2-2 from naphthalene through C3-dibenzothiophene. The 5 individual alkylated PAH compounds which are not asterixed in Table 2-2 (1-methylnaphthalene, 2-methylnapthalene, 2,6-dimethylnaphthalene, 2,3,5-dimethylnaphthalene, and 1-methylphenanthrene), are included in the calculation of the LMW PAHs for 1990 because some of the asterixed low molecular weight alkyl homologs were not measured in 1990; thus, the 1990 LWM PAH summation includes a slightly different set of PAHs from what was used for all other years, and most likely provides a slight underestimation of

the LWM PAH compared to later years. The HWM PAHs are primarily principal components of creosote and coal-tar mixtures or are derived from the combustion of fossil fuels, and are generally the heavier-molecular-weight PAHs. The HMW PAHs are defined as the PAH compounds in Table 2-2 marked with an asterisk between fluoranthene and benzo(g,h,i)perylene. Although PAH compounds cannot be attributed exclusively to one of these source types, this classification represents a general approximation of the relative proportion of petrogenic and pyrogenic PAH compounds.

Reporting Polychlorinated Biphenyls (PCBs). PCB data are presented and analyzed as the sum of the 20 PCB congener analytes (Table 2-2). There are 209 possible PCB congeners, with approximately 100 of those PCB congeners comprising more than 95% of the total PCB in most Aroclor formulations and environmental samples. The 20 PCB congeners that have been measured in the CSO sediment investigations were originally selected for the NOAA National Status and Trends monitoring project because they cover a wide range of PCB characteristics (congeners with from two to ten chlorine substitutions on the biphenyl molecule), and are among the most abundant; these 20 congeners together comprise about 50% of the total PCB in most US coastal sediments. Therefore, it is possible to estimate the total PCB concentration in most coastal sediments by multiplying the sum of the 20 PCB congener concentrations by two.

Reporting Pesticides. Total DDT and Total Chlordane are used to represent the chlorinated pesticide concentrations in this report; the individual pesticide compound data are presented in Appendix A. Because of the variability and unreliability in the 4,4'-DDT data, particularly in 2006 but also in some of the earlier years, the 4,4'-DDT data for all years and all stations have been excluded in the summation for Total DDT. Total DDT was calculated for this report as the sum of the other 5 common DDT compounds (2,4'-DDD, 2,4'-DDE, 2,4'-DDT, 4,4'-DDD, and 4,4'-DDE). The 4,4,'DDT concentration was about 10% of the Total DDT in samples that appeared to have little or no problems with the analysis of 4,4'-DDT, so the Total DDT value used in this report is likely an underestimation by approximately 10% compared to the more commonly used summation based on all 6 DDT, DDE, and DDD compounds. Total Chlordane is based on the sum of the four chlordane compounds that have been consistently measured in the CSO studies since 1994; heptachlor, heptachlorepoxide, alpha-chlordane (cis-chlordane), and trans-nonachlor.

2.3.2 Metal Analysis

The analyses of sediments for metal contaminants were performed by the MWRA Central Laboratory according to methods listed in Table 2-4. Detailed information is provided in Prasse *et al.,* (2007). Analytical methods for metal contaminants used in the 2006 study are comparable to those used by the historical studies (Blake *et al*., 1998; Durell *et al*., 1991; Durell, 1995; Lefkovitz *et al*., 2000, 2006; NOAA, 1998).

2.3.3 Grain Size and TOC Analysis

Grain Size. Grain size was performed by Azimuth Geo Services in Austin, Texas. Samples were analyzed for grain size by a sequence of wet sieving and dry sieving. The sand/gravel fraction was separated from the mud fraction and then transferred to a 200-mL beaker, decanted, and dried overnight at 95°C. The dried sand/gravel fraction was mixed by hand to disaggregate the material, and then dry-sieved on stacked sieves ranging in size from -1 to 4 phi. Each size class was weighed to the nearest 0.1 mg on a top-loading balance. Particles smaller than 4 phi were analyzed using the pipette method. The data were presented in weight percent by size class. Percent fines are defined as the sum of the percent clay and percent silt in a sediment sample. In addition, the gravel:sand:silt:clay ratio, and a numerical approximation of mean size and sorting (standard deviation), were calculated.

Table 2-4. Sediment Metal Contaminant Analysis Methods

Parameter	Analysis Lab	Units	Method[1]	Reference
Major Metals (Al, Fe)	DLS	% dry wt.	ICP/FAA	DLS SOP DCN #1193/#1008/#1199
Trace Metals (Ag, Cd, and Pb)	DLS	µg/g	ICP/GFA/FAA	DLS SOP DCN #1193/#1008/#1150/#1199
Trace Metals (Cr, Cu, Ni)	DLS	µg/g	ICP/FAA/GFA	DLS SOP DCN #1193/#1008/#1150/#1199
Trace Metals (Hg)	DLS	µg/g	CVA	DLS SOP DCN #1027/#1049
Trace Metals (Zn)	DLS	µg/g	ICP/FAA	DLS SOP DCN #1193/#1008/#1199

[1] When more than one instrument is listed, this is the order that would be applied. (i.e. First they were run on ICP, then FAA or GFA, if necessary).
ICP = inductively coupled plasma
FAA = flame atomic absorption
GFA = graphite furnace atomic absorption
CVA = cold-vapor atomic absorption
SOP = standard operating procedure. DCN = document control number. The SOP revision number is not included in the DCN. Contact the MWRA Central Laboratory for the most current revision number.

TOC. TOC samples were processed and analyzed by the MWRA Central Laboratory according to DLS SOP #1168, *Total Organic Carbon in Sediment by Combustion with Infrared Detection (Tekmar-Dorhmann DC-190*). Sediment samples for TOC analysis were thawed in the refrigerator. A portion of the wet sample (approximately 250 mg) was transferred to a scintillation vial. The sample was treated with 5 mL of 10% HCl to remove inorganic carbon, and the sample was heated in a water bath at 70° C for 10 minutes. The analyzer operates through the high-temperature conversion of all carbon in the treated sample to carbon dioxide in the presence of oxygen. The carbon dioxide was quantified by infrared detection, and results were reported as %C dry-weight.

2.3.4 *Clostridium perfringens* Analysis

Clostridium perfringens was performed by BAL Laboratory in Cranston, Rhode Island. BAL Laboratory has performed these analyses in the earlier CSO studies as well, ensuring consistency and data comparability. Sediment extraction methods for microbiological parameters followed those developed by Emerson and Cabelli (1982), as modified by Saad (1992). A known aliquot of homogenized sediment was transferred to a sterile 50-mL polypropylene centrifuge tube. Sterile sodium hexametaphosphate solution was added to the sample, and the tube was capped and mixed thoroughly for 10−15 seconds. Sterile deionized water was added, and the sample was remixed and allowed to settle for 10 minutes. The supernatant was removed from the tube with a sterile pipette and placed in a sterile test tube. The tubes were stored on ice and analyzed within 30 minutes. Analysis of the supernatant was performed by membrane filtration. Enumeration of *C. perfringens* spores followed the method of Bisson and Cabelli (1979). The extract was filtered through a sterile, 0.45-µm pore size, gridded membrane filter that retains the bacteria. After filtration, the membrane containing the bacterial cells was placed on a selective differential medium and incubated. The filters for enumeration of *C. perfringens* spores were incubated anaerobically at 44.5°C for 24 hours. Following incubation, the filters were exposed to ammonium hydroxide for 15−30 seconds. Yellowish colonies that turned red to dark pink upon exposure were counted as *C. perfringens*. Data were reported as number of colonies per 100 mL.

In 2006, *C. perfringens* samples were frozen instead of refrigerated, and thus had to be analyzed as soon as defrosted. This deviation is not expected to affect data quality or comparability, and a clarification was made to the CW/QAPP (Prasse *et al.*, 2007) about sample handling.

2.4 Data Analysis Procedures

Data presentation and most data analyses were performed on station mean data (i.e., the mean of three replicates from each station per year). Sediment grain size, as percent fines (sum of silt/clay), TOC, *Clostridium perfringens*, and organic and metal contaminant concentrations (station mean) were compared using box plots and bar charts. Data summary tables were also compiled for use in the main part of this report, and detailed individual parameter and individual replicate sample data for 2006 are presented in Appendix A. Station average data for each year and the key contaminants are presented in Appendix B.

Statistical analyses were used to determine if there were significant differences in contaminant levels among potentially CSO-impacted sites and sites expected to be relatively unimpacted by CSOs, and to determine if contaminant concentrations had changed since the previous CSO sediment investigations in 1990, 1994, 1998, and 2002. Sediment contaminant data measured in 1997 as part of the MWRA Harbor Benthic Survey (Blake *et al*. 1998) were also included, where available.

2.4.1 General Data Treatment and Presentation

Box plots were used to visualize the average site concentration distribution from 1990 to 2006, and identify points with extreme values. The ends of the box represent the 25th and 75th quartiles, and the red line across the middle represents the median value. The short black dash represents the mean value for each station. The "whiskers" are lines extending from the ends of the box to the outermost data point that falls within the distances computed (a distance of 1.5 times the interquartile range, difference between 25th and 75th quartiles). Data points above or below the whiskers represent possible outliers. Green horizontal lines represent the group means of "Near" and "Far" stations. Box plots were prepared using the JMP software (The Statistical Discovery Software, a product of SAS). Bar charts were used to visualize the temporal trends in sediment data and were prepared in Microsoft® Excel 2003. The error bars on the bar charts represent one standard deviation.

All data used for statistical analyses were tested for normality and homogeneity of variance prior to performing statistical analysis. An alpha level of 0.05 was used to assign statistical significance. Levene's test was used to determine the homogeneity of variance. Using the Box and Cox method, it was determined that using the $\log_{10}$ transformation of non-normally distributed data would conform better to the assumptions of parametric analyses. Data that were $\log_{10}$ transformed are noted in the tables of this report with an asterisk. An outlier (one of the three samples collected at DB14 and analyzed for PAHs during the 2002 sampling event) was removed from all PAH data analyses.

2.4.2 Statistical Analysis

Correlations. Correlation analyses were used to assess the intensity of association between the various variables and to determine if grain size and/or TOC control, or notably influence, the concentrations of contaminants at individual stations. Pearson product-moment correlations were performed between selected common parameters in 1990, 1994, 1998, 2002, 2006 and TOC, grain size and major metals by "Near"/"Far" stations. The common parameters among years included Cd, Cr, Cu, Pb, Hg, Ni, Ag and Zn, *Clostridium perfringens*, Total PAH, total LMW-PAH, total HMW-PAHs, Sum 4 Chlordanes, Sum 5 DDTs, and Sum 20 PCBs. The results of the correlations are discussed in Section 4.2.1.

Student *t*-test. To address whether the "Near" and "Far" stations differed significantly from each other for any given parameter, stations were grouped to constitute "Near" and "Far" stations as described previously. These groups were compared using Student *t*-tests. "Near" versus "Far" comparisons were made for each year (1990, 1994, 1998, 2002, and 2006) for all parameters: metals (Al, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Ag, Zn), Sum 4 Chlordanes, Sum 5 DDTs, Sum 20 PCBs, Total PAH, total LMW-PAHs, total HMW-PAHs, and *Clostridium perfringens.* The results of the *t*-tests are discussed in Section 4.2.2.

Student t-test analyses were also used to evaluate whether two different groupings of "Far" stations ("Far I" and "Far II") differed significantly from "Near" stations, and if the two different grouping of "Far" stations yielded different results. Far I represented the Harbor or "closer" Far stations (i.e., DB03, DB06, DB12, SWEX, T02) and Far II represented the distant "Far" stations (T01, T03, T05A, T06, T07, T08). These analyses were conducted only for the last two sampling periods (2002 and 2006) for all parameters: metals (Al, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Ag, Zn), chlordanes, DDTs, PCBs, PAHs, and *Clostridium perfringens.* The results of the *t*-tests are discussed in Section 4.2.2.

One-Way ANOVA. One-way Analysis of Variance (ANOVA) analyses were used to examine temporal trends among 1990, 1994, 1997, 1998, 2002, and 2006 data at all stations sampled in this time period. Results were evaluated to determine if there was a statistically significant difference in the contaminant concentrations at each station over the sampling years. Similar to the t-test analyses, the parameters evaluated included TOC, sediment grain size (measured as percent fines), *Clostridium perfringens*, PAHs (measured as total PAHs, LMW PAHs, and HMW PAHs), PCBs (measured as the sum of 20 PCB congeners), DDTs (measured as the sum of five DDT compounds), chlordanes (measured as the sum of four chlordane compounds), and various metals. Tables containing the ANOVA results are presented with each relevant parameter and can be read as follows: "a", "b", "c", "d", "e", and "f" represent the years 1990, 1994, 1997, 1998, 2002, and 2006, respectively [Tables C-1(a), C-2(a), C-3(a), and C-4(a)]. If two or more letters are listed together within a set of parentheses, then the measurements of the given parameter in those years are not significantly different. Letters that are not listed together within the same set of parentheses represent years that are significantly different. The letters are listed in each cell in order of descending value, with the year with the maximum value listed first. For example, the ANOVA result for TOC for Station DB01 (as shown in Table C-1(a) in Appendix C) is a(ebfd). In this case, "a" is significantly higher than "e", "b", "f", and "d". However, "e", "b', "f" and "d" are not significantly different from one another, although "e" is higher than the other stations, as indicated by the order in which the letters are shown. The comprehensive results of the ANOVA tests are presented in Appendix C.

ANOVA analyses were also run to evaluate differences in various parameters at "Near" and at "Far" sites across the sampling years (1990, 1994, 1997, 1998, 2002, and 2006). "Near" stations included DB01, DB04, T04, DB10, DB14 and CO19; "Far" stations included: DB03, DB06, DB12, and SWEX3, T01, T02, T03, T05A, T06, T07 and T08. "Near" and "Far" comparisons across the years were run for all parameters: metals (Al, Cd, Cr, Cu, Fe, Pb, Hg, Ni, Ag, Zn), DDTs, chlordanes, PCBs, PAHs, and *Clostridium perfringens*. Results for these ANOVA analyses are presented in Section 4.2.3.

Principal Component Analysis (PCA).
The PAH and PCB data were analyzed using principal component analysis (PCA). PCA analysis is a data exploratory and analysis tool designed to explore large data sets, focusing on the compositional variability between samples. The PCA exploratory technique is used to help recognize stations that share similar PAH and PCB composition (i.e., similar *relative* PAH and PCB compound concentrations) and those that have clearly different composition. Samples which visually "cluster" are chemically similar, and may have similar source(s) of the contamination.

PCA produces graphical depictions of relationships between samples and variables (e.g., PAH compounds or PCB congeners) based on pattern recognition. It achieves this by reducing the "n" dimensionality of the data (where n = number of variables or samples, whichever is smaller) by finding linear combinations of the variables in the data which account for the maximum amounts of variance. These linear combinations are the principle components. The 1st principle component (PC) accounts for the maximum amount of variance and each successive PC accounts for less of the remaining variance. PCA yields a distribution of samples (e.g., sediment samples) in n-dimensional space, where n is the number of variables.

Prior to the PCA analysis the PAH compound data were normalized to the total concentration in each sample in order to eliminate influences caused by concentration alone. The goal of these analyses is to identify differences and similarities between samples based on PAH pattern recognition, and therefore other influential factors need to be removed. Normalized data for different potential source materials (e.g., PCB Aroclor formulations and PAH containing hydrocarbon materials) was also included in the data set. PCA was performed by using EinSight (Version 4.02; Infometrix, Inc., Seattle, WA).

2.4.3 Sediment Quality Reference Value Evaluations

The sediment data were compared to selected sediment quality reference values, to help put the measured contaminant concentrations into perspective. The sediment contaminant data were compared to the National Oceanic and Atmospheric Administration (NOAA) National Status and Trends/Mussel Watch (NS&T/MW) "high" values, which are useful reference values determined statistically using the NS&T/MW monitoring program dataset (Table 2-5; Daskalakis and O'Connor, 1995). The listed reference values were set as the geometric mean plus one standard deviation, using the NS&T/MW U.S. coastal monitoring program sediment site data. Daskalakis and O'Connor (1995) also compiled a comprehensive Coastal Sediment Database (COSED) of chemical contaminant concentrations in US sediments, and this is a useful reference for contaminant concentrations measured around the country and what would typically be considered elevated concentrations, on a national level.

The sediment contaminant data were also compared to effects-based sediment quality guideline (SQG) values (Table 2-5). Effects range-low (ERL) and effects range-median (ERM) values are the most commonly used and referenced sediment quality guidelines. They were initially developed by scientists at NOAA (Long and Morgan, 1990) and were later revised after compiling additional data (Long *et. al*., 1995). These are scientifically derived values of potential for biological effects to sediment dwelling organisms from sediment-sorbed contaminants. The concentration below the ERL value represents a minimal-effect range; a range representing conditions in which ecologic and toxic effects are rarely expected. Concentrations between the ERL and ERM represent a possible-effects range within which effects would occasionally occur, and concentrations above the ERM value represent a probable-effects range where effects would be expected to frequently occur. A second set of similarly derived marine SQGs were developed by MacDonald *et. al.* (1996); threshold effects levels (TEL) and probable effects levels (PEL). The TEL represents the concentration below which sediment toxicity would not be expected to be observed and the PEL is the concentration above which sediment toxicity would likely occur.

Table 2-5. Sediment Quality Reference Values: Marine/Estuarine Sediment TEL, PEL, ERL and ERM Values, and NS&T/MW "High" Values

Contaminant	Reference Value − Sediment Concentration (mg/kg, dry weight, for metals and μg/kg, dry weight, for organics)				
	Marine/Estuarine SQGs		Marine/Estuarine SQGs		NS&T/MW "High" Value[e]
	TEL[a]	PEL[b]	ERL[c]	ERM[d]	
As	7.24	41.6	8.2	70	13
Cd	0.68	4.21	1.2	9.6	0.54
Cr	52.3	160	81	370	125
Cu	18.7	108	34	270	42
Pb	30.2	112	46.7	218	45
Hg	0.13	0.7	0.15	0.71	0.22
Ni	15.9	42.8	20.9	51.6	42
Ag	0.73	1.77	1	3.70	0.52
Zn	124	271	150	410	135
Total PAH	1,684	16,770	4,022	44,792	2,180
Low PAH	312	1,442	552	3,160	450
High PAH	655	6,676	1,700	9,600	1,730
Total PCB	21.6	189	22.7	180	80
Total DDT	3.89	51.7	1.58	46.1	22
DDE	2.07	374	2.2	27	NA[f]
DDD	1.22	7.81	2	20	NA
DDT	1.19	4.77	1	7	NA
Chlordane	2.26	4.79	0.5	60	4.5
Dieldrin	0.72	4.3	0.02	8	2.9
Lindane	0.32	0.99	NA	NA	NA

[a] TEL: Threshold Effect Level (MacDonald *et al*., 1996)
[b] PEL: Probable Effect Level (MacDonald *et al*., 1996)
[c] ERL: Effects Range Low (Long *et al.*, 1995; Long & Morgan, 1990, for DDD, DDT, dieldrin and chlordane).
[d] ERM: Effects Range Median (Long *et al*., 1995; Long & Morgan, 1990, for DDD, DDT, dieldrin and chlordane).
[e] NS&T/MW "High" data from Daskalakis and O'Connor (1995).
[f] NA: not applicable. There is no value for this parameter.

3.0 RESULTS

The primary goal of this study was to generate sediment quality data for specific Boston Harbor locations, consider the apparent impact of the studied CSOs on the local sediment quality, and discuss changes in contaminant concentrations between 2006 and historical studies (1990, 1994, 1998, and 2002). Study locations are sometimes described with some detail, but at times only a simple reference to the station identifier is given, for brevity. Referring to Figure 2-1 and Table 2-1 can be help as stations are discussed.

Historical data collected in the Fox Point/Commercial Point area nearly 20 years ago (Eaganhouse and Sherblom, 1990; Gallagher *et al.,* 1992; Wallace *et al.,* 1991) showed higher contaminant concentrations there than at the surrounding Harbor areas. However, Gallagher *et al.* (1992) concluded that the data were insufficient to attribute the increased concentrations of organic and metal contaminants in this area to the Fox Point CSO. Instead, they suggested that most sediment contaminants measured in Dorchester Bay originated from Deer Island and Nut Island sewage treatment plant discharges. Elimination of sludge discharges from the Deer Island and Nut Island facilities in December 1991 significantly reduced the amount of contaminants available for transportation into Dorchester Bay (Werme and Hunt, 2003). The loading of contaminants to Boston Harbor was further reduced beginning in 1997 when secondary treatment at the Deer Island Treatment Plant was phased in and the Nut Island discharge into Quincy Bay was closed in 1998. Additional reductions occurred in September 2000 with the transfer of Deer Island effluent to the Massachusetts Bay outfall.

Sections 3.1 through 3.4 present the results of physical, chemical, and sewage tracer measurements at all stations studied from 1990 through 2006, and discuss the results of the one-way ANOVA analyses (Appendix C) where relevant. Data in these sections are presented as box plots showing the distribution of annual mean data at each station for all parameters for all available years (see Section 2.4.1 for interpretation of the box plot information). Data are also summarized in tables in Sections 3.1 through 3.4; tables which present the 2006 data (mean of 2006 replicates), and the minimum, maximum and overall mean of the annual means from 1990, 1994, 1997, 1998, 2002, and 2006.

Section 4 discusses the results of additional statistical evaluations of the data including the correlation of contaminants to TOC and percent fines, the comparison of contaminant concentrations at "Near" and "Far" stations, and temporal trends at "Near" and "Far" stations. The data collected in 2006, with results for each individual station, including means and standard deviations between replicates, are presented in Appendix A. Summaries of historical contaminant means from 1990, 1994, 1997, 1998, 2002, and 2006 are presented in Appendix B. Results of the one-way ANOVA analyses for individual stations are provided in Appendix C. It should be noted that in this report, as in the most recent previous CSO sediment reports, the sediment contaminant data have not been thoroughly evaluated and interpreted by considering sediment characteristic such as TOC and grain size. It has been well established that contaminant concentrations are often controlled by, and/or correlated with, the organic content (e.g., TOC) and the grain size (e.g., percent fines) of the sediment, and a thorough data assessment often includes evaluating both "raw" and normalized (e.g., to TOC, grain size, and/or major metals, such as Al or Fe).

3.1 Grain Size and TOC Results

Overall, in 2006, the sampling stations located in the vicinity of the CSOs (the "Near" stations) generally exhibited higher average percentages of fine sediments (clay and silt) and percent TOC than the "Far" stations (Figure 3-1, Figure 3-2, and Table 3-1). Percent fines were highest at Stations DB01, DB04, T04, and C019 (91.3% to 97.6%) in 2006, and represented maximum station values for DB01, DB04, and C019. The lowest percent fines levels were found at "Far" stations T08 in Hingham/Hull Bay (6.34%) and DB06 off Carson Beach (7.48%), and levels at these stations have been very consistent over time. The percent fines were, on average, generally higher in 2006 than in earlier years (except SWEX3, T03, and T08);

several "Far" stations had maximum percent fines values in 2006, including DB03, DB06, DB12, T01, T02, T06, and T07. The 2006 values at DB12 off Thompson Island, T02 near the Airport, and T07 in Quincy Bay were statistically significantly higher than previous years [Table C-1(a)].

In 2006, the TOC concentrations were found to be highest at Station DB14 off Commercial Point (4.99%) and at Station DB10 in the Neponset River (4.31%). The lowest TOC concentrations were found at "Far" stations T08 in Hingham/Hull Bays (0.36%) and DB06 off Carson Beach (0.25%). Most TOC concentrations in 2006 at "Near" and "Far" stations were similar to or lower than the station mean values, and minimum TOC values were measured in 2006 at "Far" stations SWEX3 (statistically significant), T03, T05A, and T08.

The increase in the percent fines in many of the 2006 sediment samples is consistent with the broad increase in the sediment aluminum concentration that was observed in 2006. However, it is interesting to observe that there is not a similar increase in the percent TOC; TOC and percent fines are often correlated. In this case, the increase in the amount of fine grain surface sediment is observed along with a stable or even small decrease in the TOC content of the sediments. The current source of much of the fine grain surface sediment appears to be unassociated with the source of much of the TOC. Discharge from CSOs and the Deer Island Treatment Plant has historically likely been significant contributors of TOC to the sediments and those sources have been significantly curtailed in recent years.

Table 3-1 . Fines and TOC 2006 Mean and 1990−2006 Combined Data by Station (%, dry weight)

Station	N	Fines				TOC			
			All Years				All Years		
		2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN
Near Stations									
DB01	5	91.3	30.1	91.3	74.0	2.69	2.32	6.26	3.42
DB04	5	91.5	60.8	91.5	78.0	2.41	2.30	3.15	2.57
T04	6	95.6	77.7	97.4	87.6	3.84	3.23	7.14	4.26
DB10	5	83.1	54.1	97.1	77.0	4.31	2.96	4.54	4.04
DB14	5	64.6	51.9	74.1	61.7	4.99	4.31	8.60	5.94
C019	4	97.6	95.9	97.6	96.8	3.20	2.83	3.20	2.98
Far Stations									
DB03	5	38.6	18.5	38.6	23.0	1.20	0.540	1.32	1.02
DB06	5	7.48	5.87	7.48	6.73	0.254	0.233	0.263	0.248
DB12	5	77.3	43.5	77.3	52.3	2.29	1.88	2.89	2.45
SWEX3	4	51.8	51.8	66.4	59.5	1.30	1.30	2.57	2.10
T01	5	41.4	20.7	41.4	31.1	1.02	0.973	1.83	1.49
T02	5	83.8	37.9	83.8	56.9	1.99	1.44	1.99	1.66
T03	3	57.3	57.3	82.6	66.5	2.14	2.14	3.57	2.84
T05A	3	28.6	12.4	32.1	24.4	0.489	0.489	1.42	0.927
T06	3	58.0	26.4	58.0	41.8	1.80	1.60	1.88	1.76
T07	4	80.6	54.5	80.6	61.9	2.42	2.16	3.09	2.60
T08	5	6.34	5.43	10.4	6.86	0.362	0.362	1.17	0.580

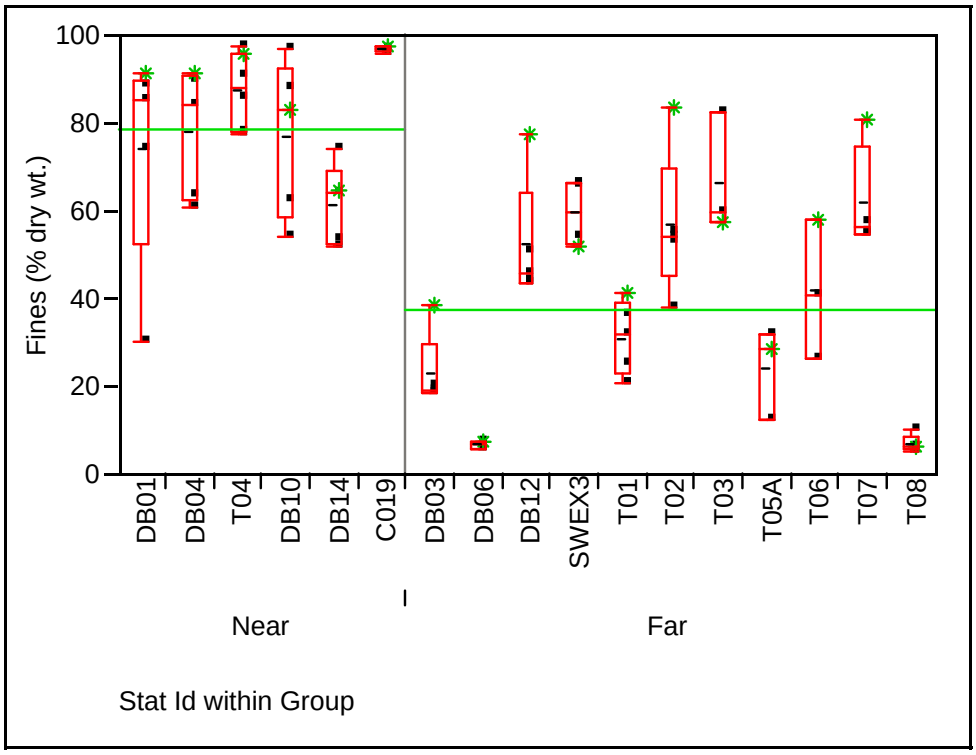


Figure 3-1. Sediment Percent Fines at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

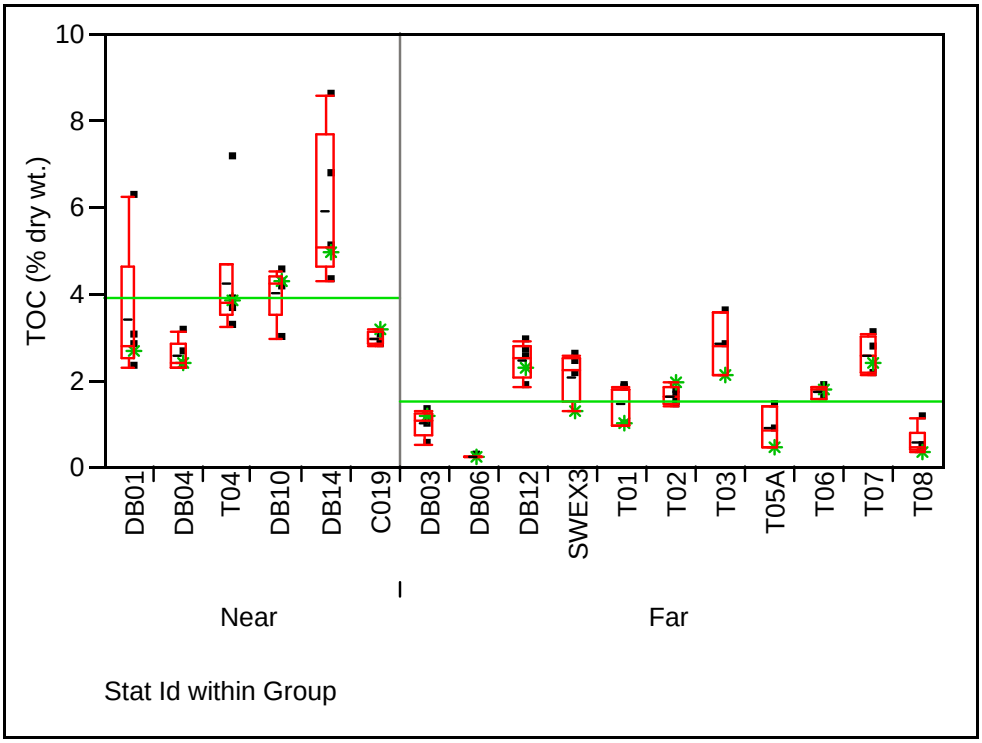


Figure 3-2. Total Organic Carbon at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

3.2 Organic Contaminant Results

The detailed organic contaminant data for 2006 have been compiled in Tables A-3 and A4 in Appendix A. Station average organic contaminant data for stations sampled in 1990, 1994, 1997, 1998, 2002, and 2006 are summarized in Table B-3 in Appendix B (Note: PCBs, DDTs, and Chlordane were not measured in 1990). The following sections discuss the data by parameter and reference the one-way ANOVA analyses where relevant (See Appendix C for ANOVA results).

3.2.1 PAH Concentrations

PAH concentrations are presented as total PAH, low molecular weight (LMW) or petrogenic PAHs, high molecular weight (HMW) or pyrogenic PAHs, and % pyrogenic PAHs of the total PAHs. In general, PAH concentrations in 2006 at stations "Near" CSOs were higher and more variable than those measured at stations "Far" from CSOs (Figure 3-3; see Section 2.4.1 for how to interpret the box plots). The relatively high PAH concentrations measured at "Near" stations are not surprising given that those stations are located close to urban sources, adjacent to highly industrial areas and in a known depositional area of Boston Harbor. In addition to being exposed to CSO discharge, they are in locations where street and other urban runoff can directly contribute significant amounts of petroleum and combustion related PAH.

The highest PAH concentrations have consistently been found at Station DB14, with concentrations as high as 156,000 ng/g Total PAH observed in 1998 (Table 3-1). DB14 continues to be a station with high PAH concentrations, with the 2006 concentrations being higher than the average measured from 1990 to 2006 (Table 3-1). Total PAH concentrations in 2006 (green star) ranged from 1,490 ng/g at "Far" station T08 to 125,400 ng/g at "Near" station DB14. 2006 concentrations were within the range of historical values at the "Near" stations and were higher than the station mean values at T04, DB10, DB14, and CO19. At the "Far" stations, total PAH concentrations in 2006 were generally lower than or similar to the station mean values, with the lowest values in all years (minimum values) measured at DB03, SWEX3, T03, and T05A in 2006; the lowest concentrations were at DB03, DB06, and T08 in 2006, all being below the overall mean for the "Far" stations (Figure 3-1). The low organic contaminant concentrations at stations DB06 and T08 are consistent with the low TOC and relatively coarse grain size at these stations.

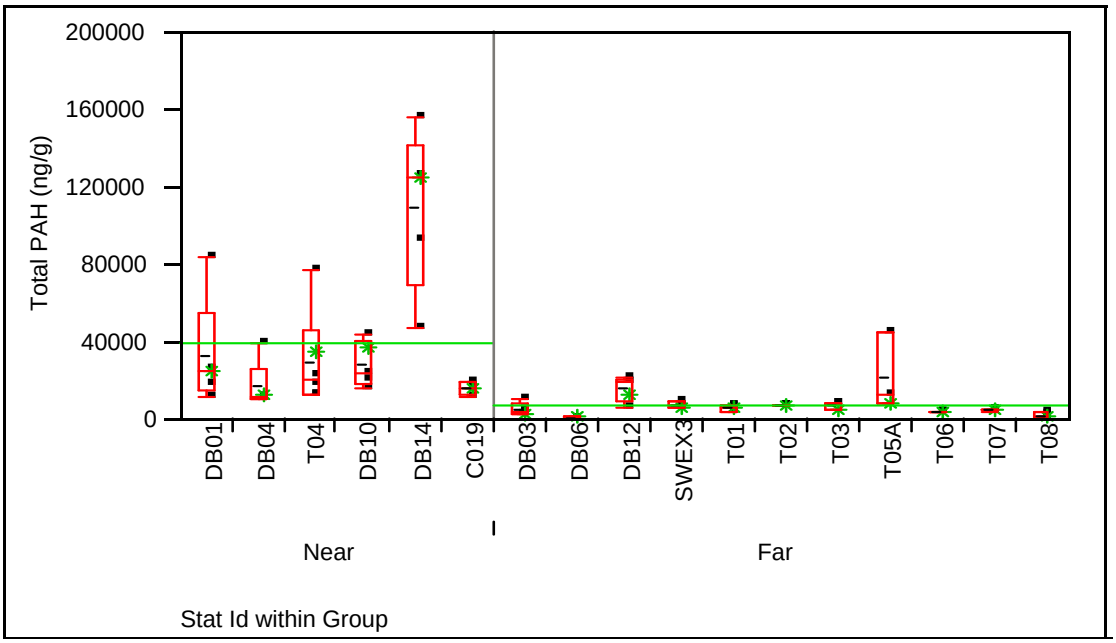


Figure 3-3. Total PAHs at "Near" and "Far" Stations
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

Table 3-2 . PAH 2006 Mean and 1990−2006 Combined Data Summarized by Station (ng/g, dry weight)

Station	N	Total PAH				LMW PAH				HMW PAH			
			All Years				All Years				All Years		
		2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN
Near Stations													
DB01	5	24,742	11,873	83,621	33,037	4,029	2,964	17,972	7,303	20,713	8,910	47,872	22,178
DB04	5	12,623	10,764	39,654	17,172	2,494	1,839	12,688	4,631	10,129	6,193	26,966	11,994
T04	6	35,328	12,431	76,687	29,684	8,799	1,833	28,212	8,848	26,529	7,175	48,475	20,266
DB10	5	37,134	15,899	44,168	28,333	7,859	3,130	11,283	6,267	29,275	12,136	32,885	20,942
DB14	5	125,377	46,788	155,689	109,530	32,890	7,517	58,194	33,715	92,487	28,199	97,495	73,601
C019	4	16,032	11,226	19,450	15,998	3,341	3,139	4,900	3,877	12,691	8,087	14,550	12,121
Far Stations													
DB03	5	3,004	3,004	10,350	5,106	669	465	3,814	1,547	2,335	1,978	6,536	3,339
DB06	5	1,575	371	1,575	758	278	79	278	140	1,297	292	1,297	585
DB12	5	12,722	6,601	21,791	15,965	3,103	978	6,573	4,545	9,618	3,512	15,217	10,997
SWEX3	4	5,955	5,955	9,877	7,390	1,561	1,561	3,089	2,165	4,394	4,394	6,788	5,225
T01	5	5,710	3,371	7,567	5,657	1,699	1,268	3,211	2,236	4,011	2,103	4,490	3,420
T02	5	7,257	6,728	7,562	7,140	1,639	1,639	2,246	1,973	5,618	4,753	5,618	5,167
T03	3	5,479	5,479	8,837	7,499	1,596	1,596	3,363	2,544	3,883	3,883	5,505	4,954
T05A	3	8,527	8,527	45,222	22,053	2,529	2,529	17,658	8,235	5,997	5,997	27,564	13,819
T06	3	4,409	4,066	4,409	4,181	1,054	1,054	1,280	1,195	3,355	2,789	3,355	2,986
T07	4	5,536	4,398	5,536	5,145	1,286	1,286	1,675	1,418	4,250	3,050	4,250	3,726
T08	5	1,494	650	3,817	2,149	495	229	1,701	857	999	421	2,116	1,292

The types of PAH compounds present in the sediment can provide some information on sources and can help in the interpretation of temporal and spatial trends. The vast majority of the PAH in the Boston Harbor sediment, and most coastal environments, are anthropogenic. Pyrogenic (or HMW) PAHs are derived from combustion of organic materials, including combustion of petroleum products, and are characterized by four to five ring higher molecular weight PAH compounds. Petrogenic (or LWM) PAHs generally originate with refined and unrefined petroleum products and are characterized by the one to three ring, lower molecular weight PAH compounds. While petrogenic PAHs are present in most marine sediments, they usually are less abundant than pyrogenic PAHs, except near point sources of petroleum hydrocarbons such as oil spills, refineries, or other sources of petroleum products (Neff, 2002).

The distribution of LMW and HMW PAH data is similar to that of total PAHs, with concentrations generally higher and more variable at the "Near" stations than at the "Far" stations (Figure 3-4 and Figure 3-5). Similar to Total PAH, the highest concentrations of LMW and HMW have consistently been found at "Near" Station DB14, at Commercial Point. Concentrations of LMW PAHs in 2006 were within the range of historical values, and were generally less than or similar to the mean value at each station, with minimum values for the station and all study years measured at several of the "Far" stations (SWEX3, T02, T03, T05A, T06, T07). HWM PAHs in 2006, however, were near the upper end of the distribution over the study years for three "Near" stations in southern Dorchester Bay and the Neponset River (T04, DB10, and DB14), and were the highest ever measured at four of the "Far" stations (DB06, T02, T06, and T07), although HMW concentrations at these stations remained low.

Figure 3-6 shows the relative amount of HMW PAHs as a percentage of the total PAH and illustrates the changes in PAH distribution in the sediments. As expected, the pyrogenic PAH in all cases is greater than 50% of the total PAH, and in past years was generally above 70%. In 2006, the percent of pyrogenic PAHs was the highest ever measured at all stations and ranged from 68% at "Far" station T08 in Hingham/Hull Bay to 84% at "Near" station DB01 (Appendix B). The high total PAH concentration at Station DB14 in 2006, for instance, can mainly be attributed to increase in the HMW PAH.

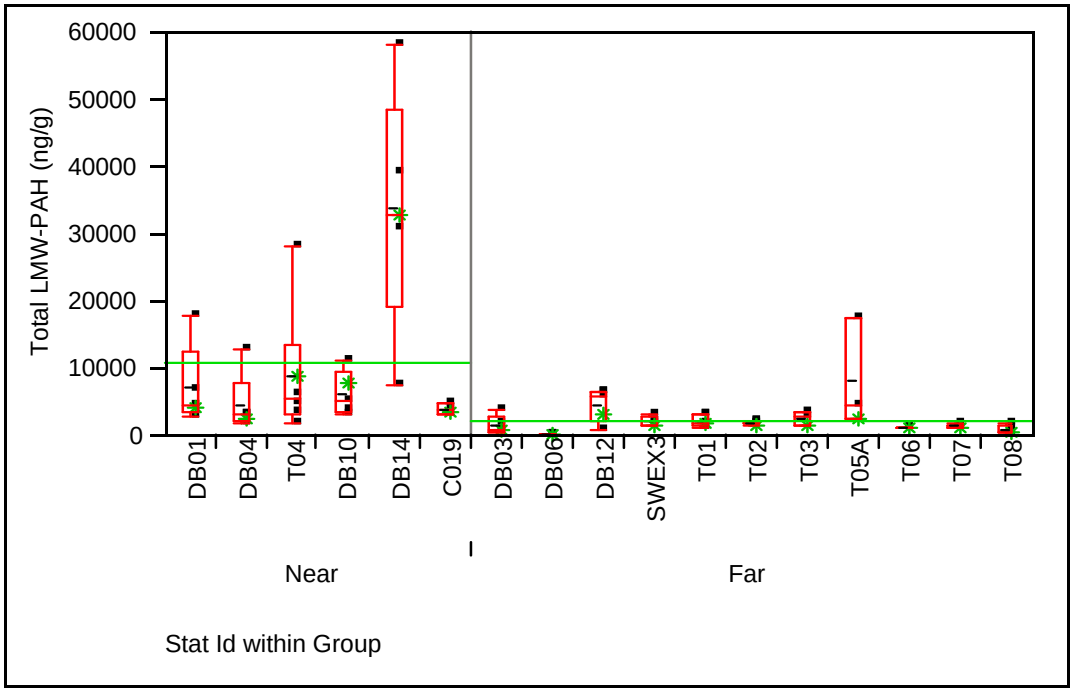


Figure 3-4. Total LMW PAHs at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

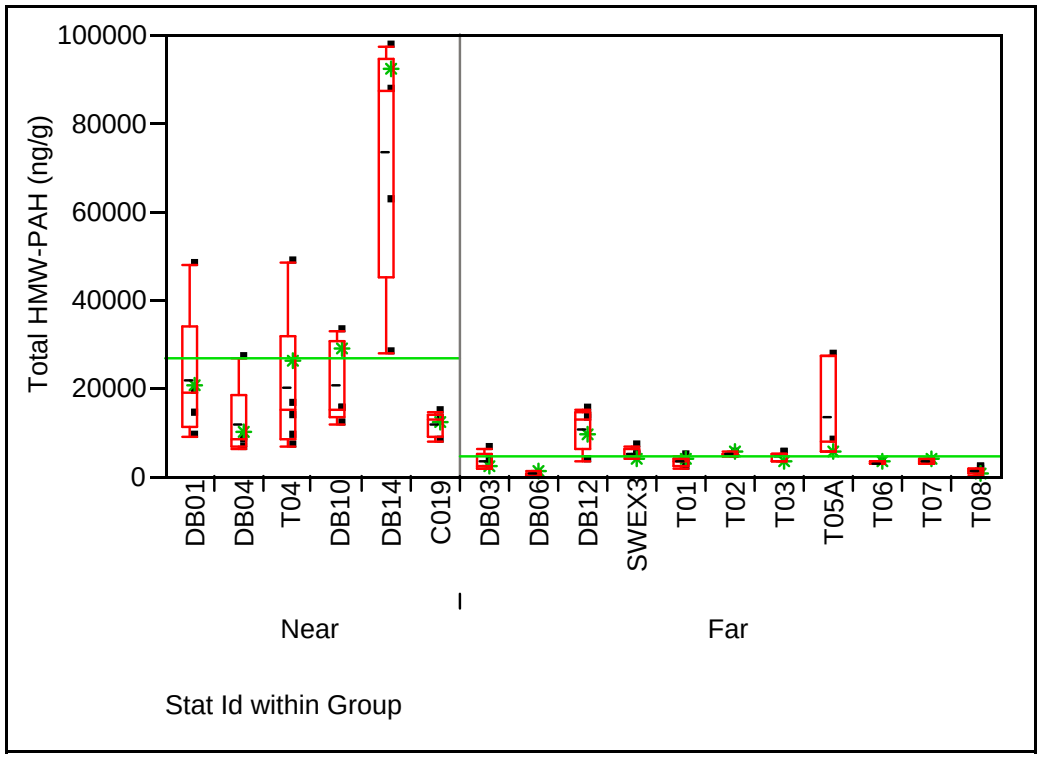


Figure 3-5 . Total HMW PAHs at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

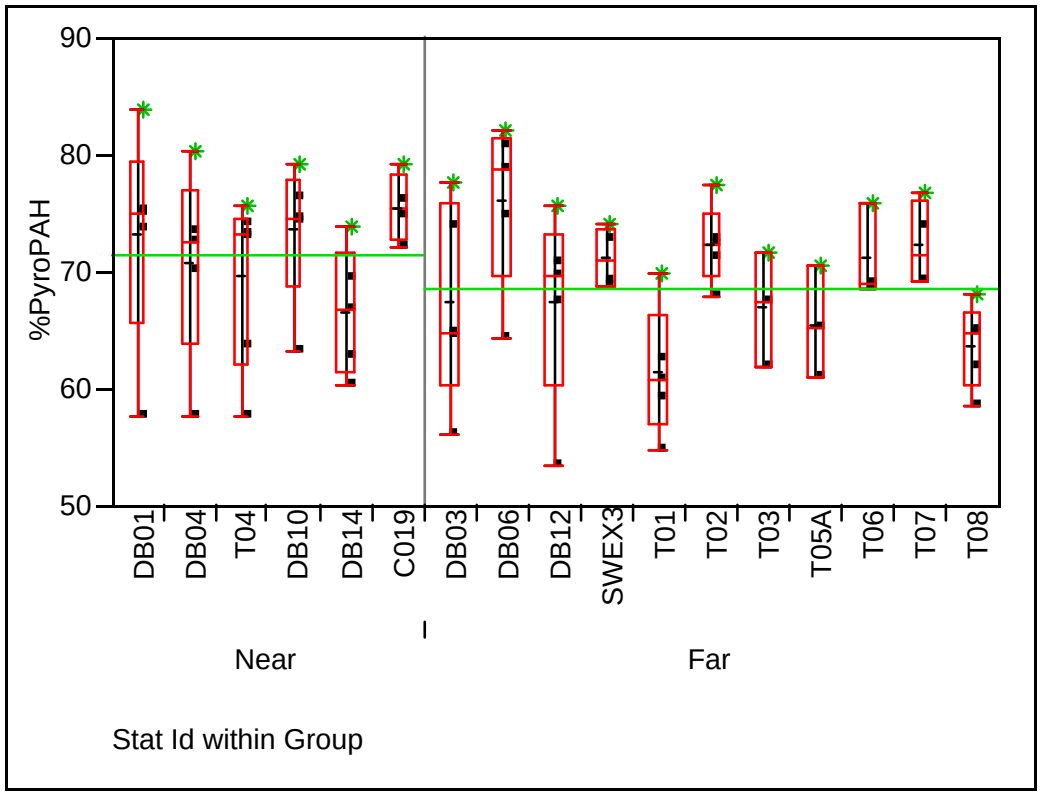


Figure 3-6. Pyrogenic PAHs as a Percent of Total PAHs at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

The PAH concentrations are elevated in the sediments at several of the "Near" stations, but it is difficult to determine the sources of the PAH. The sources of the PAH are likely numerous, including CSO discharge and runoff. Principal component analysis (PCA) indicates that the PAH composition is and has been quite similar in most of the sediments. Most of the samples cluster with generally little spread in the PCA presentation (Figure 3-7), with "Near" and "Far" stations well interspersed with each other. A few of the samples separate slightly from the majority of the samples (e.g., some of the samples from T01 off Deer Island and T08 in Hingham/Hull Bay), possibly due to slightly lower relative amounts of HMW PAH; these are, however, samples with low overall PAH concentrations. The PCA indicates that many of the samples have commonality with the PAH composition of soot (i.e., primarily combustion PAH, with some uncombusted petroleum). However, the PCA shows that the PAH composition is quite similar to that of Standard Reference Material 1946; SRM 1946 is an urban sediment with PAH from a variety of petrogenic and pyrogenic sources, with a dominance of the pyrogenic PAH. The PCA also shows that the PAH composition has little in common with fresh petroleum materials, or discrete HMW PAH sources such as coke or coal tar; the PAH is mostly from a blend of common urban mixtures of PAH. These results suggest that, for the most part, the sources of the PAH in the sediments are a common blend of urban sources, with no distinguishable unique source of PAH to a subset of the stations.

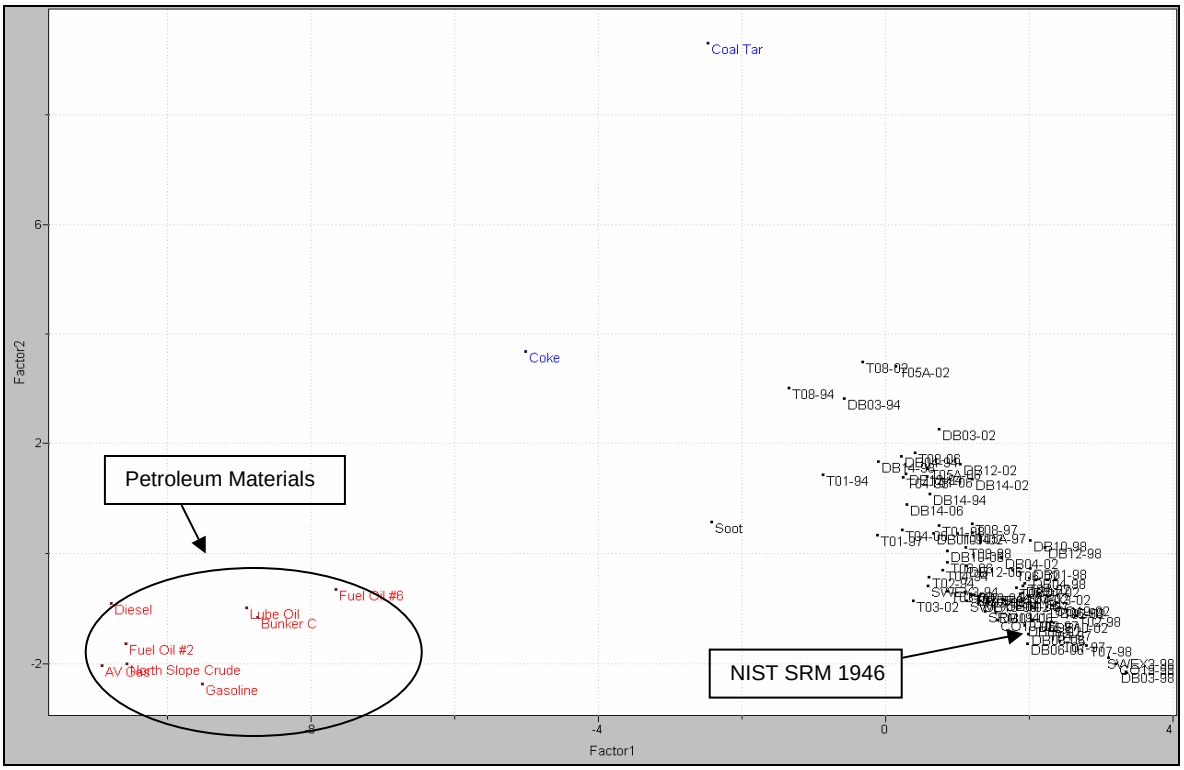


Figure 3-7. Principal Component Analysis of PAH Compound Composition in the Sediment Samples and Petroleum and Other Hydrocarbon Materials

3.2.2 PCB Concentrations

The PCB concentrations are presented as the sum of the 20 PCB congeners. PCB concentrations were quite variable among "Near" and "Far" stations, with lower concentrations generally found at the "Far" stations (Figure 3-8). However, "Near" stations DB01 and DB04 off Carson Beach have consistently had PCB concentrations as low as most "Far" stations, and "Far" station DB12 off Thompson Island has generally had among the highest PCB concentrations, along with "Near" stations T04, DB10, and DB14.

PCB concentrations in 2006 ranged from 5.42 ng/g dry weight ("Far" Station T08) to 401 ng/g dry weight ("Near" Station DB10; Table 3-3). Concentrations of PCB at "Near" stations DB01, DB10, and CO19 were the highest ever measured in 2006, while the other stations had concentrations similar to or lower than the station mean values. The high PCB levels at DB10 in the Neponset River are not surprising given that the Neponset River is likely a major source of PCBs to Dorchester Bay; there are reported sources upstream from station DB10 (Zimmerman and Breault, 2003). However, the concentration increase and historical high at this station in 2006 is of interest. The 2006 PCB concentrations appear to gradually decrease with increasing distance from the mouth of the Neponset River. In contrast, the "Far" station concentrations in 2006 were mostly lower than the station mean values, with minimum or near minimum values measured at five of the stations (T01, T03, T05A, T06, and T08). The exception was at SWEX3 off Spectacle Island, which had a PCB concentration close to the station historical maximum, but still quite close to the mean of the "Far" stations.

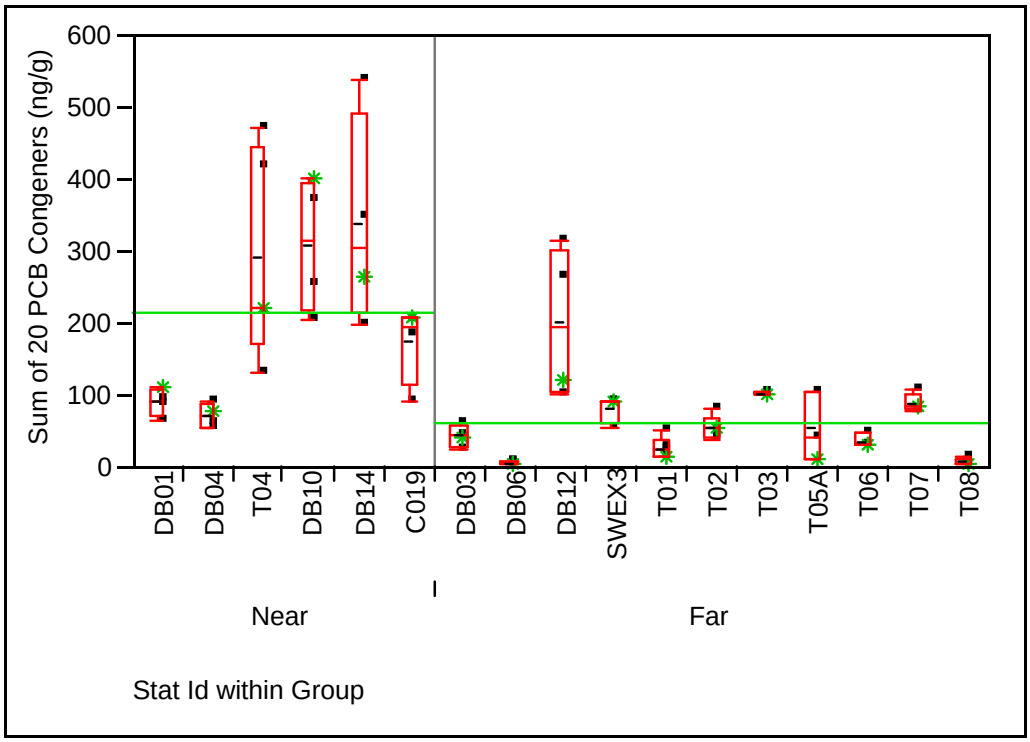


Figure 3-8. Concentrations of 20 PCB Congeners at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

While it is not surprising to find elevated levels of PCBs in sediments from stations within Boston Harbor, it is difficult to determine the sources. Like PAH, the PCB sources are numerous in urban and industrial locations such as this. An evaluation of PCB congener patterns in "Near", "Far" and "Harbor" stations using PCA revealed that PCBs in sediment from Station DB10 near the mouth of the Neponset River were somewhat different from other sediment samples (Figure 3-9, Group A). This is consistent with the previously mentioned possibility that DB10 may be located closer to a significant source of PCB (i.e., the Neponset River) than other stations. The PCA results also indicate that the PCBs from Station DB14 (Commercial Point) in 1994 and 1998, and T04 (Fox Point) in 1998, differ from the PCB composition of the rest of the samples (Group B). This suggests that Stations DB14 and T04 may have been subject to local input of PCB early on (e.g., BOS-89 and BOS-90 CSOs), but that these sources may have since been controlled. The remaining stations have broadly similar PCB composition that has many characteristics in common with Aroclor 1254 (the most common Aroclor in urban sediments).

Table 3-3. PCB 2006 Mean and 1990−2006 Combined Data by Station (ng/g, dry weight)

Station	N	Sum of 20 PCB Congeners			
			All Years		
		2006	MIN	MAX	MEAN
Near Stations					
DB01	4	112	66.7	112	90.4
DB04	4	79.1	54.4	90.9	71.6
T04	5	222	132	472	291
DB10	4	401	204	401	308
DB14	4	264	198	540	337
C019	4	210	93.1	210	173
Far Stations					
DB03	4	42.7	25.0	60.5	43.5
DB06	4	6.13	4.53	7.21	6.16
DB12	4	121	100	316	201
SWEX3	4	90.5	53.8	91.3	81.6
T01	5	13.7	13.6	51.0	26.3
T02	5	53.7	39.5	82.3	55.3
T03	3	102	102	104	103
T05A	3	12.8	12.8	106	53.7
T06	3	31.0	30.1	47.8	36.3
T07	4	86.4	79.7	108	89.4
T08	5	5.42	5.42	13.4	7.67

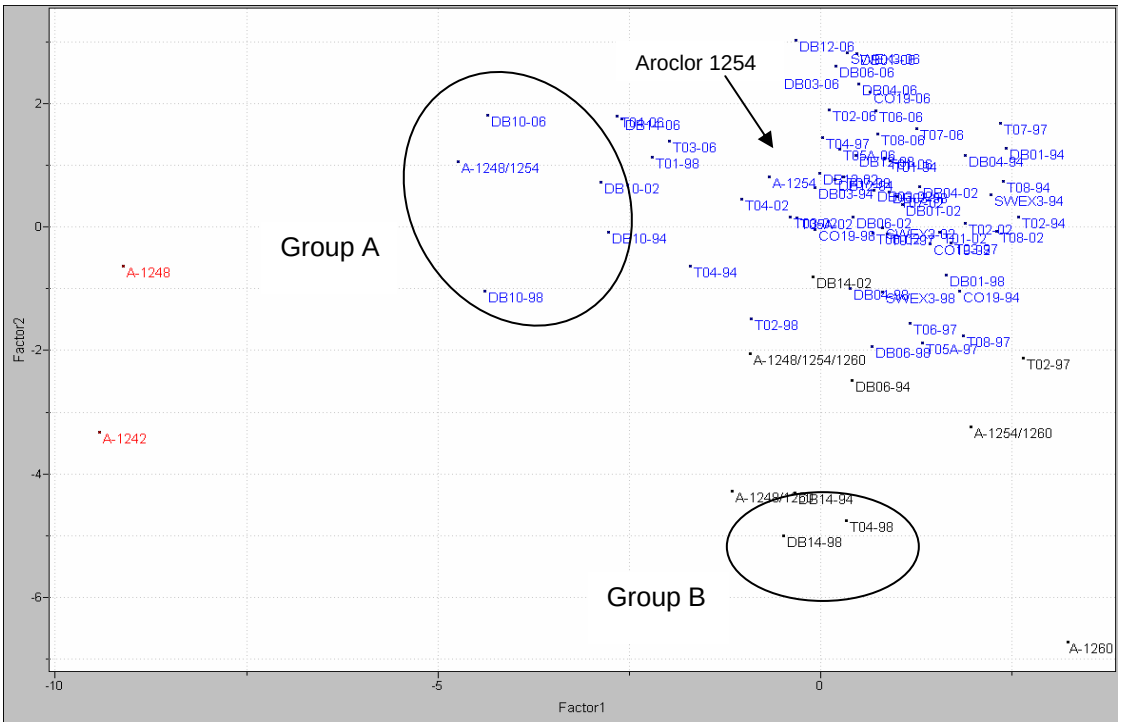


Figure 3-9. Principal Component Analysis of PCB Composition in the Sediment Samples and Selected PCB Aroclors

Note: **Group A** : DB10-94, 98, 02, 06 **Group B**: DB14-94, 98; and T04-98; A = Aroclor

3.2.3 Pesticide Concentrations

Total DDT is presented as the sum of five of the six DDT compounds; the compound 4,4'-DDT was excluded, as described in Section 2.3.1.1. Station means are summarized in Table B-3 (Appendix B) and statistical comparison of results from the five years measured are provided in Appendix C. DDT concentrations were higher and more variable at the "Near" stations than at the "Far" stations, with the highest historical concentrations measured at DB10 in the Neponset River and DB14 off Commercial Point (Figure 3-10). Total DDT concentrations ranged from 0.65 ng/g dry weight ("Far" Station DB06 off Carson Beach) to 50.9 ng/g dry weight ("Near" Station DB10) in 2006 (Table 3-4). Concentrations of DDT at "Near" stations in 2006 were less than the station mean value for all stations, and the lowest ever measured at DB14 (Figure 3-10). Likewise, "Far" station DDT concentrations were less than station mean values, and minimum or near minimum values were measured at T01, T05A, T06, and T07, in 2006; the DDT concentrations have declined throughout the study area. The consistently low pesticide concentrations, like other organic contaminant concentrations, at stations DB06 and T08 are consistent with the low TOC and relatively coarse grain size at these stations.

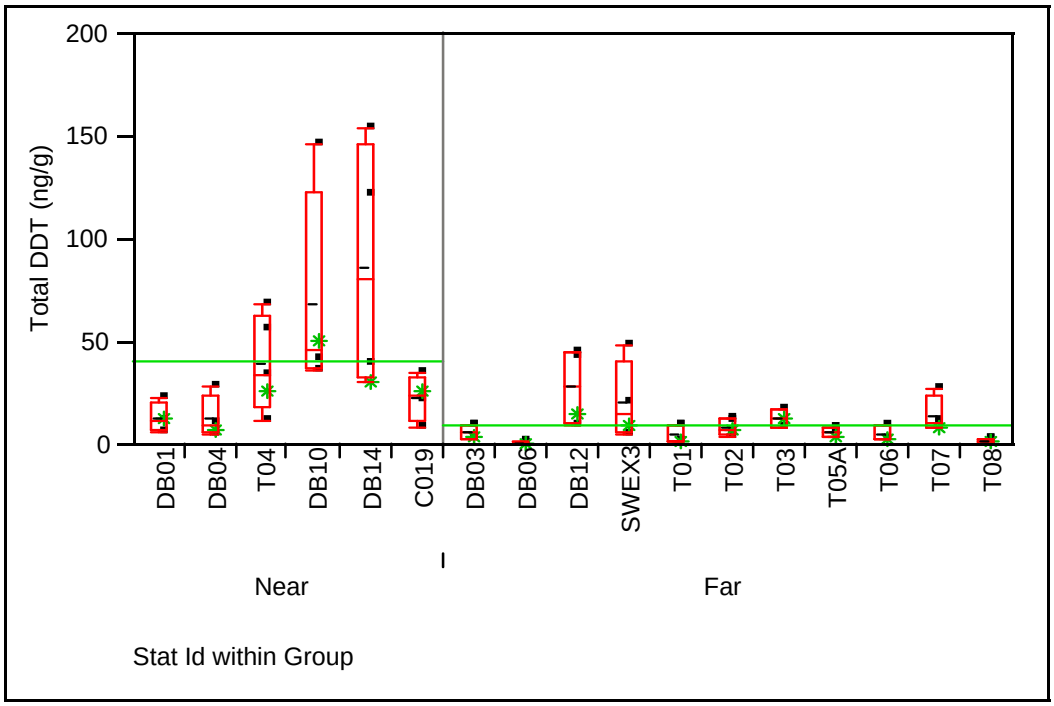


Figure 3-10. Total DDT Concentrations at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

Similar to the Total DDT, concentrations of Total Chlordane were higher and more variable at the "Near" stations (Figure 3-11). Total Chlordane concentrations ranged from 0.089 ng/g dry weight ("Far" Station T08 in Hingham/Hull Bay) to 9.46 ng/g dry weight ("Near" Station DB14 at Commercial Point) in 2006 (Table 3-4). Concentrations of Total Chlordane at "Near" stations in 2006 were similar to or less than the station mean values for all stations. Minimum or near minimum concentrations were measured at DB04 off Carson Beach and DB14 (Figure 3-11) in 2006. However, the Total Chlordane concentration measured at "Near" station DB10 in the Neponset River in 2006 (9.28 ng/g) was statistically significantly higher than in previous years [Table C-3(a)], and similar to the concentration at DB14 (historically the station with the highest Chlordane concentration). "Far" station Chlordane concentrations in 2006 were all less than station mean values, and minimum or near minimum station values were measured at T01, T02, T03, T05A, T06, T07, and T08 in 2006. The Chlordane concentrations appear to, like DDT, for the most part also have been declining in recent years.

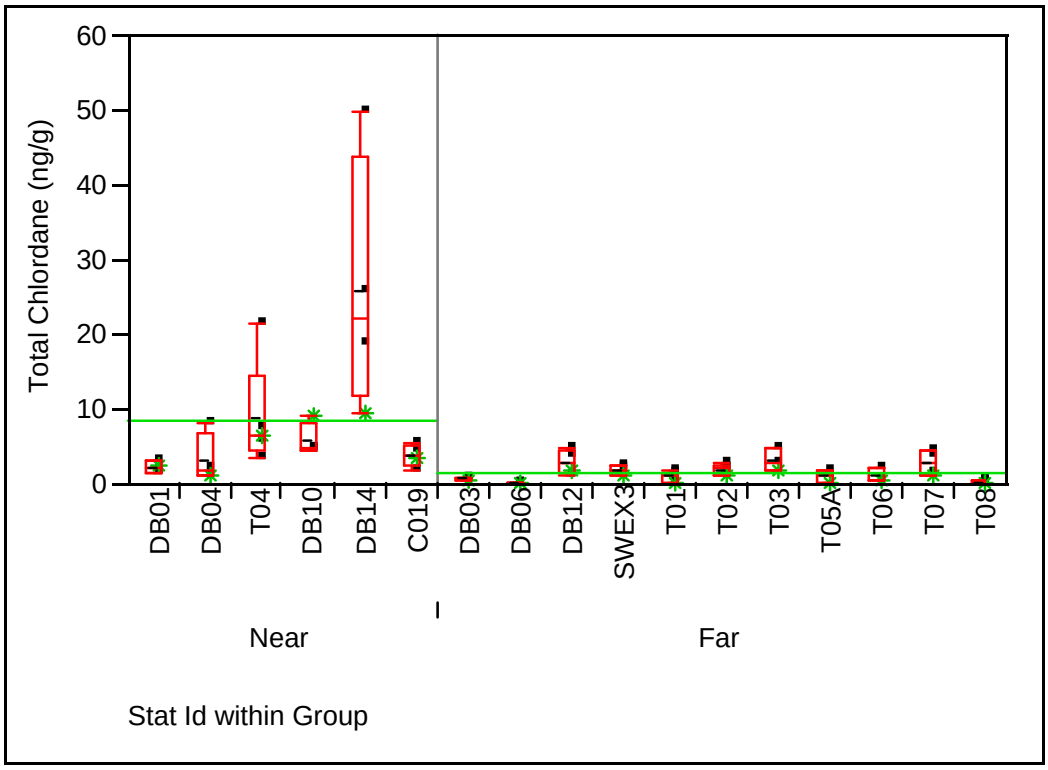


Figure 3-11 . Total Chlordane Concentations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

Table 3-4. Pesticide 2006 Mean and 1990−2006 Combined Data by Station (ng/g, dry weight)

Station	N	Total DDT				Total Chlordane			
			All Years				All Years		
		2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN
Near Stations									
DB01	4	12.4	5.84	22.8	13.1	2.43	1.52	3.20	2.28
DB04	4	6.95	5.18	27.9	12.7	1.16	1.00	8.16	3.14
T04	5	25.8	11.6	68.8	39.1	6.41	3.42	21.4	8.93
DB10	4	50.9	36.1	146	68.7	9.28	4.56	9.28	5.87
DB14	4	30.2	30.2	154	86.2	9.46	9.46	49.9	26.0
C019	4	26.0	8.64	34.9	22.9	3.45	1.98	5.54	3.83
Far Stations									
DB03	4	3.74	2.31	9.45	6.11	0.499	0.379	0.963	0.692
DB06	4	0.647	0.457	1.18	0.695	0.133	0.0694	0.242	0.136
DB12	4	14.6	9.38	45.5	28.0	1.73	1.23	4.67	2.83
SWEX3	4	9.25	4.98	48.0	20.6	1.22	1.18	2.61	1.83
T01	5	1.55	1.42	9.66	4.76	0.231	0.231	1.78	1.00
T02	5	7.56	3.53	12.6	8.36	1.09	1.08	2.97	1.92
T03	3	12.3	8.27	17.3	12.6	1.99	1.99	4.97	3.27
T05A	3	3.63	3.63	7.87	5.77	0.274	0.274	2.00	1.18
T06	3	2.86	2.38	9.85	5.03	0.452	0.452	2.11	1.05
T07	4	7.96	7.96	27.4	14.2	1.13	1.13	4.62	2.82
T08	5	1.20	0.590	2.94	1.61	0.0888	0.0787	0.481	0.293

3.3 Metals Results

Sediment samples were analyzed for silver (Ag), aluminum (Al), cadmium (Cd), chromium (Cr), copper (Cu), iron (Fe), mercury (Hg), nickel (Ni), lead (Pb), and zinc (Zn) in 2006, and in all prior years except 1990 (silver and mercury were not measured in 1990). The station average concentrations measured in 1990, 1994, 1997, 1998, 2002, and 2006 are summarized in Table B-4 in Appendix B. Statistical analyses (one-way ANOVAs) were performed to compare concentrations of metals over time by station as µg/g dry weight. Al and Fe results are presented on a percent dry weight basis. The non-normalized concentration data are presented in tables and figures in this section. Results of the statistical analyses are presented in Appendix C and discussed below where relevant.

3.3.1 Major Metals: Aluminum and Iron

Aluminum (Al) and iron (Fe) annual concentrations, reported as percent dry weight, are shown in Figure 3-12 and Figure 3-13, respectively. Al and Fe are both crustal elements and in the absence of significant anthropogenic sources or major changes in sedimentology, would not be expected to show temporal changes, assuming the source and characteristics of the surface sediment remains the same over time.

Al concentrations in 2006 ranged from 4.4% at station T08 in Hingham/Hull Bay to 8.7% at station T04 in Savin Hill Cove (Table 3-5). Al levels were the highest ever measured at most "Near" stations (DB01, DB04, T04, CO19) and at about half of the "Far" stations (DB03, DB12, T02, T03, T06, T07) in 2006. Fe concentrations in 2006 ranged from 1.42% at "Far" station DB06 off Carson Beach to 4.55% at "Near" station CO19 off Fort Point Channel. In 2006, concentrations of Fe at most "Near" and "Far" stations were similar to the station mean value, with maximum values measured at "Near" station T04 at Fox Point and "Far" stations DB06, DB12, T02, and T06 (Table 3-5). The Fe concentration measured for T04 in 2006 appears to be an outlier.

Table 3-5. Crustal Element 2006 Mean and 1990−2006 Combined Data by Station (%, dry weight)

Station	N	Al				Fe			
			All Years				All Years		
		2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN
Near Stations									
DB01	5	7.75	5.67	7.75	6.77	3.62	2.82	4.52	3.71
DB04	5	8.62	5.50	8.62	6.97	3.77	2.94	4.11	3.64
T04	6	8.70	5.85	8.70	7.08	4.43	3.79	4.43	4.02
DB10	5	6.97	5.89	7.14	6.52	4.32	3.62	4.75	4.21
DB14	5	4.90	4.00	6.97	5.33	3.06	2.84	3.71	3.37
C019	4	7.99	7.00	7.99	7.48	4.55	4.34	4.78	4.60
Far Stations									
DB03	5	5.67	4.62	5.67	5.17	2.31	1.99	2.44	2.19
DB06	5	4.51	3.33	5.11	4.33	1.42	1.30	1.42	1.37
DB12	5	6.92	5.33	6.92	5.99	3.38	3.04	3.38	3.16
SWEX3	4	6.23	6.23	7.33	6.78	2.82	2.82	4.14	3.71
T01	5	6.47	5.19	6.50	6.02	2.37	1.93	2.60	2.30
T02	5	7.73	5.67	7.73	6.54	3.49	2.63	3.49	3.04
T03	3	7.54	6.97	7.54	7.35	3.40	3.40	3.98	3.76
T05A	3	5.93	5.49	6.44	5.95	2.06	1.91	2.46	2.14
T06	3	6.68	6.33	6.68	6.50	3.08	2.69	3.08	2.93
T07	4	6.89	5.60	6.89	6.19	3.11	2.83	3.38	3.11
T08	5	4.41	3.00	4.98	4.14	1.66	1.52	2.03	1.73

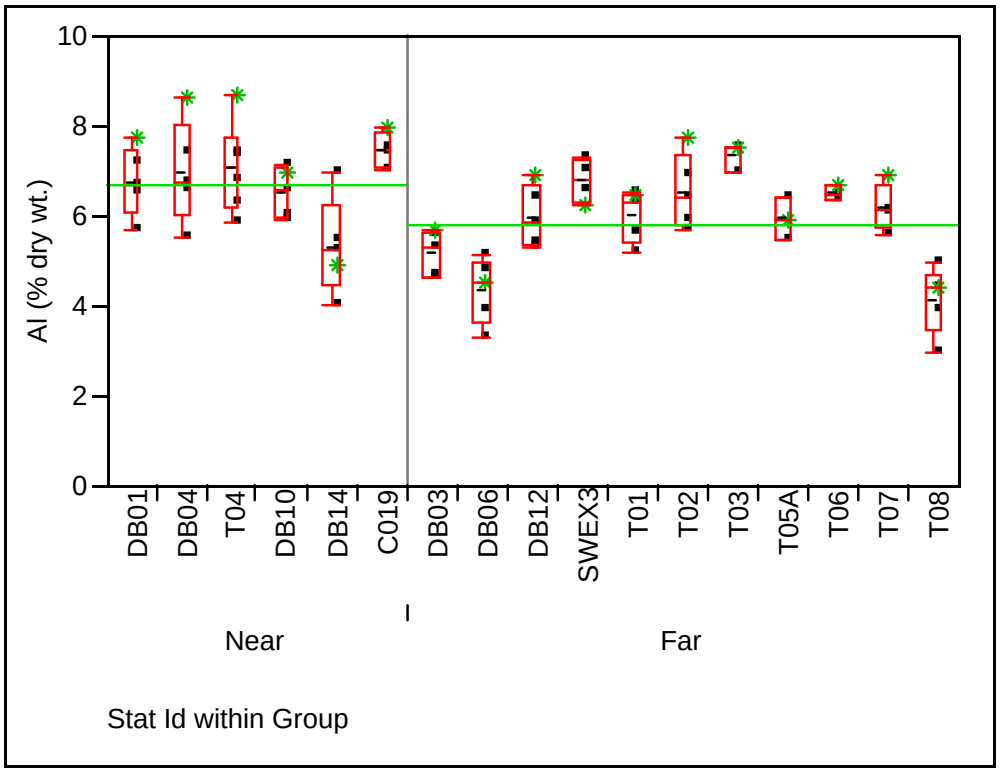


Figure 3-12. Aluminum Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

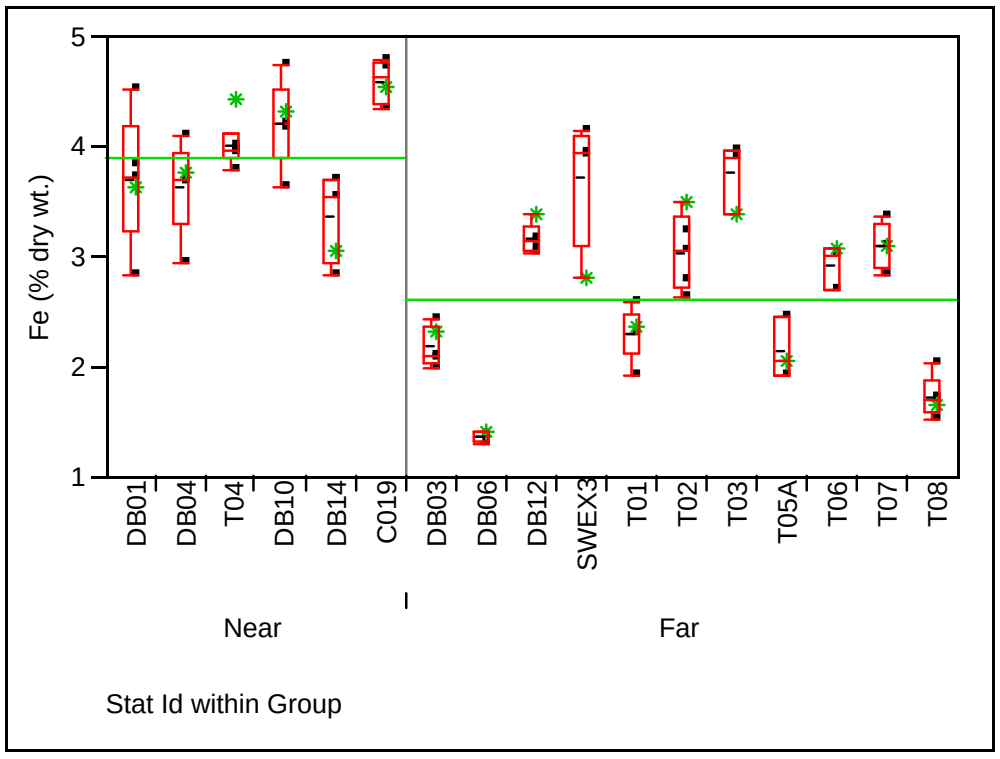


Figure 3-13. Iron Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

3.3.2 Contaminant Metals: Cadmium, Chromium, Copper, Lead, Mercury, Nickel, Silver, and Zinc

Cadmium, Cr, Cu, Pb, Hg, Ni, Ag, and Zn annual means are shown in Figures 3-14 through 3-21, and are summarized in Table 3-6. In general, the "Near" sampling stations had higher average concentrations of each of the metals than "Far" sampling stations. Concentrations of metals were quite variable over time at most stations, except for Cd, Pb, and Zn at most "Far" stations. The Cd and Zn were quite similar at most "Near" stations as well, with the exception for one apparent outlier in the data from DB01 off Carson Beach. Metals concentrations at each of the "Near" stations in 2006 were generally less than the station mean, and Cu, Hg, and Ag concentrations were the lowest ever measured at most of the "Near" stations. In addition, "Near" stations DB14 at Commercial Point and C019 off Fort Point Channel had minimum concentrations of most metals in 2006, and concentrations of Cr, Cu, Hg, and Zn at C019 in 2006 were statistically significantly lower than in previous years [Table C-4(a)]. Metals concentrations at "Far" stations were in 2006 generally similar to or lower than the station means, with some stations (DB12, SWEX3, T03, T05A) having minimum concentrations for most metals in 2006. Concentrations of Cu, Hg, and Ag in 2006 were among the lowest ever measured at most of the "Far" stations, with Cu concentrations being statistically significantly lower at T03, T05A, and T07. The consistently low contaminant metals concentrations at stations DB06 and T08 are consistent with the relatively coarse grain size, and lower crustal element (Al and Fe) and TOC concentrations, at these stations

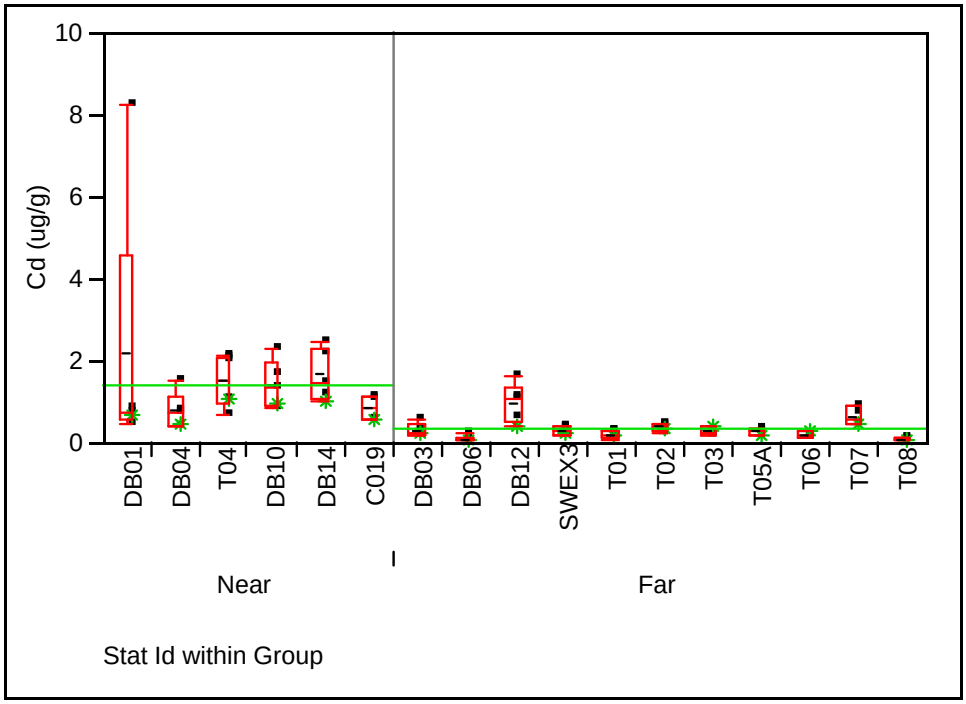


Figure 3-14. Cadmium Concentrations at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

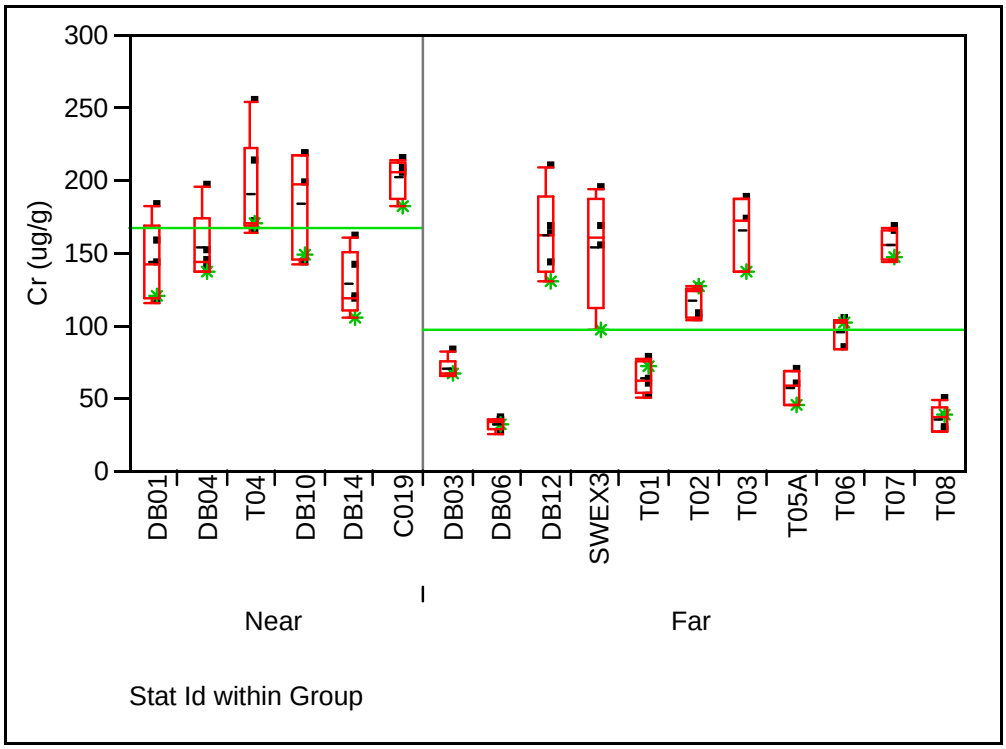


Figure 3-15. Chromium Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

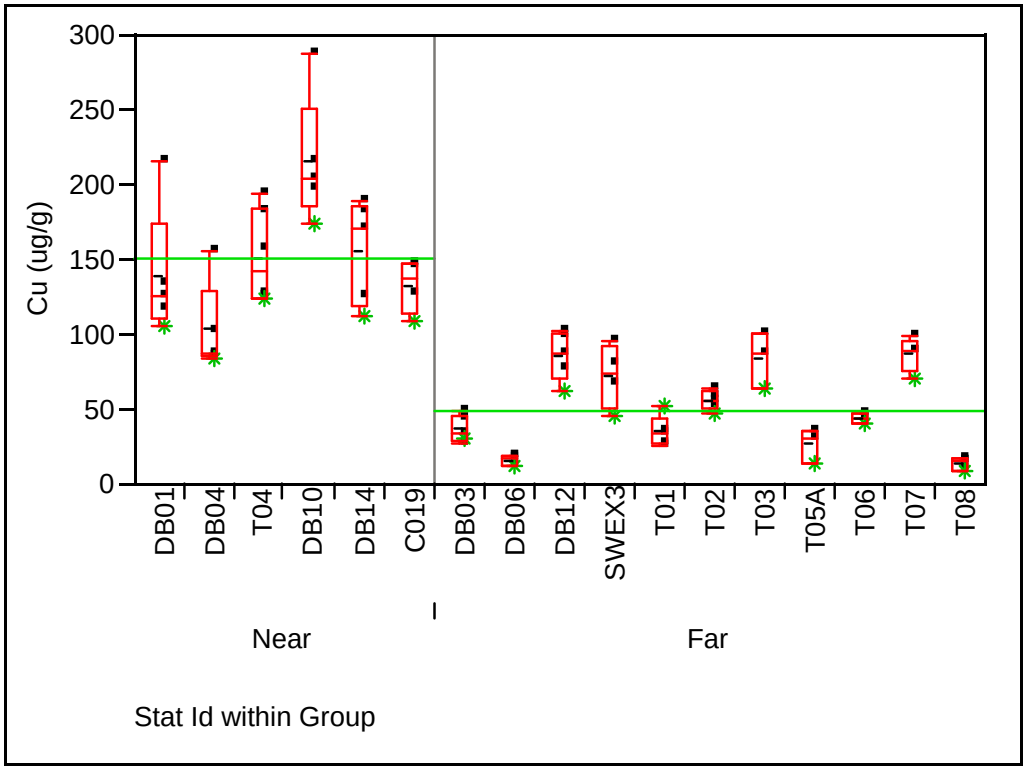


Figure 3-16. Copper Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

Table 3-6. Metals 2006 Mean and 1990–2006 Combined Data by Station (µg/g, dry weight)

Station	N	Cd				Cr				Cu				Pb			
			All Years				All Years				All Years				All Years		
		2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN	2006	MIN	MAX	MEAN
Near Stations																	
DB01	5	0.673	0.486	8.28	2.21	121	116	183	144	106	106	215	140	167	146	469	218
DB04	5	0.456	0.393	1.50	0.782	138	138	196	154	83.7	83.7	156	103	154	102	159	138
T04	6	1.07	0.712	2.12	1.52	170	164	254	190	125	125	193	152	215	145	389	215
DB10	5	0.959	0.845	2.29	1.43	149	142	218	185	174	174	288	216	351	182	427	314
DB14	5	1.03	1.03	2.47	1.67	106	106	160	129	113	113	190	157	290	290	719	460
C019	4	0.603	0.593	1.14	0.857	183	183	215	202	109	109	148	133	126	126	150	136
Far Stations																	
DB03	5	0.244	0.174	0.597	0.319	67.4	65.3	82.8	70.0	30.4	27.7	48.5	36.9	57.3	54.6	69.8	59.6
DB06	5	0.071	0.0584	0.254	0.104	33.3	26.4	36.3	33.0	12.8	12.3	19.1	16.1	33.0	28.4	36.7	31.6
DB12	5	0.409	0.409	1.62	0.971	130	130	209	163	62.6	62.6	103	86.0	92.7	92.7	134	117
SWEX3	4	0.235	0.183	0.423	0.297	97.7	97.7	194	154	45.8	45.8	95.7	72.3	59.9	59.9	108	86.8
T01	5	0.171	0.0888	0.320	0.214	73.1	50.6	78.3	64.7	52.0	26.7	52.0	35.2	40.2	32.8	50.8	39.9
T02	5	0.336	0.257	0.485	0.390	127	105	127	118	47.7	47.7	64.5	56.0	67.3	62.5	67.3	63.8
T03	3	0.414	0.216	0.414	0.300	137	137	187	166	64.7	64.7	101	84.6	94.7	94.7	122	107
T05A	3	0.215	0.215	0.349	0.284	45.6	45.6	69.2	57.8	13.8	13.8	36.2	26.9	32.3	32.3	45.8	39.4
T06	3	0.283	0.149	0.283	0.211	102	84.2	103	96.6	40.8	40.8	47.9	44.4	82.3	61.4	82.3	68.8
T07	4	0.456	0.456	0.943	0.654	147	144	167	156	70.8	70.8	99.0	86.8	107	107	111	109
T08	5	0.108	0.069	0.123	0.099	38.6	26.7	49.0	36.1	9.80	9.80	16.9	13.9	29.7	25.8	29.7	27.1

Table 3-6. Metals 2006 Mean and 1990–2006 Combined Data by Station (µg/g, dry weight) (continued)

Station	N	Hg[1]				Ni				Ag[1]				Zn			
		2006	All Years			2006	All Years			2006	All Years			2006	All Years		
			MIN	MAX	MEAN		MIN	MAX	MEAN		MIN	MAX	MEAN		MIN	MAX	MEAN
Near Stations																	
DB01	5	0.472	0.472	0.741	0.622	28.6	28.6	73.4	40.0	1.86	1.86	3.48	2.63	271	220	1472	489
DB04	5	0.634	0.498	0.634	0.587	31.1	28.5	47.9	35.0	2.11	1.91	2.97	2.46	181	164	275	196
T04	6	0.666	0.666	2.29	1.21	35.7	35.0	44.3	38.7	2.96	2.64	5.59	3.77	290	216	435	294
DB10	5	1.02	1.02	1.18	1.07	31.3	31.3	51.5	40.4	2.27	2.27	5.05	3.34	311	273	473	337
DB14	5	0.537	0.537	1.07	0.797	23.3	23.3	44.7	34.6	1.40	1.40	2.18	1.85	322	322	507	412
C019	4	0.651	0.651	0.812	0.754	39.6	37.3	44.8	40.3	2.78	2.78	4.76	3.69	200	200	234	218
Far Stations																	
DB03	5	0.188	0.183	1.35	0.478	18.1	15.0	24.9	18.5	0.774	0.713	0.885	0.793	92.0	69.7	97.6	86.0
DB06	5	0.0759	0.0652	0.0759	0.0707	8.87	8.87	13.8	10.5	0.311	0.303	0.359	0.326	39.4	33.7	46.7	40.1
DB12	5	0.400	0.400	0.810	0.619	26.6	26.6	34.0	30.3	1.76	1.76	3.76	2.54	146	141	172	156
SWEX3	4	0.355	0.355	0.697	0.554	22.9	22.9	36.0	32.4	1.21	1.21	4.03	2.42	96.2	96.2	156	134
T01	5	0.123	0.123	0.260	0.199	16.3	16.3	20.5	18.8	0.600	0.599	0.895	0.692	69.4	63.1	77.2	69.8
T02	5	0.405	0.310	0.606	0.402	29.9	23.3	32.2	27.2	1.25	1.25	2.50	1.86	122	101	122	111
T03	3	1.26	0.967	1.26	1.10	29.1	29.1	41.5	35.5	2.58	2.58	3.23	2.89	139	139	161	153
T05A	3	0.104	0.104	0.224	0.170	13.8	13.8	19.8	15.9	0.337	0.337	1.13	0.629	58	58	84	73
T06	3	0.364	0.364	0.685	0.481	25.5	21.8	25.5	23.8	1.44	1.44	2.25	1.72	111	92.9	111	102
T07	4	0.769	0.769	1.13	0.892	29.4	26.6	32.5	29.4	3.33	3.33	5.56	4.43	139	138	147	141
T08	5	0.0711	0.0711	0.125	0.0924	11.2	9.63	13.7	11.7	0.255	0.255	0.530	0.407	46.6	38.8	47.9	45.0

[1]Mercury and silver data were not collected in 1990, so the "N" value for these parameters is one less than that listed in the table.

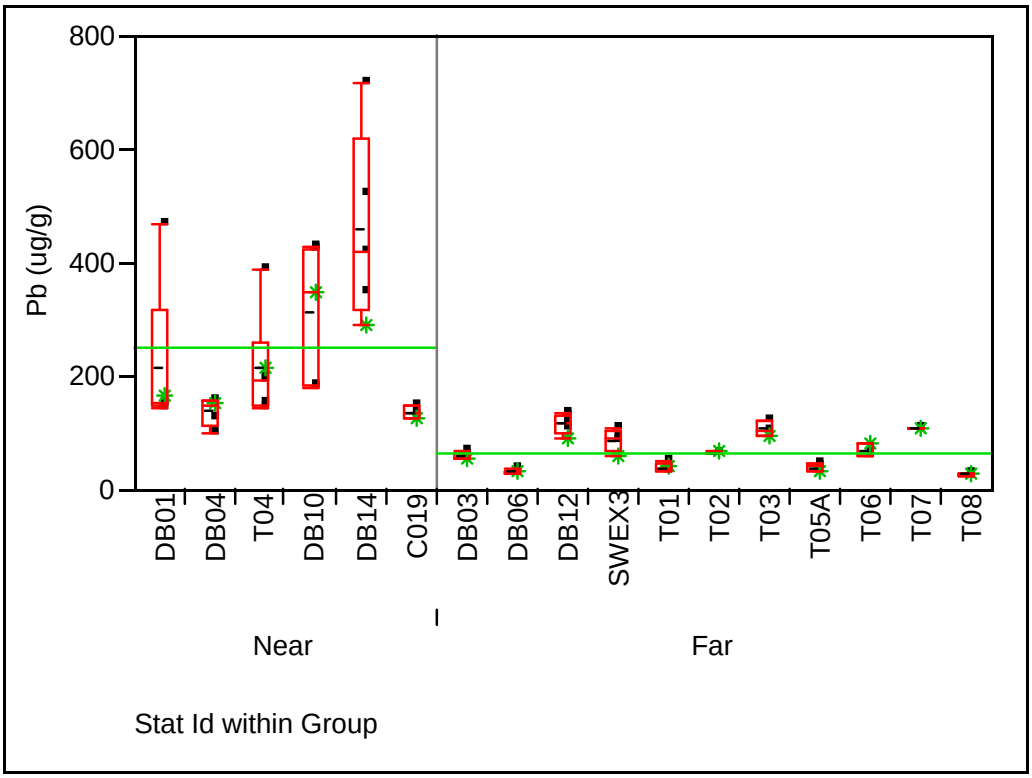


Figure 3-17. Lead Concentrations at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

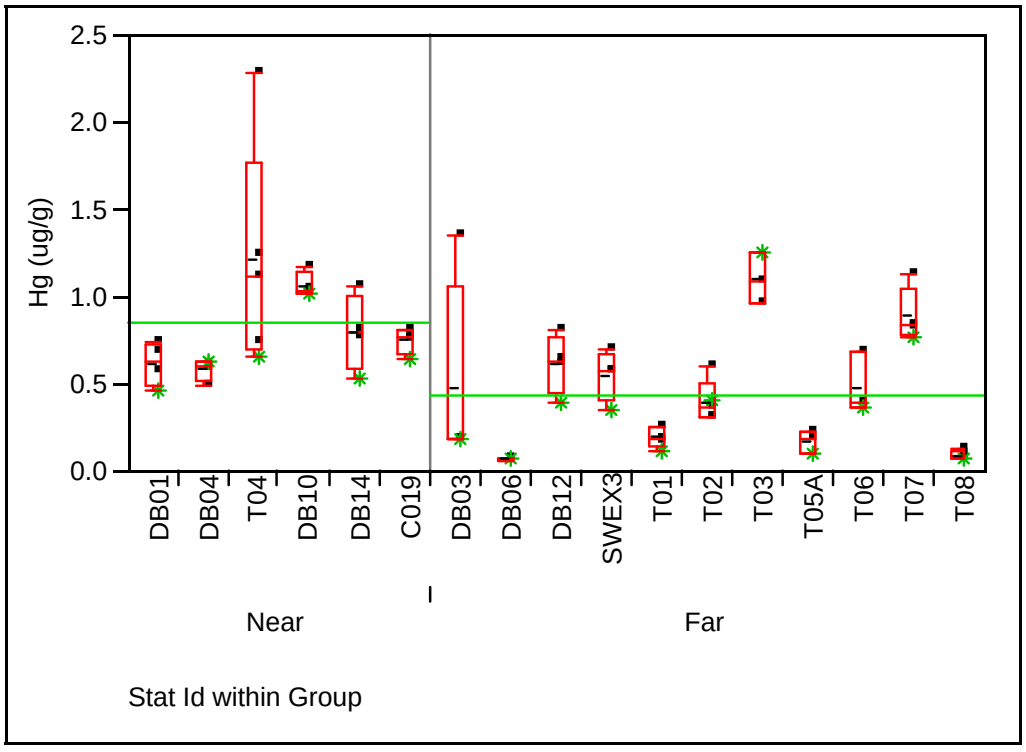


Figure 3-18. Mercury Concentrations at "Near" and "Far" Stations, 1990−2006
(see Table 2-1 and Figure 2-1 for station descriptions and locations)

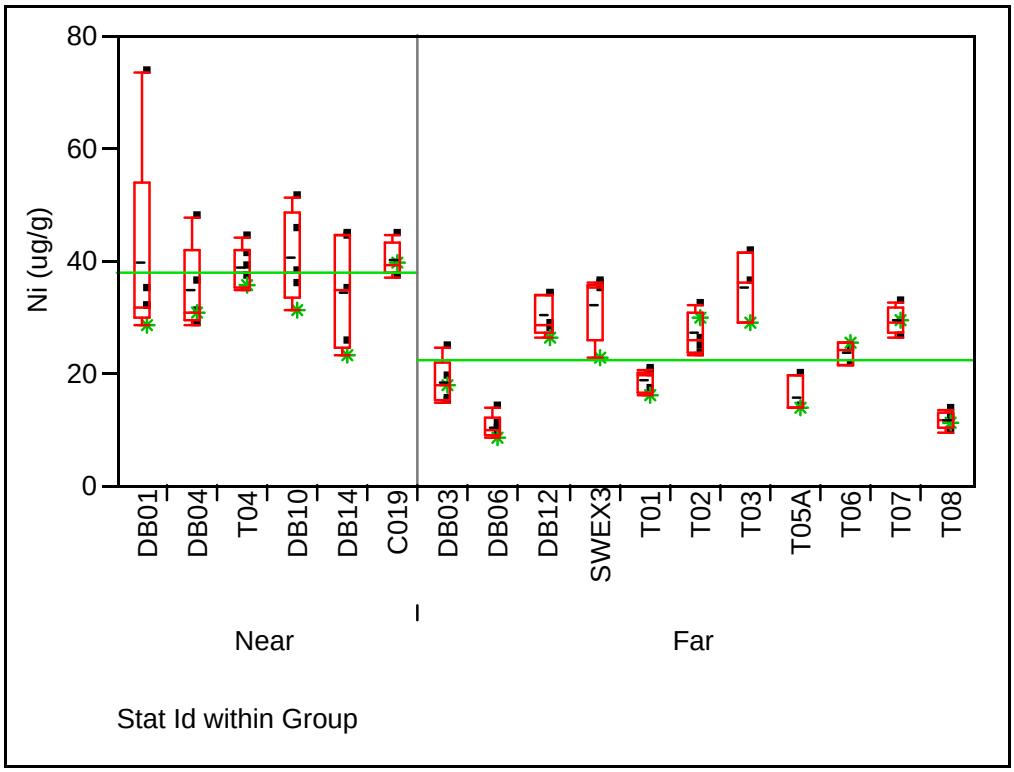


Figure 3-19. Nickel Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

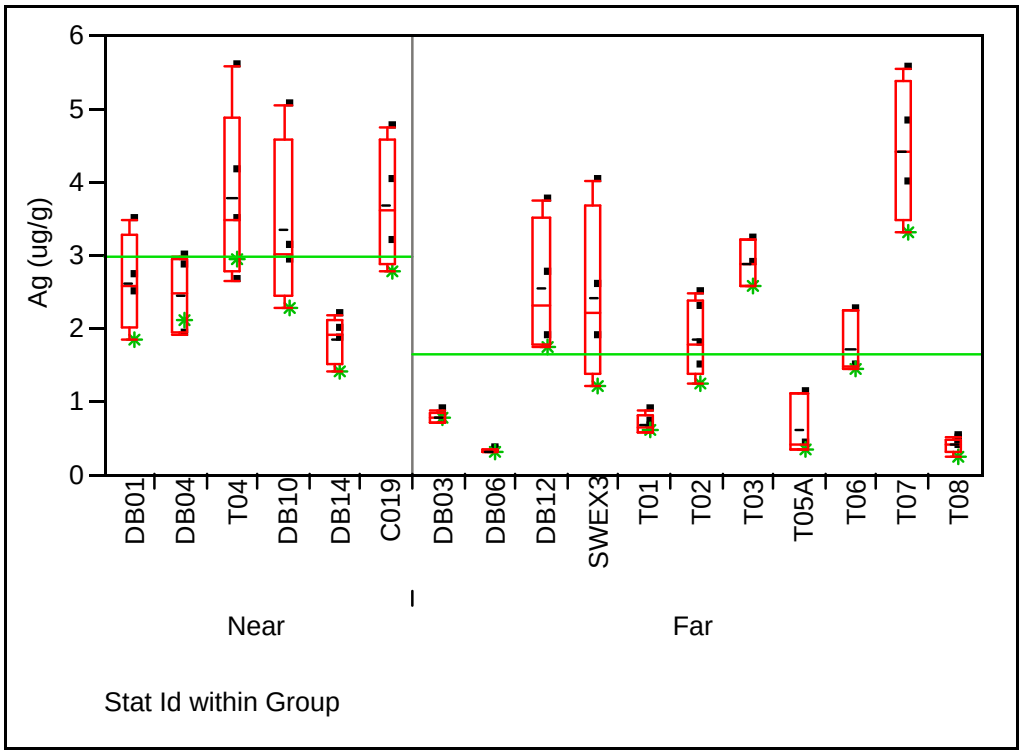


Figure 3-20. Silver Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

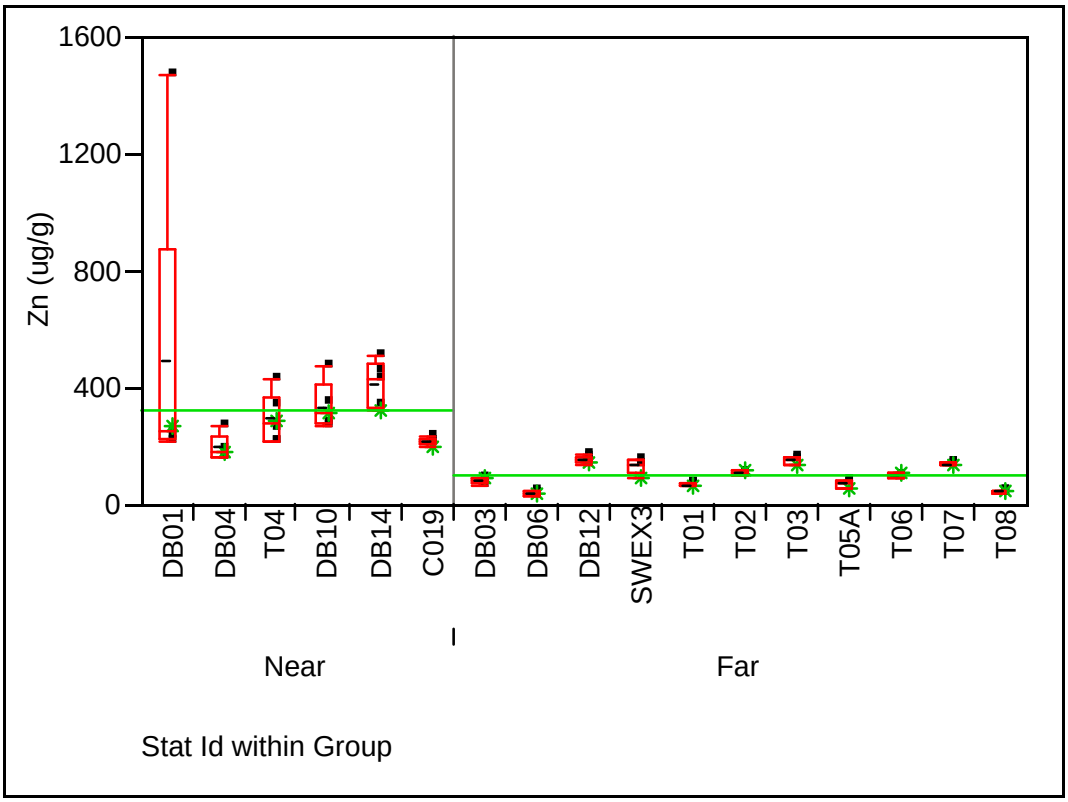


Figure 3-21. Zinc Concentrations at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

3.4 Sewage Tracer Results (*Clostridium perfringens*)

Clostridium perfringens, a spore-forming bacterium, is a parameter associated with sewage and wastewater and can be used to trace sewage inputs to Dorchester Bay and Boston Harbor through CSOs or wastewater treatment facilities. Concentrations of this parameter measured in 1990, 1994, 1997, 1998, 2002, and 2006 are summarized in Table B-2 in Appendix B. Statistical analyses (one-way ANOVAs) were performed to compare concentrations of *Clostridium perfringens* by station over time. Results of these analyses are presented in Appendix C. The *Clostridium* data appeared log-distributed in the early study years, but less so in recent years.

Clostridium levels were more variable over time at "Near" stations than at "Far" stations (Figure 3-22). In 2006, *C. perfringens* levels ranged from 240 colony forming units (cfu) per gram dry weight ("Far" station T05A in Presidents Roads) to 17,300 cfu per gram dry weight ("Near" station C019 off Fort Point Channel; Table 3-7). 2006 levels of *C. perfringens* at each "Near" station were among the lowest ever measured, except at C019, and were similar to those measured at many of the "Far" stations. Minimum concentrations were also measured at most of the "Far" stations in 2006. When *C. perfringens* concentrations were normalized to percent fines, concentrations at T01 off Deer Island, T06 off Peddocks Island, and T07 in Quincy Bay were significantly lower in 2006 than in previous years [Table C-1(b)].

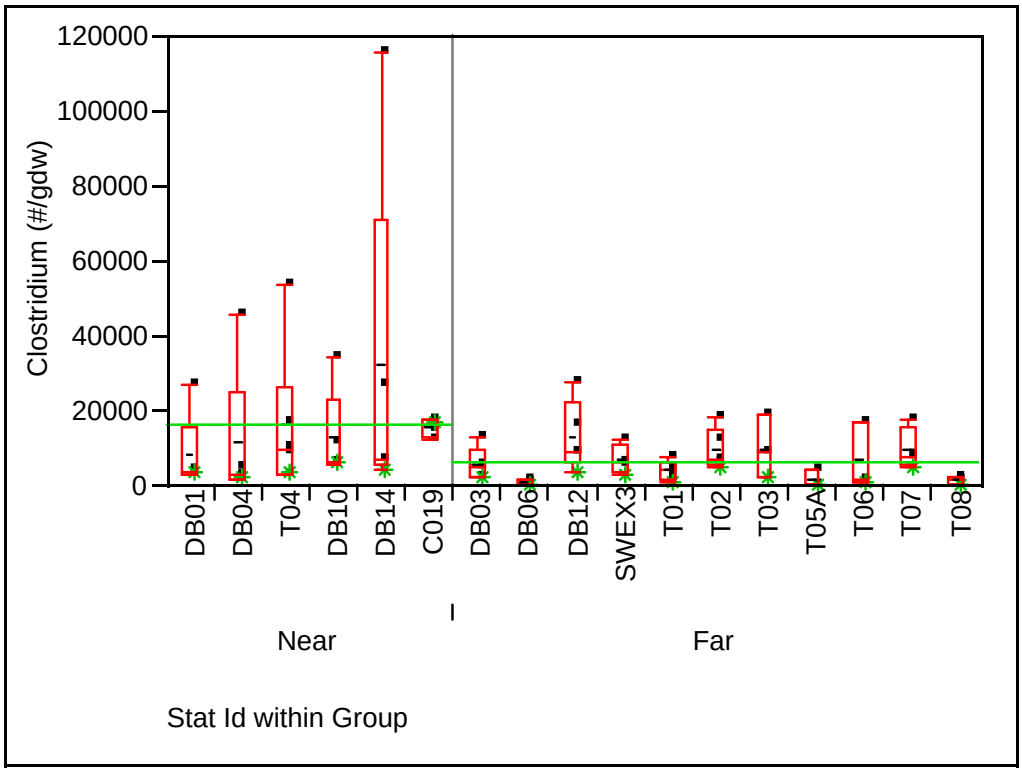


Figure 3-22. Densities of Clostridium perfringens at "Near" and "Far" Stations, 1990−2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

Table 3-7 . *Clostridium perfringens* 2006 Mean and 1990−2006 Combined Data by Station (spores/g dry weight)

Station	N	*Clostridium perfringens*			
		2006	All Years		
			MIN	MAX	MEAN
DB01	5	3,341	3,037	27,033	8,399
DB04	5	2,609	1,360	45,533	11,467
T04	6	3,338	3,220	53,400	16,079
DB10	5	6,135	5,343	34,567	12,858
DB14	5	4,599	4,599	115,400	32,168
C019	4	17,294	12,643	17,767	15,709
DB03	5	2,369	2,369	12,963	5,792
DB06	5	326	213	1,990	842
DB12	5	3,798	3,798	27,800	13,278
SWEX3	4	2,998	2,998	12,433	6,988
T01	5	1,101	1,101	7,717	4,037
T02	5	4,831	4,831	18,333	9,650
T03	3	2,032	2,032	18,667	9,935
T05A	3	240	240	4,300	1,665
T06	3	1,225	1,225	17,233	6,743
T07	4	5,115	5,115	18,000	9,749
T08	5	414	387	2,567	1,432

4.0 DISCUSSION

The results of the graphical and statistical analyses are used to evaluate the sediment quality. These data will be used in conjunction with information on the CSO and sewage treatment improvement program to determine the potential impact of CSO discharge on Dorchester Bay and Boston Harbor sediment quality.

4.1 Overview of Sediment Quality in Boston Harbor

Like other urbanized coastal embayments in the Northeast United States, Boston Harbor has a long history of receiving domestic and industrial wastes. As early as the seventeenth century, sewers funneled household wastes and stormwater runoff to numerous discharge locations in the Harbor. In 1833, local ordinances allowed human waste to be discharged into the evolving combined sewer system (Dolin, 1990). During this same period, wide scale filling of the Harbor's tidal areas inhibited the transport of these wastes away from the near-shore waters of the Harbor. In response to a severe cholera epidemic in the 1860s, plans were developed to upgrade the sewer system by centralizing stormwater and untreated domestic/commercial waste for discharge off Moon Island in Quincy Bay. The success of this project led to the expansion of sewer services to neighboring communities and to the building of additional outfalls off Deer Island in 1895 and Nut Island in 1904. Primary treatment plants were built at these locations in 1968 and 1952, respectively (Havens and Emerson/Parsons Brinkerhoff, 1983). However, these facilities soon lapsed into disrepair. Even when functioning properly, sludge was discharged into the Harbor; after digestion it was mixed into the effluent and discharged. Therefore, most contaminants in sewage was discharged into the Harbor for decades.

Despite the improvements in the sewer system, a burgeoning population and the impacts of industrialization throughout the first half of the twentieth century increasingly stressed Boston Harbor, as it did many urbanized coastal areas (Stolzenbach and Adams, 1998). In response, the Clean Water Act was passed in the early 1970s mandating wastewater facilities to upgrade to secondary treatment, which provides substantially greater removal of solids, organic matter, and most contaminants. Further federal regulation of toxic chemicals and banning of contaminants like PCBs and DDTs in the 1970s and 80s have led to the continued reduction in toxic discharges over the past 30 years.

MWRA was created in 1985 with a mandate for short-term and long-term remediation activities to decrease sewage discharge into the Harbor. During the late 1980s these included more rigorous enforcement of industrial pretreatment regulations, preventing toxic contaminants entering the wastewater system, the cessation of scum discharge into the Harbor, and more reliable chlorination of wastewater discharge. In December 1991 a major milestone was met as all sludge discharges into the Harbor ended. Throughout the 1990s, pumping capacity in the system increased, allowing for more combined sewer flows to be diverted to the newly improved Deer Island treatment plant and reducing CSOs. The first batteries of secondary treatment came on line in late 1997 and early 1998. The completion of the inter-island tunnel resulted in the transfer of all flow from the Nut Island treatment plant to be pumped, treated, and discharged from the Deer Island facility in July 1998. This allowed for most wastewater effluent to receive secondary treatment. All treated wastewater discharge to Boston Harbor ended in September 2000 as the new deepwater outfall was opened in Massachusetts Bay. Continued improvements in wastewater quality were the result of the third battery of secondary treatment coming on line in March 2001, implementation of corrosion control in the water supply system which reduced copper and lead leaching into the source water, and continued work with dental and medical facilities to reduce mercury discharge into the sewer system. Also, continued improvements to the secondary facilities and secondary treatment process increased the proportion of flow receiving full secondary treatment.

Evidence of the effectiveness of these pollution mitigation activities have been reported for Boston Harbor from sediment core and other data. Contaminant input to the sediments (documented with lead profiles in sediments) gradually increased from the latter half of the nineteenth century, peaked in the post World War

II era, and has decreased since (Bothner *et al*., 1998). Bothner *et al*. (1998) report the level of lead and other metal contaminants in Boston Harbor decreased substantially between 1977 and 1993, based on analysis of trace metals in surface sediments from four stations in the outer portions of Boston Harbor, contaminant profiles from cores collected in depositional areas of the harbor, and a compilation and analysis of historical data from the harbor. A decrease of 46% ± 12% in background corrected lead levels in the upper two cm of core samples was observed and similar decreases in chromium, copper, mercury, silver, and zinc reported. Bothner *et al.* (1998) suggest these decreases are due to cessation of sewage sludge discharge to the Harbor in 1991 by MWRA, source reduction efforts by industry, improved wastewater handling and treatment, and for lead, diminished use in gasoline beginning around 1973.

4.1.1 Contaminant Levels in Boston Harbor Sediments

Recent data (1994 to 2006) for contaminant chemicals in the surface sediments (upper two cm) of Boston Harbor and Massachusetts Bay show a wide range in concentration within a contaminant class (e.g., persistent organic chemicals such as PAH, PCB, DTT) and for several individual metals (Hunt *et al.,* 2006). From a system wide perspective, contaminant levels are generally lowest in offshore Massachusetts and Cape Cod Bays and highest in the inner portion of Boston Harbor and Quincy Bay. The highest concentrations for most contaminants are consistently found in Dorchester Bay and Boston Inner Harbor. However, variability within a given station and in sampling time is high and often reflects differences in bulk sediment characteristics such as grain size distribution and total organic carbon content. This is especially evident in the stations located near the MWRA outfall in Massachusetts Bay, an area known to be highly heterogeneous and dynamic with respect to sediment properties, and in the Dorchester Bay where several storm water and combined sewer discharges (CSOs) are located. Natural processes, including storms and sediment transport which impact the source and physical characteristics of the sediment, directly and indirectly influence the contaminant concentrations and the observed variability. These natural processes impact the results throughout the study area, but local anthropogenic inputs appear to have a greater influence on the contamination in Dorchester Bay and the Inner Harbor than in the Outer Harbor and offshore.

Long-term MWRA sediment monitoring data show that on average contaminant levels in Dorchester Bay are 2 to 5 times higher than those in other parts of the outer Harbor. Total DDT and PCB show the largest difference, historically ranging up to six fold higher in Dorchester Bay. In contrast, PAH, Cu, Pb, and Cd concentrations have recently been ~2 to 3 times higher in Dorchester Bay than in other outer Harbor sites. This pattern is apparent in data from 1994 to 2006. Time series data from these regions also show apparent decreases in the average level for several contaminants. For example, PAH, PCB, DDT, mercury, cadmium, and silver each decrease on average since 1994 in the inner Harbor, outer Harbor, and Dorchester Bay. These trends are illustrated in Figure 4-1 which shows Ag concentrations from 1994 to 2006. In contrast to these contaminants, lead and copper levels (Figure 4-2) do not appear to have decreased in the Harbor since 1994. Thus, some contaminants appear to continue to decrease in Harbor sediments since the early 1990s. However, the variability in the data and limited number of samples from each area makes the observed decrease statistically insignificant. Moreover, systematic trends in the data are difficult to prove due to the high variability and changes in response to events such as storms (Lefkovitz *et al*., 2000), especially for contaminants such as lead, copper, and PAH that are associated with urban runoff. The major storm of June 1998 likely contributed to the apparent slight average increase in the Dorchester Bay data from 1998 relative to the longer term trend. Regardless, observations from individual stations and for areas within the Harbor through 2004 suggest many contaminants in Boston Harbor sediments have continued to experience the downward trend through the mid 1990s, as observed by Bothner *et al.* (1998).

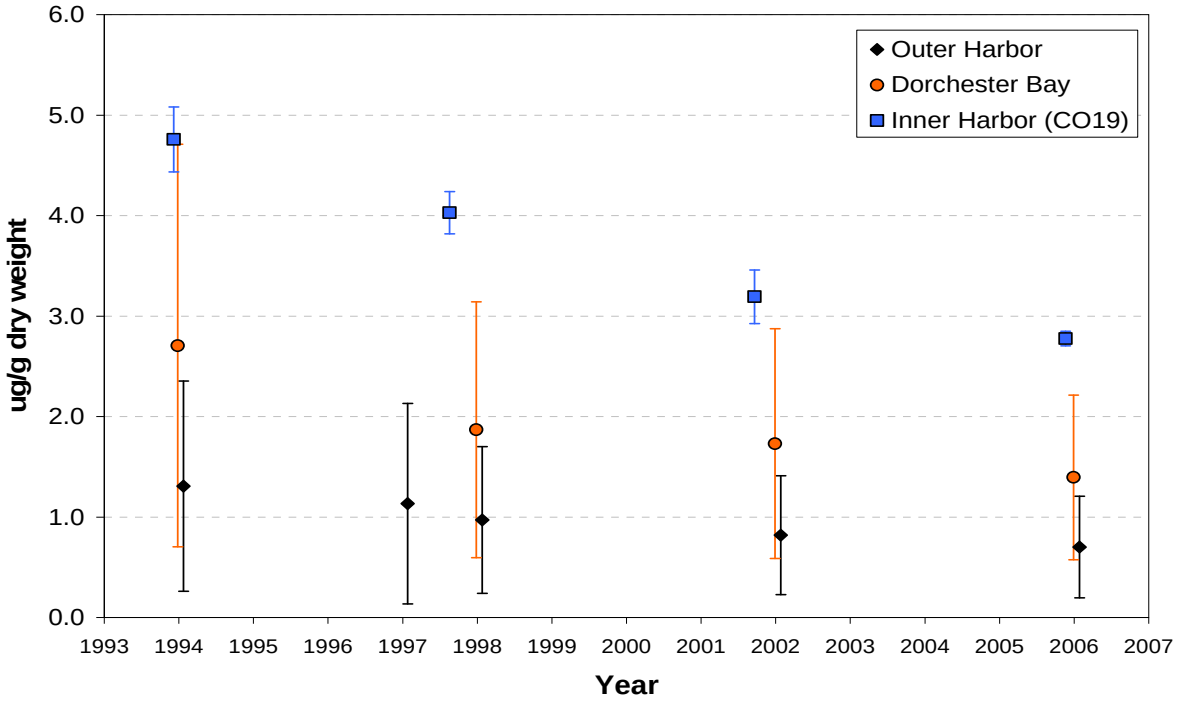


Figure 4-1. Silver concentrations from Boston Harbor surface sediments are low in the outer Harbor and generally appear to be declining since the early 1990s

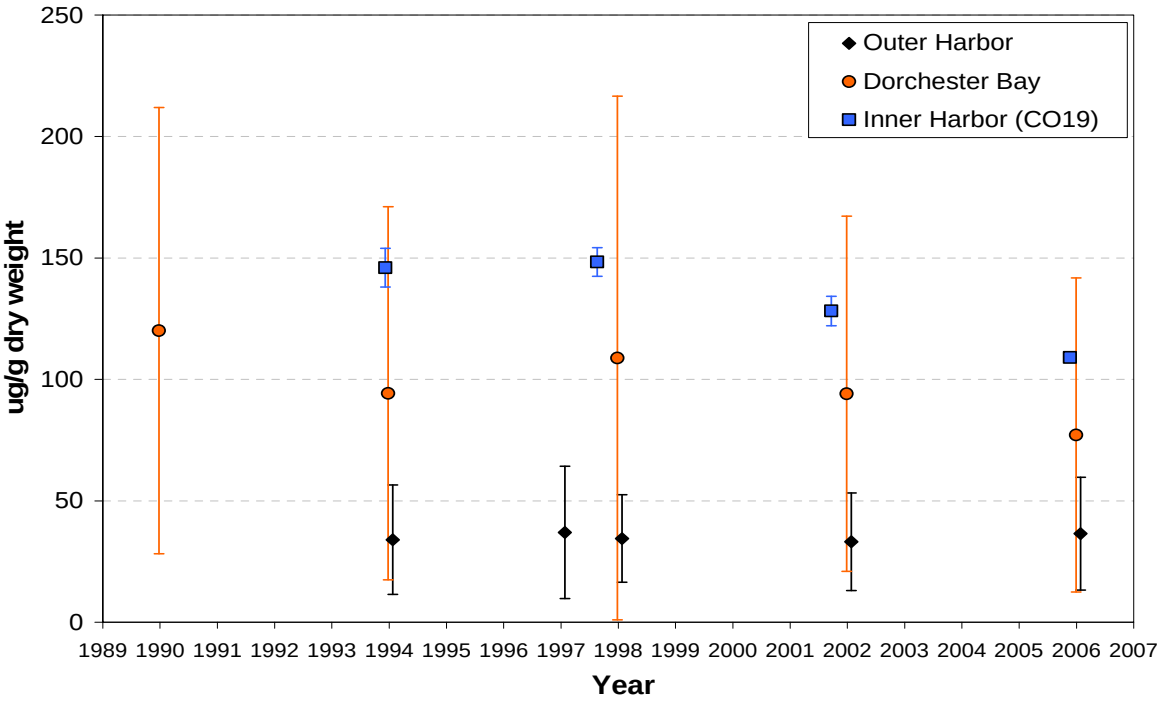


Figure 4-2. Copper concentrations in Boston Harbor surface sediments are high in Dorchester Bay and the Inner Harbor with little evidence of decline since the early 1990s.

Within the context of the observed spatial distributions and apparent temporal trends, an understanding of the major sources of contaminants to Boston Harbor and sediment transport processes affecting the fate of these contaminants is important for understanding the role of the CSO discharges on Harbor sediment quality. One of the most difficult problems in environmental monitoring is to measure the relative contributions and impacts of different sources of pollution. CSOs are never the sole source of pollutants. Besides the treatment plants and CSOs, known sources of contaminants to the Harbor include atmospheric deposition, stormwater runoff (including street runoff), upstream river sources, boats, and deposition and transport of pollutants originating elsewhere in the Harbor. For example, precipitation can have a large impact on CSO discharges as well as on contaminant concentrations in sediments near CSO outfalls during years with heavy amounts of precipitation resulting in larger CSO discharges. It is impossible to precisely determine the proportion of a contaminant originating from a specific CSO, but the historical significance of CSOs, and the reduction of input from CSOs as a result of control measures, is indisputable, as is evident from the dramatic decline in Coprostanol and several chemical contaminants.

Historically, sewage from treatment plants was the predominant contaminant sources to Boston Harbor, contributing at least 75 percent of the metals and PAH loads in the early 1990s (Alber and Chan, 1994). CSOs and stormdrains contributed a very small percentage (<10%) of the estimated metals and PAH load. Throughout the 1990s the load from the MWRA treatment plants decreased as better primary and then secondary treatment was brought on line. After September 2000, the contributions from treatment plants were essentially eliminated, elevating the relative importance of the other known sources.

Transport and fate of contaminants introduced into in Boston Harbor was considered at length in Stolzenbach and Adams (1998). They concluded that Boston Harbor acted as a sink for most contaminants and particularly noted that areas near sources and with weaker transport functions (e.g., lower energy input, less bottom shear stress, faster particle settling rates) tend to retain particles and associated contaminants. Conversely areas that have stronger transport functions (i.e., erosional areas) located in the entrance channels of the outer Harbor were less likely to be the final repository of contaminants. The areas within the Harbor that are typically depositional in nature are close to the sources or are shallow regions with limited advective movement and dispersion of the sediments. These areas typically accumulate sediment and contaminants, are characterized by high organic carbon content, and are dominated by clays and silts (fine grained sediments). Of particular note relative to this CSO sediment study are the findings of Wallace *et al*. (1991) who studied the areas near the Fox Point CSO discharge and concluded that that a CSO source alone could not account for the observed sedimentation rate and contaminant levels in nearby Savin Hill Cove. They thus concluded that this area of the Harbor tended to focus fine particles and contaminants from other areas of the Harbor and would retain these signals for longer periods.

Given the types and location of the present dominant sources of contaminants to the Harbor (atmospheric deposition, rivers, stormwater runoff, CSO discharge), it is not surprising that the distribution of contaminants is as it is (high closer to the terrestrial sources and in areas that focus sediment accumulation) and that certain chemicals, especially those that are slow to degrade in the environment (PAHs) or are highly particle-reactive (e.g., copper and lead) display only slow responses to the Harbor clean up. It is less clear why some contaminants such as DDT, silver, and cadmium are apparently decreasing more rapidly. This in part may be due to the nature of the sources and geochemical changes occurring as the sediments transition to lower levels of reactive carbon (Zago *et al*., 2001) and hence less reducing and more oxidizing conditions. These considerations are important to the ability to detect and understand the contaminant response in sediments near CSO discharges to facility upgrades and termination of discharges, particularly in Dorchester Bay which may serve to accumulate contaminants from throughout the Harbor system and will respond more slowly than those areas only accumulating contaminants from nearby sources.

4.1.2 Potential Ecological Implications of Measured Sediment Contaminant Levels

The sediment data were compared to selected sediment quality reference values described in section 2.4.3, to put the measured sediment concentrations into perspective. In summary, the NS&T/MW "high" values (Table 2-5), are reference values generated from a large national database and represent what would typically be considered elevated concentrations, on a national level for coastal environments. The effects range-low (ERL), effects range-median (ERM), threshold effects levels (TEL), and probable effects levels (PEL) are empirically derived effects-based sediment quality guideline (SQG) values based on observations with field-collected samples (Table 2-5). The ERL and TEL represent concentrations at which ecologic and toxic impact would rarely be expected. The ERMs and PELs represent concentrations at which effects would be expected to frequently occur. Although the ERL and ERM values have traditionally been used most widely, the TEL and PEL values are generally recognized as somewhat more reliable. However, the ERL/TEL and ERM/PEL values are quite similar. The more conservative PEL value will be used for most SQG evaluations in this section.

The representativeness of SQG values is sometimes hotly debated, and the application of SQGs should be made with caution. The reference values are *screening* tools that were developed to evaluate the general potential for impact to benthic organisms, and should be used in combination with other methods to assess contamination. It is widely recognized that ERL/ERM and TEL/PEL SQGs are general values that are based on large datasets, and may not fully represent the potential for effects at a specific location; there are site-to-site variations in bioavailability and contaminant interactions, benthic communities, and thus the potential for toxicity from contaminants. Although these SQG values were never intended as sediment quality criteria, and should not be used as such, they can be useful as a semiquantitative point of reference for reviewing sediment data. SQGs, their appropriate use, and their limitations are described in more detail in SJRWMD (1998, 2004a) and Battelle (2002), and the referenced base documents (e.g., Long *et al.*, 1995; MacDonald *et al.*, 1996).

Evaluation Using National Sediment Concentration Reference Values

Table 4-1 shows the percentage of stations had concentrations of surface sediment contaminants exceeding the NS&T/MW "high" concentration values (Table 2-5). Table 4-1 shows the rates of exceedances for all stations measured from 1990 through 2006 (77 stations), and also separately the results for the 17 stations sampled in 2006, both as the full station set and separated into "Near" and "Far" stations. Table 4-1 also presents the NS&T/MW "high" value exceedances for the NOAA NS&T/MW sites, the EMAP sites, and the full set of COSED site (Daskalakis and O'Connor, 1995), for comparison purposes.

NS&T/MW "high" concentration value was exceeded in from 10% (nickel) of the samples to 90% (PAH) of the samples, when evaluating the complete 1990−2006 dataset. There was a slightly lower rate of exceedances for all contaminants in the 2006 dataset, compared to the full 1990−2006 dataset, indicating declining contaminant concentrations. The rate of exceedances was clearly higher for the "Near" stations, with all "Near" stations in 2006 exceeding the NS&T/MW "high" value for Cu, Pb, Hg, Ag, Zn, PAH, and PCB. By comparison, 13% to 18% of the NS&T/MW stations (and 8% to 31% of all COSED stations) exceeded the NS&T/MW "high" for the listed contaminants. This discrepancy is not surprising, since the NS&T/MW stations includes stations along the entire US coast, and only a small proportion of those stations are in urban locations, such as Boston Harbor. The NS&T/MW dataset, which this reference value is based on, includes a large proportion of relatively "clean" locations with relatively little impact from local sources of contamination.

Table 4-1. Percent of Station with Surface Sediment NS&T/MW "High" Value Exceedances

	NS&T/MW "High" Value Exceedances						
	% Station Exceedances in COSED Dataset			% Station Exceedances in This Study			
	NS&T/MW Stations	EMAP Stations	All COSED Stations	All Stations 1990−2006	All Stations 2006	"Near" Stations 2006	"Far" Stations 2006
Study Information							
Total # of station	224	500	3878	77	17	6	11
Parameter							
Cd	16	12	31	44	29	83	0
Cr	14	3	11	55	47	67	36
Cu	18	10	25	73	71	100	55
Pb	13	12	23	79	77	100	64
Hg	15	12	30	75	71	100	55
Ni	13	5	11	10	0	0	0
Ag	16	8	22	86	82	100	73
Zn	15	17	22	58	53	100	27
Total PAH	14	2	6	90	88	100	82
Total PCBs	15	5	15	74	71	100	55
Total DDT	18	9	23	29	24	67	0
Total Chlordane	14	2	8	25	18	50	0

Table 4-2. Number and Percent of Boston Harbor Stations with Surface Sediment TEL, PEL, ERL, and ERM Exceedances

Contaminant	Sediment Quality Guideline Exceedances − All 17 Study Stations in 2006 Marine/Coastal Guidelines							
	TEL		PEL		ERL		ERM	
	Count[a]	Percent[b]	Count	Percent	Count	Percent	Count	Percent
Metals								
Cd	3	18	0	0	0	0	0	0
Cr	14	82	2	12	12	71	0	0
Cu	14	82	4	24	13	77	0	0
Pb	16	94	6	35	13	77	2	12
Hg	13	77	3	18	13	77	3	18
Ni	14	82	0	0	12	71	0	0
Ag	13	77	7	41	12	71	0	0
Zn	9	53	3	18	6	35	0	0
Organic Compounds								
Total PAH	15	88	4	24	14	82	1	6
Total PCB	15	88	7	41	15	88	8	47
Total DDT	11	65	0	0	14	82	1	6
Total Chlordane	5	29	3	18	11	65	0	0

[a] The number of stations that exceeded the SQG value

[b] The percentage of the total number of stations that exceeded the SQG value.

Evaluation Using Ecologically Based Sediment Quality Reference Values

Table 4-2 shows the number and percent of 2006 stations that had surface sediment contaminant concentrations exceeding the TEL, PEL, ERL, and ERM SQG values (Table 2-5). Most stations had contaminant concentrations that exceeded the low TEL and ERM values for most contaminants (e.g., Cr, Cu, Pb, Hg, Ni, Ag, PAH, PCB, and DDT). The more relevant PEL or ERM values, which indicate levels of likely impact to sediment dwelling benthic organisms, were exceeded at more than 20% of the stations for Cu, Pb, Ag, PAH, and PCB; the most notable effect-based SQG exceedances were observed for Pb, Ag, and PCB.

The TEL and PEL-values were used to generate hazard quotient (HQ) values using the 2006 data (Table 4-3a and 4-3b). The HQ is defined as the measured concentration of the contaminant in the sediment sample divided by the TEL or PEL value. HQs were determined using both the lower TEL and higher PEL values. The HQs for each of the eight metals and four major organic contaminant classes (total PAH, total PCB, total DDT, and total chlordane) were also summed for each station to determine a hazard index (HI), which can be used as an overall measure of the potential "potency" of the sediment contamination. The mean HQ was also calculated for each station, and is another measure of overall potential for effects.

Stations with TEL-based HI results above 10−20, as well as PEL-based HI results of about 2−5 and higher, indicate that the sediments may be toxic to benthic organisms (Lee *et al*., 2001). This relationship was confirmed by Durell *et al.* (SJRWMD, 2004b) with correlations between the HIs and biological benthic quality indices in Florida sediments. Table 4-3a presents the HQ and HI data for the 2006 station data based on the lower TEL values, and Table 4-3b is based on the higher PEL values. The PEL-based HI values for the 2006 stations are also presented in Figure 4-3.

Table 4-3a. Estimated Hazard Quotient (HQ) for Contaminants in the Study Station Sediments in 2006 (HQ: ratio of surface sediment concentration to TEL)

Site	PAH	PCB	DDT	Chlor	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Station Mean HQ	Station Total HI
Near Stations														
DB01	14.7	10.3	3.2	1.1	1.0	2.3	5.7	5.5	3.6	1.8	2.5	2.2	4.49	53.9
DB04	7.5	7.3	1.8	0.5	0.7	2.6	4.5	5.1	4.9	2.0	2.9	1.5	3.43	41.2
T04	21.0	20.5	6.6	2.8	1.6	3.3	6.7	7.1	5.1	2.3	4.1	2.3	6.95	83.4
DB10	22.1	37.2	13.1	4.1	1.4	2.9	9.3	11.6	7.8	2.0	3.1	2.5	9.75	117.0
DB14	74.5	24.5	7.8	4.2	1.5	2.0	6.1	9.6	4.1	1.5	1.9	2.6	11.68	140.2
CO19	9.5	19.4	6.7	1.5	0.9	3.5	5.8	4.2	5.0	2.5	3.8	1.6	5.37	64.4
Mean	**24.9**	**19.9**	**6.5**	**2.4**	**1.2**	**2.8**	**6.3**	**7.2**	**5.1**	**2.0**	**3.1**	**2.2**	**7.0**	**83.3**
Far Stations														
DB03	1.8	4.0	1.0	0.2	0.4	1.3	1.6	1.9	1.5	1.1	1.1	0.7	1.37	16.5
DB06	0.9	0.6	0.2	<0.1	0.1	0.6	0.7	1.1	0.6	0.6	0.4	0.3	0.51	6.1
DB12	7.6	11.2	3.8	0.8	0.6	2.5	3.4	3.1	3.1	1.7	2.4	1.2	3.43	41.1
T01	3.4	1.3	0.4	0.1	0.3	1.4	2.8	1.3	1.0	1.0	0.8	0.6	1.19	14.3
T02	4.3	5.0	1.9	0.5	0.5	2.4	2.6	2.2	3.1	1.9	1.7	1.0	2.26	27.1
T03	3.3	9.5	3.2	0.9	0.6	2.6	3.5	3.1	9.7	1.8	3.5	1.1	3.56	42.7
T05A	5.1	1.2	0.9	0.1	0.3	0.9	0.7	1.1	0.8	0.9	0.5	0.5	1.07	12.9
T06	2.6	2.9	0.7	0.2	0.4	2.0	2.2	2.7	2.8	1.6	2.0	0.9	1.75	21.0
T07	3.3	8.0	2.1	0.5	0.7	2.8	3.8	3.5	5.9	1.9	4.6	1.1	3.18	38.1
T08	0.9	0.5	0.3	<0.1	0.2	0.7	0.5	1.0	0.6	0.7	0.4	0.4	0.51	6.1
SWEX3	3.5	8.4	2.4	0.5	0.4	1.9	2.5	2.0	2.7	1.4	1.7	0.8	2.34	28.1
Mean	**3.3**	**4.8**	**1.5**	**0.4**	**0.4**	**1.7**	**2.2**	**2.1**	**2.9**	**1.3**	**1.7**	**0.8**	**1.9**	**23.1**
All Stations														
Mean	**10.9**	**10.1**	**3.3**	**1.1**	**0.7**	**2.1**	**3.7**	**3.9**	**3.7**	**1.6**	**2.2**	**1.3**	**3.7**	**44.4**

Table 4-3b. Estimated Hazard Quotient (HQ) for Contaminants in the Study Station Sediments in 2006 (HQ:ratio of surface sediment concentration to PEL)

Site	PAH	PCB	DDT	Chlor	Cd	Cr	Cu	Pb	Hg	Ni	Ag	Zn	Station Mean HQ	Station Total HI
Near Stations														
DB01	1.48	1.18	0.24	0.51	0.16	0.76	0.98	1.49	0.67	0.67	1.05	1.00	0.85	10.2
DB04	0.75	0.84	0.13	0.24	0.11	0.86	0.78	1.38	0.91	0.73	1.19	0.67	0.72	8.6
T04	2.11	2.35	0.50	1.34	0.25	1.06	1.15	1.92	0.95	0.83	1.67	1.07	1.27	15.2
DB10	2.21	4.25	0.98	1.94	0.23	0.93	1.61	3.13	1.45	0.73	1.28	1.15	1.66	19.9
DB14	7.48	2.79	0.58	1.98	0.24	0.66	1.05	2.59	0.77	0.54	0.79	1.19	1.72	20.7
CO19	0.96	2.22	0.50	0.72	0.14	1.14	1.01	1.12	0.93	0.92	1.57	0.74	1.00	12.0
Mean	**2.50**	**2.27**	**0.49**	**1.12**	**0.19**	**0.90**	**1.10**	**1.94**	**0.95**	**0.74**	**1.26**	**0.97**	**1.20**	**14.4**
Far Stations														
DB03	0.18	0.45	0.07	0.10	0.06	0.42	0.28	0.51	0.27	0.42	0.44	0.34	0.30	3.5
DB06	0.09	0.06	0.01	0.03	0.02	0.21	0.12	0.29	0.11	0.21	0.18	0.15	0.12	1.5
DB12	0.76	1.28	0.28	0.36	0.10	0.81	0.58	0.83	0.57	0.62	1.00	0.54	0.64	7.7
T01	0.34	0.15	0.03	0.05	0.04	0.46	0.48	0.36	0.18	0.38	0.34	0.26	0.25	3.1
T02	0.43	0.57	0.15	0.23	0.08	0.79	0.44	0.60	0.58	0.70	0.71	0.45	0.48	5.7
T03	0.33	1.08	0.24	0.42	0.10	0.86	0.60	0.85	1.79	0.68	1.46	0.51	0.74	8.9
T05A	0.51	0.14	0.07	0.06	0.05	0.28	0.13	0.29	0.15	0.32	0.19	0.21	0.20	2.4
T06	0.26	0.33	0.06	0.09	0.07	0.64	0.38	0.73	0.52	0.60	0.81	0.41	0.41	4.9
T07	0.33	0.91	0.15	0.24	0.11	0.92	0.66	0.96	1.10	0.69	1.88	0.51	0.70	8.5
T08	0.09	0.06	0.02	0.02	0.03	0.24	0.09	0.26	0.10	0.26	0.14	0.17	0.12	1.5
SWEX3	0.36	0.96	0.18	0.25	0.06	0.61	0.42	0.53	0.51	0.53	0.68	0.36	0.45	5.4
Mean	**0.33**	**0.54**	**0.11**	**0.17**	**0.06**	**0.57**	**0.38**	**0.57**	**0.53**	**0.49**	**0.71**	**0.36**	**0.40**	**4.83**
All Stations														
Mean	**1.10**	**1.15**	**0.25**	**0.50**	**0.11**	**0.69**	**0.63**	**1.05**	**0.68**	**0.58**	**0.91**	**0.57**	**0.68**	**8.21**

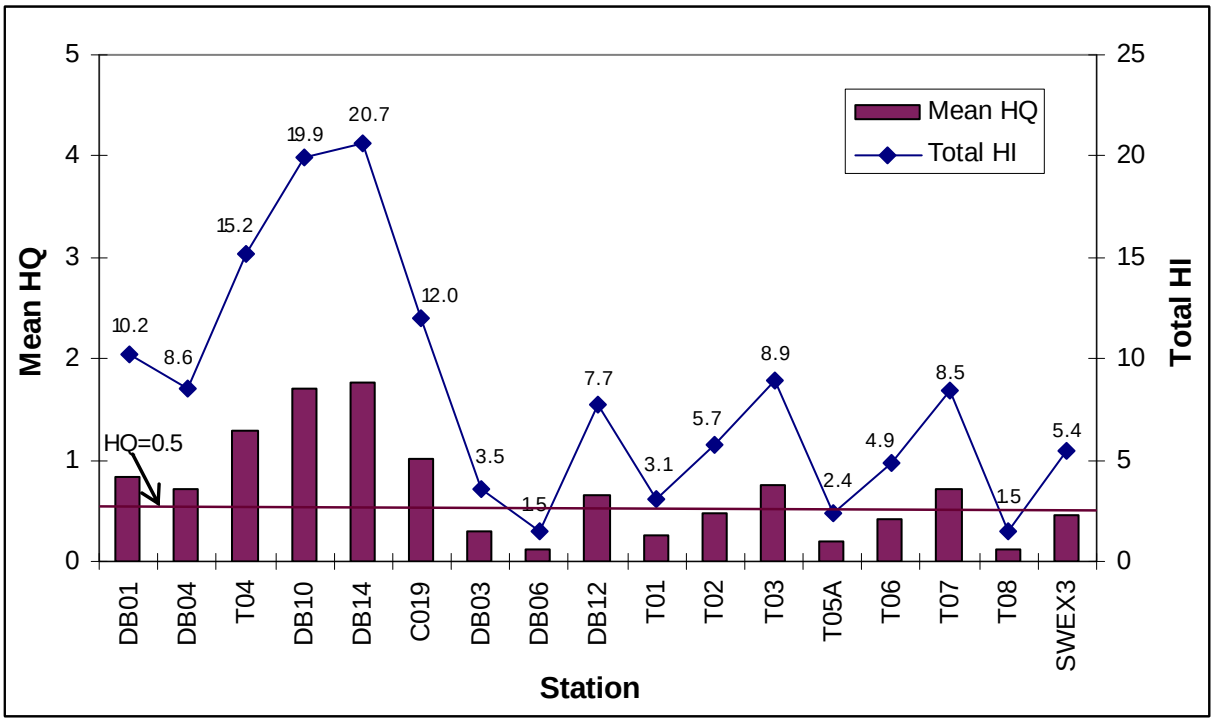


Figure 4-3. Mean HQ and Total HI, based on PEL values, for Study Stations in 2006 (see Table 2-1 and Figure 2-1 for station descriptions and locations)

Table 4-3b and Figure 4-3 also present the mean HQs, based on PEL values. The average PEL or ERM-based HQs are sometimes used as an additional measure to determine the potential for contamination to cause toxic effects on sediment organisms, and benthic ecological response (SJRWMD, 2004a−b; Hyland *et al*., 2003; Hyland *et al*., 1999; Long *et al*., 2000, MacDonald, 2000).

Of the 17 stations sampled in 2006, a total of 11 had PEL-based HIs greater than 5. All "Near" stations and five of the 11 "Far" stations (DB12, T02, T03, T07, and SWEX3) had HIs above 5, and "Near" stations DB01, T04, DB10, DB14, and CO19 had HIs above 10. Similarly, all "Near" stations and three of the 11 "Far" stations (DB12, T03, and T07) had mean HQs above 0.5, and "Near" stations T04, DB10, DB14, and CO19 had mean HQs above 1.

Table 4-4 presents the average percent contribution of the different key contaminants to the calculated HI values, based on both TEL and PEL SQG values. Figure 4-4 illustrates the PEL-based contaminant contribution to the HI. This table shows the *average* information for the "Near", "Far", and all stations as a whole. However, the chemicals contributing most of to the toxicity of the sediments vary slightly for different location. The toxicity is clearly contributed by several contaminants, and no single contaminant dominates the contribution or contributes more than about 20% of the potential toxicity. PAH, PCB. Pb, and Ag contribute the most to the toxicity in the "Near" sediments, while the metals Ni, Ag, Cr, and Pb contribute the most to the lower potential toxicity of the "Far" stations.

Table 4-5 summarizes several of the key measures of the SQG evaluation that have been presented in this section. The data presented in this section indicate that the sediment contaminants at most of the "Near" stations (e.g., T04, DB10, and DB14) have a high likelihood to cause deleterious effects on benthic organisms, and that there is a potential for such effect at all of the "Near" stations and at several of the "Far" stations (e.g., DB12, T03, and T07). These are common findings for urban sediments. Several contaminants collectively contribute to the potential for toxicity, with PAH, PCB, and Pb having the most notable contributions.

Table 4-4. Average Percent Contribution of Different Contaminants to the Hazard Index (HI) of Study Sediments in 2006

Contaminant	Average % Contribution to HI[a]					
	All Stations 2006		"Near" Stations 2006		"Far" Stations 2006	
	Using TEL	Using PEL	Using TEL	Using PEL	Using TEL	Using PEL
PAH	15.9	8.0	22.0	12.5	14.5	6.4
PCB	19.2	11.6	21.9	14.5	18.4	9.9
DDT	5.9	2.6	6.9	3.1	5.8	2.0
Chlordane	1.8	4.0	2.7	7.4	1.3	2.8
Cadmium	1.8	1.3	1.5	1.2	1.8	1.3
Chromium	6.7	10.9	4.1	7.2	7.8	11.9
Copper	9.1	7.8	8.5	8.3	9.4	7.7
Lead	9.3	12.5	9.2	13.6	9.3	11.8
Mercury	8.8	7.4	6.7	7.0	9.5	7.6
Nickel	4.9	8.5	3.0	6.0	6.9	12.2
Silver	5.9	12.3	4.8	10.7	6.3	12.3
Zinc	3.5	7.8	2.7	6.6	3.6	8.4

[a] HI: Hazard index; the sum of the HQ values.
[b] The sediment quality reference measures are threshold effects levels (TEL) and probable effects levels (PEL).

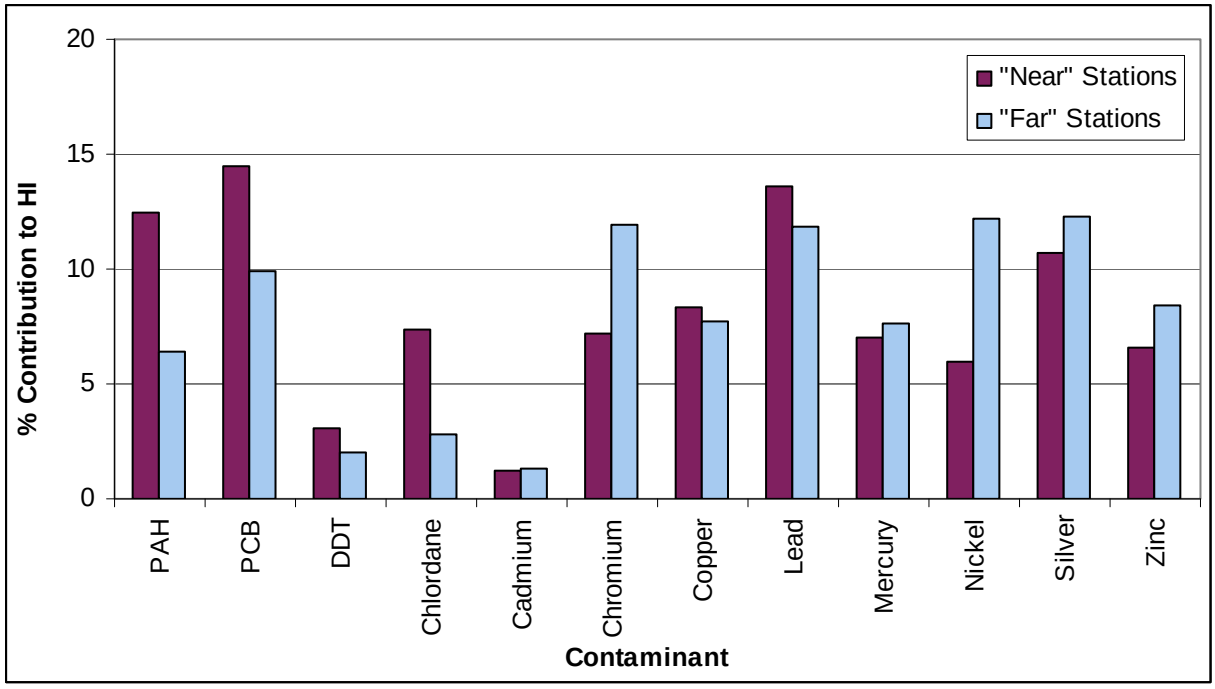


Figure 4-4. Percent Contribution to the Overall PEL-Based HI of 12 Key Contaminants

Table 4-5: Mean Hazard Index (HI) and Mean Hazard Quotient (HQ) Determined from PEL Sediment Quality Guideline Values and 2006 Sediment Concentration Data

Location	PEL-Based SQG Evaluation using 2006 Station Data			
	Mean HI	Mean HQ (PEL quotient)	% of Stations with Mean HQ>0.5	Contaminants with Mean HQ>1
"Near" Stations	14.4	1.20	100	PAH (2.50), PCB (2.27), Chlordane (1.12), Cu (1.10), Pb (1.94), Ag (1.26)
"Far" Stations	4.83	0.40	27	None
All Stations	8.21	0.68	53	PAH (1.10), PCB (1.15), Pb (1.05)

As discussed earlier, the application of sediment quality guidelines should be made with caution; sediment quality guidelines are only one of several approaches available to evaluate the quality of potentially contaminated sediment, and should be used in conjunction with other procedures. Most of the guidelines were developed for individual parameters and do not fully incorporate additive or interactive effects due to multiple toxic components. Applying SQGs does not fully incorporate site-specific considerations, and the specific nature of sediment being assessed. For instance, SQGs were based on a TOC content of 1%, and the amount and type or organic matter can significantly impact the bioavailability of contaminants. A high acid volatile sulfide (AVS) concentration in the sediment also appears to reduce the bioavailability of certain toxic metals, including cadmium, copper, nickel, lead, and zinc (DiToro *et al*.; 1990, 1992).

Additionally, the benthic community in Boston Harbor may not respond to the contaminant exactly as had been observed in the dataset used to develop the SQGs. Since the chemical structure and origins of the organic matter are unknown sediments described in this report, it is not possible to definitively link the fraction of mud, the TOC concentration, the AVS content, the contaminant concentration, and the potential ecological effect in the sediments. Nonetheless, using SGQs as one component of a sediment quality assessment can be useful to obtain a general perspective of the potential for ecological impact from the contaminants measured in the surface sediments.

4.2 CSO Influence on Sediment Quality

Many factors can control the quality of sediments, especially in an urban setting where both anthropogenic and naturally-occurring contaminant sources are present. Physical factors such as proximity to source and depositional nature of the sedimentary environment influence the fate of contaminants. Grain size and organic carbon levels also play a large role in controlling levels of contaminants in marine sediments. Moreover, bottom conditions relating to the oxidative state of the sediments also affect the fate of contaminants in sediments. Under anoxic conditions, some metals such as manganese are released, and others become tightly bound to sulfides and are sequestered (Hunt *et al.,* 2006). The abundance and types of organisms living in the sediment can also play a part in sediment quality through advective mixing and irrigation, which distribute contaminants from the surface sediments to deeper sediments and visa versa. Precipitation and resulting flows into the Harbor from CSOs, storm drains, rivers, and terrestrial run-off can also have an impact on sediment quality both locally and regionally.

CSOs are just one anthropogenic influence on sediment quality in Boston Harbor. Determining whether contaminant inputs from CSOs affect sediment quality and whether the impact is local or regional is difficult. Temporal variability in contaminant levels in sediments confounds the discussion of CSO influence. The following discussion of the data collected during CSO studies from 1990, 1994, 1998, 2002, and 2006 presents the correlation of measured contaminants to TOC and fines in stations adjacent ("Near") to CSOs and stations removed ("Far") from CSOs to help determine if there are measurable differences attributable to sediment characteristics along with proximity to CSOs. Comparison of contaminants at these "Near" and "Far" stations by study year, using the Student *t*-test, is also made to see if localized impacts are discernable. In addition, one-way ANOVAs were performed to evaluate parameter trends over time at "Near" and "Far" stations.

4.2.1 Correlation of Contaminant Concentrations to Sediment Characteristics (TOC and Grain Size)

Total organic carbon (TOC) and grain size, presented here as percent fines (percent clay and silt), are often used to characterize sediment type. The relationship of TOC and percent fines in estuarine and marine sediment is generally not impacted by anthropogenic sources of contaminants, and generally show good correlation; the coarser the sediment (lower percent fines) the lower the organic carbon content, typically. Figures 4-5 and 4-6 illustrate the relationship between TOC and fines at "Near" and "Far" stations measured as part of the CSO studies from 1990 to 2006. As is typically observed in marine sediments, increases in total organic carbon concentration were positively correlated with increases in percent fines at the "Far" stations (Figure 4-6). This plot also demonstrates the lower TOC values measured at many of the "Far" stations in 2006. The relationship of percent fines to TOC at the "Near" stations is not as well defined and appears to be negatively correlated (Figure 4-5). This lack of relationship appears to be primarily caused by the samples with the higher TOC content (e.g., those with TOC greater than 4%); the TOC in these particular samples may be disassociated and unrelated to the bulk sediment. The proximity of some sampling stations to CSO outfalls may help to explain the variations in percent fines and TOC over the years, and TOC in the discharge that is unrelated to particles and subsequent bulk sediment.

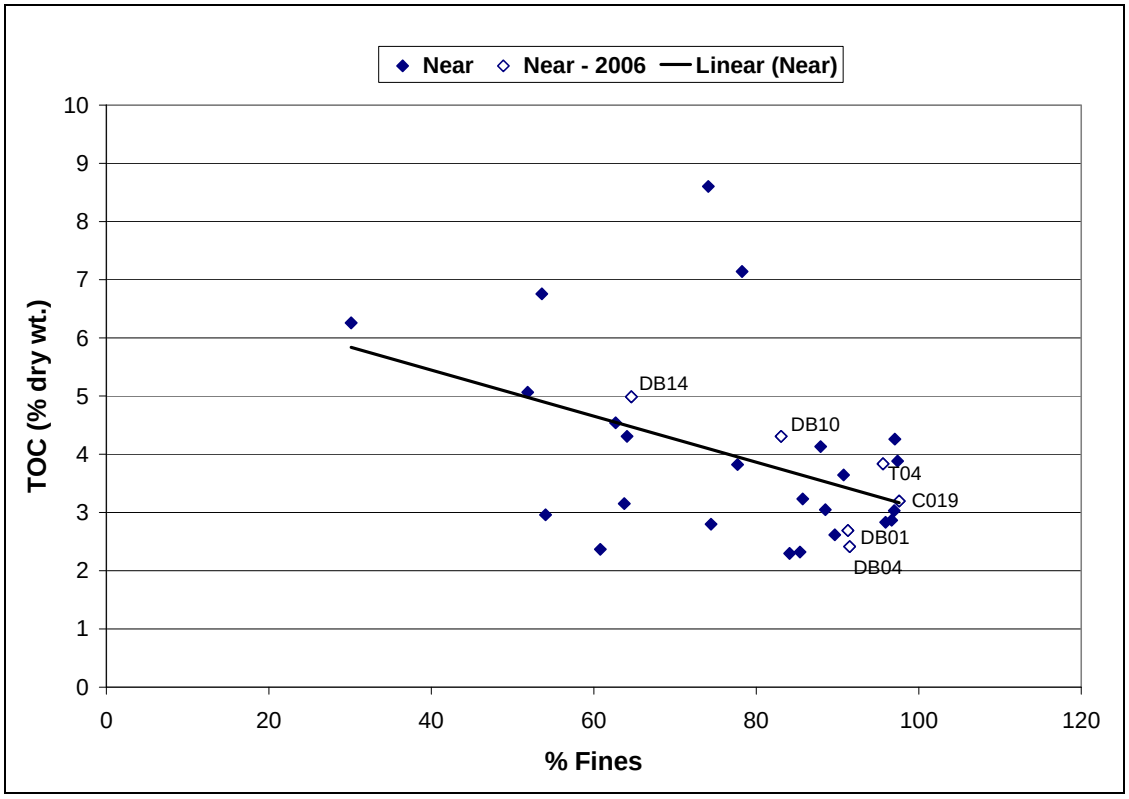


Figure 4-5. Mean TOC vs. Percent Fines for "Near" Stations

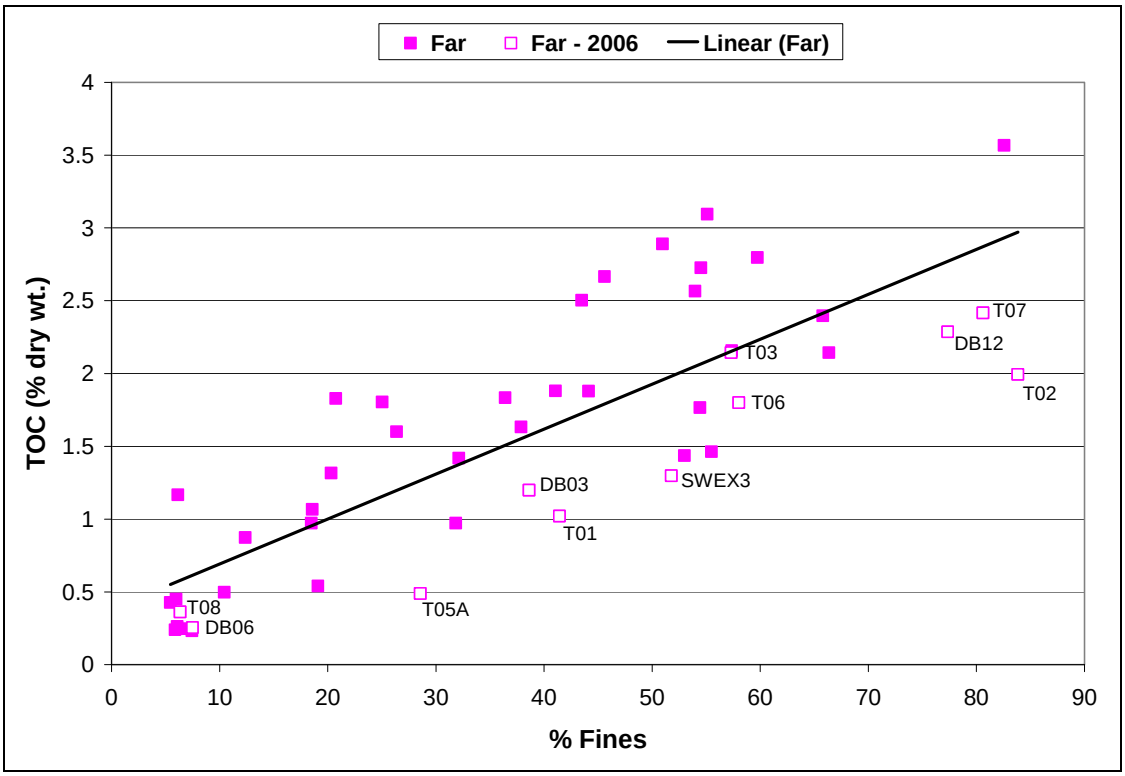


Figure 4-6. Mean TOC vs. Percent Fines for "Far" Stations

Table 4-6. Summary of Pearson Product Moment Correlation Coefficients for TOC and Fines at "Near" and "Far" Stations

Parameter	"Far" Stations				"Near" Stations			
	TOC		Fines		TOC		Fines	
	Pearson Product Moment Correlation Coefficient (r)	p	Pearson Product Moment Correlation Coefficient (r)	p	Pearson Product Moment Correlation Coefficient (r)	p	Pearson Product Moment Correlation Coefficient (r)	p
TOC	1.00		0.78	<0.0001	1.00		-0.34	0.001
Fines	0.78	<0.0001	1.00		-0.34	0.001	1.00	
Aluminum	0.59	<0.0001	0.74	<0.0001	-0.33	0.001	0.52	<0.0001
Cadmium	0.46	<0.0001	0.34	<0.0001	0.44	<0.0001	-0.60	<0.0001
Chromium	0.85	<0.0001	0.81	<0.0001	-0.17	0.11	0.46	<0.0001
Copper	0.82	<0.0001	0.72	<0.0001	0.38	0.0002	-0.36	0.0005
Iron	0.84	<0.0001	0.87	<0.0001	-0.19	0.07	0.67	<0.0001
Lead	0.83	<0.0001	0.72	<0.0001	0.65	<0.0001	-0.65	<0.0001
Mercury	0.55	<0.0001	0.49	<0.0001	0.39	0.0006	0.02	0.83
Nickel	0.85	<0.0001	0.82	<0.0001	0.25	0.02	-0.16	0.13
Silver	0.77	<0.0001	0.67	<0.0001	-0.15	0.19	0.35	0.002
Zinc	0.86	<0.0001	0.82	<0.0001	0.56	<0.0001	-0.62	<0.0001
Sum 5DDTs	0.44	<0.0001	0.31	0.0003	0.47	<0.0001	-0.40	0.004
Sum Chlordanes	0.69	<0.0001	0.52	<0.0001	0.70	<0.0001	-0.51	<0.0001
Sum PCBs	0.58	<0.0001	0.43	<0.0001	0.59	<0.0001	-0.25	0.03
Total PAH	0.30	0.0003	0.17	0.05	0.71	<0.0001	-0.60	<0.0001
Sum LMW PAH	0.22	0.007	0.07	0.43	0.70	<0.0001	-0.52	<0.0001
Sum HMW PAH	0.34	<0.0001	0.22	0.008	0.67	<0.0001	-0.57	<0.0001
Clostridium	0.56	<0.0001	0.42	<0.0001	0.17	0.12	-0.23	0.03
Log Clostridium	0.69	<0.0001	0.56	<0.0001	0.32	0.002	-0.18	0.09

Note: shaded values indicate $p<0.05$ = statistically significant

TOC and percent fines can also be predictive of contaminant concentrations in sediments. Correlation of contaminants measured in 1990, 1994, 1997, 1998, 2002, and 2006 were evaluated using Pearson Product Moment Correlations to determine parameter correlations with TOC and percent fines. Table 4-6 presents a summary of the Pearson Product Moment correlation coefficients for TOC and fines for 1990, 1994, 1997, 1998, 2002, and 2006 combined, relative to metals, DDT, Chlordane, PCB, PAH, and *Clostridium*.

As observed in Figure 4-6 and Table 4-6, TOC and fines at "Far" stations show a strong positive significant correlation ($r = 0.78$). In contrast, the correlation coefficient for TOC and fines for "Near" stations is much lower and actually shows a negative correlation ($r = -0.34$). Aluminum has a fairly strong ($r = 0.74$) correlation to fines at the "Far" stations, which is to be expected because aluminum is a crustal element and in the absence of anthropogenic sources it is directly related to the sediment geochemistry, and thus the percent fines.

TOC is significantly correlated to all parameters for "Far" stations. All correlations for TOC with metals, pesticides, PCBs, PAHs, and *Clostridium* were positive, and correlations between TOC and most metals (Cr, Cu, Fe, Pb, Ni, Zn) exhibited strong relationships (i.e., $r > 0.80$). Moderately strong ($0.55 \leq r \leq 0.77$) positive correlations exist between TOC and Hg, *Clostridium*, Al, PCBs, Total Chlordanes, log

Clostridium, and Ag. PAHs (Total PAHs, LMW PAHs, and HMW PAHs) and TOC showed the weakest correlations ($r = 0.22 – 0.34$).

Similarly, correlations at "Far" stations for percent fines with metals, pesticides, PCBs, HMW PAHs, and *Clostridium* were significant; Total PAHs and LMW PAHs did not show a significant correlation to fines (i.e., $P > 0.05$). All of the correlation coefficients for percent fines were positive and exhibited moderately to fairly strong relationships ($0.67 \leq r \leq 0.87$) for most metals (Al, Cr, Cu, Fe, Pb, Ni, Ag, and Zn). While most organics showed significant correlations with percent fines, these correlations were weak and ranged from 0.22 (HMW PAH) to 0.52 (Total Chlordanes). Although exhibiting significantly positive relationships with percent fines, *Clostridium* had a lower r value (0.42), suggesting a slightly weaker relationship with percent fines than with TOC at "Far" stations.

In contrast, not all parameters were significantly correlated with TOC at "Near" stations. For example, Cr, Fe, Ag, and *Clostridium* did not show a significant correlation to TOC ($p > 0.05$). The other parameters at the "Near" stations showed significant correlations with TOC, with a weak negative correlation observed between Al and TOC ($r = −0.33$; related to the relationship between AL and fines discussed earlier) and moderately strong ($0.56 \leq r \leq 0.71$) positive correlations between TOC and Pb, Zn, Total Chlordanes, PCBs, Total PAHs, LMW PAHs, and HMW PAHs.

Unlike the data from the "Far" stations, Hg, Ni, and log *Clostridium* did not show a significant correlation with percent fines at "Near" stations. The remaining parameters were significantly correlated ($p < 0.05$) with percent fines, but they showed mostly negative or variable and unpredictable, relationships rather than the positive correlations observed in the "Far" data. Again, this is related to the lack of correlation between TOC and fines at the "near" station that was discussed earlier, and the likely variability in organic matter and particle loadings near shore and atypical fluctuations in how the contaminants associate with and relate to the TOC and particle size near shore. Only Al and Fe showed a moderate to relatively strong correlation ($r= 0.052$ to 0.67) with fines at the "Near" stations, as those are major metals primarily attributed to the sediment mineralogy.

Overall, the weaker or negative correlations at the "Near" stations may be a result of increased impacts from anthropogenic sources, possibly including the nearby CSOs, and loadings of larger particles with higher proportion of TOC, and significant variability in the TOC-to-particle size relationship in CSO discharge. The negative correlation between TOC and percent fines at the "Near" stations may be a result of both a proportionately higher amount of the TOC mostly associated with larger particles and high inorganic particulate loads of fine particles coming from the CSOs. The significantly positive correlations observed at most "Far" stations between TOC and fines and between these parameters and many of the organic parameters and metals appear to indicate that these sediments are less impacted by anthropogenic inputs, and/or have seen the contaminants equilibrating with the sediment organic matter and the particles over time, following the more typical sediment contaminant-to-sediment relationship.

TOC appears to be a controlling factor of the contaminants in most sediment, including the "Near" sediments for most contaminants. This is particularly the case for the organic contaminants, as expected, but also for several metals; however the TOC content is not related to the concentration of chromium, silver, or *Clostridium* near CSOs. CSOs can be a source of TOC to the sediments and depending on the size and density of the particles (i.e., association with mineralogy), deposition can be relatively localized, in some cases within 100 to 1000 meters from the source (Stolzenbach and Adams, 1998). This can act to focus contaminants in localized areas and depending on sedimentation rates and other geochemical processes, can lead to localized contaminant distributions.

4.2.2 Comparison of Organic and Metals Concentrations at "Near" and "Far" Stations

As discussed previously, determining the nature and extent of CSO impact on local and regional sediment quality is difficult. Grouping stations as "Near" and "Far" from CSOs within Dorchester Bay and statistically comparing the group contaminant concentrations was another way to discern if local impacts relative to proximity of CSOs were discernable. Student *t*-tests were used to determine if the concentrations of various parameters measured at the "Near" stations within Dorchester Bay (DB01, DB04, T04, DB10, DB14, and C019) (see Figure 2-1) were significantly different from the concentrations of those same parameters at the "Far" stations (DB03, DB06, DB12, SWEX3, T01, T02, T03, T05A, T06, T07, and T08) in 1990, 1994, 1998, 2002, and 2006. The results of this analysis were also used to support the "Near"/ "Far" grouping discussions throughout this report.

Table 4-7 shows the t-statistic and p-value for Student *t*-test results comparing concentrations at "Near" and "Far" stations from 1990, 1994, 1998, 2002, and 2006 for parameters with available data for those years. Concentrations for all parameters tested were always greater at the "Near" stations. In 1990, the "Near" stations were significantly different from the "Far" stations for all 13 parameters analyzed that year (selected metals, PAHs, and *Clostridium*). For each of the other CSO sediment study years tested (1994, 1998, 2002, and 2006), 18 parameters were compared, and only Al (in 1994), *Clostridium* (in 1994 and 1998), and log *Clostridium* (in 1994 and 1998) were *not* significantly different between the "Near" and "Far" groups; the contaminant chemicals were consistently present at significant higher concentrations in the "Near" sediments than in the "Far" sediments. One of the most notable changes is the decline in the *Clostridium* density after 1990, and the greater similarity in the "Near" and "Far" *Clostridium* data than for most contaminants. This notable decline in *Clostridium*, and particularly at the stations near CSOs, has resulted in more similar (and lower) *Clostridium* levels throughout the study area. This illustrates how fecal contamination, and other contamination, from CSO discharge has decreased and become less of a contributor to the sediment contaminant concentrations.

The analyses show that the concentrations of most parameters were significantly greater at "Near" than and "Far" stations ($p < 0.05$); consistent with the hypothesis that CSO outfalls are a source of contaminants to nearby sediments. This station grouping is slightly different in this report than in prior CSO sediment reports, as discussed earlier, resulting in different t-test outcomes for 1994, 1998, and 2002 than those reported before. These t-test results support the conclusion that there may be some level of impact from CSOs related to sediment quality in the vicinity of the CSOs, although it does not reliably separate contributions from other urban and shoreline sources from CSO point sources.

To further examine the spatial extent to which impacts from CSOs are discernable, and whether different station grouping methods notably impact the results, a second t-test was performed which used two sub-groups of "Far" stations: the Harbor and Close-by "Far" stations (i.e., DB03, DB06, DB12, SWEX3, T02; "Far-I") and the more distant "Far" stations (i.e., T01, T03, T05A, T06, T07, T08; "Far-II"). Data from the 2002 and 2006 surveys were used to compare the two "Far" sub-groups to the "Near" stations (Table 4-8). As with the full set of 11 "Far" stations, most parameters were statistically significantly different between the "Near" stations and each of the two "Far sub-groups". The exceptions were log *Clostridium* for the Harbor/Close-by "Far" stations ("Far-I") in 2002, and LMW PAHs for distant "Far" stations in 2002. The results of this analysis show that the concentrations of most contaminants at "Near" stations are statistically significantly higher than at the "Far" stations, whether they are in Dorchester Bay and relatively close-by to CSOs, or whether they are kilometers distant. Therefore, it appears that the selection of stations for the "Far" station grouping is less critical than one might have thought, and the effects of CSOs on sediment chemistry are fairly localized; the contaminant concentrations at "Far" stations relatively close to CSOs are significantly lower than at the "Near" stations. These results also justify the decision to group all "Far" stations together for the purpose of the data analysis and discussion, gaining additional statistical power and rigor.

Table 4-7. Summary of Student t-Test results for "Near" and "Far" Stations

Parameter	"Far"		"Near"		t-test result	
	Mean	Std. Dev.	Mean	Std. Dev.	t-statistic	p-value
1990						
Aluminum	5.62	0.75	7.09	0.48	-5.89	<0.0001
Cadmium*	0.64	0.37	3.31	2.60	-6.00	<0.0001
Chromium	95.1	61.8	180	39.4	-4.15	0.0004
Copper	56.8	38.8	190	24.9	-10.33	<0.0001
Iron	2.18	0.78	3.57	0.74	-4.36	0.0002
Lead*	68.8	34.3	352	158	-7.37	<0.0001
Nickel*	22.4	9.74	52.3	24.0	-5.85	<0.0001
Zinc*	99.9	49.5	599	459	-6.72	<0.0001
Total PAH*	3,620	2,830	35,500	29,900	-6.18	<0.0001
Sum LMW PAH*	511	439	6,460	7,000	-6.05	<0.0001
Sum HMW PAH*	1980	1470	20,900	16,800	-6.49	<0.0001
Clostridium	14,250	12,000	55,200	38,300	-3.84	0.001
Log *Clostridium*	3.94	0.53	4.67	0.25	-3.91	0.003
1994						
Aluminum	5.07	1.81	5.83	1.41	-1.44	0.16
Cadmium*	0.39	0.44	1.34	0.73	-6.73	<0.0001
Chromium	108	69.2	184	68.2	-3.42	0.002
Copper	48.1	36.3	142	41.4	-7.52	<0.0001
Iron	2.53	0.88	3.64	0.70	-4.33	<0.0001
Lead*	63.3	40.8	196	86.2	-7.48	<0.0001
Mercury*	0.51	0.79	0.89	0.32	-4.48	0.0002
Nickel	21.7	10.2	33.6	6.35	-4.27	0.0001
Silver	1.85	1.53	4.01	1.47	-4.47	<0.0001
Zinc	92.5	53.0	250	69.9	-8.01	<0.0001
Sum 5DDTs*	14.4	14.6	75.7	60.5	-5.54	<0.0001
Sum Chlordanes*	1.66	1.32	8.66	11.9	-5.55	<0.0001
Sum PCBs*	71.7	87.0	246	198	-4.85	<0.0001
Total PAH*	8,300	6,930	42,500	41,700	-5.65	<0.0001
Sum LMW PAH*	2,830	2,460	12,500	13,700	-4.63	<0.0001
Sum HMW PAH*	5,470	4,520	30,000	28,100	-6.13	<0.0001
Clostridium	7,860	5,760	8,420	5,410	-0.31	0.76
Log *Clostridium*	3.74	0.42	3.82	0.32	-0.69	0.49
1998						
Aluminum	5.20	1.02	6.28	0.77	-3.75	0.0006
Cadmium*	0.52	0.54	1.38	0.62	-5.78	<0.0001
Chromium	96.0	57.8	153	29.3	-4.20	0.0002
Copper*	52.8	31.6	170	89.3	-7.81	<0.0001
Iron	2.60	0.87	4.07	0.45	-7.09	<0.0001
Lead*	68.0	34.3	325	240	-7.55	<0.0001
Mercury*	0.37	0.30	1.06	0.72	-5.75	<0.0001
Nickel	22.2	9.41	37.0	5.06	-6.55	<0.0001
Silver	1.85	1.73	2.97	0.76	-2.82	0.008
Zinc*	99.6	47.6	323	128	-8.16	<0.0001
Sum 5DDTs*	15.1	26.7	43.0	43.1	-4.52	<0.0001
Sum Chlordanes*	1.97	1.66	14.3	18.1	-4.52	<0.0001
Sum PCBs*	79.1	102	276	190	-5.46	<0.0001

Table 4-7. Summary of Student t-Test results for "Near" and "Far" Stations (continued)

Parameter	"Far"		"Near"		t-test result	
	Mean	Std. Dev.	Mean	Std. Dev.	t-statistic	p-value
1998 (cont.)						
Total PAH*	5,860	6,050	54,000	53,600	-6.68	<0.0001
Sum LMW PAH*	1,720	1,820	18,300	21,000	-6.17	<0.0001
Sum HMW PAH*	4,140	4,260	35,800	32,600	-6.85	<0.0001
Clostridium	5,280	3,110	6,940	5,330	-1.18	0.25
Log *Clostridium*	3.58	0.44	3.69	0.40	-0.84	0.41
2002						
Aluminum	5.99	0.82	6.65	0.75	-2.83	0.007
Cadmium*	0.25	0.20	0.70	0.27	-7.93	<0.0001
Chromium	105	54.9	174	27.1	-6.00	<0.0001
Copper*	50.9	26.1	144	45.9	-9.10	<0.0001
Iron	2.76	0.87	4.22	0.49	-7.73	<0.0001
Lead*	70.1	38.7	189	110	-6.76	<0.0001
Mercury	0.41	0.34	0.76	0.19	-4.63	<0.0001
Nickel	23.4	8.95	37.8	7.56	-5.79	<0.0001
Silver	1.47	1.14	2.56	0.52	-4.70	<0.0001
Zinc*	102	39.9	264	96.9	-8.33	<0.0001
Sum 5DDTs*	4.71	3.68	18.6	18.0	-4.92	<0.0001
Sum Chlordanes*	0.97	0.82	5.27	6.71	-5.06	<0.0001
Sum PCBs*	51.1	48.2	125	63.5	-5.39	<0.0001
Total PAH*	10,270	12,500	23,100	26,600	-4.12	0.0002
Sum LMW PAH*	3,620	4,880	6,760	9,100	-2.67	0.01
Sum HMW PAH*	6,651	7,790	16,300	17,500	-4.64	<0.0001
Clostridium	4,230	3,700	10,200	9,640	-2.54	0.02
Log *Clostridium*	3.34	0.62	3.82	0.43	-2.95	0.005
2006						
Aluminum	6.27	1.46	7.49	1.49	-2.82	0.007
Cadmium*	0.27	0.14	0.80	0.26	-9.15	<0.0001
Chromium	90.8	43.2	144	32.4	-4.6	<0.0001
Copper	41.0	25.4	118	33.0	-9.33	<0.0001
Iron	2.65	0.82	3.96	0.63	-5.90	<0.0001
Lead*	63.3	29.4	217	124	-9.10	<0.0001
Mercury*	0.37	0.46	0.66	0.26	-5.30	<0.0001
Nickel	21.1	8.21	31.6	5.91	-4.80	<0.0001
Silver	1.26	1.00	2.23	0.62	-4.28	<0.0001
Zinc*	96.3	41.1	263	64.5	-10.72	<0.0001
Sum 5DDTs*	5.93	5.92	25.4	15.1	-6.27	<0.0001
Sum Chlordanes*	0.80	0.73	5.37	3.47	-7.47	<0.0001
Sum PCBs*	51.5	46.3	215	113	-7.50	<0.0001
Total PAH*	5,610	3,700	41,900	40,200	-8.09	<0.0001
Sum LMW PAH*	1,450	987	9,900	11,300	-6.70	<0.0001
Sum HMW PAH*	4,160	2,770	32,000	29,000	-8.48	<0.0001
Clostridium	2,220	1,910	6,220	5,570	-2.95	0.008
Log *Clostridium*	3.13	0.50	3.65	0.35	-3.97	0.0002

Note: Shaded cells indicate significant differences ($p < 0.05$).

* Data were log-transformed to meet the assumption of normality.

Table 4-8. Summary of Student t-Test results for "Near" and Two Sub-Groups of "Far" Stations in 2002 and 2006

Parameter	"Far-I"		"Far-II"		"Near"		t-test result "Far-I"		t-test result "Far-II"	
	Mean	SD	Mean	SD	Mean	SD	t-statistic	p-value	t-statistic	p-value
2002										
Aluminum	6.01	0.93	5.97	0.74	6.65	0.75	-2.20	0.04	-2.71	0.01
Cadmium*	0.26	0.24	0.23	0.15	0.70	0.27	-5.44	<0.0001	-6.57	<0.0001
Chromium	108	51.8	103	58.7	174	27.1	-4.47	0.0002	-4.68	<0.0001
Copper*	52.8	21.4	49.3	30.0	144	45.9	-7.24	<0.0001	-7.22	<0.0001
Iron	2.87	0.97	2.66	0.78	4.22	0.49	-4.89	<0.0001	-7.19	<0.0001
Lead*	77.4	44.6	64.0	33.1	189	110	-5.27	<0.0001	-6.58	<0.0001
Mercury	0.35	0.24	0.46	0.41	0.76	0.19	-5.41	<0.0001	-2.78	0.01
Nickel	25.1	8.81	22.1	9.08	37.8	7.56	-4.48	<0.0001	-5.66	<0.0001
Silver	1.28	0.66	1.62	1.42	2.56	0.52	-6.27	<0.0001	-2.62	0.02
Zinc*	105	38.5	98.5	41.9	264	96.9	-6.99	<0.0001	-7.91	<0.0001
Sum 5DDTs*	4.13	3.33	5.19	3.99	18.6	18.0	-4.49	<0.0001	-4.15	0.0002
Sum Chlordanes*	0.79	0.51	1.12	1.00	5.27	6.71	-4.82	<0.0001	-4.11	0.0002
Sum PCBs*	44.6	35.3	56.6	57.3	125	63.5	-4.24	0.0004	-3.98	0.0005
Total PAH*	8,440	7,440	11,800	15,700	23,100	26,600	-3.33	0.003	-3.15	0.003
Sum LMW PAH*	2,580	2,370	4,490	6,200	6,760	9,110	-2.87	0.009	-2.01	0.05
Sum HMW PAH*	5,870	5,260	7,310	9,510	16,300	17,500	-3.54	0.002	-3.73	0.0007
Clostridium	4,910	3,420	3,670	3,930	10,200	9,640	-2.18	0.04	-2.67	0.01
Log *Clostridium*	3.45	0.62	3.24	0.62	3.82	0.43	-2.02	0.05	-3.27	0.003
2006										
Aluminum	6.21	1.89	6.32	1.04	7.49	1.49	-2.17	0.04	-2.73	0.01
Cadmium*	0.26	0.14	0.27	0.15	0.80	0.26	-6.63	<0.0001	-7.57	<0.0001
Chromium	91.1	44.5	90.6	43.4	144	32.4	-3.98	0.0004	-4.22	0.0002
Copper	39.9	21.0	42.0	29.3	118	33.0	-7.95	<0.0001	-7.35	<0.0001
Iron	2.68	1.01	2.61	0.66	3.96	0.63	-4.43	0.0001	-6.27	<0.0001
Lead*	62.1	25.1	64.4	33.3	217	124	-8.44	<0.0001	-7.53	<0.0001
Mercury*	0.28	0.18	0.45	0.59	0.66	0.26	-4.99	<0.0001	-3.42	0.003
Nickel	21.3	9.10	20.9	7.65	31.6	5.91	-3.93	0.0004	-4.69	<0.0001
Silver	1.06	0.58	1.42	1.24	2.23	0.62	-5.56	<0.0001	-2.47	0.02
Zinc*	99.2	44.4	93.8	39.4	263	64.5	-7.46	<0.0001	-8.99	<0.0001
Sum 5DDTs*	7.15	6.72	4.91	5.14	25.4	15.1	-4.53	0.0002	-6.77	<0.0001
Sum Chlordanes*	0.93	0.70	0.69	0.76	5.37	3.47	-6.04	<0.0001	-7.36	<0.0001
Sum PCBs*	62.8	51.0	42.0	41.2	215	113	-4.80	0.0001	-6.74	<0.0001
Total PAH*	6,100	4,790	5,190	2,560	41,900	40,200	-6.25	<0.0001	-7.90	<0.0001
Sum LMW PAH*	1,450	1,220	1,440	782	9,900	11,300	-5.40	<0.0001	-6.25	<0.0001
Sum HMW PAH*	4,650	3,610	3,750	1,810	32,000	29,100	-6.51	<0.0001	-8.38	<0.0001
Clostridium	2,860	1,780	1,690	1,900	6,220	5,570	-2.41	0.03	-3.27	0.004
Log *Clostridium*	3.30	0.46	2.99	0.50	3.66	0.35	-2.51	0.02	-4.70	<0.0001

Note: Shaded cells indicate significant differences ($p < 0.05$).
Far-I (Harbor/Close-by "Far" stations): DB03, DB06, DB12, SWEX3, T02
Far-II (Distant "Far" stations): T01, T03, T05A, T06, T07, T08
*indicates data were log transformed to meet normality assumptions

4.2.3 Temporal Trends at "Near" and "Far" Stations

One-way ANOVAs were run to evaluate temporal changes to sediment quality at both "Near" and "Far" stations for various parameters across the five sampling years (1990, 1994, 1998, 2002, and 2006). Significant differences in concentrations over the sampling years for the "Near" and "Far" groups as a whole are noted in Table 4-9 (see Section 2.4.2 for an explanation of how to interpret the information in Table 4-9), and the trends are illustrated graphically in Figures 4-7 through 4-10 for %fines, silver, DDT, and *Clostridium*, respectively. Similar information for individual stations is compiled in Appendix C. When significant differences are noted in Table 4-9 (and Appendix C), the highest value is listed first. The lines below the values in Table 4-9 group the years that are *not* significantly different from one another; a break in the lines shows which years are different. The results of these ANOVAs show that concentrations of many contaminants have decreased at "Near" stations since 1990 and 1994, while percent fines have increased significantly from 1990 to 2006. The data also suggests that the decline may have "leveled off" for several contaminants, with the concentrations measured in 2002 being comparable to, and sometimes lower than, what was measured in 2006. Other contaminants, such as chromium, chlordane, and PAH, did not show a statistically significant decline at the "Near" stations as a group, possibly due to high variability in the contaminant concentrations, and/or some recent increases (e.g., the PAH in 2006). The cause for the observed decreases is most likely not attributed to one event but the general trend toward environmental control of contaminant releases combined with the improvements in sewage (including CSO) control in the Harbor (Werme and Hunt, 2002). CSOs appear to have some local effect on sediment quality but whether these impacts affect a wider area or are long term is not clear.

At "Near" stations, percent fines, most metals, DDTs, PCBs, and *Clostridium* differed significantly at some level among the five sampling years ($p<0.05$). Concentrations of most contaminants at "Near" stations decreased from 1990 to 2006, but percent fines, Al, and Fe showed significant increases among the five sampling years tested (Figure 4-7; the Al and Fe due to their relationship with the mineralogy and the fine-grained sediment). Silver and Total DDTs showed a gradual decrease over time, decreasing significantly from 1994 to 2002 and 2006 (Figures 4-8 and 4-9), while several other contaminants (Cd, Ni, Ag, Zn, *Clostridium*; Figure 4-10) showed a dramatic significant decrease from 1990 to 1994, with subsequent years being statistically similar to 1994. This decrease coincides with the cessation of sludge disposal in Boston Harbor in 1991, and some early CSO management in Dorchester Bay. The statistical differences for Fe, Hg, and PCBs were not as strong ($0.01 \leq p \geq 0.04$) as for the other parameters tested, and concentrations for these three parameters in 2006 were similar to those in the early 1990's.

At "Far" stations, percent fines, Al, Cd, DDTs, Chlordanes, LMW PAHs, and *Clostridium* differed significantly among the five sampling years. As with the "Near" stations, percent fines and Al showed significant increases among the five sampling years that were tested. Concentrations of DDTs decreased significantly from 1998 to 2002, and LMW PAHs, but not Total PAH, showed a significant increase from 1990 to 2002. However, 2006 concentrations for these two contaminants were statistically similar to those in the early 1990s. Concentrations of Chlordanes in 2006 were significantly lower than concentrations in 1994 and 1998 and showed the strongest statistical trend ($p = 0.0004$) of the organic contaminants. *Clostridium* at "Far" stations decreased significantly from 1990 to 1994 and further from 1994 to 2006.

With the exception of percent fines, Al, and Fe, most of the parameters showing temporal trends at "Near" stations showed significant decreases from concentrations measured in 1990 and/or 1994. Concentrations in 2006 were often significantly lower than those measured in the early 1990's, but were similar to or lower than those measured in 1998 and 2002. This is consistent with ANOVA results for individual parameters by station (see Appendix C).

Table 4-9. Summary of One Way ANOVA Results for "Near" and "Far" stations in 1990 to 2006

(years that share an underline are not significantly different)

Parameter	"Near"			"Far"		
	F statistic	P	Specific Differences*	F statistic	p	Specific Differences*
TOC	1.13	0.35		1.02	0.40	
% Fines	8.41	<0.0001	'02 '06 '98 '94 '90 ---------- ---	3.53	0.009	'06 '02 '98 '94 '90 ----------
Aluminum	6.56	0.0001	'06 '90 '02 '98 '94 ---------- ----------	4.33	0.003	'06 '02 '90 '98 '94 ---------- ----------
Cadmium	12.69	<0.0001	'90 '98 '94 '06 '02 --- ----------	4.41	0.002	'90 '98 '94 '06 '02 ---------- ----------
Chromium	2.95	0.05		0.44	0.77	
Copper	6.56	0.0001	'90 '98 '02 '94 '06 --------- ----------	0.86	0.49	
Iron	3.55	0.01	'02 '98 '06 '94 '90 ---------- ----------	0.88	0.48	
Lead	4.22	0.004	'90 '98 '06 '94 '02 ---------- ----------	0.21	0.93	
Mercury	2.94	0.04	'98 '94 '02 '06 ---------- ----------	0.39	0.76	
Nickel	7.95	<0.0001	'90 '02 '98 '94 '06 ---- ----------	0.29	0.88	
Silver	11.80	<0.0001	'94 '98 '02 '06 ---- -------- ----------	1.34	0.26	
Zinc	7.86	<0.0001	'90 '98 '02 '06 '94 ---- ----------	0.15	0.96	
Sum 5DDTs	9.62	<0.0001	'94 '98 '06 '02 -------- -------- ---------	3.86	0.01	'98 '94 '06 '02 ---------- ----------
Sum 4 Chlordanes	2.45	0.07		6.51	0.0004	'98 '94 '02 '06 ---------- --------- ----------
Sum 20 PCBs	3.73	0.02	'98 '06 '94 '02 ---------- ----------	1.11	0.35	
Total PAH	1.39	0.25		2.26	0.07	
Sum LMW PAH	2.20	0.08		3.6	0.008	'02 '94 '98 '06 '90 ---------- ----------
Sum HMW PAH	1.66	0.17		2.05	0.09	
Clostridium	21.20	<0.0001	'90 '02 '94 '98 '06 ---- ----------	13.37	<0.0001	'90 '94 '98 '02 '06 ---- ---------- ----------

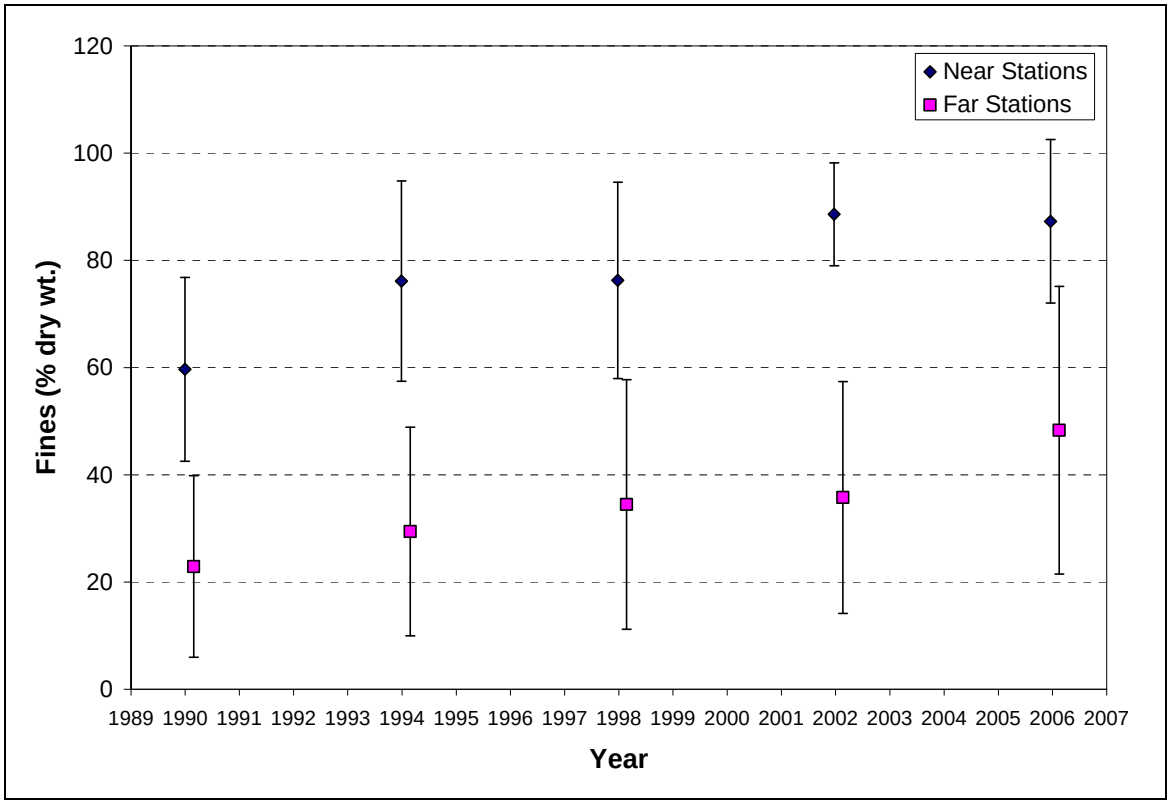


Figure 4-7. Mean %Fines for "Near" and "Far" Stations from 1990 to 2006

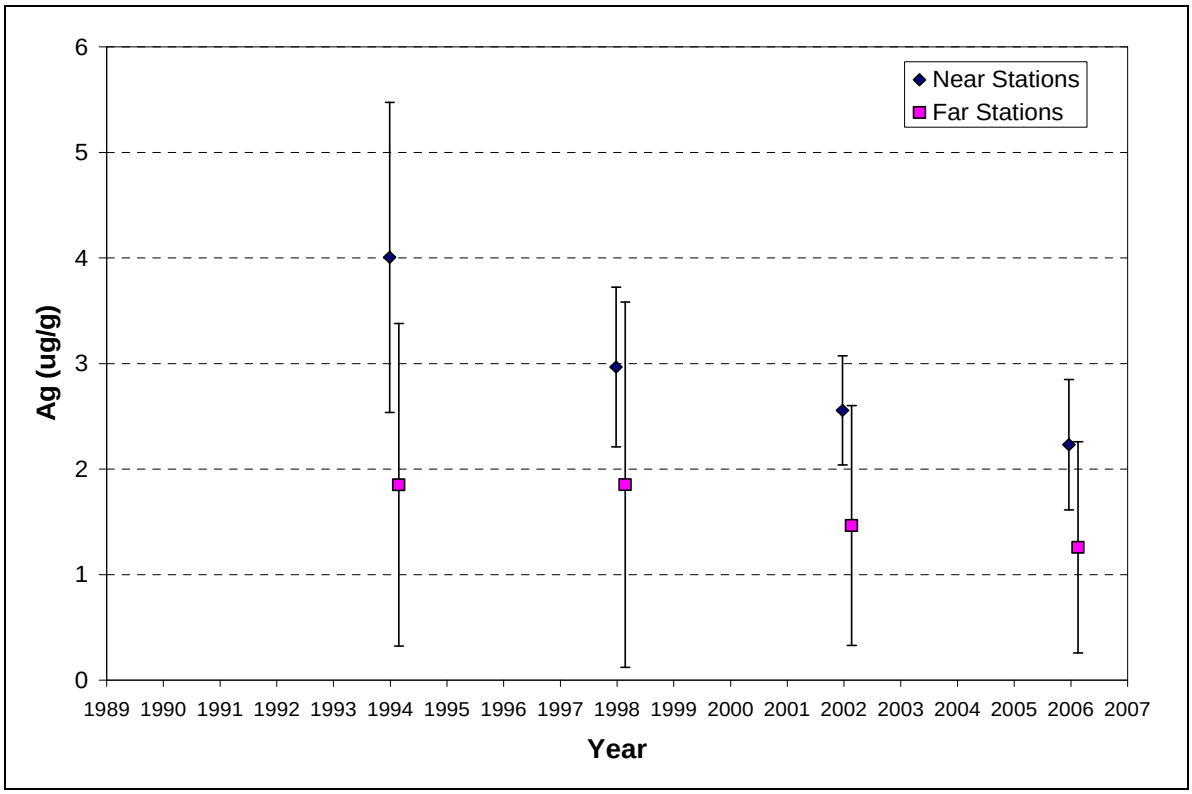


Figure 4-8. Mean Silver Concentrations for "Near" and "Far" Stations from 1994 to 2006

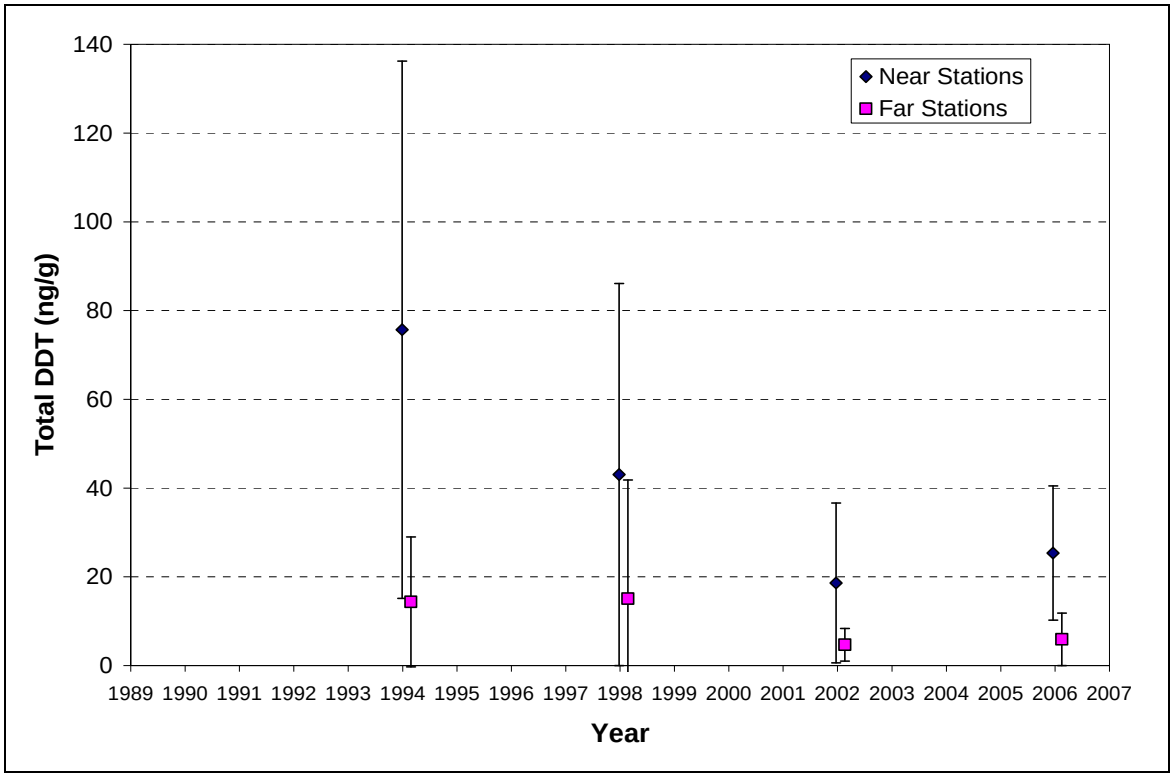


Figure 4-9. Mean Total DDT Concentrations for "Near" and "Far" Stations from 1994 to 2006

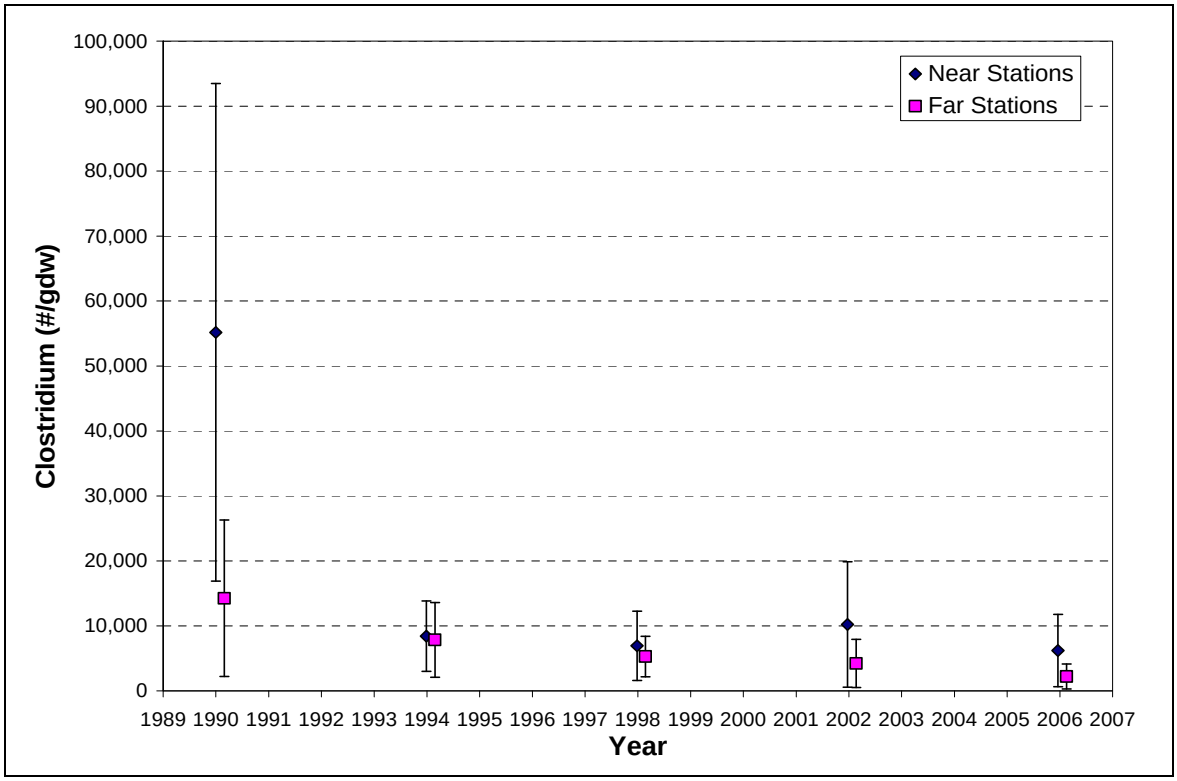


Figure 4-10. Mean *Clostridium* Density for "Near" and "Far" Stations from 1990 to 2006

The statistically significant decrease in *Clostridium* was recently attributed to the implementation of secondary treatment of sewage in 1998 and cessation of effluent from Nut Island, and the relocation of the Deer Island Outfall in 2000 (Macioleck *et al.,* 2005). The localized decline in *Clostridium* can also be linked to improvements at the Fox Point and Commercial Point CSOs in the early 1990's. *Clostridium* concentrations at the "Near" stations have been slowly decreasing but have remained statistically similar at "Near" stations since 1994 (Figure 4-10). This may indicate that there is still a source to these "Near" stations, possibly the nearby CSOs or these stations are located in depositional areas resulting in sediment focusing of more contaminated sediments (Stolzenbach and Adams, 1998).

Temporal trends are difficult to discern statistically for a number of parameters, such as percent fines, even when the average values and the graphical presentation seems to illustrate the change (Figure 4-7). While ANOVA analyses (Appendix C) show that some stations have experienced significant increases of percent fines over time, statistical comparison among the sampling years did not show consistent temporal trends (i.e., within a group as a whole; Table 4-6). With the exception of the change from 1990 to 1994, the temporal changes in percent fines (and several other parameters) appear to be station specific. For example, fines were significantly lower ($p<0.05$) at Station DB10 in 1998 compared to 1994 and 2002 (Figure 3-1, Table B-1, Table C-1). The significant decrease in percent fines in 1998 could be a result of the large storm event that occurred in June of that year, possibly from scouring the area at the mouth of the Neponset River. The percent fines returned to previously measured levels in 2002; however, the two CSO outfalls in the Neponset River upstream from Station DB10 were both closed as of 2000, suggesting that the higher TOC and percent fines values observed in 2002 may have been caused by an alternate source, such as the storm drain or other sources upstream in the Neponset River.

4.3 CSO Outfall Discharge and Potential Impacts on Sediment Quality

As discussed above, impacts to sediment quality are variable and cannot necessarily be attributed solely to CSOs. Few parameters showed statistically significant temporal trends in 2006, though slightly more parameters show a significant temporal decrease over all sampling years at "Near" stations compared to "Far" stations. Most contaminants showed variable, but generally decreasing, concentrations from 1990 to 2006. This was particularly the case for contaminants that can be confidently attributed to sewage and CSOs, such as *Clostridium*, silver, and DDT. However, a number of notable spikes in contaminant concentrations were observed in 1998, and one possible explanation given for these isolated increases was the significant rain event that occurred in June of 1998 (Lefkovitz *et al*., 2006). More recently, several major rainfall events occurred in the fall of 2005 and spring of 2006. The following sections discuss the estimated CSO flows in 2006 relative to precipitation and the possible impact precipitation has had on recent sediment quality related to proximity of CSOs.

4.3.1 Summary of CSO Estimated Discharges and Annual Precipitation from 1990 to 2006

CSO discharge is a combination of storm water runoff and sanitary sewage overflow. The amount of flow from individual CSOs is related to a number of factors including drainage area, the amount of in-system storage available, the amount and intensity of precipitation, temperature, the background flow through the sewerage system, the state of the tide and Deer Island Treatment Plant capacity.

Modeled CSO flow data are presented in Figure 4-11. The model includes precipitation, temperature and tides; the estimates are upgraded to include infrastructure changes in the collection system, as sewer separation and other improvements come online. Table 4-10 shows the estimated flows by CSO from 1990 through 2006. As of the 2006 sampling event, only two CSO outfalls in the vicinity of the study area had been closed; BOS-93 and BOS-95 were closed entirely as of February 1998 and June 2000, respectively (Table 1-1and 1-2). However, the South Dorchester Bay Sewer Separation project, which involves CSOs BOS-88, BOS-89, and BOS-90, was near completion at the time of the 2006 sampling, and BOS-88 was plugged in 2003.

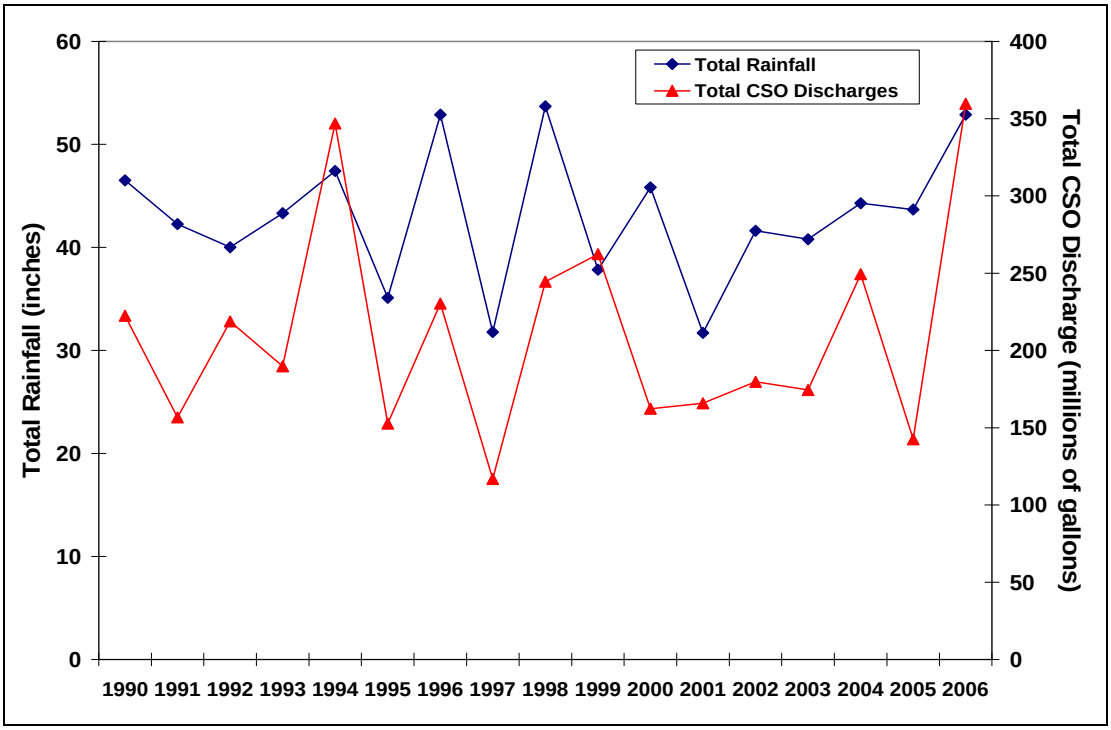


Figure 4-11. Total Annual Rainfall and Modeled Total Annual Discharges from CSOs*, 1990−2006

*The CSO outfalls included in these totals are BOS-81 through BOS-90, BOS-93, and BOS-95 (see Figure 1-1); total CSO Discharge is an estimated value based on modeled discharge amounts.

Table 4-10. Modeled Discharge Amounts (Mgal) and Rainfall for Dorchester Bay CSOs 1990−2006

Year	North Dorchester Bay							South Dorchester Bay			Neponset River		Total CSO Flow	Total Annual Rainfall
	BOS-81	BOS-82	BOS-83	BOS-84	BOS-85	BOS-86	BOS-87	BOS-88	BOS-89	BOS-90	BOS-93	BOS-95	(Mgal)	(inches)
1990	2.6	5.7	1.1	5	1.2	12.6	7.2	5.7	91.7	86.2	3.5		222.5	46.5
1991	2.4	5.5	0.7	4.8	0.1	5.6	0.3	2.7	52.8	78.2	3.5		156.6	42.25
1992	2.4	5.4	0.9	4.7	0.3	66.9	0.7	3.5	52.2	77.6	4.2		218.8	40.02
1993	0.6	3.5	0.4	2.6	0	91.5	1.5	4.5	36	46.8	2.3		189.7	43.31
1994	0.2	5.7	0.8	3	0.3	250	3.6	6.1	43.2	30.7	3.2		346.8	47.42
1995	0.1	3.5	0.6	1.8	0.1	93.6	2.3	3.2	26.7	18.5	2.3		152.7	35.1
1996	0.1	6.4	0.8	3.4	0	129	3.8	5.5	46.9	31.1	3.6		230.3	52.88
1997	0	1.5	0.2	0.8	0	88.2	0.9	1.4	13.5	9.6	0.8	No	116.9	31.77
1998	0.4	8	1.3	4.3	0.6	113	5.7	13.4	54.3	43.8	closed	Data	244.5	53.69
1999	0.5	5.5	1.1	3	0.4	177	3.8	4.6	38.7	27.6	closed	0.1	262.2	37.84
2000	3.44	5.92	1.86	1.76	0.18	3.13	0.59	0	65.5	79.1	closed	0.72	162.26	45.83
2001	3.24	6.34	2.09	3.34	1.31	5.38	1.78	0	30.7	112	closed	closed	165.84	31.71
2002	1.24	1.62	0.5	0.25	0	0.02	0.07	0	78.9	97	closed	closed	179.64	41.62
2003	2.29	3.71	1.2	1.49	0.41	1.44	closed	closed	73.2	90.8	closed	closed	174.44	40.78
2004	2.66	5.18	2.23	3.03	0.07	1.92	closed	closed	90.2	144	closed	closed	249.33	44.29
2005[a]	1.72	3.71	1.55	2.82	1.1	1.97	closed	closed	67.7	62.1	closed	closed	142.57	43.68
2006	3.01	5.63	2.01	3.66	1.34	6.17	closed	closed	155	182	closed	closed	359.63	52.89

Infrastructure changes affecting the CSO discharge in the study area have coincided with improvements at Deer Island and highly variable patterns of precipitation. Annual rainfall fluctuated widely from 1994 to 2002, after which it remained fairly stable through 2005 (Figure 4-11 and Table 4-10). There were three significant storms in 2005 during April through June, and unusually wet conditions in October 2005 caused extreme run-off during that time (Libby et al. 2006b). In 2006, annual rainfall was the highest ever measured (52.89 inches), due largely to a very wet May and June, when 12.5 inches and 10.1 inches of rain fell, respectively (Figure 4-12). This two month precipitation total was a record for any two consecutive months in Boston. The previous May-June combination record was set May-June 1998, when 18.42 inches accumulated (National Weather Service, 2006, provided by MWRA).

Modeled CSO discharges in 2006 in Dorchester Bay were the highest ever estimated (~360 million gallons), more than twice the 2005 level (~143 million gallons) (Table 4-10; Figures 4-11, 4-13, and 4-14). The discharge volumes from individual CSOs in North Dorchester Bay were generally similar (i.e., under 10 million gallons annually) and fairly constant from 1990 to 2006, with the exception of BOS-86 which exhibited a marked increase in discharge volumes in 1992 and then had a marked decrease in discharge volume in 2000. The discharge volumes at two of the South Dorchester Bay CSOs (BOS-89 and BOS-90) were generally higher than in those in North Dorchester Bay. Discharges at these CSOs have decreased steadily from 1990 to 1997, and then increased steadily from 1997 through 2006 (Figure 4-14). During the period when sewer separation projects were ongoing in South Dorchester (1999−2007), the amount of stormwater, carried in separated storm sewers, directed to the Fox and Commercial Point facilities gradually increased. This stormwater had previously been transported to Deer Island treatment plant in combined sewers. In 2002, CSO treatment facilities for BOS-88 and BOS-89 (Fox Point) and BOS-90 (Commercial Point) were upgraded. Therefore, after 2002, a majority of the CSO discharge to Dorchester Bay (North and South) received enhanced treatment with improved screening, chlorine disinfection, and dechlorination. The Fox Point and Commercial Point CSO treatment facilities are gravity CSO facilities, meaning that combined wastewater arrives and leaves the CSO facility by gravity instead of pumping. The disinfected wastewater overflows to the receiving water as quickly as it arrives at the facility.

Although total rainfall is correlated with total CSO discharges (Figure 4-11), the intensity of the rainfall and frequency of storms can have an important effect on the activation of CSOs. During periods of sustained precipitation, the ground can become saturated, increasing the amount of storm water runoff entering the sewer system and the amount of flow treated at the CSO facilities during a storm. When the volume of storm water flow entering the combined sewer system exceeds the system's capacity, the excess is discharged untreated into the receiving waters. Figure 4-15 shows the activation frequency, or the number of times per year, that each CSO overflowed (in the model). CSO activations in North Dorchester Bay peaked in 1998 and 1999, and then decreased sharply through 2002. In South Dorchester Bay, CSO activations also peaked in 1998, followed by a sharp decrease through 2001. The number of CSO activations throughout Dorchester Bay has remained fairly stable since 2002, even though total precipitation amounts have increased steadily since 2001. Therefore, the number of CSO activations has decreased in recent years, even during years with large increases in rainfall and CSO discharge volume. With the completion of the sewer separation project in South Dorchester Bay in 2007, combined sewer discharges, and consequently, CSO activations, were eliminated, and only storm water discharges will remain.

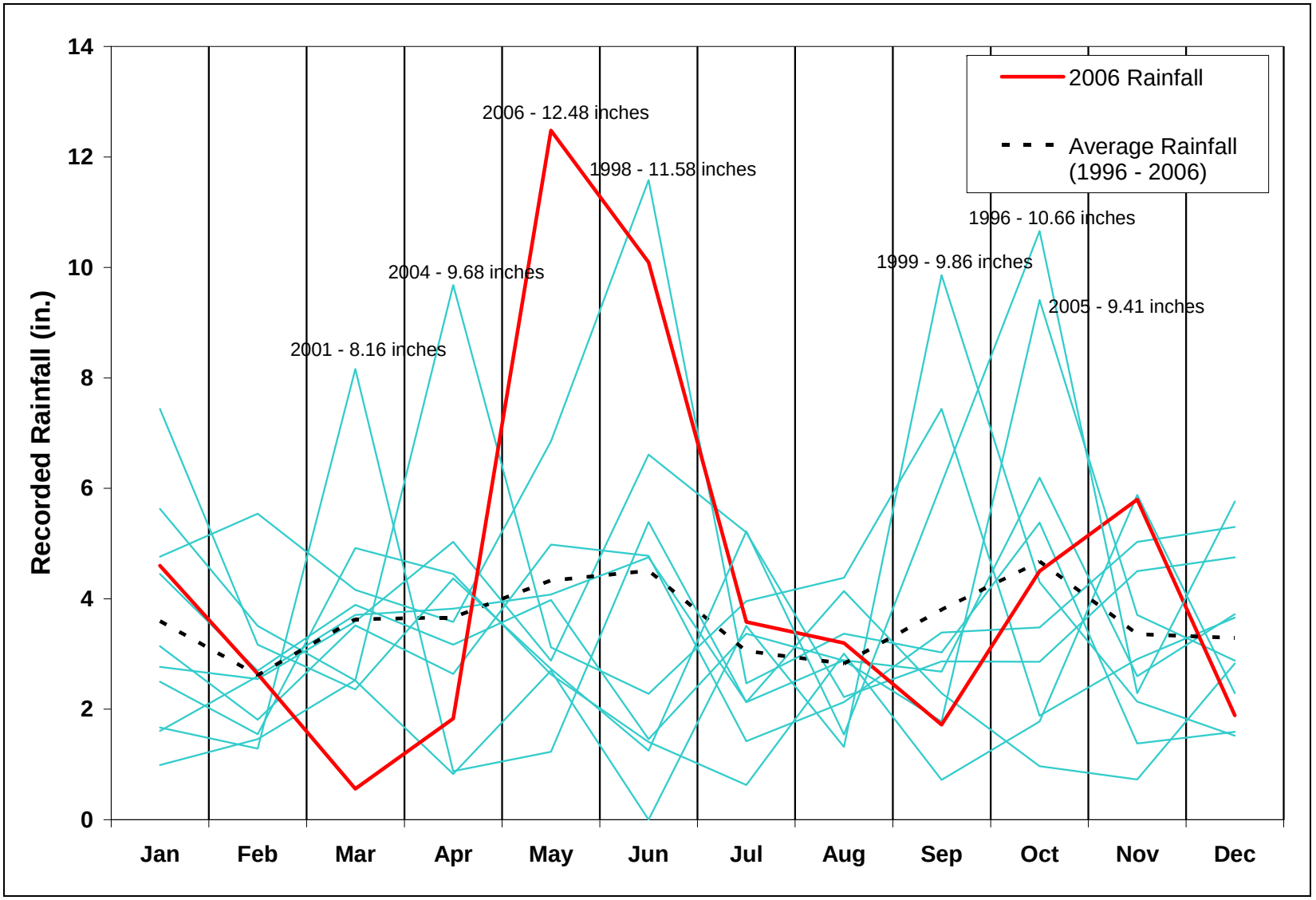


Figure 4-12. Monthly Recorded Rainfall Amounts and Average Rainfall Amount, 1996–2006

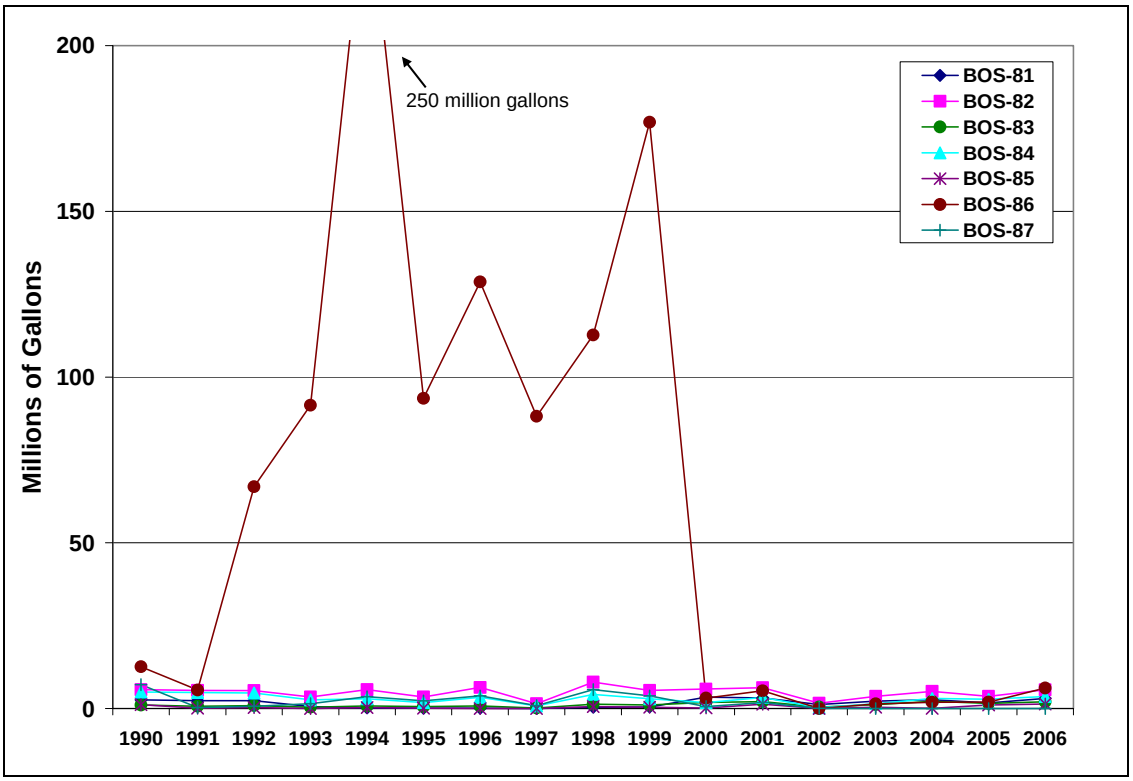


Figure 4-13. North Dorchester Bay CSO Discharges by Outfall

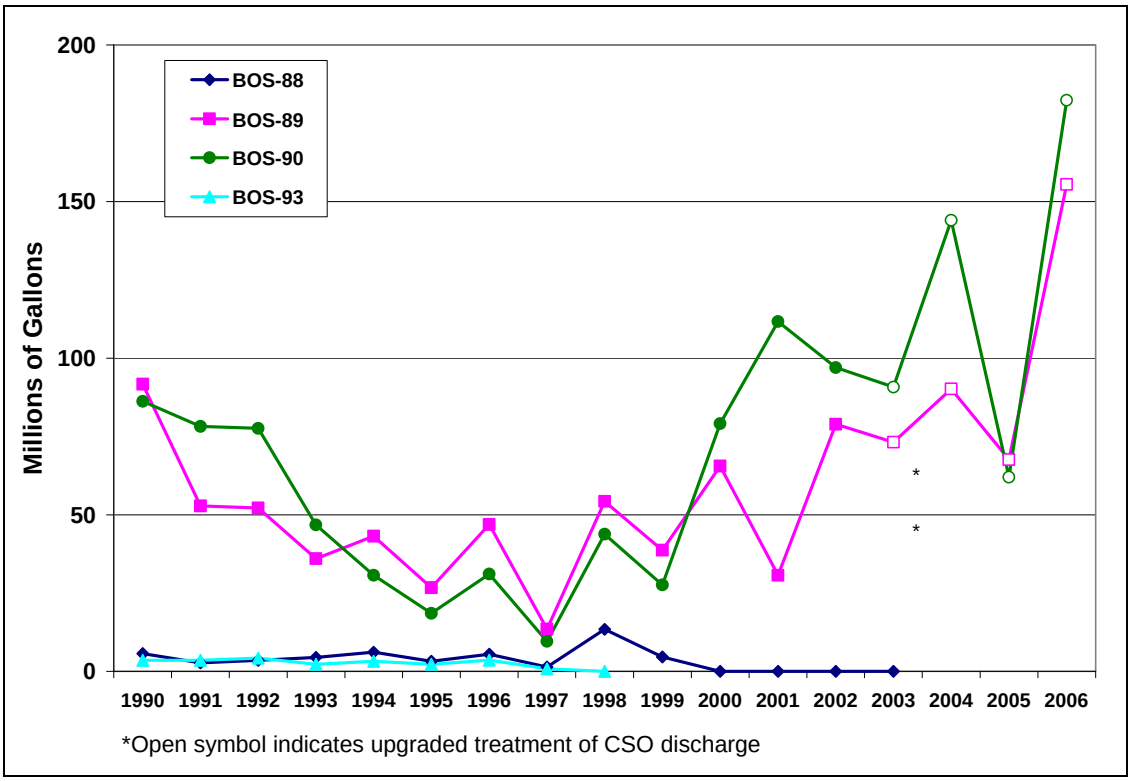


Figure 4-14. South Dorchester Bay CSO Discharges by Outfall

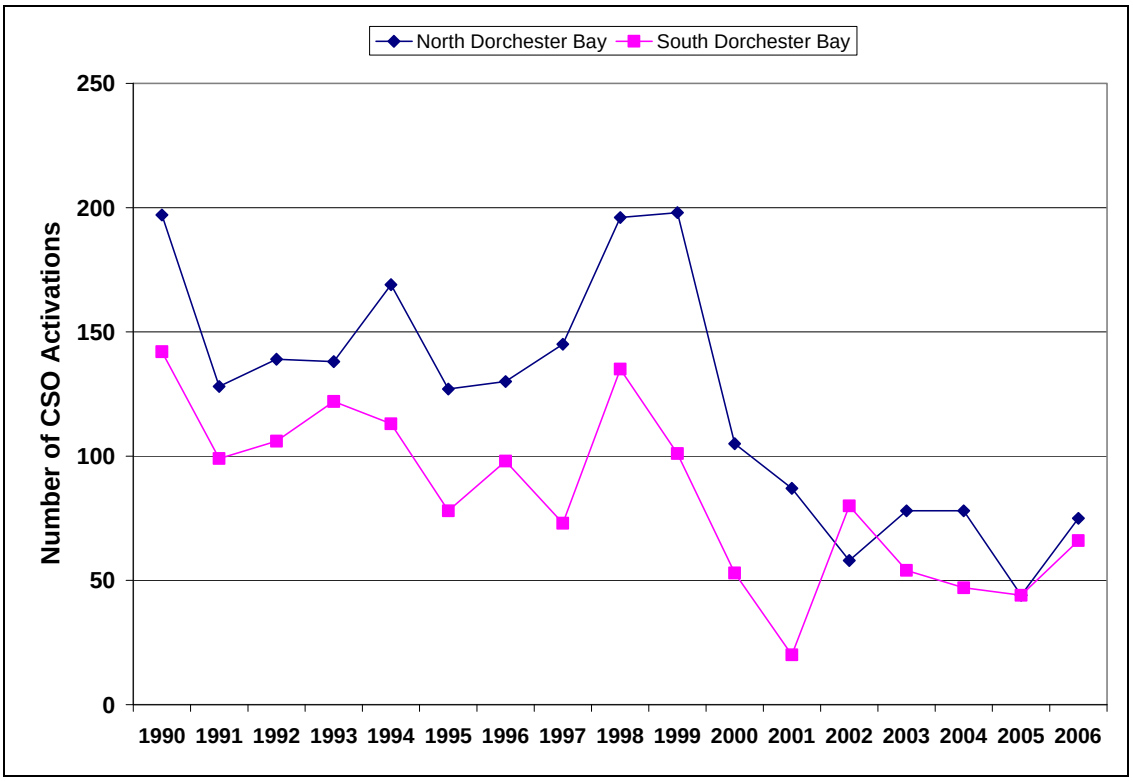


Figure 4-15. Modeled CSO Activations in North and South Dorchester Bay from 1990 to 2006

*The CSO outfalls included are BOS-81 - BOS-90 (Figure 1-1); total CSO activations are an estimated value based on the model.

4.3.2 Effect of Precipitation on Sediment Quality

As discussed above, record rainfall in May/June 2006, and prior to that in June 1998, resulted in an increase in CSO flow into Boston Harbor and may need to be considered when evaluating the contaminant results for samples collected in August 2006 (and 1998). Figure 4-16 shows the relationship between annual modeled CSO discharge and annual precipitation. There is a positive correlation between the two parameters, and as mentioned earlier, 2006 was a year marked by both high annual precipitation and high total CSO discharge. However, CSO activations have remained fairly stable since 2002, likely reducing the impact of the increased precipitation in 2005 and 2006 on sediment quality near the CSO outfalls.

The CSO discharge amounts at CSOs BOS-89 (adjacent to Station T04) and BOS-90 (adjacent to Station DB14) both appear to have been impacted by this extended period of high precipitation and the increase in stormwater flow resulting from sewer separation projects mentioned in Section 4.3.1, as they were the highest ever modeled in 2006 (Table 4-10). Temporal trends at the two "Near" stations closest to these CSOs (T04 and DB14) show that even with major precipitation events in May and June of 2006, concentrations of most contaminants at these stations were not significantly elevated in 2006 compared to previous years. The spike in concentration observed for some parameters (TOC, PAH, Hg, Pb, and Zn) in 1998, which was hypothesized as being due to a major rainfall event in June 1998, were not observed for most of these parameters in 2006. Concentrations at T04 and DB14 in 2006 were lower than 1998 concentrations and statistically similar to 2002 concentrations for most metal and organic contaminants and *Clostridium perfringens*. The exception was Total PAH at DB14, and HMW PAH at DB14 and T04, where concentrations in 2006 were statistically similar to maximum values measured in 1998. PAHs are a contaminant typically associated with storm water runoff, and the increase in PAHs in sediments near CSO outfalls is likely due to the increased precipitation in 2006.

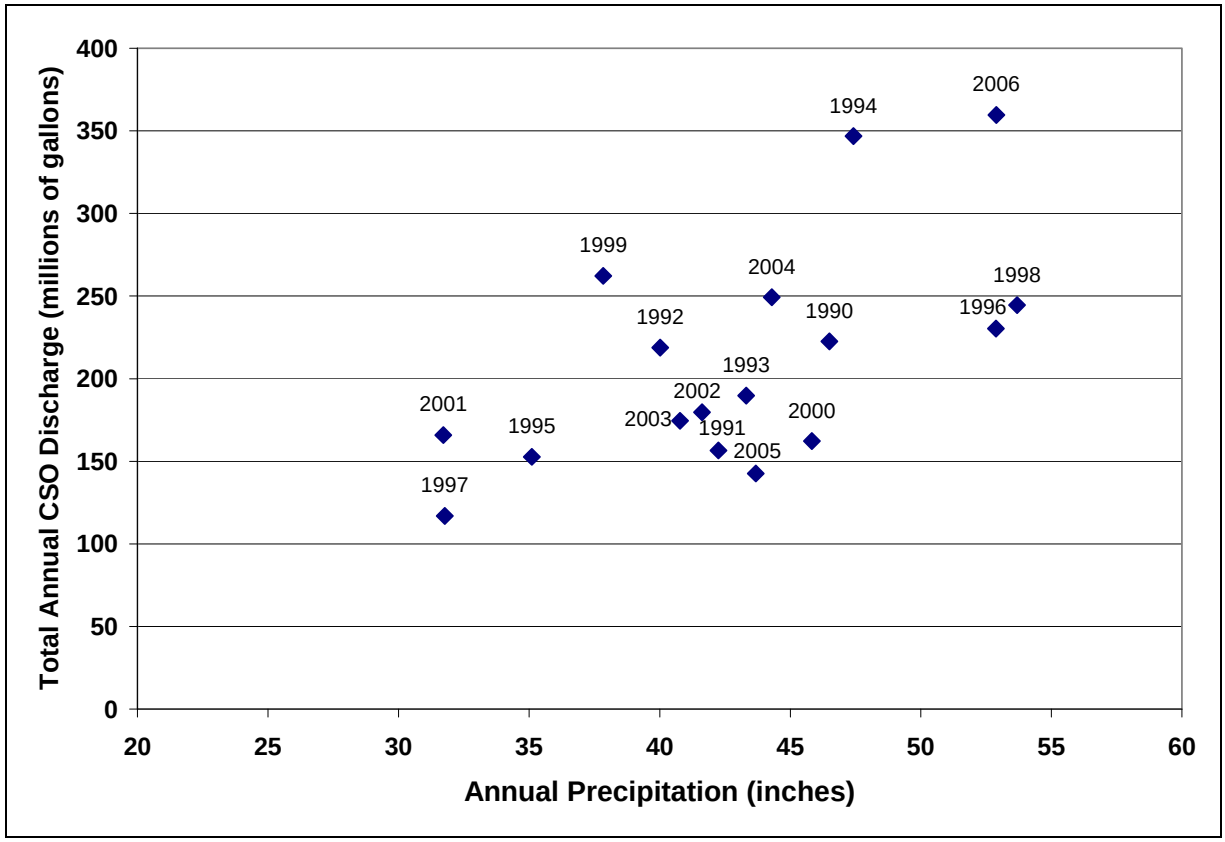


Figure 4-16. Relationship Between Modeled CSO Discharge and Annual Precipitation

While Station DB10 is not in direct proximity to a CSO, it is adjacent to a large storm drain and is in the mouth of the Neponset River, and downstream of CSOs; the flow of the River was likely impacted by the significant precipitation of May/June 2006. Total PAH (Figure 4-17), LMW PAH, and HMW PAH concentrations in 2006 were statistically similar to peak 1998 concentrations. In addition, HMW PAH concentrations in 2006 and 1998 were statistically significantly higher than the other years tested (1990, 1994, and 2002). Concentrations of some other organic contaminants at DB10 in 2006, such as PCBs (Figure 4-18) and Chlordanes were higher, and in some cases statistically significantly higher, than in previous years. These observations indicate that inputs such as storm drains can have significant localized impacts to sediment quality.

Another interesting observation is the change in PAH pattern at two "Near" Stations (T04 and DB14) in 1998. As discussed above, the amount of Total PAH at both of these "Near" stations, as well as at Station DB10, increased significantly in 1998 (Figure 4-17), most likely attributed to the rain event in June of that year. In addition, the types of PAH compounds at "Near" Stations T04 and DB14 also changed in 1998. Figure 4-19 shows the decrease of pyrogenic PAHs in 1998 at stations T04 relative to previous years, including 1997. This decrease in percent pyrogenic PAHs was also observed at Station DB14. However, a similar change in PAH composition was not observed at Station DB10. The change in percent pyrogenic PAHs at T04 and DB14 (i.e., slight increase in petrogenic PAH) is most likely due to the composition of the effluent from the nearby CSOs, possibly contributed by an increased run-off from nearby industrial areas due to the storm event.

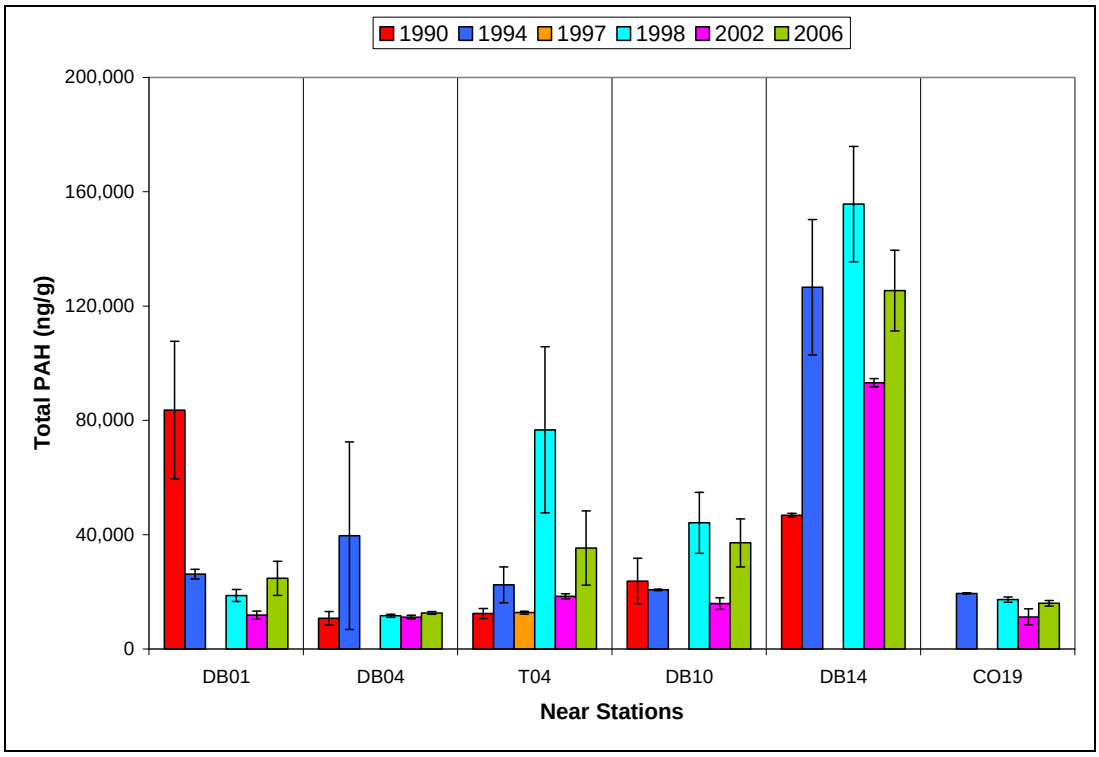


Figure 4-17. Total PAH Concentrations at "Near" Stations for 1990, 1994, 1997, 1998, 2002, and 2006

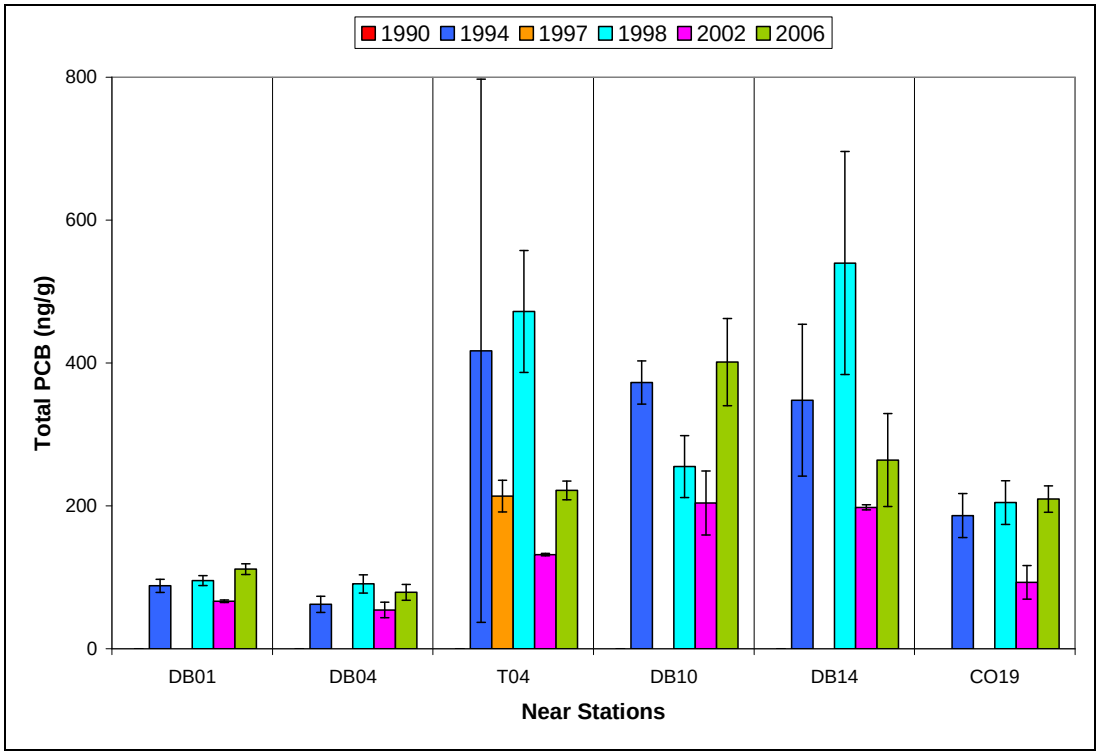


Figure 4-18. PCB Concentrations at "Near" Stations for 1990, 1994, 1997, 1998, 2002, and 2006

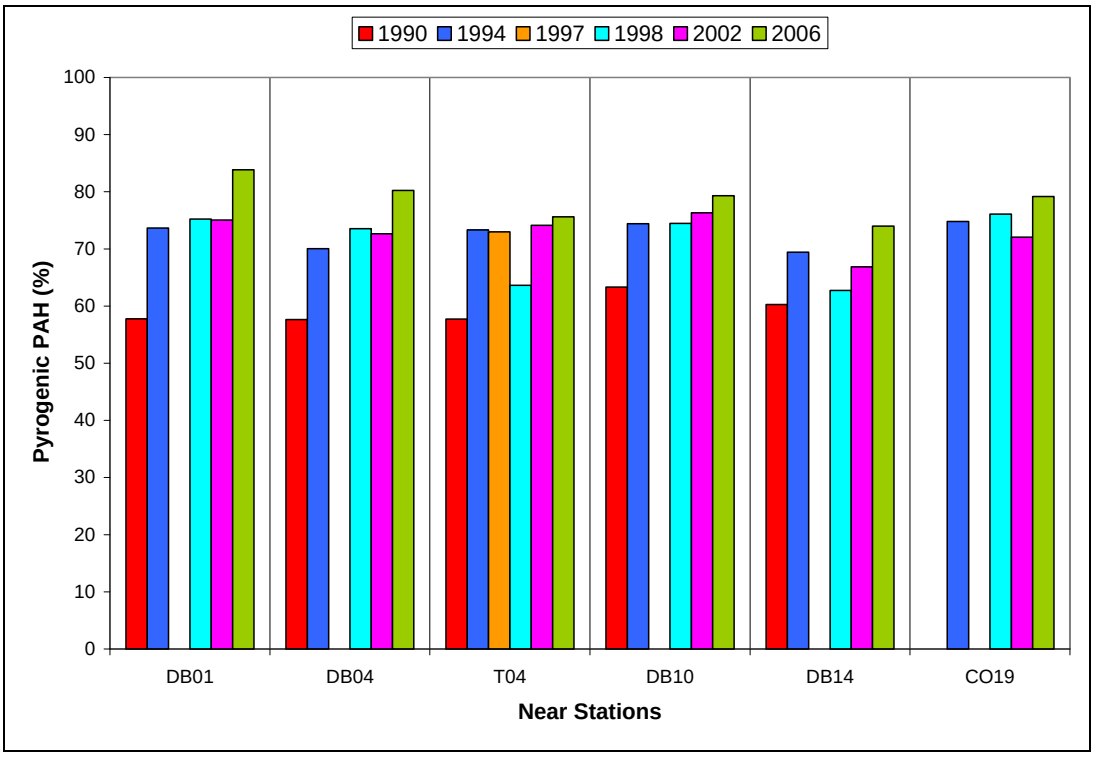


Figure 4-19. Percent Pyrogenic PAHs of Total PAHs at "Near" Stations for 1990, 1994, 1997, 1998, 2002, and 2006

The fact that total PAH increased significantly at Station DB10, which is not near a CSO but is near a large storm drain, with no similar change in PAH pattern as at T04 and DB14 indicates that while the total increase in PAHs is still likely due to the increased runoff as a result of the June 1998 storm, the source of the PAHs to the sediments at Station DB10 is different than the source of the increased PAHs at the other two stations. Pyrogenic PAH from PAH depositions and streets may have contributed more to the PAH at DB10, for instance.

The relative percent pyrogenic PAHs at the two "Near" stations returned to previously measured values in 2002 indicating the temporary extent of the impact (Figure 4-19). The PAH concentrations and the ratio of PAHs at the other "Near" and "Far" stations were similar in 1998 to previous years, indicating that the impacts observed in the sediments were isolated to nearshore stations, particularly those near to specific CSOs or possibly large storm drains. It may be that the other "Near" stations (DB01, DB04, and CO19) did not experience a similar increase in PAH concentrations because the outfalls in the vicinity of these stations did not experience a dramatic increase in discharges following the 1998 event, unlike the CSO adjacent to T04 and DB14.

4.3.3 Effect of CSO Improvements on Sediment Quality

The contamination of Boston Harbor and Dorchester Bay sediment has declining since the early 1990s. In general, the Harbor-wide reductions in the concentrations of the sewage tracer *Clostridium perfringens,* and in most metals and organic contaminants throughout the Harbor and Dorchester Bay, are likely due, in large part, to the cessation of sludge disposal in Boston Harbor, improvements made to sewage treatment at the Deer Island treatment plant, and the relocation of the outfall into Massachusetts Bay.

In addition, CSO improvement projects, such as sewer separation and upgraded CSO treatment at individual CSOs in South Dorchester Bay, have most likely accelerated the sediment quality improvement in Dorchester Bay. The CSO improvements may have prevented possible large increases in some contaminants in 2006, despite major precipitation events in October 2005 and May/June 2006. In 1998, spikes in TOC, PAH, Hg, Pb, and Zn concentrations at Station T04, and in some cases at Station DB14, were hypothesized to be due to a significant rain event that occurred in June of 1998 (Lefkovitz *et al.*, 2006). A similar impact on sediment quality, except for PAHs, was not observed in 2006, even though total discharges from CSOs in Dorchester Bay were the highest in recent years. Also notable is that although CSO flows and discharge volumes increased during the recent high rainfall periods, the overall CSO activations are declining; CSO discharge is occurring less frequently and at fewer locations.

5.0 CONCLUSIONS

The purpose of the 2006 CSO Sediment Study was to determine if there have been changes over time to the sediment quality in the Boston Harbor study area and whether the changes (if any) could be attributed to CSO outfalls in the area. Of particular interest were the changes in sediment contaminant concentrations related to the ongoing improvements to the CSO system in the study area. Overall, contaminant concentrations in sediments both near and far from CSOs have shown a general decline since the early 1990s, but few statistically significant decreases in concentrations have been observed in the most recent surveys (2002 and 2006) compared to recent years. There appears to be a continuation of a trend of sediment quality improvement for several contaminants, but the rate of improvement is declining and few contaminants are significantly lower in 2006 compared to 2002. The concentrations of chromium, copper, lead, mercury, nickel, and zinc were significantly lower in 2006 than in 2002 at some stations (e.g., C019). However, more contaminant concentrations were similar in 2002 and 2006, and lower in either (or both) of those years compared to the 1990's (e.g., PAH, PCB, DDT, chlordane, cadmium, chromium, copper, lead, mercury, nickel, silver, and zinc, at one or several stations).

Sediment quality impacts resulting from CSO improvements are difficult to discern, particularly because many aspects of the CSO improvement program are an ongoing process, have been partially implemented over time, or had not been fully implemented at the time of sampling. The general depositional nature of the Dorchester Bay area, which may collect contaminants from other parts of the Harbor is also complex, is difficult to accurately incorporate and can confounds the data interpretation. In addition, sediment quality impacts from CSOs can be both short- and long-term and quite localized, as evidenced by the spike in some parameters (PAHs, PCBs, Coprostanol for example) in 1998 relative to measurements made the prior sampling year, and the subsequent decrease to previously measured concentrations in 2002. Some, although few, elevated contaminant signals were also observed in response to the high flow during the summer of 2006. At the time of the 2006 sampling event, five CSO outfalls in the vicinity of the study area had been closed (BOS-87, BOS-88, BOS-89, BOS-93 and BOS-95), and facility upgrades had also occurred at the Fox Point and Commercial Point CSO treatment facilities. The overall annual amount of overflow discharged into Boston Harbor decreased considerably between 1999 and 2000 and then appeared to level off, due to a combination of meteorological events and the diversion/consolidation of flow between and among outfalls and from the increased discharge capacity added to the system by the Deer Island Treatment Facility and the diversion of the outfall to Massachusetts Bay. Although CSO flows increased in 2004 and 2006, primarily due to more rainfall, the number of CSO activations has continued to decline, resulting in more effective management of the CSO/SWO, including a lower contaminant loading.

The overall general decrease in contaminant concentrations observed since 1990 may be partly an indication of a Harbor-wide reduction in contaminant sources, rather than a CSO-related decrease only, and may partly be attributable to wastewater treatment upgrades (removal of sludge, implementation of secondary treatment, and the relocation of the Deer Harbor outfall to Massachusetts Bay in 2000). Much of the initial decreases in chlordane, DDT, and PCB for example, are most likely attributed to regulatory control of these compounds (i.e. banning of DDT and regulation of PCBs in 1970's). However, some of the observed declines in the Dorchester Bay sediment contamination (e.g., *Clostridium*, DDT, and various metals such as cadmium, copper, silver, and mercury) can most likely be attributed to the CSO Program. *Clostridium* and silver are clear indicators of sewage sources. The significant declines in the concentration of these contaminants in sediment near CSOs clearly demonstrate improvements that can be attributed to CSO management actions. Other subtle impacts to sediment quality at several "Near" stations were increases in the PAH concentrations at several stations in 2006, likely attributable to storm events in the summer of 2006 and associated runoff and high flow in the Neponset River from selected CSOs.

The data clearly demonstrate that the CSO Control Plan is having a positive long-term impact on the sediment quality of Dorchester Bay and the Inner Harbor. As CSO improvements continue, the results presented in this report will be useful in combination with future results so that temporal trends can be identified and causal connections between sediment quality and CSO system improvements can be definitively drawn. Optimization of the study sampling design may also aid in drawing direct links to CSO improvements, as additional CSO improvements projects are completed and the long-term monitoring plans are being considered. Changes to the sampling design and sampling frequency, including a design that potentially includes targeted sampling following individual storms, or other modifications may allow for more direct comparisons between CSO discharge and sediment quality. In addition, incorporating Deer Island Treatment Plant influent data as a surrogate for CSO discharge data during storm event, may allow for effectively estimating CSO loadings.

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Appendix A

2006 Data, Individual Replicates, Means, and Standard Deviations

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Table A-1. Grain-size, TOC and Clostridium Data for 2006

		% Fines	TOC	CLOSTRIDIUM	LOG 10 CLOSTRIDIUM
Station	Sample_ID	PCT	PCT	#/GDW	Log #/GDW
DB01	HT0610C0	92.96	2.87	3454.41	3.54
DB01	HT0610C1	92.94	2.76	3880.88	3.59
DB01	HT0610C2	87.96	2.44	2689.16	3.43
	Mean	91.29	2.69	3341.48	3.52
	STD	2.88	0.22	603.83	0.08
DB04	HT0610B4	93.27	2.64	3349.14	3.52
DB04	HT0610B7	92.06	2.25	1395.33	3.14
DB04	HT0610B8	89.16	2.35	3083.33	3.49
	Mean	91.50	2.41	2609.27	3.39
	STD	2.11	0.20	1059.67	0.21
T04(/DB13)	HT06106E	97.22	3.65	3462.69	3.54
T04(/DB13)	HT06106F	95.88	4.02	2707.89	3.43
T04(/DB13)	HT061070	93.71	3.84	3843.14	3.58
	Mean	95.60	3.84	3337.91	3.52
	STD	1.77	0.19	577.82	0.08
DB10	HT06105C	96.82	5.27	6675.86	3.82
DB10	HT061061	55.97	2.96	4283.08	3.63
DB10	HT061063	96.44	4.69	7446.08	3.87
	Mean	83.08	4.31	6135.01	3.78
	STD	23.48	1.20	1649.40	0.13
DB14	HT061067	72.35	6.07	1461.15	3.16
DB14	HT061068	44.71	3.21	1984.22	3.30
DB14	HT061069	76.83	5.68	10350.88	4.01
	Mean	64.63	4.99	4598.75	3.49
	STD	17.40	1.55	4988.35	0.46
C019	HT06103B	96.88	2.97	18857.14	4.28
C019	HT061041	97.53	3.00	17040.94	4.23
C019	HT061046	98.41	3.62	15982.97	4.20
	Mean	97.61	3.20	17293.68	4.24
	STD	0.77	0.37	1453.66	0.04
DB03	HT061083	54.42	1.67	2793.65	3.45
DB03	HT061084	18.89	0.60	949.03	2.98
DB03	HT061085	42.52	1.33	3364.49	3.53
	Mean	38.61	1.20	2369.06	3.32
	STD	18.08	0.55	1262.46	0.30
DB06	HT0610C8	6.71	0.25	324.38	2.51
DB06	HT0610C9	7.77	0.25	252.62	2.40
DB06	HT0610CA	7.96	0.26	400.00	2.60
	Mean	7.48	0.25	325.67	2.51
	STD	0.67	0.01	73.70	0.10
DB12	HT06107A	83.76	3.36	5388.49	3.73
DB12	HT06107B	79.03	2.29	2780.54	3.44
DB12	HT06107D	69.22	1.21	3226.09	3.51
	Mean	77.34	2.29	3798.37	3.56
	STD	7.42	1.08	1394.98	0.15

Table A-1. Grain-size, TOC and Clostridium Data for 2006 (cont'd)

		% Fines	TOC	CLOSTRIDIUM	LOG 10 CLOSTRIDIUM
Station	Sample_ID	PCT	PCT	#/GDW	Log #/GDW
SWEX3	HT061089	45.83	1.34	4303.03	3.63
SWEX3	HT06108A	56.20	0.85	2306.55	3.36
SWEX3	HT06108B	53.33	1.70	2385.28	3.38
	Mean	51.79	1.30	2998.29	3.46
	STD	5.35	0.42	1130.63	0.15
T01	HT0610AA	47.35	0.90	1450.67	3.16
T01	HT0610AB	32.18	0.70	468.75	2.67
T01	HT0610AF	44.76	1.47	1383.00	3.14
	Mean	41.43	1.02	1100.81	2.99
	STD	8.11	0.40	548.42	0.28
T02	HT06102E	80.58	1.94	4430.77	3.65
T02	HT061030	85.51	2.02	5297.78	3.72
T02	HT061032	85.39	2.02	4764.44	3.68
	Mean	83.83	1.99	4831.00	3.68
	STD	2.81	0.05	437.32	0.04
T03	HT061090	52.40	1.54	1616.35	3.21
T03	HT061096	56.45	3.10	2360.16	3.37
T03	HT061097	63.08	1.79	2118.58	3.33
	Mean	57.31	2.14	2031.70	3.30
	STD	5.39	0.84	379.44	0.08
T05A	HT06109D	31.95	0.59	399.56	2.60
T05A	HT06109E	21.45	0.46	190.66	2.28
T05A	HT0610A1	32.25	0.41	130.66	2.12
	Mean	28.55	0.49	240.29	2.33
	STD	6.15	0.09	141.15	0.25
T06	HT061019	56.76	1.81	625.00	2.80
T06	HT06101C	54.83	1.83	1508.06	3.18
T06	HT061020	62.44	1.76	1543.38	3.19
	Mean	58.01	1.80	1225.48	3.05
	STD	3.95	0.04	520.33	0.22
T07	HT061026	82.76	2.49	2588.82	3.41
T07	HT061027	77.15	2.55	7250.00	3.86
T07	HT061029	81.93	2.21	5507.03	3.74
	Mean	80.61	2.42	5115.28	3.67
	STD	3.03	0.18	2355.15	0.23
T08	HT06100D	7.26	0.53	724.57	2.86
T08	HT061011	6.36	0.32	282.28	2.45
T08	HT061013	5.41	0.24	234.85	2.37
	Mean	6.34	0.36	413.90	2.56
	STD	0.93	0.15	270.09	0.26

Table A-2. Metals Data for 2006.

	Station:	DB01	DB01	DB01	DB01	DB01
	Sample:	HT0610C0	HT0610C1	HT0610C2	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.66	0.69	0.68	0.67	0.01
Chromium	ug/g	128.00	128.00	107.00	121.00	12.12
Copper	ug/g	107.00	107.00	103.00	105.67	2.31
Lead	ug/g	164.00	162.00	175.00	167.00	7.00
Mercury	ug/g	0.56	0.45	0.41	0.47	0.08
Nickel	ug/g	29.00	29.60	27.30	28.63	1.19
Silver	ug/g	2.01	2.01	1.55	1.86	0.27
Zinc	ug/g	265.00	262.00	286.00	271.00	13.08
Aluminum	PCTDRYWT	8.29	7.61	7.36	7.75	0.48
Iron	PCTDRYWT	3.82	3.67	3.38	3.62	0.22
	Station:	DB04	DB04	DB04	DB04	DB04
	Sample:	HT0610B4	HT0610B7	HT0610B8	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.49	0.45	0.42	0.46	0.03
Chromium	ug/g	154.00	120.00	139.00	137.67	17.04
Copper	ug/g	94.30	75.00	81.80	83.70	9.79
Lead	ug/g	130.00	220.00	113.00	154.33	57.50
Mercury	ug/g	0.60	0.42	0.89	0.63	0.24
Nickel	ug/g	34.50	28.40	30.40	31.10	3.11
Silver	ug/g	2.39	1.79	2.15	2.11	0.30
Zinc	ug/g	203.00	162.00	178.00	181.00	20.66
Aluminum	PCTDRYWT	9.26	7.25	9.36	8.62	1.19
Iron	PCTDRYWT	4.25	3.59	3.47	3.77	0.42
	Station:	T04(/DB13)	T04(/DB13)	T04(/DB13)	T04(/DB13)	T04(/DB13)
	Sample:	HT06106E	HT06106F	HT061070	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	1.02	1.01	1.17	1.07	0.09
Chromium	ug/g	168.00	172.00	171.00	170.33	2.08
Copper	ug/g	116.00	122.00	136.00	124.67	10.26
Lead	ug/g	192.00	209.00	245.00	215.33	27.06
Mercury	ug/g	0.63	0.68	0.69	0.67	0.03
Nickel	ug/g	34.90	35.40	36.80	35.70	0.98
Silver	ug/g	2.90	2.82	3.17	2.96	0.18
Zinc	ug/g	274.00	286.00	310.00	290.00	18.33
Aluminum	PCTDRYWT	8.62	8.77	8.70	8.70	0.08
Iron	PCTDRYWT	4.32	4.36	4.62	4.43	0.16

Table A-2. Metals Data for 2006 (cont'd.)

	Station:	DB10	DB10	DB10	DB10	DB10
	Sample:	HT06105C	HT061061	HT061063	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	1.07	0.81	1.00	0.96	0.13
Chromium	ug/g	166.00	112.00	169.00	149.00	32.08
Copper	ug/g	140.00	214.00	168.00	174.00	37.36
Lead	ug/g	195.00	638.00	219.00	350.67	249.13
Mercury	ug/g	1.48	0.57	1.01	1.02	0.46
Nickel	ug/g	31.60	29.00	33.20	31.27	2.12
Silver	ug/g	2.72	1.65	2.45	2.27	0.56
Zinc	ug/g	282.00	366.00	286.00	311.33	47.38
Aluminum	PCTDRYWT	7.72	6.28	6.92	6.97	0.72
Iron	PCTDRYWT	4.47	4.26	4.22	4.32	0.13
	Station:	DB14	DB14	DB14	DB14	DB14
	Sample:	HT061067	HT061068	HT061069	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	1.28	0.74	1.07	1.03	0.27
Chromium	ug/g	134.00	69.80	114.00	105.93	32.85
Copper	ug/g	140.00	85.20	114.00	113.07	27.41
Lead	ug/g	358.00	195.00	317.00	290.00	84.79
Mercury	ug/g	0.64	0.34	0.63	0.54	0.17
Nickel	ug/g	29.20	16.30	24.40	23.30	6.52
Silver	ug/g	1.78	0.88	1.55	1.40	0.47
Zinc	ug/g	377.00	232.00	357.00	322.00	78.58
Aluminum	PCTDRYWT	6.20	3.76	4.73	4.90	1.23
Iron	PCTDRYWT	3.86	2.26	3.07	3.06	0.80
	Station:	C019	C019	C019	C019	C019
	Sample:	HT06103B	HT061041	HT061046	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.61	0.60	0.60	0.60	0.00
Chromium	ug/g	180.00	185.00	183.00	182.67	2.52
Copper	ug/g	109.00	110.00	108.00	109.00	1.00
Lead	ug/g	123.00	127.00	127.00	125.67	2.31
Mercury	ug/g	0.62	0.64	0.69	0.65	0.04
Nickel	ug/g	39.10	39.50	40.10	39.57	0.50
Silver	ug/g	2.73	2.86	2.74	2.78	0.07
Zinc	ug/g	202.00	200.00	198.00	200.00	2.00
Aluminum	PCTDRYWT	7.86	7.93	8.19	7.99	0.17
Iron	PCTDRYWT	4.37	4.65	4.64	4.55	0.16

Table A-2. Metals Data for 2006 (cont'd)

	Station:	DB03	DB03	DB03	DB03	DB03
	Sample:	HT061083	HT061084	HT061085	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.24	0.17	0.32	0.24	0.07
Chromium	ug/g	72.70	52.10	77.40	67.40	13.46
Copper	ug/g	33.50	21.00	36.70	30.40	8.30
Lead	ug/g	65.40	46.60	60.00	57.33	9.68
Mercury	ug/g	0.18	0.15	0.23	0.19	0.04
Nickel	ug/g	20.90	15.30	18.00	18.07	2.80
Silver	ug/g	0.74	0.56	1.02	0.77	0.23
Zinc	ug/g	101.00	80.10	95.00	92.03	10.76
Aluminum	PCTDRYWT	5.94	4.72	6.34	5.67	0.84
Iron	PCTDRYWT	2.51	1.94	2.49	2.31	0.32
	Station:	DB06	DB06	DB06	DB06	DB06
	Sample:	HT0610C8	HT0610C9	HT0610CA	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.07	0.08	0.07	0.07	0.00
Chromium	ug/g	32.00	33.50	34.30	33.27	1.17
Copper	ug/g	12.00	12.80	13.70	12.83	0.85
Lead	ug/g	32.60	32.00	34.50	33.03	1.31
Mercury	ug/g	0.07	0.07	0.08	0.08	0.00
Nickel	ug/g	9.54	8.25	8.83	8.87	0.65
Silver	ug/g	0.26	0.35	0.32	0.31	0.04
Zinc	ug/g	39.60	38.30	40.30	39.40	1.01
Aluminum	PCTDRYWT	5.73	3.94	3.85	4.51	1.06
Iron	PCTDRYWT	1.52	1.33	1.41	1.42	0.10
	Station:	DB12	DB12	DB12	DB12	DB12
	Sample:	HT06107A	HT06107B	HT06107D	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.58	0.36	0.28	0.41	0.16
Chromium	ug/g	184.00	130.00	77.10	130.37	53.45
Copper	ug/g	88.80	61.60	37.40	62.60	25.71
Lead	ug/g	130.00	90.30	57.90	92.73	36.11
Mercury	ug/g	0.51	0.43	0.26	0.40	0.12
Nickel	ug/g	37.70	25.90	16.30	26.63	10.72
Silver	ug/g	2.46	1.67	1.16	1.76	0.66
Zinc	ug/g	206.00	144.00	89.40	146.47	58.34
Aluminum	PCTDRYWT	10.20	6.56	4.00	6.92	3.12
Iron	PCTDRYWT	4.84	3.26	2.04	3.38	1.40

Table A-2. Metals Data for 2006 (cont'd)

	Station:	SWEX3	SWEX3	SWEX3	SWEX3	SWEX3
	Sample:	HT061089	HT06108A	HT06108B	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.27	0.16	0.28	0.24	0.07
Chromium	ug/g	102.00	69.20	122.00	97.73	26.66
Copper	ug/g	46.80	30.80	59.80	45.80	14.53
Lead	ug/g	55.50	46.70	77.40	59.87	15.81
Mercury	ug/g	0.47	0.21	0.39	0.35	0.13
Nickel	ug/g	21.90	16.30	30.40	22.87	7.10
Silver	ug/g	1.12	0.98	1.52	1.21	0.28
Zinc	ug/g	89.30	74.40	125.00	96.23	26.00
Aluminum	PCTDRYWT	5.92	4.28	8.48	6.23	2.12
Iron	PCTDRYWT	2.94	1.95	3.57	2.82	0.82
	Station:	**T01**	**T01**	**T01**	**T01**	**T01**
	Sample:	**HT0610AA**	**HT0610AB**	**HT0610AF**	**Mean**	**Stdev**
Not normalized	**UNITS**					
Cadmium	ug/g	0.19	0.16	0.17	0.17	0.02
Chromium	ug/g	82.50	62.70	74.20	73.13	9.94
Copper	ug/g	25.00	106.00	24.90	51.97	46.79
Lead	ug/g	46.20	32.40	42.10	40.23	7.09
Mercury	ug/g	0.15	0.09	0.13	0.12	0.03
Nickel	ug/g	17.30	15.70	15.90	16.30	0.87
Silver	ug/g	0.65	0.45	0.70	0.60	0.13
Zinc	ug/g	78.30	60.20	69.80	69.43	9.06
Aluminum	PCTDRYWT	6.44	6.25	6.71	6.47	0.23
Iron	PCTDRYWT	2.49	2.20	2.43	2.37	0.15
	Station:	**T02**	**T02**	**T02**	**T02**	**T02**
	Sample:	**HT06102E**	**HT061030**	**HT061032**	**Mean**	**Stdev**
Not normalized	**UNITS**					
Cadmium	ug/g	0.35	0.34	0.32	0.34	0.02
Chromium	ug/g	127.00	128.00	125.00	126.67	1.53
Copper	ug/g	46.60	49.00	47.40	47.67	1.22
Lead	ug/g	65.70	67.40	68.90	67.33	1.60
Mercury	ug/g	0.69	0.25	0.28	0.41	0.24
Nickel	ug/g	30.30	30.80	28.60	29.90	1.15
Silver	ug/g	1.31	1.25	1.19	1.25	0.06
Zinc	ug/g	121.00	124.00	121.00	122.00	1.73
Aluminum	PCTDRYWT	7.59	7.89	7.72	7.73	0.15
Iron	PCTDRYWT	3.46	3.51	3.50	3.49	0.03

Table A-2. Metals Data for 2006 (cont'd)

	Station:	T03	T03	T03	T03	T03
	Sample:	HT061090	HT061096	HT061097	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.31	0.62	0.32	0.41	0.18
Chromium	ug/g	128.00	140.00	143.00	137.00	7.94
Copper	ug/g	54.20	74.10	65.80	64.70	10.00
Lead	ug/g	88.30	102.00	93.70	94.67	6.90
Mercury	ug/g	2.56	0.73	0.48	1.26	1.14
Nickel	ug/g	28.60	29.10	29.70	29.13	0.55
Silver	ug/g	1.88	3.51	2.34	2.58	0.84
Zinc	ug/g	125.00	156.00	136.00	139.00	15.72
Aluminum	PCTDRYWT	7.84	7.89	6.90	7.54	0.56
Iron	PCTDRYWT	3.17	3.64	3.38	3.40	0.24
	Station:	T05A	T05A	T05A	T05A	T05A
	Sample:	HT06109D	HT06109E	HT0610A1	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.27	0.17	0.21	0.21	0.05
Chromium	ug/g	49.70	40.80	46.20	45.57	4.48
Copper	ug/g	14.80	12.00	14.60	13.80	1.56
Lead	ug/g	36.40	30.40	30.10	32.30	3.55
Mercury	ug/g	0.08	0.15	0.08	0.10	0.04
Nickel	ug/g	15.40	13.50	12.50	13.80	1.47
Silver	ug/g	0.32	0.23	0.46	0.34	0.12
Zinc	ug/g	60.90	52.60	59.00	57.50	4.35
Aluminum	PCTDRYWT	6.07	5.79	5.92	5.93	0.14
Iron	PCTDRYWT	2.13	2.04	2.01	2.06	0.06
	Station:	T06	T06	T06	T06	T06
	Sample:	HT061019	HT06101C	HT061020	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.28	0.30	0.27	0.28	0.02
Chromium	ug/g	96.60	101.00	109.00	102.20	6.29
Copper	ug/g	38.60	40.50	43.20	40.77	2.31
Lead	ug/g	107.00	71.60	68.20	82.27	21.49
Mercury	ug/g	0.37	0.33	0.39	0.36	0.03
Nickel	ug/g	24.10	25.20	27.30	25.53	1.63
Silver	ug/g	1.36	1.46	1.50	1.44	0.07
Zinc	ug/g	110.00	109.00	115.00	111.33	3.21
Aluminum	PCTDRYWT	6.37	6.90	6.78	6.68	0.28
Iron	PCTDRYWT	2.95	3.08	3.20	3.08	0.13

Table A-2. Metals Data for 2006 (cont'd.)

	Station:	T07	T07	T07	T07	T07
	Sample:	HT061026	HT061027	HT061029	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.41	0.50	0.47	0.46	0.05
Chromium	ug/g	147.00	147.00	147.00	147.00	0.00
Copper	ug/g	72.70	69.20	70.60	70.83	1.76
Lead	ug/g	111.00	106.00	104.00	107.00	3.61
Mercury	ug/g	0.71	0.87	0.72	0.77	0.09
Nickel	ug/g	29.60	28.70	30.00	29.43	0.67
Silver	ug/g	3.45	3.02	3.53	3.33	0.27
Zinc	ug/g	140.00	138.00	139.00	139.00	1.00
Aluminum	PCTDRYWT	7.01	6.62	7.05	6.89	0.24
Iron	PCTDRYWT	2.96	3.13	3.24	3.11	0.14
	Station:	T08	T08	T08	T08	T08
	Sample:	HT06100D	HT061011	HT061013	Mean	Stdev
Not normalized	**UNITS**					
Cadmium	ug/g	0.15	0.09	0.08	0.11	0.03
Chromium	ug/g	39.90	37.80	38.00	38.57	1.16
Copper	ug/g	11.40	9.20	8.80	9.80	1.40
Lead	ug/g	32.00	31.60	25.40	29.67	3.70
Mercury	ug/g	0.09	0.07	0.05	0.07	0.02
Nickel	ug/g	11.80	11.20	10.70	11.23	0.55
Silver	ug/g	0.32	0.23	0.21	0.26	0.06
Zinc	ug/g	52.40	45.40	42.10	46.63	5.26
Aluminum	PCTDRYWT	4.41	4.47	4.36	4.41	0.06
Iron	PCTDRYWT	1.73	1.65	1.59	1.66	0.07

Table A-3. DB01 PAH Data 2006

	Station	DB01	DB01	DB01	DB01	DB01
	Sample_ID	HT0610C0	HT0610C1	HT0610C2		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	79.66	58.26	47.22	61.71	16.49
1-NAPHTHALENE	ng/g, dry wt.	62.77	47.47	38.18	49.47	12.42
C2-NAPHTHALENE	ng/g, dry wt.	59.85	40.97	36.15	45.66	12.53
C3-NAPHTHALENE	ng/g, dry wt.	105.67	68.79	57.64	77.37	25.14
C4-NAPHTHALENES	ng/g, dry wt.	177.62	119.40	106.05	134.36	38.06
BIPHENYL	ng/g, dry wt.	7.49	6.47	5.24	6.40	1.13
ACENAPHTHYLENE	ng/g, dry wt.	50.46	44.80	38.73	44.66	5.86
ACENAPHTHENE	ng/g, dry wt.	99.33	56.74	48.69	68.26	27.21
DIBENZOFURAN	ng/g, dry wt.	60.41	36.81	34.12	43.78	14.47
FLUORENE	ng/g, dry wt.	130.11	76.46	67.97	91.51	33.69
C1-FLUORENES	ng/g, dry wt.	87.34	63.32	51.37	67.34	18.32
C2-FLUORENES	ng/g, dry wt.	65.73	50.72	49.34	55.26	9.09
C3-FLUORENES	ng/g, dry wt.	61.89	49.84	45.28	52.34	8.58
ANTHRACENE	ng/g, dry wt.	401.63	242.09	210.26	284.66	102.54
PHENANTHRENE	ng/g, dry wt.	1923.30	1139.26	1014.41	1358.99	492.68
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	911.87	598.11	523.80	677.93	205.98
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	588.30	420.65	366.11	458.36	115.80
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	244.37	174.18	175.22	197.92	40.23
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	89.04	72.52	68.52	76.69	10.88
DIBENZOTHIOPHENE	ng/g, dry wt.	117.66	75.91	67.32	86.97	26.93
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	100.24	71.31	60.13	77.23	20.70
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	87.45	63.21	61.33	70.66	14.57
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	90.06	68.57	68.98	75.87	12.29
1-METHYLNAPHTHALENE	ng/g, dry wt.	46.89	36.20	30.25	37.78	8.43
2-METHYLNAPHTHALENE	ng/g, dry wt.	38.82	26.85	22.32	29.33	8.53
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	18.78	5.43	13.46	12.56	6.72
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	23.31	16.10	14.57	17.99	4.66
1-METHYLPHENANTHRENE	ng/g, dry wt.	214.96	138.03	118.96	157.32	50.82
FLUORANTHENE	ng/g, dry wt.	4344.40	2924.84	2628.24	3299.16	917.27
PYRENE	ng/g, dry wt.	3495.89	2399.03	1936.60	2610.50	800.87
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	1866.74	1336.45	1143.52	1448.90	374.49
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	521.55	370.26	331.07	407.63	100.59
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	170.83	120.50	98.67	130.00	37.01
BENZ(A)ANTHRACENE	ng/g, dry wt.	1694.16	1281.86	1065.23	1347.08	319.50
CHRYSENE	ng/g, dry wt.	1940.78	1449.06	1281.88	1557.24	342.51
C1-CHRYSENES	ng/g, dry wt.	1093.70	852.72	747.46	897.96	177.50
C2-CHRYSENES	ng/g, dry wt.	605.82	469.27	393.59	489.56	107.56
C3-CHRYSENES	ng/g, dry wt.	418.18	334.40	294.29	348.96	63.21
C4-CHRYSENES	ng/g, dry wt.	327.04	266.40	238.32	277.25	45.34
BENZO(B)FLUORANTHENE	ng/g, dry wt.	2991.59	2340.80	2040.18	2457.52	486.33
BENZO(K)FLUORANTHENE	ng/g, dry wt.	799.90	663.23	577.75	680.29	112.05
BENZO(E)PYRENE	ng/g, dry wt.	1383.21	1093.49	947.87	1141.52	221.61
BENZO(A)PYRENE	ng/g, dry wt.	1747.77	1393.33	1182.58	1441.23	285.62
PERYLENE	ng/g, dry wt.	371.00	285.35	243.74	300.03	64.89
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	1479.71	1203.84	1029.12	1237.56	227.18
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	297.01	247.46	212.14	252.20	42.63
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	1104.42	902.88	770.03	925.78	168.37
BENZOTHIAZOLE	ng/g, dry wt.	45.37	14.77	28.22	29.45	15.34
Totals						
Total PAH	ng/g, dry wt.	31385.95	22970.91	19868.52	24741.79	5959.43
Sum LMW PAH	ng/g, dry wt.	5424.63	3526.50	3135.98	4029.03	1224.29
Sum HMW PAH	ng/g, dry wt.	25961.33	19444.41	16732.54	20712.76	4743.33
% Pyrogenic PAH	%	82.72%	84.65%	84.22%	83.86%	1.01%

Table A-3. DB04 PAH Data 2006 (cont'd)

	Station	DB04	DB04	DB04	DB04	DB04
	Sample_ID	HT0610B4	HT0610B7	HT0610B8		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	61.02	58.57	55.42	58.34	2.80
C1-NAPHTHALENE	ng/g, dry wt.	39.12	43.03	40.89	41.02	1.96
C2-NAPHTHALENE	ng/g, dry wt.	37.35	34.22	34.73	35.43	1.68
C3-NAPHTHALENE	ng/g, dry wt.	51.54	51.01	50.95	51.17	0.32
C4-NAPHTHALENES	ng/g, dry wt.	85.34	83.44	82.58	83.79	1.41
BIPHENYL	ng/g, dry wt.	6.16	6.56	5.64	6.12	0.46
ACENAPHTHYLENE	ng/g, dry wt.	51.17	47.97	47.37	48.84	2.04
ACENAPHTHENE	ng/g, dry wt.	36.23	35.37	31.26	34.29	2.65
DIBENZOFURAN	ng/g, dry wt.	30.44	31.38	29.12	30.31	1.14
FLUORENE	ng/g, dry wt.	52.66	53.95	48.93	51.85	2.61
C1-FLUORENES	ng/g, dry wt.	46.69	45.45	44.39	45.51	1.15
C2-FLUORENES	ng/g, dry wt.	47.25	40.30	37.95	41.83	4.83
C3-FLUORENES	ng/g, dry wt.	37.16	43.87	36.16	39.06	4.19
ANTHRACENE	ng/g, dry wt.	171.99	160.59	163.48	165.36	5.93
PHENANTHRENE	ng/g, dry wt.	674.16	717.93	694.51	695.53	21.91
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	465.00	427.19	415.27	435.82	25.96
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	332.41	299.14	312.65	314.73	16.73
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	161.16	145.90	138.42	148.49	11.59
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	68.54	53.74	57.88	60.05	7.63
DIBENZOTHIOPHENE	ng/g, dry wt.	45.57	43.03	40.69	43.10	2.44
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	55.09	47.76	47.14	49.99	4.42
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	51.92	48.49	49.16	49.86	1.81
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	50.42	43.87	47.26	47.18	3.27
1-METHYLNAPHTHALENE	ng/g, dry wt.	33.09	37.37	32.03	34.16	2.82
2-METHYLNAPHTHALENE	ng/g, dry wt.	22.47	23.93	22.71	23.04	0.78
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	7.13	6.54	6.68	6.79	0.31
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	14.04	13.43	12.65	13.38	0.70
1-METHYLPHENANTHRENE	ng/g, dry wt.	104.76	92.26	93.08	96.70	7.00
FLUORANTHENE	ng/g, dry wt.	1671.38	1322.50	1264.92	1419.60	219.94
PYRENE	ng/g, dry wt.	1381.93	1374.98	1384.25	1380.39	4.82
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	926.26	802.95	856.80	862.00	61.82
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	283.86	256.10	252.98	264.31	16.99
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	110.93	98.35	80.67	96.65	15.20
BENZ(A)ANTHRACENE	ng/g, dry wt.	677.07	661.78	705.14	681.33	21.99
CHRYSENE	ng/g, dry wt.	741.41	726.59	744.98	737.66	9.75
C1-CHRYSENES	ng/g, dry wt.	498.66	482.69	509.93	497.09	13.69
C2-CHRYSENES	ng/g, dry wt.	257.37	247.31	270.90	258.53	11.84
C3-CHRYSENES	ng/g, dry wt.	174.02	185.06	187.24	182.11	7.09
C4-CHRYSENES	ng/g, dry wt.	140.82	134.74	142.42	139.33	4.05
BENZO(B)FLUORANTHENE	ng/g, dry wt.	1234.23	912.50	922.26	1023.00	183.00
BENZO(K)FLUORANTHENE	ng/g, dry wt.	352.43	336.86	385.44	358.24	24.81
BENZO(E)PYRENE	ng/g, dry wt.	552.77	574.79	591.60	573.05	19.47
BENZO(A)PYRENE	ng/g, dry wt.	770.66	781.17	824.66	792.16	28.63
PERYLENE	ng/g, dry wt.	136.88	133.89	145.41	138.73	5.98
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	541.07	549.21	571.68	553.99	15.86
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	117.72	115.13	117.52	116.79	1.44
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	397.76	409.35	437.23	414.78	20.29
BENZOTHIAZOLE	ng/g, dry wt.	8.36	30.02	13.27	17.22	11.36
Totals						
Total PAH	ng/g, dry wt.	13145.50	12230.82	12491.66	12622.66	471.20
Sum LMW PAH	ng/g, dry wt.	2573.05	2479.33	2429.28	2493.88	72.98
Sum HMW PAH	ng/g, dry wt.	10572.46	9751.49	10062.38	10128.78	414.49
% Pyrogenic PAH	%	80.43%	79.73%	80.55%	80.24%	0.44%

Table A-3. T04 PAH Data 2006 (cont'd)

	Station	T04(/DB13)	T04(/DB13)	T04(/DB13)	T04(/DB13)	T04(/DB13)
	Sample_ID	HT06106E	HT06106F	HT061070		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	93.98	250.87	123.37	156.07	83.40
C1-NAPHTHALENE	ng/g, dry wt.	75.93	174.68	102.52	117.71	51.10
C2-NAPHTHALENE	ng/g, dry wt.	71.48	169.11	92.28	110.96	51.43
C3-NAPHTHALENE	ng/g, dry wt.	104.04	261.36	151.83	172.41	80.65
C4-NAPHTHALENES	ng/g, dry wt.	213.54	572.68	303.65	363.29	186.85
BIPHENYL	ng/g, dry wt.	12.97	28.19	15.18	18.78	8.22
ACENAPHTHYLENE	ng/g, dry wt.	83.07	92.50	81.37	85.65	6.00
ACENAPHTHENE	ng/g, dry wt.	89.06	294.67	124.54	169.43	109.91
DIBENZOFURAN	ng/g, dry wt.	58.98	220.36	84.22	121.19	86.81
FLUORENE	ng/g, dry wt.	111.20	330.54	157.76	199.83	115.57
C1-FLUORENES	ng/g, dry wt.	87.50	210.11	116.24	137.95	64.12
C2-FLUORENES	ng/g, dry wt.	100.91	251.11	148.27	166.76	76.79
C3-FLUORENES	ng/g, dry wt.	164.06	312.60	198.09	224.92	77.82
ANTHRACENE	ng/g, dry wt.	298.18	782.79	383.12	488.03	258.78
PHENANTHRENE	ng/g, dry wt.	1510.42	4304.72	2111.33	2642.16	1470.84
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	848.96	1806.45	1085.32	1246.91	498.78
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	717.45	1422.10	894.35	1011.30	366.59
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	459.64	882.72	548.00	630.12	223.18
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	218.75	357.45	249.09	275.10	72.91
DIBENZOTHIOPHENE	ng/g, dry wt.	100.13	294.67	138.78	177.86	102.99
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	111.85	253.67	144.71	170.08	74.24
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	143.23	299.79	183.85	208.96	81.25
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	188.80	368.98	243.16	266.98	92.42
1-METHYLNAPHTHALENE	ng/g, dry wt.	66.67	144.71	82.10	97.83	41.33
2-METHYLNAPHTHALENE	ng/g, dry wt.	46.30	104.30	55.45	68.68	31.18
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	16.41	40.23	20.64	25.76	12.71
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	30.21	80.71	43.41	51.44	26.19
1-METHYLPHENANTHRENE	ng/g, dry wt.	194.01	409.97	250.28	284.75	112.03
FLUORANTHENE	ng/g, dry wt.	3398.44	7571.70	4625.95	5198.70	2144.77
PYRENE	ng/g, dry wt.	2643.23	6226.47	3107.69	3992.46	1948.60
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	1809.90	3356.66	2277.39	2481.32	793.29
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	738.28	1224.80	835.04	932.71	257.54
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	242.19	374.10	266.88	294.39	70.13
BENZ(A)ANTHRACENE	ng/g, dry wt.	1241.20	2071.22	1456.31	1589.58	430.76
CHRYSENE	ng/g, dry wt.	1161.97	2134.26	1646.26	1647.50	486.14
C1-CHRYSENES	ng/g, dry wt.	860.92	1521.90	1139.72	1174.18	331.84
C2-CHRYSENES	ng/g, dry wt.	492.08	742.94	659.41	631.47	127.74
C3-CHRYSENES	ng/g, dry wt.	375.88	569.14	463.12	469.38	96.78
C4-CHRYSENES	ng/g, dry wt.	262.32	430.45	309.35	334.04	86.74
BENZO(B)FLUORANTHENE	ng/g, dry wt.	1839.79	3340.97	2686.48	2622.41	752.64
BENZO(K)FLUORANTHENE	ng/g, dry wt.	653.17	1071.63	904.54	876.45	210.64
BENZO(E)PYRENE	ng/g, dry wt.	1135.56	1557.92	1257.31	1316.93	217.40
BENZO(A)PYRENE	ng/g, dry wt.	1109.15	2089.23	1601.03	1599.81	490.04
PERYLENE	ng/g, dry wt.	230.63	475.48	270.46	325.52	131.38
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	897.89	1774.05	985.95	1219.29	482.44
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	179.58	332.30	202.62	238.16	82.33
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	622.36	1152.68	659.41	811.48	296.07
BENZOTHIAZOLE	ng/g, dry wt.	39.81	30.66	32.24	34.24	4.89
Totals						
Total PAH	ng/g, dry wt.	24564.65	49788.43	31630.38	35327.82	13012.04
Sum LMW PAH	ng/g, dry wt.	5650.58	13369.44	7377.37	8799.13	4051.08
Sum HMW PAH	ng/g, dry wt.	18914.06	36418.99	24253.01	26528.69	8971.60
% Pyrogenic PAH	%	77.00%	73.15%	76.68%	75.61%	2.14%

Table A-3. DB10 PAH Data 2006 (cont'd)

	Station	DB10	DB10	DB10	DB10	DB10
	Sample_ID	HT06105C	HT061061	HT061063		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	120.63	493.22	156.90	256.92	205.45
C1-NAPHTHALENE	ng/g, dry wt.	93.62	336.62	92.57	174.27	140.60
C2-NAPHTHALENE	ng/g, dry wt.	80.69	156.33	97.00	111.34	39.81
C3-NAPHTHALENE	ng/g, dry wt.	106.53	160.41	118.38	128.44	28.32
C4-NAPHTHALENES	ng/g, dry wt.	189.77	354.81	213.85	252.81	89.15
BIPHENYL	ng/g, dry wt.	22.33	35.28	22.22	26.61	7.51
ACENAPHTHYLENE	ng/g, dry wt.	136.66	123.03	130.54	130.08	6.83
ACENAPHTHENE	ng/g, dry wt.	87.39	355.49	107.06	183.31	149.43
DIBENZOFURAN	ng/g, dry wt.	70.49	287.52	80.93	146.31	122.40
FLUORENE	ng/g, dry wt.	130.13	478.51	142.56	250.40	197.65
C1-FLUORENES	ng/g, dry wt.	99.19	165.17	115.59	126.65	34.35
C2-FLUORENES	ng/g, dry wt.	119.92	108.07	102.73	110.24	8.80
C3-FLUORENES	ng/g, dry wt.	121.20	87.00	116.15	108.12	18.46
ANTHRACENE	ng/g, dry wt.	299.80	1005.96	296.31	534.03	408.72
PHENANTHRENE	ng/g, dry wt.	1722.26	4159.80	1705.18	2529.08	1412.27
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	918.54	1406.99	930.86	1085.46	278.52
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	751.10	822.44	733.78	769.11	46.99
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	449.70	380.64	434.68	421.67	36.32
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	248.77	146.14	245.99	213.63	58.47
DIBENZOTHIOPHENE	ng/g, dry wt.	107.80	255.57	113.07	158.81	83.83
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	109.56	143.42	111.81	121.60	18.93
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	82.29	128.46	126.91	112.55	26.22
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	184.98	133.90	160.73	159.87	25.55
1-METHYLNAPHTHALENE	ng/g, dry wt.	76.31	257.59	83.55	139.15	102.63
2-METHYLNAPHTHALENE	ng/g, dry wt.	49.56	168.31	48.64	88.84	68.83
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	16.11	54.72	19.15	29.99	21.47
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	25.99	41.19	29.07	32.09	8.03
1-METHYLPHENANTHRENE	ng/g, dry wt.	216.88	317.42	206.86	247.05	61.15
FLUORANTHENE	ng/g, dry wt.	4465.13	6341.66	4290.89	5032.56	1137.05
PYRENE	ng/g, dry wt.	3699.68	5124.98	3550.12	4124.93	869.30
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	2376.09	2650.85	2376.07	2467.67	158.64
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	886.65	802.05	876.35	855.02	46.16
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	309.37	212.07	289.32	270.25	51.38
BENZ(A)ANTHRACENE	ng/g, dry wt.	1534.49	2438.31	1423.59	1798.80	556.60
CHRYSENE	ng/g, dry wt.	1981.55	2499.55	1710.29	2063.80	401.00
C1-CHRYSENES	ng/g, dry wt.	1244.51	1380.60	1097.35	1240.82	141.66
C2-CHRYSENES	ng/g, dry wt.	720.12	673.60	626.78	673.50	46.67
C3-CHRYSENES	ng/g, dry wt.	565.47	499.35	473.54	512.79	47.41
C4-CHRYSENES	ng/g, dry wt.	316.56	462.05	303.50	360.71	88.01
BENZO(B)FLUORANTHENE	ng/g, dry wt.	3189.81	3696.43	3104.23	3330.16	320.08
BENZO(K)FLUORANTHENE	ng/g, dry wt.	797.45	1157.92	847.24	934.20	195.34
BENZO(E)PYRENE	ng/g, dry wt.	1594.91	1837.08	1473.02	1635.00	185.31
BENZO(A)PYRENE	ng/g, dry wt.	1872.81	2544.08	1710.29	2042.39	442.01
PERYLENE	ng/g, dry wt.	322.61	500.47	289.66	370.91	113.40
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	1232.43	1803.68	1127.01	1387.71	364.08
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	245.28	398.59	233.31	292.39	92.16
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	854.24	1386.16	780.01	1006.80	330.62
BENZOTHIAZOLE	ng/g, dry wt.	31.47	569.32	302.04	300.94	268.93
Totals						
Total PAH	ng/g, dry wt.	33076.71	46765.33	31558.89	37133.64	8375.74
Sum LMW PAH	ng/g, dry wt.	6063.57	11369.97	6141.98	7858.50	3041.27
Sum HMW PAH	ng/g, dry wt.	27013.14	35395.36	25416.91	29275.14	5360.02
% Pyrogenic PAH	%	81.67%	75.69%	80.54%	79.30%	3.18%

Table A-3. DB14 PAH Data 2006 (cont'd)

	Station	DB14	DB14	DB14	DB14	DB14
	Sample_ID	HT061067	HT061068	HT061069		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	402.08	243.64	714.62	453.45	239.65
C1-NAPHTHALENE	ng/g, dry wt.	354.17	232.89	592.70	393.26	183.06
C2-NAPHTHALENE	ng/g, dry wt.	431.82	355.46	745.71	510.99	206.82
C3-NAPHTHALENE	ng/g, dry wt.	915.91	656.88	943.40	838.73	158.08
C4-NAPHTHALENES	ng/g, dry wt.	1465.91	1221.35	1715.28	1467.51	246.97
BIPHENYL	ng/g, dry wt.	49.09	35.83	87.36	57.43	26.76
ACENAPHTHYLENE	ng/g, dry wt.	148.86	281.52	143.62	191.33	78.15
ACENAPHTHENE	ng/g, dry wt.	580.68	658.30	1180.34	806.44	326.12
DIBENZOFURAN	ng/g, dry wt.	404.55	415.17	918.69	579.47	293.82
FLUORENE	ng/g, dry wt.	714.77	803.33	1253.02	923.71	288.61
C1-FLUORENES	ng/g, dry wt.	518.18	514.70	657.04	563.31	81.19
C2-FLUORENES	ng/g, dry wt.	642.05	541.71	585.81	589.86	50.29
C3-FLUORENES	ng/g, dry wt.	620.45	509.01	552.38	560.62	56.18
ANTHRACENE	ng/g, dry wt.	1590.91	2161.17	2747.35	2166.48	578.24
PHENANTHRENE	ng/g, dry wt.	8784.09	9113.89	15844.52	11247.50	3984.55
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	4113.64	4535.62	6221.52	4956.92	1115.31
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	3102.27	3042.70	3430.56	3191.84	208.87
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	1750.00	1436.04	1569.92	1585.32	157.54
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	721.59	418.02	633.78	591.13	156.22
DIBENZOTHIOPHENE	ng/g, dry wt.	551.14	648.35	1050.97	750.15	265.01
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	576.14	658.30	798.04	677.49	112.19
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	670.45	627.02	620.70	639.39	27.09
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	723.86	557.35	564.01	615.08	94.27
1-METHYLNAPHTHALENE	ng/g, dry wt.	256.25	139.20	433.27	276.24	148.05
2-METHYLNAPHTHALENE	ng/g, dry wt.	188.13	121.28	375.13	228.18	131.58
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	169.32	115.31	238.39	174.34	61.70
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	232.95	172.04	264.56	223.19	47.03
1-METHYLPHENANTHRENE	ng/g, dry wt.	1002.27	1136.04	1479.17	1205.83	245.99
FLUORANTHENE	ng/g, dry wt.	16590.91	16493.16	20786.84	17956.97	2451.23
PYRENE	ng/g, dry wt.	13068.18	12767.98	16425.97	14087.37	2030.83
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	6386.36	7748.94	7224.52	7119.94	687.28
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	2034.09	1947.90	2238.58	2073.52	149.30
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	813.64	426.55	622.15	620.78	193.55
BENZ(A)ANTHRACENE	ng/g, dry wt.	5209.09	5870.93	6359.73	5813.25	577.48
CHRYSENE	ng/g, dry wt.	6272.73	6162.32	6840.14	6425.06	363.68
C1-CHRYSENES	ng/g, dry wt.	3327.27	3636.96	3786.10	3583.44	234.05
C2-CHRYSENES	ng/g, dry wt.	1727.27	1651.20	1830.14	1736.20	89.80
C3-CHRYSENES	ng/g, dry wt.	1354.55	1165.55	1258.22	1259.44	94.50
C4-CHRYSENES	ng/g, dry wt.	1009.09	1042.52	931.08	994.23	57.19
BENZO(B)FLUORANTHENE	ng/g, dry wt.	9727.27	9292.05	9791.24	9603.52	271.63
BENZO(K)FLUORANTHENE	ng/g, dry wt.	2890.91	3075.76	3248.49	3071.72	178.83
BENZO(E)PYRENE	ng/g, dry wt.	4581.82	4446.37	4621.10	4549.76	91.67
BENZO(A)PYRENE	ng/g, dry wt.	6036.36	6518.46	6519.87	6358.23	278.75
PERYLENE	ng/g, dry wt.	1127.27	1305.85	1258.22	1230.45	92.47
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	4390.91	4316.86	4541.03	4416.27	114.21
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	876.36	943.23	919.64	913.08	33.92
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	3390.91	3280.82	3431.51	3367.74	77.97
BENZOTHIAZOLE	ng/g, dry wt.	81.67	0.00	42.95	41.54	40.85
Totals						
Total PAH	ng/g, dry wt.	116333.98	118165.91	141629.89	125376.59	14105.54
Sum LMW PAH	ng/g, dry wt.	28366.70	28446.94	41856.06	32889.90	7765.02
Sum HMW PAH	ng/g, dry wt.	87967.27	89718.97	99773.83	92486.69	6371.34
% Pyrogenic PAH	%	75.62%	75.93%	70.45%	74.00%	3.08%

Table A-3. C019 PAH Data 2006 (cont'd)

	Station	C019	C019	C019	C019	C019
	Sample_ID	HT06103B	HT061041	HT061046		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	153.72	156.76	167.19	159.22	7.06
C1-NAPHTHALENE	ng/g, dry wt.	71.96	76.23	67.34	71.84	4.44
C2-NAPHTHALENE	ng/g, dry wt.	69.21	70.48	74.53	71.41	2.78
C3-NAPHTHALENE	ng/g, dry wt.	85.88	87.50	96.11	89.83	5.50
C4-NAPHTHALENES	ng/g, dry wt.	122.69	130.59	153.30	135.52	15.89
BIPHENYL	ng/g, dry wt.	15.28	15.29	16.51	15.69	0.71
ACENAPHTHYLENE	ng/g, dry wt.	95.83	100.80	100.47	99.03	2.78
ACENAPHTHENE	ng/g, dry wt.	39.24	43.48	42.33	41.69	2.20
DIBENZOFURAN	ng/g, dry wt.	40.28	44.15	46.93	43.79	3.34
FLUORENE	ng/g, dry wt.	63.66	71.01	69.10	67.92	3.82
C1-FLUORENES	ng/g, dry wt.	62.27	69.41	65.33	65.67	3.59
C2-FLUORENES	ng/g, dry wt.	65.51	74.07	96.34	78.64	15.92
C3-FLUORENES	ng/g, dry wt.	54.17	88.16	72.41	71.58	17.01
ANTHRACENE	ng/g, dry wt.	185.19	207.45	212.26	201.63	14.45
PHENANTHRENE	ng/g, dry wt.	561.34	647.61	727.59	645.51	83.15
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	391.20	448.14	444.58	427.97	31.89
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	342.59	405.59	417.45	388.54	40.23
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	239.58	284.57	299.53	274.56	31.20
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	211.81	234.04	182.78	209.54	25.70
DIBENZOTHIOPHENE	ng/g, dry wt.	44.44	51.99	48.23	48.22	3.78
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	59.61	66.49	70.87	65.66	5.68
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	43.52	86.84	86.79	72.38	25.00
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	114.81	131.12	146.23	130.72	15.71
1-METHYLNAPHTHALENE	ng/g, dry wt.	58.11	61.27	58.91	59.43	1.64
2-METHYLNAPHTHALENE	ng/g, dry wt.	34.29	36.07	33.75	34.70	1.21
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	15.28	15.16	33.61	21.35	10.62
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	17.48	19.15	22.52	19.72	2.57
1-METHYLPHENANTHRENE	ng/g, dry wt.	94.91	107.98	110.85	104.58	8.50
FLUORANTHENE	ng/g, dry wt.	1527.78	1755.32	1757.08	1680.06	131.88
PYRENE	ng/g, dry wt.	1469.91	1662.23	1733.49	1621.88	136.35
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	1106.48	1252.66	1273.58	1210.91	91.04
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	530.09	503.99	481.13	505.07	24.50
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	163.19	184.84	163.92	170.65	12.29
BENZ(A)ANTHRACENE	ng/g, dry wt.	695.61	696.23	756.12	715.99	34.76
CHRYSENE	ng/g, dry wt.	846.37	836.79	909.09	864.09	39.27
C1-CHRYSENES	ng/g, dry wt.	601.15	615.09	645.98	620.74	22.94
C2-CHRYSENES	ng/g, dry wt.	406.49	322.64	416.08	381.74	51.40
C3-CHRYSENES	ng/g, dry wt.	354.96	288.68	348.78	330.81	36.61
C4-CHRYSENES	ng/g, dry wt.	174.62	173.58	199.30	182.50	14.56
BENZO(B)FLUORANTHENE	ng/g, dry wt.	1479.01	1452.83	1695.80	1542.55	133.37
BENZO(K)FLUORANTHENE	ng/g, dry wt.	444.66	462.26	486.89	464.60	21.21
BENZO(E)PYRENE	ng/g, dry wt.	701.34	692.45	798.95	730.91	59.09
BENZO(A)PYRENE	ng/g, dry wt.	865.46	873.58	1022.73	920.59	88.55
PERYLENE	ng/g, dry wt.	156.49	151.89	161.71	156.70	4.92
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	645.99	625.47	652.97	641.48	14.29
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	137.40	134.91	139.86	137.39	2.48
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	492.37	467.92	503.50	487.93	18.20
BENZOTHIAZOLE	ng/g, dry wt.	19.09	34.63	5.08	19.60	14.78
Totals						
Total PAH	ng/g, dry wt.	15117.17	15925.74	17052.84	16031.91	972.19
Sum LMW PAH	ng/g, dry wt.	3011.09	3461.18	3550.92	3341.07	289.27
Sum HMW PAH	ng/g, dry wt.	12106.08	12464.55	13501.91	12690.85	724.91
% Pyrogenic PAH	%	80.08%	78.27%	79.18%	79.18%	0.91%

Table A-3. DB03 PAH Data 2006 (cont'd)

	Station	DB03	DB03	DB03	DB03	DB03
	Sample_ID	HT061083	HT061084	HT061085		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	16.53	19.35	31.25	22.38	7.81
C1-NAPHTHALENE	ng/g, dry wt.	13.11	12.30	20.33	15.25	4.42
C2-NAPHTHALENE	ng/g, dry wt.	15.55	10.01	16.78	14.11	3.61
C3-NAPHTHALENE	ng/g, dry wt.	25.55	16.92	25.46	22.64	4.96
C4-NAPHTHALENES	ng/g, dry wt.	21.75	19.40	30.67	23.94	5.95
BIPHENYL	ng/g, dry wt.	1.92	2.44	3.38	2.58	0.74
ACENAPHTHYLENE	ng/g, dry wt.	14.21	20.02	23.96	19.39	4.90
ACENAPHTHENE	ng/g, dry wt.	4.66	6.16	8.30	6.37	1.83
DIBENZOFURAN	ng/g, dry wt.	5.44	5.76	9.34	6.84	2.17
FLUORENE	ng/g, dry wt.	8.97	11.07	15.86	11.97	3.53
C1-FLUORENES	ng/g, dry wt.	16.38	14.35	18.63	16.46	2.14
C2-FLUORENES	ng/g, dry wt.	25.37	25.24	31.48	27.37	3.56
C3-FLUORENES	ng/g, dry wt.	26.10	9.92	40.97	25.66	15.53
ANTHRACENE	ng/g, dry wt.	29.72	36.76	45.37	37.28	7.84
PHENANTHRENE	ng/g, dry wt.	96.60	111.60	142.36	116.85	23.33
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	95.33	88.57	115.28	99.73	13.88
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	87.18	74.58	112.27	91.34	19.19
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	48.39	46.15	62.62	52.38	8.93
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	26.28	24.27	27.55	26.03	1.65
DIBENZOTHIOPHENE	ng/g, dry wt.	7.87	7.82	11.40	9.03	2.05
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	12.58	10.98	15.97	13.18	2.55
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	14.21	11.69	20.37	15.42	4.47
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	15.70	11.69	22.45	16.61	5.44
1-METHYLNAPHTHALENE	ng/g, dry wt.	10.05	11.75	20.06	13.95	5.36
2-METHYLNAPHTHALENE	ng/g, dry wt.	7.87	5.90	9.94	7.90	2.02
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	2.48	4.44	4.39	3.77	1.11
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	4.98	2.78	5.93	4.56	1.61
1-METHYLPHENANTHRENE	ng/g, dry wt.	19.39	18.95	24.77	21.04	3.24
FLUORANTHENE	ng/g, dry wt.	237.42	283.43	350.69	290.52	56.97
PYRENE	ng/g, dry wt.	239.23	272.81	319.44	277.16	40.28
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	192.11	216.12	255.79	221.34	32.16
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	85.73	93.00	131.94	103.56	24.85
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	36.07	25.69	48.38	36.71	11.36
BENZ(A)ANTHRACENE	ng/g, dry wt.	120.13	136.09	166.34	140.85	23.47
CHRYSENE	ng/g, dry wt.	128.02	139.89	181.91	149.94	28.32
C1-CHRYSENES	ng/g, dry wt.	109.86	115.56	154.67	126.70	24.39
C2-CHRYSENES	ng/g, dry wt.	69.14	73.21	101.17	81.17	17.43
C3-CHRYSENES	ng/g, dry wt.	53.83	51.17	78.11	61.04	14.85
C4-CHRYSENES	ng/g, dry wt.	31.41	26.53	44.07	34.00	9.05
BENZO(B)FLUORANTHENE	ng/g, dry wt.	220.99	244.80	309.34	258.38	45.71
BENZO(K)FLUORANTHENE	ng/g, dry wt.	67.72	70.70	95.72	78.05	15.38
BENZO(E)PYRENE	ng/g, dry wt.	113.18	135.33	158.56	135.69	22.69
BENZO(A)PYRENE	ng/g, dry wt.	145.70	177.14	204.28	175.71	29.32
PERYLENE	ng/g, dry wt.	26.99	64.93	40.95	44.29	19.19
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	109.55	128.48	152.72	130.25	21.64
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	23.99	27.90	32.59	28.16	4.30
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	84.77	104.15	115.76	101.56	15.66
BENZOTHIAZOLE	ng/g, dry wt.	46.77	7.79	38.33	30.96	20.51
Totals						
Total PAH	ng/g, dry wt.	2581.69	2845.89	3583.50	3003.69	519.21
Sum LMW PAH	ng/g, dry wt.	607.65	577.66	821.39	668.90	132.91
Sum HMW PAH	ng/g, dry wt.	1974.04	2268.24	2762.11	2334.80	398.23
% Pyrogenic PAH	%	76.46%	79.70%	77.08%	77.75%	1.72%

Table A-3. DB06 PAH Data 2006 (cont'd)

	Station	DB06	DB06	DB06	DB06	DB06
	Sample_ID	HT0610C8	HT0610C9	HT0610CA		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	11.18	5.54	4.73	7.15	3.51
C1-NAPHTHALENE	ng/g, dry wt.	7.44	3.62	3.42	4.83	2.27
C2-NAPHTHALENE	ng/g, dry wt.	7.01	2.99	2.52	4.17	2.47
C3-NAPHTHALENE	ng/g, dry wt.	14.89	7.38	5.31	9.19	5.04
C4-NAPHTHALENES	ng/g, dry wt.	18.67	4.79	3.68	9.05	8.36
BIPHENYL	ng/g, dry wt.	0.81	0.46	0.39	0.55	0.23
ACENAPHTHYLENE	ng/g, dry wt.	51.15	2.29	2.54	18.66	28.14
ACENAPHTHENE	ng/g, dry wt.	2.68	1.39	1.15	1.74	0.82
DIBENZOFURAN	ng/g, dry wt.	4.66	1.71	0.88	2.41	1.99
FLUORENE	ng/g, dry wt.	7.94	1.87	1.70	3.84	3.56
C1-FLUORENES	ng/g, dry wt.	7.81	1.86	1.80	3.82	3.45
C2-FLUORENES	ng/g, dry wt.	10.07	3.02	1.68	4.92	4.51
C3-FLUORENES	ng/g, dry wt.	6.32	1.21	1.30	2.94	2.92
ANTHRACENE	ng/g, dry wt.	40.06	4.26	4.81	16.38	20.51
PHENANTHRENE	ng/g, dry wt.	159.68	22.40	19.54	67.21	80.10
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	129.50	13.24	12.07	51.60	67.47
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	83.22	10.18	9.10	34.17	42.49
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	37.62	5.17	4.83	15.87	18.83
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	9.58	2.19	2.02	4.60	4.32
DIBENZOTHIOPHENE	ng/g, dry wt.	8.86	1.48	1.38	3.91	4.29
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	18.54	0.00	1.92	6.82	10.20
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	19.89	0.00	1.89	7.26	10.98
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	14.34	1.96	2.00	6.10	7.14
1-METHYLNAPHTHALENE	ng/g, dry wt.	5.28	2.52	2.16	3.32	1.71
2-METHYLNAPHTHALENE	ng/g, dry wt.	3.56	1.52	1.27	2.12	1.26
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	1.37	1.36	1.57	1.43	0.12
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	2.19	0.00	0.28	0.82	1.19
1-METHYLPHENANTHRENE	ng/g, dry wt.	32.34	2.95	2.81	12.70	17.01
FLUORANTHENE	ng/g, dry wt.	469.57	60.96	55.98	195.50	237.36
PYRENE	ng/g, dry wt.	405.97	47.60	46.59	166.72	207.20
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	200.28	28.76	25.80	84.95	99.89
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	156.97	14.25	14.40	61.88	82.36
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	43.44	3.17	3.58	16.73	23.13
BENZ(A)ANTHRACENE	ng/g, dry wt.	233.29	21.99	20.60	91.96	122.40
CHRYSENE	ng/g, dry wt.	217.59	29.59	27.74	91.64	109.08
C1-CHRYSENES	ng/g, dry wt.	139.08	18.01	15.77	57.62	70.55
C2-CHRYSENES	ng/g, dry wt.	59.78	10.97	9.56	26.77	28.60
C3-CHRYSENES	ng/g, dry wt.	39.37	10.02	8.03	19.14	17.54
C4-CHRYSENES	ng/g, dry wt.	43.52	7.59	6.18	19.10	21.16
BENZO(B)FLUORANTHENE	ng/g, dry wt.	353.30	55.79	48.11	152.40	174.03
BENZO(K)FLUORANTHENE	ng/g, dry wt.	108.35	16.84	15.42	46.87	53.24
BENZO(E)PYRENE	ng/g, dry wt.	166.00	26.90	23.25	72.05	81.38
BENZO(A)PYRENE	ng/g, dry wt.	245.63	32.28	27.27	101.73	124.65
PERYLENE	ng/g, dry wt.	49.69	6.80	5.25	20.58	25.22
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	173.85	31.35	25.09	76.76	84.14
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	34.77	5.64	4.66	15.02	17.11
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	130.10	24.56	18.64	57.77	62.71
BENZOTHIAZOLE	ng/g, dry wt.	11.43	35.39	26.96	24.59	12.15
Totals						
Total PAH	ng/g, dry wt.	3723.37	529.85	470.93	1574.72	1861.02
Sum LMW PAH	ng/g, dry wt.	653.26	94.20	86.99	278.15	324.87
Sum HMW PAH	ng/g, dry wt.	3070.12	435.65	383.94	1296.57	1536.15
% Pyrogenic PAH	%	82.46%	82.22%	81.53%	82.07%	0.48%

Table A-3. DB12 PAH Data 2006 (cont'd)

	Station	DB12	DB12	DB12	DB12	DB12
	Sample_ID	HT06107A	HT06107B	HT06107D		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	97.64	150.56	54.15	100.79	48.28
C1-NAPHTHALENE	ng/g, dry wt.	60.21	106.86	29.50	65.52	38.96
C2-NAPHTHALENE	ng/g, dry wt.	44.52	84.83	27.55	52.30	29.42
C3-NAPHTHALENE	ng/g, dry wt.	63.90	112.52	41.15	72.53	36.46
C4-NAPHTHALENES	ng/g, dry wt.	85.20	149.23	43.27	92.57	53.36
BIPHENYL	ng/g, dry wt.	8.41	13.60	4.39	8.80	4.62
ACENAPHTHYLENE	ng/g, dry wt.	121.17	59.78	27.46	69.47	47.60
ACENAPHTHENE	ng/g, dry wt.	23.09	76.48	14.03	37.87	33.75
DIBENZOFURAN	ng/g, dry wt.	27.17	87.25	13.18	42.53	39.35
FLUORENE	ng/g, dry wt.	50.38	133.62	23.24	69.08	57.52
C1-FLUORENES	ng/g, dry wt.	50.26	103.07	28.90	60.74	38.18
C2-FLUORENES	ng/g, dry wt.	84.44	98.46	40.90	74.60	30.01
C3-FLUORENES	ng/g, dry wt.	74.23	83.08	37.18	64.83	24.35
ANTHRACENE	ng/g, dry wt.	243.62	340.65	58.39	214.22	143.41
PHENANTHRENE	ng/g, dry wt.	520.41	1217.55	253.52	663.83	497.76
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	539.54	725.26	195.21	486.67	268.95
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	658.16	514.27	179.15	450.53	245.78
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	336.73	237.36	114.93	229.67	111.10
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	116.71	97.14	46.99	86.95	35.96
DIBENZOTHIOPHENE	ng/g, dry wt.	34.06	80.44	17.32	43.94	32.70
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	59.69	78.46	29.32	55.83	24.80
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	110.46	77.58	40.23	76.09	35.14
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	110.08	72.53	47.15	76.59	31.66
1-METHYLNAPHTHALENE	ng/g, dry wt.	62.83	93.45	24.66	60.31	34.47
2-METHYLNAPHTHALENE	ng/g, dry wt.	28.53	57.97	14.93	33.81	22.00
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	10.64	14.83	10.90	12.12	2.35
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	13.90	29.67	9.46	17.68	10.62
1-METHYLPHENANTHRENE	ng/g, dry wt.	117.98	172.08	40.65	110.24	66.06
FLUORANTHENE	ng/g, dry wt.	1581.63	1745.01	583.94	1303.53	628.51
PYRENE	ng/g, dry wt.	1658.16	1562.60	578.02	1266.26	597.94
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	1862.24	1210.96	452.11	1175.11	705.75
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	584.18	408.78	180.00	390.99	202.68
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	159.44	152.74	64.22	125.47	53.14
BENZ(A)ANTHRACENE	ng/g, dry wt.	913.12	726.14	232.02	623.76	351.90
CHRYSENE	ng/g, dry wt.	1019.50	738.48	272.39	676.79	377.36
C1-CHRYSENES	ng/g, dry wt.	832.45	598.18	227.47	552.70	305.04
C2-CHRYSENES	ng/g, dry wt.	386.52	314.51	145.58	282.20	123.68
C3-CHRYSENES	ng/g, dry wt.	247.34	220.46	111.46	193.09	71.96
C4-CHRYSENES	ng/g, dry wt.	164.89	138.45	63.69	122.34	52.49
BENZO(B)FLUORANTHENE	ng/g, dry wt.	1445.04	1167.07	479.96	1030.69	496.78
BENZO(K)FLUORANTHENE	ng/g, dry wt.	396.28	339.18	146.72	294.06	130.75
BENZO(E)PYRENE	ng/g, dry wt.	684.40	542.68	232.02	486.37	231.39
BENZO(A)PYRENE	ng/g, dry wt.	1001.77	809.40	307.65	706.27	358.37
PERYLENE	ng/g, dry wt.	142.73	132.28	49.36	108.12	51.16
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	543.44	479.47	193.92	405.61	186.10
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	119.68	104.53	41.40	88.54	41.52
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	405.14	356.13	147.29	302.85	136.94
BENZOTHIAZOLE	ng/g, dry wt.	5.05	4.89	7.31	5.75	1.35
Totals						
Total PAH	ng/g, dry wt.	16839.23	15736.90	5588.87	12721.67	6201.73
Sum LMW PAH	ng/g, dry wt.	3434.88	4551.37	1323.87	3103.37	1639.09
Sum HMW PAH	ng/g, dry wt.	13404.35	11185.53	4265.00	9618.29	4766.98
% Pyrogenic PAH	%	79.60%	71.08%	76.31%	75.66%	4.30%

Table A-3. SWEX3 PAH Data 2006 (cont'd)

	Station	SWEX3	SWEX3	SWEX3	SWEX3	SWEX3
	Sample_ID	HT061089	HT06108A	HT06108B		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	74.81	41.72	90.85	69.12	25.05
C1-NAPHTHALENE	ng/g, dry wt.	51.77	42.13	101.92	65.27	32.10
C2-NAPHTHALENE	ng/g, dry wt.	50.46	30.75	61.57	47.60	15.61
C3-NAPHTHALENE	ng/g, dry wt.	54.90	32.89	68.32	52.04	17.89
C4-NAPHTHALENES	ng/g, dry wt.	55.31	32.89	74.51	54.23	20.83
BIPHENYL	ng/g, dry wt.	7.25	4.63	9.40	7.09	2.39
ACENAPHTHYLENE	ng/g, dry wt.	36.53	18.10	41.61	32.08	12.37
ACENAPHTHENE	ng/g, dry wt.	12.51	8.54	15.18	12.08	3.34
DIBENZOFURAN	ng/g, dry wt.	14.90	10.36	18.14	14.46	3.91
FLUORENE	ng/g, dry wt.	26.24	16.92	35.71	26.29	9.40
C1-FLUORENES	ng/g, dry wt.	34.92	19.76	47.38	34.02	13.83
C2-FLUORENES	ng/g, dry wt.	39.56	23.24	65.79	42.87	21.47
C3-FLUORENES	ng/g, dry wt.	33.31	16.21	53.98	34.50	18.92
ANTHRACENE	ng/g, dry wt.	74.08	42.77	92.92	69.92	25.34
PHENANTHRENE	ng/g, dry wt.	256.35	168.38	326.15	250.29	79.06
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	252.31	128.06	344.43	241.60	108.58
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	215.98	120.95	330.37	222.43	104.86
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	122.52	65.69	195.41	127.87	65.02
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	53.09	28.77	55.53	45.80	14.79
DIBENZOTHIOPHENE	ng/g, dry wt.	19.98	13.36	25.45	19.60	6.05
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	37.75	22.29	57.64	39.23	17.72
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	47.03	26.96	88.14	54.04	31.19
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	49.66	28.14	81.96	53.25	27.09
1-METHYLNAPHTHALENE	ng/g, dry wt.	51.77	40.34	101.92	64.68	32.75
2-METHYLNAPHTHALENE	ng/g, dry wt.	22.51	18.94	42.02	27.82	12.42
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	9.99	6.34	13.09	9.81	3.38
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	15.28	8.30	18.42	14.00	5.18
1-METHYLPHENANTHRENE	ng/g, dry wt.	60.76	32.81	80.98	58.18	24.19
FLUORANTHENE	ng/g, dry wt.	561.14	350.99	731.03	547.72	190.37
PYRENE	ng/g, dry wt.	589.40	362.06	770.39	573.95	204.61
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	536.92	289.33	749.30	525.18	230.21
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	193.17	104.35	261.48	186.33	78.79
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	72.87	32.89	94.47	66.74	31.25
BENZ(A)ANTHRACENE	ng/g, dry wt.	278.44	161.88	368.07	269.46	103.39
CHRYSENE	ng/g, dry wt.	285.73	171.85	370.11	275.90	99.50
C1-CHRYSENES	ng/g, dry wt.	268.24	151.91	345.58	255.24	97.49
C2-CHRYSENES	ng/g, dry wt.	161.82	86.80	217.77	155.46	65.72
C3-CHRYSENES	ng/g, dry wt.	113.85	65.10	156.43	111.80	45.70
C4-CHRYSENES	ng/g, dry wt.	69.54	40.12	87.01	65.55	23.70
BENZO(B)FLUORANTHENE	ng/g, dry wt.	494.20	297.95	591.98	461.37	149.74
BENZO(K)FLUORANTHENE	ng/g, dry wt.	158.90	90.91	179.95	143.25	46.54
BENZO(E)PYRENE	ng/g, dry wt.	247.83	147.80	292.41	229.35	74.06
BENZO(A)PYRENE	ng/g, dry wt.	358.62	210.56	437.59	335.59	115.26
PERYLENE	ng/g, dry wt.	61.81	34.96	70.04	55.60	18.35
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	218.67	124.34	239.25	194.09	61.27
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	48.11	26.86	55.72	43.56	14.96
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	169.11	97.36	185.06	150.51	46.71
BENZOTHIAZOLE	ng/g, dry wt.	2.40	1.41	5.02	2.95	1.87
Totals						
Total PAH	ng/g, dry wt.	6188.22	3621.37	8055.53	5955.04	2226.26
Sum LMW PAH	ng/g, dry wt.	1565.90	910.61	2207.85	1561.46	648.63
Sum HMW PAH	ng/g, dry wt.	4622.31	2710.76	5847.68	4393.58	1580.92
% Pyrogenic PAH	%	74.70%	74.85%	72.59%	74.05%	1.26%

Table A-3. T01 PAH Data 2006 (cont'd)

	Station	T01	T01	T01	T01	T01
	Sample_ID	HT0610AA	HT0610AB	HT0610AF		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	24.34	30.11	17.41	23.95	6.36
C1-NAPHTHALENE	ng/g, dry wt.	29.54	20.76	14.64	21.64	7.49
C2-NAPHTHALENE	ng/g, dry wt.	36.02	23.29	33.67	31.00	6.78
C3-NAPHTHALENE	ng/g, dry wt.	49.68	36.64	59.69	48.67	11.56
C4-NAPHTHALENES	ng/g, dry wt.	60.14	52.98	62.20	58.44	4.84
BIPHENYL	ng/g, dry wt.	5.27	3.10	3.01	3.80	1.28
ACENAPHTHYLENE	ng/g, dry wt.	18.59	32.45	33.81	28.28	8.42
ACENAPHTHENE	ng/g, dry wt.	33.85	29.36	12.19	25.13	11.43
DIBENZOFURAN	ng/g, dry wt.	38.20	22.07	17.83	26.04	10.75
FLUORENE	ng/g, dry wt.	63.48	55.85	53.35	57.56	5.28
C1-FLUORENES	ng/g, dry wt.	41.25	50.66	51.77	47.89	5.78
C2-FLUORENES	ng/g, dry wt.	37.33	30.57	44.77	37.56	7.10
C3-FLUORENES	ng/g, dry wt.	22.95	18.32	23.64	21.64	2.89
ANTHRACENE	ng/g, dry wt.	149.62	192.05	236.38	192.68	43.39
PHENANTHRENE	ng/g, dry wt.	461.92	447.00	406.74	438.56	28.55
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	258.56	345.46	312.98	305.67	43.91
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	171.41	176.59	207.33	185.11	19.42
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	68.56	61.15	82.93	70.88	11.08
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	20.63	22.96	23.51	22.36	1.53
DIBENZOTHIOPHENE	ng/g, dry wt.	32.10	31.57	28.13	30.60	2.16
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	26.73	50.55	30.90	36.06	12.72
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	22.66	32.45	26.28	27.13	4.95
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	15.11	19.76	15.58	16.82	2.56
1-METHYLNAPHTHALENE	ng/g, dry wt.	22.00	16.89	11.47	16.78	5.27
2-METHYLNAPHTHALENE	ng/g, dry wt.	19.97	12.49	9.49	13.98	5.40
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	7.31	4.17	7.17	6.22	1.77
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	14.82	9.25	18.36	14.14	4.59
1-METHYLPHENANTHRENE	ng/g, dry wt.	55.49	78.58	67.35	67.14	11.55
FLUORANTHENE	ng/g, dry wt.	537.46	665.54	738.21	647.07	101.64
PYRENE	ng/g, dry wt.	418.34	609.25	534.84	520.81	96.22
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	318.12	556.27	478.05	450.81	121.39
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	98.63	128.03	134.70	120.45	19.19
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	27.02	29.14	39.35	31.84	6.60
BENZ(A)ANTHRACENE	ng/g, dry wt.	253.86	369.43	340.56	321.28	60.14
CHRYSENE	ng/g, dry wt.	221.28	302.35	281.13	268.25	42.04
C1-CHRYSENES	ng/g, dry wt.	173.77	251.29	238.85	221.30	41.63
C2-CHRYSENES	ng/g, dry wt.	100.59	104.12	115.42	106.71	7.75
C3-CHRYSENES	ng/g, dry wt.	62.31	56.77	80.57	66.55	12.45
C4-CHRYSENES	ng/g, dry wt.	40.18	60.97	50.51	50.56	10.39
BENZO(B)FLUORANTHENE	ng/g, dry wt.	301.38	415.48	420.55	379.14	67.39
BENZO(K)FLUORANTHENE	ng/g, dry wt.	94.76	126.15	130.28	117.06	19.43
BENZO(E)PYRENE	ng/g, dry wt.	137.11	193.22	183.99	171.44	30.09
BENZO(A)PYRENE	ng/g, dry wt.	214.49	329.38	305.13	283.00	60.56
PERYLENE	ng/g, dry wt.	44.12	60.27	62.74	55.71	10.11
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	142.54	200.23	201.13	181.30	33.57
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	35.70	48.16	46.17	43.34	6.69
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	99.64	143.17	137.14	126.65	23.58
BENZOTHIAZOLE	ng/g, dry wt.	19.14	3.52	3.04	8.56	9.16
Totals						
Total PAH	ng/g, dry wt.	4823.48	6224.74	6081.81	5710.01	771.08
Sum LMW PAH	ng/g, dry wt.	1627.80	1732.71	1736.54	1699.02	61.70
Sum HMW PAH	ng/g, dry wt.	3195.68	4492.03	4345.28	4010.99	709.89
% Pyrogenic PAH	%	66.25%	72.16%	71.45%	69.95%	3.23%

Table A-3. T02 PAH Data 2006 (cont'd)

	Station	T02	T02	T02	T02	T02
	Sample_ID	HT06102E	HT061030	HT061032		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	49.15	66.83	69.45	61.81	11.04
C1-NAPHTHALENE	ng/g, dry wt.	29.83	44.95	39.66	38.15	7.67
C2-NAPHTHALENE	ng/g, dry wt.	36.36	44.74	32.88	38.00	6.10
C3-NAPHTHALENE	ng/g, dry wt.	53.25	52.74	44.09	50.02	5.15
C4-NAPHTHALENES	ng/g, dry wt.	69.91	59.70	59.31	62.97	6.01
BIPHENYL	ng/g, dry wt.	6.97	7.61	7.06	7.21	0.34
ACENAPHTHYLENE	ng/g, dry wt.	44.59	43.32	35.56	41.16	4.89
ACENAPHTHENE	ng/g, dry wt.	23.27	19.21	16.68	19.72	3.32
DIBENZOFURAN	ng/g, dry wt.	21.65	20.37	18.02	20.01	1.84
FLUORENE	ng/g, dry wt.	39.61	35.07	32.64	35.77	3.54
C1-FLUORENES	ng/g, dry wt.	39.29	35.98	31.06	35.44	4.14
C2-FLUORENES	ng/g, dry wt.	49.57	44.36	31.91	41.94	9.07
C3-FLUORENES	ng/g, dry wt.	39.72	40.75	32.03	37.50	4.76
ANTHRACENE	ng/g, dry wt.	107.14	100.06	86.10	97.77	10.71
PHENANTHRENE	ng/g, dry wt.	346.32	322.36	302.03	323.57	22.17
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	265.15	265.62	218.00	249.59	27.36
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	238.10	229.52	185.12	217.58	28.44
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	128.79	132.81	112.53	124.71	10.74
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	63.20	62.28	54.44	59.97	4.82
DIBENZOTHIOPHENE	ng/g, dry wt.	26.08	26.30	23.26	25.22	1.70
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	37.12	38.81	30.08	35.34	4.63
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	28.03	28.88	22.17	26.36	3.66
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	48.92	56.61	49.69	51.74	4.23
1-METHYLNAPHTHALENE	ng/g, dry wt.	26.99	38.59	32.21	32.60	5.81
2-METHYLNAPHTHALENE	ng/g, dry wt.	15.63	21.28	21.54	19.48	3.34
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	7.62	8.72	6.48	7.60	1.12
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	11.04	10.91	8.03	9.99	1.70
1-METHYLPHENANTHRENE	ng/g, dry wt.	61.90	60.22	48.84	56.99	7.11
FLUORANTHENE	ng/g, dry wt.	856.06	836.84	725.85	806.25	70.29
PYRENE	ng/g, dry wt.	759.74	765.92	645.47	723.71	67.83
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	612.55	626.66	515.16	584.79	60.72
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	207.79	201.15	182.68	197.21	13.01
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	52.49	68.47	48.96	56.64	10.40
BENZ(A)ANTHRACENE	ng/g, dry wt.	365.13	354.68	319.13	346.31	24.11
CHRYSENE	ng/g, dry wt.	386.51	404.21	361.88	384.20	21.26
C1-CHRYSENES	ng/g, dry wt.	294.41	311.09	278.37	294.62	16.36
C2-CHRYSENES	ng/g, dry wt.	148.03	166.44	147.14	153.87	10.90
C3-CHRYSENES	ng/g, dry wt.	121.71	129.78	113.34	121.61	8.22
C4-CHRYSENES	ng/g, dry wt.	76.64	77.57	75.46	76.56	1.06
BENZO(B)FLUORANTHENE	ng/g, dry wt.	644.74	640.00	600.48	628.41	24.30
BENZO(K)FLUORANTHENE	ng/g, dry wt.	177.63	190.22	168.02	178.62	11.13
BENZO(E)PYRENE	ng/g, dry wt.	296.05	309.10	282.35	295.83	13.38
BENZO(A)PYRENE	ng/g, dry wt.	424.34	420.06	383.75	409.39	22.30
PERYLENE	ng/g, dry wt.	74.01	74.90	69.79	72.90	2.73
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	274.67	284.34	266.44	275.15	8.96
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	59.46	62.02	57.36	59.61	2.33
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	203.13	214.99	200.82	206.31	7.60
BENZOTHIAZOLE	ng/g, dry wt.	6.92	25.26	177.14	69.77	93.44
Totals						
Total PAH	ng/g, dry wt.	7496.91	7588.02	6685.26	7256.73	497.00
Sum LMW PAH	ng/g, dry wt.	1722.09	1719.19	1474.45	1638.58	142.14
Sum HMW PAH	ng/g, dry wt.	5774.82	5868.83	5210.80	5618.15	355.89
% Pyrogenic PAH	%	77.03%	77.34%	77.94%	77.44%	0.47%

Table A-3. T03 PAH Data 2006 (cont'd)

	Station	T03	T03	T03	T03	T03
	Sample_ID	HT061090	HT061096	HT061097		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	116.25	75.62	18.67	70.18	49.02
C1-NAPHTHALENE	ng/g, dry wt.	166.67	121.11	24.67	104.15	72.51
C2-NAPHTHALENE	ng/g, dry wt.	115.20	94.38	23.87	77.82	47.86
C3-NAPHTHALENE	ng/g, dry wt.	107.37	93.78	26.95	76.03	43.05
C4-NAPHTHALENES	ng/g, dry wt.	93.17	77.59	27.97	66.24	34.05
BIPHENYL	ng/g, dry wt.	16.11	12.13	3.20	10.48	6.61
ACENAPHTHYLENE	ng/g, dry wt.	25.61	33.58	12.50	23.90	10.64
ACENAPHTHENE	ng/g, dry wt.	20.47	19.06	7.52	15.68	7.10
DIBENZOFURAN	ng/g, dry wt.	19.35	21.18	7.00	15.84	7.71
FLUORENE	ng/g, dry wt.	35.34	32.97	12.09	26.80	12.80
C1-FLUORENES	ng/g, dry wt.	52.12	40.84	12.91	35.29	20.19
C2-FLUORENES	ng/g, dry wt.	56.37	58.99	16.70	44.02	23.69
C3-FLUORENES	ng/g, dry wt.	44.29	41.14	12.91	32.78	17.28
ANTHRACENE	ng/g, dry wt.	89.81	94.08	33.81	72.57	33.63
PHENANTHRENE	ng/g, dry wt.	325.47	337.29	140.37	267.71	110.44
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	313.17	249.56	93.34	218.69	113.12
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	279.61	229.90	76.74	195.42	105.74
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	161.06	131.59	43.65	112.10	61.08
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	82.88	57.48	16.09	52.15	33.71
DIBENZOTHIOPHENE	ng/g, dry wt.	28.07	27.53	10.76	22.12	9.84
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	53.35	40.38	13.93	35.89	20.09
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	60.96	47.95	14.75	41.22	23.82
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	66.10	54.75	13.93	44.93	27.44
1-METHYLNAPHTHALENE	ng/g, dry wt.	167.37	121.68	23.67	104.24	73.42
2-METHYLNAPHTHALENE	ng/g, dry wt.	65.83	46.34	11.38	41.18	27.59
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	28.97	27.98	5.19	20.71	13.45
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	22.82	18.00	6.85	15.89	8.19
1-METHYLPHENANTHRENE	ng/g, dry wt.	68.34	52.64	21.21	47.39	24.00
FLUORANTHENE	ng/g, dry wt.	693.44	674.58	281.76	549.93	232.43
PYRENE	ng/g, dry wt.	640.87	564.16	233.61	479.55	216.42
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	539.09	455.26	168.03	387.46	194.60
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	200.20	176.96	52.15	143.11	79.62
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	68.00	58.84	16.19	47.68	27.65
BENZ(A)ANTHRACENE	ng/g, dry wt.	304.05	342.77	120.69	255.84	118.63
CHRYSENE	ng/g, dry wt.	316.07	333.51	121.55	257.04	117.66
C1-CHRYSENES	ng/g, dry wt.	261.10	272.63	90.52	208.08	101.98
C2-CHRYSENES	ng/g, dry wt.	163.19	170.72	50.78	128.23	67.18
C3-CHRYSENES	ng/g, dry wt.	119.39	122.68	40.52	94.20	46.52
C4-CHRYSENES	ng/g, dry wt.	58.06	78.88	25.26	54.07	27.03
BENZO(B)FLUORANTHENE	ng/g, dry wt.	486.13	559.82	205.17	417.04	187.15
BENZO(K)FLUORANTHENE	ng/g, dry wt.	153.74	173.37	62.50	129.87	59.16
BENZO(E)PYRENE	ng/g, dry wt.	239.63	276.60	100.00	205.41	93.14
BENZO(A)PYRENE	ng/g, dry wt.	336.69	369.24	137.07	281.00	125.70
PERYLENE	ng/g, dry wt.	58.75	70.27	26.72	51.92	22.56
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	207.85	267.34	102.59	192.59	83.43
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	47.32	60.35	22.33	43.33	19.32
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	161.47	201.16	79.74	147.46	61.91
BENZOTHIAZOLE	ng/g, dry wt.	6.21	12.00	3.97	7.39	4.14
Totals						
Total PAH	ng/g, dry wt.	7022.47	6908.62	2505.19	5478.76	2575.82
Sum LMW PAH	ng/g, dry wt.	2235.62	1915.27	636.36	1595.75	846.16
Sum HMW PAH	ng/g, dry wt.	4786.84	4993.35	1868.83	3883.01	1747.38
% Pyrogenic PAH	%	68.16%	72.28%	74.60%	71.68%	3.26%

Table A-3. T05A PAH Data 2006 (cont'd)

	Station	T05A	T05A	T05A	T05A	T05A
	Sample_ID	HT06109D	HT06109E	HT0610A1		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	110.68	39.00	60.00	69.89	36.85
C1-NAPHTHALENE	ng/g, dry wt.	74.62	24.83	43.49	47.65	25.15
C2-NAPHTHALENE	ng/g, dry wt.	54.09	33.20	40.53	42.61	10.59
C3-NAPHTHALENE	ng/g, dry wt.	67.37	42.19	47.87	52.48	13.21
C4-NAPHTHALENES	ng/g, dry wt.	110.41	54.95	81.97	82.44	27.73
BIPHENYL	ng/g, dry wt.	8.40	5.29	6.95	6.88	1.56
ACENAPHTHYLENE	ng/g, dry wt.	40.33	36.72	41.44	39.49	2.47
ACENAPHTHENE	ng/g, dry wt.	105.94	28.39	47.31	60.54	40.44
DIBENZOFURAN	ng/g, dry wt.	69.02	22.66	49.68	47.12	23.29
FLUORENE	ng/g, dry wt.	129.34	51.43	71.58	84.12	40.44
C1-FLUORENES	ng/g, dry wt.	79.72	44.01	58.49	60.74	17.96
C2-FLUORENES	ng/g, dry wt.	62.20	46.09	60.52	56.27	8.85
C3-FLUORENES	ng/g, dry wt.	37.39	47.92	26.53	37.28	10.69
ANTHRACENE	ng/g, dry wt.	264.55	140.63	142.26	182.48	71.08
PHENANTHRENE	ng/g, dry wt.	1085.25	346.35	675.18	702.26	370.19
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	537.33	263.02	404.20	401.52	137.18
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	317.46	222.66	266.46	268.86	47.45
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	136.39	108.46	123.07	122.64	13.97
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	45.39	38.28	42.90	42.19	3.61
DIBENZOTHIOPHENE	ng/g, dry wt.	70.55	26.30	47.42	48.09	22.13
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	70.08	35.29	56.23	53.86	17.52
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	66.43	43.36	59.05	56.28	11.78
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	54.67	37.89	46.07	46.21	8.39
1-METHYLNAPHTHALENE	ng/g, dry wt.	62.18	20.33	35.24	39.25	21.21
2-METHYLNAPHTHALENE	ng/g, dry wt.	44.52	14.30	25.77	28.20	15.26
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	8.69	5.51	7.98	7.39	1.67
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	18.46	12.10	13.55	14.70	3.33
1-METHYLPHENANTHRENE	ng/g, dry wt.	134.04	61.20	100.49	98.57	36.46
FLUORANTHENE	ng/g, dry wt.	1399.18	580.73	914.54	964.82	411.54
PYRENE	ng/g, dry wt.	1127.58	544.27	751.95	807.93	295.66
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	803.06	541.67	666.14	670.29	130.75
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	293.95	221.35	280.01	265.10	38.52
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	53.73	54.56	67.74	58.68	7.86
BENZ(A)ANTHRACENE	ng/g, dry wt.	632.31	294.49	458.66	461.82	168.93
CHRYSENE	ng/g, dry wt.	539.45	274.36	408.50	407.44	132.55
C1-CHRYSENES	ng/g, dry wt.	420.07	266.95	363.45	350.16	77.42
C2-CHRYSENES	ng/g, dry wt.	176.87	140.89	180.19	165.98	21.79
C3-CHRYSENES	ng/g, dry wt.	118.28	85.28	110.57	104.71	17.27
C4-CHRYSENES	ng/g, dry wt.	99.05	50.85	75.86	75.25	24.11
BENZO(B)FLUORANTHENE	ng/g, dry wt.	709.69	346.40	559.00	538.36	182.52
BENZO(K)FLUORANTHENE	ng/g, dry wt.	225.51	111.23	163.81	166.85	57.20
BENZO(E)PYRENE	ng/g, dry wt.	338.26	172.67	264.14	258.36	82.95
BENZO(A)PYRENE	ng/g, dry wt.	543.88	294.49	425.90	421.42	124.75
PERYLENE	ng/g, dry wt.	116.07	47.99	86.72	83.59	34.15
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	363.69	143.01	292.81	266.50	112.67
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	83.35	35.17	69.21	62.58	24.77
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	263.09	100.00	209.88	190.99	83.17
BENZOTHIAZOLE	ng/g, dry wt.	41.79	5.70	7.61	18.37	20.30
Totals						
Total PAH	ng/g, dry wt.	11446.59	5714.40	8418.56	8526.52	2867.62
Sum LMW PAH	ng/g, dry wt.	3487.19	1683.96	2417.22	2529.46	906.84
Sum HMW PAH	ng/g, dry wt.	7959.40	4030.44	6001.33	5997.06	1964.49
% Pyrogenic PAH	%	69.54%	70.53%	71.29%	70.45%	0.88%

Table A-3. T06 PAH Data 2006 (cont'd)

	Station	T06	T06	T06	T06	T06
	Sample_ID	HT061019	HT06101C	HT061020		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	23.79	24.23	37.98	28.66	8.07
C1-NAPHTHALENE	ng/g, dry wt.	26.14	21.05	28.67	25.29	3.88
C2-NAPHTHALENE	ng/g, dry wt.	32.16	27.88	25.96	28.67	3.18
C3-NAPHTHALENE	ng/g, dry wt.	41.00	34.73	34.51	36.75	3.69
C4-NAPHTHALENES	ng/g, dry wt.	48.08	35.53	41.91	41.84	6.28
BIPHENYL	ng/g, dry wt.	4.15	3.98	4.57	4.23	0.30
ACENAPHTHYLENE	ng/g, dry wt.	18.81	15.93	19.87	18.20	2.04
ACENAPHTHENE	ng/g, dry wt.	17.05	13.88	19.87	16.93	3.00
DIBENZOFURAN	ng/g, dry wt.	14.15	12.89	16.97	14.67	2.09
FLUORENE	ng/g, dry wt.	24.28	21.51	27.70	24.50	3.10
C1-FLUORENES	ng/g, dry wt.	22.19	19.91	22.33	21.48	1.36
C2-FLUORENES	ng/g, dry wt.	23.96	28.68	25.96	26.20	2.37
C3-FLUORENES	ng/g, dry wt.	9.86	15.91	19.14	14.97	4.71
ANTHRACENE	ng/g, dry wt.	76.86	54.01	69.75	66.87	11.70
PHENANTHRENE	ng/g, dry wt.	307.13	210.29	259.57	259.00	48.42
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	191.35	144.65	168.21	168.07	23.35
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	146.81	111.04	136.60	131.48	18.43
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	72.68	53.85	64.24	63.59	9.43
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	45.35	21.67	26.83	31.28	12.45
DIBENZOTHIOPHENE	ng/g, dry wt.	21.39	15.34	19.43	18.72	3.08
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	24.28	19.75	21.17	21.74	2.32
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	19.94	19.12	12.24	17.10	4.23
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	12.74	15.13	19.43	15.77	3.39
1-METHYLNAPHTHALENE	ng/g, dry wt.	21.60	18.39	24.75	21.58	3.18
2-METHYLNAPHTHALENE	ng/g, dry wt.	11.96	10.34	14.44	12.25	2.06
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	17.21	14.96	6.00	12.72	5.93
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	10.32	6.98	6.66	7.99	2.03
1-METHYLPHENANTHRENE	ng/g, dry wt.	40.04	32.50	39.44	37.33	4.19
FLUORANTHENE	ng/g, dry wt.	667.33	431.73	561.19	553.42	117.99
PYRENE	ng/g, dry wt.	533.86	363.22	462.59	453.22	85.70
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	358.59	259.67	327.73	315.33	50.61
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	77.51	59.58	98.17	78.42	19.31
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	32.00	30.11	40.31	34.14	5.43
BENZ(A)ANTHRACENE	ng/g, dry wt.	246.25	170.43	235.43	217.37	41.01
CHRYSENE	ng/g, dry wt.	248.63	176.83	252.51	225.99	42.62
C1-CHRYSENES	ng/g, dry wt.	164.17	137.11	175.66	158.98	19.79
C2-CHRYSENES	ng/g, dry wt.	86.96	73.94	91.37	84.09	9.06
C3-CHRYSENES	ng/g, dry wt.	66.62	56.51	71.97	65.03	7.85
C4-CHRYSENES	ng/g, dry wt.	45.44	31.27	43.06	39.92	7.59
BENZO(B)FLUORANTHENE	ng/g, dry wt.	410.41	288.31	411.09	369.94	70.69
BENZO(K)FLUORANTHENE	ng/g, dry wt.	124.91	95.98	120.03	113.64	15.49
BENZO(E)PYRENE	ng/g, dry wt.	192.72	140.95	190.30	174.66	29.21
BENZO(A)PYRENE	ng/g, dry wt.	278.37	199.90	264.71	247.66	41.92
PERYLENE	ng/g, dry wt.	59.72	40.49	49.16	49.79	9.63
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	208.18	148.64	180.54	179.12	29.80
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	41.64	30.50	37.82	36.65	5.66
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	44.97	32.93	131.74	69.88	53.91
BENZOTHIAZOLE	ng/g, dry wt.	11.42	15.06	42.51	23.00	17.00
Totals						
Total PAH	ng/g, dry wt.	4954.83	3583.82	4687.87	4408.84	726.85
Sum LMW PAH	ng/g, dry wt.	1176.08	905.41	1081.00	1054.16	137.31
Sum HMW PAH	ng/g, dry wt.	3778.76	2678.41	3606.87	3354.68	591.94
% Pyrogenic PAH	%	76.26%	74.74%	76.94%	75.98%	1.13%

Table A-3. T07 PAH Data 2006 (cont'd)

	Station	T07	T07	T07	T07	T07
	Sample_ID	HT061026	HT061027	HT061029		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	37.25	50.58	39.82	42.55	7.07
C1-NAPHTHALENE	ng/g, dry wt.	29.03	36.23	27.28	30.85	4.75
C2-NAPHTHALENE	ng/g, dry wt.	34.30	35.43	33.99	34.57	0.76
C3-NAPHTHALENE	ng/g, dry wt.	44.88	47.80	43.53	45.40	2.18
C4-NAPHTHALENES	ng/g, dry wt.	56.10	50.05	59.77	55.31	4.91
BIPHENYL	ng/g, dry wt.	6.17	6.72	6.14	6.34	0.32
ACENAPHTHYLENE	ng/g, dry wt.	29.81	30.67	30.31	30.26	0.43
ACENAPHTHENE	ng/g, dry wt.	15.16	13.79	17.92	15.62	2.10
DIBENZOFURAN	ng/g, dry wt.	18.27	17.12	18.25	17.88	0.66
FLUORENE	ng/g, dry wt.	25.48	24.61	27.79	25.96	1.64
C1-FLUORENES	ng/g, dry wt.	25.64	30.20	26.45	27.43	2.43
C2-FLUORENES	ng/g, dry wt.	33.82	35.55	28.63	32.67	3.60
C3-FLUORENES	ng/g, dry wt.	25.00	27.35	22.94	25.10	2.21
ANTHRACENE	ng/g, dry wt.	68.60	60.64	67.64	65.63	4.35
PHENANTHRENE	ng/g, dry wt.	288.50	243.73	294.68	275.64	27.80
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	205.16	194.99	192.55	197.56	6.69
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	174.70	166.45	154.71	165.29	10.05
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	75.97	104.87	85.72	88.85	14.70
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	38.95	59.92	40.18	46.35	11.77
DIBENZOTHIOPHENE	ng/g, dry wt.	21.00	20.09	22.27	21.12	1.09
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	28.85	28.18	29.47	28.83	0.65
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	29.81	21.16	31.98	27.65	5.72
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	29.97	41.38	30.64	34.00	6.40
1-METHYLNAPHTHALENE	ng/g, dry wt.	26.05	33.40	25.52	28.33	4.41
2-METHYLNAPHTHALENE	ng/g, dry wt.	13.87	16.78	13.46	14.70	1.81
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	18.75	7.48	19.76	15.33	6.82
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	8.86	8.56	8.52	8.65	0.19
1-METHYLPHENANTHRENE	ng/g, dry wt.	43.44	41.49	41.86	42.26	1.03
FLUORANTHENE	ng/g, dry wt.	626.69	626.57	624.52	625.93	1.22
PYRENE	ng/g, dry wt.	538.53	569.51	532.43	546.82	19.88
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	399.09	437.53	371.70	402.77	33.07
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	104.50	161.70	104.81	123.67	32.93
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	50.01	63.37	52.07	55.15	7.19
BENZ(A)ANTHRACENE	ng/g, dry wt.	239.50	260.74	240.37	246.87	12.02
CHRYSENE	ng/g, dry wt.	268.82	302.97	273.97	281.92	18.41
C1-CHRYSENES	ng/g, dry wt.	217.50	235.95	205.48	219.64	15.35
C2-CHRYSENES	ng/g, dry wt.	121.09	139.55	123.93	128.19	9.94
C3-CHRYSENES	ng/g, dry wt.	93.11	116.60	104.16	104.62	11.75
C4-CHRYSENES	ng/g, dry wt.	58.77	61.33	57.90	59.33	1.78
BENZO(B)FLUORANTHENE	ng/g, dry wt.	477.77	530.66	472.99	493.81	32.01
BENZO(K)FLUORANTHENE	ng/g, dry wt.	135.63	160.67	152.49	149.60	12.77
BENZO(E)PYRENE	ng/g, dry wt.	229.72	255.23	235.20	240.05	13.43
BENZO(A)PYRENE	ng/g, dry wt.	311.59	321.34	316.62	316.51	4.87
PERYLENE	ng/g, dry wt.	59.63	60.41	60.87	60.30	0.63
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	230.94	242.38	233.91	235.74	5.94
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	47.17	51.60	47.69	48.82	2.42
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	43.50	181.78	42.90	89.40	80.01
BENZOTHIAZOLE	ng/g, dry wt.	18.79	67.75	19.45	35.33	28.08
Totals						
Total PAH	ng/g, dry wt.	5385.38	5852.29	5370.02	5535.90	274.12
Sum LMW PAH	ng/g, dry wt.	1286.33	1297.46	1272.90	1285.56	12.30
Sum HMW PAH	ng/g, dry wt.	4099.06	4554.84	4097.12	4250.34	263.71
% Pyrogenic PAH	%	76.11%	77.83%	76.30%	76.75%	0.94%

Table A-3. T08 PAH Data 2006 (cont'd)

	Station	T08	T08	T08	T08	T08
	Sample_ID	HT06100D	HT061011	HT061013		
	Units	Value	Value	Value	Mean	STD
NAPHTHALENE	ng/g, dry wt.	6.93	5.60	17.82	10.12	6.70
C1-NAPHTHALENE	ng/g, dry wt.	5.95	5.75	15.84	9.18	5.77
C2-NAPHTHALENE	ng/g, dry wt.	7.43	8.08	25.89	13.80	10.47
C3-NAPHTHALENE	ng/g, dry wt.	13.50	11.49	27.73	17.58	8.85
C4-NAPHTHALENES	ng/g, dry wt.	16.84	9.51	32.85	19.74	11.94
BIPHENYL	ng/g, dry wt.	0.99	0.80	3.23	1.67	1.35
ACENAPHTHYLENE	ng/g, dry wt.	11.62	5.03	14.79	10.48	4.98
ACENAPHTHENE	ng/g, dry wt.	4.61	1.44	27.88	11.31	14.44
DIBENZOFURAN	ng/g, dry wt.	3.97	2.05	20.20	8.74	9.97
FLUORENE	ng/g, dry wt.	8.29	3.62	39.68	17.20	19.61
C1-FLUORENES	ng/g, dry wt.	9.56	4.76	24.18	12.83	10.11
C2-FLUORENES	ng/g, dry wt.	13.77	7.90	18.63	13.43	5.37
C3-FLUORENES	ng/g, dry wt.	5.24	7.21	23.33	11.92	9.92
ANTHRACENE	ng/g, dry wt.	20.99	7.67	74.24	34.30	35.22
PHENANTHRENE	ng/g, dry wt.	91.04	36.55	231.83	119.81	100.77
C1-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	67.65	33.65	142.23	81.17	55.54
C2-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	51.07	27.47	83.91	54.15	28.35
C3-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	20.72	12.85	28.73	20.77	7.94
C4-PHENANTHRENES/ANTHRACENES	ng/g, dry wt.	11.03	5.49	10.57	9.03	3.07
DIBENZOTHIOPHENE	ng/g, dry wt.	6.39	2.96	16.07	8.47	6.80
C1-DIBENZOTHIOPHENES	ng/g, dry wt.	9.89	5.71	18.63	11.41	6.59
C2-DIBENZOTHIOPHENES	ng/g, dry wt.	8.94	5.82	15.93	10.23	5.18
C3-DIBENZOTHIOPHENES	ng/g, dry wt.	8.03	4.34	10.44	7.60	3.07
1-METHYLNAPHTHALENE	ng/g, dry wt.	4.34	5.28	11.26	6.96	3.75
2-METHYLNAPHTHALENE	ng/g, dry wt.	3.16	2.56	10.81	5.51	4.60
2,6-DIMETHYLNAPHTHALENE	ng/g, dry wt.	3.01	1.84	4.08	2.98	1.12
2,3,5-TRIMETHYLNAPHTHALENE	ng/g, dry wt.	2.70	1.74	6.77	3.74	2.67
1-METHYLPHENANTHRENE	ng/g, dry wt.	16.04	8.00	33.14	19.06	12.84
FLUORANTHENE	ng/g, dry wt.	153.74	69.06	261.70	161.50	96.55
PYRENE	ng/g, dry wt.	128.21	61.12	209.07	132.80	74.08
C1-FLUORANTHENES/PYRENES	ng/g, dry wt.	106.68	48.02	196.27	116.99	74.66
C2-FLUORANTHENES/PYRENES	ng/g, dry wt.	37.30	19.16	45.09	33.85	13.31
C3-FLUORANTHENES/PYRENES	ng/g, dry wt.	15.37	8.62	18.49	14.16	5.05
BENZ(A)ANTHRACENE	ng/g, dry wt.	60.30	28.30	113.83	67.48	43.22
CHRYSENE	ng/g, dry wt.	71.24	32.09	103.54	68.96	35.78
C1-CHRYSENES	ng/g, dry wt.	52.04	26.45	90.63	56.37	32.31
C2-CHRYSENES	ng/g, dry wt.	29.83	15.39	38.75	27.99	11.78
C3-CHRYSENES	ng/g, dry wt.	23.39	12.36	25.83	20.53	7.18
C4-CHRYSENES	ng/g, dry wt.	13.20	6.58	19.59	13.12	6.51
BENZO(B)FLUORANTHENE	ng/g, dry wt.	107.19	45.64	140.10	97.64	47.95
BENZO(K)FLUORANTHENE	ng/g, dry wt.	39.27	15.18	46.74	33.73	16.49
BENZO(E)PYRENE	ng/g, dry wt.	49.68	22.98	64.80	45.82	21.17
BENZO(A)PYRENE	ng/g, dry wt.	72.42	30.68	104.53	69.21	37.03
PERYLENE	ng/g, dry wt.	13.09	6.56	21.23	13.63	7.35
INDENO(1,2,3-C,D)PYRENE	ng/g, dry wt.	60.41	22.88	66.66	49.98	23.68
DIBENZO(A,H)ANTHRACENE	ng/g, dry wt.	21.35	4.73	15.54	13.87	8.44
BENZO(G,H,I)PERYLENE	ng/g, dry wt.	8.95	4.00	15.10	9.35	5.56
BENZOTHIAZOLE	ng/g, dry wt.	4.62	4.18	10.58	6.46	3.57
Totals						
Total PAH	ng/g, dry wt.	1398.63	658.28	2425.68	1494.20	887.56
Sum LMW PAH	ng/g, dry wt.	387.63	206.26	891.77	495.22	355.19
Sum HMW PAH	ng/g, dry wt.	1011.00	452.03	1533.91	998.98	541.04
% Pyrogenic PAH	%	72.28%	68.67%	63.24%	68.06%	4.55%

Table A-4. DB01 PCB/Pesticide Data 2006.

	Station	DB01	DB01	DB01	DB01	DB01
	Sample_ID	HT0610C0	HT0610C1	HT0610C2		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	1.86	1.85	1.61	1.77	0.14
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.89	0.84	0.81	0.85	0.04
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	3.47	3.55	3.03	3.35	0.28
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	3.83	3.26	3.63	3.57	0.29
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	5.81	5.12	5.57	5.50	0.35
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	5.94	5.76	5.23	5.64	0.37
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	1.22	1.25	0.00	0.82	0.71
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	17.33	14.90	16.21	16.15	1.22
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	8.28	7.22	7.93	7.81	0.54
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	19.04	17.09	17.54	17.89	1.02
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	7.36	6.02	6.68	6.69	0.67
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	16.60	15.48	15.28	15.79	0.71
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	12.07	11.38	11.04	11.50	0.52
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	2.12	2.07	2.05	2.08	0.04
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	4.71	4.33	4.09	4.38	0.31
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	3.49	3.20	3.04	3.24	0.23
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.87	0.52	0.52	0.64	0.21
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	2.18	1.32	1.29	1.60	0.51
Decachlorobiphenyl	ng/g, dry wt.	3.21	1.98	1.67	2.29	0.81
DDTs						
o,p'-DDD	ng/g, dry wt.	2.08	1.26	1.49	1.61	0.42
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	7.78	5.43	5.54	6.25	1.33
p,p'-DDE	ng/g, dry wt.	5.52	3.88	4.11	4.50	0.89
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	2.14	1.51	1.41	1.69	0.40
trans-Nonachlor	ng/g, dry wt.	0.95	0.63	0.65	0.74	0.18
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.42	0.31	0.32	0.35	0.06
gamma-Chlordane	ng/g, dry wt.	2.24	1.55	1.42	1.74	0.44
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	1.84	15.92	1.27	6.34	8.30
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_PCB Congeners	ng/g, dry wt.	120.25	107.13	107.23	111.54	7.55
Sum4_Chlordanes	ng/g, dry wt.	3.10	2.14	2.06	2.43	0.58
Sum5_DDTs	ng/g, dry wt.	15.38	10.56	11.14	12.36	2.63

Table A-4. DB04 PCB/Pesticide Data 2006 (cont'd)

	Station	DB04	DB04	DB04	DB04	DB04
	Sample_ID	HT0610B4	HT0610B7	HT0610B8		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	1.68	1.61	1.35	1.55	0.17
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.94	0.62	0.49	0.68	0.23
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	3.26	3.15	2.51	2.98	0.41
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	2.59	2.71	1.85	2.38	0.46
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	3.01	3.50	2.26	2.92	0.62
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	4.75	5.06	4.02	4.61	0.54
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	1.07	1.20	0.91	1.06	0.14
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	9.42	11.50	8.00	9.64	1.76
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	5.31	6.14	4.62	5.35	0.76
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	12.53	14.46	10.95	12.65	1.76
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	4.43	5.09	3.90	4.47	0.60
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	11.51	12.94	10.07	11.51	1.43
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	8.69	9.63	7.45	8.59	1.10
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	1.64	2.01	1.46	1.71	0.28
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	3.33	4.45	2.97	3.58	0.77
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	2.75	3.05	2.40	2.73	0.33
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.53	0.59	0.46	0.53	0.06
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.93	1.10	1.03	1.02	0.08
Decachlorobiphenyl	ng/g, dry wt.	1.17	1.13	1.01	1.10	0.09
DDTs						
o,p'-DDD	ng/g, dry wt.	0.87	0.81	0.67	0.78	0.10
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	3.48	3.41	2.71	3.20	0.43
p,p'-DDE	ng/g, dry wt.	3.14	2.98	2.76	2.96	0.19
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.74	0.83	0.72	0.77	0.06
trans-Nonachlor	ng/g, dry wt.	0.42	0.41	0.36	0.40	0.03
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.22	0.23	0.19	0.22	0.02
gamma-Chlordane	ng/g, dry wt.	0.79	0.85	0.79	0.81	0.04
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.55	4.45	0.60	1.87	2.24
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	79.54	89.95	67.71	79.07	11.13
Sum4_Chlordanes	ng/g, dry wt.	1.16	1.25	1.08	1.16	0.08
Sum5_DDTs	ng/g, dry wt.	7.50	7.20	6.14	6.95	0.72

Table A-4. T04(/DB13) PCB/Pesticide Data 2006 (cont'd)

	Station	T04(/DB13)	T04(/DB13)	T04(/DB13)	T04(/DB13)	T04(/DB13)
	Sample_ID	HT06106E	HT06106F	HT061070		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	6.98	8.28	7.88	7.71	0.66
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	4.02	4.83	4.24	4.36	0.42
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	17.39	19.56	17.14	18.03	1.33
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	12.32	14.05	12.80	13.06	0.89
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	15.76	17.18	16.13	16.36	0.74
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	21.33	23.23	21.70	22.09	1.01
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	23.44	25.41	23.48	24.11	1.13
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	11.72	11.88	11.49	11.70	0.19
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	26.32	28.26	25.24	26.61	1.53
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	9.35	8.97	8.13	8.82	0.62
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	23.32	27.34	23.97	24.87	2.16
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	17.19	19.06	17.48	17.91	1.00
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	5.11	5.83	4.65	5.20	0.60
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	9.02	10.71	9.33	9.69	0.90
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	5.47	6.23	5.70	5.80	0.39
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	1.17	1.17	1.14	1.16	0.02
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	1.90	2.25	1.93	2.03	0.19
Decachlorobiphenyl	ng/g, dry wt.	2.30	2.55	1.76	2.21	0.40
DDTs						
o,p'-DDD	ng/g, dry wt.	2.77	6.18	2.69	3.88	1.99
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	10.15	22.19	10.57	14.30	6.83
p,p'-DDE	ng/g, dry wt.	7.29	8.77	6.91	7.65	0.98
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	4.52	5.53	4.65	4.90	0.55
trans-Nonachlor	ng/g, dry wt.	1.43	1.78	1.30	1.50	0.24
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.64	0.78	0.58	0.67	0.10
gamma-Chlordane	ng/g, dry wt.	4.68	5.63	4.71	5.01	0.54
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	2.02	2.93	3.01	2.66	0.55
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	214.12	236.77	214.19	221.70	13.06
Sum4_Chlordanes	ng/g, dry wt.	5.96	7.30	5.96	6.41	0.78
Sum5_DDTs	ng/g, dry wt.	20.21	37.13	20.17	25.84	9.78

Table A-4. DB10 PCB/Pesticide Data 2006 (cont'd)

	Station	DB10	DB10	DB10	DB10	DB10
	Sample_ID	HT06105C	HT061061	HT061063		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	15.74	11.15	17.86	14.92	3.43
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	11.15	8.89	12.17	10.74	1.68
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	44.55	33.89	46.54	41.66	6.80
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	29.47	22.85	30.17	27.50	4.04
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	39.13	29.74	39.63	36.17	5.57
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	51.32	39.36	53.44	48.04	7.60
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	9.01	6.30	9.18	8.16	1.62
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	43.17	33.50	46.54	41.07	6.77
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	21.59	15.83	23.40	20.27	3.95
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	46.20	34.75	55.08	45.34	10.19
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	13.96	10.91	14.33	13.07	1.88
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	34.25	28.09	37.86	33.40	4.94
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	24.18	20.95	27.08	24.07	3.07
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	7.11	6.46	7.57	7.05	0.56
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	12.87	14.23	13.86	13.65	0.70
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	8.28	9.01	8.46	8.58	0.38
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	1.41	1.60	1.49	1.50	0.10
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	2.86	3.76	3.29	3.30	0.45
Decachlorobiphenyl	ng/g, dry wt.	2.99	1.95	3.23	2.72	0.68
DDTs						
o,p'-DDD	ng/g, dry wt.	7.22	10.04	8.88	8.71	1.42
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	26.37	30.65	29.65	28.89	2.24
p,p'-DDE	ng/g, dry wt.	15.10	10.73	14.02	13.28	2.28
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	4.02	4.65	3.65	4.11	0.51
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	7.48	5.97	6.43	6.63	0.77
trans-Nonachlor	ng/g, dry wt.	3.12	2.08	2.77	2.66	0.53
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	1.46	0.96	1.29	1.24	0.25
gamma-Chlordane	ng/g, dry wt.	7.29	5.95	6.45	6.56	0.68
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	1.29	1.01	2.14	1.48	0.59
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	419.22	333.21	451.20	401.21	61.02
Sum4_Chlordanes	ng/g, dry wt.	10.60	8.05	9.20	9.28	1.28
Sum5_DDTs	ng/g, dry wt.	48.68	51.42	52.54	50.88	1.99

Table A-4. DB14 PCB/Pesticide Data 2006 (cont'd)

	Station	DB14	DB14	DB14	DB14	DB14
	Sample_ID	HT061067	HT061068	HT061069		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	12.23	8.50	9.55	10.09	1.92
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	7.26	5.09	6.25	6.20	1.09
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	24.89	16.76	18.42	20.02	4.30
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	18.78	12.80	14.80	15.46	3.04
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	21.67	14.86	16.74	17.76	3.52
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	27.90	19.81	21.43	23.05	4.28
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	38.99	24.22	29.87	31.03	7.45
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	17.49	11.52	12.37	13.79	3.23
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	39.90	26.87	34.26	33.68	6.53
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	11.97	7.00	17.42	12.13	5.21
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	41.45	22.21	29.25	30.97	9.73
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	30.05	15.72	21.93	22.57	7.19
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	18.51	3.62	6.40	9.51	7.92
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	10.82	6.61	9.25	8.89	2.13
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	6.07	4.00	5.21	5.09	1.04
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.98	0.66	0.87	0.83	0.16
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	1.57	1.13	1.48	1.39	0.23
Decachlorobiphenyl	ng/g, dry wt.	1.77	1.45	1.77	1.66	0.18
DDTs						
o,p'-DDD	ng/g, dry wt.	4.67	2.80	5.45	4.31	1.36
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	17.56	10.36	18.51	15.48	4.45
p,p'-DDE	ng/g, dry wt.	11.04	8.91	11.24	10.39	1.29
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	8.54	5.48	7.38	7.14	1.54
trans-Nonachlor	ng/g, dry wt.	2.80	1.57	2.61	2.33	0.66
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	1.09	0.61	0.94	0.88	0.24
gamma-Chlordane	ng/g, dry wt.	8.20	5.22	7.27	6.90	1.53
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	1.44	0.79	0.85	1.03	0.36
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	332.29	202.83	257.26	264.13	65.00
Sum4_Chlordanes	ng/g, dry wt.	11.34	7.05	9.99	9.46	2.19
Sum5_DDTs	ng/g, dry wt.	33.27	22.07	35.19	30.18	7.09

Table A-4. C019 PCB/Pesticide Data 2006 (cont'd)

	Station	C019	C019	C019	C019	C019
	Sample_ID	HT06103B	HT061041	HT061046		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	3.73	3.38	4.05	3.72	0.33
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	1.22	1.01	1.38	1.21	0.19
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	5.11	4.91	5.49	5.17	0.30
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	7.31	6.44	7.47	7.08	0.55
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	10.57	8.53	10.46	9.85	1.15
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	10.60	9.63	11.06	10.43	0.73
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	31.79	27.43	32.78	30.67	2.84
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	13.35	12.15	14.22	13.24	1.04
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	32.35	30.32	35.22	32.63	2.46
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	11.99	10.46	13.33	11.93	1.44
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	29.30	24.77	30.33	28.13	2.96
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	21.38	18.75	22.56	20.90	1.95
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	7.31	5.97	7.02	6.77	0.70
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	14.44	11.90	13.97	13.44	1.35
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	7.05	6.66	8.04	7.25	0.71
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	1.81	1.48	1.57	1.62	0.17
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	3.20	2.73	2.82	2.92	0.25
Decachlorobiphenyl	ng/g, dry wt.	2.63	2.60	2.88	2.71	0.15
DDTs						
o,p'-DDD	ng/g, dry wt.	3.40	3.22	4.22	3.61	0.54
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	12.42	11.33	15.28	13.01	2.04
p,p'-DDE	ng/g, dry wt.	8.88	8.62	10.56	9.35	1.05
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	3.06	2.36	3.28	2.90	0.48
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	2.29	2.15	2.22	2.22	0.07
trans-Nonachlor	ng/g, dry wt.	1.17	1.06	1.44	1.23	0.20
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.49	0.45	0.60	0.52	0.08
gamma-Chlordane	ng/g, dry wt.	2.78	2.71	2.84	2.78	0.07
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	3.61	3.18	5.03	3.94	0.96
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	215.14	189.14	224.67	209.65	18.39
Sum4_Chlordanes	ng/g, dry wt.	3.46	3.22	3.66	3.45	0.22
Sum5_DDTs	ng/g, dry wt.	24.70	23.17	30.06	25.97	3.62

Table A-4. DB03 PCB/Pesticide Data 2006 (cont'd)

	Station	DB03	DB03	DB03	DB03	DB03
	Sample_ID	HT061083	HT061084	HT061085		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	0.67	0.90	1.60	1.05	0.48
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.25	0.68	0.56	0.50	0.22
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	1.23	2.74	2.57	2.18	0.82
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	1.01	1.85	1.95	1.60	0.52
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	1.29	2.08	2.51	1.96	0.62
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	2.02	2.86	3.52	2.80	0.75
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.49	0.67	0.72	0.63	0.12
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	4.85	4.06	8.01	5.64	2.09
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	2.41	1.99	3.89	2.76	1.00
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	5.79	4.91	9.32	6.67	2.33
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	1.90	1.38	3.18	2.15	0.93
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	5.55	3.69	7.60	5.61	1.96
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	4.08	2.75	5.57	4.13	1.41
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	0.95	0.64	1.14	0.91	0.25
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	1.89	1.28	2.40	1.85	0.56
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	1.16	0.82	1.53	1.17	0.35
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.20	0.15	0.26	0.21	0.05
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.37	0.33	0.53	0.41	0.10
Decachlorobiphenyl	ng/g, dry wt.	0.36	0.33	0.70	0.47	0.21
DDTs						
o,p'-DDD	ng/g, dry wt.	0.35	0.38	0.66	0.47	0.17
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	1.65	1.44	2.31	1.80	0.45
p,p'-DDE	ng/g, dry wt.	1.13	0.99	2.29	1.47	0.72
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.26	0.31	0.42	0.33	0.08
trans-Nonachlor	ng/g, dry wt.	0.13	0.15	0.23	0.17	0.05
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.07	0.08	0.12	0.09	0.03
gamma-Chlordane	ng/g, dry wt.	0.28	0.33	0.47	0.36	0.10
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.27	0.22	0.22	0.23	0.03
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	36.46	34.11	57.55	42.71	12.91
Sum4_Chlordanes	ng/g, dry wt.	0.39	0.45	0.65	0.50	0.14
Sum5_DDTs	ng/g, dry wt.	3.14	2.82	5.26	3.74	1.33

Table A-4. DB06 PCB/Pesticide Data 2006 (cont'd)

	Station	DB06	DB06	DB06	DB06	DB06
	Sample_ID	HT0610C8	HT0610C9	HT0610CA		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	0.21	0.21	0.18	0.20	0.02
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.06	0.06	0.05	0.06	0.00
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	0.24	0.23	0.26	0.24	0.02
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.18	0.18	0.19	0.18	0.01
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.25	0.27	0.24	0.25	0.01
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.38	0.36	0.39	0.37	0.01
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.09	0.03	0.05
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	0.68	0.63	0.68	0.66	0.03
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	0.43	0.42	0.42	0.42	0.01
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.99	0.91	0.92	0.94	0.04
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	0.38	0.40	0.45	0.41	0.03
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	0.91	0.87	0.89	0.89	0.02
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	0.69	0.65	0.66	0.67	0.02
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	0.12	0.13	0.13	0.13	0.01
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	0.29	0.22	0.22	0.24	0.04
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	0.25	0.20	0.21	0.22	0.03
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.03	0.01	0.02
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.11	0.11	0.06	0.09	0.03
Decachlorobiphenyl	ng/g, dry wt.	0.11	0.10	0.09	0.10	0.01
DDTs						
o,p'-DDD	ng/g, dry wt.	0.00	0.07	0.00	0.02	0.04
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	0.38	0.27	0.24	0.30	0.08
p,p'-DDE	ng/g, dry wt.	0.55	0.20	0.22	0.32	0.20
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.08	0.08	0.08	0.08	0.00
trans-Nonachlor	ng/g, dry wt.	0.06	0.05	0.05	0.05	0.01
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.04	0.02	0.03	0.03	0.01
gamma-Chlordane	ng/g, dry wt.	0.08	0.07	0.07	0.07	0.01
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.16	0.17	0.14	0.16	0.02
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	6.27	5.94	6.16	6.13	0.17
Sum4_Chlordanes	ng/g, dry wt.	0.14	0.13	0.13	0.13	0.00
Sum5_DDTs	ng/g, dry wt.	0.94	0.55	0.45	0.65	0.25

Table A-4. DB12 PCB/Pesticide Data 2006 (cont'd)

	Station	DB12	DB12	DB12	DB12	DB12
	Sample_ID	HT06107A	HT06107B	HT06107D		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	4.31	2.83	1.67	2.94	1.32
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	1.90	1.09	0.61	1.20	0.65
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	8.31	5.32	2.93	5.52	2.70
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	6.95	4.51	2.30	4.59	2.33
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	8.06	5.53	2.66	5.42	2.70
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	12.39	8.23	4.37	8.33	4.01
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	23.25	18.18	8.86	16.76	7.30
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	12.57	9.49	4.81	8.95	3.91
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	27.55	21.96	10.84	20.12	8.51
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	8.99	7.98	3.48	6.82	2.94
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	20.30	16.03	8.22	14.85	6.13
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	14.78	11.85	6.15	10.93	4.39
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	3.69	2.70	1.42	2.60	1.14
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	7.31	5.39	2.90	5.20	2.21
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	4.42	3.26	1.77	3.15	1.33
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	1.20	0.86	0.47	0.84	0.36
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	1.94	1.26	0.77	1.32	0.59
Decachlorobiphenyl	ng/g, dry wt.	2.08	1.37	1.09	1.51	0.51
DDTs						
o,p'-DDD	ng/g, dry wt.	1.94	1.59	0.76	1.43	0.60
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	15.73	5.51	2.92	8.05	6.77
p,p'-DDE	ng/g, dry wt.	7.83	4.94	2.50	5.09	2.67
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	1.75	1.05	0.66	1.15	0.55
trans-Nonachlor	ng/g, dry wt.	0.88	0.51	0.33	0.57	0.28
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.46	0.25	0.16	0.29	0.16
gamma-Chlordane	ng/g, dry wt.	1.92	1.21	0.72	1.29	0.60
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	2.04	0.67	0.53	1.08	0.83
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	170.00	127.86	65.29	121.05	52.69
Sum4_Chlordanes	ng/g, dry wt.	2.62	1.56	0.99	1.73	0.83
Sum5_DDTs	ng/g, dry wt.	25.49	12.04	6.18	14.57	9.90

Table A-4. SWEX3 PCB/Pesticide Data 2006 (cont'd)

	Station	SWEX3	SWEX3	SWEX3	SWEX3	SWEX3
	Sample_ID	HT061089	HT06108A	HT06108B		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	2.54	1.21	2.33	2.02	0.71
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.65	0.35	1.18	0.73	0.42
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	2.29	1.36	3.24	2.30	0.94
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	2.65	1.17	4.80	2.87	1.83
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	3.18	1.24	7.60	4.01	3.26
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	4.26	2.24	6.10	4.20	1.93
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	10.52	4.65	27.08	14.08	11.63
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	5.61	2.59	12.69	6.96	5.18
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	12.74	6.10	27.80	15.55	11.12
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	4.65	2.26	10.18	5.70	4.06
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	10.26	5.49	21.46	12.41	8.20
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	7.87	4.29	14.69	8.95	5.28
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	1.99	1.26	3.22	2.16	0.99
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	3.78	2.33	5.68	3.93	1.68
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	2.41	1.41	3.24	2.35	0.92
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.84	0.39	0.76	0.66	0.24
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.88	0.49	1.30	0.89	0.41
Decachlorobiphenyl	ng/g, dry wt.	0.91	0.47	0.86	0.75	0.24
DDTs						
o,p'-DDD	ng/g, dry wt.	0.79	0.69	2.04	1.17	0.75
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	2.97	2.27	9.42	4.89	3.94
p,p'-DDE	ng/g, dry wt.	2.24	1.77	5.56	3.19	2.07
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.70	0.41	1.01	0.71	0.30
trans-Nonachlor	ng/g, dry wt.	0.33	0.27	0.92	0.51	0.36
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.17	0.14	0.41	0.24	0.15
gamma-Chlordane	ng/g, dry wt.	0.77	0.46	1.12	0.79	0.33
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.30	0.31	0.34	0.32	0.02
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	78.03	39.32	154.23	90.52	58.46
Sum4_Chlordanes	ng/g, dry wt.	1.02	0.69	1.93	1.22	0.64
Sum5_DDTs	ng/g, dry wt.	6.01	4.73	17.02	9.25	6.76

Table A-4. T01 PCB/Pesticide Data 2006 (cont'd)

	Station	T01	T01	T01	T01	T01
	Sample_ID	HT0610AA	HT0610AB	HT0610AF		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	0.56	0.58	0.73	0.62	0.09
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.10	0.13	0.15	0.13	0.02
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	0.39	0.44	0.59	0.47	0.10
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.34	0.41	0.56	0.44	0.11
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.41	0.49	0.68	0.53	0.14
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.63	0.71	0.94	0.76	0.16
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	1.05	1.28	1.76	1.36	0.36
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	0.59	0.73	1.02	0.78	0.22
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	1.40	1.61	2.21	1.74	0.42
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	0.53	0.62	0.85	0.67	0.17
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	1.58	1.91	2.59	2.02	0.51
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	1.20	1.46	1.94	1.53	0.37
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	0.31	0.44	0.87	0.54	0.29
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	0.67	0.85	1.16	0.89	0.25
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	0.46	0.59	0.80	0.61	0.17
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.12	0.11	0.33	0.19	0.13
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.15	0.20	0.28	0.21	0.07
Decachlorobiphenyl	ng/g, dry wt.	0.18	0.22	0.27	0.23	0.04
DDTs						
o,p'-DDD	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	0.74	0.73	1.06	0.84	0.19
p,p'-DDE	ng/g, dry wt.	0.58	0.71	0.84	0.71	0.13
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.13	0.14	0.18	0.15	0.03
trans-Nonachlor	ng/g, dry wt.	0.07	0.07	0.09	0.08	0.01
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.03	0.04	0.05	0.04	0.01
gamma-Chlordane	ng/g, dry wt.	0.15	0.15	0.21	0.17	0.03
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.26	0.24	0.22	0.24	0.02
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	10.68	12.77	17.72	13.72	3.61
Sum4_Chlordanes	ng/g, dry wt.	0.21	0.21	0.27	0.23	0.04
Sum5_DDTs	ng/g, dry wt.	1.31	1.44	1.90	1.55	0.31

Table A-4. T02 PCB/Pesticide Data 2006 (cont'd)

	Station	T02	T02	T02	T02	T02
	Sample_ID	HT06102E	HT061030	HT061032		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	2.37	1.90	1.92	2.06	0.27
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	1.98	0.58	0.46	1.01	0.85
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	2.70	2.07	1.70	2.16	0.51
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	2.46	1.98	2.23	2.22	0.24
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	2.67	2.55	1.86	2.36	0.44
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	3.51	3.27	2.79	3.19	0.37
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	5.66	6.28	5.24	5.73	0.52
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	2.97	3.23	2.79	3.00	0.22
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	7.33	8.40	6.83	7.52	0.80
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	2.78	3.29	2.97	3.01	0.26
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	6.48	7.39	6.50	6.79	0.52
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	4.90	5.51	4.88	5.10	0.36
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	1.76	1.88	1.69	1.78	0.10
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	3.42	3.65	3.09	3.39	0.28
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	2.16	2.43	2.00	2.20	0.22
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.47	0.62	0.41	0.50	0.11
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	1.12	0.90	0.72	0.91	0.20
Decachlorobiphenyl	ng/g, dry wt.	0.89	0.79	0.72	0.80	0.09
DDTs						
o,p'-DDD	ng/g, dry wt.	0.86	0.99	0.96	0.94	0.07
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	3.24	3.59	3.78	3.54	0.28
p,p'-DDE	ng/g, dry wt.	3.11	3.02	3.13	3.09	0.06
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.63	0.73	0.67	0.68	0.05
trans-Nonachlor	ng/g, dry wt.	0.38	0.44	0.42	0.41	0.03
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.19	0.19	0.20	0.19	0.00
gamma-Chlordane	ng/g, dry wt.	0.69	0.79	0.74	0.74	0.05
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.44	0.38	0.37	0.40	0.04
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	55.64	56.72	48.81	53.72	4.29
Sum4_Chlordanes	ng/g, dry wt.	1.01	1.16	1.09	1.09	0.08
Sum5_DDTs	ng/g, dry wt.	7.20	7.60	7.88	7.56	0.34

Table A-4. T03 PCB/Pesticide Data 2006 (cont'd)

	Station	T03	T03	T03	T03	T03
	Sample_ID	HT061090	HT061096	HT061097		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	3.69	4.44	3.76	3.96	0.42
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	5.92	2.56	1.70	3.39	2.23
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	11.57	5.90	4.49	7.32	3.75
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	8.74	4.59	3.51	5.62	2.76
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	9.96	5.00	3.84	6.27	3.25
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	12.97	7.53	6.07	8.86	3.64
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	13.78	8.80	7.30	9.96	3.39
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	6.67	4.64	4.07	5.13	1.36
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	14.93	11.10	9.44	11.82	2.82
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	4.95	3.57	3.34	3.96	0.87
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	14.49	10.86	9.73	11.69	2.49
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	11.20	8.46	7.66	9.11	1.86
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	4.24	2.55	1.86	2.88	1.22
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	7.49	4.94	4.46	5.63	1.63
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	4.31	3.25	3.22	3.59	0.62
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.78	0.53	0.58	0.63	0.13
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	1.48	1.25	1.41	1.38	0.11
Decachlorobiphenyl	ng/g, dry wt.	1.26	1.35	1.27	1.29	0.05
DDTs						
o,p'-DDD	ng/g, dry wt.	2.00	1.28	1.00	1.43	0.52
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	8.18	0.00	0.00	2.73	4.72
p,p'-DDD	ng/g, dry wt.	8.81	4.65	3.36	5.61	2.85
p,p'-DDE	ng/g, dry wt.	2.73	2.63	2.15	2.50	0.31
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	2.22	1.14	0.96	1.44	0.68
trans-Nonachlor	ng/g, dry wt.	0.75	0.50	0.39	0.55	0.19
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.35	0.25	0.22	0.27	0.07
gamma-Chlordane	ng/g, dry wt.	2.40	1.23	1.04	1.55	0.74
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.71	0.28	0.30	0.43	0.24
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	138.42	91.33	77.73	102.49	31.85
Sum4_Chlordanes	ng/g, dry wt.	2.98	1.64	1.35	1.99	0.87
Sum5_DDTs	ng/g, dry wt.	21.72	8.56	6.50	12.26	8.26

Table A-4. T05A PCB/Pesticide Data 2006 (cont'd)

	Station	T05A	T05A	T05A	T05A	T05A
	Sample_ID	HT06109D	HT06109E	HT0610A1		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	0.22	0.30	0.40	0.31	0.09
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.18	0.17	0.18	0.18	0.01
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	0.35	0.38	0.54	0.42	0.10
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.42	0.44	0.59	0.49	0.09
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.61	0.64	0.78	0.68	0.09
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.58	0.55	0.83	0.65	0.16
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.15	0.00	0.00	0.05	0.09
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	1.91	1.16	1.73	1.60	0.39
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	0.83	0.48	0.77	0.70	0.19
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	2.12	1.20	1.94	1.75	0.49
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	0.73	0.41	0.63	0.59	0.16
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	2.12	1.29	2.10	1.84	0.48
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	1.63	1.00	1.64	1.43	0.36
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	0.44	0.27	0.46	0.39	0.10
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	0.99	0.56	0.95	0.83	0.24
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	0.60	0.37	0.60	0.52	0.14
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.11	0.09	0.11	0.10	0.01
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.18	0.11	0.18	0.16	0.04
Decachlorobiphenyl	ng/g, dry wt.	0.13	0.10	0.17	0.13	0.04
DDTs						
o,p'-DDD	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	1.84	1.62	2.07	1.84	0.23
p,p'-DDE	ng/g, dry wt.	1.77	1.62	1.97	1.79	0.18
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.13	0.15	0.22	0.17	0.05
trans-Nonachlor	ng/g, dry wt.	0.09	0.11	0.12	0.11	0.02
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.04	0.06	0.06	0.05	0.01
gamma-Chlordane	ng/g, dry wt.	0.14	0.17	0.26	0.19	0.07
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.19	0.13	0.20	0.17	0.04
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	14.33	9.51	14.60	12.82	2.86
Sum4_Chlordanes	ng/g, dry wt.	0.21	0.27	0.34	0.27	0.07
Sum5_DDTs	ng/g, dry wt.	3.61	3.24	4.04	3.63	0.40

Table A-4. T06 PCB/Pesticide Data 2006 (cont'd)

	Station	T06	T06	T06	T06	T06
	Sample_ID	HT061019	HT06101C	HT061020		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	1.33	1.25	1.91	1.50	0.36
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.34	0.31	0.39	0.34	0.04
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	1.21	1.14	1.62	1.32	0.26
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.95	0.92	1.14	1.01	0.12
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.88	0.98	1.13	1.00	0.12
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	2.15	2.13	2.75	2.34	0.35
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	2.21	2.43	3.31	2.65	0.58
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	1.28	1.43	2.14	1.62	0.46
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	3.25	3.52	5.46	4.08	1.21
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	1.24	1.37	2.39	1.67	0.63
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	3.63	3.70	5.21	4.18	0.89
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	2.94	3.05	3.95	3.31	0.56
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	0.64	0.64	1.21	0.83	0.33
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	1.48	1.69	2.34	1.84	0.45
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	1.17	1.30	1.64	1.37	0.25
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.25	0.26	0.32	0.28	0.04
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.52	1.32	0.77	0.87	0.41
Decachlorobiphenyl	ng/g, dry wt.	0.60	1.02	0.85	0.82	0.21
DDTs						
o,p'-DDD	ng/g, dry wt.	0.28	0.00	0.50	0.26	0.25
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	0.93	1.03	2.07	1.34	0.63
p,p'-DDE	ng/g, dry wt.	0.91	1.04	1.82	1.26	0.49
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.25	0.27	0.37	0.29	0.06
trans-Nonachlor	ng/g, dry wt.	0.12	0.14	0.20	0.16	0.04
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.07	0.08	0.12	0.09	0.02
gamma-Chlordane	ng/g, dry wt.	0.24	0.32	0.40	0.32	0.08
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.31	0.28	0.56	0.38	0.15
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	26.06	28.44	38.54	31.02	6.63
Sum4_Chlordanes	ng/g, dry wt.	0.37	0.41	0.57	0.45	0.11
Sum5_DDTs	ng/g, dry wt.	2.12	2.06	4.39	2.86	1.33

Table A-4. T07 PCB/Pesticide Data 2006 (cont'd)

	Station	T07	T07	T07	T07	T07
	Sample_ID	HT061026	HT061027	HT061029		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	1.73	2.28	1.69	1.90	0.33
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.47	0.69	0.49	0.55	0.12
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	2.33	3.16	2.43	2.64	0.45
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	2.14	2.85	2.39	2.46	0.36
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	2.21	3.68	2.48	2.79	0.78
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	4.82	6.51	5.04	5.46	0.92
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	7.03	11.54	8.82	9.13	2.27
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	4.02	6.68	4.40	5.03	1.44
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	10.18	16.02	11.38	12.53	3.08
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	3.83	5.91	3.79	4.51	1.21
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	11.03	14.53	11.99	12.51	1.81
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	9.13	10.84	9.83	9.94	0.86
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	2.38	2.86	2.63	2.62	0.24
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	5.67	5.89	6.36	5.97	0.35
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	3.92	4.03	4.67	4.21	0.41
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.81	0.75	0.90	0.82	0.07
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	1.45	1.45	2.34	1.75	0.51
Decachlorobiphenyl	ng/g, dry wt.	1.44	1.78	1.57	1.59	0.17
DDTs						
o,p'-DDD	ng/g, dry wt.	0.67	1.51	0.95	1.04	0.43
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	2.42	5.54	3.25	3.74	1.62
p,p'-DDE	ng/g, dry wt.	1.96	4.80	2.78	3.18	1.46
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	1.60	0.00	0.53	0.92
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.59	0.99	0.76	0.78	0.20
trans-Nonachlor	ng/g, dry wt.	0.26	0.48	0.30	0.35	0.12
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.15	0.27	0.16	0.20	0.07
gamma-Chlordane	ng/g, dry wt.	0.80	1.37	0.99	1.06	0.29
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.27	0.38	0.31	0.32	0.06
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	74.58	101.47	83.17	86.41	13.73
Sum4_Chlordanes	ng/g, dry wt.	0.85	1.48	1.06	1.13	0.32
Sum5_DDTs	ng/g, dry wt.	5.05	11.85	6.98	7.96	3.50

Table A-4. T08 PCB/Pesticide Data 2006 (cont'd)

	Station	T08	T08	T08	T08	T08
	Sample_ID	HT06100D	HT061011	HT061013		
	Units	Value	Value	Value	Mean	STD
PCBs						
2,4'-Dichlorobiphenyl	ng/g, dry wt.	0.22	0.19	0.20	0.21	0.02
2,2',5-Trichlorobiphenyl	ng/g, dry wt.	0.06	0.00	0.00	0.02	0.03
2,4,4'-Trichlorobiphenyl	ng/g, dry wt.	0.26	0.12	0.12	0.17	0.08
2,2',3,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.31	0.11	0.10	0.17	0.12
2,2',5,5'-Tetrachlorobiphenyl	ng/g, dry wt.	0.36	0.11	0.12	0.20	0.14
2,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.58	0.23	0.26	0.36	0.20
3,3',4,4'-Tetrachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',4,5,5'-Pentachlorobiphenyl	ng/g, dry wt.	1.03	0.28	0.32	0.54	0.43
2,3,3',4,4'-Pentachlorobiphenyl	ng/g, dry wt.	0.52	0.16	0.18	0.29	0.20
2,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	1.35	0.43	0.49	0.76	0.52
3,3',4,4',5-Pentachlorobiphenyl	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
2,2',3,3',4,4'-Hexachlorobiphenyl	ng/g, dry wt.	0.50	0.15	0.16	0.27	0.20
2,2',3,4,4',5'-Hexachlorobiphenyl	ng/g, dry wt.	1.42	0.49	0.54	0.82	0.52
2,2',4,4',5,5'-Hexachlorobiphenyl	ng/g, dry wt.	1.07	0.39	0.42	0.63	0.39
2,2',3,3',4,4',5-Heptachlorobiphenyl	ng/g, dry wt.	0.29	0.11	0.12	0.18	0.10
2,2',3,4,4',5,5'-Heptachlorobiphenyl	ng/g, dry wt.	0.53	0.20	0.21	0.31	0.19
2,2',3,4',5,5',6-Heptachlorobiphenyl	ng/g, dry wt.	0.39	0.16	0.17	0.24	0.13
2,2',3,3',4,4',5,6-Octachlorobiphenyl	ng/g, dry wt.	0.08	0.00	0.00	0.03	0.04
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl	ng/g, dry wt.	0.18	0.06	0.06	0.10	0.07
Decachlorobiphenyl	ng/g, dry wt.	0.26	0.08	0.09	0.14	0.10
DDTs						
o,p'-DDD	ng/g, dry wt.	0.29	0.06	0.00	0.12	0.15
o,p'-DDE	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
o,p'-DDT	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
p,p'-DDD	ng/g, dry wt.	0.78	0.27	0.42	0.49	0.26
p,p'-DDE	ng/g, dry wt.	1.16	0.22	0.38	0.59	0.50
p,p'-DDT	ng/g, dry wt.					
p,p'-DDMU	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Chlordanes						
Heptachlor	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Heptachlorepoxide	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Chlordane	ng/g, dry wt.	0.09	0.05	0.05	0.06	0.02
trans-Nonachlor	ng/g, dry wt.	0.03	0.02	0.02	0.03	0.01
Oxychlordane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
cis-Nonachlor	ng/g, dry wt.	0.03	0.02	0.02	0.02	0.01
gamma-Chlordane	ng/g, dry wt.	0.13	0.05	0.07	0.08	0.04
Other Pesticides						
Aldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Dieldrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Endrin	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Hexachlorobenzene	ng/g, dry wt.	0.18	0.13	0.16	0.16	0.03
Lindane	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Mirex	ng/g, dry wt.	0.00	0.00	0.00	0.00	0.00
Totals						
Sum20_ PCB Congeners	ng/g, dry wt.	9.44	3.28	3.55	5.42	3.48
Sum4_Chlordanes	ng/g, dry wt.	0.12	0.07	0.07	0.09	0.03
Sum5_DDTs	ng/g, dry wt.	2.23	0.56	0.80	1.20	0.90

Appendix B

Historical Means 1990, 1994, 1998, 2002, and 2006

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Table B-1. Sediment Grain Size and TOC Results – 1990, 1994, 1997, 1998, 2002, and 2006.

	1990		1994		1997		1998		2002		2006	
Station	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**	**% Fines[a]**	**TOC (%)**
DB01	30.13	6.26	74.43	2.80	-[b]	-[b]	85.40	2.32	88.50	3.05	91.29	2.69
DB04	63.77	3.15	60.80	2.37	-[b]	-[b]	89.67	2.62	84.10	2.30	91.50	2.41
T04	77.70	3.82	85.73	3.23	97.40	3.88	78.27	7.14	90.77	3.64	95.60	3.84
DB10	62.70	4.54	87.93	4.13	-[b]	-[b]	54.07	2.96	97.07	4.26	83.08	4.31
DB14	64.10	4.31	51.87	5.07	-[b]	-[b]	53.60	6.76	74.10	8.60	64.63	4.99
C019	-[b]	-[b]	95.93	2.83	-[b]	-[b]	96.67	2.87	97.00	3.03	97.61	3.20
DB03	18.47	0.97	18.57	1.07	-[b]	-[b]	19.10	0.54	20.30	1.32	38.61	1.20
DB06	6.07	0.26	7.43	0.23	-[b]	-[b]	5.87	0.24	6.81	0.25	7.48	0.25
DB12	44.13	1.88	45.60	2.67	-[b]	-[b]	43.50	2.50	50.97	2.89	77.34	2.29
SWEX3	-[b]	-[b]	53.97	2.57	-[b]	-[b]	66.37	2.14	65.80	2.40	51.79	1.30
T01	-[b]	-[b]	36.40	1.83	20.73	1.83	25.03	1.80	31.83	0.97	41.43	1.02
T02	-[b]	-[b]	37.87	1.63	55.50	1.46	53.00	1.44	54.43	1.77	83.83	1.99
T03	-[b]	-[b]	-[b]	-[b]	82.57	3.57	-[b]	-[b]	59.73	2.80	57.31	2.14
T05A	-[b]	-[b]	-[b]	-[b]	32.13	1.42	-[b]	-[b]	12.37	0.87	28.55	0.49
T06	-[b]	-[b]	-[b]	-[b]	41.07	1.88	-[b]	-[b]	26.37	1.60	58.01	1.80
T07	-[b]	-[b]	-[b]	-[b]	55.10	3.09	57.37	2.16	54.51	2.73	80.61	2.42
T08	-[b]	-[b]	6.13	1.17	5.97	0.45	5.43	0.43	10.43	0.50	6.34	0.36

[a] Percent fines is the sum of %silt and %clay
[b] No data available

Table B-2. Comparison of Sediment *Clostridium perfringens* Data for 1990, 1994, 1997, 1998, 2002, and 2006 Samples. Raw data are not normalized.

	1990		1994		1997		1998		2002		2006	
Station	***C. perfringens* (spores/g DW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/g DW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/g DW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/g DW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/g DW)**	***C. perfringens* Log 10**	***C. perfringens* (spores/g DW)**	***C. perfringens* Log 10**
DB01	27033.33	4.39	3036.67	3.46	-	-	3983.33	3.59	4600.00	3.66	3341.48	3.52
DB04	45533.33	4.65	5116.67	3.69	-	-	1360.00	3.09	2713.33	3.38	2609.27	3.39
T04(/DB13)	53400.00	4.73	10483.33	4.00	17000.00	4.23	9033.33	3.84	3220.00	3.44	3337.91	3.52
DB10	34566.67	4.53	11966.67	4.08	-	-	5343.33	3.64	6276.67	3.80	6135.01	3.78
DB14	115400.00	5.04	7286.67	3.73	-	-	6786.67	3.83	26766.67	4.42	4598.75	3.49
C019	-	-	12643.33	3.99	-	-	15133.33	4.16	17766.67	4.25	17293.68	4.24
DB03	12963.33	4.09	5283.33	3.70	-	-	5720.00	3.76	2623.33	3.42	2369.06	3.32
DB06	1990.00	3.28	1283.33	3.11	-	-	396.67	2.59	213.33	2.32	325.67	2.51
DB12	27800.00	4.44	16500.00	4.21	-	-	9266.67	3.95	9026.67	3.94	3798.37	3.56
SWEX3	-	-	12433.33	4.09	-	-	6590.00	3.81	5930.00	3.77	2998.29	3.46
T01	-	-	4833.33	3.68	7716.67	3.88	4373.33	3.64	2160.00	3.32	1100.81	2.99
T02	-	-	12100.00	4.08	18333.33	4.26	6253.33	3.78	6733.33	3.82	4831.00	3.68
T03	-	-	-	-	18666.67	4.26	-	-	9106.67	3.93	2031.70	3.30
T05A	-	-	-	-	4300.00	3.63	-	-	453.33	2.56	240.29	2.33
T06	-	-	-	-	17233.33	4.19	-	-	1770.00	3.24	1225.48	3.05
T07	-	-	-	-	18000.00	4.25	7763.33	3.89	8116.67	3.91	5115.28	3.67
T08	-	-	2566.67	3.31	1900.00	3.25	1893.33	3.25	386.67	2.50	413.90	2.56

Table B-3. Comparison of Sediment Organic Contaminants (ng/g dry wt.) for 1990, 1994, 1997, 1998, 2002, and 2006 Samples. Raw data are not normalized.

Station	Total PAH (ng/g, DW)	Sum of LMW PAH (ng/g, DW)	Sum of HMW PAH (ng/g, DW)	%Pyrogenic PAH	Sum20_PCB Congeners (ng/g, DW)	Sum4_ Chlordanes (ng/g, DW)	Sum5_DDTs (ng/g, DW)
1990							
DB01	83620.80	17971.61	47871.54	57.76	-	-	-
DB04	10764.04	1839.49	6193.37	57.67	-	-	-
T04/DB13	12430.64	1832.93	7174.78	57.73	-	-	-
DB10	23758.95	3130.25	15006.35	63.32	-	-	-
DB14	46787.50	7517.13	28198.52	60.27	-	-	-
DB03	3541.48	464.85	1977.56	56.02	-	-	-
DB06	720.35	90.49	463.63	64.37	-	-	-
DB12	6601.19	978.40	3512.21	53.34	-	-	-
1994							
DB01	26201.42	6901.07	19300.35	73.65	88.11	3.20	22.76
DB04	39654.14	12687.72	26966.42	70.05	62.25	8.16	27.88
T04/DB13	22468.79	6025.63	16443.16	73.33	417.12	5.88	68.78
DB10	20705.27	5298.97	15406.30	74.40	372.77	4.56	146.24
DB14	126596.46	39090.45	87506.01	69.43	347.98	25.84	153.66
C019	19450.11	4900.30	14549.81	74.80	186.46	4.34	34.88
DB03	10349.88	3814.19	6535.69	64.81	45.68	0.93	8.93
DB06	495.08	96.55	398.53	80.77	7.21	0.24	1.18
DB12	19275.19	6354.13	12921.06	67.38	265.89	3.69	45.49
SWEX3	9877.07	3089.23	6787.84	68.74	90.62	2.61	20.22
T01	7566.66	3076.48	4490.19	59.32	28.83	1.48	9.20
T02	7561.84	2160.69	5401.15	71.28	55.75	2.22	12.61
T08	2998.82	1226.33	1772.49	61.88	7.90	0.42	2.94
1997							
T04/DB13	12750.33	3443.67	9306.67	72.99	213.57	7.57	33.53
T01	6844.00	3210.67	3633.33	54.74	51.00	1.78	9.66
T02	6999.80	2246.47	4753.33	67.91	82.29	2.97	11.83
T03	8179.67	2674.67	5505.00	67.37	102.03	4.97	17.30
T05A	12410.57	4515.90	7894.67	65.11	42.17	2.00	5.82
T06	4068.53	1279.53	2789.00	68.55	47.81	2.11	9.85
T07	4398.43	1348.43	3050.00	69.28	108.29	4.62	27.40
T08	1784.97	630.87	1154.10	64.99	13.37	0.48	2.29
1998							
DB01	18745.33	4649.55	14095.78	75.24	95.46	1.95	11.34
DB04	11627.66	3076.88	8550.78	73.54	90.85	2.24	10.85
T04/DB13	76686.82	28211.77	48475.06	63.65	472.12	21.39	55.88
DB10	44167.71	11282.51	32885.21	74.45	255.13	4.75	36.09
DB14	155689.04	58193.87	97495.17	62.75	539.97	49.87	122.16
C019	17283.31	4126.80	13156.51	76.11	204.72	5.54	21.94
DB03	3175.95	819.98	2355.97	73.89	60.46	0.96	9.45
DB06	371.04	78.60	292.45	78.84	6.77	0.07	0.49
DB12	19436.48	5718.22	13718.27	70.88	315.52	4.67	42.57
SWEX3	6538.72	1795.87	4742.85	72.85	91.25	2.32	47.99
T01	4792.42	1927.93	2864.49	60.70	24.53	1.21	1.95
T02	6727.88	1836.12	4891.76	72.72	45.33	2.26	6.28
T07	5204.78	1364.41	3840.37	73.81	83.16	3.89	11.33
T08	650.12	228.88	421.23	64.83	5.92	0.39	0.59
2002							
DB01	11873.43	2963.73	8909.71	75.05	66.66	1.52	5.84
DB04	11189.11	3057.64	8131.47	72.65	54.35	1.00	5.18
T04/DB13	18439.05	4774.29	13664.76	74.13	131.93	3.42	11.58
DB10	15898.78	3762.79	12136.00	76.31	204.10	4.88	41.51

Table B-3. Comparison of Sediment Organic Contaminants (ng/g dry wt.) for 1990, 1994, 1997, 1998, 2002, and 2006 Samples. Raw data are not normalized (cont.).

Station	Total PAH (ng/g, DW)	Sum of LMW PAH (ng/g, DW)	Sum of HMW PAH (ng/g, DW)	%Pyrogenic PAH	Sum20_PCB Congeners (ng/g, DW)	Sum4_ Chlordanes (ng/g, DW)	Sum5_DDTs (ng/g, DW)
DB14	93199.57	30883.36	62316.21	66.86	197.91	18.81	39.00
C019	11226.15	3139.35	8086.80	72.07	93.11	1.98	8.64
DB03	5457.19	1966.03	3491.16	64.46	25.00	0.38	2.31
DB06	628.09	155.45	472.64	74.85	4.53	0.10	0.46
DB12	21790.52	6573.18	15217.33	69.76	100.07	1.23	9.38
SWEX3	7189.40	2214.29	4975.11	69.19	53.83	1.18	4.98
T01	3370.87	1268.28	2102.59	62.62	13.55	0.32	1.42
T02	7152.98	1982.78	5170.20	72.28	39.47	1.08	3.53
T03	8837.28	3363.08	5474.20	61.95	104.42	2.86	8.27
T05A	45222.23	17658.27	27563.96	60.93	106.08	1.27	7.87
T06	4065.82	1251.95	2813.87	69.09	30.11	0.57	2.38
T07	5439.47	1674.95	3764.52	69.22	79.68	1.62	10.17
T08	3816.90	1701.25	2115.65	58.62	5.75	0.08	1.05
2006							
DB01	24741.79	4029.03	20712.76	83.86	111.54	2.43	12.36
DB04	12622.66	2493.88	10128.78	80.24	79.07	1.16	6.95
T04/DB13	35327.82	8799.13	26528.69	75.61	221.70	6.41	25.84
DB10	37133.64	7858.50	29275.14	79.30	401.21	9.28	50.88
DB14	125376.59	32889.90	92486.69	74.00	264.13	9.46	30.18
C019	16031.91	3341.07	12690.85	79.18	209.65	3.45	25.97
DB03	3003.69	668.90	2334.80	77.75	42.71	0.50	3.74
DB06	1574.72	278.15	1296.57	82.07	6.13	0.13	0.65
DB12	12721.67	3103.37	9618.29	75.66	121.05	1.73	14.57
SWEX3	5955.04	1561.46	4393.58	74.05	90.52	1.22	9.25
T01	5710.01	1699.02	4010.99	69.95	13.72	0.23	1.55
T02	7256.73	1638.58	5618.15	77.44	53.72	1.09	7.56
T03	5478.76	1595.75	3883.01	71.68	102.49	1.99	12.26
T05A	8526.52	2529.46	5997.06	70.45	12.82	0.27	3.63
T06	4408.84	1054.16	3354.68	75.98	31.02	0.45	2.86
T07	5535.90	1285.56	4250.34	76.75	86.41	1.13	7.96
T08	1494.20	495.22	998.98	68.06	5.42	0.09	1.20

"-" indicates "not analyzed"

Table B-4. Comparison of Sediment Metal Contaminants (ug/g dry wt.) for 1990, 1994, 1997, 1998, 2002, and 2006 Samples. Raw data are not normalized.

Conce4ntration (µg/g, dry weight)										
Station	**Ag**	**Al[a]**	**Cd**	**Cr**	**Cu**	**Fe[a]**	**Hg**	**Ni**	**Pb**	**Zn**
1990										
DB01	-	6.52	8.28	116.30	215.07	2.82	-	73.42	468.73	1471.97
DB04	-	7.44	1.50	195.75	156.33	3.70	-	47.86	149.65	275.18
T04	-	7.41	2.01	212.07	181.73	4.01	-	44.31	191.63	342.29
DB10	-	7.14	2.29	217.67	215.21	3.62	-	51.54	427.36	472.62
DB14	-	6.97	2.47	160.30	183.06	3.70	-	44.34	522.61	433.38
DB03	-	5.31	0.60	82.84	48.52	2.09	-	19.31	59.67	97.64
DB06	-	5.11	0.25	34.18	18.56	1.39	-	13.85	36.74	46.69
DB12	-	6.44	1.06	168.19	103.19	3.07	-	34.03	109.99	155.47
1994										
DB01	3.48	5.67	0.84	157.33	134.33	3.72	0.74	34.67	152.20	233.00
DB04	2.97	5.50	0.82	138.50	87.00	2.94	0.62	28.50	158.70	168.00
T04	5.59	6.83	2.12	254.00	157.50	3.79	1.24	37.33	198.73	266.00
DB10	5.05	6.00	1.69	217.67	198.33	4.22	1.18	38.00	182.10	273.33
DB14	2.18	4.00	1.48	119.33	126.33	2.84	0.77	25.67	346.67	343.67
C019	4.76	7.00	1.14	214.67	146.00	4.34	0.81	37.33	137.13	218.00
DB03	0.89	4.67	0.23	65.33	27.67	1.99	1.35	15.33	54.63	69.67
DB06	0.36	3.33	0.07	35.00	12.33	1.35	0.08	9.00	28.43	33.67
DB12	3.76	5.33	1.13	209.33	98.67	3.14	0.81	34.00	130.10	171.67
SWEX3	4.03	7.00	0.42	194.33	95.67	3.95	0.58	36.00	107.83	156.33
T01	0.89	6.50	0.31	78.33	26.67	2.60	0.26	20.50	32.80	67.67
T02	2.50	5.67	0.48	125.67	59.33	2.63	0.37	23.33	63.07	101.00
T08	0.53	3.00	0.10	49.00	16.00	2.03	0.10	13.67	25.87	47.33
1997										
T04	4.16	7.38	1.10	170.30	125.10	3.95	1.12	41.19	152.25	217.29
T01	0.65	5.62	0.18	50.62	36.44	1.93	0.26	20.31	37.70	77.21
T02	2.28	6.94	0.46	107.52	64.51	2.80	0.61	32.24	62.54	112.57
T03	3.23	7.54	0.22	173.05	100.98	3.98	0.97	41.48	121.75	160.85
T05A	1.13	6.44	0.29	69.24	36.25	2.46	0.22	19.77	40.02	84.30
T06	2.25	6.33	0.20	84.20	47.90	2.69	0.69	21.76	62.79	92.89
T07	4.82	6.16	0.74	144.48	88.51	2.83	1.13	26.60	110.54	137.76
T08	0.47	4.43	0.09	26.72	10.07	1.52	0.13	9.63	26.91	38.81
1998										
DB01	2.47	6.69	0.76	141.93	116.87	3.84	0.58	31.60	145.97	220.00
DB04	2.85	6.56	0.74	151.03	103.30	4.11	0.60	36.30	124.80	192.03
T04	3.48	5.85	2.10	163.65	193.48	3.97	2.29	38.68	388.50	435.00
DB10	3.13	5.89	1.37	142.43	287.83	4.16	1.03	35.97	423.33	351.00
DB14	1.84	5.28	2.20	116.88	170.47	3.54	1.07	34.87	719.33	507.00
C019	4.03	7.40	1.09	204.67	148.33	4.78	0.79	44.80	150.30	234.33
DB03	0.71	4.62	0.35	67.97	33.40	2.10	0.18	15.03	56.40	83.93
DB06	0.30	3.90	0.07	26.43	17.77	1.30	0.07	9.93	29.20	36.50
DB12	2.74	5.40	1.62	162.43	88.03	3.04	0.65	28.83	116.17	163.50
SWEX3	2.59	6.58	0.35	154.43	80.27	3.93	0.70	34.97	90.77	141.50
T01	0.71	5.19	0.32	58.87	33.60	2.30	0.17	19.68	50.83	71.77
T02	1.80	5.91	0.42	104.70	52.93	3.05	0.31	24.58	62.90	108.17
T07	5.56	6.10	0.94	164.50	99.03	3.38	0.83	32.47	110.10	146.97
T08	0.41	3.89	0.12	28.97	16.93	1.71	0.08	12.23	27.47	44.13

Table B-4. Comparison of Sediment Metal Contaminants (ug/g dry wt.) for 1990, 1994, 1997, 1998, 2002, and 2006 Samples. Raw data are not normalized (cont.).

Concentration (µg/g, dry weight)										
Station	**Ag**	**Al[a]**	**Cd**	**Cr**	**Cu**	**Fe[a]**	**Hg**	**Ni**	**Pb**	**Zn**
2002										
DB01	2.72	7.20	0.49	182.67	125.93	4.52	0.69	31.57	154.23	250.67
DB04	1.91	6.75	0.39	145.00	86.53	3.67	0.50	31.03	102.10	163.70
T04	2.64	6.33	0.71	170.67	127.33	3.96	0.75	34.97	145.37	216.33
DB10	2.92	6.58	0.84	197.00	203.63	4.75	1.04	45.45	184.18	278.83
DB14	1.97	5.49	1.18	140.83	189.77	3.71	0.81	44.70	419.33	454.67
C019	3.19	7.54	0.59	207.67	128.18	4.73	0.76	39.30	130.08	220.83
DB03	0.80	5.61	0.17	66.57	44.35	2.44	0.19	24.87	69.83	86.90
DB06	0.33	4.82	0.06	36.33	19.07	1.37	0.07	10.90	30.70	44.40
DB12	1.89	5.85	0.63	143.30	77.50	3.17	0.61	27.87	134.43	141.00
SWEX3	1.87	7.33	0.18	168.33	67.47	4.14	0.58	35.93	88.77	141.67
T01	0.60	6.31	0.09	62.50	27.37	2.30	0.18	17.27	37.70	63.07
T02	1.49	6.43	0.26	124.43	55.47	3.23	0.31	25.87	63.23	111.70
T03	2.87	6.97	0.27	187.00	88.03	3.90	1.09	36.03	106.00	159.67
T05A	0.42	5.49	0.35	58.70	30.57	1.91	0.18	14.07	45.77	76.57
T06	1.48	6.48	0.15	103.47	44.63	3.02	0.39	24.03	61.37	103.10
T07	4.00	5.60	0.47	167.00	88.80	3.11	0.84	29.07	107.27	140.47
T08	0.37	4.98	0.07	37.48	16.60	1.72	0.08	11.88	25.77	47.92
2006										
DB01	1.86	7.75	0.67	121.00	105.67	3.62	0.47	28.63	167.00	271.00
DB04	2.11	8.62	0.46	137.67	83.70	3.77	0.63	31.10	154.33	181.00
T04(/DB13)	2.96	8.70	1.07	170.33	124.67	4.43	0.67	35.70	215.33	290.00
DB10	2.27	6.97	0.96	149.00	174.00	4.32	1.02	31.27	350.67	311.33
DB14	1.40	4.90	1.03	105.93	113.07	3.06	0.54	23.30	290.00	322.00
C019	2.78	7.99	0.60	182.67	109.00	4.55	0.65	39.57	125.67	200.00
DB03	0.77	5.67	0.24	67.40	30.40	2.31	0.19	18.07	57.33	92.03
DB06	0.31	4.51	0.07	33.27	12.83	1.42	0.08	8.87	33.03	39.40
DB12	1.76	6.92	0.41	130.37	62.60	3.38	0.40	26.63	92.73	146.47
SWEX3	1.21	6.23	0.24	97.73	45.80	2.82	0.35	22.87	59.87	96.23
T01	0.60	6.47	0.17	73.13	51.97	2.37	0.12	16.30	40.23	69.43
T02	1.25	7.73	0.34	126.67	47.67	3.49	0.41	29.90	67.33	122.00
T03	2.58	7.54	0.41	137.00	64.70	3.40	1.26	29.13	94.67	139.00
T05A	0.34	5.93	0.21	45.57	13.80	2.06	0.10	13.80	32.30	57.50
T06	1.44	6.68	0.28	102.20	40.77	3.08	0.36	25.53	82.27	111.33
T07	3.33	6.89	0.46	147.00	70.83	3.11	0.77	29.43	107.00	139.00
T08	0.26	4.41	0.11	38.57	9.80	1.66	0.07	11.23	29.67	46.63

[a] Al and Fe reported as percent dry weight
"-" indicates "not analyzed"

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Appendix C

Additional Statistical Analysis Results

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Table C-1 (a). One-Way ANOVA Results for TOC and Percent Fine Fraction of Sediments Collected in from 1990 to 2006.

a=1990, b=1994, c=1997, d=1998, e=2002, f=2006.

Station	TOC	Fines	Fines Normalized *C. perfringens*	*C. perfringens*
"Near" Stations				
DB01	a(ebfd)	(fed)(b)(a)	a(edbf)	a(edfb)
DB04	a(dfbe)		a(bef)(efd)	a(bfe)(fed)
T04	d(cfaeb)	(cfe)(feb)(bda)	(ac)(cbd)(bdfe)	(ac)(cbd)(bdfe)
DB10		(ebf)(bfa)(fad)	a(bdfe)	(ab)(befd)
DB14	(ed)(dbf)(bfa)		(ae)(edb)(dbf)	(ae)(edb)(dbf)
C019				
"Far" Stations				
DB03			(abd)(de)(ef)	(adb)(dbef)
DB06			(ab)(df)(fe)	(ab)(dfe)
DB12		f(ebad)	a(bde)(def)	a(bde)(def)
SWEX3	(bed)f		b(def)	b(def)
T01		(fbe)(bed)(edc)	(c)(db)(be)(f)	c(bde)(ef)
T02		f(cedb)	(cb)(edf)	(cb)(edf)
T03	(ce)(ef)	c(ef)	(ce)(ef)	c(ef)
T05A	(ce)(ef)		c(ef)	c(ef)
T06		(fc)(ce)	(c)(e)(f)	c(ef)
T07	c(ef)(fd)	f(dce)	(c)(ed)(f)	c(edf)
T08			(bdc)(cf)(fe)	(bcdf)(cdfe)

Note: Letters are arranged in order from the year of highest value to the year of lowest value.

Table C-1 (b). The p-values Corresponding to One-Way ANOVA Results for TOC and Percent Fines Fraction of Sediments Collected in 1990 to 2006.

Station	TOC	Fines	Fines Normalized *C. perfringens*	*C. perfringens*
"Near" Stations				
DB01	0.0005	<0.0001	0.0003	0.002
DB04	<0.0001	0.05	<0.0001*	<0.0001*
T04	0.0004	0.0002	0.0002*	0.0002*
DB10	0.06	0.008	0.0003*	0.0009*
DB14	0.001	0.21	0.0003*	0.0005*
C019	0.20	0.60	0.60	0.59
"Far" Stations				
DB03	0.34	0.36*	0.0002*	0.002*
DB06	0.08	0.07	<0.0001*	<0.0001*
DB12	0.41	0.003*	<0.0001	0.0002
SWEX3	0.002	0.10	0.0009*	0.0002
T01	0.24	0.006	<0.0001*	<0.0001
T02	0.15	0.0001	<0.0001	0.0001*
T03	0.04	0.0005	0.01	0.005
T05A	0.01	0.06	0.0005	0.003*
T06	0.77	0.04	0.0004*	0.001*
T07	0.0002	0.0009	<0.0001	0.0003
T08	0.17	0.46*	0.004	0.01*

Note: Shaded cells indicate statistical significance

* indicates data were log transformed to meet the assumptions for ANOVA

Table C-2 (a). One-Way ANOVA results for Total PAH, LMW-PAHs and HMW-PAH concentrations in sediments collected from 1990 to 2006.

a=1990, b=1994, c=1997, d=1998, e=2002, f=2006.

Station	Total PAHs	TOC Normalized Total PAHs	Sum LMW PAHs	TOC Normalized LMW PAHs	Sum HMW PAHs	TOC Normalized HMW PAHs
"Near" Stations						
DB01	a(bfd)(de)	(a)(bfd)(e)	a(bdf)(dfe)	(abd)(df)(fe)	(a)(fbd)(e)	(afbd)e
DB04						
T04	d(fbeca)	(dfb)(fbe)(beca)	d(fbe)(bec)(ca)	(df)(fbe)(ca)	(df)(fbe)(bec)(eca)	(fdb)(bec)(eca)
DB10	(df)(fab)(abe)	(df)(fabe)	(df)(fbe)(bea)	(df)(fbe)(bea)	(df)(bae)	(df)(fbae)
DB14	(dbf)(bfe)(a)	(fbd)(dae)	(db)(bfe)(a)	(dbf)(fe)(ea)	(dfb)(e)(a)	(fbd)(bde)(dea)
C019	(bdf)e	(bd)(df)(fe)	(bd)(dfe)	(bd)(fe)	(bdf)e	(bd)(df)e
"Far" Stations						
DB03				(bde)(def)(efa)		
DB06						
DB12	(edbf)(fa)		(ebdf)(fa)		(edbf)(fa)	
SWEX3		(fb)(bed)	(bed)(edf)			(fb)(bde)
T01						
T02			(cbed)(edf)	(cbde)(bdef)		
T03			(ec)(cf)			
T05A	e(cf)	e(fc)	e(cf)	e(fc)	e(cf)	e(fc)
T06						
T07		(dfe)(ec)				(dfe)(ec)
T08						

Note: Letters are arranged in order from the year of highest concentration to the year of lowest concentration.

Table C-2 (b). The p-values for One-Way ANOVA results for Total PAH, LMW-PAH, and HMW-PAH concentrations in sediments collected from 1990 to 2006.

Station	Total PAHs	TOC Normalized Total PAHs	Sum LMW PAHs	TOC Normalized LMW PAHs	Sum HMW PAHs	TOC Normalized HMW PAHs
"Near" Stations						
DB01	<0.0001*	<0.0001	<0.0001*	0.0006	<0.0001*	0.0001
DB04	0.14	0.15	0.14	0.16	0.11	0.13
T04	0.0005	0.0004	<0.0001*	<0.0001*	<0.0001*	0.0002
DB10	0.003	0.006	0.0008*	0.002*	0.001	0.004
DB14	0.0002	0.007	0.0004	0.001	<0.0001	0.006
C019	0.001	0.0006	0.005	0.001	0.0006	0.0005
"Far" Stations						
DB03	0.43	0.10*	0.05*	0.003*	0.43	0.09*
DB06	0.47	0.53	0.47	0.52	0.44	0.50
DB12	0.009	0.14	0.008	0.06	0.007	0.07
SWEX3	0.08	0.02	0.03	0.07	0.13	0.01
T01	0.16	0.19	0.08*	0.53	0.13	0.08*
T02	0.63	0.39	0.007	0.02*	0.28	0.63
T03	0.09	0.57	0.02	0.28	0.19	0.69
T05A	0.0005	0.0007	0.0006	0.0004	0.0006	0.001
T06	0.60	0.98	0.06	0.49*	0.22	0.98
T07	0.44	0.02	0.37	0.15	0.21	0.008
T08	0.31*	0.23*	0.30*	0.27*	0.32*	0.20*

Shaded cells indicate statistical significance.
* indicates data were log transformed to meet the assumptions for ANOVA

Table C-3 (a). One-Way ANOVA results for PCB, DDT, and Chlordane concentrations in sediments collected from 1990 to 2006.

a=1990, b=1994, c=1997, d=1998, e=2002, f=2006.

Station	Sum PCBs	TOC Normalized PCBs	Sum 5DDTs	TOC Normalized 5DDTs	Sum Chlordanes	TOC Normalized Chlordanes
"Near" Stations						
DB01	(fd)(db)e	(fd)(b)(e)	(b)(fd)(e)	(b)(df)(e)	(bf)(fd)(de)	(bf)(fd)e
DB04	(dfb)(fbe)		b(dfe)	b(dfe)		
T04	(dbfc)(bfce)		(bdcf)(fe)	(bcd)(cdf)(dfe)	d(cfb)(fbe)	d(cbf)(fe)
DB10	(fb)(bd)(de)	(fbd)e	b(fed)	b(dfe)	f(deb)	(fd)(deb)
DB14	(db)(bfe)	(dbf)e	(bd)(ef)	(bd)(fe)	(dbe)(bef)	(dbe)(bef)
C019	(fdb)e	(dfb)e	(bf)(fd)e	(b)(fd)(e)	(db)(bf)(fe)	(db)(bf)(fe)
"Far" Stations						
DB03		(dbf)(bfe)		(db)(bf)(fe)	(dbf)(fe)	(db)(bfe)
DB06	(bdf)(fe)		b(fde)		b(fed)	
DB12	(db)(bf)(fe)	(db)(bf)(fe)	(bdf)(fe)	(bd)(fe)	(db)(bf)(fe)	(db)(bf)(fe)
SWEX3		(fd)(db)(be)				
T01	(cbd)(bdfe)			(cb)(bfed)		
T02	c(bfde)	(cbd)(bdfe)	(bc)(fd)e	(cbdf)(dfe)	(cdb)(fe)	(cdb)(dbe)(bef)
T03					c(ef)	
T05A	(ec)(cf)				(ce)(ef)	
T06			c(fe)		c(ef)	c(ef)
T07					(cde)(def)	(dc)(cef)
T08		(cdf)(dfe)(eb)				(cdb)(bfe)

Shaded cells indicate statistical significance.
Note: Letters are arranged in order from the year of highest concentration to the year of lowest concentration

Table C-3 (b). The p-values for One-Way ANOVA results for PCB, DDT and Chlordane concentrations in sediments collected from 1990 to 2006.

Station	Sum PCBs	TOC Normalized PCBs	Sum 5DDTs	TOC Normalized 5DDTs	Sum Chlordanes	TOC Normalized Chlordanes
"Near" Stations						
DB01	0.0003	0.0005	<0.0001	<0.0001	0.0005*	0.0006
DB04	0.02	0.05	0.001*	0.002*	0.29	0.30
T04/DB13	0.03*	0.27	0.002*	0.002*	<0.0001*	0.0002
DB10	0.002	0.002	0.0006*	0.002*	0.02*	0.01
DB14	0.005*	0.001	0.003	<0.0001*	0.02*	0.03
C019	0.002	0.0008	0.0003	<0.0001	0.0005	0.0005
"Far" Stations						
DB03	0.25	0.007*	0.09	0.0007*	0.01	0.003*
DB06	0.01	0.29	0.004	0.07	0.002	0.12
DB12	0.007	0.002	0.01	0.002	0.002	0.001
SWEX3	0.39	0.001*	0.39	0.43	0.16	0.23
T01	0.02*	0.14	0.05	0.01	0.05*	0.14
T02	0.0002	0.02*	<0.0001	0.009	0.0002	0.003*
T03	0.99	0.25*	0.16	0.48	0.006	0.58*
T05A	0.03*	0.30	0.05	0.06	0.02	0.17
T06	0.07	0.23	0.008*	0.24	0.004	0.001
T07	0.62	0.68	0.06*	0.12*	0.02	0.008
T08	0.29	0.001*	0.15*	0.05	0.05	0.003*

Shaded cells indicate statistical significance.
* indicates data were log transformed to meet the assumptions for ANOVA