Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina
Year 3: June 1, 2002–May 31, 2003

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ABSTRACT

A regional drought that occurred through much of 2002 allowed the evaluation of many methods employed in this monitoring program to detect a potential change in salt water and/or tidal flow in the Cape Fear Estuary. Every monitoring component was able to detect the impact of the natural drought event, strongly suggesting that any potential impact from dredging and widening the Cape Fear River and Wilmington Harbor will be detected if it occurs.

More than 1,400 tide ranges measured between 1 June 2002 and 31 May 2003 comprise the database for water level comparisons during this monitoring period. As was the case in previous years, tidal ranges within the estuary were fairly constant, but were higher than tidal ranges measured at upstream stations. Water levels in the most upstream sites and the inner Town Creek station were strongly affected by freshwater flow, especially in spring 2003 when river discharge was elevated due to extensive rainfall in the upper watershed. Yearly mean tidal ranges at all of the upstream stations were significantly different from yearly means reported in the previous monitoring period. These differences are likely associated with extremely high discharge rates in the river in spring 2003 that tend to suppress tidal range. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded no significant differences between this reporting period and the previous reporting period with the exception of three stations. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), there were no significant differences between years. There was essentially no difference between tidal lag times measured during this reporting period and those measured in 2001-2002 for the upstream stations in the Northeast Cape Fear River. Small changes were noted for mainstem stations and estuary stations, but these did not appear to vary in any systematic way. The duration of the ebb tide continues to exceed the duration of flood at most stations as reported for previous monitoring periods.

Prolonged periods of both lower, drought-induced water levels and extreme flooding in the system over the last three years have led to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. In order to reduce some of the variability in water levels associated with high discharge, tidal range data were filtered using the annual mean streamflow of 5600 cubic feet per second from Lock 1 on the Cape Fear mainstem as the cutoff. The remaining ranges for each station were then regressed against the range at P1 for each of the monitoring periods. Analysis of covariance was then used to compare the slopes of the regressions between project Year 1 (2000-2001) and Year 3 (current reporting period) at each station. The only stations where significant differences occurred were stations P7 and P8 in the Cape Fear River mainstem. Neither of these stations exhibited significant differences between these years when all data were included in the original analysis. This result reiterates the necessity of conducting additional analyses to account for or correct for the effects of

streamflow. Such analyses must be undertaken in order to identify the effects of channel modification on tidal range with greater certainty.

Most subsites within marshes and swamps flooded regularly in both spring 2003 and fall 2002 with the exception of Indian Creek (P7) and some subsites adjacent to uplands. Average water levels at high tide were generally higher and frequency of flooding greater in spring 2003 than fall 2002 and higher than previous years for most stations. Absolute water levels in the river reached the same level in adjacent swamps and marshes at all but the most interior sites, indicating that river water and any salt in the water, influences most of the swamp. Flood frequency during two-week monitoring periods were compared to annual frequency at one station and confirmed that two-week intervals twice a year adequately represent annual flood frequency. Salinity of floodwater in the river penetrated well into swamps during periods of drought and was not significantly diluted except near uplands. At least for upriver sites, levels of saltwater penetration likely represent historic maxima.

There was a steady decrease in salinity from June of 2002 until June of 2002 at Eagle Island where geochemistry is monitored monthly. This salinity pattern was in contrast to the previous two years where peaks in salinity were observed during November and May. Because of the lack of a salinity pulse during these times, several locations within Eagle Island converted to methane generating systems for the first time, while remaining sites continued to exhibit sulfate reduction characteristics.

In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), the increases in porewater salinities observed during previous summers continued through the summer of 2002. Due to the continued increase in summer salinities, all four sites were classified as sulfate reducing geochemical classifications for the first time. With the exception of Smith Creek, which already had a sulfate reducing geochemical classification, this is the first time the upper Northeast Cape Fear sites had been characterized as sulfate reducing. A similar increase in summertime porewater salinity was noted in Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island), while sites further upstream on the Cape Fear River (Black River, Dollisons Landing) had peak salinities occurring during the previous summer (2001). The salinities of Town Creek, the only site below the City of Wilmington monitored for geochemical classification, showed no obvious change in summer porewater salinity.

Winter sampling 2003 demonstrated that the drought had ended. With the exception of Town Creek, which is below the city of Wilmington, and the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island), all sites had lower winter porewater salinities than previous winters. For the upper Cape Fear River sites (Black River, Dollisons Landing), winter conditions have continued to show a steady decrease since 2000. The fresher conditions did not cause a shift in geochemical classification for these sites since they were already methanogenic. In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), the current winter 2003 porewater salinities returned to lower values after peaking during the previous winter 2002. The decrease in salinities for the more seaward stations (Rat Island and Smith Creek) was not enough to convert these systems from sulfate reducing geochemical classification. For the upstream stations (Fishing Creek, Prince George) several subsites that were converted to sulfate reducing during the previous winter returned to methanogenic geochemical classification during the current winter (2003). Porewater salinities of Town Creek, Indian Creek, and Eagle Island increased during the current winter (2003). Changes in geochemical classifications were relatively small for these sites with only a slight shift towards more saline classifications.

The epibenthic community (fish and decapods primarily) that utilize the fringing marshes and tidal swamps along the Cape Fear River consists of organisms that by definition are highly mobile and capable of demonstrating rapid changes in utilization across sites. General trends over long time periods can indicate large-scale ecosystem change to the system. Here we present fall and spring data from both Breder trap and drop trap methods collected since 1999 and focuses on evaluating trends in community level factors (e.g. diversity, species richness and species groupings).

Evaluation of species richness, diversity, and total fauna by season (spring-fall) for Breder trap data showed strong inter-annual and site differences as well as strong year-site interactions. These results are predicted based on the highly motile nature of the fauna and variable conditions within the Cape Fear River system. Principal components analysis showed some scatter among site-date combinations, but little directionality in trends. Drop trap data showed similar results with significant annual and site differences, as well as year-site interactions. Analysis of drop data by season showed fall 2000 and spring 2002 to have distinctly higher values for species richness, diversity, and total fauna from other fall and spring samples, respectively. Fall and spring data from both Breder trap and drop trap samples collected since 1999 are included in analyses. Fall 1999 thru 2000 reflect pre-dredge or background conditions.

The infaunal community is not inherently motile. Infauna at nine sites distributed among the Cape Fear River, Northeast Cape Fear River and Town Creek from 1999-2002 was compared. This period covered two major system-level impacts: a developing drought in 2001-2002, as well as the initiation of channel widening construction. Diversity and species richness were greatest in 1999, intermediate in 2000-2001, and lowest in 2002. Total faunal abundance showed a similar pattern, with higher overall abundances in 1999 and 2000, intermediate in 2001 and lowest in 2002. Principal components analyses indicated that 2002 was distinct from previous years, but all sites appear to show a gradual change over the 4-year period. The only exception was at the mouth of Town Creek, which exhibited a dramatic alteration in community composition in 2002. Examination of dominant species at each site indicated that many sites initially dominated exclusively by tidal freshwater and oligohaline species included a significant proportion of oligohaline-mesohaline polychaetes by 2002, suggesting a potential salinity affect related to the drought.

Salt sensitive herbaceous vegetation monitored at seven stations within Cape Fear Estuary indicate five of these stations have sustained impacts associated with recent occurrences of ocean-derived salt water born by tidal events. The station at Dollisons Landing shows minor damage that may be related to sulfide toxicity. These sulfides may not have originated from ocean-derived sulfates. The station at Black River shows no salinity symptoms. Sensitive herbaceous vegetation within polygons at Prince George Creek and Indian Creek showed no indications of salinity damage until this year.

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EXECUTIVE SUMMARY

All 12 monitoring stations along the Cape Fear River and its tributaries provided adequate data for the period between 1 June 2002 and 31 May 2003 to ultimately determine if the Wilmington Harbor Widening and Deepening Project impacted the tidal range in the Cape Fear Estuary. The drought of 2002 was detected in almost every component of monitoring; strongly suggesting that any significant change in the estuary directly related to dredging will be detected by the monitoring program. During this reporting period one station that had become unstable was repaired with the addition of a batter pile. Problems at the base station at Ft Caswell were also resolved. A minimum of 8.8% and a maximum of 18.8% of tides were removed from the database for a variety of reasons. These losses were similar to previous years.

Nine of the study sites each contain six subsites located varying distances from the river's edge. Water level and salinity of flooding water at these 54 subsites are determined during two-week periods in fall and spring. Most of the subsites flood during each tidal event transporting surface river water back into the swamp/marsh habitat. Water levels in the marsh or swamp reach the same level as the river whenever the flood tide exceeds the level of the river's edge. Two-week study periods in fall and spring provide adequate representation of the entire year. Elevations of some permanent benchmarks are examined at one station each year to verify that benchmarks have not moved. Four subsites at a station in the inner reaches of Town Creek were examined May 2003 and are stable. However, the Data Collection Platform (DCP) at this station has sunk 1.03' and data adjusted to account for this change.

More than 1,400 tidal ranges comprise this year's database. The degree to which the tidal range at the river's mouth is correlated with the tidal range at upriver stations will be used to determine if a change has occurred in the movement of tides up the Cape Fear River and its tributaries. A few differences in this relationship were noted last year and likely caused by drought, while a few additional ones noted this year were likely caused by extreme flooding winter and spring 2003. Most of these effects disappeared when compared to initial data. This reporting period included both drought (summer 2002) and flood (spring 2003) periods. A method has been developed to filter out these drought and flood effects at each station. This method will be finalized and verified in future reports.

Changes in the time it takes for tides to move upstream (lag time) appeared to have changed from the first to second year. This was attributed to drought, a conclusion verified by this year's data as these differences largely disappeared with higher river base flow. The duration of high and low tides remain different, with flood tides shorter than ebb tides at upstream stations.

During the drought that ended fall 2002, record levels of salinity were measured both in the river and in surface waters flooding marshes and swamps. The Prince George Station located about 16 miles upstream from Wilmington, NC along the Northeast Cape Fear River was established as a background station, but was flooded during the drought by saline water. When the drought ended and flood conditions began, most subsites in swamps again were flooded by fresh water.

One potential impact of saline water upstream is the conversion of fresh soils into soils with seawater-derived salts. Sulfate in seawater fuels bacteria that convert sulfate to toxic sulfides that kill plant roots and any animals not adapted to saline water. Studies confirmed that saltwater that flooded marshes and swamps during the drought penetrated into soils converting some previously fresh soil systems that generated methane into sulfide generating ones. Levels of saltwater in soils at one Town Creek station was almost half strength seawater during summer 2002, while salinities increased 10 times at many freshwater sites in the Northeast Cape Fear River. Levels of both soil salinity and soil sulfate levels predict a significant change of vegetation at these sites. Sites in the mainstem of the Cape Fear River also had increased salt and sulfate levels in soils, but not at the high levels found for the Northeast Cape Fear River. Regulated discharge at Lock and Dam 1 has largely kept saline water further downstream.

Salt sensitive vegetation was impacted at five of the stations monitored. At Inner Town Creek the impact was great enough to also kill woody vegetation on levees. Impacts were greatest at two stations located four and eight miles upstream of Wilmington on the Northeast Cape Fear River and less 16 miles upstream. One site, four miles upstream on the Cape Fear River also showed some minor impact.

1.0 STATION OPERATION

1.1 SUMMARY

Measurement of water levels in the main channel of the Cape Fear River, the Northeast Cape Fear River, and Town Creek continue to provide the data necessary to determine the impact associated with the widening and deepening project. Differences between the high and low points of each tide, referred to as ranges in this report, can be followed upstream from the base station at Ft Caswell (P1) to any individual station. Differences between stations with respect to tidal range, time to high or low tide, length of low and high tides were also determined. Comparisons of these variables before and after channel modifications will provide the statistical testing mechanism to determine whether the project has impacted adjacent wetlands. In addition, the absolute elevation of floodwater when related to measurements of water levels at marsh/swamp substations allows the determination of both flood duration and flood depth for any tide. This report includes data collected from 1 June 2002 through 31 May 2003. During this period, problems of communication with instruments or minor instrument malfunction were solved as they occurred. As was the case in previous monitoring years, each tide has been examined for each station and a determination made as to whether the data collected are reliable.

Several major problems were solved during the past year and minor problems solved as they occurred. The instability of the DCP platform at P8 (Dollisons Landing) was corrected with the attachment of a batter pile. The problem was identified in late spring 2002 when initial data review indicated periodic jumps in water level. During the QA/QC procedure, it was determined that the stilling well walls were interfering with the rise and fall of the floats because the piling was no longer plumb. In June 2002, efforts were made to straighten and reinforce this piling. These efforts included the installation of a chain and cable affixed to the shore that applies tension to the piling, thus keeping it vertical. The piling was repaired in January 2003 and data from this site have been reliable since the repair was completed.

Another serious data problem occurred when the U.S. Coast Guard attached a floating dock to the piling containing the DCP at P1 (Ft Caswell). This structure led to instability in the stilling well and a reduction in data quality. The dock was removed in April 2003 and the data quality returned to previous levels.

Table 1.1-1 provides a general summary of data loss that affects statistical analysis for present and future comparisons

1.2 Methodology

Water level is determined at one-second intervals at each station, except P4, with a UNIDATA shaft-encoded water level recorder housed in an aluminum stilling well. A UNIDATA Starlogger records and stores the average, maximum, and minimum values every 3 minutes. Conductivity and temperature are sampled by a UNIDATA conductivity instrument and recorded by the Starlogger every 3 minutes. Data are downloaded to a PC housed at UNCW at least once every two weeks via modem. In instances when the modem has not functioned properly, technicians on site download data on site from loggers using a laptop computer. Preliminary data quality review consists of visually reviewing data for major problems (e.g. float hang-ups in the stilling well, data transmission errors, large jumps/shifts in water level, loss of data) within 2-3 days of download. This process is done so that any major equipment problems identified can be rectified immediately. Data are then compiled into files each of which contains one month of data for each station. Data files are then sorted at six minutes intervals and the resulting data set stored for subsequent data analysis. Specific problems associated with the equipment and data acquisition are described below for each station. The following terms used in this section of the report describe general mechanisms through which data are lost or compromised.

Loss at Station P1: Because the response of each variable upstream is related to the base station at Ft Caswell (P1), the loss of a variable from P1 during a particular tide means that there is no means of comparison with other stations. Reasons for data loss at P1 as well as other stations are: 1) QA/QC Procedure, which refers to tides that were removed from the data set when measurements coincided with QA/QC and equipment maintenance procedures. In these instances, recorded water levels were inaccurate due to cleaning the water level float, removing/replacing the water level recorder, replacing the beaded cable, or performing a field reset when in-situ observations of water level were inconsistent with water levels reported by the data logger. 2) Under ranging events refers to tides that were removed from the data set when the actual water level fell below the elevation of the stilling well cap. In these instances, the instruments were unable to detect the minimum water level. 3) Absence of Data refers to tides that were lost when the data were not recorded by the data logger or were not transmitted properly via the modem or PC download process. 4) Freezing of surface water in the stilling well prohibited the float from following the rise and fall of the tides and these tides were removed. 5) Mechanical Errors refer to tides removed from the data set during the data review process because of likely mechanical malfunction. Mechanical malfunctions were suspected when the plotted data exhibited misshapen curves, large jumps, and flat lines (i.e. hang-ups). There are a variety of known and unknown causes of mechanical errors. Whenever uncertainty of data quality exists, these data are removed from the database.

Table 1.1-1. Percentages of tides unavailable for analysis and reasons for loss. Detailed descriptions of "loss" categories are listed in Section 1.2 above.

Station	% Loss at Station P1	% QA/QC	% Under-ranging Events	% Absence of Data	% Freezing	% Mechanical Errors	Total % Lost Tides
P1	N/A	0	0	2.1	0	6.7	8.8
P2	8.8	0	0	0	0	3.7	12.5
P3	8.8	0	0	0	0	1.8	10.6
P4	8.8	0	0	0	0	0	8.8
P6	8.8	0	0	0	0	0	8.8
P7	8.8	0	7.7	0.8	0	0	17.2
P8	8.8	0	0	5.2	0	4.8	18.8
P9	8.8	0.1	0	8.9	0.7	0	18.4
P11	8.8	0	0	0	0	5.9	14.7
P12	8.8	0	0	0	0	0.6	9.4
P13	8.8	0	0	0	0	0	8.8
P14	8.8	0	0	0	0	0	8.8

1.3 Ft Caswell (P1)

Ft Caswell is the most important station because this station experiences amplitude changes that are essentially oceanic tides. All upstream water levels are related to this base station. This station functioned well during the reporting period. The total percentage of lost tides at this station from June 2002 to May 2003 (8.8%) was comparable to losses reported for previous reporting periods. Communication problems necessitated manual downloading on several occasions with loss of data on one occasion. Data collected at this station still show irregularities in the shape of the water level curves periodically; however, the lack of a smooth curve usually does not affect the reported minimum and maximum water level values (i.e. reported tidal range). The attachment of a floating dock to the piling supporting the DCP at P1 disrupted data collection for approximately 35 tides in March and April 2003. The presence of the dock led to instabilities in the stilling well that resulted in irregularly shaped water level curves. The dock has since been removed and the data quality improved. A minor and temporary problem with the internal clock at this station resulted in some data loss at this station in late October 2002. Biofouling continues to be a minor problem for the conductivity (salinity) probe, especially when larvae are recruiting into the estuary, and the growth of oysters inside the stilling well led to the loss of about 29 tides in June 2002. Monthly QA/QC checks and cleaning of probes and the well interior, however, limits and corrects these problems when they occur. Corrosion of the beaded cable also affects data quality; therefore, cable integrity is assessed each month and the cable replaced when necessary. Corrosion of the cable led to the loss of about 25 tides in August/September 2002.

1.4 Town Creek Mouth (P2)

Water level curves at this station are not always as smooth as would be expected, although maximum and minimum water levels correspond well with P1. This site seems to be affected by passing ships/boats, which compromises the quality of data in some instances. The temporary build-up of a sand bar in summer and early fall 2002 may also have led to the focusing of waves on this site which affected the water level curve. Data for these tides are omitted in analyses. This area is also a feeding area for pelicans, terns, and gulls that sit on the piling and solar cell. Excrement covering the solar cell must be removed and the caustic nature of the excrement has caused increased corrosion of the metal components of the structure.

Water relatively high in salinity at this site affected the beaded cables, necessitating their replacement on occasion. Biofouling is also a problem at this station, but is identified and corrected each month (if present) during monthly QA/QC checks.

1.5 Inner Town Creek (P3)

This station has had few problems and continues to generate smooth tidal curves. The restricted and protected nature of this site continues to protect it from large waves and wakes. Fewer than 2% of the tides were lost at this station during this reporting period.

1.6 Corps Yard (P4)

NOAA operates the tidal gauge at this site and data are available at their website after curve-smoothing procedures are applied. The UNCW conductivity/salinity gauges located at this site have operated with no problems over the reporting period.

1.7 Eagle Island (P6)

This site experienced no operational difficulties during this monitoring period.

1.8 Indian Creek (P7)

This DCP and associated stilling well are set higher than others along the Cape Fear River and therefore, this site continues to experience a relatively high percentage of lost tides due to underranging (7.7% for this reporting period). This year, underranging was especially problematic in summer 2002 due to low water levels in the river associated with a regional drought and low discharge upstream. Less than 1% of the tides at this site were lost due to communication errors.

1.9 Dollisons Landing (P8)

As reported during the last monitoring period, stability became a problem at this site in spring 2002. Initial data review revealed jumps in data indicative of float hang-ups. In addition, during QA/QC visits there was a discrepancy in the measured water level versus the instrument level and the water level recorder was reset. Eventually, the piling was found to be leaning. Efforts were made to temporarily straighten the piling in summer 2002 that improved data quality. This piling was reconstructed in January 2003 through the addition of a batter pile attached to the vertical pile. The site has experienced few problems since that time. Other data loss at P8 was caused by lightening strikes in July/August, 2002.

1.10 Black River (P9)

The majority of data loss at this station was due to a faulty data logger that did not record data. The starlogger was replaced at the end of October 2002. Other forms of data loss included communication errors and freezing in the early morning hours in January 2003.

1.11 Smith Creek (P11)

Data acquisition at this site was very good this year. The shoaling reported in previous reports has ceased to be problematic and no underranging events were recorded. Fewer than 6% of the tides measured at this site were lost and those that were lost were due to lightening strikes in April 2003.

1.12 Rat Island (P12)

Since the piling was redesigned and relocated in the 2001-2002 reporting period, this station has experienced few problems. Less than 1% of the tides measured at this site were unusable and these were associated with miscellaneous mechanical errors.

1.13 Fishing Creek (P13)

There were no problems at this site.

1.14 Prince George Creek (P14)

There were no problems at this site.

2.0 MONUMENT AND STATION SURVEY VERIFICATION

2.1 Summary

Four subsites and the DCP piling benchmark at P3 were resurveyed in May 2003 to determine if elevations of any of these previously measured points had changed since the initial survey. Three of the four subsites were within 0.03' of the original survey and the most distant from the DCP only 0.12'. The 4' level on the piling, however, was 1.03' lower than the initial survey indicating that the piling had sunk.

2.2 Survey Elevation Verification of Inner Town Creek (P3)

On 28 May 2003 level lines were made using standard surveying instruments of the four subsites and the DCP instrument platform at Inner Town Creek (P3). The benchmark at this site was at 6.48' and was used as the basis for all measurements. Two separate level lines were established from two different locations and checked back to both the benchmark and the first two subsites. This was used as a check of survey technique. Both provided the same elevations. The initial elevation of subsite 1 in 1999 was 3.23' and the same elevation was measured again. At subsite 2 there was a 0.03 difference between initial (4.63') and elevation measured in May 2003 (4.60'). Subsite 3 was the exact elevation as the initial survey. Dense vegetation and distance from the benchmark made measurements of the elevation at Subsite 4 difficult. However, a measurement was eventually made 3.48' compared to the initial 3.36' elevation. Differences between these two elevations are likely due to instrument limitation and do not indicate a significant change in elevation of subsite 4.

The 4' mark on the piling holding the DCP was measured at 5.03'. This indicated that the piling had sunk 1.03'. This was suspected because of resets of the water level instrument and was the prime reason for choosing to examine this station.

3.0 RIVER WATER LEVEL/SALINITY MONITORING

3.1 Summary

More than 1,400 tide ranges measured between 1 June 2002 and 31 May 2003 comprise the database for water level comparisons during this monitoring period (Appendix A). The existing database allows analyses of between year changes in tidal amplitude as well as changes of ebb and flood duration. The correlation of tidal range from the base station at Ft Caswell with the predicted tidal range was very good and relatively unchanged from last year. As was the case in previous years, tidal ranges within the estuary were fairly constant. Tidal ranges measured at upstream stations and inner Town Creek were lower than previous years because of high river discharge, especially in spring 2003 when river discharge was elevated due to extensive rainfall in the upper watershed. High flow conditions followed a period of limited freshwater input in summer/fall 2002 associated with extreme drought conditions in the watershed. Yearly mean tidal ranges at all of the upstream stations were significantly different from yearly means reported for the previous monitoring period. Further, the mean tidal range observed at P1 (Ft Caswell) was also significantly different from the mean range reported in 2001-2002. These differences are likely associated with extremely high discharge rates in the river in spring 2003 that tend to suppress tidal range. Mean monthly maximum water levels for this reporting period were significantly higher than 2001-2002 at all stations except for P4, P8, and P11. With the exception of station P2, there was no significant difference in mean monthly minimum water level between this reporting period and last year. Comparison of regression lines, where tidal range at each site was regressed against the tidal range at P1, yielded no significant differences between this reporting period and the previous reporting period with the exception of stations P2, P3, and P7. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), there were no significant differences between years.

There was essentially no difference between tidal lag times measured during this reporting period and those measured in 2001-2002 for the upstream stations in the Northeast Cape Fear River. Small changes were noted for mainstem stations and estuary stations, but these did not appear to vary in any systematic way. The duration of the ebb tide continues to exceed the duration of flood at most stations as in previous monitoring periods. Flood and ebb durations show little change from mean durations reported in 2001-2001 for most stations (less than 3% and 2% change for flood and ebb durations, respectively). The one exception was station P1 (4.9% increase in flood duration). The relationship between tidal range at Ft Caswell and other stations differed from station to station, but was generally related to distance from the ocean and freshwater flow. High fluvial discharge in spring 2003, however, led to increased variability in the tidal ranges observed during this monitoring period.

In general, mean tidal range decreased at upstream stations. The mean tidal range for every station except P2 and P4 was significantly lower this year than the mean tidal range reported in 2001-2002. At stations P2 and P4, there was no significant difference in mean tidal range between this year and last year’s monitoring period. When the mean tidal ranges for the current year were compared to those reported for Year 1 (2000-2001), fewer differences were detected and these tended to occur at those stations more susceptible to the effects of increased runoff. It is clear that water levels are influenced by both drought and flood conditions in the rivers delivering water to the lower Cape Fear River. We have developed methods of filtering these data based on base flow conditions in the Cape Fear River that will allow the effects of these two extreme conditions to be evaluated. While any filtering process reduces the absolute number of tidal ranges that will be used, the database is more than adequate to accommodate the filtering process. Future data analyses will remove flooding and drought effects so that the effects of channel modification on tidal attributes can be determined.

In 2000-2001, salinity did not exceed 1.0 ppt at stations upstream of Eagle Island on the Cape Fear River because of the continuous release of freshwater upstream. In 2001-2002, upstream releases in the Cape Fear River had been reduced and salinities as high as 3.5 ppt were measured at P8 while salinities exceeding 14 ppt were measured at Fishing Creek, 8 miles north of Point Peter in the Northeast Cape Fear River. Maximum salinities reported for these sites during this reporting period were 5.8 ppt and 16.4 ppt, respectively. These salinities were measured in summer 2002. Increased rainfall and the end of drought conditions in November 2002 led to the return of low salinity conditions at these sites for the remainder of the monitoring period.

3.2 Database

Water level, conductivity, and temperature data collected at DCP stations from June 2002 through May 2003 are incorporated in this report. To date, approximately 1,400 tides have been analyzed for all 11 DCP stations. Specific problems associated with each station have been described in Section 1.0 of this report. Table 1.1-1 summarizes the percentage of tides unavailable for analysis.

3.3 Data Analyses Methods

Maximum, minimum, and average water level and conductivity/temperature were recorded every 3 minutes. The final data set used for analyses consists of 3-minute averages of water level and conductivity collected every 6 minutes. The 6-minute means were plotted after each two-week interval and the resulting curves visually inspected by a senior analyst for quality control purposes. Suspect data, such as outliers or data points that deviate from a smooth curve, were discarded. Unreliable data, such as those collected during periods of mechanical malfunction, equipment maintenance, under-ranging events, and freezing events, were also removed. The remaining data were then filtered to extract the maximum and minimum water levels associated with each tidal event. For this report, a tidal event consists of one high water/low water pair.

The high and low water values contained in the final data set were used to determine the mean tidal range, the duration of flooding, and the duration of ebbing for each site. These data were also used to compute tidal lags between sites. The mean tidal range was computed from the difference in water level between each high and low tide event for each station. The tidal range for each of the 1,410 measured tides for each station during the study period is provided in Appendix A. Statistical differences between the range values for stations upstream before versus after channel deepening for a specified tidal change at the river mouth (P1) will be used to determine if the project has altered the flooding regimen upstream. Monthly mean tidal ranges, maximum/minimum water level and maximum/minimum salinity values for each station are given in Table 3.3-1. Yearly mean tidal ranges and standard deviation are given in Figure 3.3-1 for this reporting period and both previous reporting periods. A Wilcoxon rank-sum test was used to compare yearly means for each station and significant differences (P<0.05) denoted by asterisks in Figure 3.3-1. With the exception of stations P2 and P4, the mean tidal ranges measured during this reporting period were significantly less (P<0.05) than the means reported in 2001-2002. Ranges at P2 and P4 were not significantly different from mean tidal ranges reported for those stations in 2001-2002. This reduction in mean tidal range is most likely the result of increased rainfall and streamflow in spring 2003 (see Figure 3.5-1). In previous reports, these two factors have been shown to reduce tidal range at monitoring stations.

Table 3.3-1. Monthly maximum, minimum, and range of salinity for each station. Monthly maximum, minimum, and range of water level for each station are also given. All water levels are relative to NAVD88 with the exception of P4 (USACE yard), which is relative to MSL.

		Salinity (ppt)			Water Level (ft)		
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P1	2002-Jun	35.2	15.8	19.4	2.72	-4.04	6.76
	2002-Jul	34.6	15.1	19.5	4.03	-4.22	8.25
	2002-Aug	34.1	17.2	16.9	4.48	-2.58	7.06
	2002-Sep	32.6	14.8	17.8	4.67	-2.52	7.19
	2002-Oct	32.5	13.5	19.0	3.42	-3.6	7.02
	2002-Nov	29.4	13.5	15.9	3	-4.2	7.2
	2002-Dec	29.2	12.7	16.5	2.88	-4.13	7.01
	2003-Jan	28.2	12.2	16.0	2.9	-4.52	7.42
	2003-Feb	30.8	13.6	17.2	2.9	-4.19	7.09
	2003-Mar	24.9	16.1	8.8	4.02	-3.63	7.65
	2003-Apr	24.0	12.8	11.2	4.23	-3.89	8.12
	2003-May	25.5	12.5	13.0	5.01	-4.26	9.27
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P2	2002-Jun	25.7	8	17.7	3.44	-2.53	5.97
	2002-Jul	20.2	7.3	12.9	3.27	-2.73	6
	2002-Aug	25.5	1.1	24.4	3.88	-2.3	6.18
	2002-Sep	17.4	0.1	17.3	3.7	-2.4	6.1
	2002-Oct	17.8	1.4	16.4	3.8	-2.19	5.99
	2002-Nov	12.1	0.2	11.9	4	-2.7	6.7
	2002-Dec	12.1	0.1	12	3.39	-2.84	6.23
	2003-Jan	12.3	0.1	12.2	3.69	-2.83	6.52
	2003-Feb	12	0.1	11.9	3.46	-2.79	6.25
	2003-Mar	2	0.1	1.9	4.16	-2.36	6.52
	2003-Apr	2.7	0	2.7	4.22	-2.45	6.67
	2003-May	10.8	0.1	10.7	3.74	-2.83	6.57
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P3	2002-Jun	24.5	1.9	22.6	1.61	-2.27	3.88
	2002-Jul	18.7	0.2	18.5	1.52	-2.43	3.95
	2002-Aug	19.3	0.1	19.2	2.1	-2	4.1
	2002-Sep	11.9	0.1	11.8	2.3	-1.4	3.7
	2002-Oct	19.9	0.1	19.8	2.5	-1.34	3.84
	2002-Nov	8.8	0.1	8.7	2.28	-1.79	4.07
	2002-Dec	7.5	0.1	7.4	1.94	-2.24	4.18
	2003-Jan	2.7	0.1	2.6	2.7	-2.67	5.37
	2003-Feb	3.3	0.1	3.2	3.06	-2.1	5.16
	2003-Mar	1	0	1	3.07	-1.73	4.8
	2003-Apr	0.1	0	0.1	3.08	-1.97	5.05
	2003-May	8.1	0	8.1	2.02	-2.26	4.28

Table 3.3-1. (continued)

		Salinity (ppt)			Water Level (ft)		
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P4	2002-Jun	18.5	9.3	9.2	5.36	-0.66	6.02
	2002-Jul	16.9	4.7	12.2	5.24	-0.8	6.04
	2002-Aug	18.6	9.3	9.3	5.81	-0.28	6.09
	2002-Sep	12.9	5.6	7.3	5.59	-0.35	5.94
	2002-Oct	16.8	2.2	14.6	5.86	-0.35	6.21
	2002-Nov	7.1	0.6	6.5	5.93	-0.64	6.57
	2002-Dec	4.7	0.3	4.4	5.43	-1.11	6.54
	2003-Jan	6.3	0.3	6	5.62	-1.52	7.14
	2003-Feb	4.5	0.1	4.4	5.52	-1.51	7.03
	2003-Mar	0.4	0	0.4	6.15	-0.31	6.46
	2003-Apr	0.9	0	0.9	6.25	-0.29	6.54
	2003-May	3.9	0	3.9	5.78	-0.93	6.71
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P6	2002-Jun	21	0.5	20.5	3.02	-2.89	5.91
	2002-Jul	20.6	0.8	19.8	2.72	-3.18	5.9
	2002-Aug	16.3	0.9	15.4	3.51	-2.43	5.94
	2002-Sep	14	0.1	13.9	3.68	-2.05	5.73
	2002-Oct	17.8	0.1	17.7	3.93	-2.03	5.96
	2002-Nov	9.6	0.1	9.5	3.54	-2.9	6.44
	2002-Dec	7.7	0	7.7	3.15	-3.31	6.46
	2003-Jan	9.3	0	9.3	3.32	-3.49	6.81
	2003-Feb	9	0	9	3.23	-3.45	6.68
	2003-Mar	0.1	0	0.1	3.87	-2.29	6.16
	2003-Apr	0.6	0	0.6	4.03	-2.27	6.3
	2003-May	9.6	0	9.6	3.55	-3.13	6.68
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P7	2002-Jun	6.9	0.2	6.7	2.82	-2.4	5.22
	2002-Jul	5.9	0.2	5.7	2.66	-2.4	5.06
	2002-Aug	10	0.1	9.9	3.15	-2.34	5.49
	2002-Sep	0.3	0.1	0.2	2.97	-2.09	5.06
	2002-Oct	1.8	0.1	1.7	3.39	-2.16	5.55
	2002-Nov	0.1	0	0.1	3.39	-2.32	5.71
	2002-Dec	0.1	0.1	0	3.15	-2.3	5.45
	2003-Jan	0.3	0	0.3	3.24	-2.34	5.58
	2003-Feb	0.1	0.1	0	3.18	-2.33	5.51
	2003-Mar	0.1	0	0.1	3.93	-1.1	5.03
	2003-Apr	0.1	0	0.1	4.68	-1.08	5.76
	2003-May	0.1	0	0.1	3.64	-2.24	5.88
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P8	2002-Jun	4	0.1	3.9	2.8	-2.24	5.04
	2002-Jul	4.6	0.1	4.5	2.68	-2.44	5.12
	2002-Aug	5.7	0.1	5.6	3.45	-1.67	5.12
	2002-Sep	0.2	0.1	0.1	2.94	-1.66	4.6
	2002-Oct	3.4	0	3.4	3.53	-1.78	5.31
	2002-Nov	0.1	0	0.1	3.39	-2.62	6.01
	2002-Dec	0.1	0	0.1	3.36	-3.38	6.74
	2003-Jan	0.1	0	0.1	3.36	-2.76	6.12
	2003-Feb	0.1	0	0.1	3.35	-2.47	5.82
	2003-Mar	0.1	0	0.1	4.13	0.13	4.00
	2003-Apr	0.1	0	0.1	5.53	-0.31	5.84
	2003-May	0.1	0	0.1	3.93	-2.08	6.01
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P9	2002-Jun	0.7	0.1	0.6	2.6	-2.19	4.79
	2002-Jul	0.7	0.1	0.6	2.42	-2.45	4.87
	2002-Aug	0.2	0.1	0.1	2.82	-2.04	4.86
	2002-Sep	0.2	0.1	0.1	2.91	-1.63	4.54
	2002-Oct	0.2	0.1	0.1	2.58	-1.75	4.33
	2002-Nov	0.1	0.1	0	3.19	-1.87	5.06
	2002-Dec	0.1	0	0.1	3.2	-2.41	5.61
	2003-Jan	0.1	0	0.1	7.15	-2.69	9.84
	2003-Feb	0.1	0	0.1	7.49	-1.65	9.14
	2003-Mar	0.1	0	0.1	4.47	0.97	3.5
	2003-Apr	0.1	0	0.1	4.77	-0.5	5.27
	2003-May	0.1	0	0.1	3.99	-3.94	7.93

Table 3.3-1. (continued)

		Salinity (ppt)			Water Level (ft)		
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P11	2002-Jun	21.3	4.5	16.8	3.54	-2.19	5.73
	2002-Jul	16.5	1.4	15.1	2.99	-2.76	5.75
	2002-Aug	21.4	1.3	20.1	3.78	-2.63	6.41
	2002-Sep	15.3	0.5	14.8	3.14	-2.48	5.62
	2002-Oct	16.5	1.3	15.2	3.47	-2.38	5.85
	2002-Nov	10.7	0.1	10.6	3.55	-2.75	6.3
	2002-Dec	7.8	0.1	7.7	3.16	-3.04	6.2
	2003-Jan	7.9	2.9	5	3.29	-3.01	6.3
	2003-Feb	9.1	0.1	9	3.31	-3.01	6.32
	2003-Mar	0.5	0	0.5	3.94	-2.17	6.11
	2003-Apr	2.6	0	2.6	4.41	-2.1	6.51
	2003-May	0.1	0	0.1	3.1	-3.08	6.18
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P12	2002-Jun	20.3	2	18.3	2.54	-2.62	5.16
	2002-Jul	17.2	1	16.2	3.97	-2.77	6.74
	2002-Aug	16.9	2.7	14.2	2.76	-2.53	5.29
	2002-Sep	11.4	0.3	11.1	2.59	-2.38	4.97
	2002-Oct	17.8	0.6	17.2	3.14	-2.23	5.37
	2002-Nov	9.5	0.1	9.4	3.16	-2.45	5.61
	2002-Dec	6.9	0.1	6.8	2.8	-2.93	5.73
	2003-Jan	8.9	0.1	8.8	2.87	-3.32	6.19
	2003-Feb	8.5	0.1	8.4	2.93	-3.26	6.19
	2003-Mar	0.1	0.1	0	3.46	-2.03	5.49
	2003-Apr	1.5	0	1.5	3.53	-1.97	5.5
	2003-May	8.3	0	8.3	3.17	-2.61	5.78
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P13	2002-Jun	16.4	1.6	14.8	3.41	-1.83	5.24
	2002-Jul	14.7	0.6	14.1	2.08	-2.57	4.65
	2002-Aug	10.4	0.6	9.8	2.54	-2.13	4.67
	2002-Sep	3.9	0.2	3.7	2.44	-1.76	4.2
	2002-Oct	13.7	0.2	13.5	2.66	-1.84	4.5
	2002-Nov	4.9	0.1	4.8	2.65	-2.2	4.85
	2002-Dec	0.9	0.1	0.8	2.36	-2.74	5.1
	2003-Jan	1.2	0.1	1.1	2.39	-3.05	5.44
	2003-Feb	1	0.1	0.9	2.51	-2.96	5.47
	2003-Mar	0.1	0	0.1	3.06	-1.76	4.82
	2003-Apr	0.1	0	0.1	3.16	-1.74	4.9
	2003-May	1.8	0	1.8	2.83	-2.34	5.17
Site	Month	Maximum	Minimum	Range	Maximum	Minimum	Range
P14	2002-Jun	5.1	0.2	4.9	1.88	-1.74	3.62
	2002-Jul	2.8	0.3	2.5	1.66	-1.99	3.65
	2002-Aug	3.5	0.4	3.1	2.05	-1.61	3.66
	2002-Sep	0.6	0.1	0.5	1.98	-1.2	3.18
	2002-Oct	2.6	0.1	2.5	2.31	-1.21	3.52
	2002-Nov	0.8	0.1	0.7	2.14	-1.6	3.74
	2002-Dec	0.1	0.1	0	1.99	-2.08	4.07
	2003-Jan	0.1	0.1	0	1.93	-2.45	4.38
	2003-Feb	0.1	0.1	0	2.2	-2.3	4.5
	2003-Mar	0.1	0	0.1	2.76	-0.91	3.67
	2003-Apr	0.1	0.1	0	3.01	-1.13	4.14
	2003-May	0.1	0	0.1	2.34	-1.6	3.94

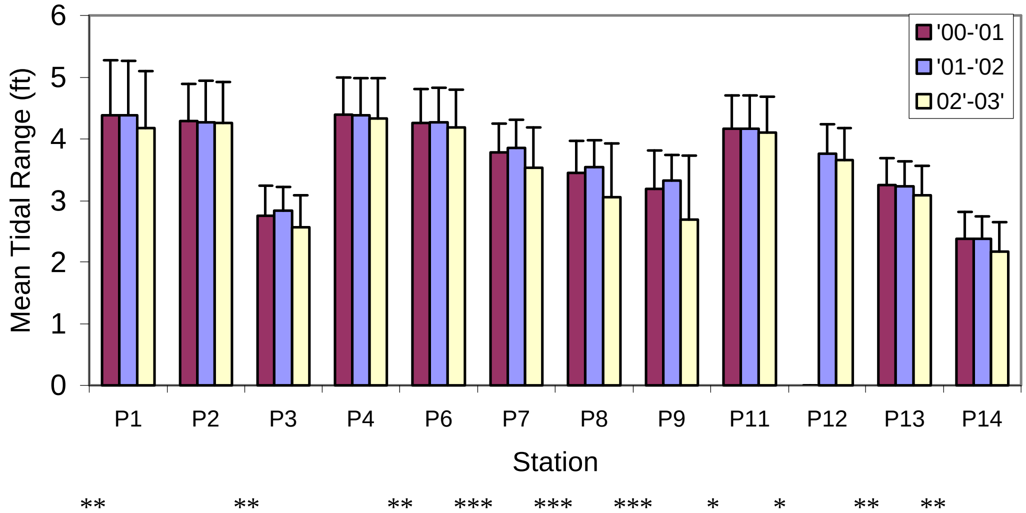


Figure 3.3-1. Mean water level for each station for monitoring years 2000-2001, 2001-2002, and 2002-2003. All water levels are relative to NAVD88 with the exception of P4 (USACE yard), which is relative to MSL. Error bars show one standard deviation. Asterisks denote stations where significant differences between yearly means (p<0.05) occurred during one or more monitoring periods (the number of asterisks denotes the number of significantly different yearly mean pairs). P-values for yearly mean tidal range comparisons are given in Table 3-3.3.

Table 3.3-2. Summary of statistical tests for yearly data collected at 11 DCP stations. Yearly means of tidal ranges were compared. Also shown are yearly differences in the slopes of the best-fit lines generated by regressing each tidal range for each station on the corresponding tidal range for P1. These were compared using analysis of covariance. NS indicates no significant difference at P<0.05. Asterisks denote significant differences between years and P values are given. N/A indicates insufficient data to complete analyses.

Station	Y1/Y2 Mean Tidal Range	Y2/Y3 Mean Tidal Range	Y1/Y3 Mean Tidal Range	Y1/Y2 Regression Slope	Y2/Y3 Regression Slope	Y1/Y3 Regression Slope
P1	NS	*(<0.0001)	*(<0.0001)	---	---	---
P2	NS	NS	NS	*(<0.0001)	*(<0.0001)	NS
P3	NS	*(<0.0001)	*(<0.0001)	* (<0.0001)	* (0.0011)	NS
P4	NS	NS	NS	NS	NS	NS
P6	*(0.0025)	*(<0.0001)	NS	NS	NS	NS
P7	*(0.0640)	*(<0.0001)	*(<0.0001)	*(0.0247)	* (0.0077)	NS
P8	*(<0.0001)	*(<0.0001)	*(<0.0001)	NS	NS	NS
P9	*(<0.0001)	*(<0.0001)	*(<0.0001)	NS	NS	NS
P11	NS	*(0.0099)	NS	NS	NS	NS
P12	N/A	*(<0.0001)	N/A	N/A	NS	N/A
P13	NS	*(<0.0001)	*(<0.0001)	NS	NS	NS
P14	NS	*(<0.0001)	*(<0.0001)	* (0.0088)	NS	NS

Tidal lags were determined by measuring the difference in time for high (or low) tide at 2 different stations as described in the Year 1 report. All tidal lags were calculated relative to station P1 and are being used to evaluate the impact of dredging on the propagation of the tidal wave upriver. Mean tidal range, flood duration, ebb duration and tidal lags for each station are given in Table 3.3-3. During this reporting period, high tide lag values increased at all estuary and mainstem stations relative to last year's values. High tide lags in the Northeast Cape Fear remained constant. Both increases and decreases in low tide lag were noted among stations relative to the 2001-2002 values, while some stations further upstream experienced no change. With the exception of stations P1 and P3, mean flood durations were lower than mean ebb durations. Flood and ebb durations varied little from those values reported in the last monitoring period (Hackney et al., 2002) except for station P1 (5% increase in mean flood duration, and 1.5% increase in ebb). This increase may be an artifact of the loss of data from this station during the time period when a floating dock was attached to the stilling well (see Section 1.0 Station Operation).

Table 3.3-3. Summary of tidal data generated from data collection platforms (DCP) at eleven stations along the Cape Fear River and tributaries. Values in italicized parentheses are the percent change between the current monitoring interval and the previous reporting period. Positive values indicate an increase and negative values a decrease. ND indicates that a change was not measurable. N/A indicates that data were insufficient to measure a reliable change. Mean lag times are also given in parentheses for both high and low tide.

Station Number	Mean Tidal Range (ft)	Mean Flood Duration (hr) *(% change)*	Mean Ebb Duration (hr) *(%change)*	Mean High Tide Lag From P1 (hr) ('01-'02 lag time)	Mean Low Tide Lag From P1 (hr) ('01-'02 lag time)
P1	4.18 ± 22.0%	6.52 (+4.9)	6.3 (+1.58)	-----	------
P2	4.26 ± 15.5%	5.72 (-0.9)	6.72 (+1.3)	1.7 (1.8)	1.88 (1.7)
P3	2.57 ± 20.1%	6.37 (+1.9)	6.03 (-0.3)	3.4 (2.85)	2.92 (2.82)
P4	4.34 ± 14.8%	5.67 (-2.6)	6.73 (-1.04)	1.73 (1.81)	2.42 (2.41)
P6	4.19 ± 14.4%	5.83 (-0.3)	6.6 (+0.5)	2.7 (2.37)	2.18 (2.73)
P7	3.54 ± 18.3%	5.77 (+0.7)	6.63 (-0.5)	3.17 (2.58)	2.6 (3.12)
P8	3.06 ± 28.1%	5.82 (-0.2)	6.58 (0)	3.53 (3.13)	3.00 (3.47)
P9	2.70 ± 38.2%	5.88 (+1.9)	6.53 (-1.5)	3.93 (3.13)	3.77 (3.75)
P11	4.11 ± 14.1%	5.78 (+0.3)	6.62 (-0.2)	2.15 (2.25)	2.68 (2.75)
P12	3.65 ± 14.3%	5.87 (+0.9)	6.55 (-0.5)	2.6 (2.63)	3.0 (3.07)
P13	3.09 ± 15.3%	5.88 (+0.5)	6.52 (-0.5)	3.12 (3.12)	3.48 (3.51)
P14	2.17 ± 22.5%	5.95 (+1.2)	6.45 (-1.1)	4.2 (4.2)	4.52 (4.53)

Table 3.3-4. Yearly comparisons of mean monthly maximum and minimum water levels collected at the 11 DCP stations. Significant differences were identified using a Wilcoxon Rank Sum test. NS indicates no significant difference at P<0.05. Asterisks denote significant differences between years and P values are given. N/A indicates insufficient data to complete analyses.

Station	Yr1/Yr2 Mean Monthly Maximum WL	Yr2/Yr3 Mean Monthly Maximum WL	Yr1/Yr2 Mean Monthly Minimum WL	Yr2/Yr3 Mean Monthly Minimum WL
P1	NS	*(0.0018)	NS	NS
P2	NS	*(0.0327)	NS	*(0.0348)
P3	NS	*(0.0179)	NS	NS
P4	NS	NS	NS	NS
P6	NS	*(0.0026)	NS	NS
P7	NS	*(0.0110)	*(0.0006)	NS
P8	NS	NS	NS	NS
P9	NS	*(0.0032)	NS	NS
P11	NS	NS	*(0.0425)	NS
P12	N/A	*(0.0106)	N/A	NS
P13	NS	*(0.0086)	NS	NS
P14	NS	*(0.0363)	NS	NS

3.4 Upstream Tidal Effects

Stations upstream of Point Peter are increasingly influenced by river flow in both branches of the Cape Fear Estuary and are considered separately from estuarine stations P1, P2, and P4, and from each other.

3.41 Ft Caswell (P1) and Outer Town Creek (P2)

The tidal ranges observed at the Ft Caswell base station show good agreement with the predicted tides for the area (Figure 3.41-1). When observed tidal ranges are regressed against the predicted tidal ranges, the slope and correlation coefficient are similar to those documented in previous year's report (slope=1.08, R^2 = 0.94 and slope = 1.06, R^2 = 0.94 for Year 1 and Year 2, respectively). The mean tidal range at P1 was significantly lower than the mean reported for the last reporting period (See Table 3.3-2, Figure 3.3-1). The mean tidal range of the Outer Town Creek (P2) site, however, does not differ significantly from ranges reported for previous monitoring periods. As seen in Figure 3.41-2, the tidal range at P2 is strongly and positively correlated with observed tidal ranges at P1. The slope of the P1 versus P2 regression for this monitoring period was significantly higher (P<0.0001) than the slope reported in 2001-2002 (Table 3.3-2), but not significantly different from the slope measured in the first monitoring period. One possible explanation for the difference in statistical significance among years may be the greater variability in tidal ranges at P2 during year 2 (R^2 = 0.66) compared to year 1 (R^2 = 0.96) and this year (R^2 = 0.88). While the observed deviations from the predicted tides at P2 (and P1 for that matter) may be associated with wind events, upland run-off events, and to a lesser degree, periods of increased river discharge; the overall impact of these events on water level is much less than other up river sites.

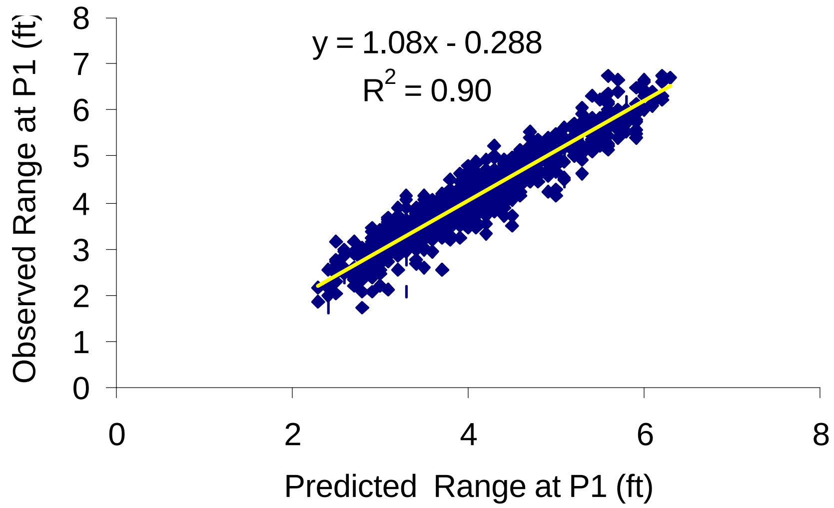


Figure 3.41-1. Plot of predicted tidal range at P1 relative to measured tidal range at P1 for June 2002 to May 2003.

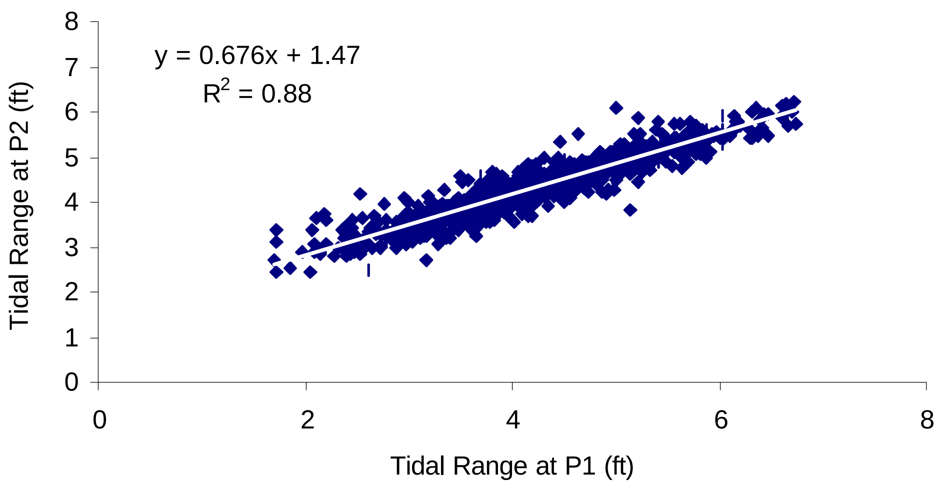


Figure 3.41-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Outer Town Creek (P2).

The water level curve at P1 has remained generally symmetrical and shows less evidence of the time asymmetries (Table 3.3-3) measured at other stations. These asymmetries, as evidenced by the unequal flood and ebb durations shown in Table 3.3-3, begin at site P2 and continue up river to all monitoring sites. The duration of flooding tide at P2 was essentially the same as the value reported in the last monitoring period; however, the low tide duration increased slightly. The tidal lag between P2 and P1 changed little during this monitoring period relative to 2001-2002.

3.42 Inner Town Creek (P3)

For this reporting period, the mean tidal range observed at this site was approximately 1.7 feet less than the tidal range observed at the creek mouth. The mean tidal range from June 2002 to May 2003 was significantly lower (by -0.27 feet) than the mean tidal range reported for June 2001 to May 2002 and for October 2000 to May 2001. This difference may be associated with dramatic increases in upland runoff at P3 this year due to high rainfall, especially in spring 2003. As shown in the Year 1 report, large runoff events often cause a decrease in the magnitude of the tidal range, thereby lowering the mean when they occur. Water level curves generated for this station and computed tidal ranges continue to exhibit a wide range of variability and to depend on flow conditions in the creek. The correlation between tides at P3 and P1 this year (R^2=0.26) was slightly lower than that reported for the previous two monitoring periods. The slope of the P1 versus P3 regression for this monitoring period was significantly higher (P= 0.0011) than the slope reported in 2001-2002 (Table 3.3-2), but not significantly different from the slope reported for year 1. This result indicates that low flow conditions in the river during the last reporting period had a profound effect on tidal range relationships for those sites susceptible to periodically high runoff.

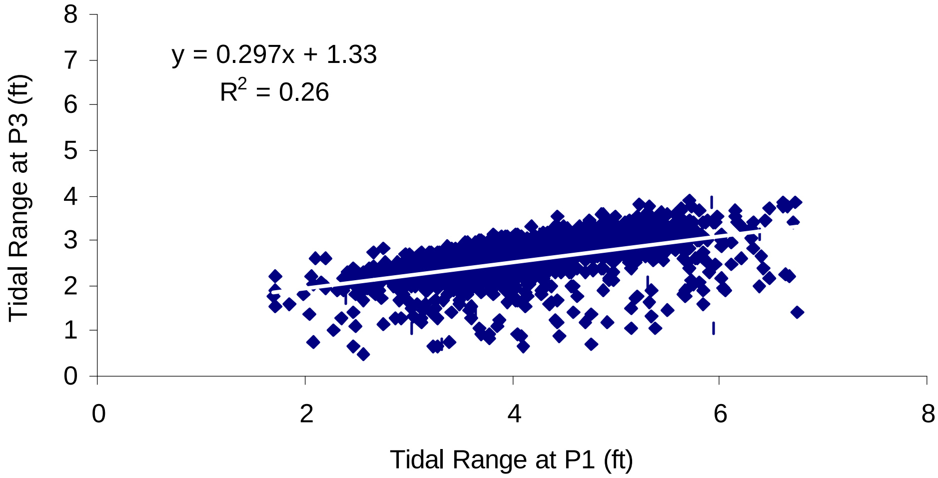


Figure 3.42-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Inner Town Creek (P3).

3.43 Corps Yard (P4)

The tidal range observed at P4 continues to approximate the range observed at the P1 base station (Figure 3.43-1). The slope (0.65) of the P1/P4 regression was not significantly different from the slopes reported for the previous two monitoring periods. The mean tidal range for this station was slightly higher than that calculated for Ft Caswell (Table 3.3-2), but was not significantly different from the means measured at this station during the previous two monitoring periods (Figure 3.3-1). Water level curves generated for P4 continue to show a slight time asymmetry that does not occur at P1; mean ebb and flood durations of 6.7 and 5.7 hours, respectively. Both the mean high and low tide lags at this station are very similar to those reported in 2001-2002 (Table 3.3-3). Water levels at the Corps yard are impacted by changes in river discharge (see Figure 3.5-2), but to a much lesser degree than stations further upstream. Water levels observed at P4 do not appear to be impacted by non-tidal forcing mechanisms any more or any less than those observed at sites P1 and P2.

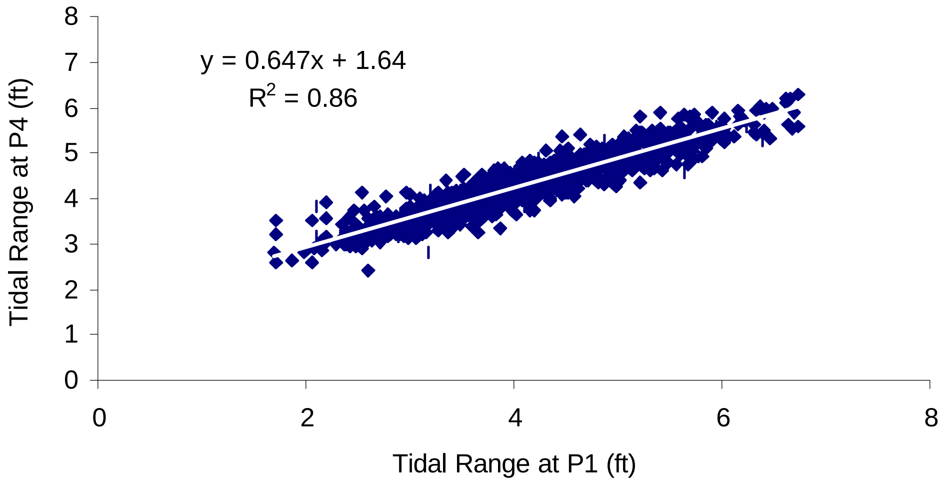


Figure 3.43-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and the Corps Yard station (P4).

3.44 Cape Fear River: Eagle Island (P6), Indian Creek (P7), Dollisons Landing (P8), and Black River (P9)

The mean tidal ranges computed for these sites were comparable to or lower than the mean determined for P1. In general, tidal range decreased with distance upriver (Table 3.3-3) with P9 exhibiting the lowest tidal range of these sites. Figures 3.44-1, 3.44-2, 3.44-3, and 3.44-4 illustrate the relationship between tidal range at these Cape Fear River sites and tidal range at Ft Caswell. In general, tidal range at each upriver site is positively correlated with tidal range at the mouth, however, the degree of correlation decreases upriver. Water levels at all of these stations were strongly impacted by periods of high river discharge. The R^2 values at these sites were much lower than the value reported for 2001-2002 when base flow conditions prevailed in the river and there was greater consistency in upriver discharge. Both of these factors are recognized to control water level at these sites. At these stations, the mean tidal ranges measured over this reporting period, were significantly lower than those measured during in 2001-2002 and, in most cases, significantly lower than the ranges reported for the first year of monitoring (Figure 3.3-1, Table 3-3.2). The mean monthly maximum water levels for these stations were significantly higher than values reported in 2001-2002 at all stations except P8. No significant difference in minimum water levels was noted between years for these stations (Table 3-3.4). Comparisons of the regression slopes between years yielded no significant differences with the exception of P7 (Table 3.3-2) where the difference in the magnitude of the slope was less than 0.04 and is likely not meaningful given the variability in the tidal range data. When regression slopes for this reporting period were compared to year 1, no significant differences between years were detected. In contrast to last year's observations, mean tidal ranges for this reporting period were significantly lower than the previous reporting period. In most cases, the mean tidal range for this reporting period also was significantly lower than the mean reported in year 1. As mentioned for other stations, this decrease in tidal range is likely due to the prolonged period of high river discharge in spring 2003 and not related to dredging activities.

The mainstem upriver sites continue to exhibit pronounced time asymmetries as shown in previous reports. The duration of flooding and ebbing tide at these stations has changed little (~2% or less) since the last reporting period (Table 3.3-3). The mean high tide lag from P1 appears to have increased during this reporting period for these stations. The mean low tide lag does not seem to vary in any systematic way. These results are not consistent with last year's observations and suggest that the transition from primarily low flow conditions in 2001-2002 to high flow conditions in 2002-2003 had a greater impact on tidal lags than did downstream channel modifications. This observation is preliminary, however, as statistical analyses of tidal lag data are incomplete.

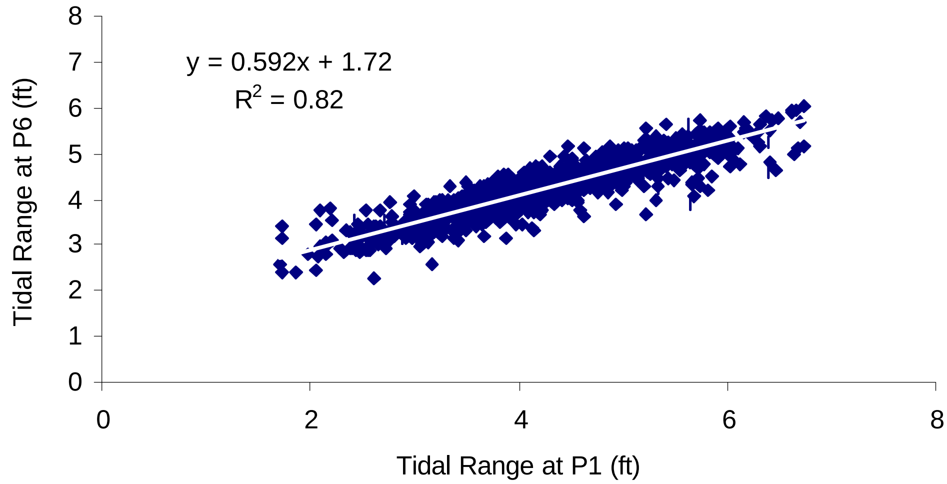


Figure 3.44-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Eagle Island (P6).

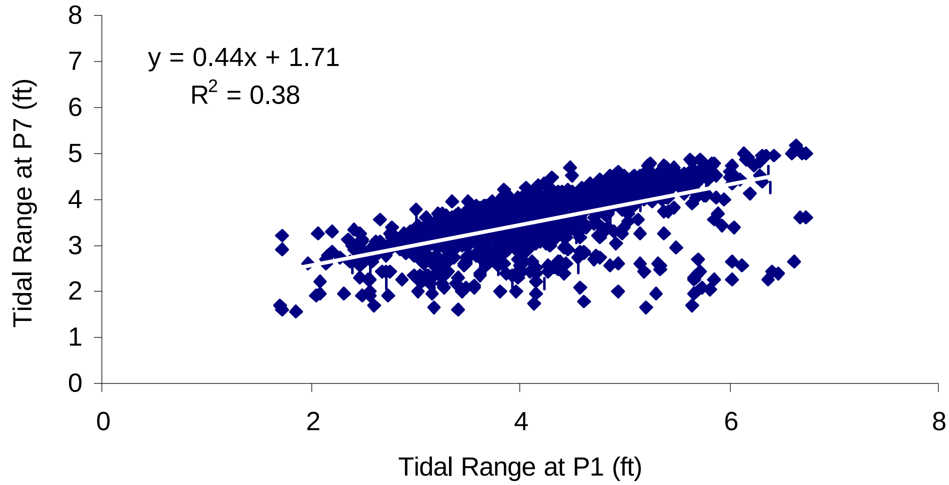


Figure 3.44-2**.** Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Indian Creek (P7).

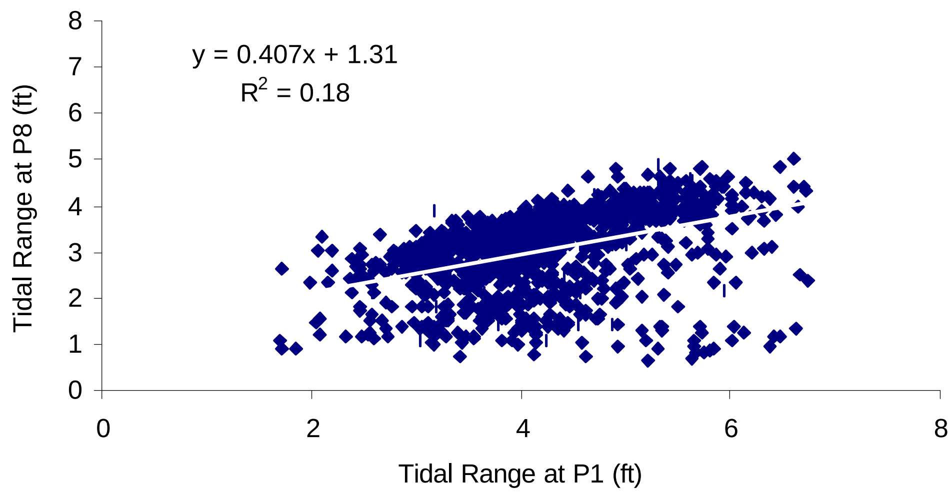


Figure 3.44-3. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Dollisons Landing (P8).

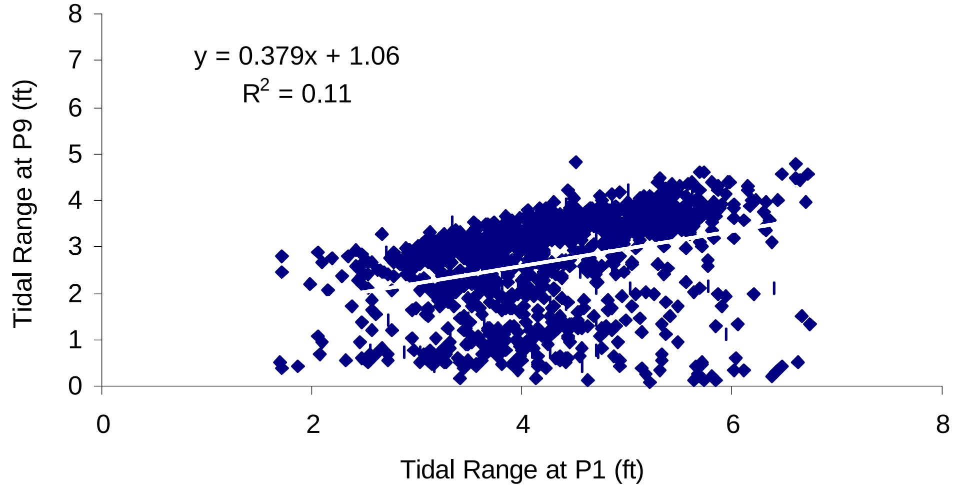


Figure 3.44-4. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Black River (P9).

3.45 Northeast Cape Fear: Smith Creek (P11), Rat Island (P12), Fishing Creek (P13), and Prince George Creek (P14)

Mean tidal ranges computed for P11, P12, P13, and P14 over the current reporting period were significantly lower than those reported in 2001-2002 (Figure 3.3-1). This year's values also were significantly lower than the ranges reported in 2000-2001 for the two most upstream stations (Table 3.3-2). Mean tidal ranges computed for these stations since June 2002 are lower than the mean determined for P1 (Table 3.3-3) and, as with the mainstem stations, tidal ranges generally decrease with distance upriver. Tidal ranges at upstream stations in the Northeast Cape Fear are positively correlated with the tidal range at P1 (Figure 3.45-1, Figure 3.45-2, Figure 3.45-3, and Figure 3.45-4). The mean tidal range at P14 on the Northeast Cape Fear River (16 miles from convergence of the Cape Fear and Northeast Cape Fear Rivers near Wilmington) continues to be less than the mean range measured at P9, 12 miles from convergence on the Cape Fear River. Tidal ranges at stations P11 and P12 are more strongly correlated to tidal ranges observed at P1 than the tidal ranges at P13 and P14. Water levels at these upriver stations are impacted strongly by other types of events; especially increased rainfall and upriver discharge. The influence of these types of events is evident by the low R^2 values for the most upstream stations. Comparisons of the regression slopes between this reporting period and previous years yielded no significant differences between years (Table 3.3-2). With the exception of P11, the mean monthly maximum water levels for this reporting period were significantly higher than those reported for year 2 (Table 3-3.4). This result differs from last year where no significant difference in monthly maximum water level was observed. No significant difference in minimum water levels was noted between this year and 2001-2002 for these stations.

All sites in the Northeast Cape Fear River continue to exhibit time asymmetries. There was very little difference in either flood or ebb duration compared to last reporting period (Table 3.3-3). Similarly, there was virtually no difference between the mean high and low tide lags observed during this reporting period and those reported for 2001-2002. This observation differs from last year when the lag data suggested that the propagation of the tidal wave had changed since the previous reporting period. Despite continuing dredging operations, no such lag was observed this year. Interpretation of our results have been complicated by the existence of both lower, drought-induced water levels and extreme flooding in the system over the last 3 years, which demonstrate the need for multiple years of data to determine if there are effects of the dredging and widening project.

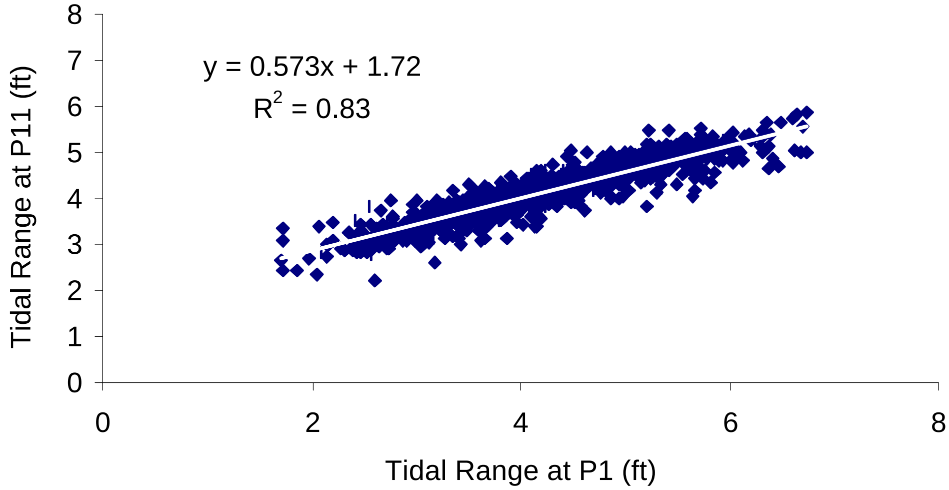


Figure 3.45-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Smith Creek (P11).

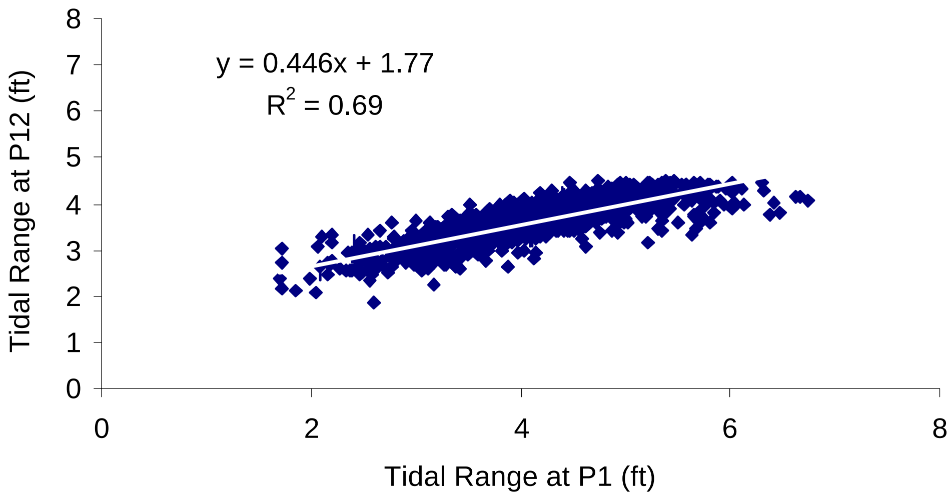


Figure 3.45-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Rat Island (P12).

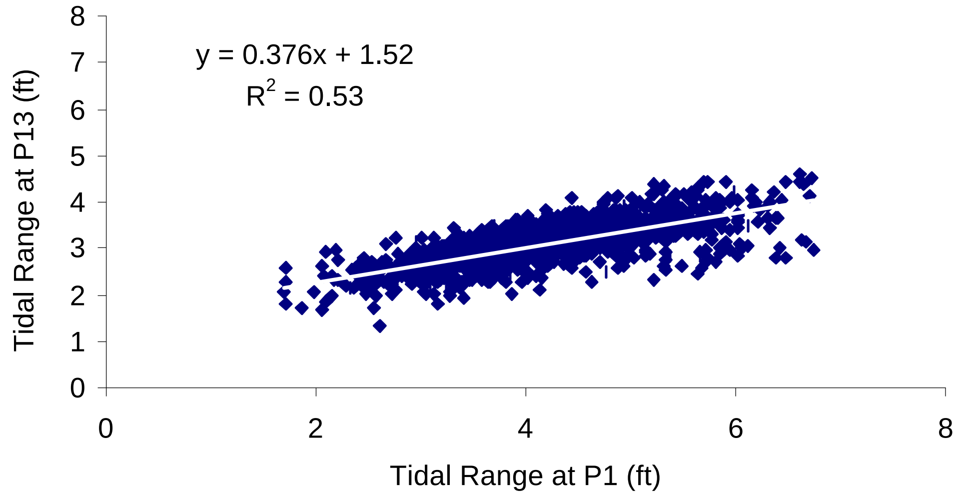


Figure 3.45-3. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Fishing Creek (P13).

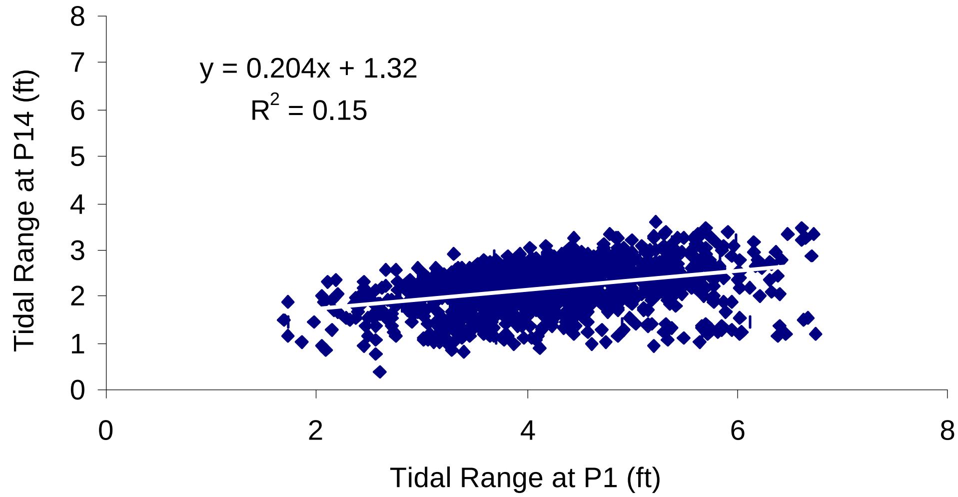


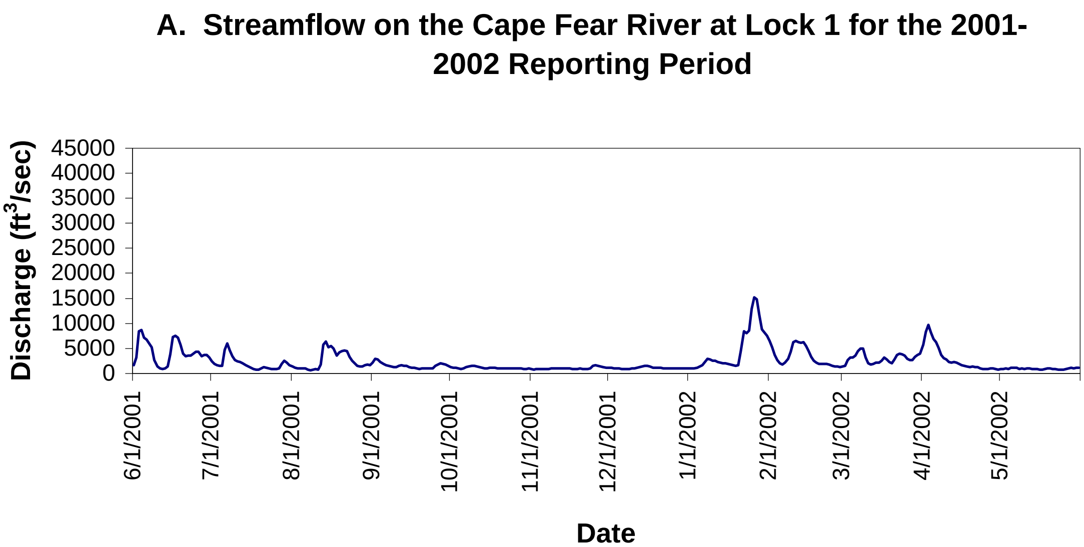
Figure 3.45-4. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Prince George Creek (P14).

3.5 Influence of Upstream Flow

The existence of prolonged periods of lower, drought-induced water levels and extreme flooding in the system over the last 3 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. During the 2001-2002 reporting period (Year 2), baseflow conditions existed for the majority of time (Figure 3.5-1a). Under these conditions, streamflow rarely exceeded annual mean streamflow (approximately 5,600 cubic feet per second) measured at Lock 1 on the Cape Fear River. In year 2, there was less variability in the tidal range data as compared to years 1 and 3 and significant differences in regression slopes and mean tidal ranges were detected between year 2 and the preceding and following years. Year 1 (2000-2001) and year 3 (this reporting period) experienced a greater frequency of high flow events and more variability in the range data. This variability, especially at upstream stations and P3, appears to occur when tidal ranges are suppressed during periods of particularly high discharge due to rain induced runoff (see year 1 report). This year, data analysis was complicated by the fact that both drought conditions and extreme flood conditions occurred over the course of the reporting period (Figure 3.5-1b). This year, two aspects of tides that are influenced by variations in discharge appear to have been affected; maximum water level significantly increased relative to previous years and mean tidal range significantly decreased relative to previous years.

While it has been documented that increases in stream flow can suppress tidal range and lead to a lowering in mean values when these conditions occur frequently or for sufficient duration, what remains unclear is the critical discharge below which tides are unaffected. Our data also suggest that this "threshold" discharge may vary from station to station depending on position in the system (Figure 3.5-2). Additional analyses are necessary to identify this threshold for each station so that changes in tidal range resulting from increased streamflow can be accounted for in the final water level analyses.

In an attempt to eliminate the effects of discharge on tidal range and more easily identify potential effects of dredging on tidal range relationships, streamflow at Lock 1 in the Cape Fear River was obtained from October 2000 to present. Using the annual mean streamflow of 5600 cubic feet per second as the cutoff, the tidal range data were filtered and ranges associated with discharges in excess of 5600 eliminated from the data set. The remaining ranges for each station were then regressed against the range at P1 for each of the monitoring periods. This procedure had the effect of removing much of the scatter due to high discharge. Analysis of covariance was then used to compare the slopes of the regressions between project year 1 (2000-2001) and year 3 (current reporting period) at each station. The only stations where significant differences occurred were stations P7 and P8 in the Cape Fear River mainstem. Neither of these stations exhibited significant differences between these years when all data were included in the original analysis. This result reiterates the necessity of conducting additional analyses to account for or correct for the effects of streamflow. Such analyses must be undertaken in order to identify the effects of channel modification on tidal range with greater certainty.



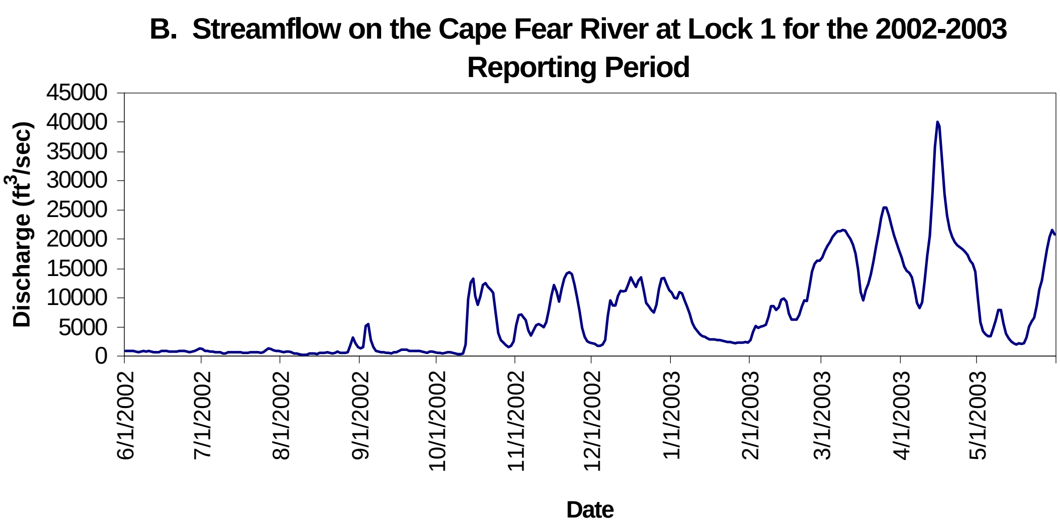


Figure 3.5-1. Plot showing discharge in the Cape Fear River at Lock 1 for the current and previous monitoring periods. Note the low discharge in late 2001 and that associated with drought conditions in summer 2002. Also note very high discharge levels in early spring 2003 relative to the maximum discharge measured during the previous reporting period.

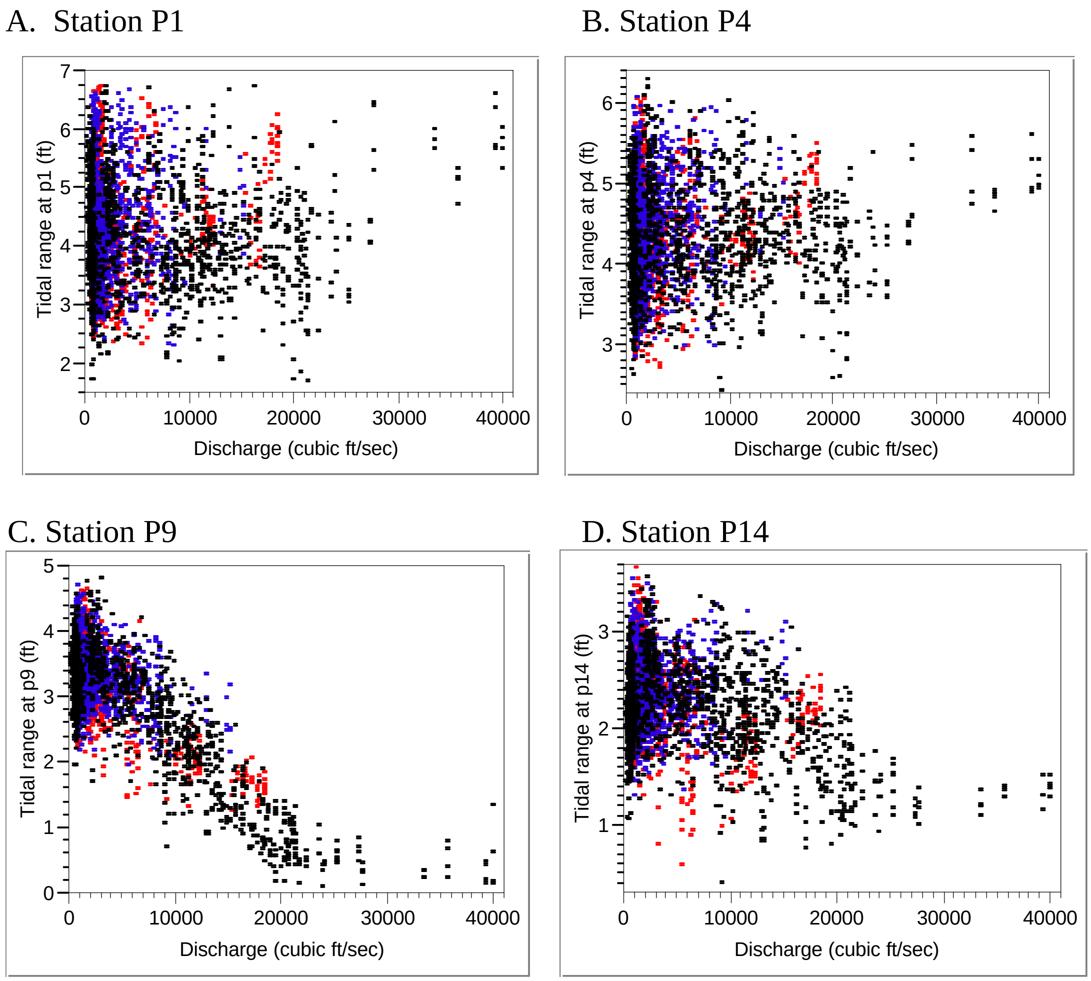


Figure 3.5-2. Bivariate scatter plots of discharge in the Cape Fear River at Lock 1 versus tidal range at selected stations for the current and previous monitoring periods.

3.6 Tidal Harmonics

A classical tidal harmonics analysis was performed (Table 3.6-1) on each of the individual stations of the Cape Fear River Project using the MATLAB version of T-Tide (Pawlowicz et al., 2002). The relative phase and amplitude of the major frequencies in the measured 6-minute water level data have been determined with error estimates and a 95% confidence level. Six consecutive months were run individually and an average was taken over the period to estimate the phase and amplitude of the significant major frequencies. Constituents were considered significant if the signal-to-noise ratio was greater than one. As expected the M2 component is the dominant constituent at every station. These phase/amplitude data provide a compression of the data in the complete time series and will eventually be used to identify differences in tidal dynamics between the stations along the river that have been impacted by channel modification activities.

Table 3.6-1 Summary of tidal harmonics for reporting period 2000-2001.

Station P01		
Constituent	avg_amp	avg_phase
M2	2.02975	225.01
N2	0.4923	209.68833
S2	0.36895	240.51167
O1	0.2252167	136.145
K1	0.2845667	125.41
N01	0.0764333	101.7

Station P02		
Constituent	amp_avg	phase_avg
M2	1.96875	272.32667
N2	0.4215833	262.57167
S2	0.2900833	297.69667
K1	0.2447	153.00333
O1	0.1944833	0.1944833
M4	0.1535167	0.1535167
M6	0.3033667	0.3033667

Station P04		
Constituent	amp	phase
M2	0.6129	65.05
N2	0.1272	55.74
S2	0.0849	96.42
K1	0.0772	239.69
O1	0.0571	234.66
M4	0.0516	11.5
L2	0.0508	66.55
M6	0.031	278.92

Station P06		
Constituent	amp_avg	phase_avg
M2	1.98278	285.504
N2	0.43112	272.682
S2	0.2692	319.314
K1	0.22582	157.12
O1	0.1929	170.414
M4	0.1704	95.73
M6	0.10836	225.764

Station P07		
Constituent	amp_avg	phase_avg
M2	1.73934	296.63
N2	0.3366	288.802
S2	0.20114	328.808
K1	0.23566	157.306
O1	0.16908	179.476
M4	0.16852	112.662
M6	0.10802	253.436

Station P09		
Constituent	amp_avg	phase_avg
M2	1.3328	244.8
N2	0.374875	265.0825
S2	0.142975	136.37
K1	0.195625	176.6275
O1	0.1709667	214.19667
M4	0.155325	178.8375
M6	0.09305	255.27

Station P11		
Constituent	amp_avg	phase_avg
M2	1.92554	285.774
N2	0.3957	268.806
S2	0.23694	257.716
K1	0.26624	157.51
O1	0.19588	168.002
M4	0.1604	99.314
M6	0.10974	221.172

Station P13		
Constituent	amp	phase
M2	1.4505	307.93333
N2	0.2927	299.76333
S2	0.1681833	338.965
K1	0.1839	179.485
O1	0.1561167	192.24667
M4	0.1539167	136.71
M6	0.1008667	280.39333

Station P14		
Constituent	amp	phase
M2	1.00526	340.748
N2	0.21422	327.408
K1	0.14894	216.164
O1	0.13456	217.394
M4	0.1234	184.618
M6	0.0819	344.65
M8	0.0188	215.196
2MS6	0.0372	83.98
2MN6	0.0554	257.236
MS4	0.03408	203.14

4.0 MARSH/SWAMP FLOOD AND SALINITY LEVELS

4.1 Summary

Most subsites flooded during every tide in both spring 2003 and fall 2002 with the exception of Indian Creek (P7) and some subsites adjacent to uplands. Average water levels at high tide were generally higher and frequency of flooding greater in spring 2003 than fall 2002 (Tables 4.2-1, 4.2-2) and higher than previous years for most stations. Water levels at subsites at one station were examined to determine if the same level of floodwater reached interior subsites as well as those adjacent to the river. Floodwater reached the same level at all but the most interior sites indicating that river water influences most of the swamp. Flood frequency during two-week monitoring periods were compared to annual frequency at one station and confirmed that two-week intervals twice a year adequately represent annual flood frequency. Salinity of floodwater in the river penetrated well into swamps during periods of drought and was not significantly diluted except near uplands. At least for upriver sites, levels of salt water penetration likely represent historic maxima.

4.2 Database

There were no problems associated with the collection of salinity and water depth at all nine stations fall 2002 (Table 4.2-1), with the exception of an occasional equipment malfunction, battery problem, or "bear" vandalism. For some unknown reason, bears occasionally bite and damage PVC housed equipment. One week of data was lost from just one subsite (P13) during fall 2003. Fall data coincided with what was the end of the drought, while spring data (Table 4.2-2) were collected mostly during high freshwater discharge within the estuary. Rapid increases in river water level during deployment of marsh/swamp monitoring equipment led to numerous incidents, which damaged equipment. Some collections were necessarily delayed until water levels had returned to levels that did not threaten to flood equipment deployed on the marsh or swamp surface. Had some collections not been delayed, water levels on the swamp surface would have been even higher than those shown in Table 4.2-2. No water level data was lost during spring 2003.

Conductivity instruments are more vulnerable to high water levels and consequently, data from three subsites were lost in spring 2003 at P6 and at one subsite at P7. Salinity during this time was near zero so little information was actually lost. One subsite at P3 was lost and salinity at 11 of 27 tides lost at one subsite at P14 during fall 2002.

Table 4.2-1. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during fall 2002. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to NAVD88 datum.

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P3	1	Fall 02	10/7/02	10/21/02	27/27	7.6	2.5	0.66	1.8
	2	Fall 02	10/7/02	10/21/02	27/27	7.2	2.5	0.83	1.7
	3	Fall 02	10/7/02	10/21/02	26/27	7.9	2.5	0.52	2.0
	4	Fall 02	10/7/02	10/21/02	26/27	8.4	2.6	1.49	1.1
	5	Fall 02	10/7/02	10/21/02	26/27	7.0	2.5	0.99	1.5
	6	Fall 02	10/7/02	10/21/02	25/27	6.3	4.5	3.31	1.2
P6	1	Fall 02	9/23/02	10/7/02	26/27	8.3	3.1	0.76	2.3
	2	Fall 02	9/23/02	10/7/02	26/27	6.2	2.9	1.56	1.3
	3	Fall 02	9/23/02	10/7/02	26/27	6.0	3.0	0.85	2.2
	4	Fall 02	9/23/02	10/7/02	26/27	5.7	3.0	1.13	1.9
	5	Fall 02	9/23/02	10/7/02	25/27	5.8	3.2	1.92	1.3
	6	Fall 02	9/23/02	10/7/02	21/27	5.0	2.8	1.74	1.1
P7	1	Fall 02	9/9/02	9/23/02	25/27	6.3	3.1	1.76	1.3
	2	Fall 02	9/9/02	9/23/02	14/27	3.9	3.2	2.23	1.0
	3	Fall 02	9/9/02	9/23/02	11/27	3.9	3.0	2.26	0.7
	4	Fall 02	9/9/02	9/23/02	9/27	4.8	3.2	2.43	0.8
	5	Fall 02	9/9/02	9/23/02	11/27	6.0	3.0	2.31	0.7
	6	Fall 02	9/9/02	9/23/02	7/27	6.3	3.1	2.37	0.7
P8	1	Fall 02	9/4/02	9/18/02	19/27	4.8	2.9	2.14	0.8
	2	Fall 02	9/4/02	9/18/02	22/27	5.9	3.0	1.54	1.5
	3	Fall 02	9/4/02	9/18/02	24/27	5.7	3.1	1.46	1.6
	4	Fall 02	9/4/02	9/18/02	19/27	5.0	2.9	1.98	0.9
	5	Fall 02	9/4/02	9/18/02	16/27	4.3	2.9	2.24	0.7
	6	Fall 02	9/4/02	9/18/02	10/27	4.3	2.9	2.38	0.5
P9	1	Fall 02	9/18/02	10/2/02	27/27	6.4	2.8	0.58	2.2
	2	Fall 02	9/18/02	10/2/02	27/27	5.3	2.7	2.21	0.5
	3	Fall 02	9/18/02	10/2/02	14/27	4.7	2.7	1.22	1.5
	4	Fall 02	9/18/02	10/2/02	15/27	5.4	2.7	2.06	0.6
	5	Fall 02	9/18/02	10/2/02	9/27	5.5	2.6	2.20	0.4
	6	Fall 02	9/18/02	10/2/02	10/27	5.2	2.9	1.92	1.0
P11	1	Fall 02	10/2/02	10/16/02	27/27	6.3	3.4	1.44	2.0
	2	Fall 02	10/2/02	10/16/02	25/27	4.9	3.5	1.82	1.7
	3	Fall 02	10/2/02	10/16/02	26/27	5.3	3.2	1.76	1.4
	4	Fall 02	10/2/02	10/16/02	22/27	6.0	3.5	1.85	1.7
	5	Fall 02	10/2/02	10/16/02	23/27	5.3	3.3	1.91	1.4
	6	Fall 02	10/2/02	10/16/02	23/27	5.7	3.0	2.04	1.0

Table 4.2-1. (continued)

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P12	1	Fall 02	10/16/02	10/30/02	27/27	7.1	3.0	0.90	2.1
	2	Fall 02	10/16/02	10/30/02	19/27	4.8	2.9	1.62	1.3
	3	Fall 02	10/16/02	10/30/02	18/27	6.4	2.8	2.00	0.8
	4	Fall 02	10/16/02	10/30/02	20/27	5.5	2.9	1.90	1.0
	5	Fall 02	10/16/02	10/30/02	12/27	6.2	2.4	2.08	0.3
	6	Fall 02	10/16/02	10/30/02	20/27	5.1	3.3	2.44	0.9
P13	1	Fall 02	11/8/02	11/22/02	24/27	6.7	2.3	1.43	0.9
	2	Fall 02	11/8/02	11/22/02	25/27	6.1	2.3	1.08	1.2
	3	Fall 02	11/8/02	11/22/02	24/27	6.2	2.3	0.75	1.6
	4	Fall 02	11/15/02	11/22/02	13/13	5.4	3.0	1.00	2.0
	5	Fall 02	11/8/02	11/22/02	24/27	4.9	2.3	1.21	1.1
	6	Fall 02	11/8/02	11/22/02	12/27	4.0	2.3	1.64	0.7
P14	1	Fall 02	10/28/02	11/11/02	26/27	8.0	2.2	0.70	1.5
	2	Fall 02	10/28/02	11/11/02	26/27	6.2	2.0	0.87	1.1
	3	Fall 02	10/28/02	11/11/02	26/27	6.5	2.2	1.08	1.1
	4	Fall 02	10/28/02	11/11/02	26/27	6.9	2.3	1.22	1.1
	5	Fall 02	10/28/02	11/11/02	23/27	5.4	2.3	1.28	1.0
	6	Fall 02	10/28/02	11/11/02	19/27	6.0	2.2	1.49	0.7

Table 4.2-2. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during Spring 2003. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to NAVD88 datum.

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
P3	1	Spr 03	4/24/03	5/8/03	27/27	7.1	2.1	0.66	1.4
	2	Spr 03	4/24/03	5/8/03	26/27	6.8	2.0	0.83	1.2
	3	Spr 03	4/24/03	5/8/03	27/27	7.3	2.1	0.52	1.6
	4	Spr 03	4/24/03	5/8/03	27/27	7.2	2.1	1.49	0.6
	5	Spr 03	4/24/03	5/8/03	26/27	6.5	2.3	0.99	1.3
	6	Spr 03	4/24/03	5/8/03	25/27	5.1	4.2	3.31	0.9
P6	1	Spr 03	3/18/03	4/1/03	26/27	6.7	3.7	0.76	2.9
	2	Spr 03	3/18/03	4/1/03	26/27	5.4	3.6	1.56	2.0
	3	Spr 03	3/18/03	4/1/03	26/27	6.6	3.2	0.85	2.4
	4	Spr 03	3/18/03	4/1/03	26/27	5.7	3.6	1.13	2.5
	5	Spr 03	3/18/03	4/1/03	26/27	5.1	3.6	1.92	1.7
	6	Spr 03	3/18/03	4/1/03	26/27	4.7	3.2	1.74	1.5
P7	1	Spr 03	4/3/03	4/17/03	24/27	7.2	4.5	1.76	2.7
	2	Spr 03	4/3/03	4/17/03	20/27	6.4	4.5	2.23	2.3

Table 4.2-2. (continued)

Station Number	Substation Number	Season	Start Date	End Date	# Flood Events	Mean Flood Duration (hr)	Maximum Depth (ft)	Marsh/Swamp Elevation (ft)	Actual water level (ft)
	3	Spr 03	4/3/03	4/17/03	18/27	6.1	4.3	2.26	2.0
	4	Spr 03	4/3/03	4/17/03	18/27	5.6	4.5	2.43	2.1
	5	Spr 03	4/3/03	4/17/03	18/27	5.8	4.3	2.31	2.0
	6	Spr 03	4/3/03	4/17/03	17/27	6.0	4.3	2.37	1.9
P8	1	Spr 03	5/13/03	5/27/03	23/27	3.7	3.0	2.14	0.9
	2	Spr 03	5/13/03	5/27/03	26/27	5.1	3.0	1.54	1.5
	3	Spr 03	5/13/03	5/27/03	26/27	5.5	3.1	1.46	1.6
	4	Spr 03	5/13/03	5/27/03	22/27	4.4	2.9	1.98	0.9
	5	Spr 03	5/13/03	5/27/03	16/27	3.7	2.9	2.24	0.7
	6	Spr 03	5/13/03	5/27/03	12/27	3.6	2.8	2.38	0.4
P9	1	Spr 03	5/7/03	5/21/03	27/27	6.9	2.5	0.58	1.9
	2	Spr 03	5/7/03	5/21/03	27/27	4.8	2.8	2.21	0.6
	3	Spr 03	5/7/03	5/21/03	19/27	3.6	2.7	1.22	1.5
	4	Spr 03	5/7/03	5/21/03	9/27	4.5	2.8	2.06	0.7
	5	Spr 03	5/7/03	5/21/03	8/27	4.5	2.8	2.20	0.6
	6	Spr 03	5/7/03	5/21/03	9/27	4.9	2.8	1.92	0.9
P11	1	Spr 03	3/13/03	3/27/03	26/27	6.5	3.6	1.44	2.2
	2	Spr 03	3/13/03	3/27/03	24/27	5.4	3.6	1.82	1.8
	3	Spr 03	3/13/03	3/27/03	25/27	5.9	3.6	1.76	1.8
	4	Spr 03	3/13/03	3/27/03	24/27	5.5	3.6	1.85	1.8
	5	Spr 03	3/13/03	3/27/03	24/27	5.7	3.6	1.91	1.7
	6	Spr 03	3/13/03	3/27/03	23/27	4.9	3.6	2.04	1.6
P12	1	Spr 02	3/27/03	4/10/03	27/27	5.8	2.7	0.90	1.8
	2	Spr 02	3/27/03	4/10/03	21/27	6.1	2.7	1.62	1.1
	3	Spr 02	3/27/03	4/10/03	14/27	4.3	2.6	2.00	0.6
	4	Spr 02	3/27/03	4/10/03	11/27	5.7	2.7	1.90	0.8
	5	Spr 02	3/27/03	4/10/03	15/27	5.9	2.6	2.08	0.5
	6	Spr 02	3/27/03	4/10/03	14/27	6.8	2.6	2.44	0.2
P13	1	Spr 02	2/25/03	3/11/03	25/27	5.6	2.4	1.43	1.0
	2	Spr 02	2/25/03	3/11/03	26/27	6.3	2.3	1.08	1.2
	3	Spr 02	2/25/03	3/11/03	27/27	6.6	2.5	0.75	1.8
	4	Spr 02	2/25/03	3/11/03	27/27	7.0	3.1	1.00	2.1
	5	Spr 02	2/25/03	3/11/03	27/27	5.6	2.4	1.21	1.2
	6	Spr 02	2/25/03	3/11/03	13/27	3.7	2.3	1.64	0.7
P14	1	Spr 02	3/4/03	3/18/03	26/27	8.7	2.3	0.70	1.6
	2	Spr 02	3/4/03	3/18/03	26/27	8.0	2.2	0.87	1.3
	3	Spr 02	3/4/03	3/18/03	26/27	7.1	2.2	1.08	1.1
	4	Spr 02	3/4/03	3/18/03	26/27	6.6	2.2	1.22	1.0
	5	Spr 02	3/4/03	3/18/03	25/27	6.3	2.2	1.28	0.9
	6	Spr 02	3/4/03	3/18/03	23/27	5.5	2.2	1.49	0.7

4.3 Marsh/Swamp Flooding

Average water levels at high tide were generally higher and frequency of flooding greater in spring 2003 than fall 2002 (Tables 4.2-1 and 4.2-2) and higher than previous years (Hackney et al., 2002, 2003) for most stations. The exception was P3 (Inner Town Creek), which has a small drainage basin where water levels are controlled by local rainfall. The trend was most noticeable at stations on the main stem of the Cape Fear River (P6-9), which has the largest drainage basin followed by the Northeast Cape Fear River stations (P11-14). Note that tidal wave characteristics were also affected by high river discharge (See Section 3). Increased water levels in the river lead to higher water levels in the swamps and marshes adjacent to the river. However, the increased cross-section of the river channel provided by the wetland systems adjacent to the river dampens the maximum height of the high tide.

4.4 Water Salinity In Marshes and Swamps

Spring 2003 and fall 2002 measures of salinity on the marsh swamp surface were extremely different. Based on salinity in the river (See Section 3), the drought ended by the end of November 2002. Consequently, the salinity of floodwaters in fall 2002 was the highest recorded since this study began and likely correspond to the highest salt levels ever experienced in the upper estuary/lower river. The impact was greatest in the Northeast Cape Fear River stations (P11-14), where saline water was recorded at four of the substations at P14, the background site (Table 4.4-1). Earlier in the season, salinity in the river was higher and salinity levels in the swamp likely higher if the relationship between DCP recorded salinity and salinity at substations within the swamp was the same as during the two-week studies. The presence of seawater was also evident in the porewater as well (See Section 5), clearly indicating that saline water not only penetrated into the swamp, but moved into sediment porewater. Water on the surface of Smith Creek (P11) was 18 ppt (50% seawater), while further upstream, Rat Island was flooded with water of 12 ppt (Table 4.4-1). It should be noted that these data were collected during a random 2-week period and do not necessarily denote the maximum salinity water that flooded these wetlands. Table 4.4-1 clearly demonstrates that flooding of the swamp surface by saline water was common during the drought and likely even higher based on salinity of the river water (Section 3) and Section 5 demonstrates that sulfate derived from seawater penetrated into swamp/marsh sediments. Salt sensitive vegetation also decreased in surface cover (See Section 8) at many stations, further suggesting that salt intrusion into marshes and swamps was higher during drought conditions. However, the highest levels of saline water in the estuary were likely not recorded by this study because all samples were collected from surface water, not from the bottom of the river where the most dense saline water would likely be found.

Stations along the main stem of the Cape Fear River were not noticeable higher in salinity than previous years due largely to the constant flow of freshwater released upstream from water control structures. A minimum release of freshwater is maintained by the Corps of Engineers from Jordan Lake to provide a water supply for several downstream municipalities, largely insulating swamps and marshes in the upper estuary from saline water. The restricted nature of the main channel at Navassa, upstream of P6, also tends to limit saline water intrusion upstream.

Note that both Town Creek (P3) and Eagle Island (P6) on the mainstem recorded floodwaters, 21 and 12 ppt, similar to levels found previously (Hackney et al., 2003). The restricted drainage area of this tributary of the Cape Fear River often has low freshwater flow during localized dry periods so saline water flooding these wetlands is not as infrequent.

Table 4.4-1. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in fall 2002.

Station Number	Station Name	Substation Number	Fall 2002 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1 - 21	23/27
		2	<1 - 19	20/27
		3	ND	ND
		4	<1 - 6	25/27
		5	<1 - 12	25/27
		6	<1 - 6	27/27
P6	Eagle Island	1	<1 - 9	27/27
		2	<1 - 13	27/27
		3	<1 - 12	27/27
		4	<1	27/27
		5	<1 - 6	23/27
		6	<1 - 7	27/27
P7	Indian Creek	1	<1 - 2	21/27
		2	<1 - 1	0/27
		3	<1 - 1	0/27
		4	1 - 2	17/27
		5	<1	0/27
		6	<1	0/27
P8	Dollisons Landing	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1 - 18	26/27
		2	<1 - 11	26/27
		3	6 - 9	27/27
		4	3 - 13	27/27

Table 4.4-1. (continued)

Station Number	Station Name	Substation Number	Fall 2002 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
		5	<1 - 18	25/27
		6	<1 - 18	22/27
P12	Rat Island	1	<1 - 12	26/27
		2	<1 - 12	22/27
		3	<1 - 11	18/27
		4	<1 - 11	17/27
		5	<1 - 11	14/27
		6	<1 - 7	9/27
P13	Fishing Creek	1	<1 - 2	8/27
		2	<1 - 2	12/27
		3	<1 - 2	25/27
		4	<1 - 2	25/27
		5	<1 - 2	7/27
		6	<1 - 1	1/27
P14	Prince George	1	<1 - 1	1/27
		2	<1 - 1	0/27
		3	<1 - 1	3/27
		4	<1 - 1	10/27
		5	<1	0/27
		6	<1	0/16*

ND = No data available.
* = Data recorded from 10/28/2002 at 11:12 to 11/05/2002 at 13:36.

In spring 2003, all evidence of the drought disappeared (Table 4.4-2) with respect to saline water flooding swamps and marshes. Even P6, the most saline of all stations recorded no flood events during the two-week monitoring period that contained measurable amounts of salt water. Sediments in swamps that had experienced dilute seawater during the drought returned to a more normal condition (See Section 5 for details) by winter 2002.

Table 4.4-2. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in spring 2003.

Station Number	Station Name	Substation Number	Spring 2003 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P6	Eagle Island	1	<1	0/27
		2	ND	ND
		3	ND	ND

Table 4.4-2. (continued)

Station Number	Station Name	Substation Number	Spring 2003 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
		4	ND	ND
		5	<1	0/27
		6	<1	0/27
P7	Indian Creek	1	ND	ND
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P8	Dollisons Landing	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1 - 1	1/27
		6	<1 - 2	17/27
P12	Rat Island	1	<1	0/27
		2	<1 - 1	0/27
		3	<1 - 2	6/27
		4	<1 - 1	1/27
		5	<1 - 1	20/27
		6	<1 - 2	3/27
P13	Fishing Creek	1	<1	0/27
		2	<1	0/27
		3	<1 - 1	0/27
		4	<1 - 1	0/27
		5	<1	0/27
		6	<1	0/27
P14	Prince George	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27

ND = no data available.

4.5 Penetration of Floodwaters Into Swamps

To what degree do floodwaters in the river penetrate into the swamp? Is the roughness of the swamp surface great enough to prevent the full extent of each tide to penetrate into the marsh/swamp? These were questions that had been posed since the beginning of the study and the subject of this section. One station was chosen (P13) to determine if these questions could be answered by combining data on the elevation of each substation, elevation of water in the river measured at the DCP, and bi-weekly flooding data.

Whenever the river water level exceeded the surface elevation of the marsh/swamp fall 2002, water typically flooded the surface at the same level as the water level in the river (Figure 4.5-1 through 4.5-5). Data were similar for spring 2002 (Figures 4.5-6 through Figure 4.5-11). This relationship implies that any change in the tidal range (higher or lower) will influence the marsh/swamp as well, at least at this one station, where the distance from the river to the upland was greatest.

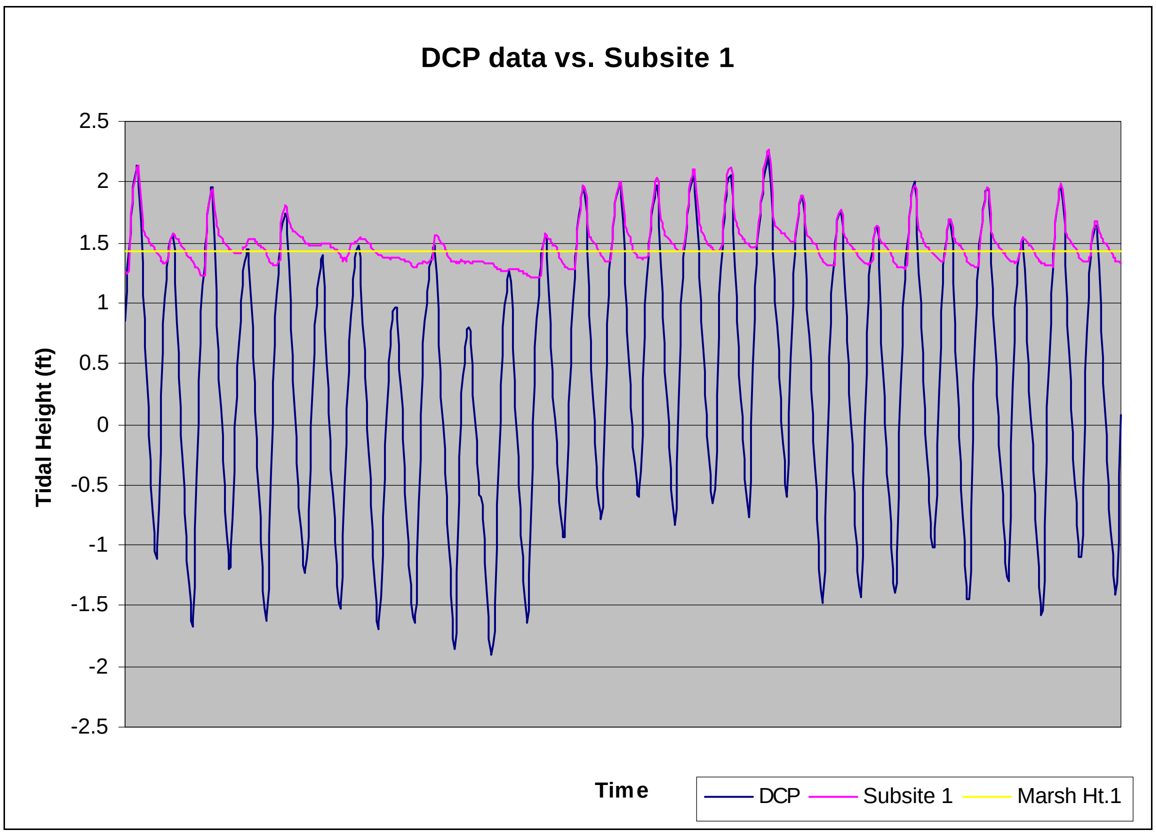


Figure 4.5-1. Subsite 1 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

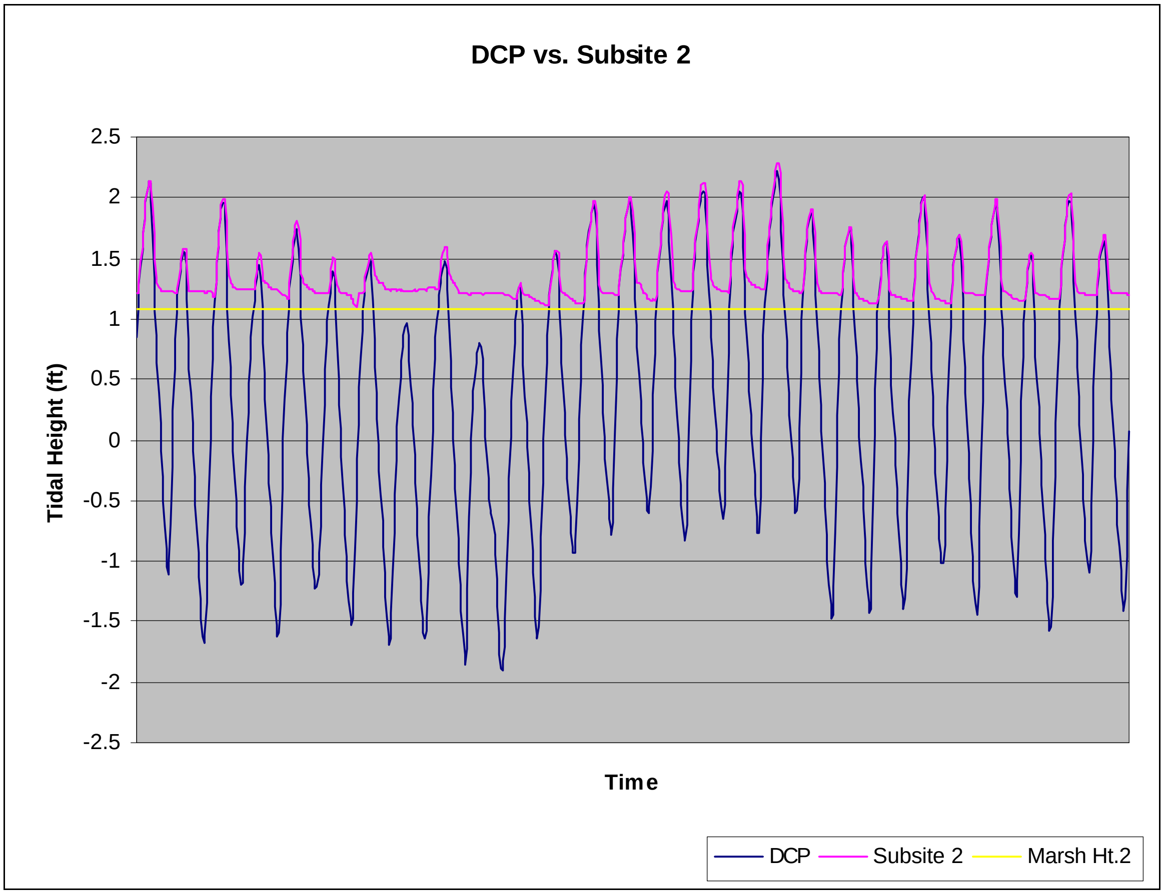


Figure 4.5-2. Subsite 2 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

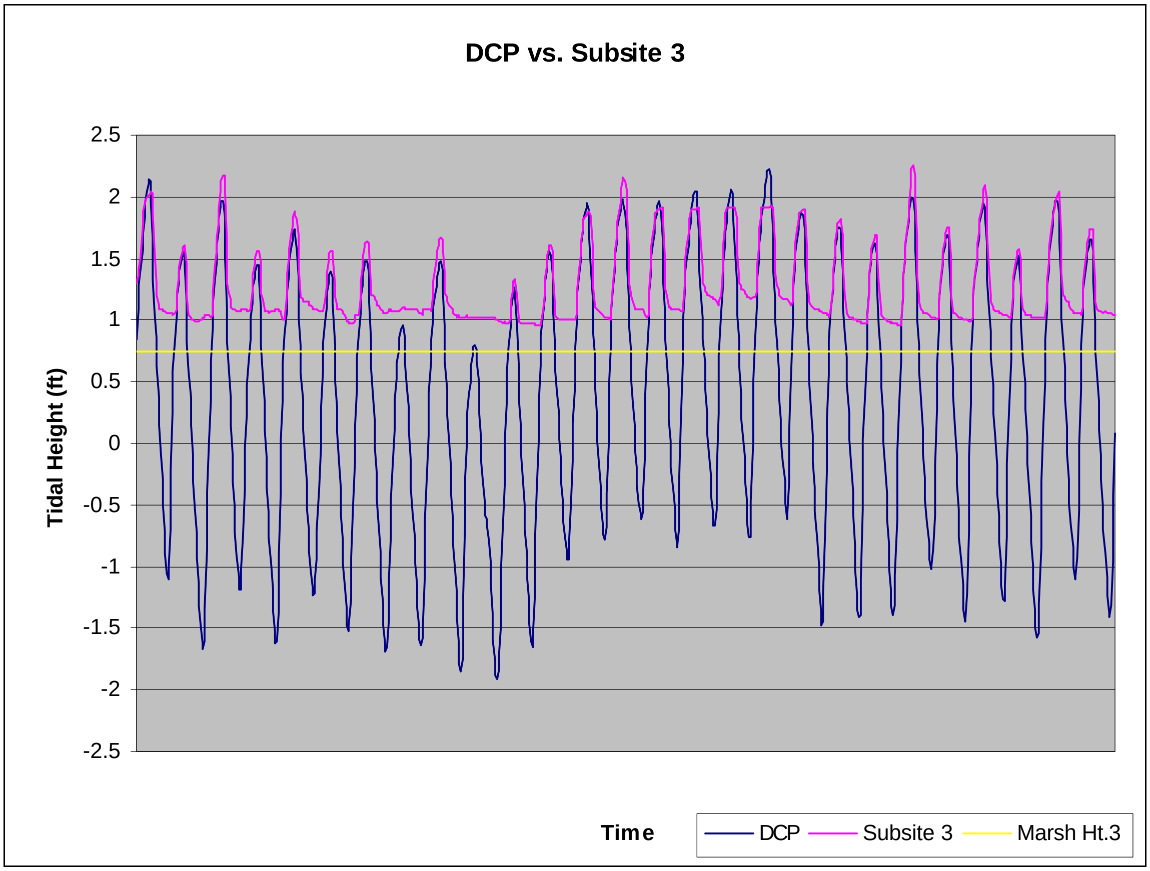


Figure 4.5-3. Subsite 3 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

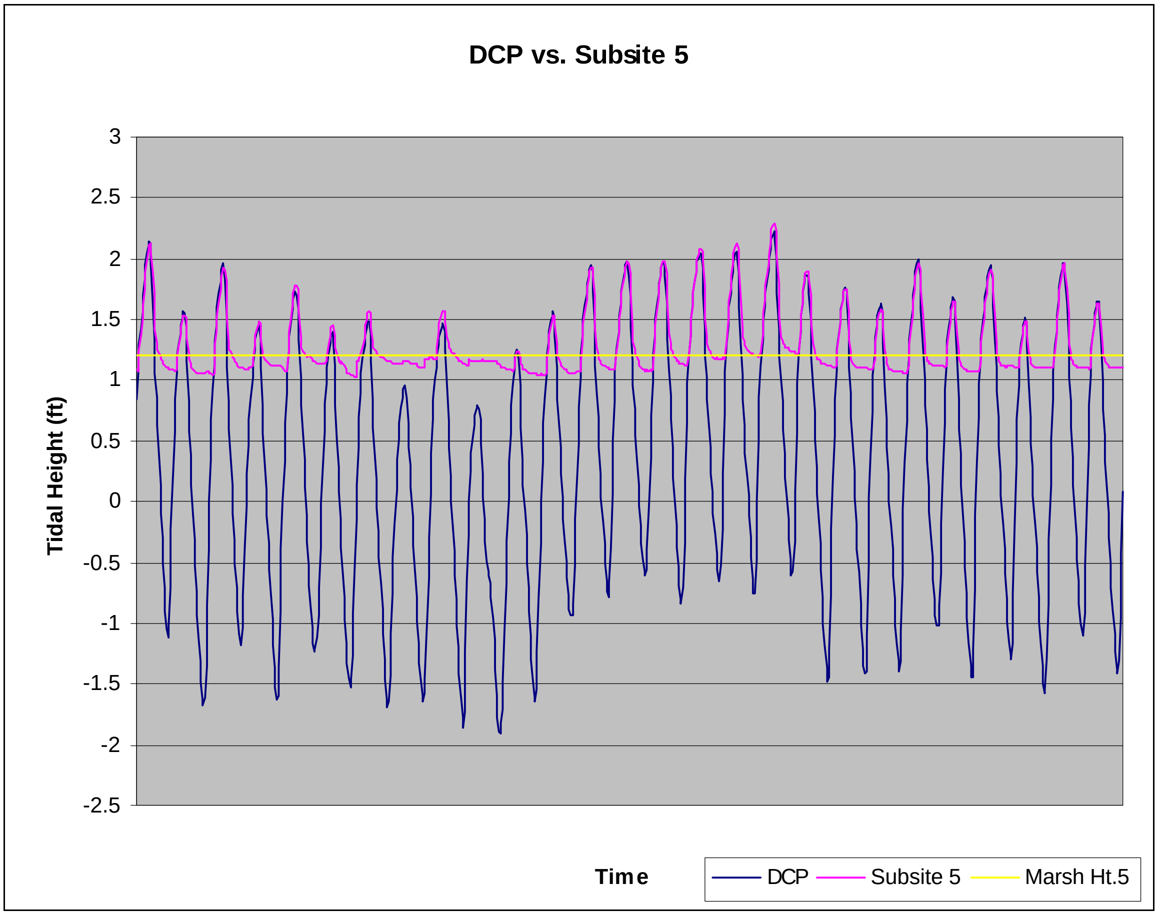


Figure 4.5-4. Subsite 5 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

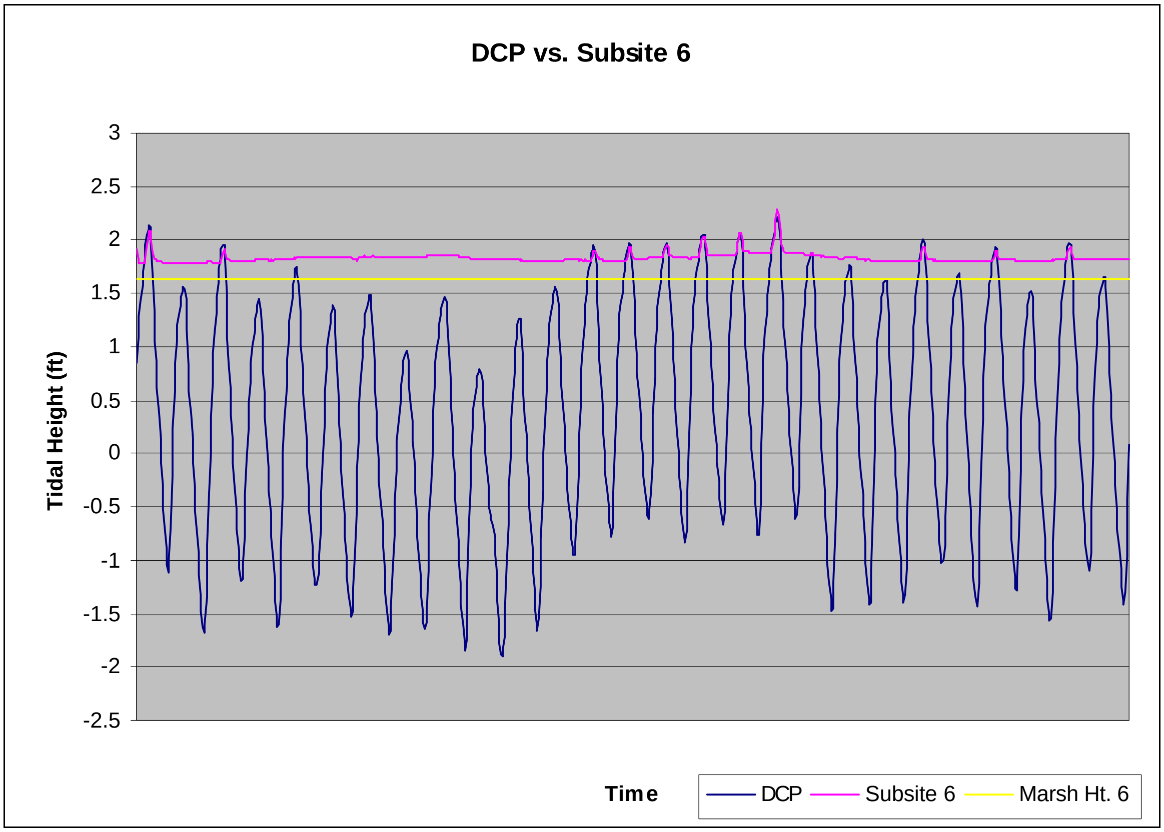


Figure 4.5-5. Subsite 6 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

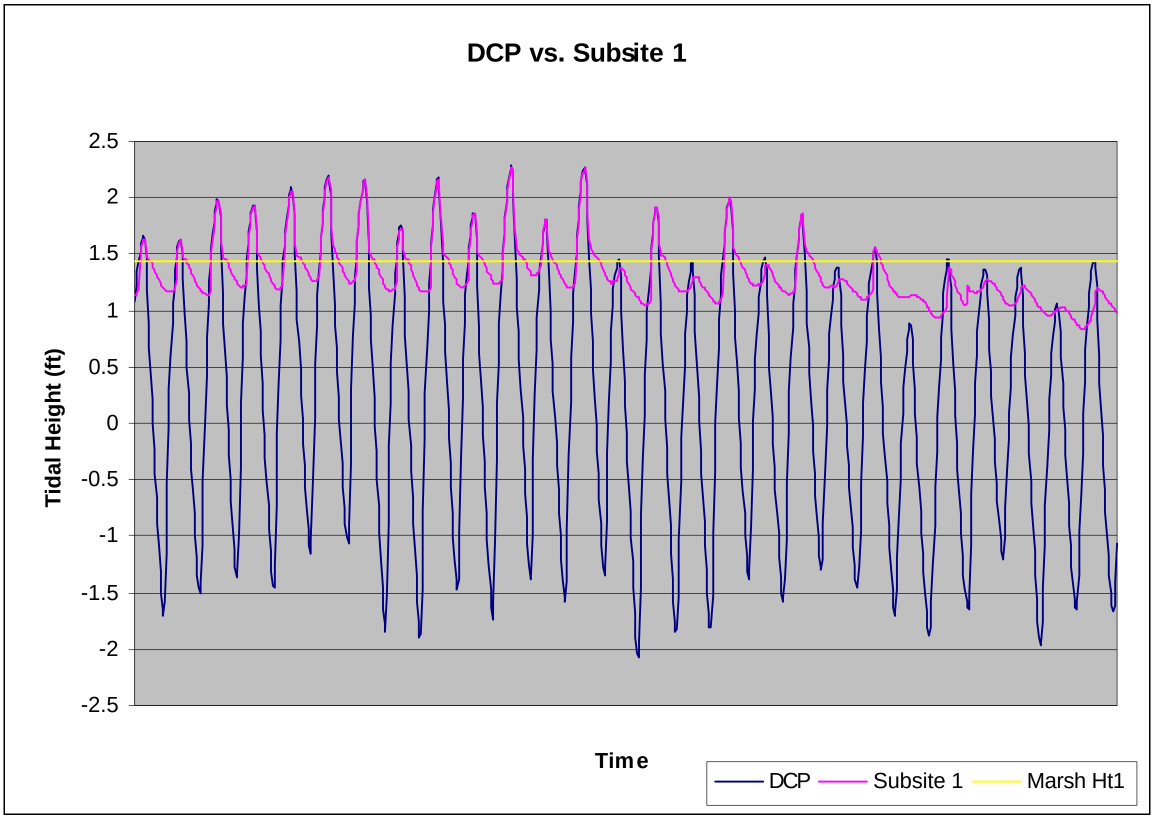


Figure 4.5-6. Subsite 1 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in spring 2002. Water levels are relative to NAVD88 elevations.

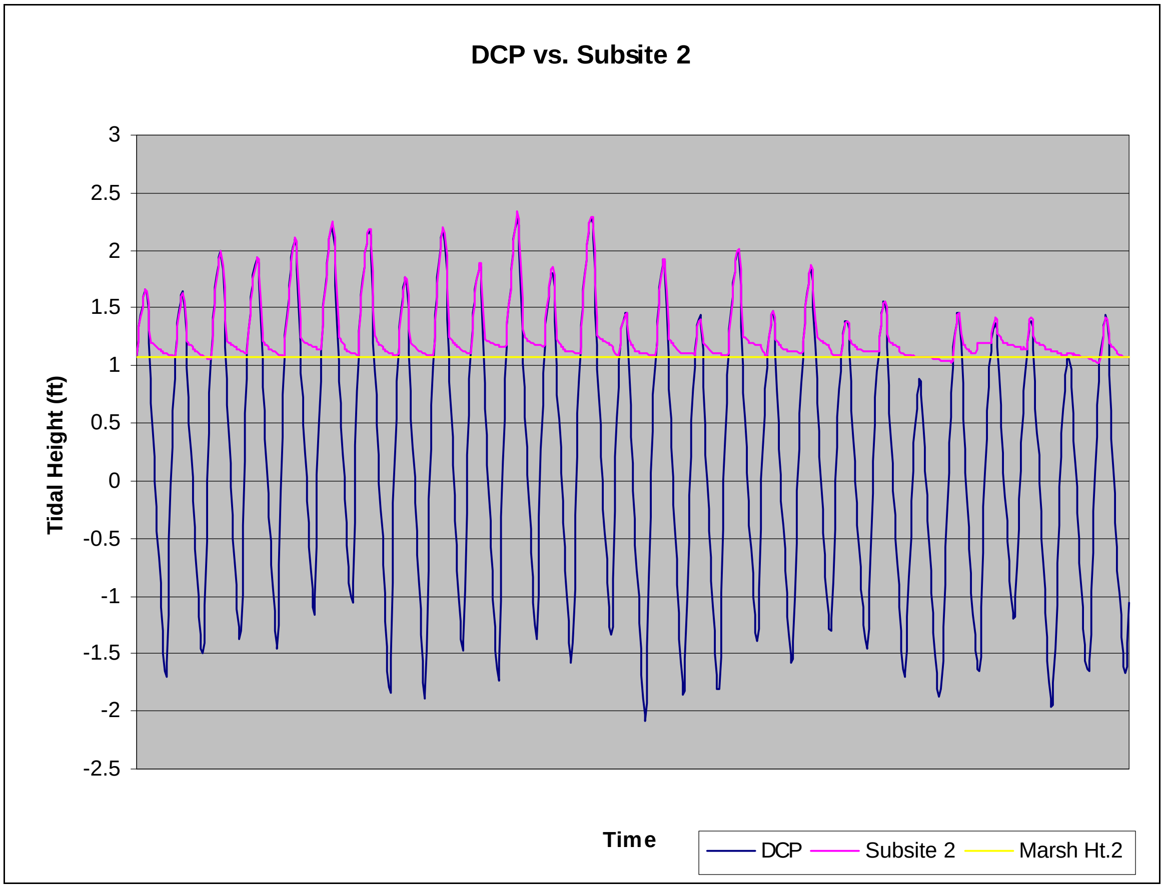


Figure 4.5-7. Subsite 2 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in spring 2002. Water levels are relative to NAVD88 elevations.

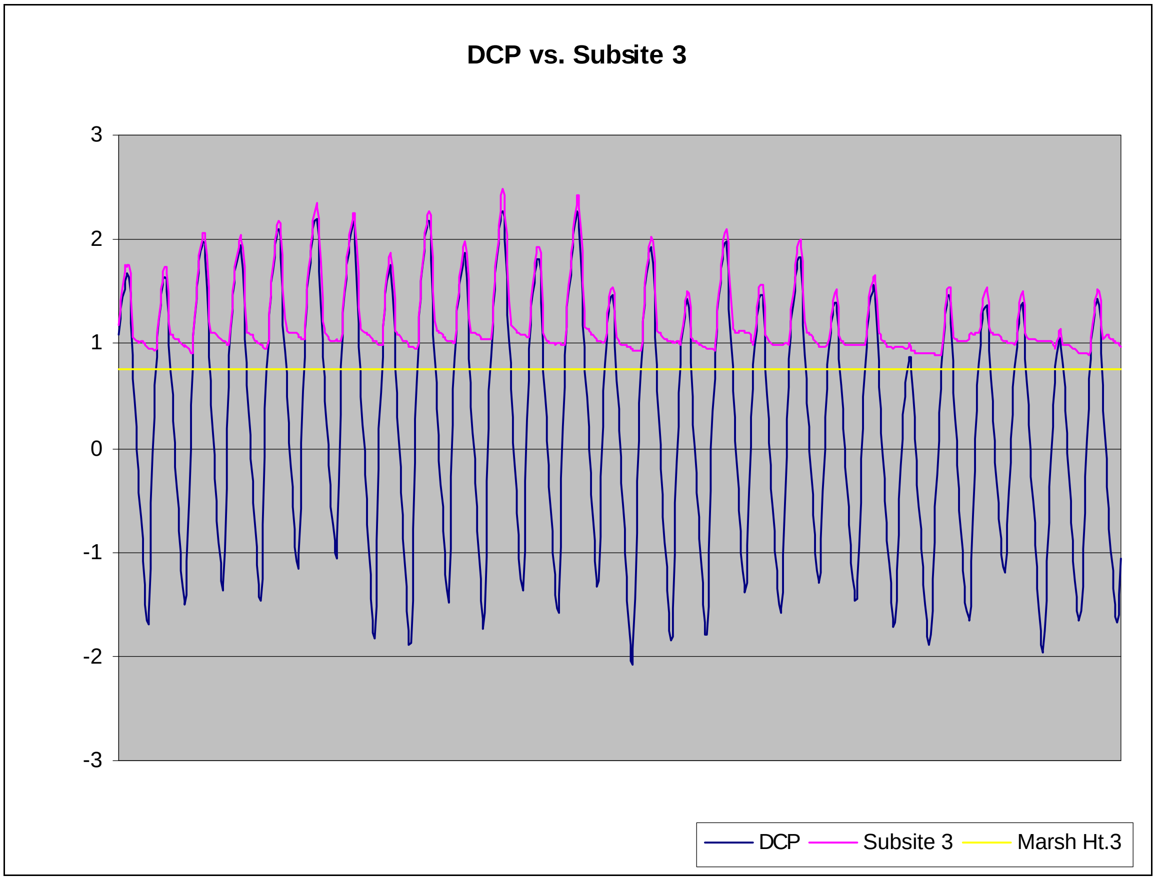


Figure 4.5-8. Subsite 3 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in spring 2002. Water levels are relative to NAVD88 elevations.

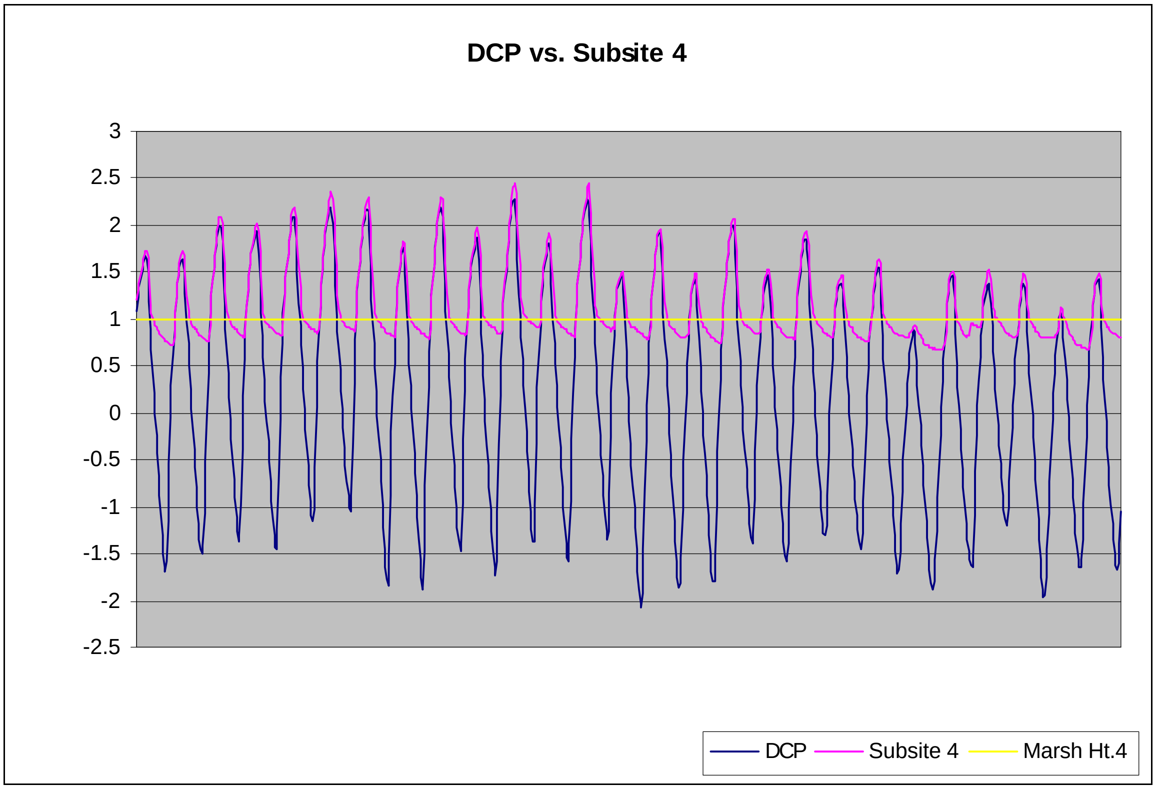


Figure 4.5-9. Subsite 4 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in spring 2002. Water levels are relative to NAVD88 elevations.

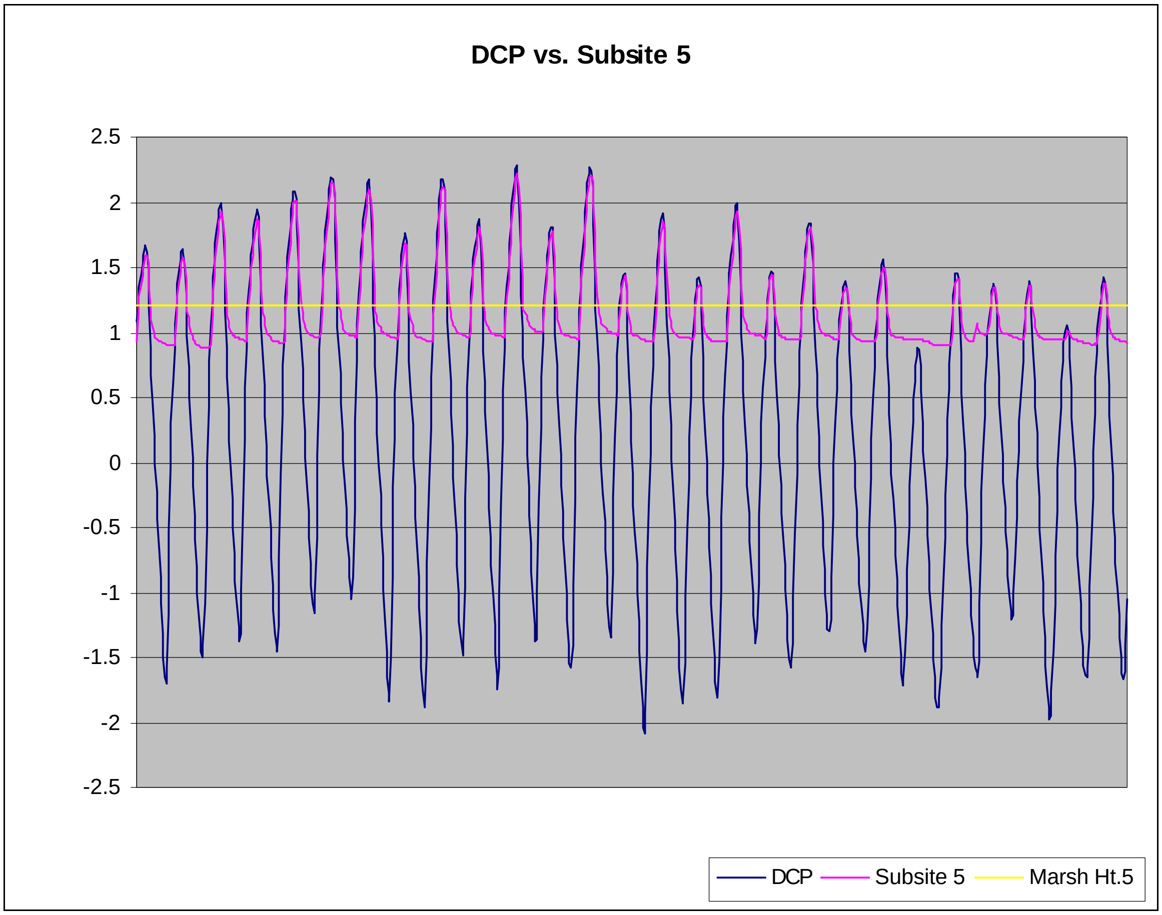


Figure 4.5-10. Subsite 5 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

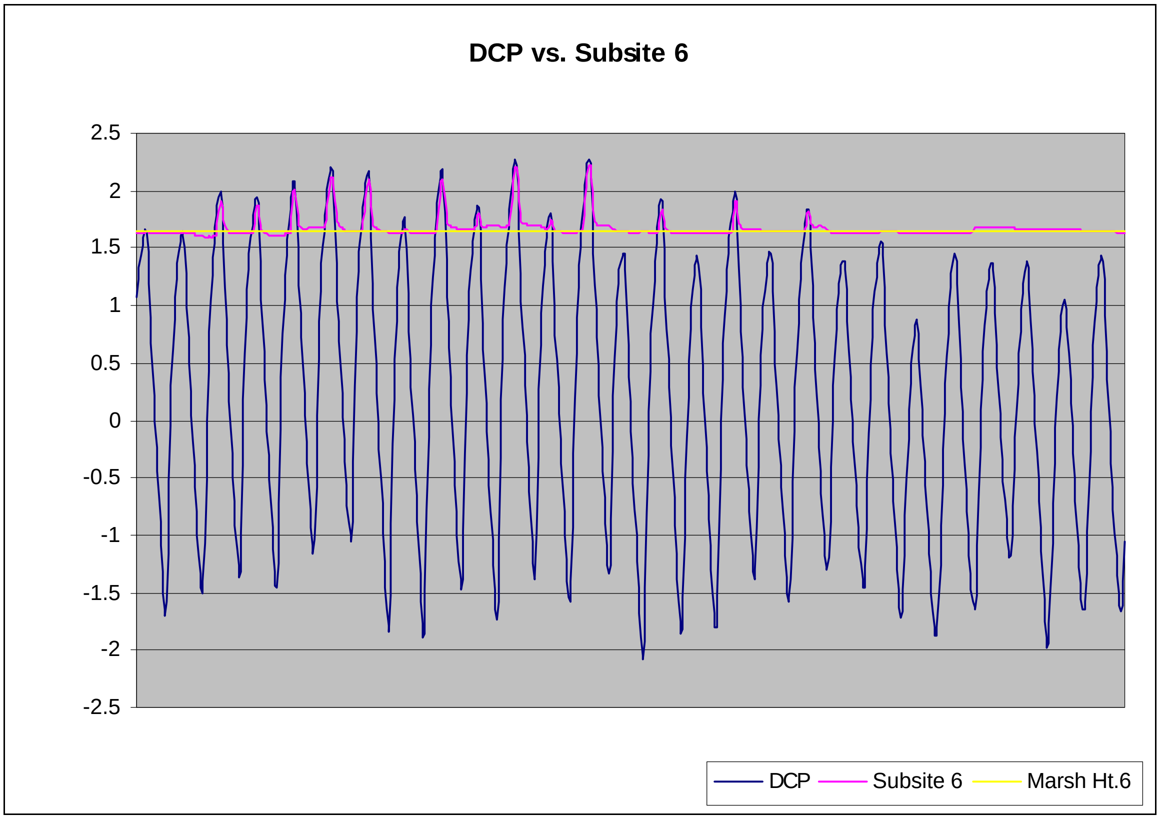


Figure 4.5-11. Subsite 6 floodwater depth at the Fishing Creek station (P13) relative to floodwater depth at the DCP during a two-week period in fall 2002. Water levels are relative to NAVD88 elevations.

4.6 Reliability of Swamp Flooding Frequency Data

The question of whether measures of flooding frequency made during two-week periods in fall and spring adequately represent the annual frequency were addressed at one station, Fishing Creek (P13) using data from the calendar year 2002. Data from Tables 4.2-1 (This report) and 4.2-2 from Hackney et al., (2002) were compared to annual expected flood frequency based on height of floodwater at the DCP and marsh surface elevation during 2002. Based on Chi Square comparisons, there were no statistical differences ($P<0.05$) for either spring (Chi Square = 0.576) or fall (Chi Square = 1.681) at d.f. = 5. While based on only one station, these data suggest that two-week data collections represent the annual frequency of flooding.

Table 4.6-1 Summary of data used to compare the number of flood events that actually flooded a subsite during spring 2003 and fall 2002 with the average number of flooding events expected based on levels of water (NAVD88) in the river measured at the DCP platform for the Fishing Creek station (P13). Statistic comparisons used two-week averages based on the annual data in the analyses. *Two week estimate based on data from 1-week.

Subsite	Flood Events	2-Week Average	Spring	Fall
1	493	19	17	24
2	633	24	25	25
3	687	26	27	25
4	660	25	26	26*
5	604	23	25	25
6	352	14	13	13

5.0 MARSH SWAMP BIOGEOCHEMISTRY

5.1 Summary

Geochemical data was collected at nine of the 12 stations along the Cape Fear River Estuary. Data from the winters of 2000, 2001, 2002, and the summers of 2000, and 2001 were presented in the previous annual reports for this project (Hackney et al., 2002, 2003). The data presented in the current report includes the winter of 2003 and the summer of 2002. The microbial modes of organic matter remineralization of the study sites range from sulfate reducing to methanogenic. Analysis of porewater chloride, sulfate, and methane was performed at six substations per station and at 6 depths per subsite. Samples were collected during the winter and summer at eight sites and monthly at a single site (P6 Eagle Island). These data were used to classify the geochemical setting of each of the 54 subsites as methanogenic (m), sulfate reducing (sr), methanogenic with evidence of past sulfate reduction (mpsr), and sulfate reducing with a non-seawater source of sulfate (srns). Classifications were compared to the previous data for these sites. Changes of the geochemical setting within soils at each site will be used to evaluate both natural and potential change caused by the current dredging project.

Station P6's (Eagle Island) geochemistry was analyzed monthly and displayed a steady decrease in salinity from June 2002 until May 2003. This monthly pattern of salinity variation was in contrast to the previous two years where peaks in salinity were observed during November and May (Hackney et al., 2003). Because of the lack of a salinity pulse during these times, several locations within Eagle Island converted to M geochemical classifications for the first time. This was particularly true during the spring and early summer of 2003. The remainder of the Eagle Island subsites were characterized by a mix of SR and MPSR classifications, similar to previous years.

The remaining eight stations were sampled twice each year, during summer and winter. In the first report, which included the winters of 2000, 2001 and the summer of 2000 (Hackney et al., 2002), three of these stations were primarily sulfate reducing year-round (P3 - Town Creek, P12 - Rat Island, and P11- Smith Creek), two were primarily methanogenic year round (P8 - Dollisons Landing, and P14 - Prince George), and four exhibited mixed conditions with sulfate reduction typically dominating the geochemistry during the summer and methanogenesis dominating during the winter (P7- Indian Creek , P9 - Black River, P12 - Rat Island, P13 - Fishing Creek) (Hackney et al., 2002). In the second report which included the summer of 2001 and the winter of 2002 (Hackney et al., 2003), two Northeast Cape Fear River sites, Prince George (P14) and Fishing Creek (P13), displayed a dramatic change in winter classification from methanogenic in the winters of 2000 and 2001 to sulfate reducing in the winter of 2002. This change resulted from an increase in salinity in much of the estuary. The other two sites on the Northeast Cape Fear River, Rat Island (P12) and Smith Creek (P11), also showed signs of increased salinity although their general classification did not change. Rat Island (P12) had several subsites classified as methanogenic converted to sulfate reducing conditions. Smith Creek (P11), which was already a sulfate reducing system, recorded higher salinities in porewaters.

The summer 2002 geochemical classifications on the Cape Fear River showed the opposite trend with evidence of a slight freshening of porewaters. Changes in classifications of the Cape Fear River sites were not as dramatic as those observed on the Northeast Cape Fear River. The general trend for Cape Fear River sites was a slight freshening of the porewaters in winter 2003 and saltier conditions in summer 2002 compared to the data contained in the previous report. Town Creek (P3), which is located below the confluence of the Northeast Cape Fear River and the Cape Fear River, displayed a similar trend as that of the Cape Fear River sites with slightly saltier conditions during the summer and slightly fresher conditions during the winter.

In the current report which includes the winter of 2003 and the summer of 2002, some long-term trends have emerged. In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), the increases in porewater salinities observed during previous summers continued through the summer of 2002. Due to the continued increase in summer salinities, all four sites were classified as sulfate reducing geochemical classifications for the first time. With the exception of Smith Creek, which already had a sulfate reducing geochemical classification, this is the first time the upper Northeast Cape Fear sites have had a summertime sulfate reducing geochemical classifications. A similar increase in summertime porewater salinity was noted in the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island), while sites further upstream on the Cape Fear River (Black River, Dollisons Landing) had peak salinities occurring during the previous summer (2001). The salinities of Town Creek, the only site below the City of Wilmington monitored for geochemical classification, showed no obvious change in summer porewater salinity.

With the exception of Town Creek, which is below the city of Wilmington, and the Cape Fear River sites immediately above the City of Wilmington (Indian Creek, Eagle Island) all sites had lower winter porewater salinities than previous winters. For the upper Cape Fear River sites (Black River, Dollisons Landing), the winter conditions have continued to show a steady decrease since 2000. The fresher conditions did not cause a shift in geochemical classification for these sites since they were already methanogenic. In the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, Smith Creek), the current winter (2003) porewater salinities returned to lower values after peaking during the previous winter (2002). The decrease in salinities for the more seaward stations (Rat Island and Smith Creek) was not enough to convert these systems from sulfate reducing geochemical classification. For the upstream stations

(Fishing Creek, Prince George), several subsites that were converted to sulfate reducing during the previous winter returned to methanogenic geochemical classification during the current winter (2003). Porewater salinities of Town, Indian Creek, and Eagle Island increased during the current winter (2003). The changes in geochemical classifications were relatively small for these sites with only slight changes towards saltier classifications.

5.2 Geochemical Theory and Classification

Porewater sampling of the metabolic products of sulfate reducing and methanogenic bacteria help establish the frequency and duration of organic soil inundation by tidal water carrying ocean-derived salt versus inundation by fresh water. Changes in flooding frequency have a more significant impact if salts from seawater enter the pore space of wetland sediments. In the presence of sufficient seawater sulfate, organic matter is remineralized via sulfate reducing bacteria in anaerobic environments generating hydrogen sulfide. In freshwater environments, organic matter is usually remineralized via methanogens that generate methane as a byproduct. In the presence of high levels of sulfate from seawater, methanogens are replaced by sulfate reducing bacteria and methanogenesis is inhibited. Hydrogen sulfide is toxic and limits both plants and animal species that do not have a behavioral or physiological mechanism to tolerate this bacterial metabolite. Thus, a shift in remineralization pathway can lead to different communities of plants and animals.

Chloride concentrations are a direct measure of salinity as it occurs in a constant proportion in seawater and has no substantial sinks or sources in wetland sediments. Therefore, the term salinity used in the biogeochemistry section of this report will refer to salinity based on measured chloride concentrations.

Chloride and sulfate concentrations are in a constant ratio in seawater (approximately 20:1). Unlike sulfate, which can decrease due to sulfate reduction, there are no common removal mechanisms (biotic or abiotic) for chloride from seawater. Therefore, chloride concentrations can be used as an indicator of the amount of sulfate originally supplied to a site by seawater. Changes in the ratio of chloride to sulfate are an indicator of sulfate reduction. In the presence of sulfate reduction, methanogenic bacteria are out competed and methane production is inhibited. Therefore, low concentrations of methane are another indicator of sulfate reduction. When sulfate concentrations decrease sufficiently, sulfate-reducing bacteria are no longer able to function and methane production dominates. Thus, a sulfate reducing threshold concentration can be identified in sulfate concentration versus depth profiles, where sulfate concentrations no longer decrease with increasing depth and methane concentrations increase. Data from all nine marsh/swamp stations of the present study place the level where the shift occurs at approximately 300µM sulfate. This corresponds to sulfate being supplied by salinities of approximately 0.4 parts per thousand.

Using this sulfate reducing threshold (300 µM sulfate), stations and substations were classified as sulfate reducing or methanogenic. Methanogenic substations that had a chloride to sulfate ratio significantly greater than seawater (>30:1) were classified as methanogenic sites with evidence of past sulfate reduction. Sulfate reducing sites with ratios less than seawater (5:1) were classified as sulfate reducing with a non-seawater source of sulfate. The four main classifications are: 1) sulfate reducing (SR), 2) methanogenic (M), 3) methanogenic with evidence of past sulfate reduction (MPSR), and 4) sulfate reducing with a non-seawater source of sulfate (SRNS). Changes in these classifications will be used to determine changes in biogeochemical setting.

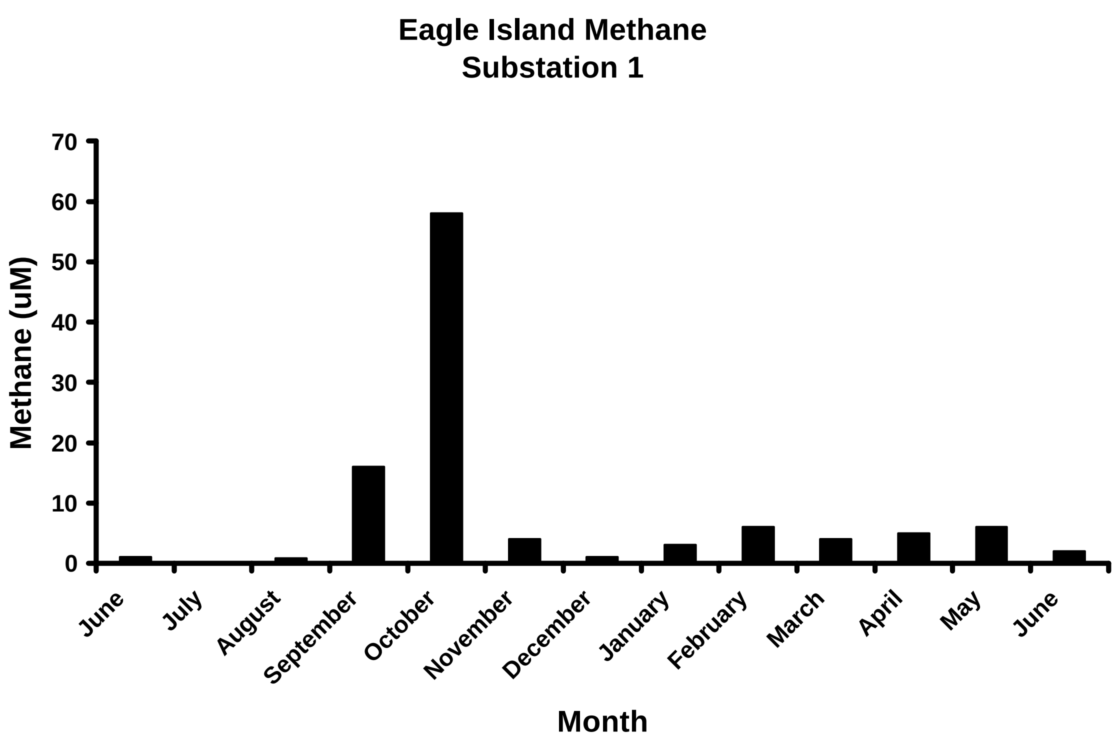
5.3 Geochemical Methodology

Biogeochemical monitoring was established in close proximity to shallow water well/conductivity/temperature substations. Six substations are distributed along the length of each of nine monitoring belt transects with number one near the river or channel and number 6 adjacent to uplands. Substations are roughly perpendicular to the segment of the stream along which they have been established. Sampling devices, peepers, are constructed of thick acrylic with wells (1-cm deep grooves) located at six different depths that sample 1, 6, 11, 16, 21, and 26 cm below the soil surface. Semipermeable membranes allow methane, sulfate, and chlorine to equilibrate with distilled water in wells. Peepers are inserted into the substrate and left for 1 week, which is ample time for equilibration. Peepers have been shown to be reliable collection devices for these types of dissolved substances (Hesslein, 1976). The concentrations of all parameters are determined after removing samples from peeper cells with a syringe equipped with a needle. Sulfate and chloride concentrations are stable under oxic conditions and can be stored in serum vials until analysis. Sulfate and chloride concentrations are determined with an ion chromatograph (Hoehler et al., 1994). Salinity is calculated from the chloride concentrations of the equilibrated peeper chamber water based on the constant ratio of chloride to total dissolved salts in seawater. Samples for porewater methane analysis are prepared by extraction of porewater methane into an inert helium headspace within a gas-tight syringe. The headspace gas is then injected into a gas chromatograph equipped with a flame ionization detector (Kelley et al., 1995) for quantitative determination of methane concentration.

Porewater is collected and analyzed at all 54 substations in all nine transect stations during mid-summer and mid-winter, the coldest and warmest parts of the year. This provides data during periods of maximum and minimum bacterial metabolism. Porewater is also collected monthly from the Eagle Island station (P6) using the same procedures. This station represents a transition between saline and fresh-dominated stations. In addition, the six substations represent the same transition along a different scale, well flooded to less flooded.

5.4 Eagle Island (P6) Annual Cycles of Sulfate, Chloride, and Methane

Eagle Island has been classified an SR and MPSR classification because both methanogenesis and sulfate reduction occur at this station (Hackney et al., 2002; Hackney et al., 2003). With the exception of the emergence of some methanogenic geochemical classifications during the current spring (2003), the general classifications and systematics of this site during the previous years has not changed. Eagle Island's general classification is based on the following observations: 1) Methane is present at depth in all substations, but is often at very low concentrations at the surface during times of high sulfate input (Figure 5.4-1), 2) Sulfate concentrations range from below the sulfate reducing threshold of 300 µM indicating methane production, to as high as 10,000 µM indicating sufficient sulfate to drive sulfate reduction (Figure 5.4-2) and, 3). Ratios of sulfate to chloride range from those found in seawater to ratios indicating a depletion of sulfate due to sulfate reduction (Figure 5.4-3).



Eagle Island Methane
Substation 1
Methane (uM)
70
60
50
40
30
20
10
0
June
July
August
September
October
November
December
January
February
March
April
May
June
Month

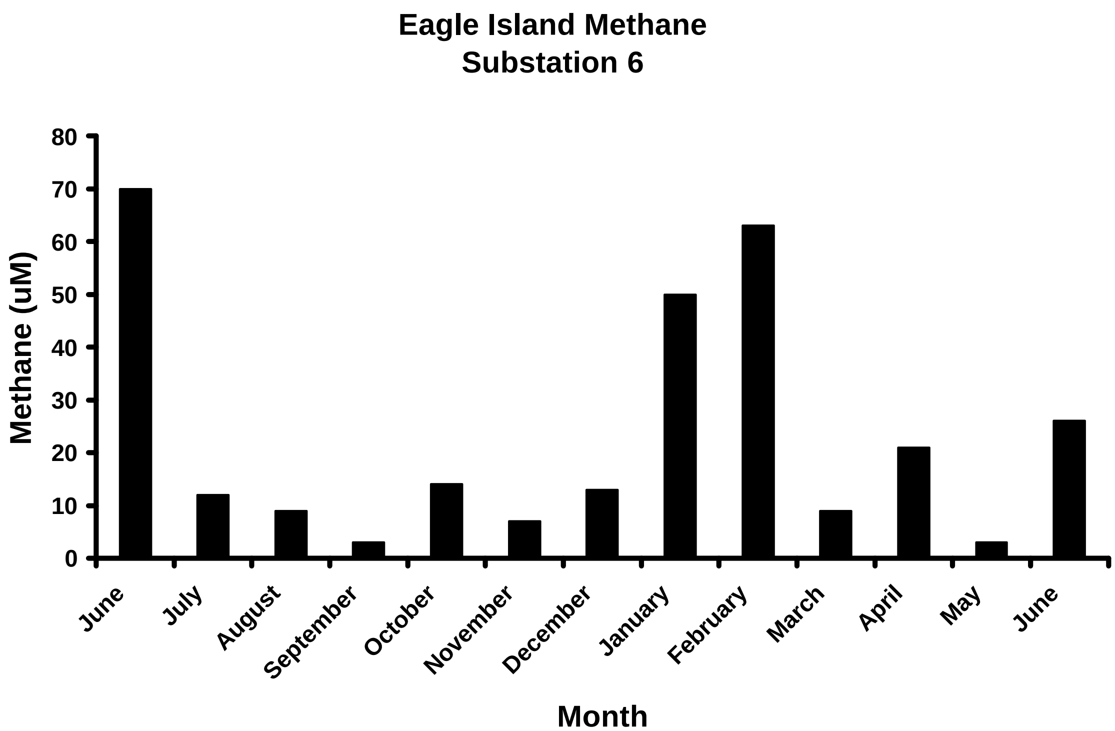
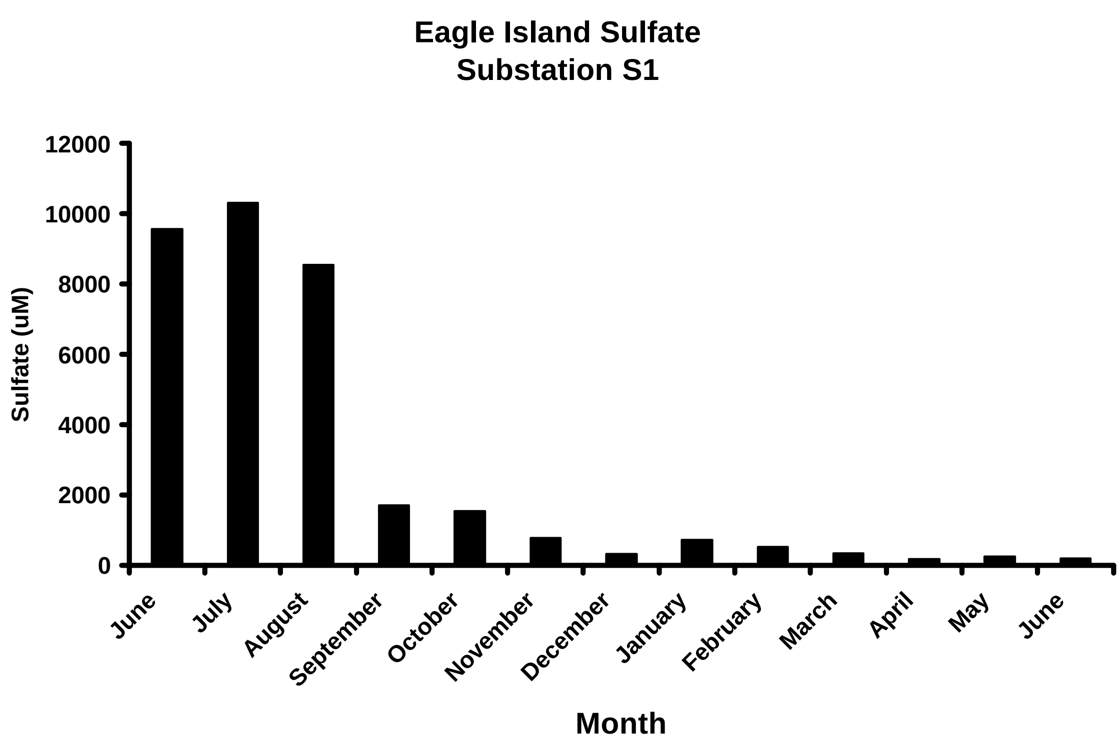


Figure 5.4-1. Methane concentrations of Eagle Island porewaters vs. month from July 2002-June 2003. Top shows site near the river's edge (S1) and bottom shows site adjacent to the upland (S6).



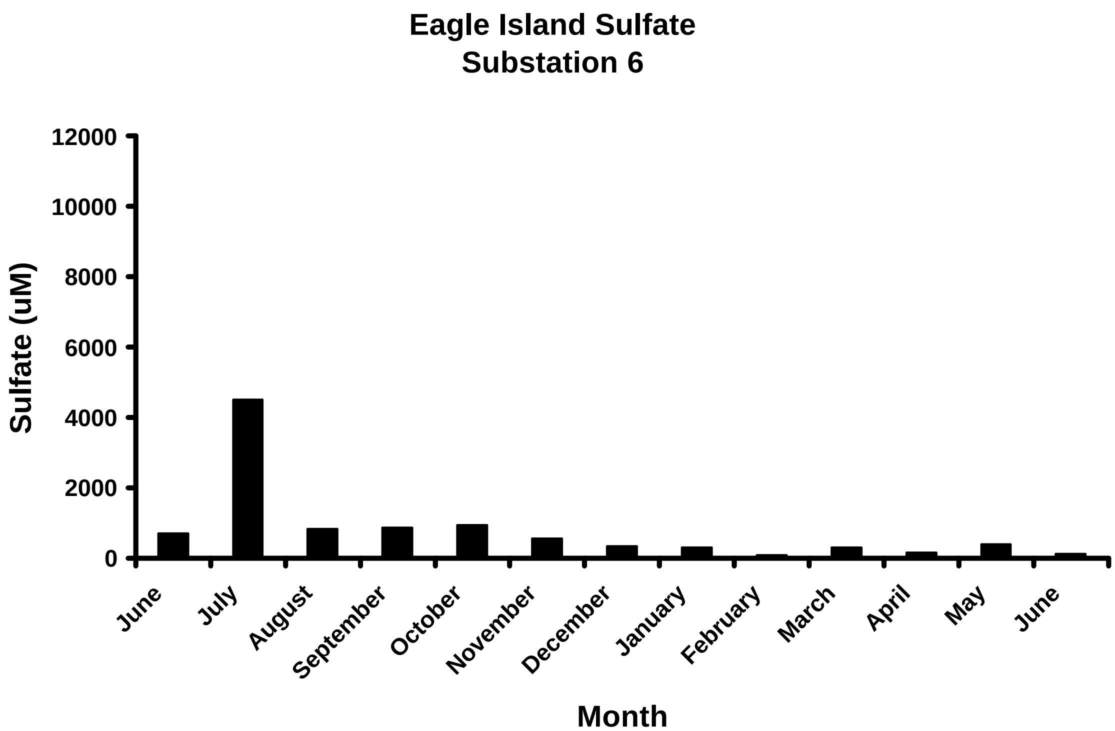
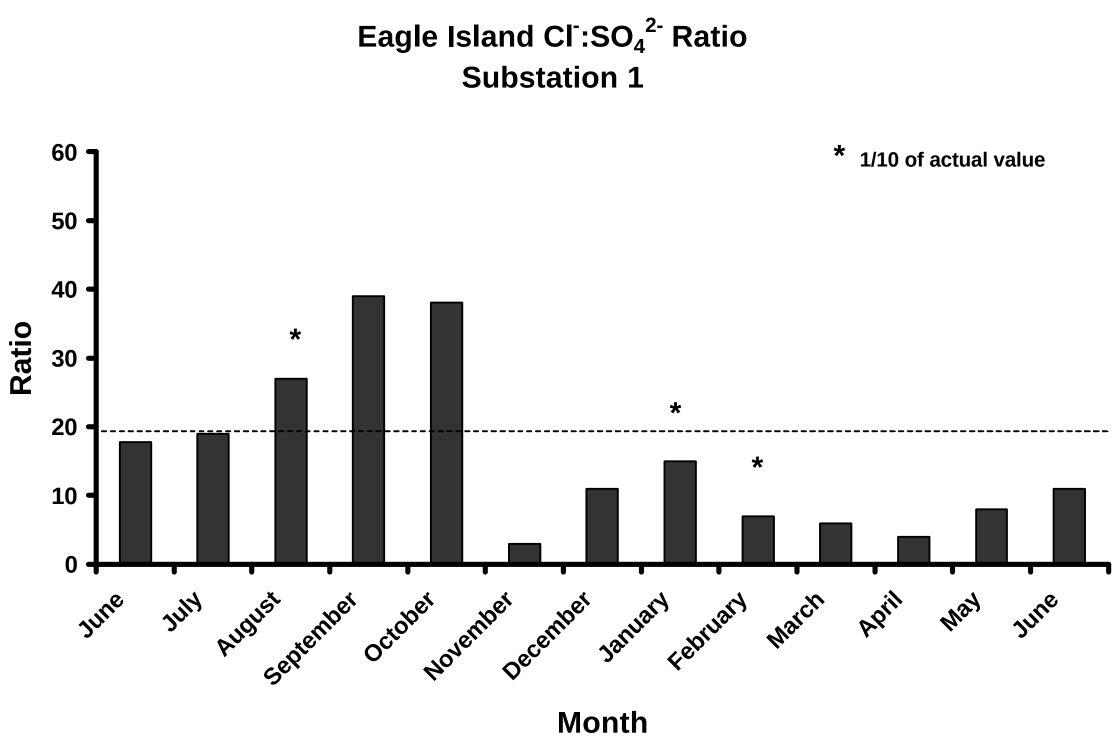


Figure 5.4-2. Sulfate concentrations of Eagle Island porewaters vs. month July 2002-June 2003. Top shows nearshore site (S1) and bottom shows most upland site (S6).



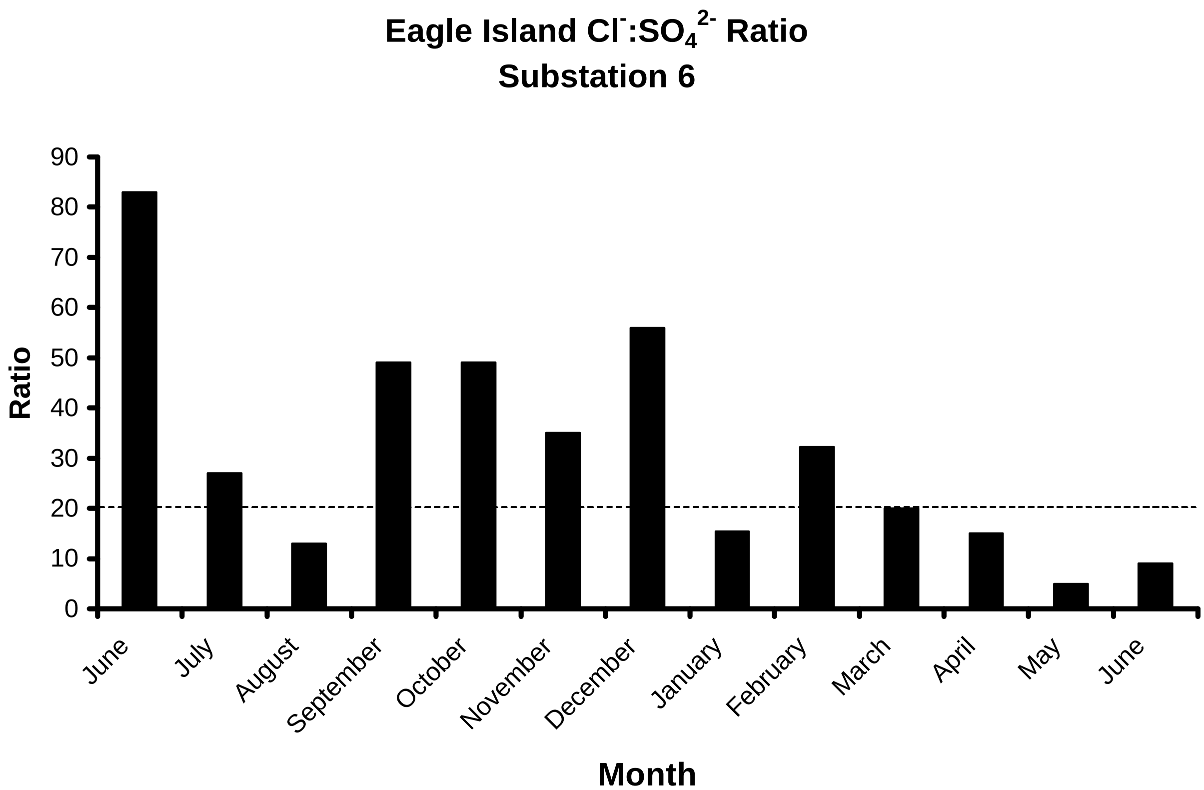
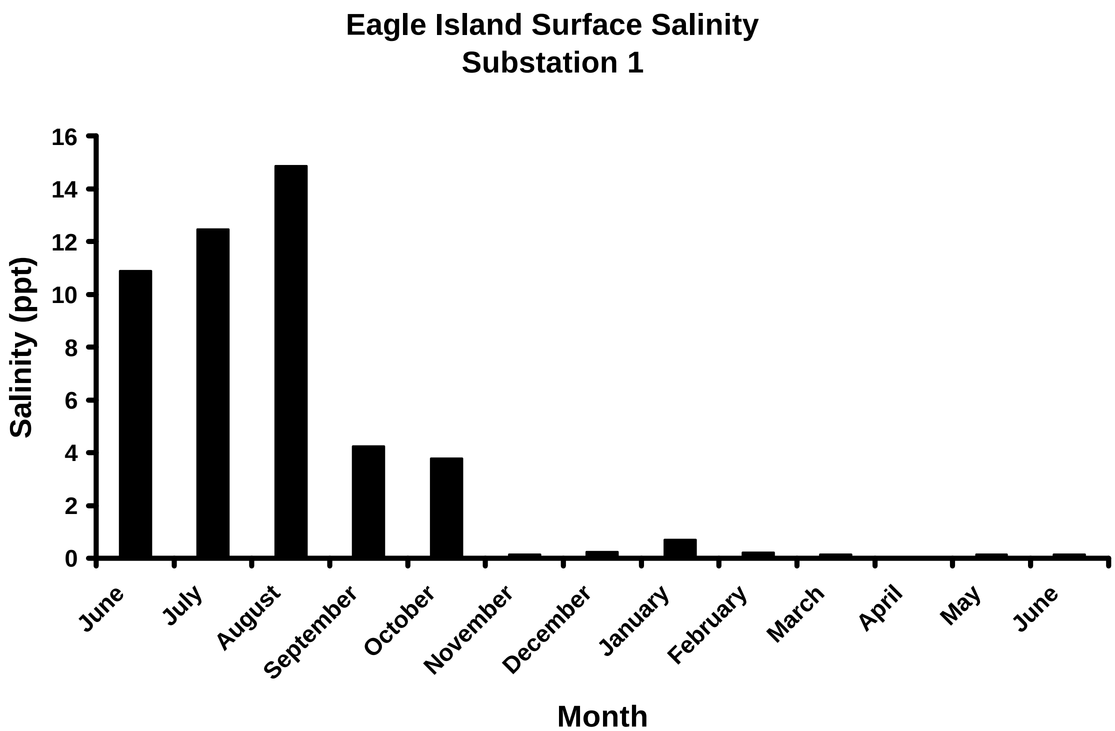


Figure 5.4-3. Chloride to sulfate ratios of Eagle Island porewaters vs. month July 2002-June 2003. Dashed line shows ratio for seawater. Top shows nearshore site (S1) and bottom shows most upland site (S6).



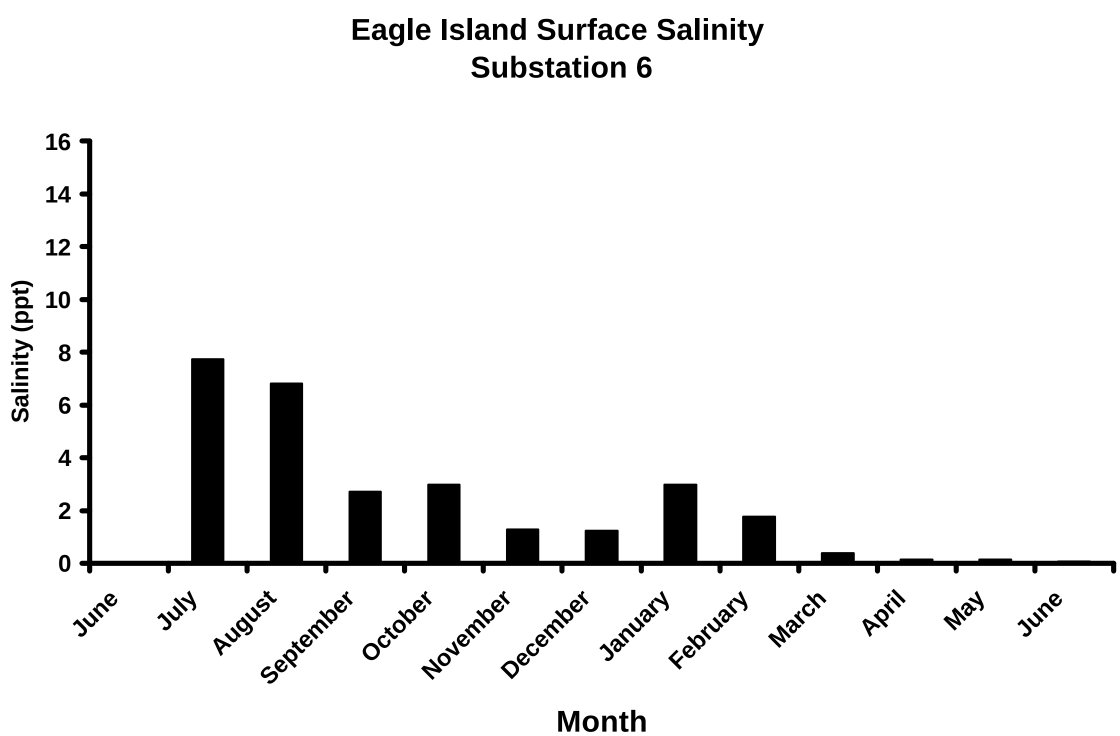


Figure 5.4-4. Salinities of Eagle Island porewaters vs. month July 2002-June 2003. Top shows nearshore site (S1) and bottom shows most upland site (S6).

Salinity input to Eagle Island varies during the year. Generally the salinity is higher during summer months when the flow rate of the river is lower, however, a massive input of salt was observed during November 2000 and 2001 and May 2001 and 2002 (Hackney et al., 2003). These events overshadowed seasonal trends and dominated geochemical conditions during the previous two report periods (Hackney et al., 2002; Hackney et al., 2003). This year the pattern of salinity variations was different. Instead of salinity peaks during November and May, the salinity steadily decreased from the summer of 2002 until the spring of 2003 (Figure 5.4-4). The steady freshening of the system was reflected in the geochemical parameters and classifications during the 2002-2003 report period.

Sulfate concentrations at Eagle Island essentially paralleled salinity trends (Figure 5.4-2), but with a slight lag because sulfate is removed by an active biological process as opposed to the much slower diffusion of sea salts vertically from the soil into surface water or laterally through horizontal drainage. Sulfate concentrations steadily decreased from the summer of 2002 until June of 2003. Most porewater sulfate values remained above or close to the sulfate reducing threshold of 300 µM throughout the winter of 2003. This resulted in the majority of geochemical classifications being either SR or MPSR (Table 5.4-1). As the spring of 2003 approached, however, the lack of a November and May salinity pulse became evident with many SR classification converted to MPSR and the occurrence of MP classifications for the first time at several locations within Eagle Island (P6).

The chloride to sulfate ratios ($Cl^-:SO_4^{2-}$) reflected the steady decrease in salinity for Eagle Island during the current study. During the summer of 2002 and the winter of 2003, the ratio of chloride to sulfate was for the most part at or above the ratio observed in seawater indicating a steady supply of seawater and sulfate reduction. As spring approached, the ratios dropped below that expected for seawater indicating an excess of sulfate (Figure 5.4-3). These ratios are expected when hydrogen sulfide (the product of sulfate reduction) reoxidizes to sulfate adding sulfate to the system that has been flushed with fresher water removing seawater chloride. Conversion of sulfate to sulfide by bacteria can produce a variety of compounds that can be converted back to sulfate under different conditions.

Methane concentrations at Eagle Island provide important supporting data for the geochemical explanations presented above. Generally, methane concentrations were higher at S6 compared to S1 (Figure 5.4-1) indicating the predominance of methanogenesis over sulfate reduction at the upland edge where resupply of sulfate via seawater is usually lower and some upland subsurface seepage is likely. There is also less vegetation at S6, which removes water during photosynthesis through evapotranspiration.

Table 5.4-1. Eagle Island (P6) Geochemical Classifications by month 2002-2003. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Sites	June 02	July	August	September	October	November	December	January	February
S1-1	II	ns	II	II	ns	II	II	II	II
S1-2	II	II	II	II	II	II	I	II	II
S1-3	II	II	II	II	II	II	I	II	II
S1-4	II	II	II	II	II	II	II	I	II
S1-5	II	II	II	II	II	II	II	I	II
S1-6	II	I*	II	II	II	II	II	I*	II
S2-1	II	II	II	II	II	II	II	II	II
S2-2	II	II	II	II	II	II	II	II	II
S2-3	II	II	II	II	II	II	II	II	II
S2-4	II	II	II	II	II	II	II	II	II
S2-5	II	II	II	II	II	II	II	II	II
S2-6	II	I*	II	II	II	II	II	II	II
S3-1	II	II	II	II	II	II	II	II	II
S3-2	II	II	II	II	II	II	II	II	II
S3-3	II	II	II	I*	II	II	II	II	II
S3-4	II	II	II	I*	II	II	II	II	II
S3-5	II	II	I*	I*	II	II	II	I*	II
S3-6	II	II	II	I*	II	II	I*	I*	I*
S4-1	II	I*	II	II	II	II	I*	II	I*
S4-2	I*	I*	II	II	II	II	I*	I*	I*
S4-3	I*	I*	II	I	II	II	I*	I*	I*
S4-4	I*	I*	II	I*	II	II	I*	I*	I*
S4-5	I*	I*	II	I*	II	II	I*	I*	I*
S4-6	I*	I*	II	I*	II	I*	I*	I*	I*
S5-1	II	II	I*	I*	II	II	II	II	I*
S5-2	II	II	I*	I*	II	II	I*	I*	I*
S5-3	II	I*	I*	I*	II	I*	I*	I*	I*
S5-4	II	I*	I*	I*	I*	I*	I*	I*	I*
S5-5	II	I*	I*	I*	I*	I*	I*	I*	I*
S5-6	I*	I*		I*	II	I*	I*	I*	I*
S6-1	II	II	II	II	II	II	II	II	I*
S6-2	I*	II	II	I*	II	II	I*	I*	I*
S6-3	I*	II	II	I*	II	II	I*	I*	I*
S6-4	I*	II	I*	I*	II	II	I*	I*	I*
S6-5	I*	II	I*	I*	II	II	I*	I*	I*
S6-6	I*	I*	II	I*	II	II	I*	I*	I*

Table 5.4-1. (continued)

Sites	March	April	May	June 03
S1-1	II	I	I	I
S1-2	II	I	I	I
S1-3	II	I	I	I
S1-4	I	I*	I	I*
S1-5	I*	I*	I*	I*
S1-6	I*	I*	I*	I*
S2-1	II	II	I	I
S2-2	II	I*	I	I
S2-3	II	I*	I*	I
S2-4	II	I*	I*	I*
S2-5	II	I*	I*	I*
S2-6	II	I*	I*	I*
S3-1	II	I*	I*	I*
S3-2	I*	I*	I*	I*
S3-3	I*	I*	I*	I*
S3-4	I*	I*	I*	I*
S3-5	I*	I*	I*	I*
S3-6	I*	I*	I*	I*
S4-1	II	I*	I	I
S4-2	I*	I*	I*	I*
S4-3	I*	I*	I*	I*
S4-4	I*	I*	I*	I*
S4-5	I*	I*	I*	I*
S4-6	I*	I*	I*	I*
S5-1	II	I		I
S5-2	I*	I*	I	I
S5-3	I*	I*	I*	I*
S5-4	I*	I*	I	I*
S5-5	I*	I*	I*	I*
S5-6	I*	I*	I*	I*
S6-1	II	I	II	I
S6-2	I*	I	I	I
S6-3	I*	I*	I*	I*
S6-4	I*	I*	I*	I*
S6-5	I*	I*	I*	I*
S6-6	I*	I*	I*	I*

5.5 Marsh/Swamp Transect Stations Geochemistry, Annual Variability

The following section compares the geochemistry of substations from the previous years 2000-2001 (Hackney et al., 2002) and 2001-2002 (Hackney et al., 2003) to the current year. The current report includes the winter of 2003 and the summer of 2002.

5.51 Town Creek (P3)

Town Creek is the most seaward station monitored for geochemistry. The average winter porewater salinities have been steadily increasing throughout the four-year study [winter 2000 = 0.8 ± 0.4 ppt; winter 2001 = 1.4 ± 0.8 ppt (Hackney et al., 2002); winter 2002 = 3.8 ppt ± 1.9 (Hackney et al., 2003); winter 2003 = 7.2 ± 4.9 ppt (Table 5.51-1)]. Porewater salinities during winter 2003 reached values as high as 17 ppt, roughly twice the highest salinities ever observed during the previous winters. The average summer salinities show no obvious changes over the 3 years of summer data [(summer 2000 = 4.3 ± 1.7 (Hackney et al., 2002); summer 2001 = 3.4 ± 0.8 (Hackney et al., 2003); summer 2002 = 4.8 ± 2.2 (Table 5.51-1)]. Average porewater salinities are always higher during the summer compared to the winters reflecting the general trend towards higher winter freshwater river flow.

The station was classified as a sulfate reducing system (SR) during the previous summers with the exception of a few deep samples which were classified as methanogenic with evidence of past sulfate reduction (MPSR) (Table 5.51-2). In the current summer (2002), 86% of the porewater sub-sites had identical summer classifications as in the previous summer of 2001. The only differences were the conversion of a few (SR) sites to (MPSR) at substation 2. This likely reflects a slight increase in bioavailable organic matter depleting the sulfate at this substation. The sulfate depletion occurred at depth at this substation, which is typical of organic rich estuarine sediments that are often sulfate reducing at the surface and methanogenic below due to depletion of sulfate, which cannot be easily re-supplied at depth.

During the first winter of this study (2000) when salinities were the lowest, a few sub-sites had a methanogenic classification (M) with the majority being (SR) and (MPSR) (Table 5.51-2). During the next 3 winters, site classifications have consisted of a combination of (SR) and (MPSR) showing the strong influence of saltwater at this seaward station. In the current winter (2003), 83% of porewater sub-sites had identical winter classifications as in the previous winter of 2002. The only differences were the conversion of a few (SR) sites to (MPSR) at substations 1 and 2. Porewater methane concentrations were generally unchanged during the current summer (2002) and winter (2003) with the exception of substations 1 and 2 which were slightly elevated reflecting methane production at depth below the zone of sulfate reduction at these substations (Table 5.51-3). This is consistent with the change in their classifications from (SR) to (MPSR).

Table 5.51-1. Salinity of sites. Salinity in parts per thousand calculated from chloride concentrations in porewaters. A --- indicates no data.

Station	Substation	Depth (cm)	Salinity	
			Summer 2002	Winter 2003
Town Creek	1	1	1.63	0.45
P3	1	6	4.93	0.76
	1	11	6.63	1.39
	1	16	7.40	2.66

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2002	Winter 2003
	1	21	7.28	4.41
	1	26	7.10	6.07
	2	1	1.46	4.67
	2	6	4.65	7.77
	2	11	5.94	12.77
	2	16	6.39	14.91
	2	21	6.52	16.44
	2	26	6.66	17.63
	3	1	1.09	1.67
	3	6	1.00	1.97
	3	11	3.21	3.83
	3	16	6.35	8.91
	3	21	8.32	13.11
	3	26	8.33	17.20
	4	1	1.56	2.80
	4	6	2.66	3.34
	4	11	3.12	5.13
	4	16	3.26	6.56
	4	21	2.91	7.89
	4	26	3.11	9.10
	5	1	1.93	3.83
	5	6	3.63	3.82
	5	11	4.76	4.82
	5	16	5.22	5.69
	5	21	5.00	6.61
	5	26	6.05	7.14
	6	1	2.76	4.24
	6	6	4.27	5.72
	6	11	5.75	7.98
	6	16	6.72	9.90
	6	21	6.29	13.00
	6	26	7.61	15.79
Eagle Island	1	1	ns	0.69
P6	1	6	12.47	0.36
	1	11	11.79	0.24
	1	16	10.19	0.19
	1	21	8.23	0.21
	1	26	7.68	0.30
	2	1	10.16	0.45
	2	6	9.32	0.61
	2	11	8.00	0.87
	2	16	7.30	1.11
	2	21	6.69	1.51
	2	26	5.99	2.25
	3	1	8.58	2.23
	3	6	8.31	3.11
	3	11	7.74	3.30
	3	16	7.37	4.45

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2002	Winter 2003
	3	21	6.16	3.95
	3	26	4.54	4.64
	4	1	6.53	1.89
	4	6	6.19	1.68
	4	11	5.32	1.69
	4	16	5.14	1.77
	4	21	4.47	2.04
	4	26	4.15	2.47
	5	1	4.56	1.95
	5	6	4.25	2.12
	5	11	4.01	2.30
	5	16	3.03	2.28
	5	21	2.83	2.46
	5	26	2.62	2.61
	6	1	7.74	2.99
	6	6	6.86	3.31
	6	11	6.06	3.55
	6	16	5.33	3.04
	6	21	4.80	3.03
	6	26	4.39	2.95
Indian Creek	1	1	1.85	0.05
P7	1	6	2.55	0.13
	1	11	2.79	0.27
	1	16	2.90	0.57
	1	21	2.70	0.96
	1	26	2.50	1.33
	2	1	3.19	0.54
	2	6	3.15	0.58
	2	11	2.83	0.61
	2	16	2.38	0.57
	2	21	1.83	0.55
	2	26	1.43	0.54
	3	1	2.20	0.31
	3	6	2.15	0.33
	3	11	2.08	0.23
	3	16	1.97	0.25
	3	21	1.90	0.29
	3	26	1.90	0.36
	4	1	1.93	0.26
	4	6	1.96	0.27
	4	11	1.98	0.30
	4	16	1.95	0.37
	4	21	1.98	0.40
	4	26	1.96	0.41
	5	1	0.60	ns
	5	6	0.68	0.11
	5	11	0.68	0.10
	5	16	0.78	0.09

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity Summer 2002	Salinity Winter 2003
	5	21	0.93	0.09
	5	26	1.00	0.08
	6	1	0.06	0.03
	6	6	0.04	0.03
	6	11	0.04	0.03
	6	16	0.05	0.04
	6	21	0.05	0.03
	6	26	0.04	0.04
Dollisons Landing P8	1	1	0.19	0.03
	1	6	0.17	0.03
	1	11	0.13	0.03
	1	16	0.17	0.03
	1	21	0.17	0.04
	1	26	0.15	0.04
	2	1	0.08	0.03
	2	6	0.06	0.02
	2	11	0.05	0.02
	2	16	0.04	0.02
	2	21	0.04	0.02
	2	26	0.04	0.02
	3	1	0.06	0.02
	3	6	0.06	0.02
	3	11	0.06	0.03
	3	16	0.05	0.03
	3	21	0.06	0.03
	3	26	0.06	0.04
	4	1	0.08	0.01
	4	6	0.08	0.02
	4	11	0.08	0.02
	4	16	ns	0.03
	4	21	0.07	0.03
	4	26	0.07	0.03
	5	1	0.09	0.01
	5	6	0.09	0.03
	5	11	0.08	0.02
	5	16	0.07	0.02
	5	21	0.07	0.03
	5	26	0.08	0.03
	6	1	0.06	0.01
	6	6	0.08	0.02
	6	11	0.09	0.01
	6	16	0.11	0.03
	6	21	0.11	0.05
	6	26	0.11	0.04
Black River P9	1	1	0.06	0.01
	1	6	0.06	0.02
	1	11	0.04	0.03
	1	16	0.03	0.03

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2002	Winter 2003
	1	21	0.03	0.03
	1	26	0.04	0.04
	2	1	0.05	0.05
	2	6	0.06	0.04
	2	11	0.04	0.04
	2	16	0.03	0.04
	2	21	0.03	0.05
	2	26	0.07	0.05
	3	1	0.05	0.03
	3	6	0.06	0.03
	3	11	0.05	0.03
	3	16	0.03	0.03
	3	21	0.03	0.03
	3	26	0.04	0.03
	4	1	0.06	0.03
	4	6	0.06	0.03
	4	11	0.05	0.03
	4	16	0.04	0.03
	4	21	0.03	0.03
	4	26	0.04	0.03
	5	1	0.07	0.02
	5	6	0.07	0.03
	5	11	0.06	0.03
	5	16	0.05	0.03
	5	21	0.03	0.03
	5	26	0.03	0.03
	6	1	0.07	0.02
	6	6	0.07	0.03
	6	11	0.07	0.02
	6	16	0.06	0.02
	6	21	0.06	0.02
	6	26	0.05	0.02
Smith Creek	1	1	13.25	3.82
P11	1	6	13.22	4.02
	1	11	12.38	4.32
	1	16	11.10	4.29
	1	21	9.89	4.32
	1	26	8.37	4.14
	2	1	13.63	3.82
	2	6	13.48	3.94
	2	11	13.17	3.60
	2	16	12.51	3.63
	2	21	11.94	4.82
	2	26	11.39	5.13
	3	1	13.40	3.89
	3	6	12.90	4.42
	3	11	12.60	4.39
	3	16	11.73	4.42

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2002	Winter 2003
	3	21	11.27	4.75
	3	26	10.80	5.35
	4	1	12.47	ns
	4	6	12.13	3.19
	4	11	11.08	3.71
	4	16	10.58	5.14
	4	21	9.75	5.82
	4	26	8.89	6.15
	5	1	10.26	2.94
	5	6	8.87	4.73
	5	11	8.10	5.82
	5	16	7.67	6.21
	5	21	7.23	6.69
	5	26	6.65	7.33
	6	1	8.99	2.28
	6	6	8.73	3.07
	6	11	10.13	3.18
	6	16	10.48	3.21
	6	21	11.23	4.30
	6	26	11.24	4.76
Rat Island	1	1	7.49	2.29
P12	1	6	6.61	2.25
	1	11	6.42	1.78
	1	16	5.89	1.48
	1	21	5.62	1.37
	1	26	5.56	1.25
	2	1	10.25	1.78
	2	6	8.91	2.01
	2	11	7.82	2.20
	2	16	6.82	2.18
	2	21	4.97	2.30
	2	26	5.70	2.48
	3	1	6.18	4.11
	3	6	5.94	4.31
	3	11	5.73	4.44
	3	16	5.18	4.36
	3	21	4.64	4.27
	3	26	4.38	4.42
	4	1	7.20	2.96
	4	6	6.03	3.05
	4	11	5.26	3.10
	4	16	4.57	3.23
	4	21	3.84	3.28
	4	26	3.13	3.36
	5	1	4.80	3.37
	5	6	8.20	4.07
	5	11	4.23	4.12
	5	16	3.94	4.16

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity Summer 2002	Salinity Winter 2003
	5	21	3.61	4.51
	5	26	3.39	4.15
	6	1	1.61	2.37
	6	6	1.67	2.62
	6	11	1.65	3.01
	6	16	1.94	2.94
	6	21	2.09	2.64
	6	26	2.20	2.72
Fishing Creek	1	1	7.21	0.02
P13	1	6	7.15	0.03
	1	11	6.46	0.04
	1	16	5.97	0.08
	1	21	5.57	0.18
	1	26	5.15	0.32
	2	1	4.37	ns
	2	6	4.17	0.11
	2	11	3.91	0.12
	2	16	3.87	0.15
	2	21	3.65	0.19
	2	26	3.17	0.26
	3	1	2.39	0.50
	3	6	2.64	0.63
	3	11	2.36	0.70
	3	16	2.30	0.78
	3	21	2.26	0.85
	3	26	2.07	1.04
	4	1	3.28	0.38
	4	6	2.83	0.50
	4	11	2.70	0.51
	4	16	2.62	0.49
	4	21	2.63	0.51
	4	26	ns	0.52
	5	1	3.47	0.07
	5	6	3.50	0.11
	5	11	3.47	0.14
	5	16	3.40	0.16
	5	21	3.46	0.16
	5	26	3.22	0.21
	6	1	0.25	0.02
	6	6	0.05	0.02
	6	11	0.04	0.02
	6	16	0.05	0.02
	6	21	0.06	0.02
	6	26	0.04	0.02
Prince George	1	1	0.97	ns
P14	1	6	1.02	0.05
	1	11	1.01	0.05
	1	16	1.01	0.05

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2002	Winter 2003
	1	21	0.90	0.05
	1	26	0.87	0.05
	2	1	0.94	0.06
	2	6	0.79	0.07
	2	11	0.78	0.08
	2	16	0.71	0.09
	2	21	0.70	0.11
	2	26	0.63	0.11
	3	1	1.13	ns
	3	6	1.04	0.04
	3	11	1.02	0.06
	3	16	1.02	0.06
	3	21	1.03	0.08
	3	26	0.98	0.14
	4	1	1.05	0.20
	4	6	0.98	0.15
	4	11	0.94	0.17
	4	16	0.85	0.18
	4	21	0.72	0.19
	4	26	0.51	0.26
	5	1	0.99	0.08
	5	6	1.12	0.09
	5	11	1.07	0.09
	5	16	1.06	0.09
	5	21	0.93	0.08
	5	26	0.80	0.08
	6	1	0.19	0.06
	6	6	0.71	0.08
	6	11	0.43	0.08
	6	16	0.43	0.10
	6	21	0.30	0.10
	6	26	0.26	0.10

Table 5.51-2. Classification of Sites. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
Town Creek	1	1	II	II	II
P3	1	6	II	II	II
	1	11	II	II	II
	1	16	II	II	II
	1	21	II	II	II
	1	26	I*	II	II
	2	1	II	II	II
	2	6	II	II	II
	2	11	II	II	I*
	2	16	II	II	I*
	2	21	II	II	I*
	2	26	II	II	I*
	3	1	II	II	II
	3	6	II	II	II
	3	11	II	II	II
	3	16	II	II	II
	3	21	II	II	II
	3	26	II	II	II
	4	1	II	II	II
	4	6	II	II	II
	4	11	II	II	II
	4	16	II	II	II
	4	21	II	II	II
	4	26	II	II	II
	5	1	II	II	I*
	5	6	II	II	II
	5	11	II	II	II
	5	16	II	II	II
	5	21	II	II	II
	5	26	II	II	II
	6	1	II	II	II
	6	6	II	II	II
	6	11	II	II	II
	6	16	II	II	II
	6	21	II	II	II
	6	26	I*	II	II
Eagle Island	1	1	II	II	II
P6	1	6	II	II	II
	1	11	II	II	II
	1	16	II	II	II
	1	21	II	II	II
	1	26	II	II	I*
	2	1	II	II	II
	2	6	II	II	II

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
	2	11	II	II	II
	2	16	II	I*	II
	2	21	II	I*	II
	2	26	II	I*	I*
	3	1	I*	II	II
	3	6	I*	I*	II
	3	11	I*	I*	II
	3	16	I*	I*	II
	3	21	I*	I*	II
	3	26	I*	I*	II
	4	1	II	II	I*
	4	6	II	I*	I*
	4	11	II	I*	I*
	4	16	II	I*	I*
	4	21	II	I*	I*
	4	26	I*	I*	I*
	5	1	II	I*	II
	5	6	I*	I*	II
	5	11	II	I*	I*
	5	16	I*	I*	I*
	5	21	I*	I*	I*
	5	26	I*	I*	I*
	6	1	II	I*	II
	6	6	I*	I*	II
	6	11	---	I*	II
	6	16	II	I*	II
	6	21	I*	I*	II
	6	26	I*	I*	I*
Indian Creek	1	1	II	II	II
P7	1	6	II	II	II
	1	11	II	II	II
	1	16	II	II	II
	1	21	II	II	II
	1	26	I	I*	II
	2	1	I	II	II
	2	6	I	I	II
	2	11	I	I	II
	2	16	I	I*	II
	2	21	I	I*	II
	2	26	I	I	II
	3	1	II	II	I*
	3	6	II	I	I*
	3	11	I	I*	I*
	3	16	I	I	I*
	3	21	II	I	I*
	3	26	I	II	I*
	4	1	I	I	II
	4	6	II	I	II
	4	11	II	I	II

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
	4	16	I	I	II
	4	21	I	I	II
	4	26	I	I	II
	5	1	II	I	I*
	5	6	I	I	I*
	5	11	II	I	I*
	5	16	II	---	I*
	5	21	I	I*	I*
	5	26	I	I	I*
	6	1	II	---	I
	6	6	I	---	I
	6	11	I	I	I
	6	16	I	I	I
	6	21	I	---	I
	6	26	II	I	I
Dollisons	1	1	I		II
Landing P8	1	6	II*	II	II
	1	11	II*	II	I
	1	16	II*	II	I
	1	21	II	I	II
	1	26	II	I	I
	2	1	II*	II	I
	2	6	II	I	I*
	2	11	I	II	I*
	2	16	I	I*	I*
	2	21	I	II	I*
	2	26	I	I	I*
	3	1	II	I	I
	3	6	I		I*
	3	11	I	I	I*
	3	16	I	I	I*
	3	21	I	I	I*
	3	26	I	II	I*
	4	1	I	I	II*
	4	6	I	I	I
	4	11	I	II	I*
	4	16	I	I	Ns
	4	21	I	II	I*
	4	26	I	II	I*
	5	1	I	I	I
	5	6	I	I	I
	5	11	I	I	I*
	5	16	I	I*	I*
	5	21	I	II	I*
	5	26	I	II	I*
	6	1	I	I	I
	6	6	I	I*	I
	6	11	I	I*	I*
	6	16	I	I*	I*

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
	6	21	I	I	I*
	6	26	I	I	I*
Black River P9	1	1	I	---	I*
	1	6	---	---	I*
	1	11	I	---	I
	1	16	I	---	II*
	1	21	II	---	I*
	1	26	I	II	I*
	2	1	I	I*	I*
	2	6	I	I*	I*
	2	11	I	I	I*
	2	16	I	I	II*
	2	21	I	I	I
	2	26	I	I*	I*
	3	1	I	II	I*
	3	6	I	II*	I*
	3	11	I	I	I
	3	16	I	I	II*
	3	21	I	I	I
	3	26	I	I	I
	4	1	I	II	I*
	4	6	II	II*	I
	4	11	I	II	II*
	4	16	I	I	II*
	4	21	I	I	II*
	4	26	I	I	II*
	5	1	II*	II*	I
	5	6	II	II	I
	5	11	I	II	II*
	5	16	I	I	II*
	5	21	II	I	II*
	5	26	II	I	I
	6	1	II*	---	I
	6	6	II*	II	II*
	6	11	II*	I	II*
	6	16	I	I*	II*
	6	21	I	I	I
	6	26	I	I	I
Smith Creek P11	1	1	II	II	II
	1	6	II	I*	II
	1	11	---	II	II
	1	16	II	II	II
	1	21	---	II	II
	1	26	---	II	II
	2	1	II	II	II
	2	6	---	I*	II
	2	11	II	II	II
	2	16	II	II	II
	2	21	II	II	II

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
	2	26	II	II	II
	3	1	II	II	II
	3	6	II	II	II
	3	11	II	II	II
	3	16	II	II	II
	3	21	II	II	II
	3	26	II	II	II
	4	1	II	II	II
	4	6	II	II	II
	4	11	II	II	II
	4	16	II	II	II
	4	21	II	II	II
	4	26	II	II	II
	5	1	II	I*	II
	5	6	II	II	II
	5	11	II	II	II
	5	16	II	II	II
	5	21	II	II	II
	5	26	II	II	II
	6	1	II	II	II
	6	6	II	I*	II
	6	11	II	I*	II
	6	16	II	I*	II
	6	21	II	---	II
	6	26	II	II	II
Rat Island	1	1	II	II	II
P12	1	6	II	II	II
	1	11	II	II	II
	1	16	II	II	II
	1	21	II	II	II
	1	26	I	II	II
	2	1	II	I*	II
	2	6	II	I*	II
	2	11	II	I*	II
	2	16	II	II	II
	2	21	II	II	I*
	2	26	I*	---	II
	3	1	II	II	II
	3	6	II	I	II
	3	11	II	I	II
	3	16	II	I	II
	3	21	II	I*	II
	3	26	II	I*	II
	4	1	II	I*	II
	4	6	I*	II	II
	4	11	I*	I*	II
	4	16	II	I*	II
	4	21	II	I*	I*
	4	26	I*	I*	I*

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
	5	1	II	I	II
	5	6	II	I	II
	5	11	I	I*	II
	5	16	II	I*	II
	5	21	II	I*	II
	5	26	I*	I*	II
	6	1	I	---	II
	6	6	I	I	II
	6	11	I	I	II
	6	16	I	I*	II
	6	21	I	I	II
	6	26	I	I	II
Fishing Creek	1	1	II	---	II
P13	1	6	II	---	II
	1	11	II	I*	II
	1	16	II	II	II
	1	21	II	I*	II
	1	26	I*	II	II
	2	1	II	I	II
	2	6	II	I	II
	2	11	II	I	II
	2	16	II	II	II
	2	21	II	II	II
	2	26	I*	II	II
	3	1	II	II	II
	3	6	I	I*	II
	3	11	II	I*	II
	3	16	II	I*	II
	3	21	II	II	II
	3	26	I	I*	II
	4	1	I	I	II
	4	6	I	II	II
	4	11	I	I	II
	4	16	I	I	II
	4	21	I	I	II
	4	26	I	I	NS
	5	1	II	I	II
	5	6	II	I	II
	5	11	II	I	II
	5	16	II	I	II
	5	21	II	II	II
	5	26	II	I	II
	6	1	I	II	II
	6	6	II*	I	I
	6	11	I	I	I
	6	16	II	II	I
	6	21	I	I*	I
	6	26	I	I	I
Prince George	1	1	I	I	II

Table 5.51-2. continued

Station	Substation	Depth (cm)	Summer 2000	Summer 2001	Summer 2002
P14	1	6	I	I	II
	1	11	I	I*	II
	1	16	I	I	II
	1	21	I	I	I*
	1	26	I	I*	I*
	2	1	I	I	II
	2	6	I	I	II
	2	11	I	I	II
	2	16	I	I	I*
	2	21	I	I*	I*
	2	26	I	I*	I*
	3	1	I	I	II
	3	6	I	II*	II
	3	11	I	I	II
	3	16	I	I*	II
	3	21	I	I	I*
	3	26	I	I	I*
	4	1	I	I	II
	4	6	I	I	II
	4	11	I*	I	II
	4	16	I	I	II
	4	21	I	I	I*
	4	26	I	I	I*
	5	1	I	II	II
	5	6	II	II	II
	5	11	I	I	II
	5	16	I	I	II
	5	21	I	I	II
	5	26	I	I*	I*
	6	1	I	I	I
	6	6	I	I	II
	6	11	I	I	I*
	6	16	I	I	I*
	6	21	I	I	I*
	6	26	I	II	I*

Table 5.51-3. Classification of Sites. Site classifications are as follows: Methanogenic I, Sulfate Reducing II, Methanogenic with evidence of past sulfate reduction I*, Sulfate reducing non-seawater source of sulfate II*.

Station	Substation	Depth (cm)	Classification			
			Winter 2000	Winter 2001	Winter 2002	Winter 2003
Town Creek P3	1	1	---	II	II	II
	1	6	---	II	II	II
	1	11	---	II	II	II
	1	16	---	I*	II	II
	1	21	---	I*	II	I*
	1	26	I*	I*	II	I*
	2	1	II	II	II	II
	2	6	II	II	II	I*
	2	11	I*	II	II	I*
	2	16	I	II	II	I*
	2	21	I*	II	II	I*
	2	26	I*	II	II	II
	3	1	II	I	II	II
	3	6	I	II	II	II
	3	11	I	II	II	II
	3	16	I*	I*	II	II
	3	21	I*	II	II	II
	3	26	I*	II	II	II
	4	1	I	II	II	II
	4	6	I*	I*	II	II
	4	11	II	I*	II	II
	4	16	II	I*	II	II
	4	21	II	II	II	II
	4	26	II	II	II	II
	5	1	---	II	II	II
	5	6	I	II	II	II
	5	11	I	II	II	II
	5	16	II	II	II	II
	5	21	---	II	II	II
	5	26	II	II	II	II
	6	1	II	II	II	II
	6	6	II	II	II	II
	6	11	II	II	II	II
	6	16	II	II	II	II
	6	21	II	II	II	II
	6	26	II	II	II	II
Eagle Island P6	1	1	---	II	II	II
	1	6	---	II	II	II
	1	11	---	II	II	II
	1	16	I	II	II	I
	1	21	I	II	II	I
	1	26	I*	II	II	I*
	2	1	I	II	II	II

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Classification Winter 2000	Winter 2001	Winter 2002	Winter 2003
	2	6	I	II	II	II
	2	11	---	II	II	II
	2	16	---	II	II	II
	2	21	I	II	II	II
	2	26	I	II	II	II
	3	1	I	II	II	II
	3	6	---	II	II	II
	3	11	I*	II	II	II
	3	16	I*	I*	II	II
	3	21	I*	II	II	I*
	3	26	II	II	II	I*
	4	1	I	II	II	II
	4	6	I*	II	II	I*
	4	11	I*	II	II	I*
	4	16	II	I*	II	I*
	4	21	I*	II*	II	I*
	4	26	I*	II	II	I*
	5	1	I	II	II	II
	5	6	I*	II	I*	I*
	5	11	I	II	I*	I*
	5	16	I*	II	I*	I*
	5	21	I*	II	II	I*
	5	26	I*	II	I*	I*
	6	1	I	I*	I*	II
	6	6	I*	I*	I*	I*
	6	11	I	I*	I*	I*
	6	16	I	I*	I*	I*
	6	21	I	I*	I*	I*
	6	26	I	I*	I*	I*
Indian Creek	1	1	I	I	I	I
P7	1	6	I	I	I	II*
	1	11	I	I	I	II
	1	16	---	I	I	II
	1	21	I	I	I	II
	1	26	I	I	I	II
	2	1	I	I	I*	I*
	2	6	I	I	I*	I*
	2	11	I	I	I*	I*
	2	16	I	I	I*	I*
	2	21	I*	I	I*	I*
	2	26	I*	I	I*	I*
	3	1	I	I	I	I*
	3	6	I*	I	I	I*
	3	11	I*	I	I*	I*
	3	16	I	I	I*	I*
	3	21	I*	I	I*	I*
	3	26	I	I	I*	I*
	4	1	I	I	I	I

Table 5.51-3. (continued)

			Classification			
Station	**Substation**	**Depth (cm)**	**Winter 2000**	**Winter 2001**	**Winter 2002**	**Winter 2003**
	4	6	I	I	I	I*
	4	11	I	I	I	I*
	4	16	I*	I	I	I*
	4	21	I*	I	I	I*
	4	26	I	I	I	I*
	5	1	I	I	I	NS
	5	6	I	I	I	I
	5	11	I	I	I	I
	5	16	I*	I	I	I
	5	21	I	I	I	I
	5	26	I*	I	I	I
	6	1	I	I	I	I
	6	6	I	I	I	I
	6	11	I	I	I	I
	6	16	I	I	I	I
	6	21	I	I	I	I
	6	26	II*	I	I	I
Dollisons	1	1	---	II*	I	I
Landing P8	1	6	I	II*	II*	I
	1	11	II	II*	II*	I
	1	16	I	II*	II*	I
	1	21	I*	II	II*	I
	1	26	II*	II*	I	I
	2	1	---	I	I	I
	2	6	---	I	I	I
	2	11	II	I	I	I
	2	16	II	I	I	I
	2	21	I	I	I	I*
	2	26	I	I	I	I
	3	1	II	I	I	I
	3	6	I	I	I	I
	3	11	II*	II*	I	I
	3	16	I	II*	I	I
	3	21	II	I	I	I
	3	26	I	I	I	I
	4	1	II	I	I	I
	4	6	I	I	I	I
	4	11	I*	I	I	I
	4	16	---	I	I	I
	4	21	---	I	I	I
	4	26	I	I	I	I*
	5	1	I	I	I	I
	5	6	II	I	I	I
	5	11	---	I	I	I
	5	16	II	I	I	I
	5	21	I	II*	I	I
	5	26	II	I	I	I
	6	1	I*	I	I	I

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Classification			
			Winter 2000	Winter 2001	Winter 2002	Winter 2003
	6	6	I	I	I	I
	6	11	II*	I	I*	I
	6	16	II	I	I	I*
	6	21	---	I	I	I
	6	26	I	I	I	I
Black River P9	1	1	---	I	I	I*
	1	6	I	I	I	I
	1	11	I	I	I	I
	1	16	I	I	I	I
	1	21	I	II	I	I
	1	26	I*	II	I	I
	2	1	I	II*	I	I
	2	6	I	II*	I	I
	2	11	I	I	I	I
	2	16	I*	I	I	I
	2	21	I	II	I	I
	2	26	I	I	I	I*
	3	1	I	II*	I	I
	3	6	I	II*	I	I
	3	11	I	II*	I	I
	3	16	I	I	I	I
	3	21	I	II	I	I
	3	26	I	II*	I	I
	4	1	I	II*	I	I
	4	6	I*	I	I	I
	4	11	I*	II*	I	I
	4	16	I*	II*	I	I
	4	21	I*	II*	I	I
	4	26	I*	II*	I	I
	5	1	I*	II*	I	I
	5	6	I	II*	I	I
	5	11	I	II*	I	I*
	5	16	I*	II*	I	I*
	5	21	I*	II*	I*	I
	5	26	I*	II*	I	I*
	6	1	I	I	I	I
	6	6	I	I	I	I
	6	11	I*	I	I	I
	6	16	I*	I	I	I
	6	21	I	II*	I	I
	6	26	I	II*	I	I
Smith Creek P11	1	1	I	II	II	II
	1	6	I*	I*	II	II
	1	11	---	II	II	II
	1	16	I*	II	II	II
	1	21	I*	II	II	II
	1	26	---	II	II	II

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Classification Winter 2000	Winter 2001	Winter 2002	Winter 2003
	2	1	II	II	---	II
	2	6	I*	II	II	II
	2	11	I*	II	II	II
	2	16	I*	II	II	II
	2	21	I*	II	II	II
	2	26	---	II	II	II
	3	1	---	II	II	II
	3	6	I*	II	II	II
	3	11	I*	II	II	II
	3	16	I*	II	II	II
	3	21	I*	II	II	II
	3	26	I*	II	II	II
	4	1	I	II	II	II
	4	6	II	I	II	II
	4	11	II	II	II	II
	4	16	II	II	II	II
	4	21	II	II	II	II
	4	26	II	II	II	II
	5	1	II	II	II	II
	5	6	II	II	II	II
	5	11	I*	II	II	II
	5	16	I*	II	II	II
	5	21	I*	II	II	II
	5	26	---	II	II	II
	6	1	---	II	II	II
	6	6	---	II	II	II
	6	11	---	II	II	II
	6	16	---	II	II	II
	6	21	---	II	II	II
	6	26	---	II	II	II
Rat Island	1	1	---	II	II	II
P12	1	6	---	II	II	II
	1	11	I*	II	II	II
	1	16	I*	II	II	II
	1	21	I*	II	II	II
	1	26	I*	II	II	II
	2	1	I*	II	II	II
	2	6	I*	I	II	II
	2	11	I*	II	II	II
	2	16	I*	II	II	II
	2	21	I*	II	II	II
	2	26	I*	II	II	II
	3	1	II	II	II	II
	3	6	I	II	II	II
	3	11	I*	II	II	II
	3	16	I	II	II	II
	3	21	I	II	II	II
	3	26	I	II	II	II

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Classification: Winter 2000	Winter 2001	Winter 2002	Winter 2003
	4	1	I*	II	II	II
	4	6	I*	I*	II	II
	4	11	I*	I*	II	II
	4	16	I*	I*	II	I*
	4	21	I*	I*	II	I*
	4	26	I*	I*	II	II
	5	1	I	II	II	II
	5	6	I	I*	I	II
	5	11	I	I*	II	II
	5	16	I	I*	II	II
	5	21	I	I*	I*	II
	5	26	I	I*	I*	II
	6	1	I	I	---	II
	6	6	I	I	---	II
	6	11	I	I	II	II
	6	16	I	II	II	II
	6	21	I	I	II	II
	6	26	I	I	II	II
Fishing Creek P13	1	1	II	II	I	I
	1	6	II	II	I	I
	1	11	I	II	II	II*
	1	16	I	II	II	II*
	1	21	I	II	II	II*
	1	26	I	II	II	II*
	2	1	---	II	I	II*
	2	6	I	II	II	I
	2	11	I	II	II	I
	2	16	I	I	II	I
	2	21	I*	I	II	I
	2	26	I*	I	II	I*
	3	1	I	I	II	I*
	3	6	I	I	II	II
	3	11	I*	I	II	I*
	3	16	I	I	II	I*
	3	21	I*	I	II	I*
	3	26	I	II	II	I*
	4	1	II*	II	II	I
	4	6	I	II	II	II
	4	11	I	II	II	II
	4	16	I	II	II	II
	4	21	I	I	II	II
	4	26	I	I	II	II
	5	1	I	I	---	I
	5	6	I	I	II	I
	5	11	I	I	II	I
	5	16	I	I	II	I
	5	21	I	I	I*	I*
	5	26	I	I	---	I*

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Classification Winter 2000	Winter 2001	Winter 2002	Winter 2003
	6	1	II	I	I	I
	6	6	I*	I	I*	I
	6	11	II	I	I	I
	6	16	---	I	I	I
	6	21	II	I	I	I
	6	26	I	I	I	I
Prince George P14	1	1	I	II*	II*	NS
	1	6	I	I	II*	II*
	1	11	I	I	II	II*
	1	16	I	I	II	II*
	1	21	I	I	II	II*
	1	26	I	I	II*	II*
	2	1	I	I	II*	I
	2	6	I	I	II*	I
	2	11	I	I	II*	I
	2	16	I	II	II*	I
	2	21	I	I*	II*	I
	2	26	I*	I	II	I
	3	1	II	I	II*	NS
	3	6	II	I	II*	II*
	3	11	I	I	II	I
	3	16	I	I	II*	I
	3	21	I	I	II	I
	3	26	I	I	II	I
	4	1	I	I	II*	I
	4	6	I	II*	II*	I
	4	11	I	I	II	I*
	4	16	I	I	II*	I*
	4	21	I	I	II	I*
	4	26	I	I	II	I*
	5	1	I	I	II	II*
	5	6	I	I	II*	I
	5	11	I	I	II	I
	5	16	I	II	II	I
	5	21	I	I	II	I
	5	26	I	I	II	I
	6	1	II*	II	II*	II*
	6	6	I	I	II	II*
	6	11	I	I	II	II*
	6	16	I	I	II	II*
	6	21	I	I	I	II*
	6	26	I	I	I	I

Table 5.51-4. Methane concentrations of sites. Porewater methane concentrations are µM.

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
Town Creek P3	1	1	8	3
	1	6	11	3
	1	11	13	6
	1	16	10	14
	1	21	14	17
	1	26	101	33
	2	1	58	239
	2	6	159	346
	2	11	199	322
	2	16	223	261
	2	21	218	307
	2	26	183	241
	3	1	12	34
	3	6	104	86
	3	11	106	85
	3	16	66	137
	3	21	48	162
	3	26	48	191
	4	1	170	NS
	4	6	153	176
	4	11	341	393
	4	16	347	484
	4	21	320	473
	4	26	327	400
	5	1	206	155
	5	6	233	197
	5	11	175	239
	5	16	168	326
	5	21	157	409
	5	26	94	391
	6	1	99	177
	6	6	265	427
	6	11	194	554
	6	16	254	610
	6	21	257	535
	6	26	239	509
Eagle Island P6	1	1	NS	3
	1	6	NS	8
	1	11	137	32
	1	16	153	78
	1	21	331	110
	1	26	330	109
	2	1	33	6
	2	6	55	13
	2	11	94	21

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
	2	16	166	33
	2	21	207	54
	2	26	209	93
	3	1	1	4
	3	6	10	3
	3	11	20	16
	3	16	20	27
	3	21	34	48
	3	26	113	178
	4	1	212	5
	4	6	211	48
	4	11	241	123
	4	16	222	235
	4	21	345	309
	4	26	189	370
	5	1	95	10
	5	6	175	40
	5	11	148	65
	5	16	243	116
	5	21	218	151
	5	26	403	NS
	6	1	12	50
	6	6	68	160
	6	11	127	220
	6	16	147	211
	6	21	143	200
	6	26	243	163
Indian Creek	1	1	1	1
P7	1	6	1	1
	1	11	1	1
	1	16	9	1
	1	21	19	4
	1	26	46	4
	2	1	4	6
	2	6	29	10
	2	11	30	24
	2	16	49	53
	2	21	53	97
	2	26	50	196
	3	1	125	12
	3	6	89	39
	3	11	104	42
	3	16	117	75
	3	21	118	90
	3	26	143	113
	4	1	12	6
	4	6	13	8

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
	4	11	15	9
	4	16	15	17
	4	21	17	20
	4	26	15	25
	5	1	39	NS
	5	6	85	4
	5	11	61	6
	5	16	83	15
	5	21	77	23
	5	26	85	25
	6	1	1	3
	6	6	52	14
	6	11	68	14
	6	16	79	18
	6	21	63	15
	6	26	79	19
Dollisons Landing P8	1	1	3	NS
	1	6	7	2
	1	11	17	2
	1	16	33	1
	1	21	10	6
	1	26	32	NS
	2	1	138	30
	2	6	230	119
	2	11	137	152
	2	16	129	187
	2	21	125	198
	2	26	139	209
	3	1	96	8
	3	6	188	25
	3	11	170	12
	3	16	233	25
	3	21	216	25
	3	26	243	34
	4	1	1	22
	4	6	107	54
	4	11	222	125
	4	16	NS	135
	4	21	304	129
	4	26	228	NS
	5	1	24	45
	5	6	71	59
	5	11	139	90
	5	16	140	159
	5	21	182	160
	5	26	148	181
	6	1	2	3

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
	6	6	69	10
	6	11	67	43
	6	16	83	69
	6	21	105	63
	6	26	108	140
Black River P9	1	1	80	3
	1	6	265	2
	1	11	326	2
	1	16	278	6
	1	21	298	144
	1	26	253	228
	2	1	3	6
	2	6	41	19
	2	11	101	25
	2	16	99	18
	2	21	113	29
	2	26	107	25
	3	1	4	4
	3	6	24	66
	3	11	101	102
	3	16	211	71
	3	21	286	73
	3	26	316	51
	4	1	3	3
	4	6	10	61
	4	11	5	130
	4	16	11	210
	4	21	19	240
	4	26	45	206
	5	1	NS	5
	5	6	29	39
	5	11	74	106
	5	16	124	102
	5	21	157	89
	5	26	259	93
	6	1	1	3
	6	6	5	70
	6	11	8	91
	6	16	14	213
	6	21	22	190
	6	26	51	226
Smith Creek P11	1	1	5	4
	1	6	55	43
	1	11	76	50
	1	16	136	57
	1	21	165	97
	1	26	134	191

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
	2	1	9	2
	2	6	18	19
	2	11	47	93
	2	16	52	98
	2	21	81	180
	2	26	116	195
	3	1	28	37
	3	6	80	74
	3	11	147	142
	3	16	126	139
	3	21	185	198
	3	26	145	225
	4	1	53	NS
	4	6	196	121
	4	11	255	299
	4	16	259	362
	4	21	383	462
	4	26	370	487
	5	1	2	3
	5	6	44	19
	5	11	132	81
	5	16	124	163
	5	21	108	128
	5	26	100	116
	6	1	1	2
	6	6	8	2
	6	11	35	10
	6	16	33	41
	6	21	32	61
	6	26	50	81
Rat Island	1	1	94	1
P12	1	6	96	2
	1	11	220	15
	1	16	40	11
	1	21	46	6
	1	26	40	6
	2	1	7	2
	2	6	32	2
	2	11	57	4
	2	16	95	9
	2	21	113	24
	2	26	120	26
	3	1	97	96
	3	6	115	118
	3	11	109	157
	3	16	118	134
	3	21	127	149

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
	3	26	130	151
	4	1	46	84
	4	6	169	213
	4	11	155	340
	4	16	177	440
	4	21	195	484
	4	26	200	463
	5	1	1	NS
	5	6	2	108
	5	11	37	152
	5	16	107	171
	5	21	143	180
	5	26	173	NS
	6	1	0	3
	6	6	0	1
	6	11	1	3
	6	16	6	2
	6	21	8	2
	6	26	7	1
Fishing Creek	1	1	0	2
P13	1	6	0	2
	1	11	1	2
	1	16	4	2
	1	21	8	3
	1	26	9	3
	2	1	2	NS
	2	6	19	4
	2	11	36	15
	2	16	39	33
	2	21	71	61
	2	26	138	97
	3	1	NS	3
	3	6	25	5
	3	11	34	15
	3	16	40	27
	3	21	59	51
	3	26	66	56
	4	1	1	7
	4	6	1	6
	4	11	12	4
	4	16	21	4
	4	21	28	4
	4	26	NS	5
	5	1	0	4
	5	6	0	5
	5	11	1	14
	5	16	2	28

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2002	Winter 2003
	5	21	3	45
	5	26	17	44
	6	1	0	4
	6	6	79	3
	6	11	120	3
	6	16	143	4
	6	21	128	4
	6	26	123	4
Prince George	1	1	7	NS
P14	1	6	113	2
	1	11	134	2
	1	16	145	2
	1	21	215	3
	1	26	257	2
	2	1	2	3
	2	6	32	11
	2	11	91	29
	2	16	119	56
	2	21	175	78
	2	26	180	70
	3	1	6	NS
	3	6	35	2
	3	11	38	4
	3	16	89	5
	3	21	131	17
	3	26	122	31
	4	1	1	67
	4	6	13	121
	4	11	103	171
	4	16	155	149
	4	21	180	120
	4	26	175	105
	5	1	0	5
	5	6	23	4
	5	11	95	9
	5	16	107	20
	5	21	154	29
	5	26	150	32
	6	1	0	19
	6	6	2	82
	6	11	68	NS
	6	16	216	184
	6	21	285	208
	6	26	240	192

Table 5.51-4. (continued)

5.52 Indian Creek (P7)

Porewaters of Indian Creek were essentially fresh during the previous 3 winters, with highest salinities never reaching above 0.2 ppt (Table 5.51-1). Winter porewater salinities increased substantially at this station in 2003. During the current winter (2003), salinities reached values as high as 1.3 ppt at the near shore substation 1 and averaged 0.4 $\pm$ .3 ppt at substations 1, 2, 3, and 4 combined. The upland substations 5 and 6 were still fresh and likely not influenced as much by tidal floodwaters. An increase in salinity was also observed in the current summer (2002). During the previous 2 summers, the majority of the subsites had values below 0.5 ppt. During the current summer (2002) most values at subsites not adjacent to uplands had salinities in the 2.0 ppt range clearly showing an increase in salinity. Classifications during the current winter (2003) and summer (2002) show evidence of the increased salinity at this station. Several subsites reached sulfate levels sufficient to sustain sulfate reduction (Table 5.52-1). Of the current summer (2002) classifications, 84% showed a change from the previous summer (2001) with most changes from (M) to (SR) or (MPSR) reflecting the shift toward higher salinities. 30% of the current winter (2003) subsites showed a shift towards higher salinity classifications (Table 5.51-2).

Table 5.52-1. Sulfate Concentrations of Sites. Porewater sulfate concentrations are µM. A --- indicates no data.

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
Town Creek	1	1	458	623
P3	1	6	713	716
	1	11	1188	765
	1	16	2015	529
	1	21	1835	298
	1	26	1712	176
	2	1	715	303
	2	6	1728	197
	2	11	209	212
	2	16	105	247
	2	21	88	229
	2	26	72	533
	3	1	515	788
	3	6	386	406
	3	11	355	381
	3	16	1947	851
	3	21	2597	1503
	3	26	2947	2828
	4	1	348	1599
	4	6	610	1217
	4	11	670	828
	4	16	503	614
	4	21	501	548
	4	26	675	635
	5	1	284	1285
	5	6	343	813
	5	11	478	622
	5	16	439	376
	5	21	503	369
	5	26	597	605
	6	1	1263	586
	6	6	788	440
	6	11	573	518
	6	16	834	618
	6	21	578	673
	6	26	1018	852
Eagle Island	1	1	NS	722
P6	1	6	10316	501
	1	11	9085	372

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
	1	16	5175	279
	1	21	745	123
	1	26	233	90
	2	1	7794	665
	2	6	5672	656
	2	11	2695	680
	2	16	861	649
	2	21	303	584
	2	26	162	483
	3	1	4774	489
	3	6	3985	558
	3	11	3547	465
	3	16	3122	491
	3	21	2107	290
	3	26	503	80
	4	1	266	357
	4	6	128	288
	4	11	49	175
	4	16	62	73
	4	21	54	29
	4	26	36	36
	5	1	484	341
	5	6	354	175
	5	11	290	162
	5	16	71	68
	5	21	45	114
	5	26	59	69
	6	1	4515	303
	6	6	3124	153
	6	11	1868	98
	6	16	865	149
	6	21	383	211
	6	26	138	213
Indian Creek	1	1	1502	248
P7	1	6	2007	779
	1	11	1839	704
	1	16	1946	498
	1	21	1252	415
	1	26	553	334
	2	1	1918	107
	2	6	1490	109
	2	11	1623	106
	2	16	1077	90
	2	21	495	56
	2	26	389	30
	3	1	61	97
	3	6	61	40
	3	11	45	31

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
	3	16	38	33
	3	21	26	18
	3	26	40	24
	4	1	917	161
	4	6	943	128
	4	11	990	112
	4	16	978	82
	4	21	1081	70
	4	26	1054	63
	5	1	122	NS
	5	6	40	137
	5	11	31	118
	5	16	31	98
	5	21	34	85
	5	26	42	73
	6	1	115	57
	6	6	62	40
	6	11	50	43
	6	16	42	47
	6	21	48	44
	6	26	37	32
Dollisons Landing P8	1	1	384	213
	1	6	313	219
	1	11	180	223
	1	16	290	219
	1	21	373	168
	1	26	95	63
	2	1	45	122
	2	6	20	51
	2	11	12	40
	2	16	8	13
	2	21	6	11
	2	26	5	13
	3	1	38	282
	3	6	18	126
	3	11	11	74
	3	16	8	58
	3	21	13	48
	3	26	5	41
	4	1	365	57
	4	6	158	145
	4	11	41	71
	4	16	NS	43
	4	21	22	21
	4	26	16	11
	5	1	186	83
	5	6	75	105
	5	11	34	55

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
	5	16	24	18
	5	21	18	65
	5	26	16	75
	6	1	99	50
	6	6	49	64
	6	11	22	29
	6	16	12	5
	6	21	9	76
	6	26	22	24
Black River	1	1	9	3
P9	1	6	15	126
	1	11	35	227
	1	16	400	238
	1	21	61	179
	1	26	10	256
	2	1	7	149
	2	6	15	87
	2	11	14	67
	2	16	717	49
	2	21	198	38
	2	26	20	21
	3	1	13	105
	3	6	16	110
	3	11	83	86
	3	16	1231	66
	3	21	234	51
	3	26	38	31
	4	1	6	45
	4	6	86	29
	4	11	401	24
	4	16	1682	18
	4	21	313	30
	4	26	409	27
	5	1	39	21
	5	6	296	17
	5	11	1102	12
	5	16	1629	12
	5	21	315	19
	5	26	64	3
	6	1	205	64
	6	6	325	50
	6	11	778	34
	6	16	701	22
	6	21	142	20
	6	26	70	18
Smith Creek	1	1	11956	3033
P11	1	6	9991	2866
	1	11	7923	3032

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
	1	16	5674	2956
	1	21	3612	2853
	1	26	1111	1708
	2	1	8509	3704
	2	6	6935	3393
	2	11	6267	2411
	2	16	4239	2149
	2	21	2740	1209
	2	26	3835	801
	3	1	12363	2710
	3	6	8920	2791
	3	11	7692	2270
	3	16	4879	1706
	3	21	3858	1472
	3	26	3270	1538
	4	1	6942	NS
	4	6	4895	1721
	4	11	3828	1117
	4	16	3014	827
	4	21	3168	727
	4	26	2537	1006
	5	1	6625	2972
	5	6	3432	4020
	5	11	2287	2691
	5	16	2230	1843
	5	21	2680	1964
	5	26	2553	2093
	6	1	5789	1696
	6	6	2685	3176
	6	11	1698	2648
	6	16	3469	745
	6	21	5296	1268
	6	26	5533	1102
Rat Island	1	1	2946	1769
P12	1	6	1163	2047
	1	11	1688	1741
	1	16	2002	1358
	1	21	2329	1103
	1	26	2139	985
	2	1	6176	1542
	2	6	2798	1711
	2	11	1703	1751
	2	16	1145	1510
	2	21	272	1350
	2	26	805	1222
	3	1	3815	1754
	3	6	2837	1725
	3	11	2375	1555

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
	3	16	2061	1264
	3	21	1716	1022
	3	26	1500	1008
	4	1	4328	1570
	4	6	1962	1075
	4	11	890	564
	4	16	405	265
	4	21	285	253
	4	26	116	300
	5	1	3253	1078
	5	6	5326	1247
	5	11	2191	1376
	5	16	1168	1439
	5	21	586	1604
	5	26	403	1921
	6	1	1318	1815
	6	6	1511	2083
	6	11	1233	2219
	6	16	1109	2077
	6	21	1109	1839
	6	26	1079	1766
Fishing Creek	1	1	5466	154
P13	1	6	5528	291
	1	11	4889	379
	1	16	4074	475
	1	21	3191	588
	1	26	2338	797
	2	1	3772	NS
	2	6	3595	210
	2	11	3257	184
	2	16	3190	170
	2	21	2759	140
	2	26	1891	126
	3	1	1361	261
	3	6	1355	309
	3	11	1188	279
	3	16	1074	242
	3	21	999	187
	3	26	823	151
	4	1	2363	229
	4	6	1740	386
	4	11	1614	435
	4	16	1349	384
	4	21	1138	397
	4	26	NS	399
	5	1	2687	157
	5	6	2674	114
	5	11	2552	101

Table 5.52-1. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2002	Winter 2003
	5	16	2414	86
	5	21	2498	73
	5	26	1842	93
	6	1	539	91
	6	6	253	82
	6	11	147	87
	6	16	96	88
	6	21	85	88
	6	26	35	94
Prince George	1	1	487	NS
P14	1	6	396	311
	1	11	317	420
	1	16	305	418
	1	21	238	427
	1	26	217	454
	2	1	643	191
	2	6	479	179
	2	11	339	148
	2	16	185	133
	2	21	128	120
	2	26	61	108
	3	1	655	NS
	3	6	556	309
	3	11	503	276
	3	16	371	256
	3	21	217	226
	3	26	158	135
	4	1	964	155
	4	6	723	100
	4	11	501	83
	4	16	369	65
	4	21	243	54
	4	26	146	54
	5	1	944	322
	5	6	931	285
	5	11	645	242
	5	16	643	161
	5	21	422	122
	5	26	241	95
	6	1	209	659
	6	6	724	585
	6	11	207	512
	6	16	50	364
	6	21	8	353
	6	26	24	281

Table 5.52-1. (continued)

5.53 Dollisons Landing (P8)

The porewaters at Dollisons Landing have been essentially fresh with only a few subsites with sulfate concentrations able to support sulfate reduction, mainly during the summer. Generally, the site has become fresher during both the winter and summer throughout the study period. During the winters of 2000 and 2001, the site had porewater salinities in the 0.1 to 0.3 ppt range (Hackney et al., 2002). Last winter (2002) and the current winter (2003) salinities are essentially below 0.1 ppt showing a marked freshening of the site (Hackney et al., 2003; Table 5.51-1). Last winter the classifications were methanogenic (M) with sulfate reduction at the near-shore substation. This winter the whole site is (M).

Salinities during the current summer (2002) (Table 5.51-1) were lower than the previous summer (2001) (Hackney et al., 2003). The salinities during the summer (2001) were elevated relative to the summers of 2000 and the current summer (2002). The summer 2002 Classifications reflected this freshening with many (SR) classifications from the previous summer being converted to (MPSR) (Table 5.51-2). During the previous summer (2001), salinities were sufficient to maintain sulfate reduction at some of these subsites, but during the current summer resupply of sulfate was lower due to lower salinities, shifting the geochemical classifications to methanogenic conditions. There is also evidence that some subsites may have had saltier conditions prior to the sampling date. Many subsites were converted from (M) during the previous summer (2001) to (MPSR) during the current summer (2002). This indicates that although the site was fresher at the time of sampling compared to the previous summer, the current spring may have had saltier condition than the previous spring.

5.54 Black River (P9)

Porewaters of the Black River station appear to be mimicking those of Dollisons landing with a steady freshening over the past 4 winters and elevated salinities during the summer of 2001 (Hackney et al., 2003) compared with the summers of 2000 (Hackney et al., 2002) and the current summer (Table 5.51-1). The geochemical classification of this site is similar to the previous year. During the summers, a mixture of methanogenic and sulfate reducing conditions were observed and during the winters the site was methanogenic (Table 5.51-2). The high seasonal variability in classifications previously observed at this site has not changed.

5.55 Smith Creek (P11)

Porewater salinities during the winter at Smith Creek have shown a steady increase from 2000 (Hackney et al., 2002) to 2002 (Hackney et al., 2003). However, salinities during the current winter (2003) [av. = 4.4 ± 1.1 ppt; (Table 5.51-2)] were lower than the winter of 2002 [(av. = 7.2 ± 2.1 ppt; (Hackney et al., 2003)]. Summer 2002 salinities showed a dramatic increase with the average value of 10.9 ± 1.9 ppt (Table 5.51-1), more than double the previous summer (2001) average value [3.7 ± 1.5 ppt; Hackney et al., 2003)].

Because of high salinity values and relatively low rates of sulfate reduction during the winter, the site continued to be classified as (SR) in the winter (Table 5.51-2). Summer classifications have been primarily (SR) in the previous years with a few (MPSR) classifications resulting from higher rates of sulfate reduction during the summer depleting the sulfate (Table 5.51-2). During the current summer 2002, however, all (MPSR) classifications were converted to (SR) due to the large increase in salinities and sulfate supply.

5.56 Rat Island (P12)

Vegetation along this transect is strongly transitional, from saline tolerant plant species near the river to salt intolerant species toward the upland boundary. Porewater salinity reflects the gradient with higher salinity at substations near the river and fresher conditions toward the uplands. Winter salinities have been steadily increasing during the past three years (Hackney et al., 2002, 2003, Table 5.51-1). During the current winter (2003), subsites near uplands showed a dramatic increase in salinity for the first time. Average substation 6 salinities have never been above 0.2 ppt, but reached 2.7 ± 0.2 ppt, representing more than a ten fold increase. A similar pattern was observed in the current summer. Previous average salinities at near-shore substation 1 have always been below 2 ppt (Hackney et al., 2002, 2003). However, during the current summer of 2002 the average salinity at substation 1 was 6.3 ± 0.7 ppt (Table 5.51-1). Salinities at upland substation 6 increased as well during the current summer (2002). Average salinities at his upland site (1.9 ± 0.2 ppt, Table 5.51-1) increased almost tenfold from previous average salinities (0.2 + 0.1 ppt, Hackney et al., 2002, 2003).

The increases in salinity at this site have altered the summer classifications significantly. In previous years some subsites had (M) and (MPSR) classifications (Table 5.51-2). This year, all but three subsites are (SR) classifications. The upland site, which was previously a freshwater methanogenic system is now a (SR) classification. This should have significant impact on the vegetation at this substation. The long-term trend in winter classification has been towards more (SR) classification. Due to the saltier condition experienced during the previous winter (2002), the classification of Rat Island during winter 2003 was essentially the same with the majority of the subsites classified as (SR) with a few (MPSR) (Table 5.51-2).

5.57 Fishing Creek (P13)

The winter porewater salinities at Fishing Creek displayed a peak during the previous winter (2002), but returned to values similar to the winters of 2000 and 2001 during the current winter (2003). Salinities of approximately 1 ppt were observed during the winter of 2002 (Hackney et el., 2003). Current winter 2003 salinities are all less than 0.5 ppt (Table 5.51-1). Porewater salinities measured during summer 2002 were the highest ever measured for Fishing Creek since the beginning of the project. Values were approximately 5-7 ppt at the near-bank substation, 3 ppt at the mid substations and essentially fresh at the upland station (Table 5.51-1).

The geochemical classifications during the previous winter (2002), when salinities were elevated, were mainly (SR) classifications with a few (M). With the return of fresher conditions in winter 2003, the classifications have returned to a mixture of all types (Table 5.51-2). The summer (2002) geochemical classifications are noticeably different than the previous summers. Geochemical classifications have typically consisted of (SR), (M), and (MPSR) during the previous summers. Due to higher salinities during the current summer (2002), the geochemical classifications are all (SR) with the exception of the most upland site, which remains a (M) classification.

5.58 Prince George Creek (P14)

Porewater salinities at Prince George display a pattern similar to that of Fishing Creek. Winter salinities peaked during the previous winter (2002) and decreased during the current winter (2003). Summer salinities continued the steady increase observed over the past two years. Current summer salinity values were approximately 1 ppt (Table 5.51-1), roughly twice previous values (Hackney et al., 2002, 2003).

Prior to last winter (2002), the majority of Prince George substations had (M) geochemical classification. During the peak in salinity observed last winter (2002), most of the subsites were classified as (SR). During the current winter (2003), many subsites returned to (M) geochemical classifications due to lower chloride (Table 5.58-1) and salinities levels (Table 5.51-1). Prior to the current summer (2002), the summer geochemical classifications were essentially all (M). Due to the increase in salinity at this site during the summer 2002, the majority of subsites have been converted to (SR).

Table 5.58-1. Chloride Concentrations (µM) at Subsites.

			Chloride	
Station	Substation	Depth (cm)	Summer 2002	Winter 2003
Town Creek	1	1	25512	7041
P3	1	6	76984	11862
	1	11	103612	21772
	1	16	115659	41514
	1	21	113795	68892
	1	26	110860	94854
	2	1	22752	72951
	2	6	72650	121374
	2	11	92800	199519
	2	16	99777	232959
	2	21	101911	256909
	2	26	104077	275520
	3	1	17095	26021
	3	6	15693	30764
	3	11	50159	59785
	3	16	99194	139221
	3	21	130031	204768
	3	26	130084	268807
	4	1	24320	43677
	4	6	41555	52138
	4	11	48779	80180
	4	16	50968	102477
	4	21	45408	123231
	4	26	48595	142137
	5	1	30180	59836
	5	6	56714	59680
	5	11	74330	75283
	5	16	81560	88981
	5	21	25512	103255
	5	26	76984	111485
	6	1	103612	66226
	6	6	115659	89406
	6	11	113795	124648
	6	16	110860	154709

Table 5.58-1. continued

Station	Substation	Depth (cm)	Chloride	
			Summer 2002	Winter 2003
	6	21	22752	203185
	6	26	72650	246654
Eagle Island	1	1	NS	10843
P6	1	6	194774	5628
	1	11	184207	3796
	1	16	159219	2904
	1	21	128553	3319
	1	26	119970	4716
	2	1	158687	6958
	2	6	145567	9519
	2	11	125004	13522
	2	16	114034	17373
	2	21	104578	23517
	2	26	93660	35155
	3	1	134129	34827
	3	6	129772	48593
	3	11	120979	51541
	3	16	115198	69581
	3	21	96252	61656
	3	26	70981	72474
	4	1	102024	29589
	4	6	96753	26197
	4	11	83148	26423
	4	16	80241	27686
	4	21	69920	31894
	4	26	64910	38585
	5	1	71194	30511
	5	6	66474	33051
	5	11	62581	35998
	5	16	47371	35685
	5	21	44241	38491
	5	26	41014	40795
	6	1	120887	46665
	6	6	107199	51787
	6	11	94660	55525
	6	16	83270	47465
	6	21	75071	47325
	6	26	68610	46054

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2002	Winter 2003
Indian Creek	1	1	28944	746
P7	1	6	39794	1998
	1	11	43527	4260
	1	16	45352	8877
	1	21	42249	15027
	1	26	38999	20792
	2	1	49772	8401
	2	6	49194	9031
	2	11	44143	9511
	2	16	37250	8917
	2	21	28664	8629
	2	26	22366	8425
	3	1	34410	4909
	3	6	33656	5102
	3	11	32526	3664
	3	16	30822	3830
	3	21	29655	4455
	3	26	29681	5562
	4	1	30097	4034
	4	6	30570	4199
	4	11	30958	4653
	4	16	30528	5715
	4	21	31006	6256
	4	26	30657	6469
	5	1	9420	NS
	5	6	10672	1666
	5	11	10673	1530
	5	16	12190	1453
	5	21	14565	1410
	5	26	15604	1275
	6	1	922	501
	6	6	550	438
	6	11	688	526
	6	16	790	557
	6	21	773	501
	6	26	625	618

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride Summer 2002	Chloride Winter 2003
Dollisons	1	1	3028	463
Landing P8	1	6	2723	432
	1	11	2099	448
	1	16	2689	451
	1	21	2637	570
	1	26	2405	628
	2	1	1326	394
	2	6	1015	388
	2	11	715	362
	2	16	609	348
	2	21	639	355
	2	26	547	351
	3	1	953	303
	3	6	956	371
	3	11	877	448
	3	16	799	508
	3	21	876	526
	3	26	938	567
	4	1	1246	186
	4	6	1250	333
	4	11	1288	329
	4	16	NS	405
	4	21	1053	401
	4	26	1022	486
	5	1	1469	150
	5	6	1435	409
	5	11	1257	389
	5	16	1104	323
	5	21	1080	425
	5	26	1254	524
	6	1	1008	152
	6	6	1282	306
	6	11	1481	224
	6	16	1708	409
	6	21	1733	816
	6	26	1642	652

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2002	Winter 2003
Black River	1	1	948	79
P9	1	6	894	348
	1	11	588	430
	1	16	490	471
	1	21	529	524
	1	26	693	563
	2	1	834	818
	2	6	885	651
	2	11	612	669
	2	16	496	670
	2	21	403	719
	2	26	1104	780
	3	1	807	394
	3	6	972	408
	3	11	749	399
	3	16	507	420
	3	21	446	432
	3	26	690	479
	4	1	884	413
	4	6	990	442
	4	11	830	461
	4	16	610	496
	4	21	480	499
	4	26	660	513
	5	1	1035	390
	5	6	1103	412
	5	11	1012	417
	5	16	735	425
	5	21	479	421
	5	26	546	455
	6	1	1033	370
	6	6	1112	405
	6	11	1058	387
	6	16	959	365
	6	21	941	320
	6	26	720	339

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride Summer 2002	Chloride Winter 2003
Smith Creek	1	1	206983	59618
P11	1	6	206607	62880
	1	11	193459	67466
	1	16	173433	67083
	1	21	154594	67459
	1	26	130806	64702
	2	1	213023	59621
	2	6	210623	61484
	2	11	205785	56175
	2	16	195514	56769
	2	21	186550	75301
	2	26	177964	80108
	3	1	209324	60771
	3	6	201609	69126
	3	11	196926	68671
	3	16	183233	69123
	3	21	176116	74265
	3	26	168712	83607
	4	1	194793	NS
	4	6	189491	49767
	4	11	173164	57971
	4	16	165294	80364
	4	21	152308	90940
	4	26	138963	96097
	5	1	160342	45960
	5	6	138664	73960
	5	11	126635	90986
	5	16	119780	96996
	5	21	112962	104456
	5	26	103964	114558
	6	1	140477	35662
	6	6	136346	47894
	6	11	158260	49732
	6	16	163761	50156
	6	21	175466	67262
	6	26	175593	74441

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2002	Winter 2003
Rat Island	1	1	117080	35743
P12	1	6	103336	35087
	1	11	100258	27851
	1	16	91984	23193
	1	21	87845	21400
	1	26	86908	19561
	2	1	160115	27787
	2	6	139190	31474
	2	11	122218	34358
	2	16	106511	34120
	2	21	77611	35979
	2	26	89048	38695
	3	1	96502	64287
	3	6	92886	67275
	3	11	89587	69449
	3	16	80905	68156
	3	21	72519	66712
	3	26	68506	69134
	4	1	112475	46194
	4	6	94168	47707
	4	11	82120	48373
	4	16	71438	50448
	4	21	59986	51245
	4	26	48882	52520
	5	1	75023	52678
	5	6	128144	63535
	5	11	66172	64449
	5	16	61565	65064
	5	21	56385	70470
	5	26	52974	64778
	6	1	25207	37089
	6	6	26095	40931
	6	11	25709	47003
	6	16	30292	46012
	6	21	32720	41281
	6	26	34398	42547

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride Summer 2002	Chloride Winter 2003
Fishing Creek	1	1	112581	344
P13	1	6	111752	472
	1	11	100878	692
	1	16	93268	1288
	1	21	87030	2805
	1	26	80430	4947
	2	1	68206	NS
	2	6	65131	1684
	2	11	61021	1887
	2	16	60446	2286
	2	21	57078	2941
	2	26	49551	4021
	3	1	37389	7851
	3	6	41247	9850
	3	11	36906	10967
	3	16	36008	12160
	3	21	35346	13313
	3	26	32409	16290
	4	1	51196	5865
	4	6	44293	7853
	4	11	42245	7929
	4	16	40973	7640
	4	21	41067	7920
	4	26	NS	8152
	5	1	54239	1143
	5	6	54664	1665
	5	11	54189	2135
	5	16	53191	2478
	5	21	53988	2559
	5	26	50262	3247
	6	1	3850	332
	6	6	784	242
	6	11	634	278
	6	16	706	266
	6	21	979	258
	6	26	550	368

Table 5.58-1. (continued)

Station	Substation	Depth (cm)	Chloride Summer 2002	Chloride Winter 2003
Prince George	1	1	15229	NS
P14	1	6	15900	797
	1	11	15748	773
	1	16	15793	785
	1	21	14126	721
	1	26	13612	713
	2	1	14705	1008
	2	6	12408	1101
	2	11	12266	1191
	2	16	11068	1452
	2	21	11006	1710
	2	26	9882	1697
	3	1	17604	NS
	3	6	16289	583
	3	11	15901	886
	3	16	15923	957
	3	21	16171	1310
	3	26	15353	2127
	4	1	16477	3176
	4	6	15292	2348
	4	11	14623	2688
	4	16	13357	2834
	4	21	11181	3007
	4	26	7990	4132
	5	1	15524	1234
	5	6	17566	1392
	5	11	16677	1442
	5	16	16625	1402
	5	21	14594	1318
	5	26	12458	1297
	6	1	2954	953
	6	6	11027	1195
	6	11	6791	1284
	6	16	6643	1503
	6	21	4746	1516
	6	26	4098	1617

6.0 BENTHIC INFAUNA COMMUNITIES

6.1 Summary

Infaunal communities associated with tidal wetlands are critical because they support the nursery function of the estuarine system. Because of the location of these communities as well as the tidal patterns and relatively narrow physical conditions needed to support them, infauna are predicted to be among the prime indicators of ecosystem impacts. This report summarizes infaunal community patterns at 9 sites distributed among the Cape Fear River, Northeast Cape Fear River and Town Creek from 1999-2002. This period covered two major potential system-level impacts: a developing drought in 2001-2002 as well as the initiation of channel widening construction.

Diversity and species richness were greatest in 1999, intermediate in 2000-2001, and lowest in 2002. Total faunal abundance showed a similar pattern, with higher overall abundances in 1999 and 2000, intermediate in 2001 and lowest in 2002. Principal components analyses indicated that 2002 was distinct from previous years, but all sites appear to show a gradual change over the 4-year period. The only exception was a station at the mouth of Town Creek (P2), which exhibited a dramatic alteration in community composition in 2002. Examination of dominant species at each site indicates that many sites initially dominated exclusively by tidal freshwater and oligohaline species included a significant proportion of oligohaline-mesohaline polychaetes by 2002, suggesting a potential salinity affect related to the drought. Further analysis of community trends after the drought has ended will be needed to distinguish climatic from channel deepening impacts.

6.2 Background

As part of the U.S. Army Corps of Engineers project to deepen and widen the Cape Fear River shipping channel from the mouth of the river to Wilmington Harbor, benthic infaunal communities have been monitored at stations predicted to have the greatest potential impacts. The focus of this sampling effort is on the fringing wetlands that border the river and represent critical habitat and nursery areas for a number of commercially and ecologically important taxa. Changes in the composition and abundance of organisms living within or directly on sediments of the fringing marsh (infauna) may result from changes in salinity, flow and tidal currents. Benthic infaunal community patterns integrate environmental changes at a specific site over time. Most infauna have limited post-larval mobility or dispersal, with abundances at a site reflecting a combination of recruitment patterns and site-specific processes. Infauna may be relatively long-lived, with lifespans of months to years for some taxa, and they occupy intermediate trophic positions, consuming detrital or planktonic food sources and being prey for larger fish and decapods. As a result, the community present in an area represents cumulative impacts of varying environmental factors over a several month period, both biotic and abiotic. Changes in the composition of the infaunal community in response to changing environmental conditions may occur more slowly than for more motile organisms that can migrate to optimal locations. However, changes in this group may also have fundamental importance for local ecosystem functioning because of their key position in nearshore estuarine food webs.

While many benthic species are resilient to short-term disturbances, long-term change associated with fluctuations in water quality, changes in tidal inundation or amplitude, changes in current flow or local hydrology, changes in salinity regime, or other physical factors may alter species composition and abundance. These physical changes may impact the infaunal community through direct mortality, reduced dispersal, food web alteration, and impacts related to increased stress (e.g. reduced feeding, competition). The monitoring effort reported here is designed to detect changes in the infaunal communities at selected sites that may be coincident with the timing of widening and deepening of the Cape Fear River shipping channel. We hope to be able to distinguish potential long-term changes related to these anthropogenic impacts from year-to-year variability related to climatic fluctuations. Current working hypotheses are: 1) Changes in salinity and/or tidal amplitude and/or inundation period will lead to changes in intertidal and shallow subtidal benthic community composition. 2) If alterations of the Cape Fear River shipping channel change estuarine flow characteristics, a change in community composition and function reflecting altered recruitment patterns may follow.

Polychaetes, oligochaetes, amphipods, and insect larvae are the dominant taxonomic groups of the Cape Fear estuary. The relative importance of specific species that dominate a site changes along the estuarine gradient from polyhaline to oligohaline and tidal freshwater conditions. Bivalves and gastropods, though common in other estuaries, are not abundant in the Cape Fear system and are generally represented primarily by juveniles (<1-2mm shell length). Polychaetes (segmented worms bearing specialized appendages) are common throughout the estuary and are generally the numerically dominant taxa in euhaline to mesohaline environments. Polychaetes have a variety of living modes including free-living, burrowing, and sedentary forms. Burrowing and tube dwelling species dominate in most of the intertidal and shallow subtidal areas and are common prey for fish, shrimp, and crabs. Oligochaetes are another group of segmented worms but they generally lack specialized appendages, have a burrowing habit and exhibit direct development. Direct development in this group often results in locally dense patches and the ability to respond quickly to local environmental changes. Their deeper burrowing habit often makes them less available as a prey resource for fish and decapods than tube dwelling polychaetes or amphipods. Amphipods are a diverse group of brooding crustaceans. This group can exhibit explosive population growth under optimal conditions, and serves as a critical food resource in fringing wetlands during at least certain time periods. Although many are free-living or pelagic, a large proportion of estuarine amphipods are tube builders that can be highly mobile over small spatial scales and may quickly colonize disturbed habitats. Insect larvae are among the most numerous and diverse groups that inhabit the oligohaline and tidal freshwater regions of the estuary, but are generally absent from lower mesohaline and more saline areas. Insect larvae exploit virtually every habitat type in the upper estuary and are distinct from other groups in having aerial dispersal. However, many insects are very sensitive to salt intrusions and are indicators of changing salinity conditions.

6.3 Methodology

Infaunal core samples were collected at nine stations along the Cape Fear River estuarine gradient. Three benthic stations are located in Town Creek (P2 at the mouth of Town Creek, P3A and P3B inner Town Creek), three stations in the main stem Cape Fear above the city of Wilmington (P6- Eagle Island, P7- Indian Creek, and P8- Dollisons Landing), and three stations in the North East Cape Fear River (P11- Smith Creek, P12- Rat Island, and P13- Fishing Creek).

These stations are the same as those being monitored for epifauna patterns (Section 7) and represent a subset of those stations being monitored for changes in physical factors (See other sections of this report).

Infaunal core samples (10 cm diameter x 15 cm deep) were collected at two upper intertidal sub-sites and two lower intertidal sub-sites at each station. These sub-sites are fixed stations that were originally marked (and positions recorded using GPS) in 1999. Three replicate core samples were collected within a one-meter area around these points. Core samples are collected at all stations in June of each year. All samples are fixed in a 10% formalin solution (~4% formaldehyde), with rose Bengal dye added, and later sieved through a 500 micron screen to remove excess sediment and preserved in 50% isopropanol. All organisms are separated from the remaining sediment by sorting under a dissecting microscope and identified to lowest reasonable taxon, in most cases this is genus or species.

The major deepening and widening efforts for the Cape Fear River channel began in late 2000. Thus, summers 1999 and 2000 represent conditions prior to the project's start. Full effects of the widening project cannot be assessed until 2-3 years of post-dredging data are available to compare to pre-dredging conditions. However, interim community patterns at each site will be assessed by examining patterns of species diversity, species richness, overall faunal density, species dominance, and faunal assemblage groupings as described by multivariate analyses. Per sample diversity was calculated using the Shannon-Weiner Diversity Index and was compared along with per sample species richness and total faunal density among subsites (high and low intertidal), sites, and years using Analysis of Variance testing for both main and interactive effects. SNK test was used to determine specific differences among years where an overall ANOVA indicated significant differences. Per sample diversity and richness provides a good estimate of local community patterns compared to overall site averages. To assess patterns of species dominance over time, all species comprising at least 3% of the total fauna at a site on a given sampling date were recorded. Principal Components Analysis followed by a biplot of the first two principal components, concentrating on species comprising greater than 3% of the individuals present at any site on any date (reducing potential artifacts associated with inclusion of rare species) was used to examine site/year groupings that may indicate spatial or temporal trends in community composition.

6.4 Faunal Patterns

Species diversity and species richness exhibited significant year (diversity: $F=12.54$, $p<0.0001$; richness: $F=31.50$, $p<0.0001$), site (diversity: $F=8.07$, $p<0.0001$; richness: $F=11.26$, $p<0.0001$), subsite (diversity: $F=17.30$, $p<0.0001$; richness: $F=18.21$, $p<0.0001$) and interactive year x site effects (diversity: $F=2.82$, $p<0.0001$; richness: $F=3.15$, $p<0.0001$) (Figures 6.4-1 and 6.4-2). All other interactions were non-significant. The year effects reflected a general decline in diversity at most sites in 2002 compared to 1999, with 2001 and 2000 representing intermediate conditions. For both species richness and diversity, SNK tests indicated an overall pattern of 1999>2000=2001>2002. However, this pattern was not consistent for all sites, as indicated by the site x year interaction effects, with lowest diversity in the low intertidal subsite of P11, P12, P3A, and P3B during 2000 (Figure 6.4-1). Species richness exhibited a similar pattern, though the general trend of lowest richness during 2002 was more consistent among sites and subsites (exceptions involving low intertidal subsites for P12 and P2). Spring 2001-summer

2002 represented a period of drought for southeastern North Carolina as well as the first sampling period following major channel deepening activities. Total faunal abundance was also low at all stations, except for P2 in 2002 compared to 1999-2000 (Figure 6.4-3; 1999=2000>2001>2002, SNK test for overall abundance patterns). As discussed below, community changes in 2001-2002 are consistent with changing salinity conditions, but further sampling during no drought years will be needed to distinguish climatic from potential hydrodynamic alteration effects.

Among site differences in diversity are expected because of the gradient from tidal freshwater to estuarine locations. Mainstem Cape Fear stations (P11-P13) had somewhat lower diversity than Northeast Cape Fear River and Town Creek stations (Figure 6.4-1 and 6.4-2), a pattern also noted in long-term monitoring of deeper stations by the Lower Cape Fear River Program. Subsite differences most often reflected higher diversity/richness in high/mid intertidal stations compared to low intertidal/subtidal stations (Figures 6.4-1 and 6.4-2), though the pattern was variable.

Principal components analyses indicated a gradation in site/year combinations, as indicated by the alignment of site/year sets along a line from upper left to lower right of the graph (Figure 6.4-4). Figures 6.4-5 through 6.4-7 show details of the PC analysis, with site/year combinations labeled, for the Town Creek, mainstem Cape Fear and Northeast Cape Fear sites to allow easier observation of patterns. The pattern for sites over time indicates a strong year gradient in community patterns. For all sites except P2, the 2002 samples group together and are distinct from other samples (lower right portion of the gradient). Other sites are generally arrayed with least saline sites and pre-drought years along the upper left area and a transition along the line to more saline conditions (positions held by more saline sites in previous years) over time. This pattern indicates a shift in most sites from lower salinity to higher salinity community types over time. Species composition patterns at a site shifted along the estuarine gradient following salinity patterns. This suggestion is supported by the species dominance patterns for most sites (Table 6.4-1 and Tables 6.4-2 through 6.4-10). Tidal freshwater sites (P12, P13, P3, P7, and P8) were dominated by typical upper estuarine species in 1999 (oligochaetes, insect larvae, certain amphipods). By 2002, most of these sites also had estuarine polychaetes (e.g. *Streblospio* and *Laeonereis*) as numerically important components of their fauna and exhibited declines in freshwater taxa such as insect larvae and certain amphipods (Table 6.4-1 and Tables 6.4-2 through 6.4-10). Stations P7 and P8 did not show an increase in polychaetes (except Spionidae sp. at P7), but did exhibit a decline in insect larvae. At P6 and P11, the lowest estuarine sites in the Northeast Cape Fear and mainstem Cape Fear sampling areas, polychaetes were present in earlier samples but became proportionately more common in 2001-2002. Site P2 was exceptional in changing from a community with an oligohaline mix of amphipods, oligochaetes and polychaetes to a site dominated exclusively by mesohaline-polyhaline polychaetes in 2002 samples. This change is also reflected in the distinct position of the 2002 samples for station P2 in the PC analyses. The increasing dominance of polychaetes at several sites also represented a proportional change in functional group composition in these areas. This change generally represented a greater proportion of tube-dwelling or surface burrowing deposit feeders, with a reduction in epibenthic grazers (6.4-1).

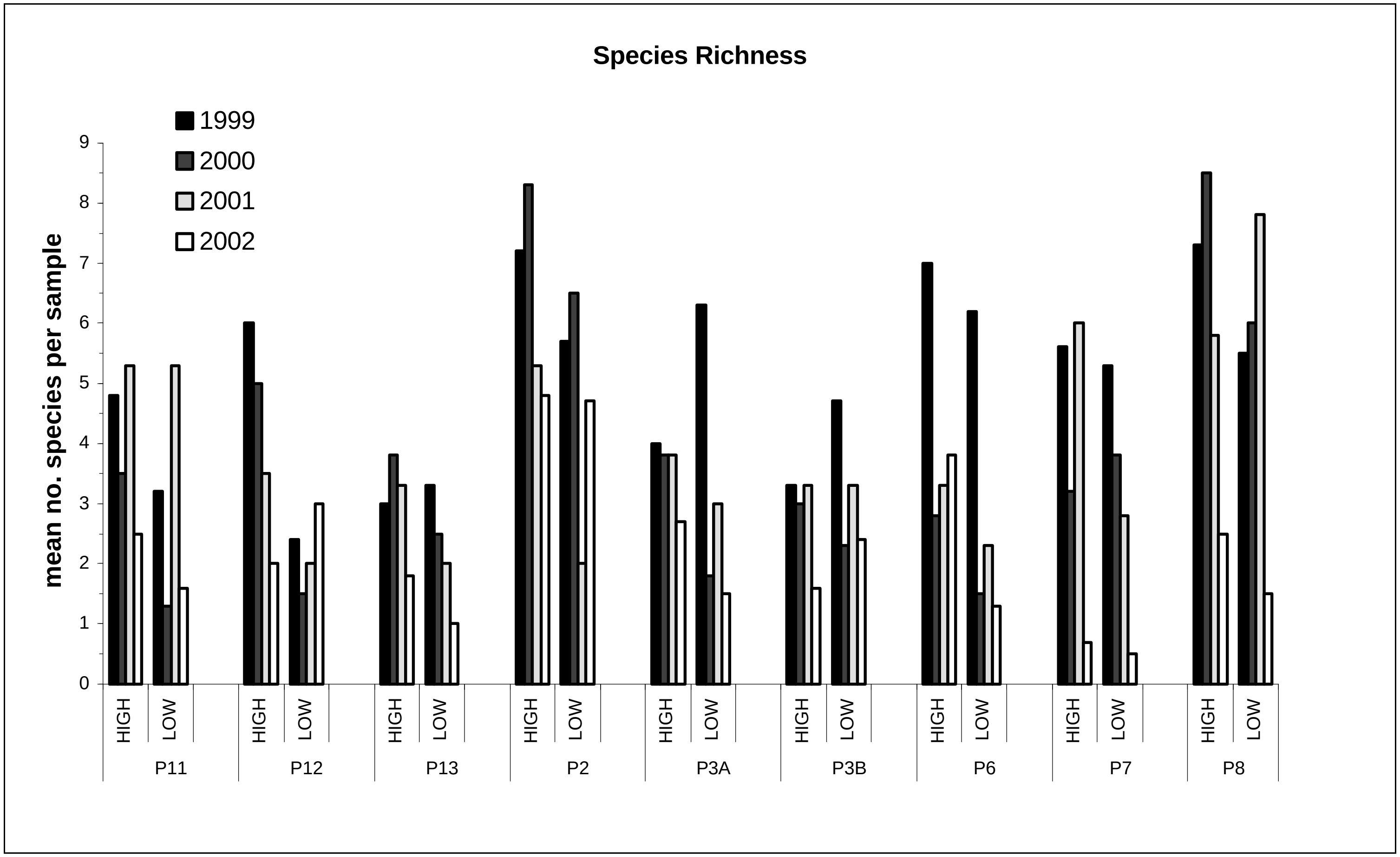


Figure 6.4-1. Per sample species richness by year, site, and subsite.

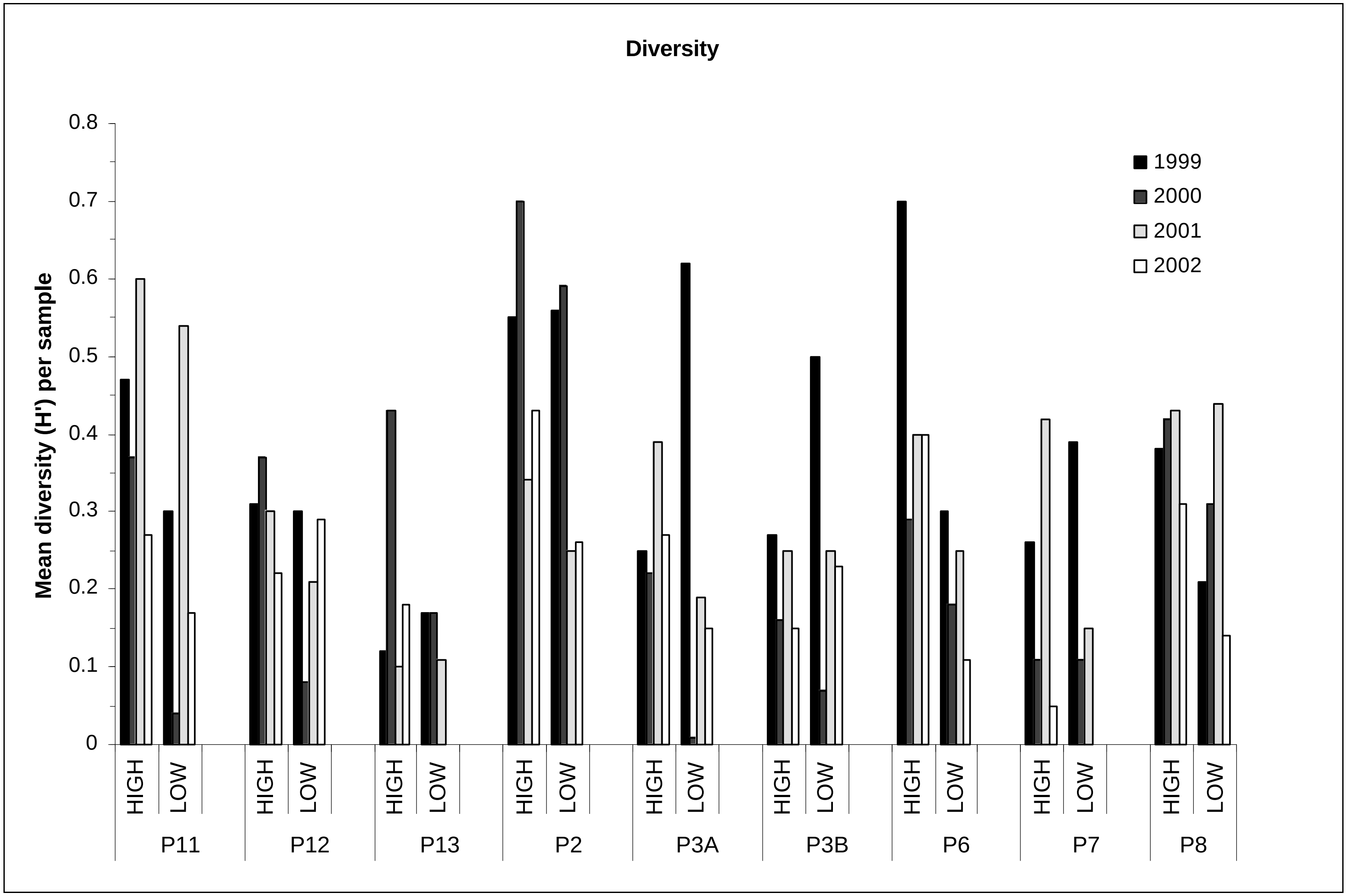


Figure 6.4-2. Per sample diversity (Shannon Weiner Diversity Index) by year, site, and subsite.

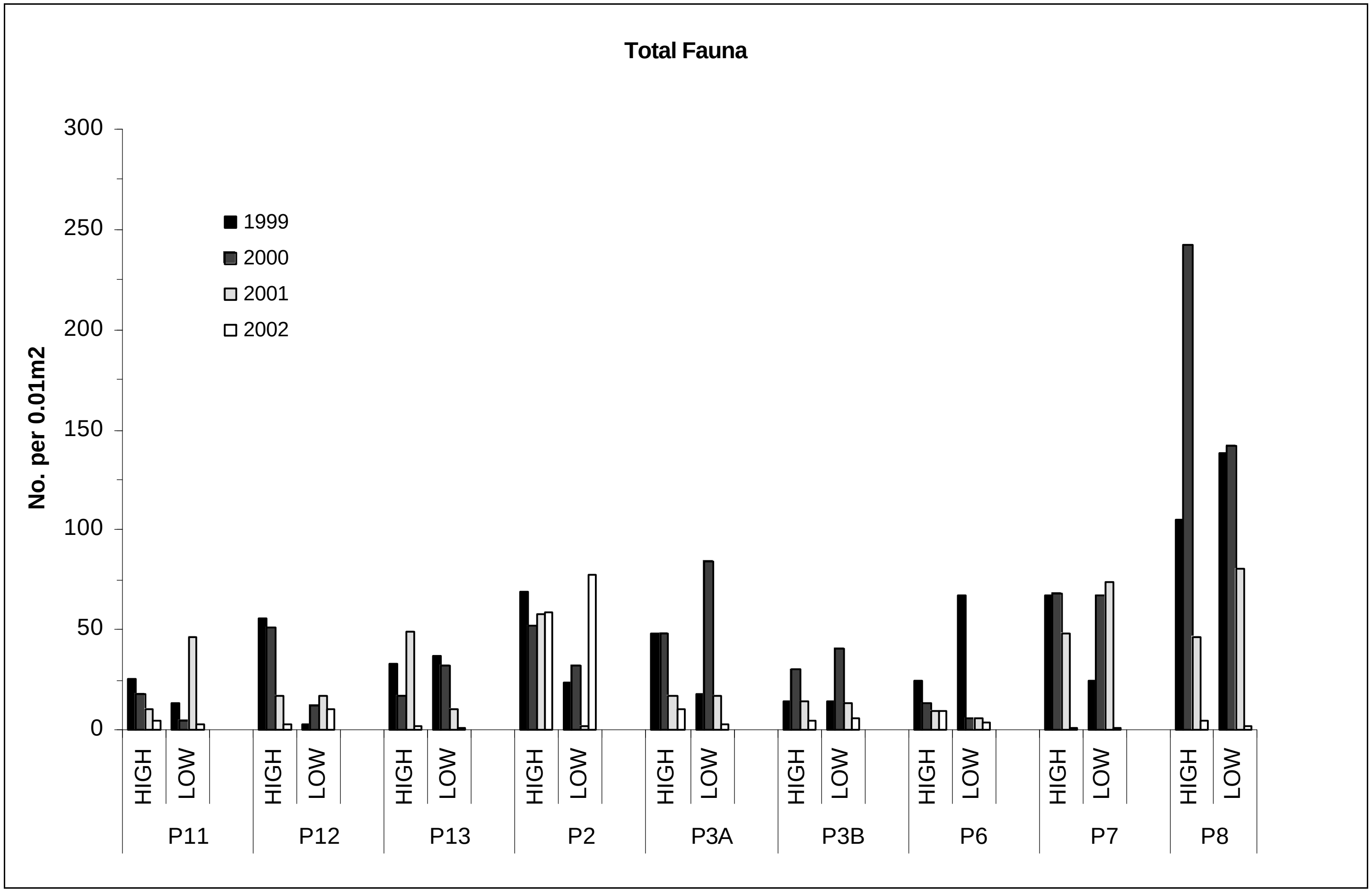


Figure 6.4-3. Per sample faunal abundance by year, site, and subsite.

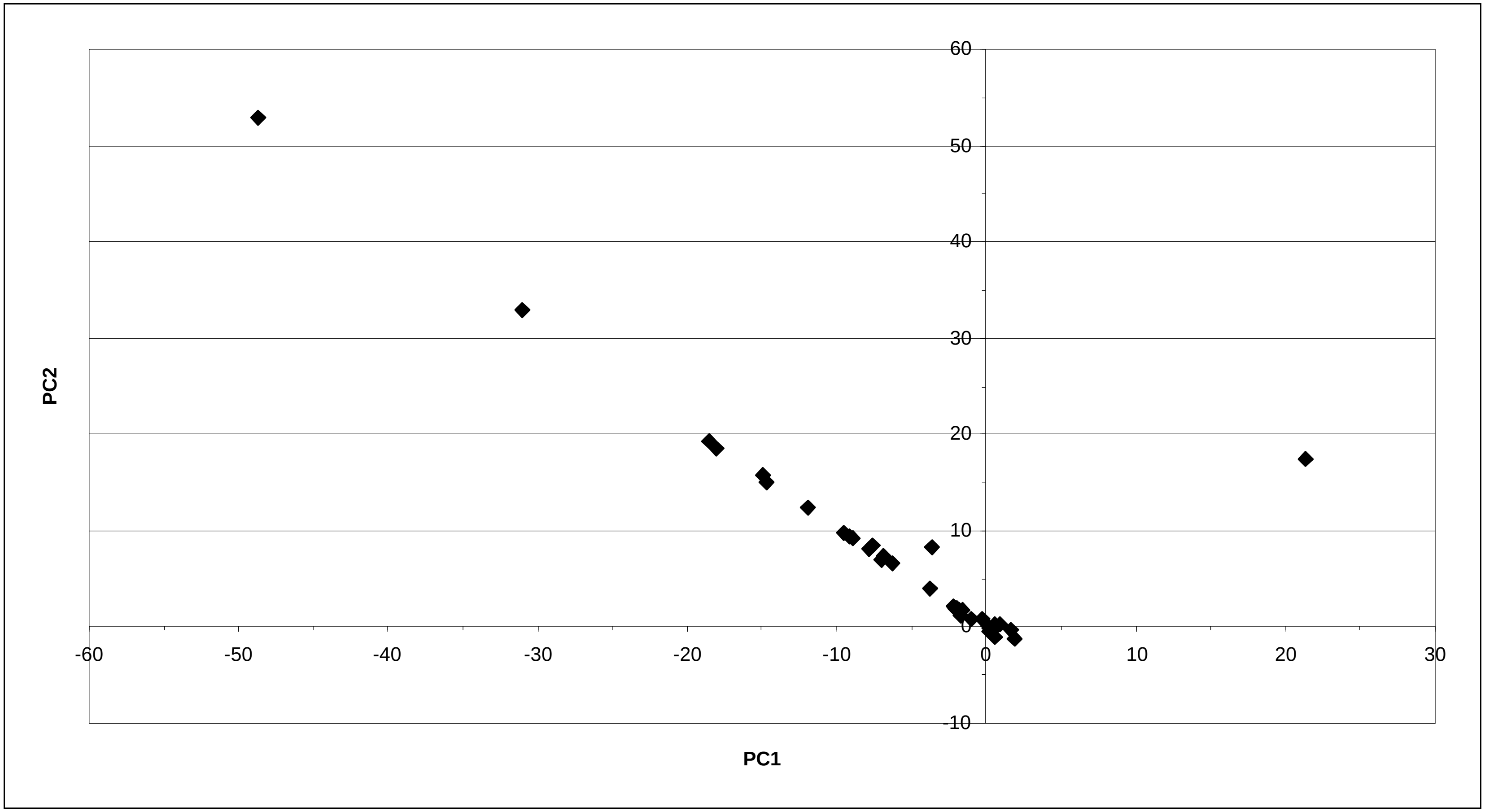


Figure 6.4-4. Biplot of first two principal components for all site/year sampling combinations. Analysis is based on all common taxa.

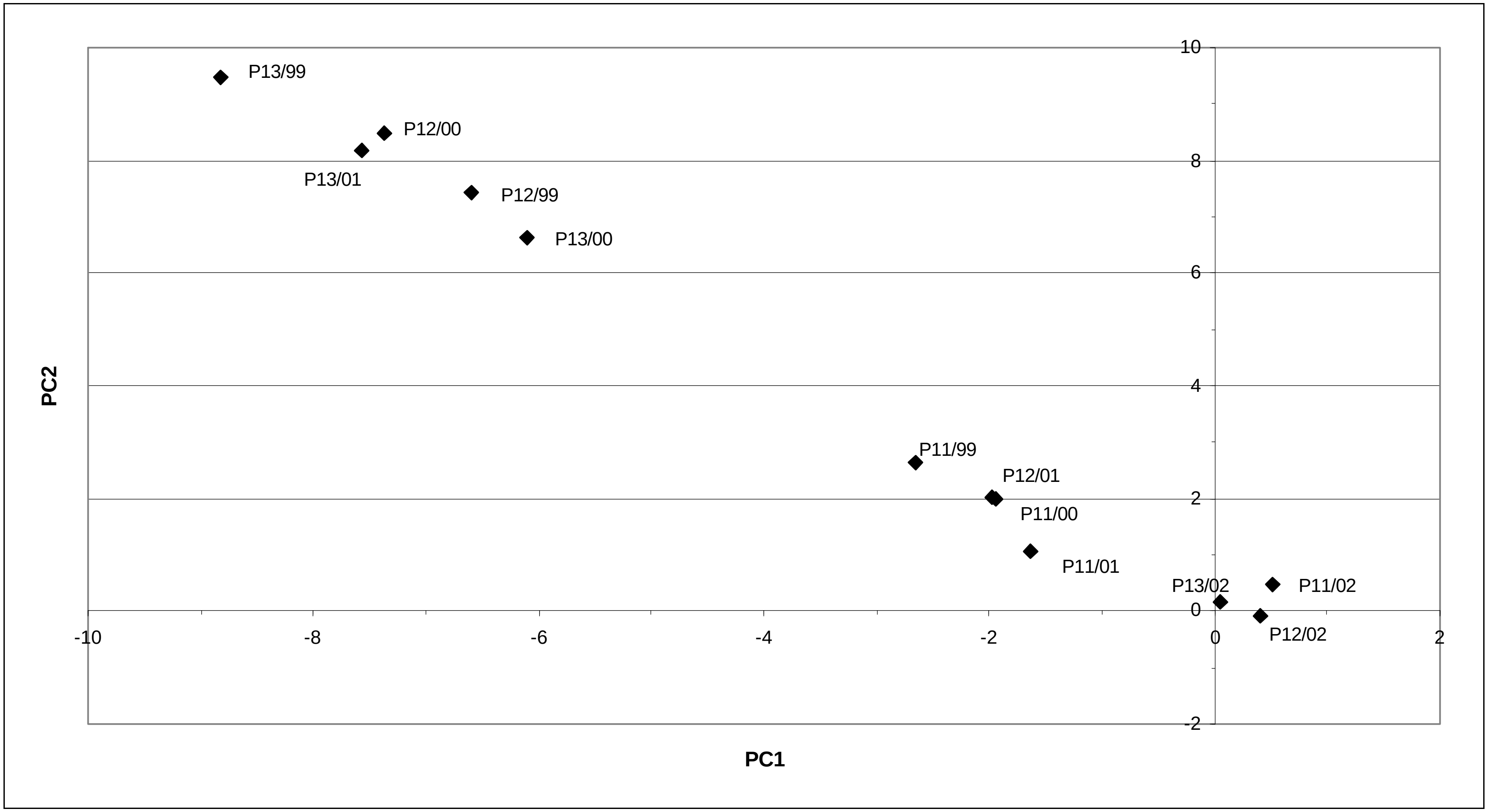


Figure 6.4-5. Biplot of first two principal components for Northeast Cape Fear River Stations, 1999-2002. Labels indicate site/year combinations.

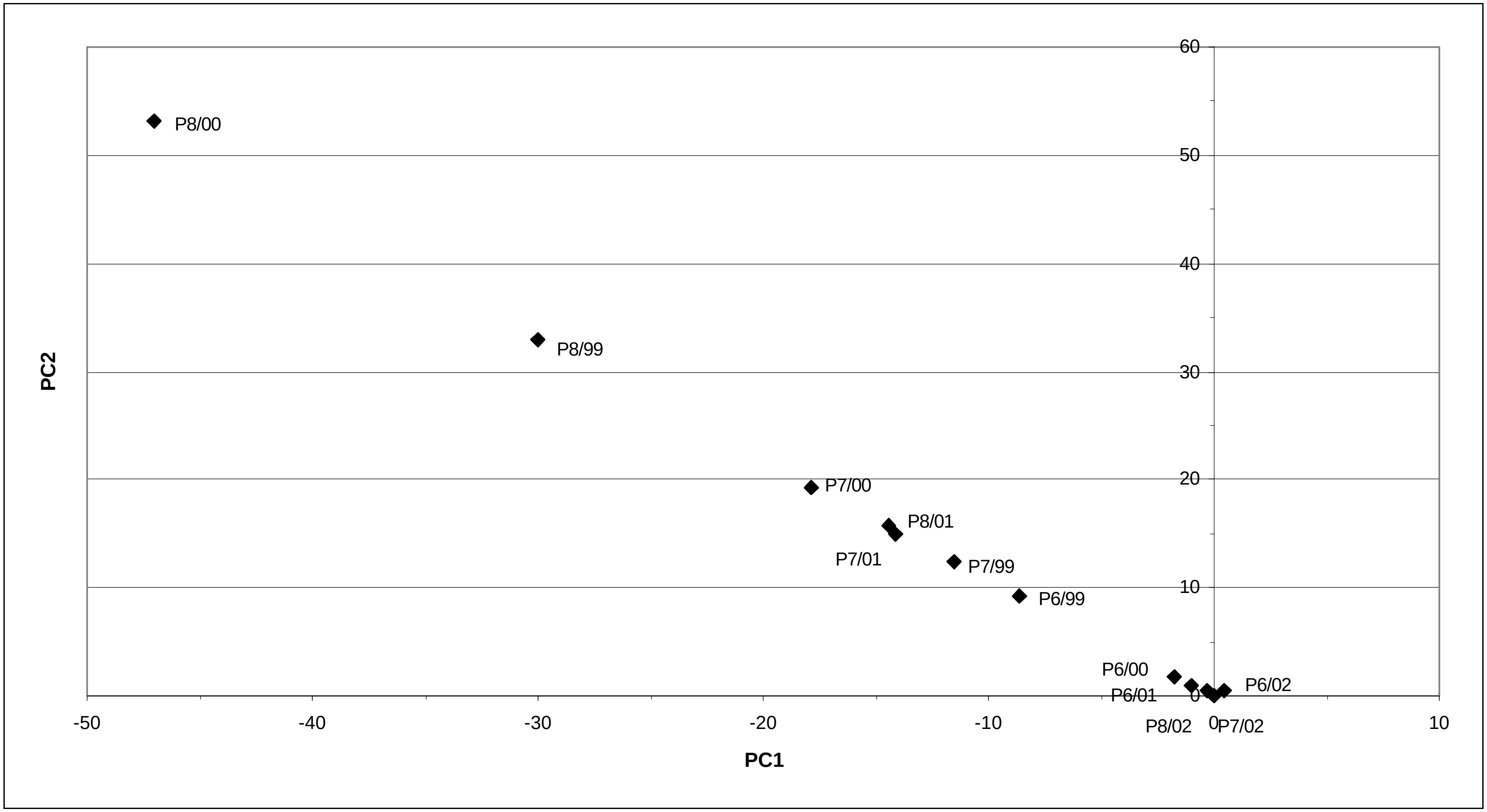


Figure 6.4-6. Biplot of first two principal components for mainstem Cape Fear River Stations, 1999-2002. Labels indicate site/year combinations.

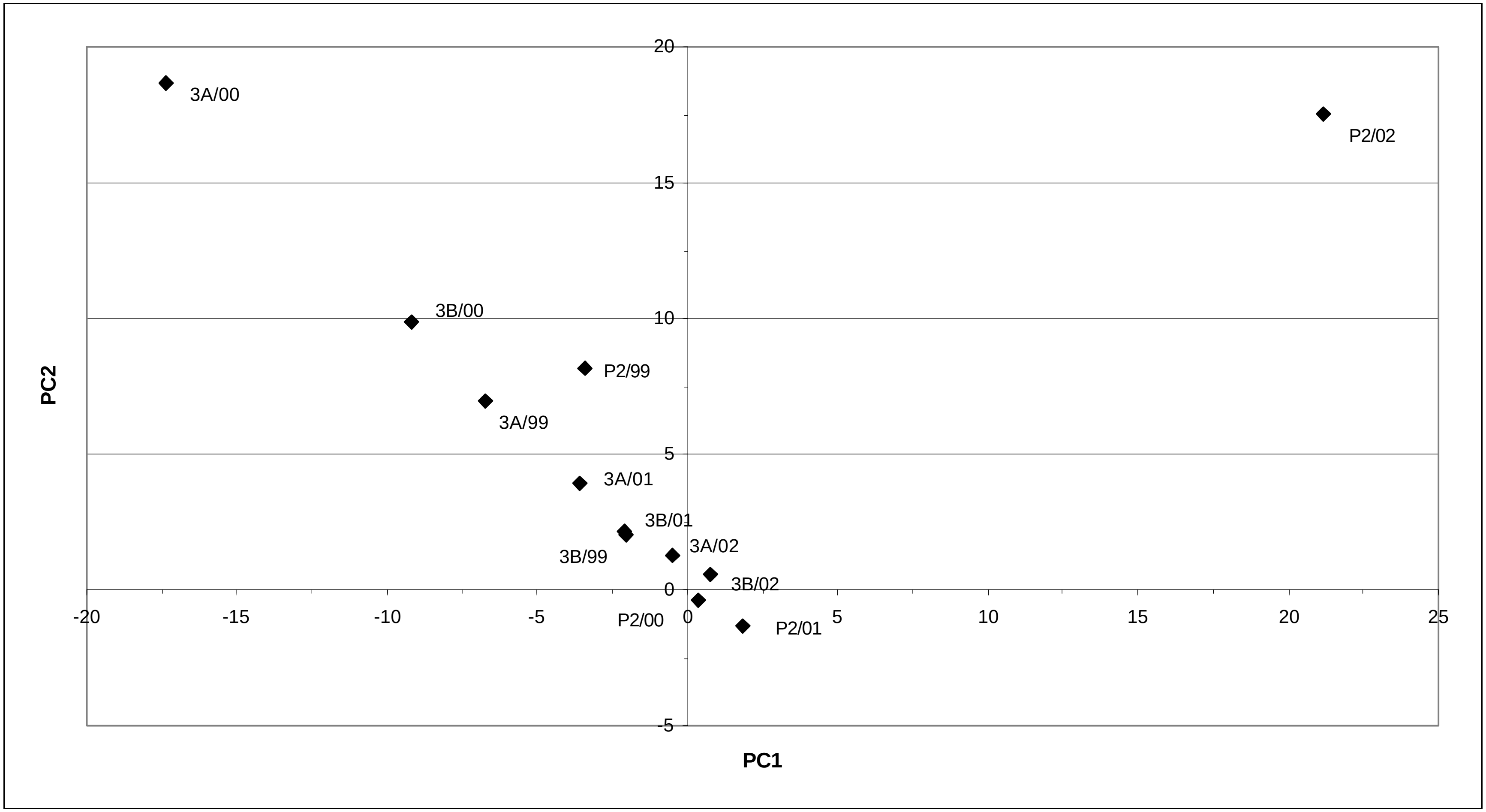


Figure 6.4-7. Biplot of first two principal components for Town Creek Stations, 1999-2002. Labels indicate site/year combinations.

Table 6.4-1. Numerically dominant taxa by site and year, 1999-2002. Mobility guilds: SM-surface mobile, SB-surface burrowing, DB-deep burrowing, ST-sedentary or tube building; Feeding guilds: D-deposit feeders, S-suspension feeders, H-grazers, shredders, detritivores, P-predators.

Year	Site	Dominant Taxa	% abundance	Guild Type mobility/feeding
1999	P11	*Hobsonia florida*	19.6	ST / D
		insect pupae	5.4	SM / ?
		oligochaeta spp.	35.7	DB / D
		Tubificoides heterochaetus	18.5	DB / D
1999	P12	*Bezzia*/*Palpomyia*	3.4	SM / H,P
		oligochaeta	83.2	DB / D
1999	P13	oligochaeta	93.0	DB / D
1999	P2	bivalve juv.	3.1	ST / S
		Hobsonia florida	5.1	ST / D
		Oligochaeta	47.1	DB / D
		Parandalia sp.	3.4	SB / ?
		Polydora ligni	14.1	ST / D
		Polydora socialis	6.0	ST / D
		Streblospio benedicti	4.2	ST / D
1999	P3A	*Dolichopus*	3.3	SM / P
		Gammarus tigrinus	4.5	SM / H,D
		Hobsonia florida	4.8	ST / D
		Oligochaeta	71.7	DB / D
		Procladius sp.	3.8	SM / H
1999	P3B	*Gammarus laurencianus*	3.6	SM / H
		Gammarus tigrinis	8.0	SM / H
		Hobsonia florida	10.9	ST / D
		Oligochaeta	54.3	DB / D
1999	P6	*Cyathura polita*	6.8	SM / H
		Laeonereis culveri	3.5	SM / D,H
		Oligochaeta	64.5	DB / D
1999	P7	oligochaeta	86.2	DB / D
1999	P8	bivalve juv.	5.3	ST / S
		oligochaeta	83.9	DB / D
2000	P11	*Boccardiella* sp.	5.5	ST / D
		Dicrotandipes sp.	4.4	SM / ?
		Maranzellaria virdis	16.5	ST / D
		Oligochaeta	63.7	DB / D
		Polypedilum sp.	3.3	SM / H
2000	P12	Nematoda*	31.6	(varied)
		oligochaeta	62.1	DB / D
2000	P13	Dolichopodid	3.0	SM / P
		Laeonereis culveri	4.0	SM / D,H
		Nematoda*	5.1	(varied)

Table 6.4-1. (continued)

			Guild Type	
Year	Site	Dominant Taxa	% abundance	mobility/feeding
		Oligochaeta	82.3	DB / D
2000	P2	*Boccardiella* sp.	51.0	ST / D
		Corophium acherasicum	8.3	ST,SM / H
		Hobsonia florida	8.3	ST / D
		Oligochaeta	13.4	DB / D
2000	P3A	Dolichopodid larvae	3.0	SM / ?
		oligochaeta	94.9	DB / D
2000	P3B	oligochaeta	94.0	DB / D
2000	P6	*Laeonereis culveri*	13.2	SM / D,H
		Maranzellaria virdis	11.8	ST / D
		Namalycastis abiuma	5.3	SM / ?
		Oligochaeta	68.4	DB / D
2000	P7	oligochaeta	94.8	DB / D
2000	P8	bivalve juv.	7.6	ST / S
		Nematoda*	6.8	(varied)
		Oligochaeta	74.7	DB / D
2001	P11	Nereidae juv.	20.4	SB / D,H
		Hobsonia florida	6.7	ST / D
		Maranzellaria virdis	35.6	ST / D
		Oligochaeta	23.1	DB / D
		Polypedilum sp.	4.9	SM / H
2001	P12	*Boccardiella* sp.	36.0	ST / D
		oligochaeta	46.0	DB / D
2001	P13	oligochaeta	92.4	DB / D
2001	P2	*Corophium acherasicum*	54.0	ST,SM / H
		oligochaeta	4.2	DB / D
		Polydora socialis	5.4	ST / D
		Tanais sp.	28.0	ST, SM / H
2001	P3A	*Eukiefferiella* sp.	7.3	SM / ?
		oligochaeta	76.1	DB / D
		Orchestia sp.	3.6	SM / H
2001	P3B	*Corophium acherasicum*	3.7	ST,SM / H
		Hobsonia florida	4.6	ST / D
		Oligochaeta	52.8	DB / D
		Orchestia sp.	27.8	SM / H
2001	P6	Amphipod sp. (juv)	3.2	SM / ?
		Dolichopodid larvae	6.5	SM / P
		Hemipodus roseus	11.3	SM / D,P
		Maranzellaria virdis	29.0	ST / D
		Oligochaeta	41.9	DB / D
2001	P7	*Dolichopus* sp.	3.7	SM / P
		Gammarus daiberi	4.9	SM / H
		Oligochaeta	82.4	DB / D
2001	P8	bivalve juv.	4.9	ST / S

Table 6.4-1. (continued)

Year	Site	Dominant Taxa	Guild Type % abundance	mobility/feeding
		oligochaeta	76.3	DB / D
		Orchestia sp.	4.2	SM / H
2002	P11	*Streblospio benedicti*	5.6	ST / D
		Tubificoides heterochaetus	67.5	DB / D
		Tubificidae	17.8	DB / D
2002	P12	*Bezzia*/*Palpomyia*	7.4	SM / H,P
		Streblospio benedicti	4.2	ST / D
		Tubificidae	26.3	DB / D
2002	P13	*Bezzia*/*Palpomyia*	14.6	SM / H,P
		Laeonereis culveri	4.9	SM / D,H
		Tubificidae	65.9	DB / D
2002	P2	*Mediomastus* sp.	4.1	DB / D
		Parandalia sp. A	3.9	SB / ?
		Streblospio benedicti	57.0	ST / D
		Fabriciola sp.	20.4	ST / D
		Fabriciola trilobata	3.2	ST / D
2002	P3A	Collembola	34.0	SM / H
		Streblospio benedicti	6.9	ST / D
		Tubificoides heterochaetus	8.2	DB / D
		Tubificidae	42.1	DB / D
2002	P3B	*Bezzia*/*Palpomyia*	4.3	SM / H,P
		Streblospio benedicti	21.5	ST / D
		Tubificoides heterochaetus	4.3	DB / D
		Enchytraeidae sp.	16.1	DB / D
		Tubificidae	39.8	DB / D
2002	P6	Collembola	5.0	SM / H
		Laeonereis culveri	16.3	SM / D,H
		Streblospio benedicti	13.8	ST / D
		Tubificoides heterochaetus	16.3	DB / D
		Uca sp.	16.3	SB,SM / D,H
		Tubificidae	18.8	DB / D
2002	P7	Tubificidae	96.8	DB / D
2002	P8	*Orchestia uhleri*	3.3	SM / H
		Tubificoides heterochaetus	3.3	DB / D
		Tubificoides sp.	79.9	DB / D

* Sampling protocol not designed for nematoda. This taxa only appears when unusually large individuals are present.

Table 6.4-2. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected on the Town Creek mouth site (P2) during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-sites for both high and low intertidal areas.

Town Creek mouth (P 2)

High Intertidal	June 99	June 00	June 01	June 02
amphipod sp.	0.2(0.4)	0(0)	0(0)	0(0)
Bezzia/*Palpomia*	0.5(1.2)	0(0)	0(0)	2.0(4.0)
juv. Bivalve	1(0.9)	0.5(0.6)	0(0)	0(0)
Boccardiella sp.	0(0)	26.5(37.2)	0(0)	0.25(0.5)
Capitellidae sp.	0(0)	0(0)	0(0)	0.25(0.5)
Cassidimidea lunifrons	0.2(0.4)	0.5(1)	0(0)	0(0)
Corophium acherasicum	0(0)	0(0)	12.5(17.4)	0(0)
Corophium acutum	0(0)	0(0)	7.8(15.5)	0(0)
Corophium sp.	0.2(0.4)	4.3(1.7)	11.8(15.6)	0(0)
Crangonyx psudogracilis	0(0)	0(0)	0(0)	0.25(0.5)
Cyathura polita	0(0)	0.8(1.5)	0(0)	0(0)
Dicrotendipes sp.	2(2.3)	1(2)	0.3(0.5)	0(0)
Eteone heteropoda	0(0)	1(0.8)	0(0)	0(0)
Eteone sp.	0(0)	0.3(0.5)	0(0)	0(0)
Fabriciola sp.	0(0)	0(0)	0(0)	37.0(74.0)
Fabriciola trilobata	0(0)	0(0)	0(0)	5.75(10.84)
Gammarus sp.	0(0)	0.8(1)	0(0)	0.25(0.5)
Gammarus tigrinus	0(0)	2.3(4.5)	0(0)	0(0)
Hobsonia florida	2(2.3)	3(5.4)	0.5(1)	0(0)
insect pupae	0(0)	0.25(0.5)	0(0)	0(0)
insect sp.	0.2(0.4)	0(0)	0(0)	0(0)
insect sp. e	0(0)	0(0)	0.3(.5)	0(0)
juv. Nereid	0(0)	0(0)	0.3(0.5)	0(0)
Laeonereis culveri	0.2(0.4)	0(0)	0(0)	0(0)
Marenzellaria virdis	1.7(4.1)	0(0)	0(0)	0(0)
Nereis falsa	0(0)	1.25(2.5)	0(0)	0(0)
Nereis riisei	0.7(1.2)	0(0)	0(0)	0(0)
Nereis succinea	0(0)	0.3(0.5)	1.5(1.9)	0(0)
Oligochaete	36.5(28.3)	8.8(13.6)	2.3(2.6)	0(0)
Orchestia uhleri	0(0)	0(0)	0(0)	0.75(1.5)
Owenia sp.	0.2(0.4)	0(0)	0(0)	0(0)
Palaemonetes pugio	0.2(0.4)	0(0)	0(0)	0(0)
Parandalia sp.	1(1.5)	0(0)	0.5(0.6)	2.75(2.21)
Polydora ligni	12.2(26.5)	0.25(0.5)	0.3(0.5)	0.75(0.96)
Polydora socialis	5.5(10)	0(0)	3.3(6.5)	0.25(0.5)
Polypedilum sp.	1.5(1.8)	0(0)	0(0)	0(0)
Streblospio benedicti	0.8(0.8)	0.75(0.5)	0.3(0.5)	8.25(9.53)
Tanais sp.	0.3(0.8)	0(0)	16.8(18.9)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	2.25(3.86)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	2.75(5.5)
Uca minax	0(0)	0(0)	0(0)	0.25(0.5)
Uca sp.	0(0)	0(0)	0(0)	0.25(0.5)

Table 6.4-2. (continued)

Town Creek mouth (P 2)

Low Intertidal	June 99	June 00	June 01	June 02
Bezzia/*Palpomia*	0.2(0.4)	0(0)	0(0)	0(0)
juv. Bivalve	0.2(0.4)	0.3(0.5)	0(0)	0.33(0.51)
Boccardiella sp.	0(0)	16.5(10.3)	0(0)	0(0)
Capitella capitata	0(0)	0(0)	0.3(0.6)	0(0)
Chironomus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Corophium sp.	0(0)	0.3(0.5)	0.3(0.6)	0(0)
Corophium lacustre	0(0)	2.5(2.4)	0(0)	0(0)
crab megalopae	0.2(0.4)	0(0)	0(0)	0(0)
Cyathura madelinae	0.2(0.4)	0(0)	0(0)	0(0)
Cyclaspis varians	0(0)	0(0)	0(0)	0.17(0.41)
Dicrotendipes sp.	0(0)	0.5(1)	0(0)	0(0)
Eteone heteropoda	0(0)	0(0)	0(0)	0.83(1.17)
Gammarus tigrinus	0.5(0.8)	0(0)	0.3(0.6)	0(0)
Edotea (*muntosa*)	0.2(0.4)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0.3(0.5)	0(0)	0.17(0.41)
gastropod juv.	1.8(4.5)	0(0)	0(0)	0(0)
Hobsonia florida	0.8(2)	4(5.5)	0(0)	0(0)
Laeonereis culveri	0.2(0.4)	0(0)	0(0)	0(0)
Mediomastus ambiseta	1.2(2)	0(0)	0(0)	3.33(7.23)
Mediomastus sp.	0.3(0.8)	0(0)	0(0)	5.0(6.32)
Mucrogammarus mucronata	0(0)	0(0)	0(0)	0.17(0.41)
Nemertean	0.2(0.4)	0(0)	0(0)	0(0)
Nereis acuminata	0(0)	0.3(0.5)	0(0)	0(0)
Nereis succinea	0(0)	1.3(1.9)	0(0)	0.17(0.41)
Oligochaete	7(8.6)	2.5(2.4)	0.3(0.6)	0(0)
Parandalia sp.	2.5(2)	1(1.4)	1(1)	2.83(4.17)
Paraprionospio pinnata	0.2(0.4)	0(0)	0(0)	0(0)
Polydora ligni	0.8(2)	1.5(3)	0(0)	0.5(1.22)
Polypedilum sp.	0.8(2)	0(0)	0(0)	0(0)
Spisula solidessima	0(0)	0(0)	0(0)	0.33(0.52)
Streblospio benedicti	3(4.1)	0(0)	0(0)	63.33(19.47)
Syllidae sp.	0.2(0.4)	0(0)	0(0)	0(0)
Tanais sp.	0(0)	0.3(0.5)	0(0)	0(0)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	1.0(2.0)

Table 6.4-3. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P3A upper Town Creek sites during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-sites for both high and low intertidal areas.

Town Creek inner a (P3A)

High Intertidal	June 99	June 00	June 01	June 02
Acarina	0(0)	0(0)	0(0)	0.17(0.41)
Bezzia/*Palpomia*	0(0)	0(0)	0.5(0.6)	0(0)
juv. Bivalve	0.2(0.4)	0(0)	0(0)	0.17(0.41)
Cassidimidea lunifrons	0(0)	0(0)	0.8(1)	0(0)
Collembola sp.	0.5(0.8)	0(0)	0(0)	8.67(17.36)
Dicrotendipes sp.	0(0)	0(0)	0(0)	0.17(0.41)
Dolichopodid larvae	0(0)	3.8(2.8)	0.8(1)	0(0)
Dolichopus sp.	2.2(1.5)	0(0)	0(0)	0(0)
Elasmopus sp.	0(0)	0.25(0.5)	0(0)	0(0)
Eukiefferiella sp.	0(0)	0(0)	2(4)	0(0)
Gammarus tigrinus	0.3(0.8)	0(0)	0(0)	0(0)
Hemipodus roseus	0(0)	0(0)	0.5(0.6)	0(0)
insect pupae	0.2(0.4)	0(0)	0(0)	0(0)
insect sp.	0.2(0.4)	0(0)	0(0)	0(0)
insect sp.b	0.2(0.4)	0(0)	0(0)	0(0)
insect sp. g	0.3(0.8)	0(0)	0(0)	0(0)
juv. Nereid	0(0)	0.3(0.5)	0(0)	0(0)
Laeonereis culveri	07(1.6)	0.5(1)	0(0)	0(0)
Megalops	0(0)	0(0)	0(0)	0.17(0.41)
Mite	0.2(0.4)	0(0)	0(0)	0(0)
Oligochaete	42.7(25.6)	42(25.6)	12(8.2)	0(0)
Olivella sp.	0(0)	0(0)	0(0)	0.17(0.41)
Orchestia sp.	0(0)	0(0)	1(1.4)	0(0)
Orchestia uhleri	0(0)	0(0)	0(0)	0.17(0.41)
Polypedilum sp.	0(0)	0.3(0.5)	0(0)	0(0)
Procladius sp.	0(0)	0.3(0.5)	0(0)	0(0)
Spionidae sp.	0(0)	0(0)	0(0)	0.17(0.41)
Streblospio benedicti	0(0)	0(0)	0(0)	0.17(0.41)
Tubificidae sp.	0(0)	0(0)	0(0)	6.66(7.99)
Uca minax	0.2(0.4)	0(0)	0(0)	0(0)
Uca pugilator	0.5(0.8)	0(0)	0(0)	0(0)
Uca sp.	0(0)	0.3(0.5)	0(0)	0.33(0.52)

Table 6.4-3. (continued)

Town Creek inner a (P3A)

Low Intertidal	June 99	June 00	June 01	June 02
Ampharetidae sp.	0.2(0.4)	0(0)	0(0)	0(0)
Amphipoda sp.	0.7(0.8)	0.3(0.5)	0(0)	0(0)
*Bezzia/Palpomi*a	0(0)	0(0)	0.3(0.5)	0(0)
juv. Bivalve	0.2(0.4)	0(0)	0(0)	0(0)
Boccardiella sp.	0(0)	0(0)	0(0)	0.33(0.51)
Cassidisca lunifrons	0.2(0.4)	0(0)	0.3(0.5)	0(0)
Collembola sp.	0(0)	0(0)	0(0)	0.33(0.52)
Cyathura polita	0(0)	0(0)	0.5(1)	0(0)
Dolichopodid larvae	0(0)	0.3(0.5)	0(0)	0(0)
Gammarus plumosa	0.2(0.4)	0(0)	0(0)	0(0)
Eukiefferiella sp.	0(0)	0(0)	0.5(1)	0(0)
Gammarus tigrinus	2.7(5.2)	0(0)	0(0)	0(0)
gastropod juv.	0.2(0.4)	0(0)	0(0)	0(0)
Hobsonia florida	3.2(3.3)	0(0)	0.8(1)	0(0)
Hydrophilidae larvae	0(0)	0.3(0.5)	0(0)	0(0)
insect larva b	0(0)	0.3(0.5)	0(0)	0(0)
Marenzellaria virdis	0.3(0.8)	0(0)	0(0)	0(0)
Mediomastus ambiseta	0.2(0.4)	0(0)	0(0)	0(0)
Mediomastus califoriensis	0.2(0.4)	0(0)	0(0)	0(0)
Melita nitida	0(0)	0(0)	0(0)	0.17(0.41)
Monopylephores sp.	0(0)	0(0)	0(0)	0.17(0.41)
Munna sp.	0.2(0.4)	0(0)	0(0)	0(0)
Oligochaete	5(9.4)	83(71.3)	14.3(8.9)	0(0)
Orchestia sp.	0(0)	0(0)	0.3(0.5)	0(0)
Polydora ligni	0.2(0.4)	0(0)	0(0)	0(0)
Polydora sp.	0.2(0.4)	0(0)	0(0)	0(0)
Polypedilum sp.	1(0.9)	0(0)	0(0)	0(0)
Streblospio benedicti	0.2(0.4)	0(0)	0.3(0.5)	1.67(2.73)
Tanytarsus sp.	0.3(0.5)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	4.5(3.27)
Tubificoides heterochaetu	*s*0(0)	0(0)	0(0)	2.17(4.36)
Uca pugilator	0.2(0.4)	0(0)	0(0)	0(0)
Uca sp.	0.2(0.4)	0(0)	0(0)	0(0)

Table 6.4-4. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P3B upper Town Creek sites during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-sites for both high and low intertidal areas.

Town Creek inner b (P3B)

High Intertidal	June 99	June 00	June 01	June 02
Bezzia/Palpomyia	0(0)	0(0)	0(0)	0.8(1.30)
juv. bivalve	0.5(0.6)	0(0)	0(0)	0(0)
Cassidimidea lunifrons	0(0)	0(0)	0.5(0.6)	0(0)
Collembola sp.	0.3(0.5)	0(0)	0(0)	0.2(0.45)
Corophium volutator	0(0)	0(0)	0.3(0.5)	0(0)
Diptera sp.	0(0)	0(0)	0(0)	0.2(0.45)
Dolichopodid larvae	0(0)	0.5(1)	0.5(0.6)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	3.0(6.71)
Eukiefferiella sp.	0(0)	0(0)	0.3(0.5)	0(0)
*Hobsonia flori*da	0(0)	0(0)	1(2)	0.2(0.45)
Hydrothassa sp.	0(0)	0(0)	0(0)	0.2(0.45)
insect larva c	0.5(0.6)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0.3(0.5)	0(0)	0(0)
Marenzellaria virdis	0.3(0.5)	0(0)	0(0)	0(0)
Munna sp.	0.3(0.5)	0(0)	0(0)	0(0)
Nereid sp.	0(0)	1.1(1.5)	0(0)	0(0)
Oligochaete	11.5(10)	27.3(13.6)	3.8(4.4)	0(0)
Orchestia sp.	0.3(0.5)	0.3(0.5)	7.5(14.3)	0(0)
Orchestia uhleri	0(0)	0.8(1)	0(0)	0(0)
Polypedilum sp.	0(0)	0.3(0.5)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0.3(0.5)	0.4(0.89)
Tubificidae sp.	0(0)	0(0)	0(0)	0.8(1.30)
Uca sp.	0.3(0.5)	0(0)	0(0)	0(0)

Table 6.4-4. (continued)

Town Creek inner b (P3B)

Low Intertidal	June 99	June 00	June 01	June 02
Amphipoda sp.	0.3(0.5)	0(0)	0(0)	0(0)
Cassidisca lunifrons	0.2(0.4)	0(0)	0(0)	0.2(0.45)
Collembola sp.	0(0)	0(0)	0(0)	0.2(0.45)
Corophium acutum	0(0)	0(0)	0.3(0.5)	0(0)
Corophium lacustre	0(0)	0(0)	0.5(1)	0(0)
Cyathura polita	0(0)	0.5(0.6)	0(0)	0(0)
Dicrotendipes sp.	0.2(0.4)	0(0)	0(0)	0.2(0.45)
Dolichopodid larvae	0(0)	0.3(0.5)	0.3(0.5)	0(0)
Gammarus sp.	0.2(0.4)	0(0)	0(0)	0.4(0.89)
Gammarus lawrencianus	0.8(2)	0(0)	0(0)	0(0)
Gammarus tigrinus	1.8(4.5)	0(0)	0(0)	0(0)
Hobsonia florida	2.5(2.2)	0(0)	0.3(0.5)	0(0)
insecta sp.	0(0)	0.25(0.5)	0(0)	0(0)
insect pupae	0(0)	0(0)	0.3(0.5)	0(0)
Laeonereis culveri	0(0)	0.3(0.5)	0(0)	0(0)
Marenzellaria virdis	0.2(0.4)	0(0)	0(0)	0(0)
Marinogammarus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Melita dentata	0(0)	0(0)	0(0)	0.2(0.45)
Mite	0(0)	0(0)	0.3(0.5)	0(0)
Munna sp.	0.5(1.2)	0(0)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.3(0.5)	0(0)
Nematoda sp.	1.5(2.3)	0(0)	0(0)	0(0)
Oligochaete	4.8(5.8)	39.3(27.9)	10.5(6.5)	0(0)
Polydora sp.	0.3(0.8)	0(0)	0(0)	0(0)
Polydora ligni	0(0)	0(0)	0.3(0.5)	0(0)
Polydora socialis	0(0)	0(0)	0(0)	0.4(0.89)
Polypedilum sp.	0.7(1.2)	0(0)	0(0)	0(0)
Procladius sp.	0.5(0.8)	0(0)	0(0)	0(0)
Rhithropanapeus harisii	0(0)	0(0)	0(0)	0.2(0.45)
Streblospio benedicti	0(0)	0(0)	0(0)	3.6(2.3)
Tubificidae sp.	0(0)	0(0)	0(0)	6.6(4.51)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0.8(1.3)

Table 6.4-5. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-sites for both high and low intertidal areas.

Eagle Island (P6)

High Intertidal	June 99	June 00	June 01	June 02
Bezzia/*Palpomia*	0.6(0.5)	0.3 (0.5)	0(0)	0.5(0.59)
juv. Bivalve	0.2(0.4)	0(0)	0(0)	0(0)
Cassidisca lunifrons	1(2.2)	0(0)	0(0)	0(0)
Chrysops sp.	0(0)	0(0)	0(0)	0.25(0.5)
Collembola sp.	1.6(1.7)	0(0)	0(0)	1.0(0.82)
Curculionidae sp.	0.4(0.9)	0(0)	0(0)	0(0)
Cyathura (*madelinae*)	0.4(0.9)	0(0)	0(0)	0(0)
Cyathura polita	0.8(1.3)	0(0)	0(0)	0(0)
Dolichopodid larvae	0(0)	0(0)	1(0.8)	0.25(0.5)
Dolichopus sp.	0.8(1.8)	0(0)	0(0)	0(0)
Enchytraeidae sp.	0(0)	0(0)	0(0)	0.25(0.5)
Eukiefferiella (*claripennis*)	0.2(0.4)	0(0)	0(0)	0(0)
gastropod juv.	0.2(0.4)	0(0)	0(0)	0(0)
Hemipodus roseus	0.8(1.8)	0(0)	1.8(1.7)	0(0)
insect larva c	0.2(0.4)	0(0)	0(0)	0(0)
insect sp h	1(2.2)	0(0)	0(0)	0(0)
insect sp I	0.4(0.9)	0(0)	0(0)	0(0)
Laeonereis culveri	3.2(4.5)	2.5(3.3)	0(0)	3.25(5.25)
Namalycastis abiuma	0(0)	1(0.8)	0(0)	0(0)
Oligochaete	9.6(10.8)	9.5(5.8)	6(8.1)	0(0)
Orchestia uhleri	1(1.2)	0(0)	0(0)	0.25(0.5)
Orchestia sp.	1.2(2.2)	0(0)	0(0)	0(0)
Procladius sp.	0.2(0.4)	0(0)	0(0)	0(0)
Syphidae	0(0)	0(0)	0.3(0.5)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	3.75(4.86)
Uca minax	0(0)	0(0)	0.3(0.5)	0.25(0.5)
Uca pugilator	0.4(0.9)	0(0)	0(0)	0(0)
Uca pugnax	0(0)	0(0)	0.3(0.5)	0(0)
Uca sp.	0.2(0.4)	0(0)	0(0)	3.25(5.19)

Table 6.4-5. (continued)

Eagle Island (P6)

Low Intertidal	June 99	June 00	June 01	June 02
amphipod sp.	0.8(1.3)	0(0)	0.5(1)	0(0)
Bezzia/*Palpomia*	0.6(0.9)	0(0)	0.3(0.5)	0(0)
juv. Bivalve	0.6(0.9)	0(0)	0(0)	0(0)
Capitellidae sp.	0(0)	0(0)	0(0)	0.25(0.5)
Cassidisca lunifrons	1(1.7)	0(0)	0(0)	0(0)
Collembola sp.	0.2(0.4)	0(0)	0(0)	0(0)
Cyathura polita	5(11.2)	0(0)	0(0)	0(0)
Dolichopus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Eukiefferiella (*claripennis*)	0.4(0.9)	0(0)	0(0)	0(0)
Gammarus daiberi	0.2(0.4)	0(0)	0.3(0.5)	0(0)
gastropod juv.	0.4(0.5)	0(0)	0(0)	0(0)
Hobsonia florida	0.2(0.4)	0(0)	0(0)	0(0)
insect pupae	1.8(2.5)	0(0)	0(0)	0(0)
insect sp.	0.2(0.4)	0(0)	0(0	0(0)
Maranzellaria virdis	0(0)	0.8(0.5)	4.5(2.4)	0(0)
Melita sp.	1(2.2)	0(0)	0(0)	0(0)
Mite	0.2(0.4)	0(0)	0(0)	0(0)
Munna sp.	1(2.2)	0(0)	0(0)	0(0)
Oligochaete	49.6(42.2)	0.8(0.5)	1.3(1.3)	0(0)
Parandalia sp.	0(0)	0(0)	0(0)	0.5(0.58)
Polydora socialis	2.6(5.8)	0(0)	0(0)	0(0)
Polydora sp.	0(0)	0(0)	0(0)	0.25(0.5)
Polypedilum sp.	0.4(0.9)	0(0)	0(0)	0(0)
Procladius sp.	0.6(1.3)	0(0)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	2.75(5.5)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	3.25(5.85)
Uca sp.	0.4(0.9)	0(0)	0(0)	0(0)

Table 6.4-6. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P7 on the main-stem Cape Fear during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-sites for both high and low intertidal areas.

Indian Creek (P7)

High Intertidal	June 99	June 00	June 01	June 02
Bezzia/*Palpomia*	0.2(0.4)	0(0)	0(0)	0(0)
juv. Bivalve	0(0)	0.2(0.4)	0.3(0.5)	0(0)
*Cassidisca lun*ifrons	0(0)	0(0)	0.8(1.5)	0(0)
Celina sp.	0.2(0.4)	0(0)	0(0)	0(0)
Chironomus sp.	0(0)	0(0)	0.3(0.5)	0(0)
Chrysops sp.	0.2(0.4)	0(0)	0(0)	0(0)
Collembola sp.	0.4(0.5)	1.2(1.8)	0(0)	0.17(0.41)
Corophium acherasicum	0(0)	0(0)	0.3(0.5)	0(0)
Corophium sp.	0(0)	0(0)	0.8(1.5)	0(0)
Cryptochironomus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Cyathura (*madelinae*)	0.4(0.9)	0.2(0.4)	0(0)	0(0)
*Cyathura poli*ta	0(0)	0.2(0.4)	3.8(3)	0(0)
Dolichopodid larvae	1.6(0.5)	0(0)	0.8(1.5)	0(0)
Dolichopus sp.	1.6(1.1)	0(0)	0(0)	0(0)
*Gammarus diabe*ri	0(0)	0(0)	6(12)	0(0)
gastropod juv.	0.2(0.4)	0(0)	0(0)	0(0)
Hobsonia florida	0(0)	0(0)	0.3(0.5)	0.17(0.41)
insect larvae	0(0)	0.4(0.9)	0(0)	0(0)
insect pupae	0.2(0.4)	0(0)	0(0)	0(0)
insect sp. b	0(0)	0(0)	1(1.4)	0(0)
Isopod sp.	0(0)	0(0)	0.3(0.5)	0(0)
Lirceus sp.	1.4(2.6)	0(0)	0(0)	0(0)
Lumbriculidae sp.	7.4(7.4)	0(0)	0(0)	0(0)
Microsectra sp.	0.8(0.8)	0(0)	0(0)	0(0)
Mite	0(0)	0.2(0.4)	0(0)	0(0)
Oligochaete	52.2(34.6)	64.2(53)	30.3(25.6)	0(0)
Orchestia sp.	0.2(0.4)	0(0)	0.3(0.5)	0(0)
Orchestia uhleri	0.6(1.3)	0(0)	0(0)	0(0)
Paratendipes sp.	0(0)	0(0)	2.8(4.9)	0(0)
Polypedilum sp.	0(0)	0(0)	0.3(0.5)	0(0)
Pristinella sp.	0.4(0.9)	0(0)	0(0)	0(0)
Spionidae sp.	0(0)	0(0)	0(0)	0.17(0.41)
Staphylinidae	0(0)	0(0)	0(0)	0.17(0.41)
Tabanus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	24.5(13.1)
Tubificoides heterochaetus	0.2(0.4)	0(0)	0(0)	0(0)
Uca pugilator	0.4(0.9)	0(0)	0(0)	0(0)
Uca sp.	0(0)	0(0)	0.5(1)	0(0)

Table 6.4-6. (continued)

Indian Creek (P7)

Low Intertidal	June 99	June 00	June 01	June 02
juv. bivalve	0.3(0.5)	0.3(0.5)	0(0)	0.17(0.41)
Cassidisca lunifrons	0.8(0.5)	0(0)	0(0)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0.17(0.41)
Cryptochironomous sp.	0.8(1.5)	0(0)	0(0)	0(0)
Cyathura polita	0(0)	0.5(0.6)	0.8(1.5)	0(0)
Cyathura (*madelinae*)	0.3(0.5)	0(0)	0(0)	0(0)
Dispio unicata	0(0)	0.3(0.5)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.3(0.5)	1(2)	0(0)
Dolichopus sp.	0.3(0.5)	0(0)	0(0)	0(0)
Gammarus daiberi	0.3(0.5)	0(0)	0(0)	0(0)
Gammarus tigrinus	0.5(1)	0(0)	0(0)	0(0)
gastropod juv.	0.8(1)	0(0)	0(0)	0(0)
insect pupae	0.5(0.6)	0(0)	0(0)	0(0)
insect sp. a	0.5(0.6)	0(0)	0(0)	0(0)
insect sp.b	0(0)	0(0)	0.5(1)	0(0)
insect sp. f	0(0)	0(0)	0.3(0.5)	0(0)
insect sp. g	0(0)	0(0)	0.3(0.5)	0(0)
Isopoda (unknown)	0(0)	0.3(0.5)	0(0)	0(0)
Laeonereis culveri	0(0)	0.3(0.5)	0(0)	0(0)
Munna sp.	0 (7.7)	0(0)	0(0)	0(0)
Oligochaete	19(11.3)	64(39.3)	70.3(64.6)	0(0)
Orchestia sp.	0(0)	0(0)	0.3(0.5)	0(0)
Palpomyia/*Bezzia*	0(0)	0(0)	0(0)	0.17(0.41)
Paratendipes sp.	0.25(0.5)	0(0)	0(0)	0(0)
Polypedilum sp.	0(0)	1.25(1)	0.5(1)	0(0)
Procladius sp.	0.3(0.5)	0(0)	0(0)	0(0)
Spionidae sp.	0(0)	0.3(0.5)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	11.0(8.17)

Table 6.4-7. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P8 on the main-stem Cape Fear during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-sites for both high and low intertidal areas.

Dollisons Landing (P8)

High Intertidal	June 99	June 00	June 01	June 02
Bezzia/*Palpomia*	0.3(0.8)	0.8 (0.5)	0.5(0.6)	0(0)
juv. Bivalve	11.2(10.6)	23.5(17.0)	4.5(4.8)	0.75(0.96)
Cassidisca lunifrons	0(0)	0(0)	0(0)	0.5(0.58)
Coleoptera larvae	0.3(0.8)	0(0)	0(0)	0(0)
Collembola sp.	1.5(1)	6.5(5)	0.3(0.5)	0(0)
Dolichopodid larvae	0(0)	6.5(4.7)	0.8(1.5)	0.5(1.0)
Dolichopus sp.	2.2(1.8)	0(0)	0(0)	0(0)
Gammarus tigrinus	1.3(3.3)	0(0)	0(0)	0(0)
gastropod juv.	1.3(3.3)	0(0)	0(0)	0(0)
Hydaticus larvae	0.3(0.5)	0(0)	0(0)	0(0)
Hydrobia sp.	0(0)	0(0)	0.3(0.5)	0(0)
Hydrophilidae larvae	0(0)	0.3(0.5)	0(0)	0(0)
insect pupae	0(0)	0(0)	1(0.8)	0(0)
insect sp. a	0(0)	0(0)	0.3(0)	0(0)
insect sp. b	0(0)	0(0)	0.8(1.5)	0(0)
insecta sp.	0.2(0.4)	0(0)	0(0)	0(0)
Lumbriculidae sp.	5(7)	2(4)	0(0)	0(0)
Microsectra sp.	3.2(7.8)	0(0)	0(0)	0(0)
Mite	0.2(0.4)	0(0)	0(0)	0(0)
Nemertea	0(0)	0(0)	0.3(0.5)	0(0)
Notomierus capricornis	0.2(0.4)	0(0)	0(0)	0(0)
Oligochaete	73.5(34.5)	180.3(74.3)	33.5(25.8)	0(0)
Omisus sp.	0(0)	0(0)	0(0)	0.75(1.5)
Orchestia sp.	0(0)	0(0)	4(3.4)	0.25(0.5)
Orchestia uhleri	3.5(3.6)	2.5(3)	0(0)	1.25(2.5)
Oribatei sp.	0(0)	0(0)	0(0)	0.25(0.5)
Paratendipes sp.	0(0)	5.8(5.4)	0(0)	0(0)
Polypedilum sp.	0.2(0.4)	2.8(4.9)	0(0)	0.25(0.5)
Rheotanytarsus sp.	0.3(0.8)	0.5(1)	0(0)	0(0)
Stratiomya sp.	0.2(0.4)	0(0)	0(0)	0(0)
Tanais sp.	0(0)	0(0)	0.3(0.5)	0(0)
Tanytarsus sp.	1(2.4)	0.5(1)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	24.25(20.0)
Tubificoides heterochaetus	0.2(0.4)	0(0)	0(0)	1.25(2.5)
Uca pugilator	0.2(0.4)	0.5(1)	0(0)	0(0)
Uca pugnax	0(0)	0(0)	0.3(0.5)	0(0)

Table 6.4-7. (continued)

Dollisons Landing (P8)

Low Intertidal	June 99	June 00	June 01	June 02
Armadillidium quadrifrons	0(0)	0(0)	0(0)	0.25(0.5)
Bezzia/*Palpomia*	0.3(0.8)	0(0)	0.5(0.6)	0.75(0.96)
juv. Bivalve	1.7(1.4)	5.8(8.9)	1.8(0.5)	0.25(0.5)
Cassidisca lunifrons	0.8(2)	0(0)	0(0)	0(0)
Coelotanypus sp.	0(0)	0(0)	0(0)	0.25(0.5)
Collembola sp.	0.8(2)	0.3(0.5)	1.5(3)	0(0)
Corophium acherasicum	0(0)	0(0)	3(2.6)	0(0)
Corophium sp.	0(0)	0(0)	0.3(0.5)	0(0)
crab megalopae	0.8(2)	0(0)	0(0)	0(0)
Cryptochironomous sp.	0.3(0.8)	0(0)	0(0)	0(0)
Cyathura polita	0(0)	0(0)	2.3(1)	0(0)
Cyathura (*madelinae*)	0.7(1.6)	0.8(1.5)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.75(0.5)	0.8(1)	0(0)
Dolichopus sp.	1(2)	0(0)	0(0)	0(0)
Gammarus tigrinus	0.3(0.8)	0(0)	0(0)	0(0)
gastropod juv.	0.2(0.4)	0.5(1)	1(2)	0.5(1.0)
insect pupae	0(0)	0.25(0.5)	0(0)	0(0)
insect sp.b	0.2(0.4)	0(0)	0.3(0.5)	0(0)
Isopoda (unknown)	0(0)	0(0)	1(2)	0(0)
Lumbriculidae sp.	3(3.9)	1.5(2.4)	0(0)	0(0)
Microsectra sp.	0.2(0.4)	0(0)	0(0)	0(0)
Munna sp.	8.3(10.6)	23.5(33)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.8(1)	0(0)
Oligochaete	122.8(76.8)	103(33.8)	63(67.6)	0(0)
Orchestia sp.	0(0)	0(0)	1.3(2.5)	0(0)
Orchestia uhleri	0(0)	0.8(1)	0(0)	0(0)
Paratendipes sp.	0.2(0.4)	1(1.2)	0(0)	0(0)
Polypedilum haterale group	2.3(5.7)	0(0)	0(0)	0(0)
Polypedilum sp.	1.3(1.4)	3(3.2)	2.5(2.4)	0(0)
Pristinella sp.	2.3(5.7)	0(0)	0(0)	0(0)
Procladius sp.	0(0)	0(0)	0.3(0.5)	0(0)
Rheotanytarsus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Tanytarsus sp.	0.3(0.8)	1(2)	0(0)	0(0)
Tribelos sp.	0.3(0.8)	0(0)	0(0)	0(0)

Table 6.4-8. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P11 on the NE Cape Fear River during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-site for both high and low intertidal areas at each station.

Smith Creek (P11)

High Intertidal	June 99	June 00	June 01	June 02
amphipod sp.	0(0)	0(0)	0.3(0.5)	0(0)
Bezzia/*Palpomia*	0(0)	0(0)	0.5(1)	0.5(0.58)
juv. Bivalve	0.3(0.5)	0(0)	0(0)	0(0)
Boccardiella sp.	0(0)	1.3(2.5)	0(0)	0(0)
Cassidisca lunifrons	1(1.4)	0.3(0.5)	1.3(1)	0(0)
Curculionidae sp.	0.8(1.5)	0(0)	0(0)	0(0)
Cyathura madelina	0(0)	0.3(0.5)	0(0)	0(0)
Dicrotendipes lobus	1(2)	0(0)	0(0)	0(0)
Dicrotendipes nirvosus	0.5(1)	0(0)	0(0)	0(0)
Dicrotendipes sp.	0(0)	1(1.4)	0.5(0.6)	0.25(0.5)
Edotea triloba	0(0)	0(0)	0.3(0.5)	0(0)
Gammarus diaberi	0(0)	0(0)	0.3(0.5)	0(0)
Gammarus tigrinus	0(0)	0.3(0.5)	0(0)	0(0)
Gammarus mucronatus	0.3(0.5)	0(0)	0(0)	0(0)
Gammarus sp.	0(0)	0(0)	0(0)	1.5(3.0)
Hobsonia florida	7.5(8.7)	0(0)	3.3(2.2)	0(0)
Hydrobia sp.	0(0)	0(0)	0(0)	0(0)
Insect larvae (Elimidae)	0(0)	0.3(0.5)	0(0)	0(0)
Insect larvae/pupae	1.3(2.5)	0(0)	0(0)	0.5(1.0)
insect pupae	1(2)	0.3(0.5)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.5(1.0)
Megalopae (Uca)	0(0)	0(0)	0.3(0.5)	0(0)
Megalops	0(0)	0(0)	0(0)	0.25(0.5)
Nemertea	0(0)	0(0)	0(0)	0.25(0.5)
juv. Nereidae sp.	0(0)	0(0)	1(1.4)	0(0)
Oligochaete	10.5(7.4)	14.3(15.4)	1.8(1.7)	0(0)
Paratendipes sp.	0(0)	0.3(0.5)	0(0)	0(0)
Polydora ligni	0.3(0.5)	0(0)	0(0)	0(0)
Polydora socialis	0.3(0.5)	0(0)	0(0)	0(0)
Polydora sp.	0(0)	0(0)	0.3(0.5)	0(0)
Polypedilium sp.	0.5(1)	0.3(0.5)	0.5(1)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	0.75(0.96)
Tubificidae sp.	0(0)	0(0)	0(0)	9.75(17.52)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	1.0(1.41)

Table 6.4-8. (continued)

Smith Creek (P11)

Low Intertidal	June 99	June 00	June 01	June 02
amphipod sp.	0.2(0.4)	0(0)	0(0)	0(0)
Bivalve sp.	0(0)	0(0)	0(0)	0.2(0.45)
Boccardiella sp.	0(0)	0(0)	0.3(0.5)	0(0)
Corophium acherasicum	0(0)	0(0)	0.5(1)	0(0)
Corophium sp.	0(0)	0(0)	0.5(1)	0(0)
crab megalopae	0.2(0.4)	0(0)	0(0)	0(0)
Cryptochironomous (*fulvens*)	0.2(0.4)	0(0)	0(0)	0(0)
Eteone heteropoda	0(0)	0(0)	0(0)	0.2(0.45)
Gammarus tigrinus	0.6(0.9)	0(0)	0(0)	0(0)
Hobsonia florida	0.6(0.5)	0(0)	0.5(0.6)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.2(0.45)
Marenzellaria virdis	1.7(3.8)	3.9(0)	20(14.4)	0(0)
nemertean	0.2(0.4)	0(0)	0.5(0.6)	0.2(0.45)
juv. Nereidae	0(0)	0(0)	10.5(3.7)	0(0)
Oligochaete	3.6(4.2)	0.3(0.5)	11.3(12.6)	0(0)
Parandalia sp. A	0(0)	0(0)	0(0)	0.2(0.45)
Pentatomidae	0(0)	0(0)	0(0)	0.2(0.45)
Polypedilum sp.	0.4(0.9)	0.5(1)	2.3(1.5)	0(0)
Streblospio benedicti	0(0)	0(0)	0(0)	2.0(3.08)
Tubificidae sp.	0(0)	0(0)	0(0)	0.4(0.89)
Tubificoides heterochaetus	6.2(13.9)	0(0)	0(0)	30.4(42.43)

Table 6.4-9. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P12 on the NE Cape Fear River during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-site for both high and low intertidal areas at each station.

Rat Island (P12)

High Intertidal	June 99	June 00	June 01	June 02
Bezzia/Palpomia	1.8(0.8)	0(0)	0.3(0.5)	1.4(2.07)
Cassidisca lunifrons	0.2(0.4)	0.3(0.5)	0.3(0.5)	0.4(0.89)
Collembola sp.	0.2(0.4)	1(0.8)	0(0)	0(0)
Corophium (*lacustre*)	0.2(0.4)	0(0)	0(0)	0(0)
Cricotopus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Dicrotendipes sp.	0(0)	0(0)	0.3(0.5)	0(0)
Dispio unicata	0(0)	0.3(0.5)	0(0)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0(0)	0.2(0.45)
Dolichopodid larvae	0(0)	0.3(0.5)	0.8(1.5)	0(0)
Dolichopus sp.	0.6(0.9)	0(0)	0(0)	0(0)
Donacia sp.	0.2(0.4)	0(0)	0(0)	0.2(0.45)
Donaciinae sp.	0(0)	0(0)	0(0)	0.2(0.45)
Gammarus sp.	0(0)	0(0)	0(0)	0.2(0.45)
gastropod juv.	0.2(0.4)	0(0)	0(0)	0(0)
Heterothissocladius sp.	0(0)	0.3(0.5)	0(0)	0(0)
Hydrobia sp.	0(0)	0.25(0.5)	0(0)	0(0)
insect larvae g	0.4(0.9)	0(0)	0(0)	0(0)
insect larvae h	1.2(2.7)	0(0)	0(0)	0(0)
insect sp. f	0(0)	0(0)	0.8(1)	0(0)
Laeonereis culveri	1(1.2)	0.3(0.5)	0(0)	0(0)
Lumbriculid sp.	0(0)	0.3(0.5)	0(0)	0(0)
Mesomelia mulsanti	0(0)	0(0)	0(0)	0.2(0.45)
Mite	0(0)	0(0)	0.3(0.5)	0(0)
Monopylephorus irroratus	1(2.2)	0(0)	0(0)	0(0)
Namalycastis sp.	0(0)	0(0)	0.3(0.5)	0(0)
Nematoda sp.	24(35.6)	17.5(13.8)	0(0)	0(0)
juv. Nereidae sp.	0(0)	0(0)	0.3(0.5)	0(0)
Nereidae sp.	0(0)	17.5(13.8)	0(0)	0(0)
Ocypode quadrata	0.2(0.4)	0(0)	0(0)	0(0)
Oligochaete	47.8(21.5)	30(19.6)	13.3(14.2)	0(0)
Orchestia sp.	0(0)	0(0)	0.5(1)	0(0)
Orchestia uhleri	0.2(0.4)	0.5(0.6)	0(0)	0(0)
Polypedilium sp.	0(0)	0(0)	0.5(1)	0(0)
Pristinella sp	0.2(0.4)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	3.2(2.59)
Uca minax	0.2(0.4)	0(0)	0(0)	0(0)
Uca pugilator	0.2(0.4)	0(0)	0(0)	0(0)
Uca sp.	0(0)	0(0)	0(0)	0.4(0.89)

Table 6.4-9. (continued)

Rat Island (P12)

Low Intertidal	June 99	June 00	June 01	June 02
amphipod sp. B	0.2(0.4)	0(0)	0(0)	0(0)
Bezzia/*Palpomia*	0.2(0.4)	0(0)	0(0)	0(0)
Boccardiella sp.	0(0)	0(0)	12.5(25)	7.6(9.91)
Collembola sp.	0(0)	0(0)	0.5(1)	0(0)
Corophium acherasicum	0(0)	0(0)	1(2)	0(0)
Edotea juv sp.	0(0)	0(0)	0(0)	0.2(.45)
Gammarus tigrinus	0.2(0.4)	0(0)	0(0)	0(0)
juv. Gastropoda	0(0)	0(0)	0.3(0.5)	0(0)
Hobsonia florida	0(0)	0(0)	0(0)	0.4(0.89)
insect	0(0)	0.3(0.5)	0(0)	0(0)
insect larvae	0(0)	0.3(0.5)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.4(0.89)
Lumbriculid sp.	0(0)	1.8(2.9)	0(0)	0(0)
Megalops	0(0)	0(0)	0(0)	0.2(0.45)
Namalycastis sp.	0(0)	0(0)	0.5(1)	0(0)
Nereis lamellosa	0(0)	0(0)	0(0)	0.2(0.45)
Oligochaete	1.6(1.1)	7.3(8.8)	2.8(3)	0(0)
Paracladopelma sp.	0.2(0.4)	0(0)	0(0)	0(0)
Polydora ligni	0.2(0.4)	0(0)	0(0)	0(0)
Polydora socialis	0(0)	0(0)	0(0)	0.2(0.45)
Polydora sp.	0.2(0.4)	0(0)	0(0)	0(0)
Polypedilum sp.	0.2(0.4)	0(0)	0(0)	0(0)
Rhithropanopeus harrisii	0(0)	0(0)	0(0)	0.2(0.45)
Spiophanes bombyx	0(0)	0(0)	0(0)	0.2(0.45)
Streblospio benedicti	0(0)	0(0)	0(0)	0.8(1.3)
Tubificidae sp.	0(0)	0(0)	0(0)	1.8(3.03)
Tubificoides heterochaetus	0(0)	0(0)	0(0)	0.4(0.89)

Table 6.4-10. Mean (no. per 0.01 m^2) and standard deviation for all taxa collected at P13 on the NE Cape Fear River during June 1999, June 2000, June 2001, and June 2002. The means presented here represent the combination of two sub-site for both high and low intertidal areas at each station.

Fishing Creek (P13)

High Intertidal	June 99	June 00	June 01	June 02
Aricidea suecica	0(0)	0(0)	0(0)	0.25(0.5)
Bezzia/Palpomyia	0(0)	0(0)	0(0)	0.75(1.5)
juv. bivalve	0(0)	0.8(1)	0(0)	0(0)
Collembola sp.	0.2(0.4)	0(0)	0(0)	0(0)
Cyathura polita	0.2(0.4)	0(0)	0(0)	0(0)
Dolichopodid larvae	0(0)	1.3(1.5)	0.3(0.5)	0.25(0.5)
Dolichopus sp.	0.4(0.5)	0(0)	0(0)	0(0)
Halipldae sp.	0.2(0.4)	0(0)	0(0)	0(0)
Hydrobia sp.	0(0)	0.3(0.5)	0(0)	0(0)
Insect larvae/pupae	0(0)	0(0)	0(0)	0.25(0.5)
insect pupae	0.2(0.4)	0(0)	0.3(0.5)	0(0)
Laeonereis culveri	0.4(0.5)	2(2.2)	0(0)	0.25(0.5)
Lumbriculid sp.	1.4(3.1)	0.5(0.6)	0(0)	0(0)
Mediomastus sp.	0.2(0.4)	0(0)	0(0)	0(0)
Megalopae (Uca)	0(0)	0(0)	0.3(0.5)	0(0)
Namalycastis sp.	0(0)	0(0)	0.3(0.5)	0(0)
Nereidae sp.	0(0)	0(0)	0(0)	0.25(0.5)
Oligochaete	29.4(15.4)	11(7.4)	46.5(27.1)	0(0)
Orchestia sp.	0(0)	0(0)	0.5(0.6)	0(0)
Oribatei sp.	0(0)	0(0)	0(0)	0.25(0.5)
Paratendipes sp.	0(0)	0.5(1)	0.8(1)	0(0)
Polypedilium sp.	0.2(0.4)	0(0)	0.3(0.5)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	2.75(4.85)

Table 6.4-10. (continued)

Fishing Creek (P13)

Low Intertidal	June 99	June 00	June 01	June 02
Bezzia/*Palpomia*	0(0)	0(0)	0.3(0.5)	0.75(0.96)
Cassidimidea lunifrons	0(0)	0(0)	0(0)	0.25(0.5)
Chirodotea caeca	0.3(0.5)	0(0)	0(0)	0(0)
Cryptochironomous (*fulvens*)	0.5(1)	0(0)	0(0)	0(0)
Dolichopodid larvae	0(0)	0.3(0.5)	0(0)	0(0)
Hobsonia florida	0(0)	0(0)	0.3(0.5)	0(0)
insect pupae	0.3(0.5)	0(0)	0(0)	0(0)
insect sp. d	0.3(0.5)	0(0)	0(0)	0(0)
larval fish	0.3(0.5)	0(0)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0(0)	0.25(0.5)
Megalopa (*Uca*)	0(0)	0(0)	0.3(0.5)	0(0)
Namalycastis sp.	0(0)	0.3(0.5)	0(0)	0(0)
Oligochaete	34.3(22.3)	29.3(30.7)	8.3(1)	0(0)
Polypedilum sp.	0.3(0.5)	1(1.4)	1.3(1.9)	0(0)
Procladius sp.	0.8(1)	0(0)	0(0)	0(0)
Tubificidae sp.	0(0)	0(0)	0(0)	4.0(6.16)

7.0 EPIBENTHIC STUDIES: DECAPODS AND EPIBENTHIC FISH

7.1 Summary

This report focuses on the epibenthic fauna (fish and decapods primarily) that utilize the fringing marshes and tidal swamps along the Cape Fear River. This group of organisms is by definition highly mobile. Temporal and spatial trends in community level factors (e.g. diversity, species richness, and species groupings) can indicate impacts of potential dredge effects. Fall and spring data from both Breder trap and drop trap samples collected since 1999 are included in those analyses. Fall 1999 through 2000 reflect pre-dredge or background conditions.

Evaluation of species richness, diversity, and total fauna by season (spring-fall) for Breder trap data showed strong inter-annual and site differences as well as strong year*site interactions. These results are predicted based on the highly motile nature of the fauna and variable conditions within the Cape Fear River system. Patterns are consistent with developing drought conditions in 2001 and 2002 and further evaluation will be needed to determine if these community fluctuations are also indicative of river widening impacts. Principal Components Analysis showed little sample grouping or directionality in trends. Drop trap results were similar to Breder traps, with significant annual and site differences as well as year*site interactions. Analysis of drop data by season showed fall 2000 and spring 2002 to have distinctly higher levels for species richness, diversity, and total faunal abundance compared to other fall and spring samples.

7.2 Background

One of the most important habitats in the Cape Fear River estuary is the riverine-wetland boundary. This area provides both refuge for resident species and forage and refuge for a number of transient species, many of which are valuable commercially and environmentally as indicators. As part of the long-term project to monitor potential changes in the communities that depend on these habitats we are examining the epibenthic community (primarily fish and decapods) found along the marsh and swamp boundary. Aside from resident fish and decapods, epibenthos include juveniles of transient fish, crabs, and shrimp as well as larger snails, amphipods, and isopods. These organisms tend to be highly motile, are often able to utilize a variety of habitats, and may respond rapidly to environmental cues. Many species have larval stages that leave the upper estuary, making recruitment, and subsequent impacts on population levels, potentially responsive to changes in river hydrology. Examples of epibenthos in the Cape Fear system include important fisheries species such as the blue crab, *Callinectes sapidus*, the spot, *Leiostomus xanthurus*, and commercial shrimp, (*Farfantopanaeus* sp. and *Litopanaeus* sp.). Many epibenthos often occupy critical intermediate trophic roles, being predators on benthos or plankton and prey for larger fish (e.g. grass shrimp, *Palaemonetes* spp., killfish, *Fundulus* spp., and bay anchovy, *Anchoa* sp.). Evaluation of epibenthos provides direct information on possible year class strength of target fishery and indicator species as well as indications of resource and ecosystem responses. Epibenthos may respond quickly to changing conditions because of their ability to move away from unfavorable conditions as well as their dependence on annual recruitment events.

In this study we focus only on the epibenthic community utilizing the fringing marsh and swamp habitats across the estuarine gradient during the spring and fall periods. This timing represents periods of recruitment into the estuary (primary recruitment in the spring and a smaller pulse in the fall of the year, with differences in species composition between seasons) that may prove important for detection of higher trophic level impacts. The habitats sampled are the most prominent structural habitats within the upper Cape Fear estuarine system and provide both refuge and forage for epifaunal organisms.

Epibenthic taxa are indicators of ecosystem level changes for three reasons: 1) their motile lifestyles allows them to quickly respond to physical changes in the environment, 2) many of the species are juveniles that represent a critical "bottleneck" in year class strength that is sensitive to hydrodynamic factors affecting larval ingress, and 3) the intermediate trophic role of many epibenthos may lead to greater responsiveness to both changes in primary consumer abundances (e.g. benthos) and higher predator abundances. Changes in tidal amplitude or salinity regimes may be first detected as a change in the distribution of certain epifaunal organisms, including shifts in dominance at a site or along the upstream/ downstream gradient. Epifauna are sensitive to changes in many physical conditions and may show behavioral avoidance depending on the factor (i.e. rapid shift in dissolved oxygen, temperature or salinity). Conversely, they may show consistency on the longer temporal scale (i.e. timing of ingress/egressing into the estuary and dominance patterns). For many epifauna, especially the juveniles of transient fish, a critical factor may be resource limitation. The presence of a consistent and abundant food resources (including benthic fauna) and refuge (structural habitat within the marsh system) are important for determining population levels and survivorship.

The objective of this section of the monitoring project is to evaluate long-term trends in abundance, species composition, and habitat utilization of epibenthos and to detect shifts (if any) in these patterns concordant with river deepening activities and any associated physical changes. The primary objective of the first 2 years of sampling (fall 1999-spring 2001) was to establish a baseline for species composition and abundance patterns. By the third year of monitoring (fall 2001-spring 2003 – the period covered in this annual report) initial effects of actual deepening activities may begin to be observed if construction had already changed hydrology in the upper estuary. Any potential long-term impacts of the river deepening project would be detected by comparison of patterns in multiple years after channel deepening has been completed to pre-construction and during construction patterns. As with the benthic infaunal sampling, some of the potential impacts to these communities are similar to those predicted for rapid sea level rise and so may indicate long-term community changes expected in other systems over the next several decades.

Hypothesis are: 1) Changes in salinity, tidal inundation, or tidal amplitude may cause shifts in the epibenthic community (composition and/or abundance) that utilizes the intertidal and shallow subtidal regions of the estuary. If these changes do occur they should be evident as shifts in faunal abundance over time at a site and possibly as shifts among sites. 2) If possible impacts due to the deepening and widening of the river channel significantly alter the benthic community they may cause a trophic cascading effect that will change the dominance patterns and possibly the distribution of some epibenthic species. 3) At the most severe extreme, hydrologic alterations may affect recruitment strength for transient species at some stations.

7.3 Methodology

Marshes and boundary wetlands in the Cape Fear River estuary provide a variety of habitats, especially in the tidally influenced areas that have both intertidal and shallow subtidal edge habitats. Two sampling methods, Breder traps and drop traps, were used to target fauna with different utilization patterns. Breder trap sampling, targets bottom-oriented organisms that utilize the intertidal marsh habitat during the period of inundation. Breder traps are a passive form of sampling that average use patterns over a several hour period. This method has the advantage of being reliably deployed among structure. Drop trap sampling targets those organisms that utilize the shallow subtidal or "edge" habitat. It is an instantaneous method that provides reliable estimates for both bottom oriented and pelagic species, with the advantage of allowing high replication, but it is difficult to deploy within heavy structure.

Breder traps are used to sample small fish and crustaceans utilizing areas within the vegetated marsh or wooded swamp. The traps are constructed of clear acrylic and when submerged, are transparent and catch epibenthic fish and crustaceans passively. At each station, traps are placed at three tidal heights; lower intertidal (near mean low water), mid intertidal (submerged ~1m depth at mean high water), and upper intertidal (submerged ~ 0.5m at mean high water). Two sets of five traps are set at each tidal height with the opening oriented either toward the channel or downstream. The orientation of the traps is based on preliminary data that indicates this positioning is optimal for obtaining highest catches. Each trap is secured to the substrate to ensure it maintains proper orientation. All traps are set on the rising tide and traps are allowed to "fish" for two hours. This time period is based on previous work and represents a compromise between obtaining higher catches and reducing possible loss due to escape or to predation or cannibalism among organisms within the traps. All organisms caught are identified to lowest possible taxon and representative specimens are preserved for verification. All organisms caught are measured for total length. Breder trap sampling is conducted at 9 sites: P11, P12, and P13 in the mainstem Cape Fear River, P6, P7, and P8 in the Northeast Cape Fear, and P2 and 2 sites at P3 in Town Creek.

Drop traps sample those epibenthos utilizing the lower marsh edge or shallow subtidal regions adjacent to the marsh. The drop trap is an aluminum square that is 1m on a side and 1m high with mesh netting and floats attached to the top edge to prevent organisms from escaping. The trap is deployed from a boat using a large boom that suspends the trap 6-8 feet above the water surface. When the trap is released its weight drives it into the substrate and seals the bottom to prevent organisms from escaping beneath the trap (each drop is checked for an adequate bottom seal upon deployment to ensure that organisms cannot escape). Eighteen replicate drops are made in the shallow subtidal areas at each station. Replicate samples are taken at least 10m apart and at least 20 minutes is allowed between each sample. Once the trap is secured the contents are removed using a steel frame sweep net with a 2mm mesh. The trap is considered empty when five consecutive sweeps of the entire trap yield no organisms. All organisms caught are identified, enumerated, and measured (total length). Representatives of each species caught are preserved for verification. Drop sampling is conducted at the same sites as Breder trap sampling, except that the two P3 subsites are sampled as one site.

Drop trap and Breder trap sampling was conducted during the same time window for all stations. However a minimum of two days was allowed between sampling methods for any station. This time period reduces possible interference between sampling methods and reduces possible impacts at the sampling stations.

For this report, we present mean abundance of epibenthos for each station by year and season (reflecting seasonal variation in faunal abundances) (Tables 7.4-1 to7.4-17). To evaluate potential trends and community level responses, analyses for this report focus on differences in species richness, diversity, and total fauna by season across years. All analyses were run on per sample calculations of species richness, diversity, and total fauna). Breder trap data was initially analyzed with year/season/site/set (upper, mid, or lower intertidal) as main effects, along with the appropriate interactions, using an analysis of variance approach. Results of that analysis indicated strong interactions, with season (reflecting differential recruitment patterns for different species), so the data was analyzed separately for each season. This analysis detected some interactions, however these interactions where attributed to sites and sets with low abundances or no fauna captured during one or more sampling events. To more directly evaluate species grouping responses we conducted a principal components analysis for common taxa (>3% of individuals captured on any one date). A biplot of the first two components were used to detect potential site/season/year groupings of samples. Data collected from drop trap sampling was also analyzed for community level responses, examining per sample species richness, total fauna abundance, and diversity by year/site/season. As with the Breder trap data interactions related to site differences seem to reflect the patchy nature of the epibenthos and magnitude effects, where some sampling periods had few or no fauna collected at a particular site.

7.4 Faunal patterns

A total of 42 taxa have been collected using Breder trap sampling since the initiation of this project in fall 1999. The mean abundance along with standard errors for each taxon by site/season/year is presented in tables 7.4-1 to 7.4-9. Drop trap sampling collected a total of 66 taxa. Likewise the mean abundance and standard error of each taxa present at a site is presented in tables 7.4-10 to 7.4-17. These data clearly show the variable nature of individual taxa, but they also highlight the consistent occurrence of certain groups of taxa.

Diversity and total abundance showed both temperal and site differences. For fall Breder trap sampling among all four years, 2002 demonstrated significantly higher total fauna ($F=44.06$ $p<0.0001$), species richness ($F=38.81$, $p<0.0001$), and diversity ($F=19.99$, $p<0.0001$) compared to 1999, 2000, and 2001 (Figure 7.4-1 to 7.4-2). Site effects involve Town Creek sites (P2, P3a, and P3b) and the Smith Creek site (P11) being similar for all three factors and having significantly higher species richness and diversity than other sites based on Student-Newman-Keuls procedure. Patterns are less clear for spring sampling. While there were significant year effects for all three factors (species richness, total fauna, and diversity), these involved differences between 2001 and 2003, which had consistently lower values for richness, diversity, and total abundance. There was no difference between spring 1999, 2000, 2002, and 2003 (Figure 7.4-3 to 7.4-4). Like fall samples the Town Creek sites (P2, P3a, and P3b) tend to group together and differ from other sites in diversity and total abundance. However, these differences were not consistent and there were interactions among sampling period/site patterns. Like the Breder trap data, drop trap samples were analyzed for community level, year and site effects for each season. Spring 2002 demonstrated significantly higher species richness ($F=18.57$, $p<0.0001$) and diversity ($F=9.43$, $p<0.0001$) with all other years not differing from one another (Figure 7.4-5 to 7.4-6). Site effects were variable, although Town Creek sites (P2, P3) and Smith Creek (P11) tended to have higher values than other sites, though they did not differ on a consistent basis. Fall drop trap data showed no clear pattern among years or sites, although 2000 tended to have higher diversity and abundance than other fall samples (Figure 7.4-7 to 7.4-8). Year*site interactions were noted for both seasons, however the source of these interactions is based on the variable relative abundances among sites and the fact that some sites had zero catches for some seasons.

Principal components analysis was run on Breder trap data to evaluate potential community level responses across all sampling periods including all year and season combinations. These analyses contrasted sharply with the analogous infaunal results that showed both strong year effects and accounted for a significant amount of variation within the data set. Overall the plots of the first two principal components show little directionality (Figure 7.4-9), (% variation explained prin1=0.08, prin2=0.15) with few outlier sample/date combinations. The biplot of the first two principal components for each of the three tributary systems provides more detail of patterns and emphasis on similarity among all samples except for P2, P6, P11, and P12 for specific dates (Figure 7.4-10 to 7.4-12). Drop trap data were not analyzed using principal components because of the large number of sampling data-site combinations with low abundances or no fauna collected.

The results of these analyses highlight the need for a multiyear approach to community analysis and the usefulness of community level investigations. To date we have seen little to indicate any impact of construction, however the peak in species richness and diversity noted in spring of 2002 is interesting because this coincides with our timeline of observing the first potential impacts of construction. However this may represent a single event and the potential impact of drought conditions, prevalent during this time period, must be considered. If these climatic conditions drive faunal patterns (rather than river widening), then a "rebound" would be expected in subsequent years of sampling.

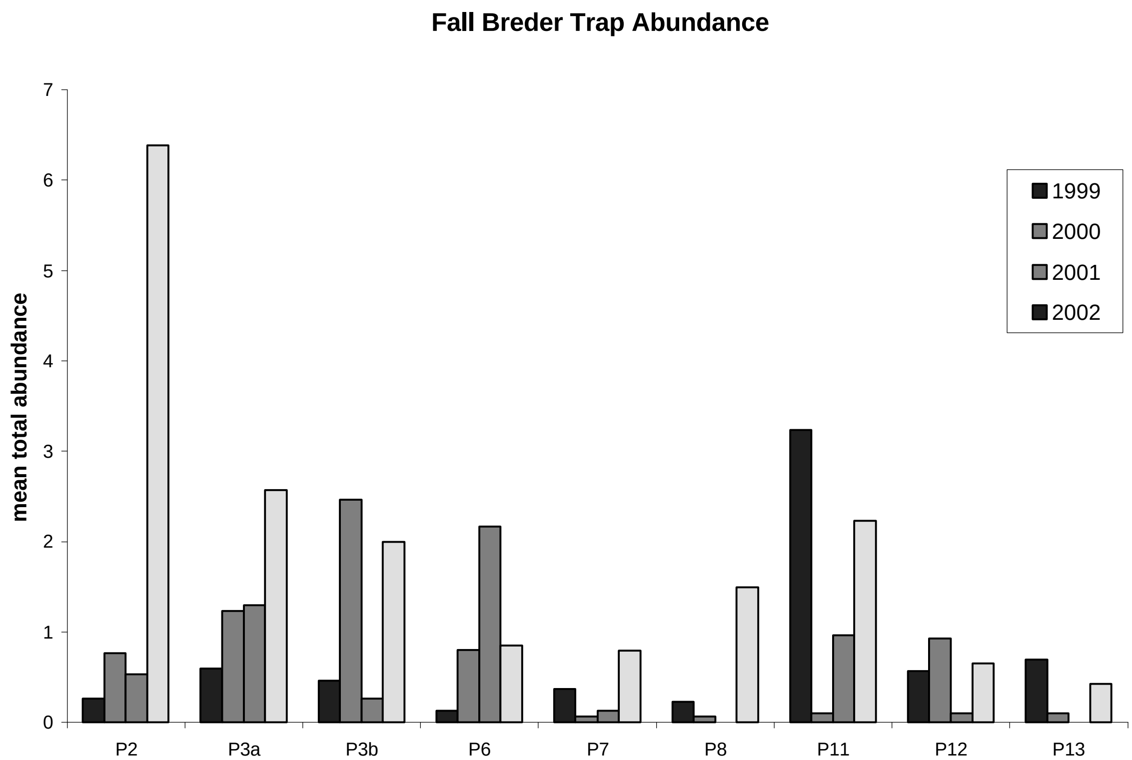


Figure 7.4.1. Mean total abundance per sample for fall Breder Trap sample 1999-2002

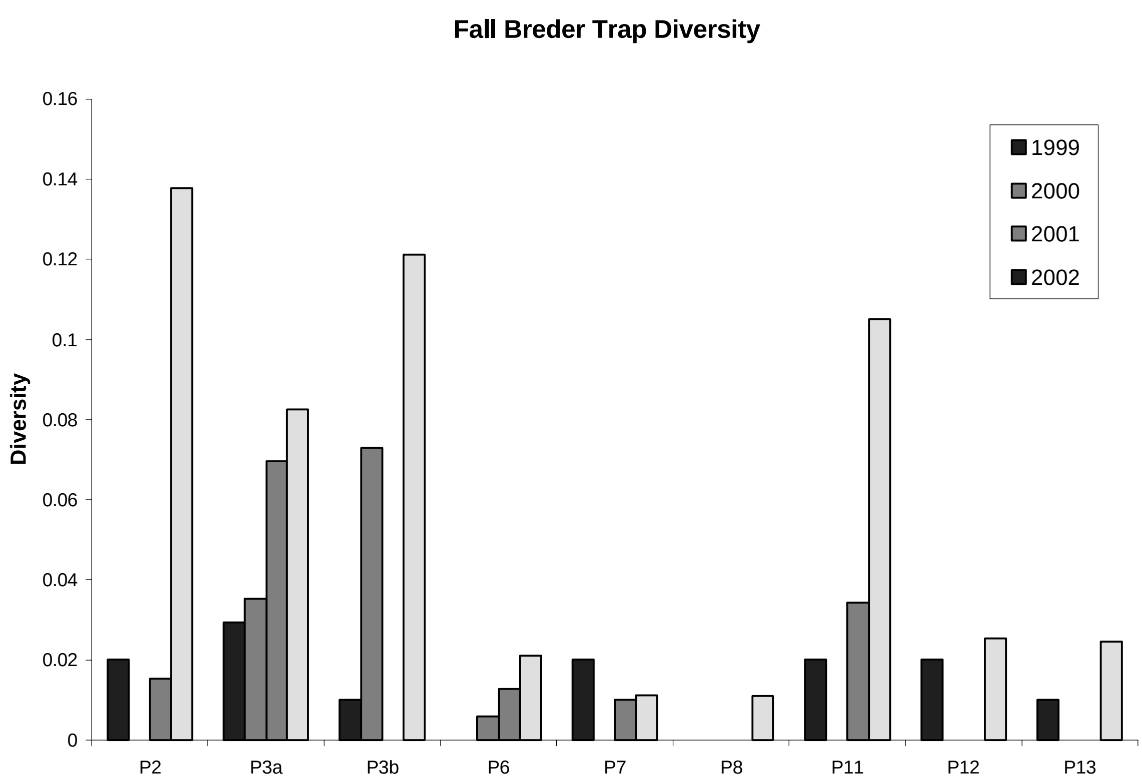


Figure 7.4.2. Mean diversity per sample for fall Breder trap samples 1999-2002

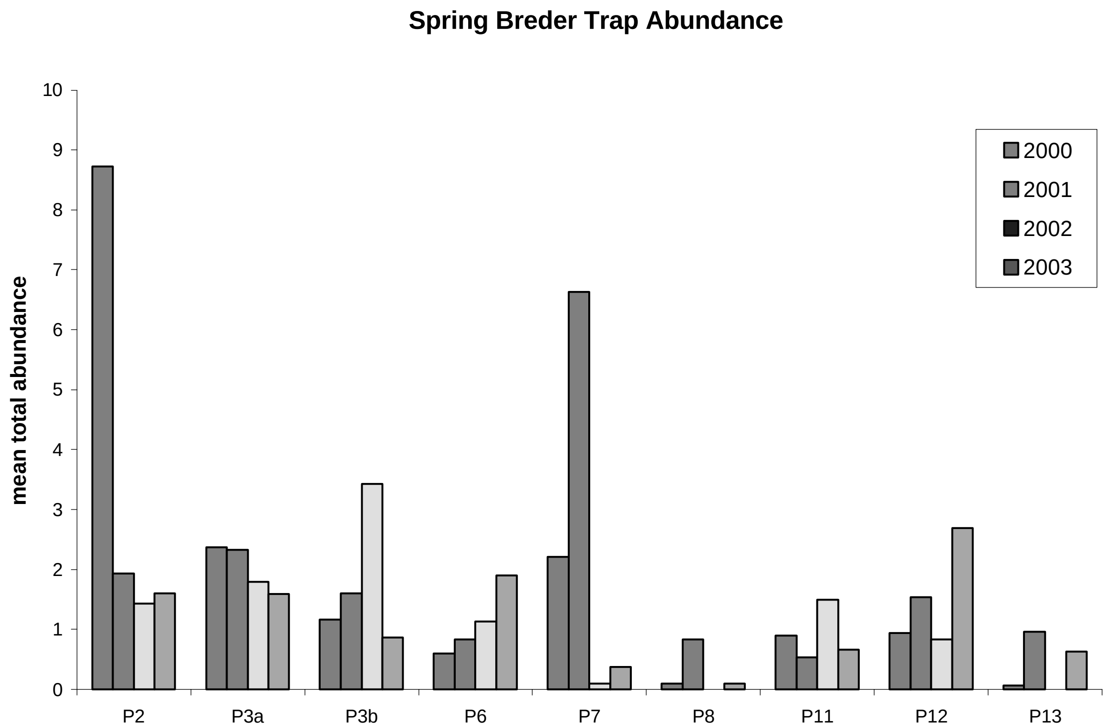


Figure 7.4.3. Mean total abundance per sample for spring sampling periods 2000-2003

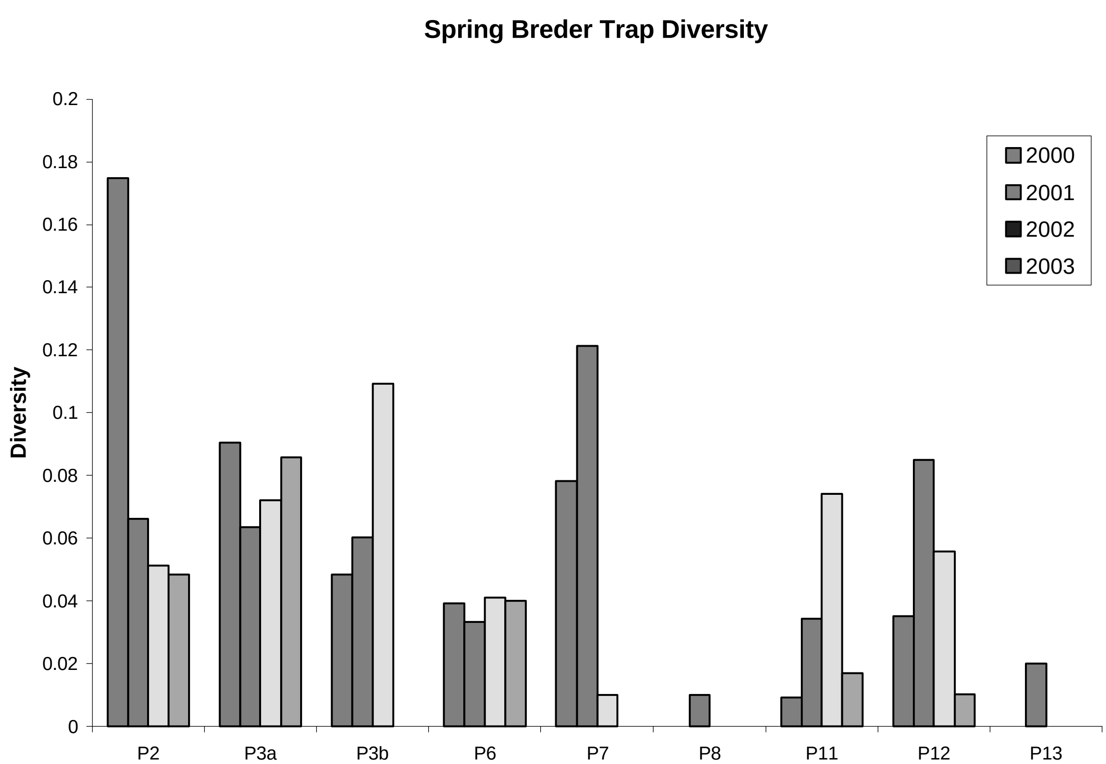


Figure 7.4.4 Mean diversity by site for spring sampling periods 2000-2003

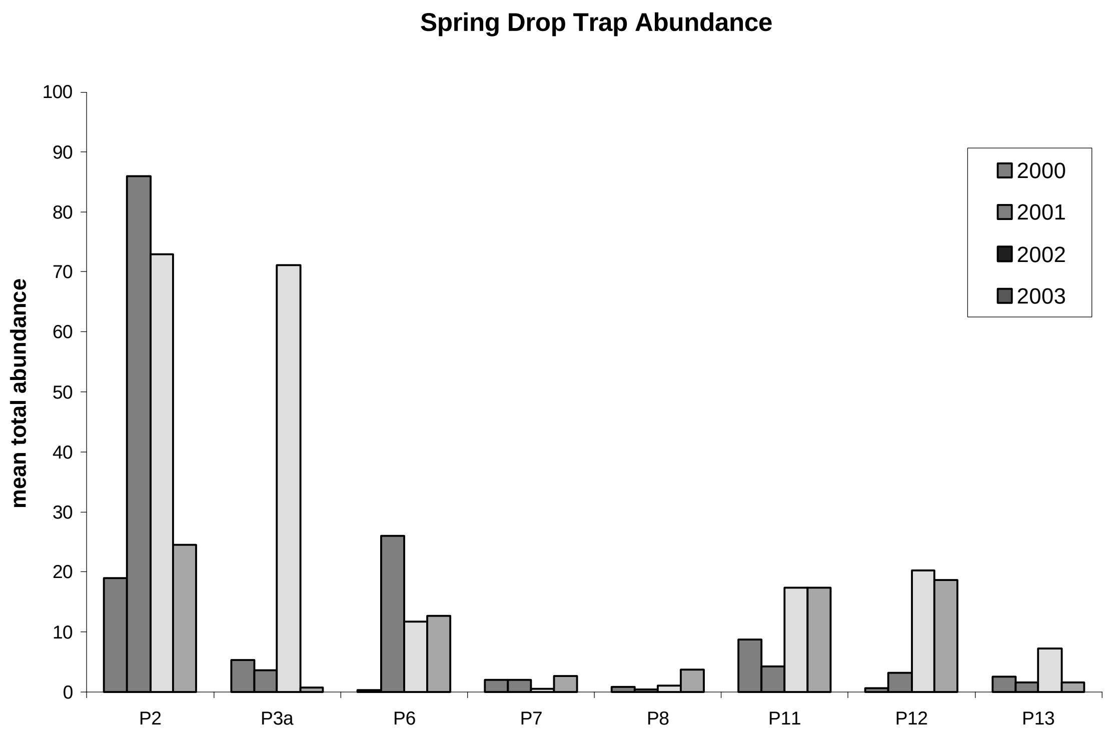


Figure 7.4.5 Mean total abundance per sample for drop traps taken in spring samplings 2000-2003

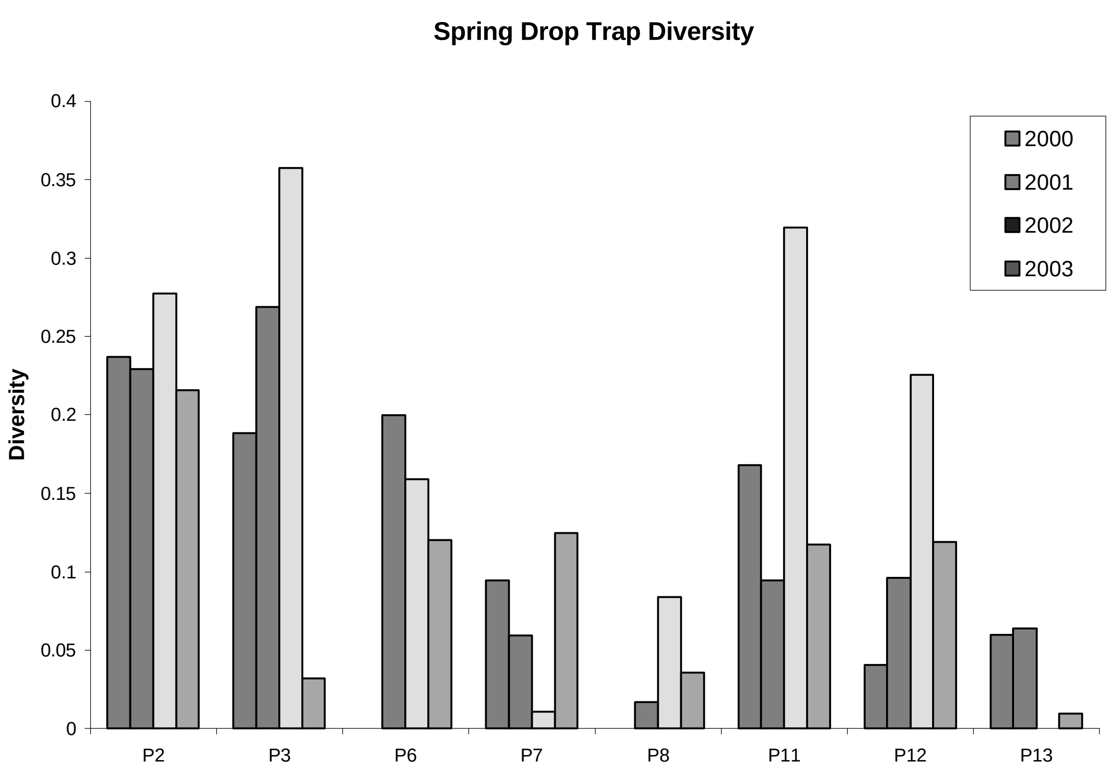


Figure 7.4.6 Mean diversity for drop trap all sring drop trap samplings 2000-2003

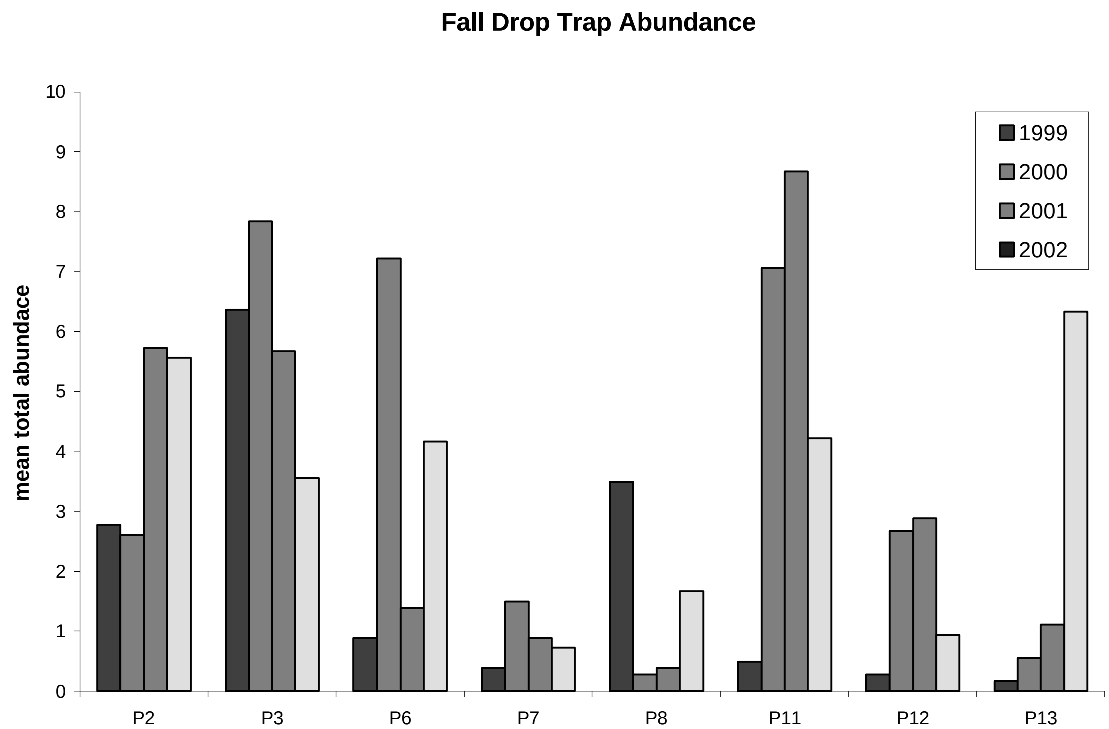


Figure 7.4.7. Mean total abundance per sample from all fall drop trap samplings 1999-2002

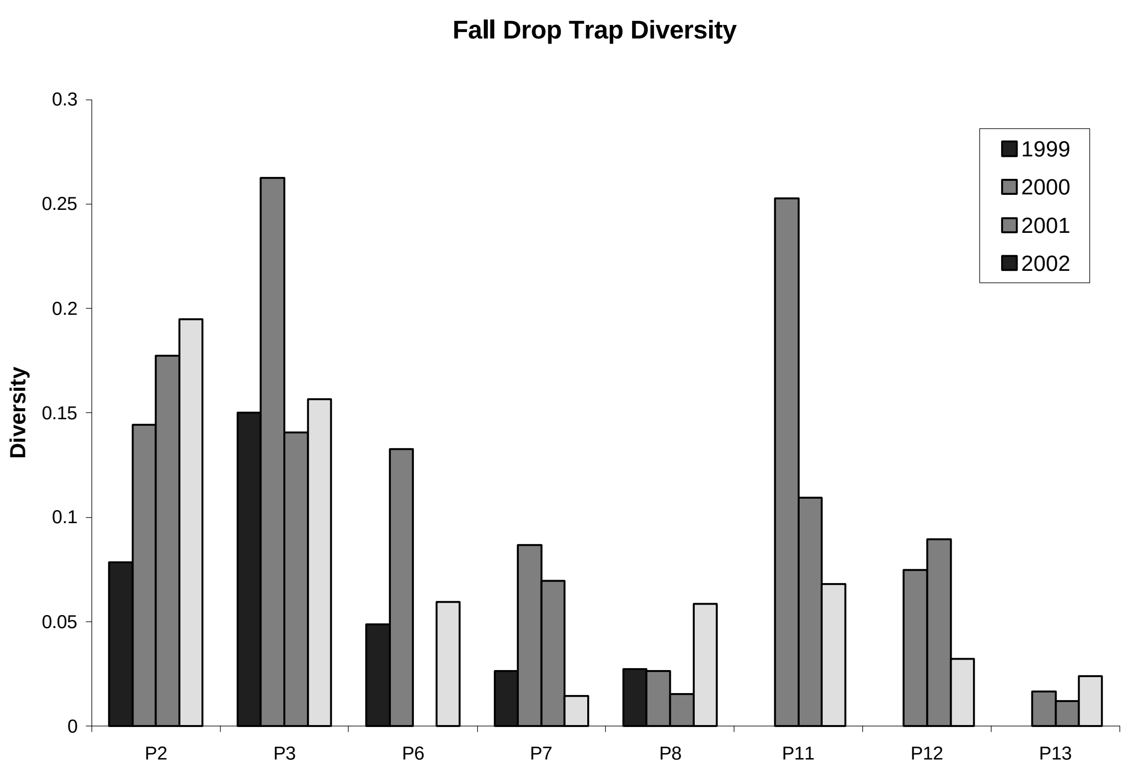


Figure 7.4.8. Mean diversity from fall drop trap samplings 1999-2002

All Sites Combined

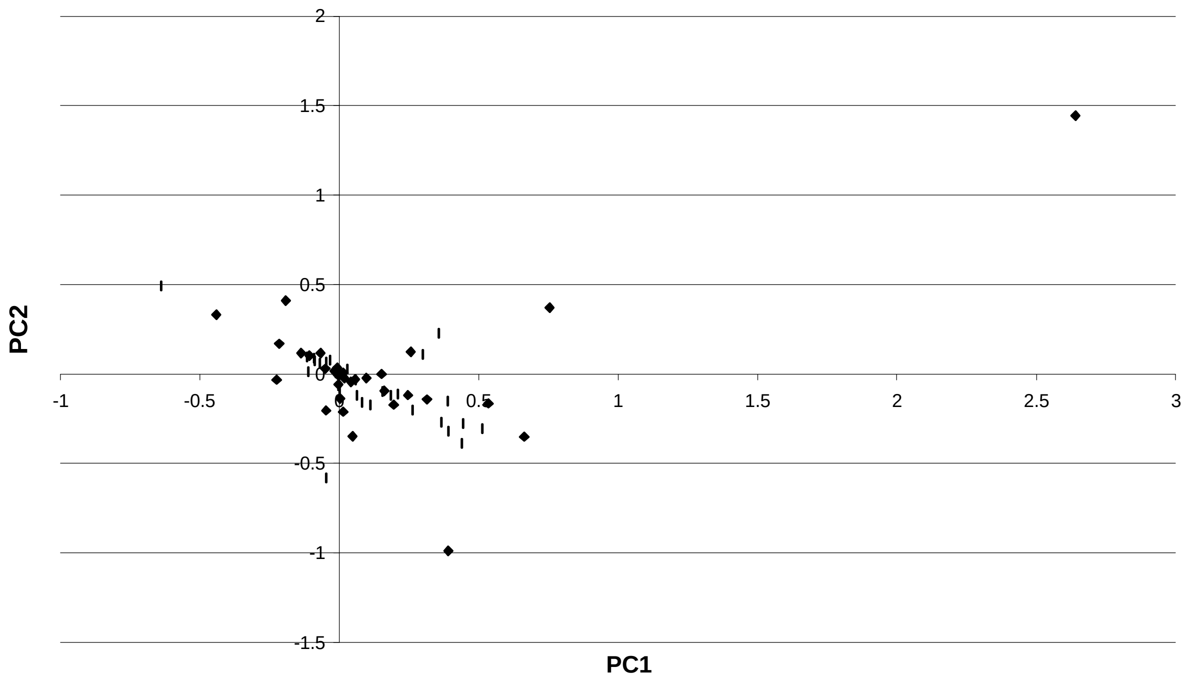


Figure 7.4-9. First two principal components for all stations combined. All seasons 1999-2003

P2-P3

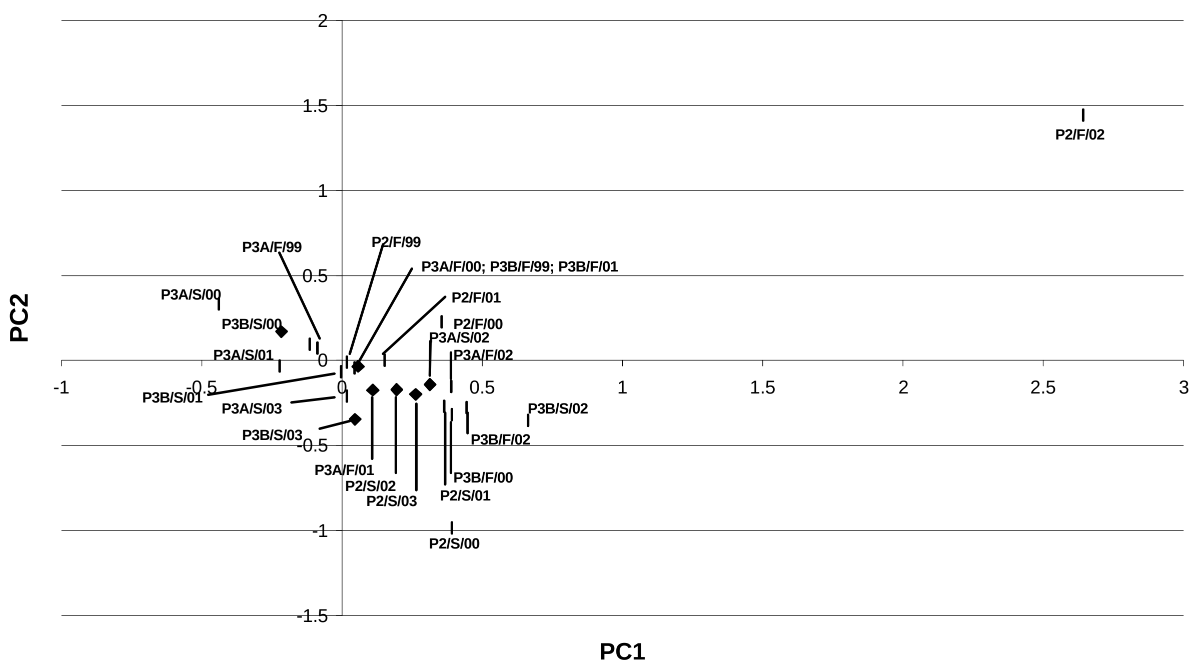


Figure 7.4-10. First two principal components for Town Creek stations (Mouth of Town Creek=P2, upper Town Creek=P3a and P3b). All seasons, 1999-2003

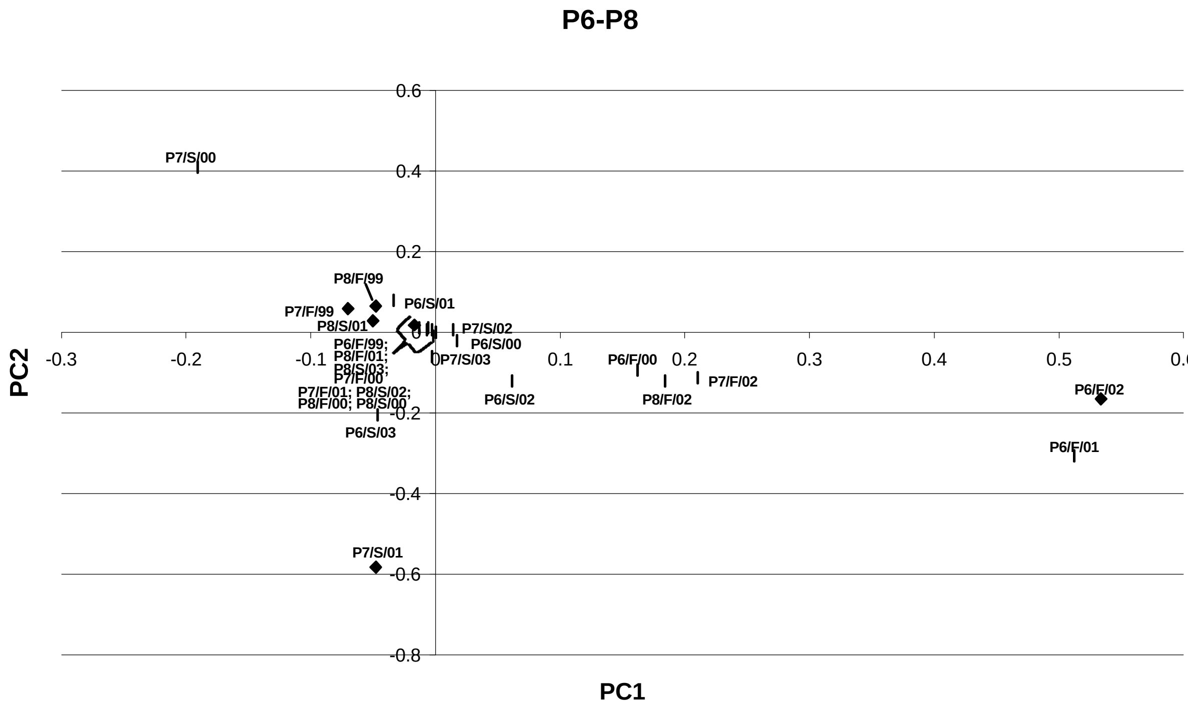


Figure 7.4-11. First two principal components for the main stem Cape Fear River stations (Eagle Island=P6, Indian Creek=P7, and Dollisons Landing=P8). All seasons, 1999-2003

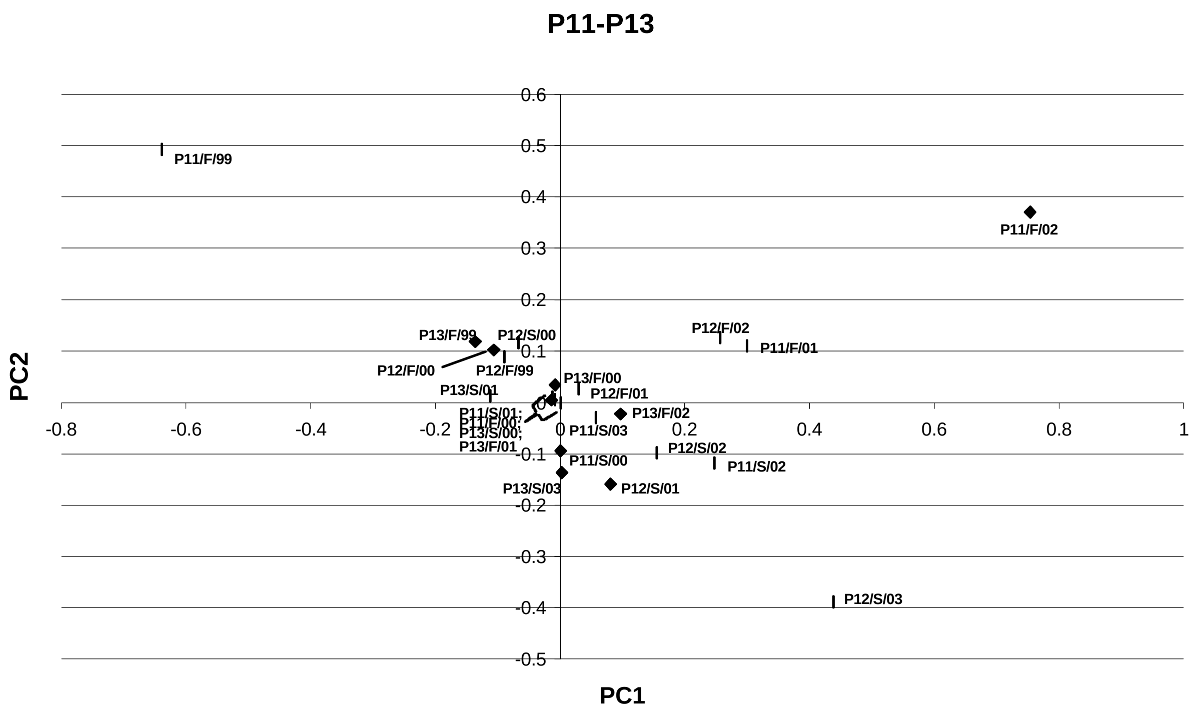


Figure 7.4-12. First two principal components for the Northeast Cape Fear River stations (Smith Creek=P11, Rat Island=P12, and Fishing Creek=P13). All seasons, 1999-2003

Table 7.4-1a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P2 (mouth of Town Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0 (0)	0.33 (0.17)	0.11 (0.11)
Dormitator maculates	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.10 (0.10)	0.05 (0.05)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.05 (0.05)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.15 (0.08)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.40 (0.22)	0.75 (0.37)	0.89 (0.45)	0.33 (0.17)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.70 (0.33)	0.90 (0.28)	0.60 (0.27)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	4.38 (0.73)	5.00 (1.19)	4.11 (1.82)
Symphorus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.25 (0.16)	0 (0)	0 (0)
Syngnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.13 (0.13)	0 (0)	0 (0)
Trinectes maculates	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I insect	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.67 (1.31)
Uca pugnax	0 (0)	0.10 (0.07)	2.90 (1.53)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.89 (0.89)	0.11 (0.11)

Table 7.4-1b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P2 (mouth of Town Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.10 (0.10)	0.09 (0.09)	0 (0)	0.20 (0.13)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Gobionellus shufeldti	0.10 (0.10)	0.18 (0.12)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Hirudinea	0 (0)	0.09 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomas xanthurus	9.90 (2.66)	5.00 (1.46)	5.30 (2.33)	0 (0)	0 (0)	0.50 (0.22)	1.10 (0.62)	0.80 (0.36)	0.30 (0.21)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	1.50 (0.43)	1.36 (0.47)	2.30 (1.04)	2.00 (0.82)	1.10 (0.53)	1.30 (0.68)	1.00 (0.45)	1.00 (0.47)	0.10 (0.10)	0.80 (0.44)	0.80 (0.51)	1.70 (0.96)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)
U/I fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.80 (0.59)	0.10 (0.10)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)

Table 7.4-2a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P3A (Town Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.20 (.20)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0.40 (0.16)	0.22 (0.15)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.50 (0.31)	1.10 (0.41)	0.50 (0.31)	0.11 (0.11)	0.20 (0.20)	0.20 (0.20)
Gobionellus shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.80 (0.47)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.70 (0.52)	0.40 (0.31)	0.50 (0.31)	0.30 (0.15)	0.40 (0.22)	0 (0)	0.33 (0.24)	0.80 (0.61)	0.90 (0.69)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.33)	0.20 (0.13)	0.70 (0.50)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.17)	0.50 (0.31)	0.50 (0.40)
Uca pugnax	0.20 (0.20)	0.40 (0.22)	0.80 (0.25)	0 (0)	0.20 (0.20)	0.30 (0.21)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-2b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P3A (Town Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	1.00 (0.54)	1.00 (0.89)	1.50 (0.82)	0.10 (0.10)	0.30 (0.15)	0.80 (0.51)	0.20 (0.20)	0.50 (0.27)	0.89 (0.35)
Gambusia affinis	0.10 (0.10)	0.50 (0.27)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.40 (0.40)	0.90 (0.69)	0.10 (0.10)	0.60 (0.34)	0 (0)
Gobionellus shufeldti	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.80 (0.29)	1.11 (0.31)
Uca pugnax	1.50 (0.62)	2.10 (0.57)	2.00 (0.67)	0.10 (0.10)	1.40 (0.56)	1.80 (0.53)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	1.20 (0.36)	1.10 (0.48)	0 (0)	0 (0)	0 (0)

Table 7.4-3a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P3B (Town Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Fundulus confluentus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.13)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	1.00 (0.56)	0.20 (0.13)	1.00 (0.49)	0 (0)	0.30 (0.15)	0 (0)	0.50 (0.40)	0 (0)	0.10 (0.10)
Gobionellus shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.50 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	1.60 (0.40)	1.50 (0.76)	1.20 (0.59)	0.20 (0.13)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.80 (0.49)	0.90 (0.41)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.40 (0.27)	0.80 (0.51)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.20 (0.49)	1.80 (0.61)
Uca pugnax	0.50 (0.22)	0.20 (0.13)	0.40 (0.16)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.22)	0 (0)	0 (0)

Table 7.4-3b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P3B (Town Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Dormitator maculatus	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Gambusia affinis	0.10 (0.10)	0.20 (0.13)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0.40 (0.31)	1.10 (0.67)	0.60 (0.40)	2.30 (0.83)	2.30 (1.04)	0.60 (0.34)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.10 (0.10)	0.10 (0.10)	1.20 (0.53)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.47)	1.40 (0.60)
Uca pugnax	0.70 (0.26)	1.20 (0.49)	0.60 (0.34)	0.20 (0.13)	0.60 (0.40)	0.90 (0.50)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0.30 (0.15)	2.60 (0.73)	0 (0)	0 (0)	0 (0)

Table 7.4-4a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P6 (Eagle Island).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0.11 (0.11)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	1.00 (0.60)	0.80 (0.44)	0.20 (0.13)	1.90 (1.49)	1.40 (0.45)	2.89 (1.74)	0.50 (0.22)	0.50 (0.31)	3.90 (3.68)
Paralichthys albigutta	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.90 (0.23)	0.10 (0.10)
U/I fish	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-4b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P6 (Eagle Island).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Diving beetle	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.90 (0.59)	1.00 (0.89)	0.50 (0.27)	0.10 (0.10)	0.20 (0.13)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)	0.30 (0.21)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0.10 (0.10)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0.30 (0.30)	0.40 (0.22)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	2.30 (0.67)	1.80 (0.63)	0.80 (0.59)
Uca pugilator	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0.60 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-5a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P7 (Indian Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Dormitator maculatus	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Micropterus salmoides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	1.56 (0.56)	0.56 (0.34)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Uca pugnax	0.60 (0.34)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-5b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P7 (Indian Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.50 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.40 (0.16)	1.10 (0.28)	4.33 (3.85)	0.40 (0.22)	0.60 (0.22)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	6.60 (2.35)	8.20 (3.57)	2.80 (0.66)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.40 (0.22)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0.40 (0.16)	0.30 (0.21)	0 (0)
Paralichthys lethostigma	0 (0)	0.30 (0.15)	0.67 (0.44)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.33 (0.17)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)

Table 7.4-6a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P8 (Dollisons Landing).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Cambarus robustus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus confluentus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Gobionellus shufeldti	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	1.0 (1.0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.66)	0.30 (0.21)	1.10 (0.31)
Paralichthys sp.	0.20 (0.13)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-6b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P8 (Dollisons Landing).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Amphipoda	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.30 (0.15)	0.30 (0.21)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	1.00 (0.80)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.11 (0.11)	0.10 (0.10)

Table 7.4-7a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P11 (Smith Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus majalis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0 (0)	0.30 (0.21)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.20 (0.13)
Menidia beryllina	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.80)	0 (0)	0.40 (0.31)	0.40 (0.22)	0.40 (0.16)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.60 (0.27)	0.50 (0.22)	0.20 (0.13)	1.20 (0.70)	1.80 (0.61)	1.20 (0.36)
Symphorus plagiusa	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.10 (0.10)
Trinectes maculatus	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.40 (0.40)
Uca pugnax	0.10 (0.10)	0.20 (0.13)	8.50 (4.17)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-7b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P11 (Smith Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0 (0)	0 (0)	0 (0)	0.60 (0.31)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	1.30 (0.76)	0.30 (0.21)	1.0 (0.39)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.80 (0.61)	0.50 (0.22)	1.70 (0.84)	0 (0)	0 (0)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.40 (0.16)	0.40 (0.31)	1.20 (0.63)	0.33 (0.17)	0.10 (0.10)	0.10 (0.10)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.89 (0.56)	0.10 (0.10)	0.30 (0.21)

Table 7.4-8a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P12 (Rat Island).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Dormitator maculatus	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia affinis	0 (0)	0.05 (0.05)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.10 (0.10)	0.05 (0.05)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0 (0)	0.05 (0.05)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0.15 (0.08)	0.03 (0.03)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.30 (0.21)	0.40 (0.22)	0 (0)	0 (0)	0.44 (0.24)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.70 (0.33)	0.90 (0.28)	0.60 (0.27)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)	0.30 (0.21)	0.3 (0.15)	0.89 (0.26)
Syngnathidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)
Uca pugnax	0 (0)	0.40 (0.31)	0.40 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-8b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P12 (Rat Island).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0.30 (0.15)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0.80 (0.49)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.60 (0.31)	0.60 (0.31)	0.10 (0.10)	0 (0)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Leiostomas xanthurus	0.20 (0.20)	0.20 (0.13)	0.10 (0.10)	0.50 (0.31)	0.60 (0.27)	0.80 (0.49)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0.30 (0.21)	0.50 (0.22)	0 (0)	1.00 (0.39)	0.50 (0.27)	0.67 (0.55)	1.60 (0.93)	3.50 (3.06)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.15)	1.40 (1.09)	0.40 (0.22)
Paralichthys lethostigma	0 (0)	0.30 (0.21)	0.30 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)	0 (0)
Rhithropanopeus herbstii	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.10 (0.10)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-9a. Mean abundance (SE) for epibenthic fauna collected during fall breder trap samples at station P13 (Fishing Creek).

	Fall 1999			Fall 2000			Fall 2001			Fall 2002		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Dormitator maculatus	0.10 (0.10)	0.20 (0.20)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)	0 (0)
Lepomis macrochirus	0.60 (0.60)	0.30 (0.30)	0 (0)	0.20 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.10 (0.10)	0.10 (0.10)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0 (0)	0.40 (0.40)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.20)	0 (0)	0 (0)
Uca pugnax	0 (0)	0.40 (0.31)	0.40 (0.31)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-9b. Mean abundance (SE) for epibenthic fauna collected during spring breder trap samples at station P13 (Fishing Creek).

	Spring 2000			Spring 2001			Spring 2002			Spring 2003		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0.80 (0.42)	0.40 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.30 (1.10)	0.60 (0.34)	0.20 (0.13)	0 (0)	0 (0)	0 (0)
Lepomis macrochirus	0.10 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.10 (0.10)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.30)	0.10 (0.10)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.30 (0.21)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.20 (0.13)	0.40 (0.16)	0.90 (0.31)
Uca pugnax	0 (0)	0 (0)	0.10 (0.10)	0.20 (0.13)	0.60 (0.43)	0.80 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-10. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P2 (Mouth of Town Creek).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Alpheus heterochelis	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Anchoa mitchelli	0.44 (0.44)	0 (0)	1.39 (1.33)	0.28 (0.23)	0 (0)	0 (0)	2.00 (1.94)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.28 (0.14)	0 (0)
Anthinnae	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Bivalve	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	21.67 (20.80)	0 (0)
Callinectes sapidus	0.33 (0.14)	0.67 (0.23)	0.78 (0.42)	0.11 (0.11)	0.06 (0.06)	0.06 (0.06)	0.50 (0.15)	0.17 (0.09)
Gobiesox punctulatus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.44 (0.20)	0 (0)	0.06 (0.06)	0 (0)	0.17 (0.09)	0.06 (0.06)	0.11 (0.08)	0 (0)
Lagodon rhomboides	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.44 (0.23)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0 (0)	0 (0)	7.0 (2.41)	62.89 (40.60)	0.22 (0.17)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.39 (0.24)	0 (0)	5.61 (3.20)	1.28 (0.75)	1.39 (1.13)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	4.56 (4.38)
Menticirrhus saxatilis	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Micropogonias undulatus	0 (0)	0 (0)	0.44 (0.27)	0 (0)	0 (0)	0 (0)	9.06 (1.89)	16.56 (4.12)
Mugil cephalus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	1.39 (0.78)	0.89 (0.35)	0 (0)
Palaemonetes pugio	1.39 (0.88)	0.78 (0.61)	2.11 (0.81)	0.06 (0.06)	5.56 (1.35)	20.22 (10.05)	37.94 (16.39)	1.33 (0.55)
Panopeus herbstii	0.06 (0.06)	0.50 (0.31)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.11 (0.08)	0 (0)	0.11 (0.08)	0.17 (0.12)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.61 (0.57)
Penaeid	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0.17 (0.09)	0.17 (0.12)	3.50 (1.35)	0 (0)	0 (0)	3.06 (2.37)	0 (0)
Penaeus setiferus	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia cuneata	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0.06 (0.06)	0 (0)	0.06 (0.06)	0.06 (0.06)	0 (0)	0 (0)	0.22 (0.10)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Smphurus plagiusa	0 (0)	0 (0)	0 (0)	1.00 (0.44)	0 (0)	0 (0)	0 (0)	0 (0)
Syngnathid sp.	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.09)
Uca pugnax	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-11. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P3 (Town Creek).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anchoa mitchelli	1.36 (0.63)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0.06 (0.04)	0 (0)	0 (0)	0 (0)	0.09 (0.07)	0.28 (0.16)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	4.00 (2.50)	0 (0)
Callinectes sapidus	0.11 (0.10)	0 (0)	0.11 (0.08)	0 (0)	0.20 (0.11)	0.28 (0.16)	0.56 (0.27)	0 (0)
Cambarus robustus	(0.03) (0.03)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.12 (.08)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
Fundulus majalis	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.81 (0.72)	1.83 (0.62)	3.39 (1.72)	0.11 (0.08)	2.00 (1.28)	0.06 (0.06)	0.22 (0.13)	0 (0)
Gobionellus shufeldti	0.53 (0.34)	0.33 (0.16)	0.17 (0.09)	0 (0)	0.28 (0.12)	0.73 (0.39)	0.22 (0.17)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.34 (0.19)	0 (0)	0.22 (0.10)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.28 (0.14)	0 (0)	0 (0)	0.28 (0.17)	0 (0)	0 (0)
Lepomis macrochirus	0.09 (0.07)	0.06 (0.06)	0 (0)	0 (0)	1.59 (1.70)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0.06 (0.04)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	4.33 (2.22)	0 (0)
Micropogonias undulatus	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	50.44 (21.43)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	2.89 (1.19)	0 (0)
Notropis petersoni	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.22)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	1.39 (0.83)	0.56 (0.30)	0 (0)	0.17 (0.09)	7.17 (3.23)	0 (0)
Panopeus herbstii	0.06 (0.06)	0.17 (0.12)	0.06 (0.06)	0 (0)	0.06 (0.04)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.45 (0.16)	1.17 (0.59)	0 (0)	0.11 (0.08)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0 .06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	2.33 (0.67)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0.28 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	2.14 (1.05)	0.06 (0.06)	0 (0)	0 (0)	0.31 (0.17)	0.39 (0.22)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0.50 (0.22)
Uca pugnax	0.92 (0.47)	5.06 (0.96)	0 (0)	0 (0)	0.03 (0.03)	0 (0)	0 (0)	0 (0)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.78 (0.46)	0 (0)

Table 7.4-12. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P6 (Eagle Island).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anchoa mitchelli	0 (0)	1.00 (0.37)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.05 (0.05)	0.50 (0.25)
Callinectes sapidus	0.22 (0.10)	0.06 (0.06)	0 (0)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.53 (0.18)	0.22 (0.10)
Clupeidae	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.21 (0.21)	0 (0)
Corbicula fluminea	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.32 (0.27)	0.06 (0.06)
Gerres cinereus	0 (0)	0.28 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.06 (0.06)	0.22 (0.15)	0 (0)	0 (0)	0.11 (0.11)	0.11 (0.08)	0 (0)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Leiostomus xanthurus	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	1.72 (0.72)	1.00 (0.52)	0 (0)
Menidia beryllina	0.11 (0.08)	0 (0)	0.17 (0.09)	0.72 (0.42)	0 (0)	20.83 (10.04)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.28)
Micropogonias undulatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.32 (0.32)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.17)	0.16 (0.16)	0 (0)
Palaemonetes pugio	0 (0)	5.44 (3.28)	1.00 (1.00)	0 (0)	0 (0)	1.78 (0.60)	8.21 (2.52)	0.22 (0.13)
Panopeus herbstii	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	1.17 (0.56)	0.11 (0.11)	0.44 (0.23)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.26 (0.13)	10.83 (3.68)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.83 (0.35)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)	0 (0)
Sesarma reticulatum	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.05 (0.05)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.44 (0.20)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)
U/I larval fish	0 (0)	0 (0)	0 (0)	2.44 (1.72)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-13. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P7 (Indian Creek).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0.71 (0.34)	0.11 (0.11)	0 (0)	0.39 (0.28)
Callinectes sapidus	0.06 (0.06)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Dorosoma pretense	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Esox lucius	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Eucinostomus argenteus	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)
Fundulus heteroclitus	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0.06 (0.06)	0.17 (0.17)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gerres cinereus	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.06 (0.06)	0.28 (0.18)	0.22 (0.10)	0 (0)	0.29 (0.14)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.35 (0.35)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.18)	0 (0)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Menidia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.28)	0 (0)
Palaemonetes pugio	0 (0)	0.28 (0.23)	0 (0)	0.33 (0.28)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.47 (0.29)	1.56 (0.56)	0 (0)	1.50 (0.48)
Paralichthys lethostigma	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)
Rangia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0.06 (0.06)	0.44 (0.15)	0 (0)	0 (0)	0 (0)	0 (0)	0.61 (0.22)
U/I juvenile fish	0 (0)	0.39 (0.33)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	0.11 (0.11)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)

Table 7.4-14. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P8 (Dollisons Landing).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.18)	0.39 (0.14)	0.06 (0.06)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.10)	0 (0)
Esox niger	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.12 (0.08)
Fundulus heteroclitus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Gambusia holbrooki	0.22 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Gobionellus shufeldti	0.11 (0.08)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)
Lepomis gibbensis	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.76 (1.76)
Lepomis macrochirus	0.06 (0.06)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0 (0)	0 (0)	0.61 (0.39)	0 (0)	0 (0)	0.12 (0.12)
Menidia menidia	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis chalybaeus	2.94 (1.98)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Notropis petersoni	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0.11 (0.11)	0.06 (0.06)	0 (0)	1.35 (0.34)
Penaeid	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Sesarma cinereum	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Trinectes maculatus	0.17 (0.12)	0 (0)	0.11 (0.11)	0.06 (0.06)	0 (0)	0 (0)	0.06 (0.06)	0.18 (0.13)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	1.17 (0.74)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp B	0 (0)	0 (0)	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0 (0)	0.17 (0.12)	0.17 (0.09)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)

Table 7.4-15. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P11 (Smith Creek).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anchoa mitchelli	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.16)	0 (0)	0.06 (0.06)	0.11 (0.08)
Callinectes sapidus	0 (0)	0.06 (0.06)	0.50 (0.25)	0.17 (0.09)	0.11 (0.08)	0 (0)	1.17 (0.56)	0.28 (0.11)
Eucinostomus argenteus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0.22 (0.13)	0 (0)	0.06 (0.06)	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.20)	0 (0)
Lagodon rhomboides	0 (0)	0 (0)	0 (0)	0 (0)	0.72 (0.50)	0 (0)	0.11 (0.08)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.11 (0.08)	0 (0)	14.83 (9.79)	9.56 (2.30)	1.94 (0.60)	0.39 (0.23)
Logodon rhomboides	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	1.89 (0.64)	0.83 (0.61)	0 (0)	0.22 (0.17)	1.0 (0.76)	0.06 (0.06)	0 (0)
Mugil cephalus	0 (0)	0 (0)	0.28 (0.28)	0.06 (0.06)	0 (0)	0.94 (0.79)	0.17 (0.12)	0 (0)
Palaemonetes pugio	0 (0)	1.56 (0.41)	0.17 (0.17)	0.17 (0.17)	0.06 (0.06)	0.17 (0.09)	5.20 (2.38)	0.22 (0.13)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	1.17 (0.44)	0.06 (0.06)	0 (0)	16.11 (3.31)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.28 (0.14)	0 (0)
Farfantepenaeus aztecus	0 (0)	0.83 (0.49)	6.28 (4.30)	3.56 (1.16)	0 (0)	0 (0)	0.28 (0.18)	0 (0)
Penaeus setiferus	0 (0)	1.89 (0.85)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Rangia sp.	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0.06 (0.06)	0.06 (0.06)	0.17 (0.12)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Sesarma cinereum	0 (0)	0.72 (0.38)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Symphurus plagiusa	0 (0)	0 (0)	0 (0)	0.22 (0.13)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0.22 (0.17)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
U/I larval fish sp A	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)
Uca minax	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)
Uca sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)

Table 7.4-16. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P12 (Rat Island).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.28)	0 (0)	0 (0)
Brevoortia tyrannus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Callinectes sapidus	0 (0)	0.11 (0.08)	0.56 (0.27)	0.06 (0.06)	0 (0)	0 (0)	0.78 (0.26)	0 (0)
Gobionellus shufeldti	0.11 (0.08)	0.06 (0.06)	0.06 (0.06)	0 (0)	0.06 (0.06)	0.56 (0.23)	0 (0)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.10)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.28 (0.23)	0 (0)	0.11 (0.08)	0 (0)	17.56 (15.35)	0 (0)
Lepomis macrochirus	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Lutjanus griseus	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.33 (0.23)	0 (0)	0.17 (0.12)	0.39 (0.39)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	1.22 (0.66)	1.56 (0.89)	0.33 (0.16)	0.06 (0.06)	1.61 (0.93)	1.50 (0.41)	5.94 (2.60)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0.33 (0.16)	0 (0)	11.44 (3.57)
Paralichthys sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	1.17 (0.68)
Farfantepenaeus aztecus	0 (0)	0 (0)	0.06 (0.06)	0.22 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)
Rhithropanopeus harrisii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Sesarma cinereum	0 (0)	0.17 (0.09)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0.06 (0.06)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.22 (0.22)	0 (0)	0 (0)	0 (0)	0 (0)
Uca minax	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.06 (0.06)	1.11 (0.54)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

Table 7.4-17. Mean abundance (SE) for epibenthic fauna collected in drop trap sampling at station P13 (Fishing Creek).

	Fall				Spring			
	1999	2000	2001	2002	2000	2001	2002	2003
Anchoa mitchelli	0 (0)	0 (0)	0 (0)	0.28 (0.28)	0 (0)	0 (0)	0 (0)	0 (0)
Anguilla rostrata	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.17)	0.28 (0.14)	0 (0)	0.06 (0.06)
Callinectes sapidus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.17 (0.12)	0.06 (0.06)	0 (0)
Cambarus robustus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)	0 (0)
Esox americanus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)
Gambusia holbrooki	0 (0)	0.33 (0.18)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Gobionellus shufeldti	0 (0)	0 (0)	0 (0)	0 (0)	0.22 (0.15)	0.17 (0.09)	0.11 (0.08)	0 (0)
Gobiosoma sp.	0 (0)	0 (0)	0 (0)	0.11 (0.08)	0 (0)	0 (0)	0 (0)	0 (0)
Leiostomus xanthurus	0 (0)	0 (0)	0.39 (0.27)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)
Lepomis macrochirus	0.06 (0.06)	0 (0)	0 (0)	0 (0)	0.11 (0.11)	0 (0)	0 (0)	0 (0)
Menidia beryllina	0 (0)	0 (0)	0.72 (0.46)	0 (0)	1.39 (0.97)	0.22 (0.22)	6.89 (6.54)	0 (0)
Menidia menidia	0 (0)	0 (0)	0 (0)	4.28 (2.51)	0 (0)	0 (0)	0 (0)	0 (0)
Palaemonetes pugio	0 (0)	0 (0)	0 (0)	0.44 (0.29)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus herbstii	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Panopeus sp.	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Paralichthys dentatus	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.16)	0.56 (0.23)	0 (0)	1.29 (0.50)
Farfantepenaeus aztecus	0 (0)	0 (0)	0 (0)	0.33 (0.16)	0 (0)	0 (0)	0 (0)	0 (0)
Procambarus robostus	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.06 (0.06)	0 (0)
Rhithropanopeus harrisii	0 (0)	0.22 (0.10)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0.24 (0.14)
Trinectes maculatus	0 (0)	0 (0)	0 (0)	0 (0)	0.33 (0.20)	0 (0)	0 (0)	0 (0)
U/I larval fish	0 (0)	0 (0)	0 (0)	0.89 (0.89)	0 (0)	0 (0)	0 (0)	0 (0)
Uca pugnax	0.11 (0.11)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)

8.0 SALT SENSITIVE VEGETATION SURVEY

8.1 Summary

Data obtained from monitoring sensitive herbaceous vegetation at seven stations within Cape Fear Estuary indicate five of these stations have sustained impacts associated with recent occurrences of ocean-derived salt water born by tidal events. The station at Dollisons Landing shows minor damage that may be related to sulfide toxicity. These sulfides may not have originated from ocean-derived sulfates. The station at Black River shows no salinity symptoms. Sensitive herbaceous vegetation within polygons at Prince George Creek and Indian Creek showed no indications of salinity damage until this year.

A portion of the visible evidence of these impacts on sensitive herbaceous vascular plants was the result of plasmolysis and eventual cell rupture. Plasmolysis is process of shrinkage of protoplasm away from cell walls. Extreme cases also result in rupture of the cell containment and loss of cell sap. These effects were most apparent at Indian Creek and Fishing Creek where numerous plant stems were actually severed by contact with salt water such that the tops of the plants broke away from the base and fell to the substrate. Portions of the stem where contact with saltwater occurred had turned black and brown. More subtle effects of salt water were observed where portions of stems and/or inflorescence branches withered, died and browned, often remaining attached to the main plant stem. At most stations, comparative absence of plant cover was the major evidence of salt impact.

Underground structures, including, rhizomes, bulbs and roots associated with impacted plants were not examined for damage. These structures may continue to sustain damage as long as soil salinities remain at lethal levels in freshwater wetlands. Most of these structures occupy the uppermost layers of wetland substrate, generally within six inches of the surface. Some species, like *Hymenocallis crassifolia*, may actually have their bulbous rhizomes protruding slightly above the surface of the mud. Obviously, prolonged contact with salt water will cause death. If salt water covers the soil surface, is relatively low in solutes, and recedes or is diluted rapidly following tide fall, underground structures may be unharmed or only slightly damaged. Following a period of recovery they may again, in spring, be able support subaerial stems. Impacts of this sort may be measured in degrees of severity. Closely timed salinity events are certainly more detrimental than those widely spaced in time.

If these salinity events have only been associated with low freshwater flows caused by watershed precipitation deficits, then vegetation recovery can be anticipated at some of the stations. Some stations may show a mix of recovery and the appearance of additional new species. Some additional species have already been seen in the sample areas, but only time will determine if they are favored by the new conditions. Repeated salinity events, particularly at stations like Fishing Creek will result ultimately in a new set of habitats where the growth of woody species is not favored. Habitats resembling oligohaline tidal marsh might eventually develop between Rat Island and Fishing Creek or north of the Navassa railroad bridge to Indian Creek.

As indicated earlier, a sensitive herbaceous species was defined as a non-woody, perennial plant species sensitive to brackish water flooding and rooted in basal substrate (not on hummocks, root mats, stumps, logs, etc.) subject to regular, fresh tidal inundation (CZR Incorporated 2001). A list of species considered sensitive herbaceous species is likely to include a wide range of sensitivities to exposure to salt water (Appendix B). This potential range of sensitivities is not well understood and may include an understanding of variations in plant physiology and perhaps morphology that allow for survival over a variety of exposure situations, durations, and concentrations. Tolerance is probably not always linearly related to any single salinity parameter. As a possible consideration it may not always be salinity that is the direct cause of failure of a species. Sensitivity to sulfides released into the substrate by anaerobic sulfate metabolism may have a profound effect on some species abilities to cope with changing salinity.

We make use of the term sensitive herbaceous species only in a very broad, descriptive way. It should not be inferred that the term has anything to do with chemical, morphological or physiological conditions or pre-dispositions that govern how a species may exist under variations in salinity regimes.

8.2 Introduction, Background, and Methodology

As a part of the on-going Wilmington Harbor monitoring program in the Cape Fear River Estuary, seven of nine monitoring stations with belt transects were selected in 2000 as sites for sensitive herbaceous vegetation sampling. The remaining two stations (Smith Creek P11 and Eagle Island P6) currently support vegetation in substrates that regularly experience inundation by tidal water bearing substantial concentrations of ocean-derived salts and do not support sensitive herbaceous species. The seven stations at which vegetation monitoring is taking place occur within tidal zones that occasionally experience exposure to ocean-derived salt. These stations are reviewed below (Table 8.2-1). Generalized vegetation zones along each belt transect, including those containing sensitive herbaceous species, have been described (CZR Incorporated 2001).

Table 8.2-1. Locations, names and numbers of sensitive herbaceous vegetation monitoring stations in the Wilmington Harbor monitoring project, Cape Fear River Estuary, North Carolina.

Stream Name	Station Name	Station Number
Town Creek	Inner Town Creek	P3
Cape Fear River	Indian Creek	P7
Cape Fear River	Dollisons Landing	P8
Cape Fear River (near Black River)	Black River	P9
Northeast Cape Fear River	Rat Island	P12
Northeast Cape Fear River	Fishing Creek	P13
Northeast Cape Fear River	Prince George Creek	P14

A sensitive herbaceous species was defined as a non-woody, perennial plant species sensitive to brackish water flooding and rooted in basal substrate (not on hummocks, root mats, stumps, logs, etc.) subject to regular, fresh tidal inundation (CZR Incorporated 2001). Low, fresh water river flow in the Cape Fear and Northeast Cape Fear Rivers during the 2002-growing season will necessitate additional explanation of that definition.

Sampling methods and results of previous sampling at these stations during 2001 are covered in earlier reports (CZR Incorporated 2002, Hackney et al., 2002a, Hackney et al., 2002b). Vegetation conditions and soil geochemistry data at all lower sampling stations strongly suggest past saltwater incursions are responsible for the present species composition of these riparian wetlands (Hackney et al., 2002a, Hackney et al., 2002b). In the more saline environments, sulfides converted from ocean derives sulfates by anaerobic bacteria as well as salt help create an environment that is toxic to most obligate freshwater plant species. It is likely that varying degrees of sensitivity exist among, and perhaps within, species. Considering the ability of these substrates to loose sulfates (and sulfides) over relatively short periods of time under predominantly freshwater conditions (See Section 5), reversion of plant assemblages to those more typical of fresh water is a possibility. In such cases, methanogenic substrate environments could again predominate.

Previous Global Positioning System (GPS) data obtained under canopies of summer swamp forests have been subject to multipath variation in position accuracy as explained in a past report (Hackney et al., 2002a). In an attempt to correct some of this variation, sensitive herbaceous vegetation assessed during optimum growing season conditions in first week of August 2002 were marked for later GPS data collection. Configurations of sampled polygons with and without canopies were defined using polyvinyl chloride (PVC) stakes. Stakes were numbered consecutively and later located using GPS during the winter of 2003 (week of January 6) when the absence of summer foliage would improve GPS data accuracy even though dissimilar GPS data collection environments now exist between annual data sets. It appears that varying the GPS data collection season may have eliminated some if not all the multipath effects. Variations that may be associated with multipath are still present in some sample data taken under the thickest tree canopies.

Methods of collection of GPS Data remain largely the same as those used during previous years, except that canopy conditions differ and WAAS (Wide Area Augmentation System, a Federal Aviation Administration differential correction service) capability has been added to the same GPS equipment described previously. Addition of the latter capability may not have had significant effect on data accuracy since loss of the beacon signal was not experienced during real-time data collection sessions.

8.3 Hydrologic Events and Sensitive Vegetation

Results of sensitive herbaceous vegetation data collection for the last three years are presented below for each of the seven monitoring stations (Table 8.2-1). Field personnel remained the same and methodologies varied only a noted above over the three sample periods. Four potential variables were considered important during collection and presentation of the data: (1) presence/absence of sensitive herbaceous species, (2) abrupt shifts in dominance of sensitive herbaceous species (3) cover contributions of sensitive herbaceous species within delineated polygons, and (4) variations of shapes and sizes of polygons. Changes in these variables through time that coincide with chemical and physical change in flood waters, would indicate significant impact if changing conditions were caused by altering the lower Cape Fear basin configuration. Changing growing conditions noted in the following are not necessarily related to changes that may be occurring in the lower Cape Fear River from dredging and widening Wilmington Harbor. Instead, these changes are consistent with a regional drought.

8.31 Inner Town Creek

A significant decrease in the size of the sensitive herbaceous vegetation polygon has occurred since the 2001 assessment (Table 8.31-1, Figure 8.31-1). The northeast lobe of the polygon along the upper extent of the short tidal creek (tributary of the old rice ditch) no longer supports *Zizaneopsis miliacea* or other sensitive herbaceous species. The contiguous stand of sensitive herbaceous species defined during the current year has decreased in density with more substrate surface exposed between stems. One species tentatively included in the list of sensitive herbaceous species this year is *Schoenoplectus americanus*. This species appears to demonstrate only a moderate salt sensitivity. It was not noted at this station in previous sampling sessions, but may have been overlooked.

The size of the sensitive herbaceous vegetation polygon has been reduced by almost 26 percent. Cover percent of the dominant species, *Zizaneopsis miliacea*, has decreased considerably since earlier sampling (Table 8.31-1). *Sagittaria lancifolia* and *Peltandra virginica* have decreased as well. Cover by *Typha latifolia* and *Carex hyalinolepis* have remained stable since last year, but *Typha* commonly exhibits a somewhat stunted form, possibly resulting from salt stress. The persistence of *Typha latifolia* under what appears to be rather saline conditions is of great surprise, unless some hybridization with a more salinity-tolerant species has occurred. Stems of *Schoenoplectus americanus* and *Zizaneopsis miliacea* showed some browning and loss of foliar tissue this year. Young panicles of *Zizaneopsis miliacea* had not emerged from sheaths before they died during spring flowering.

Woody species along a levee adjacent to the sensitive herbaceous vegetation polygon also showed definite signs of salt stress. Here individuals of *Taxodium* sp, *Acer rubrum, Morella cerifera*, and *Rosa palustris*, alive in previous years, were now dead.

More frequent pedestrian traffic may have been partially responsible for loss of sensitive herbaceous species from within northeastern lobe of last year's polygon. The drainage area of the more distal portions of the tidal creek that is a tributary of the old rice ditch supplies and drains this area. During servicing and maintenance of swamp substations within the belt transect workers have crossed this area in the past. Frequent substrate disturbance in this area could account at least partially for more standing water and deeper penetration of saline water in this area.

In addition, high salinity saltwater events have been common and of greater salinity than at other stations, as demonstrated by data from the data collection platforms (DCP) at the Inner Town Creek Station (Figure 8.31-2). Where soils have been disturbed, salty water is more likely to stand at the surface, and less likely to be regularly flushed back to the rice ditch.

LEGEND

SENSITIVE HERBACEOUS VEGETATION POLYGON, 2002
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2001
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT

100 0 100 Feet

20 0 20 Meters

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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2002, 2001, AND 2000 AT STATION P3 (TOWN CREEK), WILMINGTON HARBOR MONITORING PROJECT, TOWN CREEK, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE:TOWNCR2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 1 FEBRUARY 2003	FIGURE 8.31-1

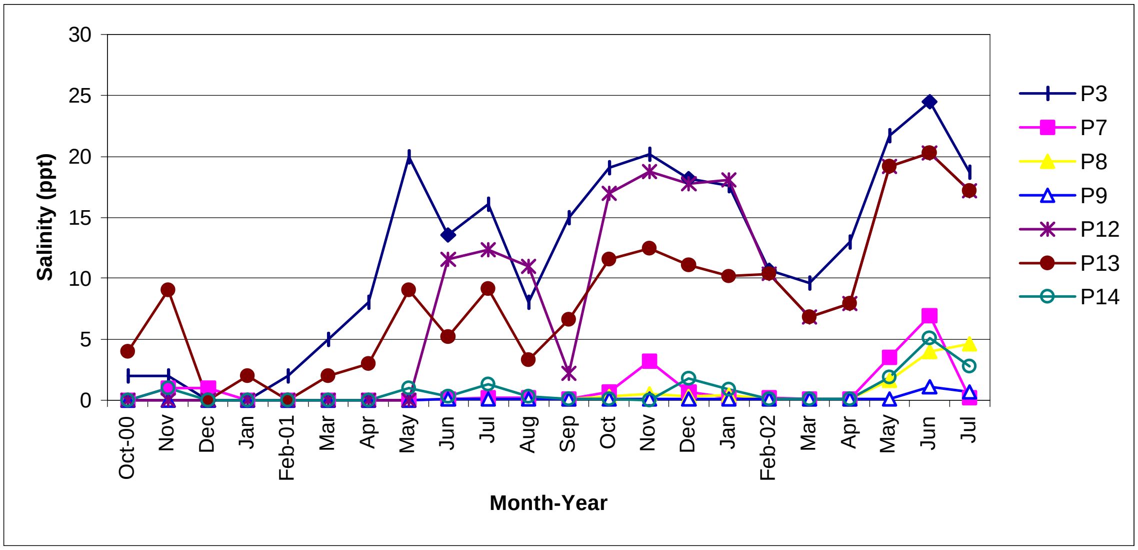


Figure 8.31-2. Maximum monthly salinity values from October 2000 – July 2003 at seven data collection platforms located near sensitive herbaceous vegetation sampling stations, Wilmington Harbor monitoring project, Cape Fear River Estuary, North Carolina.

Table 8.31-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Town Creek Station (P3), Wilmington Harbor monitoring project, Town Creek, North Carolina.

Sensitive Herbaceous Species	Year 2000 Polygon		Year 2001 Polygon		Year 2002 Polygon	
	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)
Zizaniopsis miliacea	70		60		20	
Sagittaria lancifolia	5		20		5	
Peltandra virginica	3		<1		<1	
Carex hyalinolepis	1	710.00	10	1772.50	10	1311.00
Typha latifolia	--		10		10	
Schoenoplectus americanu	--		--		*10*	

8.32 Indian Creek

The sensitive herbaceous vegetation polygon at Indian Creek is a simple four-sided figure marked by flagged trees located at each corner (Figure 8.32.1). This year, the configuration of the four-sided polygon was re-established using GPS data under winter conditions. Comparison of the resulting figures between last year (Hackney et al., 2002, Figure 8.32-1) and this year (Figure 8.32-1) shows a slightly modified polygonal shape as well as a slight change in size.

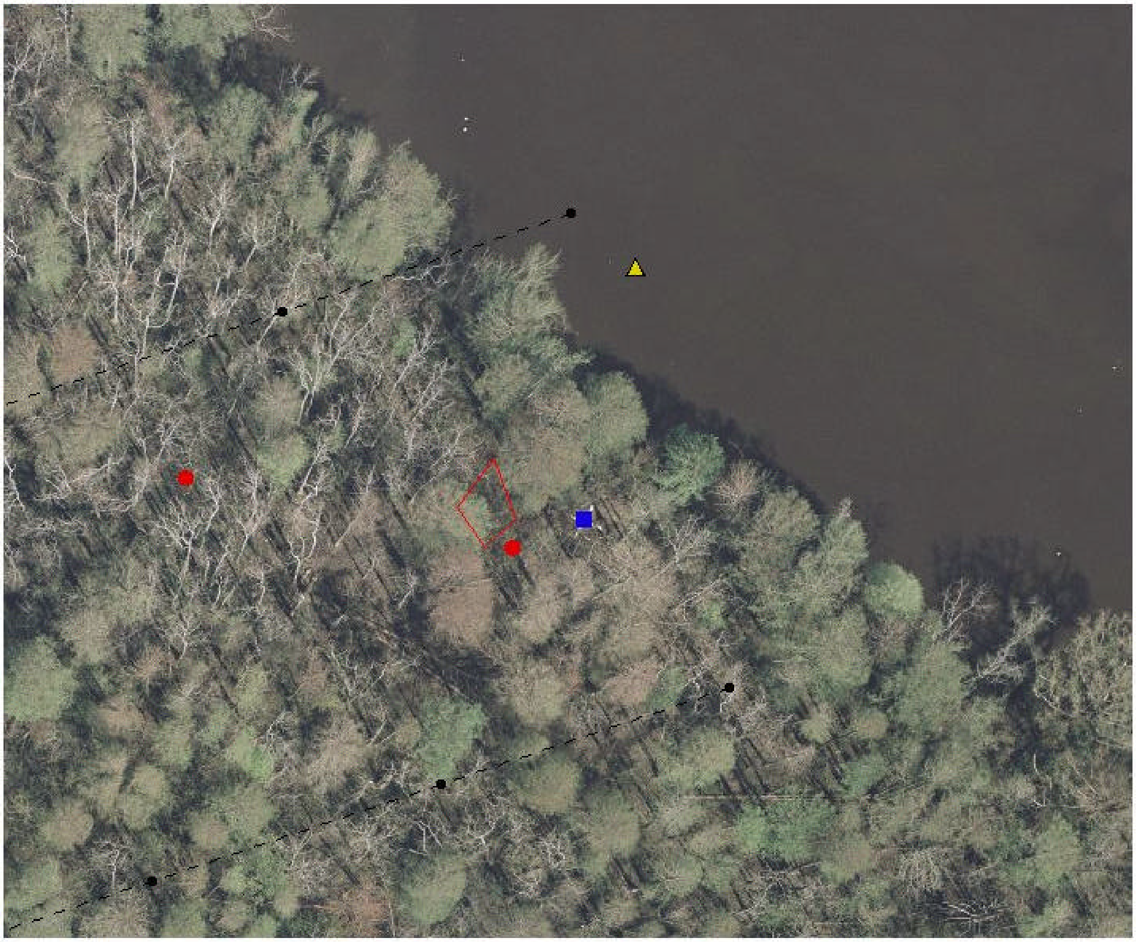
These variations reflect only different conditions under which the GPS data were taken. Data for the current configuration reflect, at least in part, a leafless tree canopy, not an actual change in size or shape of the polygon.

There have been two notable changes in the cover values contributed by sensitive herbaceous species since last year. Six species including the once dominant *Saururus cernuus* are represented by minimal, visible living material. Most visible stem fragments were no taller than two inches above the substrate, were dead, and showed brown or blackened rotten tissue at the distal tips. The height of the stems may represent the points of lysis by saline water. The over all cover contributed by all species has been considerably reduced. *Saururus cernuus* within the polygon was largely dead, as were *Boehmeria cylindrica* and other species. The viability of rhizome material within the substrate was not determined. *Carex crinita* var. *brevicrinus* (identified as *Carex crinita* last year), generally considered a sensitive herbaceous species, has apparently become more abundant since last year.

Salinity data from the DCP at Indian Creek indicates that two periods of maximum salinity incursions occurred since the last sampling season in 2001 (Figure 8.31-2). One occurred November 2001. A second incursion occurred during May and June 2002. During the second event, salinity values rose above 5 ppt (parts per thousand). The second event was of longer duration and occurred during the early part of the growing season. It was likely that the second salinity event was responsible for the abrupt loss of cover at this station. A sufficient amount of salt water flooded the swamp at the polygon and caused the demise of at least the most sensitive above ground plant parts. There were no indications of damage to woody species in the general area.

Table 8.32-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Indian Creek Station (P7), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Sensitive Herbaceous Species	Year 2000 Polygon		Year 2001 Ploygon		Year 2002 Polygon	
	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)
Saururus cernuus	2	129.78	1	129.78	--	281.88
Polygonum arifolium	3		10		--	
Cicuta maculata	5		2		<1	
Polygonum punctatum	<1		<1		--	
Commelina virginica	<1		2		1	
Carex crinita var. brevicrinus	<1		<1		10	
Carex hyalinolepis	<1		2		--	
Symphyotrichum elliottii	<1		--		--	
Triadenum walteri	<1		<1		--	
Lycopus virginicus	<1		--		--	
Galium sp.	<1		--		--	
Phanopyrum gymnocarpum	--		<1		2	
Peltandra virginica	--		--		<1	
Boehmeria cylindrical	--		<1		--	



LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNDARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT

100 0 100 Feet

20 0 20 Meters

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SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2003
AT STATION P7 (INDIAN CREEK),
WILMINGTON HARBOR MONITORING PROJECT,
CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: INDIANC2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 1 FEBRUARY 2003	FIGURE 8.32-1

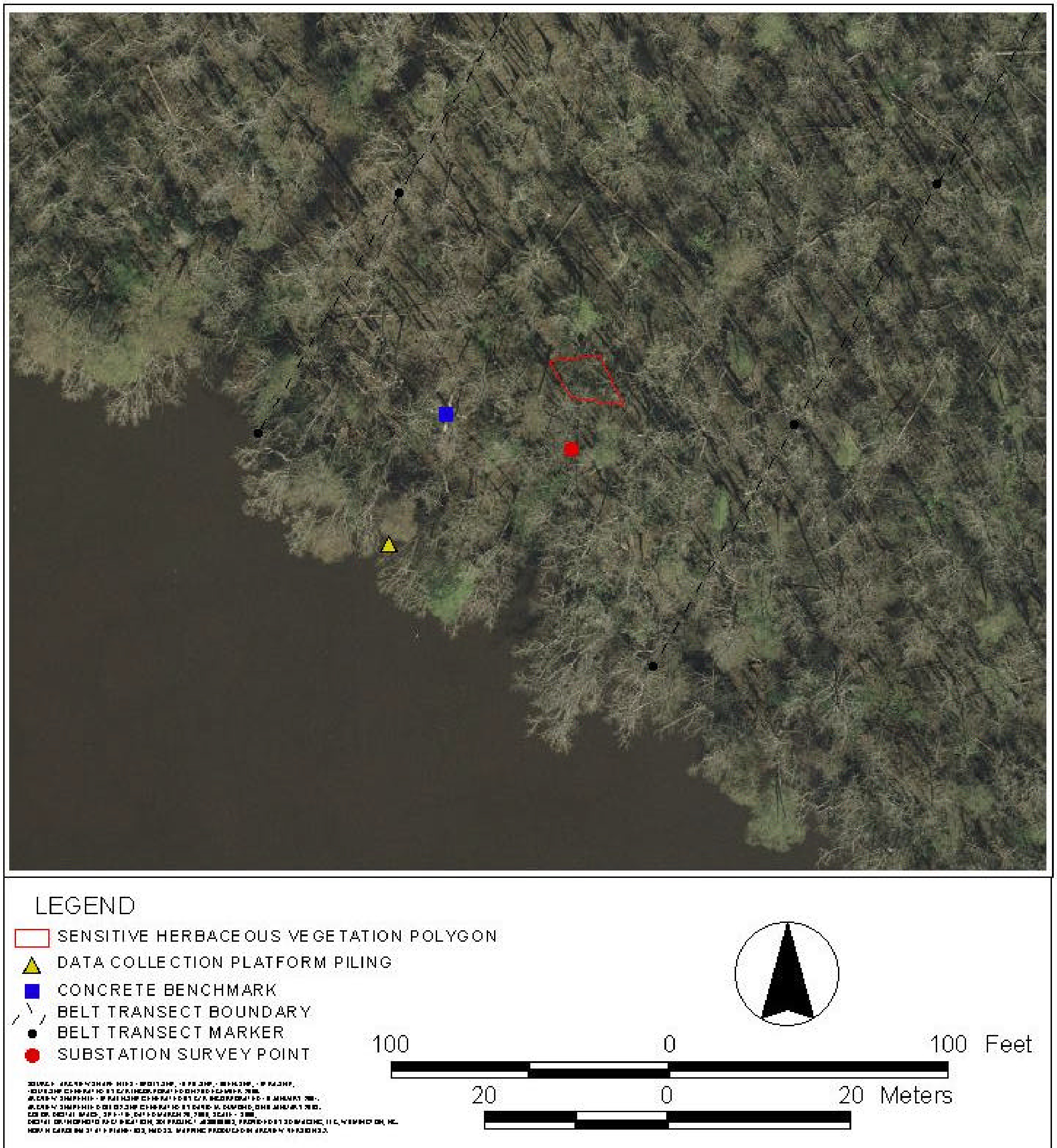
8.33 Dollisons Landing

As at Indian Creek, the polygon at Dollisons Landing is a fixed four-sided figure marked by flagged trees at each corner (Figure 8.33-1). Data for GPS locations of the corners were recollected during the winter of 2003. The polygon projected in the above figure represents this recollection of data under winter conditions. In spite of apparent small differences between the 2000 figure (Hackney et al., 2002, Figure 8.33-1) and the newer figure there have been no real changes in the shape or location of the polygon.

Changes since last years sampling are not great. *Boehmeria cylindrica*, *Rumex verticillatus* and *Cicuta maculata* have again become apparent within the polygon. *Carex crinita* and *Pontederia cordata* were not visible. A small bit of *Alternanthera philoxeroides* had been washed into the polygon and had taken root for the first time this year, and *Hymenocallis floridana* appeared from a bulb that may recently have taken root. There are no profound indications of any substantial change that may have been influenced by one or more salinity events. The strongest indication of a salinity event was the occasional death of stem tips on *Saururus cernuus* plants that likely occurred around the time of flowering. The dead stem tips seen represent aborted flowering attempts. No woody plants showed signs of salt damage.

It is apparent, however, that a salinity event of reasonable magnitude did occur at this station at least in the river during May, June and July of this year (Figure 3.31-2). The magnitude of this event was only slightly less than that of a similar event experienced at Indian Creek, where major sensitive herbaceous changes were most likely related to the salinity event. Vegetation changes at the Dollisons Landing station are, however, almost insignificant when compared to those at Indian Creek. Unfortunately, there are no other salinity data (swamp substation or peeper) from the same time period to use for comparison.

Peeper data from the summer of 2002 (Table 5.51-1) show that substrate salinity values for substation 1 at Indian Creek ranged from 1.85 to 2.90. Similar data from substation 1 at Dollisons Landing show a range of 0.13-0.19, indicating that soil salinity was not a significant plant growth factor at that time at the latter station. From the summer peeper data taken following the salinity events, the geochemical classification (Table 5.4-1) of the soil at Indian Creek was methanogenic (I). For Dollisons Landing classification was sulfate reducing from a non-seawater source (II*). Death of stems at Dollisons Landing could possibly represent sulfide toxicity due to the presence of some non-seawater source of sulfate.



DAVID M. DUMOND ECOLOGICAL SERVICES AND CONSULTING 225 CHEYENNE TRAIL WILMINGTON, NC 28409 PHONE (910)799-0363	SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2003 AT STATION P8 (DOLLISONS LANDING), WILMINGTON HARBOR MONITORING PROJECT, CAPE FEAR RIVER, NORTH CAROLINA
	WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

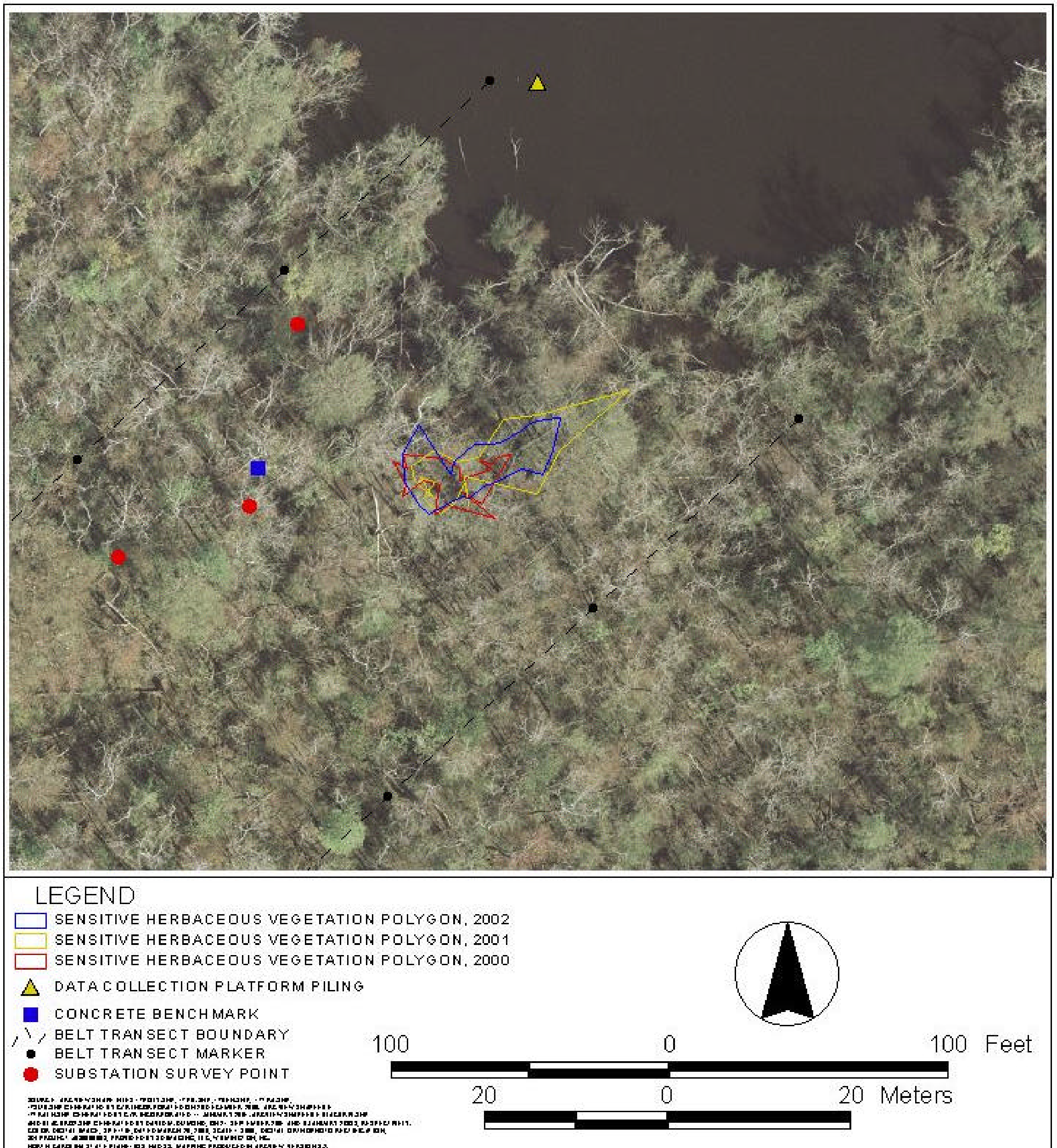
FILE: DOLLIS2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 1 FEBRUARY 2003	FIGURE 8.33-1

Table 8.33-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Dollisons Landing Station (P8), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Sensitive Herbaceous Species	Year 2000 Polygon		Year 2001 Polygon		Year 2002 Polygon	
	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)
Saururus cernuus	30		20		35	
Polygonum arifolium	10		25		3	
Boehmeria cylindrica	<1		--		<1	
Rumex verticillatus	<1		--		2	
Cicuta maculata	2		--		2	
Carex sp.	1		--		--	
Polygonum punctatum	1		1		3	
Peltandra virginica	2		1		3	
Carex crinita	<1	404.52	2	404.52	--	286.12
Dulichium arundinaceum	<1		--		--	
Triadenum walteri	<1		--		--	
Eryngium aquaticum	--		3		1	
Pontederia cordata	--		<1		--	
Hymenocallis floridana	--		--		<1	
Alternanthera philoxeroides	---		--		<1	

8.34 Black River

Changes in the shape of the sensitive herbaceous vegetation polygon at the Black River station represent annual changes in the growth of *Ludwigia palustris* (Figure 8.34-1). Based on GPS data gathered during the winter, at least some of the extension of this prostrate, inter-tidal species to the northeast is real (Table 8.34-1). The almost complete loss of *Polygonum punctatum* cannot be explained, unless it is related to disturbance in the area or lower mean water levels due to the drought. Appearance of the other species, particularly *Scutellaria lateriflora*, may be related to disturbance with subsequent tidal importation of seeds. For a member of the Lamiaceae, *Scutellaria lateriflora* is a prolific producer of seed. Four seeds are enclosed in an expanded calyx. Calices are often water-born and likely its appearance simply represents the normal results of natural dispersal. Increase or decrease in size of the polygon is not considered particularly significant at this time. No results of salinity events can be interpreted for this station.



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2002, 2001, AND 2000 AT STATION P9 (BLACK RIVER), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: BLACKR2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 1 FEBRUARY 2003	FIGURE 8.34-1

Table 8.34-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Black River (P9), Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Sensitive Herbaceous Species	Year 2000 Polygon Cover (%)	Year 2000 Polygon Size (ft^2)	Year 2001 Polygon Cover (%)	Year 2001 Polygon Size (ft^2)	Year 2002 Polygon Cover (%)	Year 2002 Polygon Size (ft^2)
Ludwigia palustris	50	431.00	20	1120.00	20	913.02
Polygonum punctatum	--		15		1	
Polygonum arifolium	--		1		<1	
Symphyotrichum elliottii	--		2		<1	
Scutellaria lateriflora	--		--		<1	
Boehmeria cylindrica	--		--		<1	

8.35 Rat Island

Two major events are underway at the Rat Island station that may result in change and possibly eventual loss of the sensitive herbaceous vegetation (Figure 8.35-1). Repeated salinity events have all but eliminated sensitive herbaceous species within and near the sample area (Figure 8.31-2). Shoreline erosion is causing slow movement of the low-tide embankment to the west. Poles marking the eastern edge of the polygon will soon be lost. Otherwise, there are no changes in size of the polygon to report.

Schoenoplectus pungens and *Carex hyalinolepis* are the remaining dominants originally considered sensitive herbaceous species (Table 8.35-1). If these can still be considered sensitive, they must fall within the most tolerant of brackish water conditions. They appear to slowly be giving way to *Spartina cynosuroides*, a rapidly encroaching species that is more tolerant of brackish water. Above ground material of *Sagittaria lancifolia* has also disappeared from the sample area. Much of the sample area is now open muddy substrate that represents considerably different growing conditions from those that existed in 2000. Most woody vegetation in the area is now dead. Many *Morella cerifera* individuals with root material exposed to tidal waters have been killed. The occurrence of *Lilaeopsis chinensis*, noted near the sample area for the first time during the winter of 2003, is an additional indicator of encroaching saline conditions. This prostrate inter-tidal species is characteristic of exposed brackish mud.

The sample area at Rat Island station will be maintained until such time as it becomes certain that reversal of salinity conditions is not a possibility. In other words, salinity events affected by low fresh water flow could remain regular events or saline conditions may give way to the return of fresh water conditions, at least for a time. Conversely, higher salinity conditions could become a permanent condition. Continued sampling in the same polygon will allow future comparative assessments.

Salinity events have strongly impacted plant-growing conditions at the Rat Island station. Freshwater conditions are not likely to return for any long duration. Away from the Northeast Cape Fear River within the belt transect, there were areas where freshwater conditions (methanogenic geochemistry) still existed prior to the winter of 2002 (Hackney et al., 2002b, Table 5.51-2). These fresh water wetlands were not the result of just regular tidal flooding, but relate more closely to the movement of freshwater seepage from the base of upland habitats. The seepage conditions that once prevailed have been modified due to sand mining along the western extent of the wetlands. The hydrologic effect of topographic modification has been to readjust the piezometric balance between the two water regimes throughout the swamp. Toward the river from the seepage wetlands, the gradual transition between seepage wetlands and tidal wetlands has moved landward and previously freshwater wetlands have now experienced salinity events. Establishment of a new sample area to the west of the existing sample site is therefore without particular merit at this time.

It is recommended that the existing sample area be monitored yearly and that additional changes be reported as long as the present polygon is at least partially intact. Changes caused by erosion should be documented using GPS.

Table 8.35-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Rat Island (P12), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Sensitive	Year 2000 Polygon		Year 2001 Polygon		Year 2002 Polygon	
Herbaceous Species	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)
Schoenoplectus americanus	100	532.94	20	532.94	30	532.94
Carex hyalinolepis	20		8		10	
Sagittaria lancifolia	10		30		--	
Alternanthera philoxeroides	<1		--		<1	
Polygonum arifolium	<1		--		--	
Ludwigia grandiflora	<1		--		--	
Polygonum punctatum	<1		1		--	
Boltonia asteroides	<1		<1		--	
Symphyotrichum subulatum	<1		<1		<1	
Peltandra virginica	--		1		--	
Rumex verticillatus	--		1		--	
Hymenocallis floridana	--		<1		--	

LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2001
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNDARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT

100 0 100 Feet

20 0 20 Meters

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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2001 AND 2000 AT STATION P12 (RAT ISLAND), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

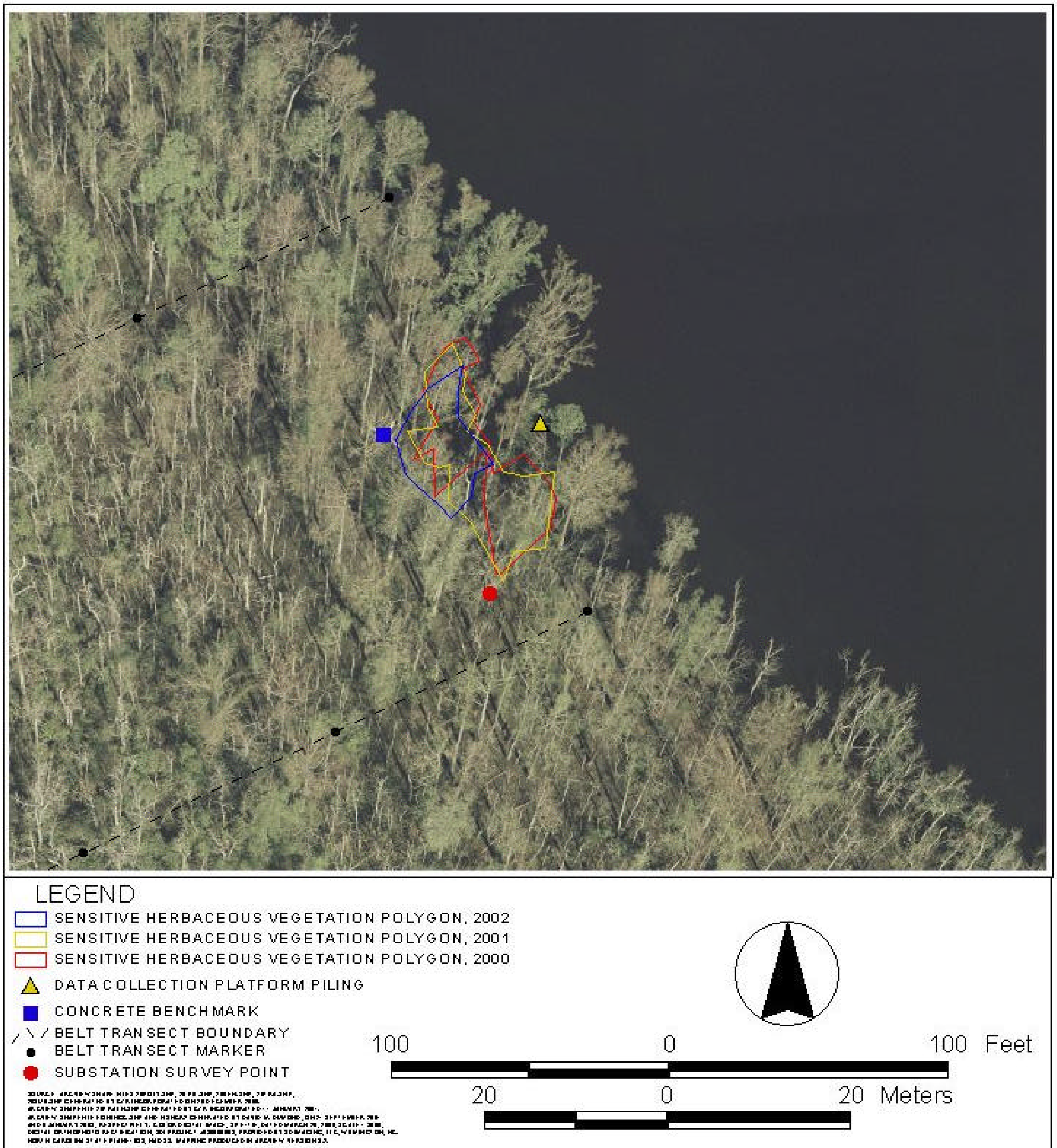
FILE: RATIS2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 1 FEBRUARY 2003	FIGURE 8.35-1

8.36 Fishing Creek

The sensitive herbaceous vegetation polygon at Fishing Creek is considerably smaller this year than in past sampling periods (Figure 8.36-1, Table 8.36-1). Winter conditions during collection of GPS data may have been responsible for some of the variation from the two past years. However, most of the decrease in size is directly related to loss of habitat for sensitive herbaceous vegetation due to repeated salinity events.

Seven species of sensitive herbaceous plants have disappeared from the sampling polygon since the summer of 2001 (Table 8.36-1). Overall cover contributed by sensitive herbaceous species has been reduced considerably. *Pontederia cordata*, previously a dominant species, is now co-dominant with four lesser species, *Sium suave*, *Sagittaria lancifolia*, *Peltandra virginica* and *Eryngium aquaticum*. These and most of the remaining species are characteristically found in tidal oligohaline marsh. This marsh type often succeeds tidal swamp forest in wetlands subject to intermittent, slow increases in salinity, especially in old rice fields. Indications of salt stress on woody plants were minor and not abundant at Fishing Creek during the summer of 2002.

Salinity events during the previous 2 winters and summer with salinity incursions up to 20 ppt during the past spring are apparent from the data (Figure 8.31-2). Substrate salinities at substation 1 at Fishing Creek for the summer of 2002 are now similar to those for the same substation at Rat Island (Table 5.5-1). Landward, salinities diminish more rapidly at Fishing Creek than do those at Rat Island. With the return of normal freshwater river flows conditions for growth of sensitive herbaceous vegetation could return, at least for a time if underground structures remain viable. However, protracted or frequent intermittent drought conditions in the Northeast Cape Fear River watershed may result in irreversible substrate and vegetation changes, particularly at the level of tree canopy cover.



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2002, 2001, AND 2000 AT STATION P13 (FISHING CREEK), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: FISHCR2.APR	APPROVED BY: CTH	#CFRM-2
DRAWN BY: DMD	DATE: 1 FEBRUARY 2003	FIGURE 8.36-1

Table 8.36-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Fishing Creek Station (P13), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Sensitive	Year 2000 Polygon		Year 2001 Polygon		Year 2002 Polygon	
Herbaceous Species	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)
Pontederia cordata	20		40		5	
Symphyotrichum elliotii.	<1		--		--	
Polygonum punctatum	2		1		--	
Sium suave	<1		2		5	
Polygonum arifolium	1		3		--	
Zizaneopsis miliacea	2		<1		<1	
Saururus cernuus	2		2		--	
Cicuta maculata	<1		2		--	
Sagittaria lancifolia	2		20		5	
Orontium aquaticum	<1	1522.20	--	1646.10	--	971.91
Peltandra virginica	<1		1		5	
Rhynchospora corniculata	<1		<1		--	
Carex sp.	<1		--		--	
Alternanthera philoxeroides	--		5		<1	
Zizania aquatica	--		2		<1	
Boltonia asteroides	--		1		--	
Rumex verticillatus	--		<1		2	
Cinna arundinacea	--		<1		--	
Eryngium aquaticum	--		<1		5	
Schoenoplectus americanus	--		--		<1	

8.37 Prince George Creek

Salinity was elevated at Prince George Creek during the spring of 2002 (Figure 8.31-2) while a smaller, but significant, event occurred during the winter of 2001. Soil pore water salinity values for the summer of 2002 are much higher than for the previous seasons (Table 5.51-1). Sulfate reducing conditions were documented in soils from the first substation during the winter of 2002 (Hackney et al., 2002b, Table 5.51-2) and are applicable as well to substation one soils data from the summer of 2002 (Table 5.52-1).

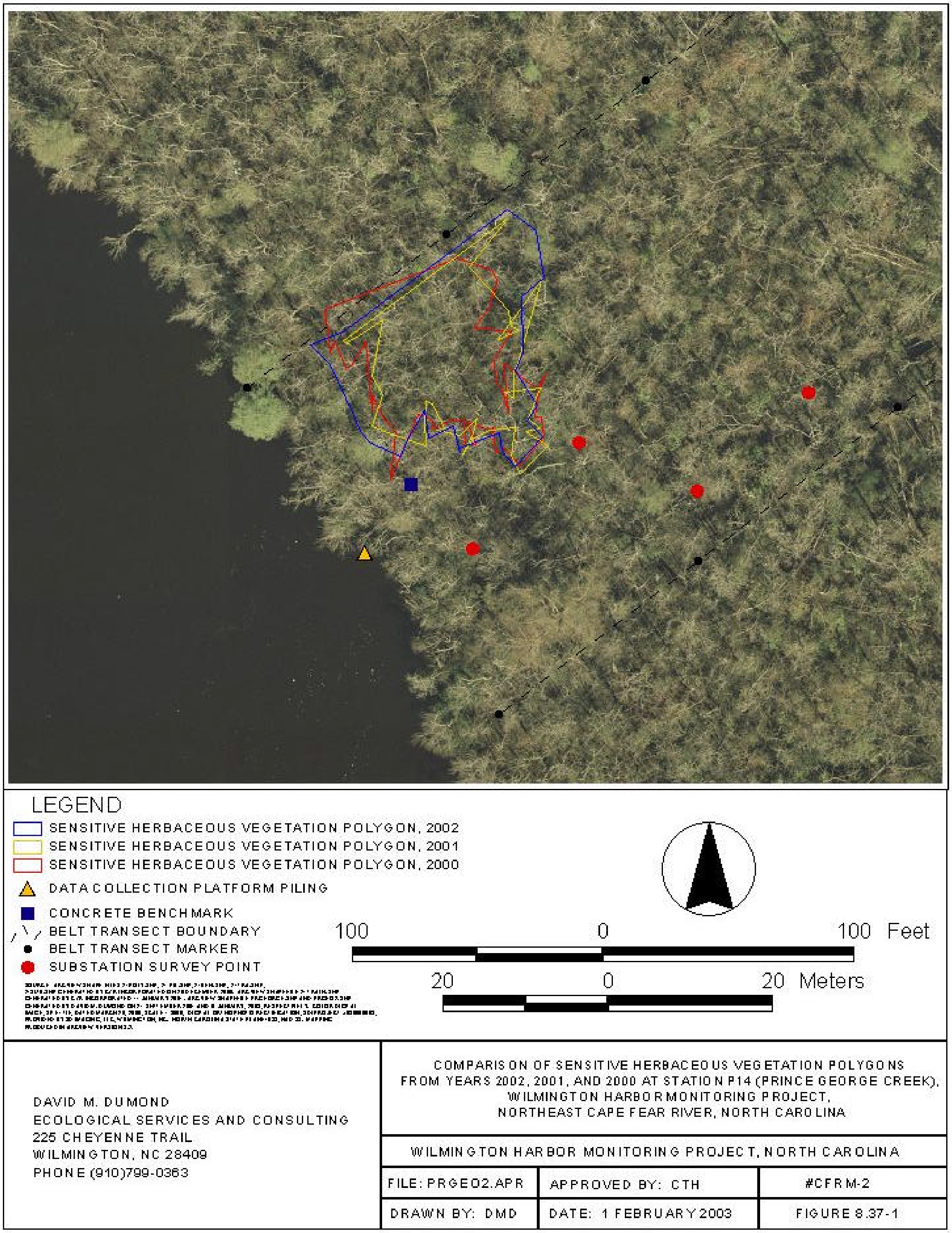
Variations in GPS data, particularly along the southwestern side of the figure (Figure 8.37-1), may be due to the effects of multipath. The entire northwestern side of the polygon should be a straight line that is common with the northern belt transect boundary. The polygon line was adjusted as appropriately as possible to show closure of this line segment. The actual location of the belt transect line is at variation with the location of the line as originally conceived. In other words, the actual transect boundary line in the field should be roughly 12 feet northwest of where it is now to match with the transect boundary line in the figure (and common with the northwest boundary of the polygon).

Increase in size of the sensitive herbaceous vegetation polygon at Prince George Creek is due largely to an actual increase in areal extent of *Saururus cernuus* (Figure 8.37-1, Table 8.37-1). Overall diversity within the polygon has not changed, four species encountered last year (*Polygonum hydropiper*, *Pontederia cordata*, *Zizania aquatica* and *Cinna arundinacea*) have disappeared and four new species, *Alternanthera philoxeroides*, *Mikania scandens*, *Decodon verticillatus* and *Hymenocallis crassifolia,* have become apparent. This replacement may be simply the results of random chance in the case of Alternanthera philoxeroides, characteristically a floating plant. Presence of the other species may be related to some effects from disturbance in the area.

The sudden change in percent cover by *Saururus cernuus* and the disappearance of *Polygonum hydropiper* are two strong indicators of modified growing conditions at Prince George Creek. Many stems of mostly *Saururus cernuus* and a few other species were withered and brown. Flowering heads of *Cicuta maculata* were brown and dead. As opposed to the results of previous years, there are ample signs that strong salinity incursions had impacted vegetation at Prince George Creek during the spring and early summer of 2002. Strong indications of damage to woody species were not apparent. Minor loss of terminal twigs was noted on *Nyssa aquatica*, *Fraxinus profunda* and *Alnus serrulata*, but this symptom may have been related to other natural events. Evidence of salinity damage on other woody species was not noticed.

Table 8.37-1. Comparisons of polygon size and percent cover contributions by sensitive herbaceous species in polygons from years 2000, 2001, and 2002 at the Prince George Creek Station (P14), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Sensitive Herbaceous Species	Year 2000 Polygon		Year 2001 Polygon		Year 2002 Polygon	
	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)	Cover (%)	Size (ft^2)
Saururus cernuus	35	3931.15	60	3669.31	20	5190.20
Polygonum hydropiper	20		15		--	
Peltandra virginica	10		8		1	
Pontederia cordata	--		5		--	
Polygonum arifolium	--		5		1	
Cicuta maculata	--		<1		<1	
Zizania aquatica	--		<1		--	
Cinna arundinacea	--		<1		--	
Boehmeria cylindrica	--		<1		<1	
Carex lupulina	--		<1		<1	
Alternanthera philoxeroides	--		--		<1	
Mikania scandens	--		--		<1	
Decodon verticillatus	--		--		<1	
Hymenocallis floridana	--		--		<1	


LEGEND
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2002
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2001
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
DATA COLLECTION PLATFORM PILING
CONCRETE BENCHMARK
BELT TRANSECT BOUNDARY
BELT TRANSECT MARKER
SUBSTATION SURVEY POINT
100 0 100 Feet
20 0 20 Meters
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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS
FROM YEARS 2002, 2001, AND 2000 AT STATION P14 (PRINCE GEORGE CREEK),
WILMINGTON HARBOR MONITORING PROJECT,
NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA
FILE: PRGEO2.APR
APPROVED BY: CTH
#CFRM-2
DRAWN BY: DMD
DATE: 1 FEBRUARY 2003
FIGURE 8.37-1

9.0 LITERATURE CITED

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APPENDIX A

LIST OF TIDAL RANGE DATA FOR ALL 14 STATIONS USED TO GENERATE FIGURES AND TABLE IN SECTION 3

APPENDIX A.

List of Tidal Range Data for all 14 Stations used to Generate Figures and Tables in Section 3.

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1	3.78	4.11	2.58	4.15	4.03	3.73	xxx	3.23	3.95	3.5	2.96	2.08
2	2.87	3.44	2.29	3.51	3.43	3.18	xxx	2.77	3.36	2.99	2.53	1.8
3	2.78	3.11	2.15	3.17	3.14	2.95	xxx	2.65	3.08	2.78	2.42	1.85
4	3	3.55	2.36	3.59	3.54	3.33	xxx	3.00	3.47	3.14	2.73	2.06
5	3.1	3.92	2.55	3.99	3.90	3.63	xxx	3.18	3.81	3.4	2.9	2.11
6	2.71	3.55	2.37	3.62	3.55	xxx	xxx	2.88	3.47	3.08	2.64	1.93
7	2.54	3.15	2.16	3.2	3.18	xxx	xxx	2.65	3.13	2.78	2.44	1.82
8	2.78	3.37	2.28	3.42	3.38	3.17	xxx	2.82	3.33	2.99	2.59	1.93
9	3.17	3.72	2.49	3.83	3.74	3.53	xxx	3.14	3.69	3.31	2.85	2.14
10	3.21	3.66	2.45	3.77	3.71	3.50	xxx	3.12	3.64	3.26	2.81	2.1
11	2.53	2.84	1.89	2.92	2.90	2.70	xxx	2.41	2.82	2.53	2.19	1.59
12	2.64	2.98	1.97	3.06	3.01	2.82	xxx	2.50	2.94	2.64	2.29	1.68
13	3	3.77	2.46	3.81	3.75	3.55	xxx	2.86	3.66	3.27	2.8	2.07
14	3.12	3.67	2.4	3.73	3.69	3.49	3.30	2.82	3.61	3.23	2.76	2.02
15	2.75	3.27	2.15	3.28	3.26	3.06	2.88	2.74	3.21	2.87	2.48	1.81
16	2.81	3.28	2.12	3.21	3.18	2.98	2.80	2.66	3.13	2.78	2.41	1.78
17	3.42	3.92	2.55	3.86	3.80	3.58	xxx	3.13	3.74	3.33	2.83	2.12
18	3.57	3.85	2.56	3.91	3.86	3.64	xxx	3.21	3.80	3.39	2.89	2.16
19	3.28	3.57	2.41	3.62	3.61	3.41	xxx	3.05	3.54	3.17	2.73	2.01
20	2.87	3.29	2.26	3.32	3.31	3.11	xxx	2.74	3.24	2.88	2.47	1.8
21	3.62	3.64	2.58	3.67	3.64	3.46	xxx	3.11	3.10	3.21	2.82	2.2
22	4.12	4.02	2.74	4.06	4.00	3.80	xxx	3.43	3.93	3.53	3.09	2.39
23	3.65	3.7	2.37	3.78	3.73	3.47	xxx	3.06	3.64	3.23	2.75	1.99
24	2.98	3.07	2.06	3.15	3.14	2.91	xxx	2.54	3.08	2.69	2.32	1.67
25	3.56	3.75	2.75	3.94	3.88	3.70	xxx	3.36	3.86	3.49	3.13	2.49
26	4.38	4.3	2.98	4.39	4.29	4.06	xxx	3.66	4.24	3.84	3.38	2.64
27	4.16	3.83	2.61	3.84	3.80	3.60	xxx	3.22	3.74	3.35	2.94	2.24
28	3.35	3.66	2.56	3.71	3.67	3.48	xxx	3.11	3.61	3.24	2.86	2.19
29	3.72	3.75	2.62	3.85	3.76	3.55	xxx	3.15	3.70	3.33	2.92	2.25
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
30	4.78	4.66	3.01	4.69	4.57	4.28	xxx	3.78	4.50	4.03	3.5	2.65

31	4.5	4.18	2.48	4.15	4.09	3.74	xxx	3.15	3.99	3.49	2.9	1.91
32	3.45	3.44	2.21	3.48	3.46	3.20	xxx	2.74	3.38	2.99	2.51	1.71
33	3.68	3.9	2.6	4	3.88	3.62	xxx	3.21	3.81	3.4	2.95	2.19
34	4.87	4.75	2.93	4.79	4.62	4.26	xxx	3.71	4.52	4	3.43	2.48
35	4.71	4.47	2.56	4.39	4.31	3.90	xxx	3.23	4.20	3.65	3.01	1.95
36	3.59	3.41	2.15	3.4	3.40	3.11	xxx	2.61	3.31	2.9	2.41	1.59
37	3.87	4	2.73	4.09	4.01	3.75	xxx	3.35	3.91	3.53	3.07	2.33
38	5.12	4.9	3.07	4.92	4.76	4.40	xxx	3.86	4.66	4.15	3.56	2.61
39	4.89	4.75	2.88	4.69	4.59	4.18	xxx	3.59	4.49	3.95	3.31	2.29
40	3.65	3.63	2.41	3.7	3.67	3.36	xxx	2.86	3.57	3.16	2.66	1.83
41	xxx	4.06	2.87	4.16	4.08	3.82	xxx	3.39	3.99	3.6	3.15	2.47
42	5.34	5.12	3.28	5.12	4.97	4.59	xxx	4.07	4.85	4.34	3.75	2.85
43	5.25	4.66	2.86	4.64	4.53	4.13	xxx	3.55	4.42	3.9	3.27	2.28
44	3.67	3.67	2.47	3.75	3.70	3.40	xxx	2.92	3.61	3.21	2.71	1.92
45	3.98	3.85	2.7	3.88	3.80	3.58	xxx	3.17	3.74	3.38	2.95	2.29
46	5.28	5.01	3.16	4.92	4.78	4.44	xxx	3.90	4.70	4.19	3.63	2.74
47	5.31	4.78	2.85	4.72	4.62	4.16	xxx	3.51	4.50	3.93	3.27	2.22
48	3.82	3.61	2.4	3.67	3.64	3.30	xxx	2.80	3.56	3.12	2.61	1.81
49	3.97	3.71	2.63	3.79	3.72	3.50	xxx	3.11	3.65	3.26	2.86	2.2
50	5.32	4.93	3.13	4.89	4.79	4.42	xxx	3.88	4.73	4.16	3.59	2.67
51	5.34	4.69	2.78	4.65	4.56	4.08	xxx	3.43	4.46	3.86	3.18	2.12
52	3.87	3.86	2.46	3.94	3.88	3.55	xxx	3.03	3.76	3.32	2.78	1.89
53	3.68	3.78	2.41	3.74	3.66	3.38	xxx	2.99	3.58	3.21	2.75	1.96
54	5.42	4.87	2.85	4.62	4.47	4.04	3.70	3.46	4.59	3.88	3.27	2.29
55	5.34	4.84	2.65	4.69	4.59	4.09	3.66	3.34	4.48	3.88	3.14	1.92
56	4.15	3.95	2.35	3.96	3.90	3.55	3.21	2.96	3.81	xxx	2.74	1.69
57	4.2	3.7	2.29	3.74	3.66	3.36	3.06	2.86	3.58	xxx	2.64	1.77
58	5.01	4.49	2.59	4.39	4.28	3.86	3.50	3.25	4.17	3.67	3.04	2.03
59	4.96	4.7	2.61	4.68	4.49	4.00	3.59	3.29	4.37	3.81	3.09	1.92
60	4.08	4.02	2.35	4.11	3.97	3.59	3.24	2.98	3.86	3.39	2.78	1.71
61	3.84	3.73	2.28	3.75	3.70	3.41	3.11	2.91	3.60	3.18	2.64	1.74
62	4.35	4.21	2.49	4.2	4.11	3.74	3.39	3.16	4.00	3.51	2.9	1.91
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
63	4.52	4.54	2.63	4.58	4.41	3.96	3.59	3.32	4.30	3.77	3.09	1.99
64	4.11	4.02	2.42	4.12	4.00	3.63	3.28	3.06	3.90	3.42	2.82	1.8
65	4.21	4.08	2.57	4.16	4.07	3.74	3.42	3.22	3.98	3.52	2.96	2.01

66	4.3	4.15	2.56	4.2	4.08	3.73	3.43	3.20	4.00	3.53	2.94	1.98
67	4.41	xxx	2.37	4.26	4.12	3.81	3.54	3.36	4.06	3.61	3.02	2.21
68	4.39	xxx	2.36	4.22	4.08	3.77	3.48	3.30	4.00	3.55	3.04	2.14
69	4.4	xxx	2.56	4.2	4.12	3.83	3.49	3.27	4.02	3.56	3	2.09
70	4.2	xxx	2.51	4.07	4.01	3.73	3.41	3.20	3.91	3.48	2.93	2.05
71	4.71	xxx	2.94	4.67	4.52	4.22	3.92	3.73	4.46	4	3.4	2.51
72	5.09	xxx	2.98	4.86	4.67	4.34	4.01	3.82	4.62	4.11	3.65	2.53
73	xxx	xxx	2.73	4.46	4.33	4.02	3.67	3.44	4.24	3.75	3.14	2.19
74	4.21	xxx	2.55	4.04	3.95	3.67	3.34	3.13	3.86	3.42	2.87	2.01
75	4.86	xxx	3.13	4.77	4.65	4.37	4.08	3.91	4.58	4.13	3.43	2.76
76	5.41	xxx	3.22	5.14	4.96	4.64	4.31	4.09	4.88	4.37	3.93	2.81
77	4.9	xxx	2.98	4.72	4.57	4.28	3.92	3.71	4.49	4	3.14	2.52
78	4.09	xxx	2.71	4.09	3.99	3.75	3.43	3.24	3.92	3.51	3.03	2.26
79	4.52	xxx	3.07	4.53	4.41	4.12	3.89	3.70	4.35	3.95	3.35	2.74
80	5.64	xxx	3.43	5.39	5.21	4.82	4.54	4.32	5.14	4.62	4.27	3.08
81	5.2	xxx	2.89	4.8	4.65	4.25	3.88	3.65	4.55	4	3.37	2.41
82	4.26	xxx	2.64	4.11	4.04	3.72	3.39	3.20	3.94	3.49	3.03	2.18
83	4.9	xxx	3.06	4.6	4.34	4.20	3.89	3.72	4.40	3.98	3.45	2.65
84	5.86	xxx	3.42	5.31	5.15	4.79	4.43	4.23	5.07	4.58	4	3
85	5.83	xxx	3.14	5.19	5.04	4.62	4.22	3.97	4.93	4.37	3.68	2.6
86	4.43	xxx	2.66	4.25	4.14	3.82	3.48	3.26	4.05	3.58	3.01	2.18
87	4.84	xxx	3.03	4.69	4.57	xxx	3.98	3.79	4.47	4.04	3.55	2.78
88	5.96	xxx	3.41	5.5	5.31	xxx	4.60	4.37	5.19	4.67	4.07	3.08
89	5.64	xxx	3.07	5.12	4.95	4.54	4.17	3.92	4.83	4.28	3.63	2.61
90	4.32	xxx	2.63	4.18	4.11	3.79	3.46	3.25	4.00	3.56	3.04	2.2
91	4.56	xxx	3.03	4.44	4.36	xxx	3.82	3.65	4.27	3.89	3.44	2.69
92	5.87	4.96	3.44	5.36	5.19	xxx	4.52	4.32	5.09	4.6	4.02	3.08
93	5.56	5.09	3.14	5.05	4.94	4.13	4.15	3.91	4.82	4.28	3.63	2.62
94	4.17	4.02	2.67	4.11	4.06	3.33	3.43	3.22	3.98	3.54	3.02	2.2
95	xxx	4.25	3.01	4.36	4.55	xxx	3.76	3.58	4.20	3.81	3.36	2.63
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
96	5.7	5.24	3.43	5.24	5.09	xxx	4.43	4.22	4.99	4.5	3.93	3.02
97	5.44	4.99	3.17	5.02	4.88	4.47	4.11	3.88	4.77	4.24	3.61	2.63
98	4.06	3.89	2.67	4.05	3.97	3.65	3.37	3.17	3.92	3.48	2.99	2.19
99	4.18	4.06	2.96	4.16	4.10	3.84	3.65	3.49	4.04	3.69	3.3	2.61
100	5.22	4.98	3.36	4.96	4.85	4.53	4.28	4.10	4.76	4.32	3.82	2.98

101	5	4.69	3.08	4.68	4.59	4.24	3.90	3.71	4.49	4.01	3.45	2.57
102	3.92	3.77	2.7	3.87	3.84	3.55	3.25	3.09	3.78	3.38	2.94	2.22
103	4.14	3.89	2.8	3.93	3.93	3.71	3.45	3.31	3.86	3.51	3.12	2.49
104	xxx	4.71	3.16	4.66	4.61	4.34	4.04	3.88	4.51	4.09	3.59	2.82
105	4.92	4.67	3.04	4.65	4.58	4.24	3.93	3.73	4.49	4.02	3.47	2.6
106	3.6	3.54	2.44	3.6	3.57	3.29	3.04	2.84	3.53	3.14	2.7	2.03
107	3.66	3.7	2.74	3.77	3.77	xxx	3.35	3.24	3.75	3.42	3.06	2.5
108	4.44	4.39	3.07	4.35	4.32	xxx	3.86	3.71	4.27	3.9	3.48	2.78
109	4.48	4.53	3.13	4.53	4.48	xxx	3.90	3.72	4.42	4.02	3.57	2.77
110	xxx	3.85	2.89	3.96	4.00	xxx	3.49	3.35	3.93	3.57	3.19	2.44
111	3.22	3.67	2.73	3.7	3.70	3.57	3.33	3.20	3.68	3.38	3.04	2.46
112	3.73	4.18	2.97	4.18	4.09	3.94	3.68	3.53	4.08	3.75	3.36	2.73
113	xxx	4.11	2.92	4.19	4.11	3.89	3.63	3.49	4.07	3.73	3.32	2.65
114	3.37	3.74	2.67	3.81	3.81	3.60	3.35	3.23	3.76	3.43	3.12	2.43
115	xxx	3.23	2.42	3.33	3.34	3.16	2.95	2.83	3.31	3.02	2.71	2.21
116	2.66	3.71	2.73	3.82	3.77	3.58	3.38	3.26	3.74	3.43	3.11	2.55
117	3.87	4	2.85	4.15	4.06	3.82	3.54	3.39	4.02	3.65	3.24	2.55
118	3.38	3.6	2.63	3.78	3.73	3.51	3.23	xxx	3.68	3.35	2.95	2.35
119	2.85	3.15	2.38	3.29	3.30	3.12	2.91	xxx	3.26	2.98	2.69	2.16
120	3.15	3.41	2.49	3.48	3.49	3.31	3.08	xxx	3.46	3.16	2.83	2.29
121	3.66	3.85	2.78	3.96	3.92	3.73	3.47	xxx	3.88	3.53	3.13	2.5
122	3.43	3.68	2.69	3.83	3.77	3.59	3.35	xxx	3.01	3.43	3.04	2.42
123	2.91	3.22	2.4	3.31	3.32	3.16	2.95	xxx	3.30	3	2.71	2.17
124	2.93	3.18	2.39	3.27	3.28	3.11	2.91	xxx	3.25	2.97	2.68	2.16
125	3.42	3.66	2.75	3.8	3.74	3.57	3.36	xxx	3.70	3.4	3.07	2.5
126	3.54	3.98	2.94	4.13	4.05	3.87	3.64	3.52	4.15	3.69	3.33	2.69
127	2.92	3.33	2.42	3.4	3.39	3.21	3.00	2.89	3.37	3.05	2.72	2.11
128	2.94	3.12	2.31	3.18	3.19	3.03	2.83	2.70	3.16	2.86	2.56	2.01
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
129	3.48	3.6	2.63	3.72	3.70	3.53	3.29	3.13	3.65	3.29	2.95	2.35
130	3.92	4.07	2.88	4.17	4.12	3.92	3.66	3.52	4.07	3.68	3.27	2.59
131	3.41	3.62	2.52	3.69	3.65	3.44	3.20	3.09	3.61	3.24	2.86	2.22
132	2.88	3.05	2.22	3.16	3.16	2.97	2.73	2.59	3.11	2.8	2.46	1.91
133	3.46	3.56	2.66	3.73	3.70	3.53	3.28	3.13	3.63	3.33	2.98	2.41
134	4.1	4.23	2.99	4.34	4.27	4.06	3.81	3.67	4.20	4.49	3.42	2.73
135	3.68	3.84	2.62	3.88	3.84	3.63	3.41	3.28	3.79	3.41	3.02	2.34

136	3.03	3.11	2.26	3.2	3.18	2.99	2.78	2.64	3.14	2.81	2.5	1.96
137	3.4	3.45	2.48	3.6	3.56	3.33	3.09	2.95	3.51	3.17	2.82	2.27
138	4.36	4.32	2.96	4.39	4.35	4.09	3.84	3.69	4.28	3.88	3.44	2.73
139	3.69	3.78	2.57	3.83	3.81	3.57	3.34	3.21	3.74	3.35	2.95	2.23
140	3.15	3.26	2.32	3.39	3.36	3.14	2.91	2.77	3.30	2.95	2.61	1.99
141	3.82	3.91	2.81	4.07	3.99	3.77	3.53	3.37	3.93	3.57	3.17	2.54
142	4.05	4.56	3.06	4.64	4.53	4.26	3.99	3.81	4.44	4.02	3.55	2.76
143	3.85	4.35	2.86	4.33	4.29	4.00	3.72	3.53	4.20	3.76	3.28	2.46
144	3.16	3.37	2.38	3.42	3.44	3.21	2.97	2.80	3.39	3.02	2.65	2.01
145	3.83	3.9	2.89	4.05	3.98	3.75	3.54	3.39	3.94	3.59	3.23	2.61
146	4.86	4.87	3.35	4.97	4.83	4.53	4.28	4.12	4.75	4.32	3.84	3.04
147	4.58	4.64	3.03	4.56	4.52	4.16	3.88	3.70	4.41	3.94	3.41	2.57
148	3.49	3.63	2.53	3.63	3.65	3.36	3.11	2.95	3.58	3.19	2.78	2.1
149	4.04	3.95	2.93	4.02	3.99	3.73	3.54	3.39	3.93	3.58	3.23	2.61
150	5.38	5.14	3.51	5.13	5.02	4.67	4.44	4.26	5.06	4.48	4	3.17
151	5.13	4.87	3.2	4.89	4.79	4.40	4.09	3.89	4.70	4.19	3.62	2.67
152	3.64	3.61	2.56	3.73	3.70	3.41	3.15	2.98	3.67	3.26	2.83	2.11
153	4.41	4.13	3.04	4.18	4.16	xxx	3.69	3.50	4.09	3.72	3.34	2.58
154	5.8	5.33	3.66	5.25	5.18	xxx	4.59	4.38	5.10	4.59	4.09	3.17
155	5.57	5.09	3.36	5.09	4.96	4.57	4.28	4.09	4.86	4.35	3.78	2.85
156	4.35	3.93	2.76	4.02	3.94	3.62	3.33	3.14	3.87	3.45	2.98	2.2
157	4.41	4.22	3.01	4.41	4.38	xxx	3.80	3.62	4.25	3.93	3.5	2.79
158	xxx	5.61	3.69	5.65	5.52	xxx	4.80	4.58	5.36	4.91	4.34	3.41
159	5.24	4.76	3.03	4.77	4.61	4.21	3.89	3.68	4.52	3.99	3.42	2.49
160	4.49	4.31	2.88	4.41	4.29	3.95	3.67	3.48	4.21	3.74	3.23	2.38
161	4.73	4.43	2.94	4.53	4.38	4.02	3.75	3.54	4.30	3.83	3.31	2.48
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
162	5.68	5.27	3.3	5.27	5.08	4.63	4.29	4.03	5.00	4.43	3.81	2.83
163	5.6	5.05	2.95	4.98	4.80	4.35	3.92	3.63	4.70	4.09	3.4	2.3
164	4.48	4.13	2.61	4.15	4.04	3.71	3.37	3.16	3.94	3.47	2.91	2.03
165	4.87	4.5	2.98	4.57	4.45	4.08	3.79	3.62	4.36	3.91	3.37	2.52
166	5.44	5	3.17	5.05	4.89	4.44	4.11	3.91	4.80	4.28	3.66	2.68
167	5.42	4.88	2.97	4.88	4.75	4.27	3.91	3.68	4.64	4.1	3.42	2.41
168	4.57	4.29	2.72	4.28	4.17	3.80	3.49	3.29	4.07	3.63	3.05	2.2
169	4.7	4.49	2.93	4.51	4.38	4.07	3.80	3.61	4.30	3.88	3.35	2.52
170	5.07	4.72	3.01	4.76	4.65	4.29	3.99	3.77	4.56	4.07	3.48	2.56

171	5.16	4.81	3.11	4.9	4.76	4.40	4.08	3.85	4.68	4.19	3.59	2.69
172	4.84	4.72	3.04	4.77	4.62	4.28	3.96	3.76	4.55	4.07	3.5	2.6
173	4.32	4.36	2.83	4.35	4.25	3.94	3.61	3.41	4.18	3.69	3.13	2.28
174	4.36	4.37	2.97	4.44	4.34	4.04	3.72	3.51	4.27	3.79	3.23	2.39
175	4.45	4.52	2.89	4.65	4.50	4.19	3.89	3.71	4.44	3.98	3.45	2.56
176	4.23	4.7	2.91	4.8	4.67	4.33	4.01	3.82	4.59	4.1	3.54	2.6
177	3.98	4.27	2.61	4.31	4.23	3.90	3.58	3.37	4.15	3.67	3.13	2.24
178	4.22	3.95	2.5	4.01	3.93	3.64	3.36	3.17	3.87	3.44	2.95	2.16
179	4.48	4.38	2.87	4.51	4.38	4.08	3.80	3.62	4.32	3.88	3.38	2.57
180	4.67	4.7	2.97	4.81	4.67	4.33	4.02	3.82	4.60	4.71	3.56	2.65
181	4.25	4.24	2.64	4.27	4.21	3.89	3.58	3.36	4.13	3.66	3.12	2.23
182	3.87	3.96	2.54	4.02	3.96	3.69	3.40	3.20	3.89	3.47	2.97	2.17
183	4.15	4.21	2.78	4.31	4.19	3.94	3.67	3.50	4.14	3.72	3.25	2.47
184	xxx	4.85	3.1	4.91	4.77	4.42	4.10	3.89	4.70	4.19	3.63	2.69
185	4.49	4.36	2.52	4.29	4.20	3.82	3.46	3.23	4.10	3.58	2.99	2.02
186	3.57	3.57	2.24	3.59	3.54	3.27	2.98	2.79	3.45	3.04	2.57	1.81
187	4.26	4.13	2.78	4.21	4.14	3.87	3.62	3.44	4.07	3.66	3.18	2.42
188	5.19	4.89	3.05	4.88	4.78	4.40	4.08	3.86	4.70	4.19	3.6	2.63
189	4.81	4.41	2.65	4.37	4.30	3.94	3.59	3.36	4.21	3.7	3.1	2.11
190	3.68	3.45	2.25	3.51	3.48	3.21	2.91	2.71	3.41	3	2.52	1.75
191	4.27	4.29	2.99	4.4	4.33	4.05	3.78	3.61	4.27	3.86	3.4	2.66
192	5.48	5.23	3.34	5.21	5.08	4.69	4.37	4.16	5.00	4.92	3.88	2.94
193	5.55	4.8	2.87	4.75	4.65	4.22	3.85	3.57	4.54	3.98	3.31	2.29
194	3.47	3.88	2.49	3.93	3.88	3.56	3.21	2.96	3.79	3.34	2.78	1.94
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
195	4.26	4.13	2.91	4.25	4.14	3.93	3.67	3.51	4.10	3.73	3.3	2.6
196	5.36	5.16	3.33	5.18	4.99	4.67	4.38	4.18	4.94	4.45	3.9	2.98
197	4.91	4.71	2.88	4.7	4.54	4.15	3.81	3.57	4.46	3.93	3.31	2.31
198	3.78	3.73	2.51	3.83	3.74	3.46	3.18	3.00	3.67	3.26	2.78	2
199	4.17	4.04	2.8	4.08	3.99	3.73	3.49	3.32	3.93	3.54	3.08	2.34
200	5.36	4.99	3.18	4.93	4.80	4.43	4.14	3.93	4.72	4.22	3.64	2.71
201	5.27	4.79	2.82	4.71	4.59	4.13	3.76	3.52	4.48	3.92	3.27	2.19
202	4.09	3.75	2.44	3.81	3.73	3.39	3.07	2.87	3.63	3.2	2.69	1.84
203	4.52	4.23	2.92	4.31	4.21	3.92	2.67	3.50	4.12	3.73	3.28	2.6
204	5.38	xxx	3.25	5.06	4.91	4.53	xxx	4.04	4.81	4.32	3.74	2.87
205	5.28	xxx	2.92	4.79	4.63	4.25	xxx	3.72	4.54	4.04	3.42	2.44

206	4.34	xxx	2.53	3.97	3.90	3.61	xxx	3.14	3.84	3.42	2.9	2.05
207	4.53	xxx	2.87	4.26	4.21	3.95	xxx	3.50	4.15	3.75	3.28	2.53
208	5.41	4.99	3.2	4.98	4.85	4.51	xxx	4.00	4.76	4.28	3.73	2.85
209	5.04	4.61	2.84	4.63	4.52	4.13	xxx	3.57	4.42	3.91	3.33	2.45
210	3.75	3.55	2.38	3.68	3.64	3.33	xxx	2.84	3.57	3.16	2.68	1.99
211	4.12	3.89	2.78	4.04	3.98	3.74	xxx	3.32	3.92	3.56	3.14	2.46
212	5.23	4.76	3.15	4.81	4.72	4.45	xxx	4.01	4.62	4.19	3.68	2.85
213	4.82	4.43	2.79	4.38	4.33	3.99	xxx	3.44	4.24	3.79	3.25	2.43
214	4.07	3.92	2.59	3.94	3.91	3.60	xxx	3.10	3.84	3.43	2.95	2.21
215	3.67	3.57	2.38	3.66	3.63	3.38	xxx	2.93	3.57	3.19	2.75	2.03
216	xxx	4.32	2.73	4.31	4.28	3.99	xxx	3.48	4.20	3.76	3.24	2.42
217	xxx	4.4	2.64	4.41	4.32	3.94	xxx	3.30	4.25	3.74	3.12	2.19
218	xxx	3.64	2.34	3.75	3.67	3.36	xxx	2.81	3.63	3.19	2.67	1.9
219	xxx	3.73	2.43	3.65	3.59	3.40	xxx	2.98	3.57	3.2	2.78	2.13
220	xxx	4.35	2.65	4.1	4.02	3.80	xxx	3.34	4.00	3.58	3.1	2.33
221	xxx	4.38	2.64	4.28	4.23	3.92	xxx	3.34	4.19	3.71	3.13	2.23
222	xxx	3.69	2.39	3.76	3.96	3.45	xxx	2.92	3.75	3.27	2.76	1.98
223	xxx	3.64	2.44	3.58	3.54	3.36	xxx	2.97	3.49	3.04	2.77	2.14
224	xxx	4.06	2.61	3.97	3.91	3.70	xxx	3.27	3.86	3.48	3.05	2.33
225	xxx	4.14	2.69	4.19	4.11	3.83	xxx	3.34	4.06	3.63	3.12	2.3
226	3.54	3.79	2.52	3.87	3.80	3.54	xxx	3.09	3.93	3.37	2.89	2.13
227	3.15	3.37	2.35	3.44	3.40	3.22	xxx	2.88	3.36	3.04	2.66	2.04
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
228	3.35	3.58	2.45	3.64	3.61	3.40	xxx	3.03	3.56	3.21	2.81	2.16
229	3.58	3.91	2.6	3.99	3.96	3.67	xxx	3.22	3.89	3.48	2.99	2.19
230	3.25	3.74	2.53	3.8	3.77	3.51	xxx	3.08	3.71	xxx	2.88	2.13
231	2.98	3.08	2.13	3.13	3.13	2.94	xxx	2.60	3.08	xxx	2.4	1.81
232	3.11	3.19	2.19	3.26	3.24	3.03	xxx	2.67	3.18	2.84	2.47	1.88
233	3.25	3.67	2.52	3.81	3.73	3.50	xxx	3.10	3.67	3.28	2.85	2.16
234	3.52	3.9	2.58	3.96	3.93	3.73	xxx	3.32	3.89	3.96	3.02	2.29
235	2.41	3.53	2.29	3.58	3.56	3.36	xxx	2.93	3.51	3.19	2.67	1.94
236	1.72	3.37	2.23	3.5	3.43	3.21	xxx	2.80	3.36	3.01	2.57	1.87
237	2.87	3.31	2.2	3.42	3.35	3.11	2.86	2.70	3.30	2.95	2.5	1.84
238	xxx	3.63	2.4	3.7	3.64	3.40	3.12	2.95	3.59	3.2	2.72	1.97
239	xxx	3.31	2.1	3.32	3.30	3.07	2.81	2.66	3.27	2.83	2.43	1.66
240	2.48	2.89	2	2.94	2.92	2.72	2.49	2.36	2.89	xxx	2.18	1.54

241	2.48	3.27	2.3	3.43	3.35	3.15	2.94	2.82	3.28	2.96	2.57	1.95
242	3.42	3.86	2.5	3.94	3.84	3.59	3.32	3.16	3.77	3.37	2.87	2.11
243	2.9	3.39	2	3.27	3.23	3.00	2.71	2.55	3.16	2.78	2.33	1.61
244	1.98	2.87	1.8	2.81	2.79	2.60	2.35	2.22	2.71	2.4	2.05	1.46
245	2.06	3.36	2.2	3.52	3.45	3.26	3.04	2.88	3.38	3.05	2.63	1.99
246	3.25	3.97	2.4	4.03	3.96	3.71	3.46	3.27	3.89	3.48	2.97	2.18
247	2.97	3.41	2	3.42	3.38	3.13	2.88	2.72	3.30	2.91	2.48	1.68
248	2.72	2.97	1.9	3.04	3.01	2.80	2.56	2.42	2.93	2.59	2.22	1.54
249	2.78	3.49	2.2	3.57	3.49	3.26	3.04	2.87	3.42	3.04	2.6	1.92
250	3.97	4.09	2.5	4.11	4.00	3.73	3.47	3.27	3.95	3.49	2.98	2.16
251	3.78	3.79	2.2	3.79	3.73	3.42	3.11	2.88	3.67	3.19	2.65	1.68
252	1.72	3.11	1.9	3.2	3.16	2.91	2.64	2.46	3.10	2.71	2.26	1.46
253	xxx	3.56	2.3	3.7	3.64	3.42	3.18	3.04	3.58	3.2	2.75	2.07
254	xxx	4.5	2.6	4.54	4.42	4.10	3.79	3.57	4.36	3.85	3.26	2.33
255	xxx	3.95	2.1	3.92	3.85	3.49	3.12	2.85	3.76	3.24	2.67	1.6
256	xxx	3.32	1.9	3.38	3.34	3.08	2.78	2.56	3.27	2.86	2.39	1.48
257	xxx	3.89	2.3	4	3.89	3.57	3.29	3.07	3.83	3.38	2.82	1.88
258	xxx	4.77	2.7	4.73	4.59	4.12	3.74	3.46	4.49	3.92	3.23	2.12
259	xxx	4.42	2.3	4.34	4.23	3.77	3.35	3.05	4.12	3.56	2.88	1.69
260	xxx	3.74	2	3.73	3.67	3.33	2.98	2.73	3.57	3.11	2.55	1.53
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
261	xxx	4.23	2.4	4.3	4.16	3.79	3.49	3.26	4.08	3.59	2.99	1.95
262	xxx	5.29	2.8	5.27	5.01	4.46	4.03	3.71	4.92	4.28	3.51	2.22
263	xxx	4.72	2.3	4.62	4.43	3.92	3.42	3.06	4.31	3.7	2.93	1.64
264	xxx	3.81	2	3.76	3.67	3.32	2.94	2.67	3.57	3.1	2.49	1.42
265	xxx	4.41	2.4	4.41	4.26	3.82	3.49	3.25	4.16	3.65	3	1.92
266	xxx	5.36	2.8	5.33	5.08	4.48	4.03	3.69	4.97	4.31	3.5	2.18
267	xxx	5.06	2.5	4.98	4.76	4.17	3.61	3.22	4.64	3.97	3.14	1.73
268	xxx	3.99	2	3.99	3.88	3.46	3.04	2.75	3.77	3.27	2.61	1.46
269	xxx	4.74	2.6	4.78	4.60	4.15	3.81	3.54	4.51	3.99	3.28	2.15
270	xxx	5.49	2.9	5.42	5.15	4.58	4.13	3.80	5.05	4.41	3.58	2.26
271	xxx	5.21	2.7	5.09	4.90	4.33	3.86	3.52	4.78	4.15	3.35	2.02
272	xxx	4.4	2.4	4.39	4.26	3.80	3.42	3.15	4.16	3.64	2.94	1.78
273	xxx	4.75	2.8	4.78	4.59	4.15	3.81	3.56	4.50	3.99	3.32	2.25
274	5.88	5.34	3	5.33	5.08	4.54	4.14	3.83	4.99	4.38	3.61	2.4
275	5.69	5.13	2.8	5.06	4.89	4.34	3.91	3.61	4.78	4.18	3.39	2.17

276	4.52	4.65	2.6	4.62	4.49	4.02	3.63	3.37	4.39	3.85	3.14	2.01
277	4.65	4.73	2.8	4.67	4.51	4.07	3.73	3.49	4.42	3.89	3.24	2.17
278	5.46	5.09	2.9	4.98	4.78	4.30	3.93	3.66	4.69	4.12	3.41	2.28
279	5.48	5.12	2.8	5.03	4.83	4.32	3.91	3.61	4.73	4.13	3.39	2.19
280	5.14	4.78	2.6	4.74	4.59	4.12	3.74	3.48	4.49	3.93	3.24	2.1
281	4.96	4.55	2.6	4.54	4.41	3.95	3.58	3.35	4.30	3.77	3.11	2.06
282	5.14	3.84	2.7	4.6	4.46	4.00	3.62	3.37	4.35	3.81	3.14	2.08
283	5.35	4.91	2.9	4.9	4.74	4.26	3.87	3.61	4.63	4.06	3.37	2.27
284	5.15	4.74	2.8	4.77	4.62	4.15	3.78	3.54	4.50	3.95	3.28	2.19
285	4.79	4.44	2.7	4.41	4.31	3.89	3.55	3.33	4.20	3.7	3.09	2.1
286	4.46	4.19	2.6	4.19	4.08	3.70	3.38	3.17	3.99	3.52	2.95	2.02
287	4.63	4.51	2.9	4.57	4.41	4.02	3.72	3.53	4.32	3.86	3.29	2.37
288	4.23	4.84	3	4.88	4.73	4.28	3.95	3.74	4.62	4.11	3.48	2.46
289	4.98	4.28	2.5	4.26	4.18	3.77	3.42	3.20	4.06	3.58	2.99	2.01
290	3.78	3.67	2.3	3.7	3.65	3.33	3.03	2.85	3.54	3.15	2.64	1.83
291	3.34	4.26	2.8	4.39	4.27	3.95	3.69	3.53	4.18	3.78	3.26	2.46
292	4.86	4.7	2.9	4.81	4.66	4.27	3.97	3.77	4.00	4.03	3.52	2.57
293	4.51	4.34	2.7	4.36	4.28	3.93	3.64	3.43	4.18	3.72	3.16	2.24
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
294	3.59	3.5	2.4	3.57	3.52	3.26	2.99	2.79	3.45	3.06	2.6	1.85
295	3.91	3.98	2.9	4.07	4.01	3.78	3.56	3.39	3.96	3.61	3.2	2.52
296	4.65	4.59	3.1	4.62	4.53	4.25	4.02	3.85	4.45	4.05	3.56	2.75
297	4.25	4.19	2.8	4.2	4.11	3.82	3.57	3.40	4.04	3.63	3.14	2.37
298	3.18	3.33	2.4	3.43	3.38	3.13	2.92	2.77	3.33	2.99	2.59	1.97
299	3.8	3.91	2.9	4.04	4.01	3.75	3.54	3.39	3.95	3.61	3.21	2.55
300	4.77	4.75	3.3	4.81	4.73	4.43	4.18	4.02	4.73	4.23	3.74	2.92
301	4.45	4.49	2.9	4.36	4.29	3.97	3.70	3.52	4.22	3.77	3.25	2.42
302	3.5	3.68	2.5	3.61	3.58	3.31	3.08	2.90	3.53	3.16	2.73	2.06
303	3.82	3.93	2.9	4.04	3.99	3.79	3.59	3.43	3.96	3.62	3.25	2.6
304	4.93	4.93	3.4	4.96	4.87	4.59	xxx	4.17	4.84	4.38	3.9	3.05
305	4.47	4.37	2.9	4.38	4.31	3.96	xxx	3.46	4.22	3.75	3.21	2.34
306	3.43	3.44	2.4	3.5	3.51	3.23	xxx	2.79	3.44	3.05	2.62	1.94
307	3.87	3.81	2.7	3.89	3.89	3.68	xxx	3.30	3.85	3.48	3.11	2.46
308	4.5	4.92	3.3	4.89	4.84	4.52	xxx	4.06	4.76	5.04	3.78	2.92
309	4.26	4.31	2.7	4.24	4.19	3.84	xxx	3.31	4.10	3.62	3.06	2.17
310	3.48	3.38	2.3	3.43	3.42	3.17	xxx	2.76	3.35	2.99	2.56	1.87

311	3.75	3.8	2.7	3.94	3.85	3.61	xxx	3.29	3.79	3.45	3.07	2.42
312	4.72	4.67	3.1	4.71	4.56	4.24	xxx	3.81	4.49	4.04	3.55	2.71
313	4.56	4.45	2.9	4.43	4.36	3.99	xxx	3.47	4.26	3.77	3.21	2.31
314	3.48	3.64	2.5	3.68	3.68	3.37	xxx	2.90	3.59	3.18	2.72	1.99
315	3.94	4.12	2.9	4.22	4.16	3.87	xxx	3.45	4.10	3.7	3.26	2.54
316	4.77	4.81	3.2	4.86	4.73	4.39	xxx	3.92	4.65	4.2	3.66	2.79
317	4.7	4.44	2.9	4.45	4.35	4.00	xxx	3.51	4.27	3.81	3.26	2.36
318	3.68	3.9	2.7	3.97	3.92	3.63	xxx	3.18	3.85	3.44	2.97	2.18
319	3.87	4	2.8	4.04	3.97	3.72	xxx	3.32	3.90	3.52	3.09	2.37
320	4.61	4.68	3.1	4.65	4.51	4.19	xxx	3.75	4.44	3.98	3.47	2.63
321	4.8	4.58	2.9	4.5	4.39	4.02	xxx	3.50	4.30	3.81	3.24	2.32
322	3.83	3.79	2.5	3.8	3.75	3.46	xxx	3.01	3.68	3.28	2.8	2.04
323	3.94	3.86	2.7	3.96	3.85	3.61	xxx	3.24	3.80	xxx	3.02	2.35
324	4.58	4.5	3	4.54	4.39	4.09	xxx	3.66	4.31	xxx	3.39	2.59
325	4.57	4.41	2.8	4.41	4.34	3.97	xxx	3.46	4.23	3.76	3.19	2.27
326	3.87	3.86	2.6	3.9	3.87	3.56	xxx	3.11	3.79	3.38	2.89	2.1
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
327	3.84	3.71	2.6	3.73	3.70	3.49	xxx	3.12	3.63	xxx	2.86	2.18
328	4.26	4.21	2.8	4.21	4.14	3.90	xxx	3.49	4.06	3.64	3.2	2.41
329	4.23	4.26	2.7	4.27	4.20	3.85	xxx	3.35	4.11	3.65	3.08	2.14
330	3.87	3.81	2.5	3.84	3.80	3.49	xxx	3.05	3.72	3.31	2.81	1.99
331	3.68	3.55	2.4	3.58	3.55	3.35	xxx	2.99	3.48	3.12	2.72	2.03
332	4	3.92	2.5	3.85	3.82	3.55	xxx	3.08	3.73	3.31	2.82	2.02
333	4.11	4.01	2.6	3.99	3.96	3.69	xxx	3.20	3.86	3.43	2.9	2.06
334	3.57	3.9	2.6	3.96	3.93	3.70	xxx	2.84	3.84	3.43	2.93	2.13
335	3.45	3.7	2.4	3.71	3.71	3.45	xxx	xxx	3.60	3.22	2.76	2.02
336	3.7	3.53	2.4	3.56	3.55	3.31	xxx	xxx	3.45	3.09	2.66	1.97
337	3.81	3.94	2.7	4.01	3.94	3.66	xxx	xxx	3.85	3.47	2.99	2.23
338	3.7	3.82	2.6	3.86	3.79	3.54	xxx	xxx	3.71	3.36	2.92	2.19
339	3.45	3.49	2.4	3.54	3.49	3.27	xxx	xxx	3.43	3.08	2.69	2.05
340	3.48	3.42	2.4	3.51	3.47	3.24	xxx	xxx	3.42	3.05	2.64	2
341	3.78	3.56	2.3	3.62	3.59	3.37	xxx	xxx	3.52	3.16	2.73	2.01
342	3.64	3.6	2.4	3.64	3.64	3.45	xxx	xxx	3.56	3.21	2.78	2.04
343	3.1	3.33	2.2	3.37	3.36	3.13	xxx	xxx	3.32	3.01	2.62	2
344	2.48	3.23	2.2	3.3	3.29	3.10	xxx	xxx	3.23	2.94	2.57	1.99
345	2.78	3.59	2.4	3.65	3.63	3.40	xxx	xxx	3.61	3.26	2.83	2.15

346	3.23	3.71	2.6	3.76	3.77	3.51	xxx	xxx	3.74	3.37	2.93	2.27
347	2.87	3.32	2.1	3.39	3.37	3.17	xxx	xxx	3.34	2.99	2.55	1.9
348	2.39	3.27	2	3.25	3.20	3.00	xxx	xxx	3.18	2.85	2.45	1.82
349	2.2	3.62	2	3.58	3.53	3.32	xxx	xxx	3.50	3.15	2.74	2.04
350	3.21	3.99	2.2	3.99	3.93	3.69	xxx	xxx	3.90	3.5	3	2.18
351	2.87	3.31	xxx	3.34	3.30	3.08	xxx	xxx	3.28	2.93	2.47	1.73
352	2.17	2.96	xxx	3.01	3.00	2.77	xxx	xxx	3.00	2.69	2.32	1.72
353	2.87	3.34	xxx	3.41	3.37	3.15	xxx	xxx	3.29	2.94	2.52	1.8
354	3.47	3.88	xxx	3.88	3.82	3.61	xxx	xxx	3.72	3.35	2.85	2.01
355	3.66	3.25	2	3.24	3.19	2.97	xxx	xxx	3.13	2.78	2.27	1.45
356	2.15	2.85		2.86	2.82	2.60	xxx	xxx	2.76	2.45	2	1.28
357	2.35	3.4	1.3	3.42	3.34	3.14	xxx	2.80	3.28	2.95	2.55	1.86
358	3.25	3.7	1.5	3.77	3.66	3.45	xxx	3.08	3.61	3.23	2.77	1.96
359	2.93	3.4	1.3	3.46	3.39	3.16	xxx	2.76	3.36	2.98	2.52	1.75
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
360	2.28	2.8	1	3.01	2.95	2.72	xxx	2.37	2.91	2.58	2.18	1.52
361	2.87	3	1.3	3.22	3.15	2.94	xxx	2.64	3.10	2.79	2.42	1.82
362	4.05	4.2	1.7	4.14	4.03	3.76	xxx	3.33	3.98	3.56	3.04	2.21
363	3.61	3.7	1.3	3.63	3.54	3.17	xxx	2.53	3.50	3.06	2.5	1.53
364	2.49	3.2	1.1	3.25	3.21	2.91	xxx	2.41	3.16	2.78	2.31	1.45
365	3.48	3.9	1.6	3.9	3.42	3.41	xxx	2.71	3.74	3.3	2.73	1.78
366	3.5	4.6	1.8	4.5	4.36	3.97	xxx	3.16	4.31	3.77	3.1	2
367	4.28	4.4	1.8	4.26	4.15	3.66	xxx	2.65	4.09	3.54	2.86	1.68
368	3.21	3.5	1.4	3.52	3.46	3.02	xxx	2.14	3.39	2.95	2.4	1.42
369	4	4.2	2.1	4.24	4.16	3.75	xxx	2.96	4.06	3.59	3.04	2.12
370	4.98	5	2.3	4.9	4.75	4.28	xxx	3.35	4.67	4.07	3.39	2.28
371	4.57	4.9	2.3	4.81	4.66	4.16	xxx	3.19	4.58	3.96	3.22	2.03
372	3.78	4	1.9	4.04	3.92	3.45	xxx	2.62	3.83	3.34	2.72	1.73
373	4.15	4.7	2.6	4.76	4.65	4.23	xxx	3.58	4.53	4.03	3.44	2.49
374	5.24	5.5	2.9	5.46	5.28	4.77	4.28	3.95	5.16	4.53	3.82	2.67
375	5.17	5	2.7	4.98	4.82	4.32	3.83	3.49	4.72	4.11	3.39	2.22
376	4.57	4.7	2.5	4.67	4.54	4.07	3.61	3.29	4.45	3.89	3.22	2.14
377	4.87	5	2.8	5	4.84	4.36	3.92	3.63	4.72	4.14	3.45	2.34
378	5.81	5.6	3	5.51	5.28	4.70	4.20	3.85	5.16	4.51	3.73	2.49
379	5.64	5.4	2.8	5.32	5.10	4.50	3.98	3.63	4.99	4.31	3.52	2.25
380	5	4.9	2.6	4.92	4.76	4.21	3.72	3.39	4.64	4.04	3.3	2.13

381	5.24	5.3	3	5.27	5.10	4.57	4.10	3.79	4.97	4.37	3.62	2.45
382	6.02	5.6	3.1	5.56	5.35	4.76	4.25	3.91	5.22	4.56	3.76	2.53
383	5.48	5.4	3	5.46	5.25	4.65	4.13	3.79	5.12	4.44	3.64	2.38
384	5.15	5.2	2.9	5.26	5.08	4.51	4.01	3.68	4.95	4.31	3.55	2.32
385	5.62	5.3	3	5.35	5.15	4.58	4.06	3.72	5.01	4.35	3.58	2.32
386	5.78	5.4	3	5.38	5.18	4.60	4.06	3.72	5.04	4.38	3.6	2.34
387	5.79	5.4	3	5.32	5.14	4.60	4.12	3.81	5.03	4.39	3.64	2.42
388	5.4	5.6	3.1	5.54	5.31	4.72	4.22	3.88	5.19	4.51	3.73	2.46
389	5.29	5.2	2.8	5.19	4.98	4.39	3.91	3.59	4.86	4.19	3.44	2.19
390	5.14	5	2.8	4.95	4.79	4.25	3.79	3.50	4.68	4.06	3.35	2.17
391	5.29	4.9	2.7	4.82	4.64	4.14	3.69	3.42	4.53	3.93	3.23	2.08
392	5.45	5.5	2.9	5.39	5.18	4.58	4.11	3.78	5.06	4.39	3.64	2.33
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
393	5.12	5.1	2.5	4.96	4.76	4.06	3.54	3.14	4.63	3.94	3.11	1.71
394	4.58	4.5	2.4	4.49	4.35	3.77	3.29	2.94	4.24	3.66	2.9	1.65
395	4.79	4.8	2.6	4.73	4.58	4.07	3.63	3.33	4.48	3.89	3.16	1.96
396	5.35	5.1	2.7	5	4.80	4.22	3.75	3.43	4.69	4.04	3.25	1.99
397	4.87	4.6	2.4	4.57	4.37	3.79	3.34	3.03	4.26	3.67	2.91	1.71
398	4.19	4.1	2.2	4.08	3.92	3.44	3.03	2.77	3.82	3.3	2.64	1.56
399	4.27	4.6	2.6	4.49	4.31	3.88	3.49	3.26	4.23	3.68	3.03	1.96
400	5.25	5	2.7	4.89	4.70	4.18	3.76	3.50	4.59	3.98	3.26	2.07
401	4.78	4.5	2.4	4.47	4.34	3.80	3.38	3.11	4.24	3.67	2.94	1.79
402	3.52	3.6	2	3.64	3.55	3.13	2.77	2.55	3.48	3.03	2.42	1.47
403	3.89	4.1	2.5	4.11	4.03	3.71	3.41	3.27	3.96	3.56	3.02	2.2
404	4.58	4.6	2.7	4.57	4.47	4.09	3.75	3.57	4.39	3.89	3.26	2.3
405	3.77	4.5	2.6	4.4	4.32	3.91	3.56	3.35	4.23	3.7	3.1	2.15
406	3.02	3.5	2.2	3.54	3.48	3.14	2.83	2.66	3.42	3	2.51	1.75
407	3.23	3.7	2.5	3.77	3.71	3.41	3.14	3.00	3.63	3.25	2.82	2.14
408	4.15	4.7	3	4.57	4.49	4.13	3.83	3.66	4.40	3.93	3.41	2.57
409	3.87	4.5	2.3	4.4	4.30	3.92	3.57	3.38	4.21	3.7	3.11	2.17
410	2.92	3.3	1.9	3.38	3.31	3.00	2.71	2.56	3.25	2.85	2.39	1.67
411	3.48	3.7	2.2	3.8	3.73	3.49	3.26	3.13	3.68	3.36	2.97	2.35
412	3.98	4.4	2.5	4.38	4.31	4.03	3.75	3.62	4.22	3.83	3.35	2.59
413	4.57	4.1	2	4.03	3.93	3.60	3.30	3.15	3.85	3.41	2.94	2.17
414	3.57	3.6	1.8	3.6	3.54	3.23	2.96	2.82	3.47	3.08	2.66	1.98
415	2.94	3.6	1.8	3.54	3.55	3.32	3.04	2.91	3.48	3.15	2.75	2.09

416	4.18	4.1	2.1	4.02	3.99	3.74	3.46	3.34	3.91	3.53	3.09	2.34
417	3.84	4.3	2.1	4.28	4.21	3.86	3.52	3.35	4.13	3.67	3.15	2.27
418	2.98	3.6	1.7	3.6	3.57	3.22	2.91	2.76	3.49	3.1	2.65	1.91
419	3.47	3.6	2	3.73	3.69	3.43	3.17	3.05	3.63	3.32	2.95	2.34
420	4.18	4.6	2.8	4.68	4.58	4.29	3.98	3.82	4.51	4.07	3.58	2.77
421	3.94	4.3	1.9	4.27	4.15	3.75	3.38	3.17	4.09	3.58	3.01	2.1
422	3.34	3.8	1.7	3.83	3.76	3.38	3.05	2.88	3.69	3.27	2.76	1.95
423	3.54	3.9	2.1	3.94	3.86	3.50	3.16	2.98	3.80	3.4	2.93	2.18
424	4.18	4.6	2.4	4.53	4.42	4.03	3.65	3.42	4.36	3.86	3.31	2.42
425	4.19	4.4	2.1	4.38	4.26	3.83	3.45	3.19	4.20	3.67	3.06	2.08
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
426	3.57	4.5	1.9	3.95	3.84	3.44	3.10	2.88	3.81	3.33	2.79	1.92
427	3.81	4	2.2	4.17	4.04	3.69	3.37	3.21	3.91	3.41	3.04	2.23
428	4.25	4.7	2.4	4.66	4.51	4.11	3.73	3.52	4.42	3.91	3.33	2.4
429	4.29	4.5	2.1	4.36	4.26	3.81	3.39	3.15	4.18	3.64	3	2.06
430	3.54	4	1.9	3.95	3.88	3.47	3.10	2.91	3.81	3.34	2.77	1.93
431	3.87	4.2	2.2	4.21	4.10	3.72	3.38	3.20	4.02	3.55	3	2.15
432	4.42	4.7	2.3	4.57	4.43	4.01	3.63	3.40	4.34	3.82	3.21	2.27
433	4.37	4.4	2	4.24	4.18	3.74	3.33	3.09	4.08	3.57	2.95	1.98
434	3.94	4	1.9	4	3.97	3.58	3.21	2.99	3.90	3.42	2.85	1.95
435	4	4.1	2.2	4.17	4.07	3.70	3.35	3.15	4.01	3.53	2.95	2.06
436	4.24	4.3	2.3	4.33	4.21	3.80	3.42	3.20	4.14	3.64	3.02	2.08
437	4.38	4.4	2.4	4.36	4.25	3.83	3.45	3.22	4.18	3.67	3.05	2.07
438	4.1	4.3	2.3	4.25	4.15	3.77	3.41	3.18	4.08	3.59	3	2.05
439	4	4.1	2.2	4.11	4.01	3.63	3.29	3.06	3.94	3.46	2.87	1.96
440	4.12	4.2	2.2	4.18	4.06	3.66	3.32	3.09	3.99	3.51	2.91	1.99
441	4.21	4.2	2.3	4.18	4.08	3.69	3.33	3.11	4.01	3.53	2.93	2
442	4.23	4.2	2.3	4.16	4.09	3.68	3.31	3.11	4.02	3.51	2.92	1.99
443	3.78	4.3	2.3	4.17	4.09	3.68	3.33	3.12	4.02	3.5	2.91	1.92
444	3.79	4	2.3	3.97	3.89	3.51	3.19	2.99	3.82	3.34	2.8	1.87
445	3.48	4.1	2.4	4.18	4.09	3.73	3.42	3.23	4.02	3.52	3	2.08
446	3.94	4.3	2.4	4.3	4.19	3.83	3.50	3.30	4.12	3.61	3.06	2.13
447	3.86	4.3	2.3	4.07	3.97	3.60	3.32	3.11	3.91	3.42	2.84	1.95
448	3.62	4	2.2	3.86	3.78	3.41	3.15	2.95	3.71	3.27	2.71	1.86
449	3.57	3.8	2.3	3.84	3.74	3.42	3.15	2.99	3.68	3.26	2.76	1.95
450	3.78	4.2	2.4	4.1	4.01	3.68	3.37	3.19	3.94	3.48	2.94	2.06

451	3.75	4	2.2	3.99	3.90	3.54	3.22	3.03	3.84	3.37	2.8	1.92
452	3.15	3.3	2	3.45	3.38	3.04	2.76	2.61	3.32	2.92	2.44	1.68
453	3.64	3.4	2.2	3.53	3.48	3.19	2.93	2.82	3.42	3.06	2.62	1.92
454	4.1	4.2	2.5	4.3	4.24	3.89	3.58	3.41	4.17	3.7	3.14	2.25
455	3.19	3.6	1.9	3.63	3.59	3.20	2.86	2.67	3.52	3.03	2.51	1.56
456	2.68	3.3	1.8	3.29	3.25	2.92	2.63	2.47	3.18	2.78	2.33	1.5
457	2.91	3.3	1.7	3.19	3.15	2.85	2.57	2.40	3.09	2.72	2.24	1.44
458	3.48	3.8	2	3.77	3.71	3.32	3.01	2.80	3.65	3.2	2.64	1.71
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
459	xxx	3.4	1.7	3.41	3.36	2.94	2.62	2.40	3.28	2.81	2.26	1.27
460	xxx	2.7	1.3	2.71	2.71	2.40	2.13	1.96	2.64	2.28	1.87	1.06
461	xxx	3.3	1.8	3.42	3.36	3.08	2.85	2.72	3.30	2.92	2.49	1.67
462	xxx	3.8	2	3.84	3.73	3.39	3.10	2.93	3.67	3.2	2.66	1.72
463	xxx	3.5	1.8	3.52	3.48	3.12	2.81	2.65	3.43	2.98	2.43	1.55
464	xxx	2.6	1.4	2.63	2.62	2.32	2.08	1.96	2.57	2.24	1.82	1.13
465	xxx	3	2	3.02	3.00	2.81	2.63	2.56	2.94	2.68	2.36	1.82
466	xxx	3.8	2.3	3.8	3.75	3.49	3.26	3.14	3.69	3.31	2.85	2.11
467	xxx	3.4	1.9	3.41	3.34	3.05	2.81	2.68	3.30	2.9	2.46	1.71
468	xxx	2.9	1.7	2.96	2.89	2.65	2.43	2.32	2.86	2.53	2.15	1.51
469	xxx	3.3	2	3.35	3.27	3.01	2.77	2.65	3.23	2.88	2.45	1.8
470	xxx	3.9	2.3	3.9	3.81	3.50	3.24	3.10	3.76	3.34	2.84	2.05
471	xxx	3.8	2.2	3.68	3.62	3.29	3.01	2.86	3.57	3.14	2.64	1.79
472	xxx	3.14	1.74	3.06	2.99	2.72	2.48	2.36	2.97	2.61	2.21	1.52
473	xxx	3.47	2.23	3.54	3.42	3.20	2.97	2.86	3.39	3.04	2.64	1.99
474	xxx	4.11	2.49	4.13	4.02	3.72	3.45	3.30	3.96	3.53	3.03	2.22
475	xxx	4.09	2.39	4.04	4.00	3.61	3.30	3.10	3.92	3.44	2.91	1.98
476	xxx	3.38	2.1	3.44	3.40	3.07	2.81	2.65	3.32	2.94	2.5	1.72
477	xxx	3.89	2.6	4.04	3.91	3.62	3.37	3.23	3.85	3.47	3.02	2.27
478	xxx	4.48	2.8	4.55	4.42	4.07	3.77	3.60	4.36	3.88	3.34	2.45
479	xxx	4.5	2.73	4.51	4.43	4.02	3.68	3.48	4.35	3.83	3.25	2.27
480	xxx	3.89	2.47	3.98	3.89	3.54	3.24	3.05	3.82	3.38	2.89	2.02
481	xxx	4.34	2.94	4.52	4.44	4.05	3.76	3.59	4.25	3.86	3.39	2.57
482	4.3	4.96	3.14	5.06	4.95	4.49	4.15	3.95	4.75	4.26	3.69	2.75
483	4.16	4.84	2.98	4.85	4.70	4.25	3.89	3.67	4.61	4.07	3.45	2.47
484	4.38	xxx	2.87	4.58	4.46	4.05	3.70	3.49	4.36	3.86	3.29	2.36
485	4.79	xxx	3.07	4.84	4.68	4.28	3.92	3.71	4.58	4.08	3.5	2.57

486	5.65	xxx	3.29	5.35	5.14	4.65	4.25	4.01	5.04	4.47	3.81	2.76
487	5.29	xxx	3.04	5.05	4.89	4.37	3.96	3.70	4.78	4.2	3.53	2.44
488	5.25	xxx	2.99	4.9	4.77	4.28	3.89	3.64	4.66	4.11	3.46	2.41
489	5.4	xxx	3.01	5.04	4.84	4.32	3.92	3.66	4.72	4.04	3.49	2.4
490	5.39	xxx	3.11	5.27	5.04	4.49	4.06	3.78	4.93	4.38	3.63	2.49
491	5.57	xxx	3.14	5.35	5.16	4.58	4.13	3.83	5.05	4.41	3.66	2.48
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
492	5.55	xxx	3.07	5.14	4.97	4.42	4.00	3.72	4.85	4.25	3.53	2.41
493	5.57	xxx	3.13	5.26	5.06	4.52	4.10	3.81	4.96	4.36	3.62	2.5
494	6.01	xxx	3.16	5.39	5.17	4.60	4.16	3.85	5.07	4.45	3.68	2.52
495	5.73	xxx	3.06	5.15	4.99	4.42	4.00	3.74	4.88	4.26	3.54	2.43
496	6.23	xxx	3.27	5.57	5.37	4.75	4.30	4.00	5.26	4.59	3.81	2.61
497	6.11	5.48	2.95	5.36	5.13	4.46	3.96	3.59	5.01	4.33	3.49	2.18
498	5.64	4.98	2.81	4.99	4.81	4.22	3.76	3.44	4.70	4.08	3.32	2.12
499	5.65	5.15	2.99	5.17	4.99	4.43	4.01	3.71	4.89	4.27	3.53	2.35
500	6.38	5.55	3.13	5.47	5.26	4.63	4.17	3.09	5.14	4.48	3.67	2.42
501	6.02	5.3	2.89	5.22	5.01	4.36	3.89		4.89	4.24	3.42	2.17
502	5.36	4.87	2.74	4.83	4.68	4.10	3.68		4.57	3.98	3.23	2.07
503	5.24	4.81	2.76	4.77	4.63	4.09	3.69		4.53	3.95	3.24	2.15
504	6.01	5.42	3	5.34	5.12	4.49	4.04		5.03	4.37	3.57	2.34
505	5.77	5.05	2.6	4.91	4.76	4.09	3.61		4.63	4	3.18	1.87
506	4.47	4.12	2.29	4.1	4.02	3.53	3.14		3.92	3.43	2.77	1.68
507	4.45	4.25	2.46	4.29	4.15	3.72	3.39		4.08	3.59	2.96	1.97
508	5.55	5.16	2.82	5.1	4.90	4.32	3.91		4.80	4.19	3.42	2.23
509	5.15	4.71	2.38	4.66	4.46	3.85	3.40		4.33	3.73	2.96	1.7
510	3.98	3.88	2.08	3.95	3.83	3.37	2.99		3.72	3.24	2.6	1.53
511	3.72	3.75	2.16	3.75	3.66	3.26	2.97		3.60	3.16	2.58	1.64
512	4.89	4.74	2.65	4.74	4.56	3.99	3.60		4.47	3.89	3.16	2
513	4.97	4.57	2.13	4.62	4.41	3.78	3.26		4.27	3.65	2.86	1.54
514	3.02	3.17	1.51	3.25	3.14	2.72	2.36		3.03	2.62	2.06	1.09
515	3.44	3.92	2.35	3.97	3.89	3.56	3.30		3.83	3.42	2.91	2.07
516	3.9	4.41	2.51	4.37	4.27	3.89	3.58		4.18	3.67	3.06	2.06
517	3.44	4.02	2.25	3.96	3.86	3.38	2.99		3.80	3.35	2.77	1.88
518	3.04	3.5	2.03	3.54	3.53	3.18	2.90		3.43	3.03	2.51	1.71
519	2.86	3.32	2	3.39	3.27	2.92	2.54		3.26	2.89	2.46	1.75
520	4.19	4.32	2.47	4.31	4.18	3.75	3.33		4.12	3.63	3.07	2.15

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
521	3.92	3.95	2.01	3.88	3.76	3.16	2.60		3.71	3.21	2.62	1.53
522	3.16	3.26	1.76	3.26	3.20	2.62	2.09		3.13	2.74	2.27	1.36
523	3.27	3.52	2.16	3.61	3.52	2.95	2.41		3.48	3.09	2.6	1.75
524	4.19	4.15	2.24	4.14	4.00	3.40	2.85		3.97	3.5	2.9	1.91
525	3.49	3.5	1.68	3.47	3.34	2.73	2.20		3.32	2.89	2.32	1.32
526	3.26	3.38	1.7	3.4	3.28	2.67	2.14		3.24	2.85	2.31	1.38
527	3.05	3.19	1.31	3.12	2.98	2.36	1.83		2.95	2.56	2.01	1.09
528	4.02	3.56	1.67	3.64	3.44	2.77	2.23		3.45	2.98	2.37	1.35
529	3.87	3.76	1.24	3.34	3.15	2.38	1.85		3.15	2.64	2.02	0.97
530	3.12	3.54	1.2	3.2	3.08	2.33	1.80		3.05	2.6	2.02	1.03
531	3.64	3.62	1.41	3.6	3.46	2.70	2.07		3.41	2.92	2.27	1.14
532	3.27	3.3	1.29	3.31	3.19	2.46	1.83		3.13	2.69	2.08	1.02
533	3.96	3.94	1.63	3.94	3.87	3.08	2.44		3.75	3.25	2.54	1.37
534	3.59	3.62	1.46	3.62	3.56	2.78	2.15		3.45	2.98	2.32	1.2
535	3.49	3.62	1.61	3.66	3.63	3.05	2.48		3.51	3.08	2.47	1.44
536	3.96	4.08	1.76	4.08	3.96	3.35	2.76		3.88	3.37	2.66	1.49
537	4.28	4.42	1.88	4.44	4.27	3.56	2.91		4.19	3.65	2.88	1.62
538	3.61	3.71	1.54	3.73	3.64	2.97	2.34		3.52	3.07	2.43	1.35
539	3.7	3.83	1.87	3.89	3.83	3.23	2.65		3.71	3.28	2.71	1.78
540	4.02	4.17	1.93	4.23	4.12	3.52	2.95		4.03	3.51	2.85	1.8
541	4.14	4.21	2.03	4.21	4.11	3.48	2.85		4.02	3.52	2.85	1.78
542	4.02	4.11	1.98	4.1	4.03	3.41	2.79		3.95	3.46	2.81	1.76
543	4.1	4.11	2.06	4.1	4.00	3.35	2.71		3.90	3.43	2.78	1.77
544	4.16	4.18	2.03	4.18	4.08	3.42	2.77		3.97	3.47	2.8	1.76
545	4.15	4.26	2.16	4.29	4.19	3.49	2.78		4.08	3.58	2.91	1.85
546	4.11	4.24	2.12	4.24	4.14	3.45	2.74		4.02	3.53	2.87	1.82
547	4.32	4.37	2.28	4.39	4.26	3.55	2.84		4.14	3.65	2.99	1.95
548	4.07	4.19	2.19	4.26	4.13	3.43	2.72		4.00	3.53	2.89	1.88
549	4.16	4.26	2.31	4.3	4.21	3.51	2.79		4.09	3.61	2.97	1.97
550	4.22	4.26	2.3	4.28	4.19	3.49	2.78		4.09	3.59	2.95	1.96
551	4.27	4.38	2.44	4.43	4.34	3.62	2.95		4.23	3.75	3.12	2.11
552	3.95	4.03	2.25	4.14	4.02	3.30	2.64		3.91	3.46	2.86	1.9
553	3.85	4	2.35	4.08	3.99	3.32	2.70		3.90	3.46	2.9	2.07
554	4.4	4.44	2.56	4.42	4.35	3.67	3.05		4.25	3.77	3.17	2.27
555	4.31	4.35	2.39	4.35	4.28	3.57	2.94		4.15	3.67	3.04	2.05

556	3.61	3.82	2.17	3.93	3.84	3.15	2.53		3.75	3.32	2.74	1.85
557	3.7	3.96	2.41	4.08	3.98	3.36	2.78		3.91	3.5	2.98	2.16

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
558	4.47	4.59	2.63	4.6	4.52	3.87	3.27		4.41	3.92	3.33	2.36
559	4.29	4.38	2.41	4.36	4.28	3.61	2.97		4.15	3.65	3.01	2.01
560	3.27	3.63	2.12	3.72	3.63	2.99	2.35		3.56	3.14	2.59	1.76
561	3.31	3.74	2.36	3.9	3.82	3.26	2.76		3.75	3.36	2.87	2.11
562	4.27	4.37	2.64	4.44	4.36	3.79	3.27		4.25	3.8	3.24	2.36
563	4	4.15	2.38	4.21	4.12	3.63	3.19		3.99	3.54	2.97	2.07
564	3	3.36	2.02	3.49	3.39	2.92	2.51		3.31	2.94	2.45	1.7
565	3.34	3.75	2.43	3.9	3.87	3.55	3.27		3.79	3.42	2.97	2.3
566	4.32	4.43	2.69	4.51	4.45	4.05	3.71		4.36	3.92	3.38	2.56
567	3.96	4.02	2.28	4.06	3.99	3.59	3.25		3.87	3.41	2.82	1.92
568	3.11	3.42	2.08	3.51	3.45	3.10	2.80		3.37	3	2.52	1.77
569	3.16	3.51	2.25	3.55	3.54	3.29	3.06		3.45	3.11	2.68	2.01
570	3.73	4.04	2.44	4.04	3.99	3.67	3.40		3.90	3.49	2.98	2.18
571	3.67	3.96	2.33	3.96	3.89	3.58	3.28		3.80	3.38	2.85	2
572	2.6	3.11	1.96	3.18	3.17	2.89	2.61		3.09	2.75	2.31	1.62
573	2.8	3.3	2.32	3.43	3.42	3.20	2.99		3.36	3.05	2.7	2.14
574	3.62	4.05	2.62	4.13	4.07	3.83	3.60		4.00	3.63	3.2	2.47
575	3.19	3.68	2.24	3.73	3.65	3.39	3.12		3.59	3.21	2.72	1.95
576	2.2	3.08	1.96	3.17	3.13	2.88	2.61		3.07	2.75	2.32	1.68
577	2.38	3.21	2.18	3.29	3.28	3.07	2.86		3.23	2.94	2.56	1.97
578	3.76	4.07	2.55	4.07	4.03	3.79	3.54		3.98	3.6	3.11	2.35
579	3.6	3.94	2.31	3.94	3.85	3.55	3.24		3.80	3.35	2.8	1.97
580	2.37	2.93	1.88	2.99	2.93	2.66	2.41		2.90	2.55	2.14	1.52
581	2.46	3.42	2.4	3.48	3.48	3.26	3.08		3.43	3.14	2.78	2.18
582	4.13	4.36	2.78	4.34	4.28	4.05	3.80		4.23	3.84	3.35	2.56
583	3.74	3.93	2.34	3.93	3.86	3.56	3.26		3.80	3.36	2.82	2.01
584	3.3	3.52	2.18	3.57	3.53	3.24	2.96		3.47	3.08	2.59	1.87
585	3.54	3.75	2.37	3.83	3.75	3.50	3.24		3.71	3.32	2.86	2.11
586	3.96	4.05	2.53	4.1	4.00	3.75	3.51		3.96	3.55	3.05	2.24
587	4.19	4.29	2.66	4.32	4.22	3.92	3.63		4.17	3.72	3.18	2.32
588	3.81	3.9	2.44	3.93	3.83	3.53	3.21		3.77	3.35	2.85	2.05
589	3.74	3.91	2.56	3.98	4.35	3.60	3.32		3.82	3.45	3	2.27
590	4.45	4.59	2.85	4.63	4.49	4.22	3.93	3.79	4.44	3.99	3.47	2.59

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
591	4.78	4.63	2.36	4.63	4.51	4.10	3.66	3.43	4.45	3.92	3.28	2.25
592	4.48	4.5	2.65	4.43	4.35	3.98	3.60	3.40	4.27	3.78	3.16	2.2
593	4.4	4.4	2.62	4.37	4.27	3.87	3.48	3.22	4.20	3.72	3.14	2.2
594	4.8	4.7	2.75	4.69	4.59	4.17	3.77	3.48	4.49	3.96	3.34	2.32
595	5.2	4.9	2.83	4.89	4.76	4.23	3.71	3.33	4.65	4.08	3.39	2.3
596	5	4.8	2.73	4.65	4.53	4.03	3.54	3.17	4.41	3.87	3.22	2.2
597	5.1	4.9	2.82	4.78	4.64	4.12	3.62	3.22	4.53	3.99	3.36	2.33
598	5.3	5	2.9	5.01	4.88	4.34	3.83	3.41	4.75	4.19	3.52	2.43
599	5.6	5.1	2.94	5.11	4.97	4.37	3.78	3.31	4.84	4.24	3.51	2.36
600	5.6	5.1	2.95	5.1	4.98	4.36	3.78	3.31	4.83	4.22	3.51	2.36
601	5.8	5.3	3.02	5.24	5.08	4.43	3.86	3.37	4.94	4.33	3.6	2.43
602	5.6	5.1	2.9	5.09	4.93	4.29	3.73	3.26	4.79	4.2	3.47	2.32
603	5.8	5.2	3.1	5.25	5.11	4.54	3.97	3.54	4.98	4.4	3.7	2.59
604	6.3	5.6	3.28	5.61	5.45	4.82	4.21	3.75	5.32	4.68	3.92	2.73
605	6.3	5.4	3.04	5.44	5.25	4.51	3.89	3.39	5.11	4.46	3.64	2.37
606	5.7	4.9	2.83	4.98	4.82	4.15	3.57	3.10	4.69	4.1	3.36	2.2
607	5.7	5.2	3.13	5.26	5.13	4.53	4.00	3.60	5.01	4.44	3.75	2.66
608	6.7	6	3.41	5.9	5.70	5.01	4.40	3.95	5.58	4.91	4.12	2.87
609	xxx	5.5	2.91	5.34	5.13	4.41	3.81	3.33	4.99	4.36	3.53	2.25
610	xxx	5	2.76	4.95	4.80	4.13	3.59	3.15	4.67	4.12	3.37	2.2
611	xxx	4.5	2.51	4.36	4.25	3.75	3.30	2.95	4.09	3.58	2.92	1.85
612	xxx	5.5	3.03	5.27	5.05	4.42	3.84	3.39	4.93	4.29	3.51	2.28
613	xxx	6.2	2.99	6.02	5.72	4.87	4.11	3.54	5.57	4.77	3.77	2.12
614	xxx	4	2.08	4	3.79	3.12	2.54	2.09	3.68	3.16	2.47	1.31
615	xxx	4.5	2.89	4.55	4.50	3.95	3.82	3.61	4.41	3.99	3.53	2.77
616	xxx	5.9	3.38	5.78	5.65	4.99	4.74	4.47	5.52	4.9	4.22	3.11
617	xxx	5.1	2.73	4.98	4.80	4.27	3.78	3.47	4.69	4.09	3.38	2.25
618	xxx	4.3	2.47	4.34	4.22	3.79	3.39	3.14	4.12	3.65	3.05	2.08
619	xxx	4.3	2.62	4.32	4.25	3.88	3.53	3.32	4.15	3.72	3.17	2.29
620	xxx	5.1	2.92	4.97	4.92	4.48	4.05	3.79	4.79	4.27	3.61	2.56
621	xxx	4.9	2.61	4.8	4.68	4.13	3.61	3.26	4.55	3.98	3.25	2.08
622	xxx	3.8	2.2	3.88	3.81	3.37	2.95	2.65	3.69	3.25	2.67	1.74
623	xxx	4.1	2.69	4.23	4.20	3.87	3.55	3.33	4.08	3.7	3.24	2.49
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
624	xxx	4.9	2.94	4.93	4.86	4.46	4.07	3.82	4.72	4.23	3.65	2.69

625	xxx	4.6	2.58	4.59	4.47	4.00	3.52	3.21	4.34	3.82	3.17	2.15
626	xxx	3.7	2.23	3.75	3.67	3.27	2.87	2.59	3.57	3.17	2.65	1.85
627	xxx	3.9	2.63	4.06	3.99	3.68	3.37	3.15	3.91	3.54	3.09	2.35
628	xxx	4.4	2.8	4.53	4.45	4.11	3.77	3.54	4.35	3.91	3.38	2.51
629	xxx	4.1	2.52	4.12	4.04	3.69	3.34	3.10	3.93	3.51	2.97	2.19
630	xxx	3.5	2.26	3.66	3.59	3.26	2.93	2.71	3.48	3.11	2.63	1.93
631	xxx	3.7	2.56	3.85	3.81	3.51	3.22	3.03	3.70	3.35	2.93	2.24
632	xxx	3.9	2.62	3.94	3.88	3.59	3.31	3.65	3.82	3.43	3.02	2.35
633	xxx	4.1	2.75	4.1	4.11	3.79	3.36	xxx	4.00	3.62	3.18	2.46
634	xxx	3.4	2.34	3.44	3.48	3.18	2.77	xxx	3.39	3.04	2.65	2.05
635	xxx	3.1	2.31	3.2	3.21	3.04	2.85	xxx	3.15	2.89	2.6	2.14
636	xxx	3.7	2.73	3.82	3.80	3.60	3.39	xxx	3.74	3.45	3.11	2.55
637	xxx	4.1	2.78	4.22	4.23	3.91	3.63	xxx	4.13	3.76	3.32	2.58
638	xxx	3.4	2.3	3.42	3.45	3.16	2.91	xxx	3.36	3.02	2.65	2.02
639	xxx	3	2.23	3.16	3.21	3.05	2.88	xxx	3.15	2.94	2.71	2.32
640	xxx	3.6	2.59	3.86	3.87	3.70	3.50	xxx	3.79	3.52	3.18	2.6
641	xxx	3.7	2.5	3.82	3.77	3.47	3.17	xxx	3.67	3.32	2.92	2.23
642	3	4	2.7	4.1	4.07	3.77	3.47	xxx	3.97	3.62	3.21	2.53
643	3.4	3.2	2.08	3.33	3.28	3.00	3.58	xxx	3.22	2.9	2.51	1.9
644	3.7	3.7	2.36	3.79	3.73	3.43	3.11	xxx	3.66	3.32	2.9	2.21
645	3.8	3.9	2.19	3.9	3.82	3.36	2.88	2.47	3.75	3.3	2.73	1.82
646	3.5	3.9	2.24	3.91	3.86	3.41	2.93	2.52	3.78	3.33	2.76	1.89
647	3.4	3.6	2.04	3.75	3.67	3.17	2.69	2.24	3.59	3.16	2.59	1.71
648	3.6	3.6	2.05	3.73	3.66	3.15	2.68	2.23	3.56	3.14	2.58	1.71
649	4	4	2.2	4.11	4.00	3.41	2.82	2.28	3.89	3.42	2.81	1.83
650	3.7	4.1	2.27	4.22	4.10	3.51	2.93	2.37	4.00	3.5	2.89	1.9
651	3.8	3.9	2.11	4.02	3.90	3.26	2.68	2.09	3.81	3.34	2.73	1.75
652	3.6	3.9	2.11	4.03	3.93	3.29	2.70	2.11	3.84	3.37	2.74	1.75
653	4.3	4.2	2.15	4.23	4.12	3.44	2.73	2.08	4.02	3.5	2.83	1.76
654	4.7	4.5	2.29	4.44	4.32	3.61	2.90	2.25	4.21	3.67	2.99	1.89
655	4	4.4	2.1	4.41	4.28	3.50	2.75	2.08	4.15	3.59	2.85	1.62
656	3.8	3.8	1.85	3.91	3.80	3.05	2.30	1.64	3.68	3.18	2.5	1.41
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
657	4.1	4.7	2.51	4.75	4.66	3.91	3.17	2.51	4.54	4.02	3.36	2.28
658	4.2	4.7	2.47	4.69	4.58	3.85	3.11	2.45	4.45	3.91	3.26	2.16
659	3.9	4.4	2.41	4.5	4.39	3.74	3.16	2.61	4.28	3.77	3.2	2.23

660	3.7	4.2	2.32	4.38	4.22	3.60	3.03	2.51	4.12	3.63	3.07	2.12
661	3.9	4.1	2.31	4.24	4.13	3.55	2.98	2.48	4.02	3.57	3.03	2.16
662	4.5	4.7	2.56	4.71	4.63	4.02	3.44	2.91	4.49	3.99	3.39	2.41
663	xxx	4.5	2.29	4.44	4.33	3.64	2.98	2.37	4.22	3.66	3.03	1.99
664	3.9	4	2.05	4	3.86	3.19	2.53	1.94	3.79	3.29	2.72	1.78
665	3.7	4.4	2.4	4.47	4.31	3.58	2.87	2.24	4.21	3.74	3.15	2.19
666	4.6	4.8	2.61	4.82	4.69	3.96	3.23	2.58	4.56	4.03	3.4	2.38
667	4.2	4.7	2.54	4.7	4.55	3.73	2.97	2.26	4.43	3.88	3.24	2.18
668	3.7	4	2.22	4.15	3.98	3.18	2.45	1.79	3.87	3.41	2.82	1.86
669	3.7	4.1	2.47	4.22	4.05	3.33	2.66	2.05	3.98	3.59	3.1	2.3
670	4.4	4.9	2.78	4.87	4.72	3.97	3.28	2.61	4.62	4.13	3.55	2.6
671	4.3	4.6	2.46	4.56	4.40	3.60	2.82	2.09	4.27	3.73	3.08	2.01
672	3.9	4	2.21	4.06	3.89	3.11	2.36	1.68	3.82	3.35	2.76	1.82
673	3.8	4.2	2.51	4.24	4.09	3.36	2.61	1.93	4.05	3.61	3.06	2.21
674	4.9	4.9	2.79	4.84	4.71	3.94	3.17	2.43	4.62	4.09	3.48	2.48
675	xxx	5	2.74	4.97	4.81	3.89	3.02	2.19	4.70	4.11	3.4	2.2
676	3.3	3.4	1.99	3.53	3.36	2.60	1.88	1.26	3.33	2.9	2.35	1.4
677	3.6	3.9	2.75	4.01	3.91	3.23	2.54	2.01	3.91	3.59	3.22	2.58
678	4.2	4.8	3.09	4.8	4.70	3.90	3.08	2.39	4.63	4.21	3.74	2.94
679	xxx	4.4	2.8	4.38	4.27	3.51	2.75	2.07	4.18	3.74	3.23	2.37
680	3.1	3.7	2.45	3.79	3.65	2.95	2.24	1.64	3.59	3.22	2.78	2.06
681	3.3	3.7	2.64	3.85	3.71	3.08	2.44	1.90	3.68	3.34	2.95	2.33
682	4.2	4.6	3.07	4.68	4.56	3.88	3.16	2.52	4.49	4.07	3.59	2.8
683	xxx	4.5	2.81	4.52	4.34	3.63	2.87	2.20	4.25	3.77	3.22	2.31
684	3.1	3.5	2.31	3.56	3.41	2.76	2.07	1.50	3.37	2.98	2.53	1.8
685	3.1	3.8	2.7	3.86	3.78	3.22	2.64	2.18	3.74	3.42	3.03	2.43
686	3.9	4.6	3.11	4.68	4.55	3.94	3.29	2.73	4.47	4.07	3.6	2.84
687	xxx	4.3	2.81	4.38	4.25	3.65	3.02	2.47	4.15	3.7	3.19	2.32
688	3.3	3.6	2.42	3.64	3.54	2.95	2.34	1.82	3.48	3.1	2.66	1.95
689	3.2	3.8	2.74	3.96	3.88	3.39	2.90	2.50	3.80	3.47	3.05	2.42

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
690	3.8	4.5	3.06	4.58	4.49	3.99	3.48	3.06	4.36	3.97	3.49	2.71
691	3.8	4.3	2.9	4.34	4.28	3.84	3.39	3.03	4.15	3.75	3.29	2.52
692	3.3	3.8	2.67	3.95	3.87	3.45	3.01	2.68	3.78	3.42	2.99	2.27
693	3.8	3.8	2.72	4.01	3.98	3.63	3.31	3.08	3.87	3.51	3.09	2.37
694	4.1	4	2.82	4.15	4.09	3.70	3.35	3.10	4.00	3.62	3.19	2.46

695	3.9	4.3	3.03	4.42	4.35	4.03	3.75	3.56	4.25	3.88	3.45	2.7
696	3.7	4.1	2.91	4.28	4.23	3.87	3.56	3.36	4.13	3.76	3.31	2.54
697	3.9	4	2.85	4.25	4.18	3.84	3.54	3.38	4.08	3.7	3.24	2.5
698	4.3	4.5	3.1	4.68	4.59	4.23	3.90	3.73	4.50	4.09	3.6	2.79
699	4.2	4.4	3	4.46	4.39	4.05	3.73	3.57	4.28	3.87	3.38	2.57
700	4.2	4.5	3.02	4.52	4.43	4.09	3.76	3.59	4.34	3.93	3.43	2.63
701	4.4	4.4	2.83	4.48	4.30	3.91	3.54	3.34	4.19	3.74	3.19	2.29
702	4.6	4.7	3.05	4.84	4.66	4.26	3.88	3.65	4.55	4.08	3.52	2.57
703	4.6	4.6	2.88	4.61	4.48	4.10	3.74	3.51	4.38	3.9	3.32	2.34
704	4.5	4.6	2.86	4.58	4.44	4.05	3.67	3.44	4.35	3.87	3.27	2.29
705	4.6	4.5	2.76	4.41	4.27	3.89	3.49	3.27	4.18	3.71	3.13	2.16
706	xxx	4.1	2.6	4.02	3.92	3.57	3.21	3.01	3.82	3.4	2.89	2.02
707	xxx	4.7	1.74	5.32	5.25	xxx	4.42	4.21	5.09	4.6	4	2.98
708	5	5.16	3.3	5.25	5.13	xxx	4.20	3.98	4.95	4.44	3.8	2.73
709	4.51	4.95	3.24	4.96	4.85	xxx	4.03	3.82	4.72	4.27	3.71	2.76
710	5.14	4.62	3.13	4.74	4.66	xxx	3.91	3.72	4.54	4.12	3.6	2.68
711	5.17	4.83	3.45	5.14	5.06	xxx	4.29	4.09	4.87	4.49	3.94	2.98
712	5.73	5.61	3.77	5.85	5.72	xxx	4.83	4.59	5.53	5.06	4.41	3.31
713	5.23	5.33	3.32	5.35	5.13	4.62	4.16	3.91	5.01	4.45	3.78	2.69
714	5.14	4.94	3.19	5.03	4.84	4.37	3.95	3.72	4.72	4.22	3.6	2.6
715	5.61	5.19	3.37	5.32	5.18	xxx	4.26	4.02	5.04	4.52	3.88	2.83
716	6.15	5.58	3.53	5.63	5.48	xxx	4.50	4.23	5.33	4.77	4.09	2.97
717	5.94	5.48	3.41	5.6	5.42	xxx	4.41	4.13	5.27	4.69	4	2.86
718	5.24	4.69	3.06	4.88	4.72	xxx	3.78	3.54	4.58	4.08	3.48	2.46
719	5.31	4.82	3.44	5.17	5.06	xxx	4.30	4.11	4.87	4.52	4	3.06
720	6.61	5.88	3.84	6.11	5.92	xxx	5.01	4.76	5.72	5.25	4.59	3.45
721	5.41	5.76	3.47	5.89	5.64	xxx	4.50	4.18	5.50	4.86	4.1	2.9
722	4.51	4.85	3.13	5.09	4.91	xxx	3.89	3.61	4.78	4.24	3.58	2.53
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
723	5.15	4.71	3.18	4.84	4.73	xxx	3.94	3.74	4.62	4.18	3.66	2.77
724	6.48	5.97	3.71	5.97	5.78	xxx	4.83	4.57	5.67	5.09	4.43	3.33
725	5.72	5.76	3.28	5.72	5.46	4.86	4.28	3.93	5.37	4.69	3.9	2.62
726	4.69	4.32	2.73	4.41	4.25	3.78	3.31	3.05	4.17	3.68	3.09	2.11
727	4.73	4.69	3.22	4.84	4.74	xxx	4.02	3.83	4.63	4.23	3.76	2.9
728	5.98	5.55	3.53	5.58	5.42	xxx	4.62	4.39	5.31	4.81	4.22	3.19
729	5.67	5.2	3.2	5.19	5.01	xxx	4.07	3.79	4.93	4.39	3.72	2.68

730	4.28	4.19	2.78	4.32	4.21	3.79	3.42	3.21	4.13	3.69	3.14	2.28
731	4.21	4.26	3.02	4.41	4.32	3.91	3.61	3.41	4.24	3.88	3.46	2.71
732	5.37	5.2	3.41	5.28	5.17	4.76	4.45	4.22	5.06	4.59	4.05	3.11
733	5.39	4.99	3.1	5.01	4.86	4.33	3.76	3.38	4.76	4.22	3.59	2.57
734	3.95	3.98	2.66	4.11	4.03	3.59	3.10	2.75	3.92	3.5	3	2.2
735	3.81	4.1	2.92	4.21	4.17	3.77	3.34	3.00	4.08	3.74	3.32	2.63
736	4.84	4.9	3.28	4.95	4.89	4.44	3.98	3.61	4.78	4.35	3.83	2.97
737	4.78	4.72	3.03	4.71	4.62	4.04	3.49	3.03	4.52	4.03	3.47	2.55
738	3.45	3.69	2.49	3.72	3.69	3.13	2.61	2.16	3.60	3.2	2.77	2.05
739	3.46	3.88	2.83	4.07	4.03	3.56	3.14	2.80	3.95	3.62	3.26	2.63
740	4.58	4.54	3.2	4.7	4.60	4.14	3.69	3.34	4.50	4.13	3.69	2.92
741	3.98	4.02	2.78	4.17	4.09	3.66	3.24	2.88	3.99	3.62	3.19	2.44
742	3.73	3.86	2.75	4.01	3.95	3.52	3.11	2.75	3.88	3.54	3.15	2.46
743	3.24	3.41	2.37	3.56	3.51	3.14	2.77	2.45	3.44	3.1	2.71	2.07
744	4.04	4.07	2.72	4.13	4.07	3.67	3.27	2.93	3.99	3.6	3.13	2.4
745	3.53	3.58	2.21	3.62	3.55	3.14	2.71	2.31	3.47	3.1	2.63	1.89
746	3.31	3.63	2.25	3.7	3.64	3.23	2.80	2.40	3.56	3.2	2.73	1.96
747	3.44	3.61	2.08	3.68	3.62	3.12	2.62	2.17	3.55	3.14	2.61	1.68
748	3.32	3.49	2.03	3.53	3.50	2.99	2.50	2.05	3.42	3.03	2.53	1.68
749	xxx	4.63	2.81	4.67	4.56	3.94	3.29	2.77	4.44	3.98	3.4	2.49
750	3.41	3.8	2.41	3.97	3.84	3.26	2.65	2.17	3.73	3.31	2.79	1.99
751	3.03	3.56	2.49	3.73	3.64	3.15	2.68	2.28	3.57	3.27	2.89	2.29
752	3.06	3.56	2.45	3.73	3.65	3.18	2.71	2.31	3.57	3.26	2.87	2.24
753	3.52	3.77	2.69	3.94	3.87	3.39	2.91	2.52	3.80	3.5	3.13	2.51
754	3.91	4	2.79	4.15	4.08	3.60	3.13	2.72	4.02	3.67	3.26	2.57
755	2.39	2.81	1.72	2.97	2.93	2.52	2.13	1.73	2.88	2.57	2.19	1.66

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
756	3.24	3.67	2.18	3.78	3.70	3.23	2.80	2.38	3.66	3.31	2.87	2.24
757	3.76	4.1	2.29	4.15	4.05	3.44	2.82	2.25	3.97	3.48	2.86	1.83
758	2.99	3.41	2.09	3.48	3.40	2.80	2.21	1.67	3.32	2.96	2.49	1.68
759	3.74	3.82	2.36	3.85	3.80	3.19	2.60	2.10	3.70	3.32	2.83	1.94
760	2.72	3.02	1.89	3.08	3.00	2.44	1.90	1.44	2.95	2.6	2.14	1.36
761	3.34	3.84	2.66	4	3.88	3.30	2.77	2.33	3.85	3.55	3.16	2.53
762	4.21	4.5	2.93	4.63	4.53	3.95	3.40	2.91	4.42	4.03	3.56	2.76
763	3.32	3.71	2.41	3.78	3.71	3.20	2.67	2.20	3.61	3.26	2.84	2.15
764	3.02	3.53	2.35	3.65	3.59	3.06	2.51	2.06	3.51	3.18	2.77	2.13

765	3.53	4.06	2.65	4.11	4.00	3.40	2.75	2.23	3.94	3.55	3.07	2.31
766	4.01	4.4	2.83	4.45	4.33	3.72	3.07	2.53	4.25	3.83	3.34	2.51
767	3.77	4.15	2.71	4.26	4.15	3.47	1.91	2.24	4.07	3.66	3.2	2.39
768	3.2	3.7	2.44	3.84	3.72	3.04	2.41	1.86	3.66	3.28	2.84	2.09
769	3.86	4.22	2.91	4.42	4.26	3.49	2.84	2.26	4.22	3.83	3.36	2.58
770	4.68	4.73	3.17	4.87	4.71	3.93	3.26	2.64	4.65	4.22	3.71	2.87
771	4.05	4.25	2.79	4.39	4.22	3.49	2.84	2.15	4.15	3.74	3.24	2.41
772	3.59	4.03	2.63	4.21	4.04	3.30	2.65	1.97	4.00	3.55	3.05	2.22
773	3.52	4	2.71	4.2	4.07	3.38	2.79	2.21	4.04	3.61	3.15	2.41
774	4.65	4.69	3.04	4.8	4.67	3.98	3.36	2.76	4.58	4.14	3.63	2.77
775	4.71	4.67	2.83	4.75	4.60	3.82	3.10	2.43	4.48	3.96	3.33	2.3
776	3.81	4.05	2.56	4.23	4.06	3.29	2.58	1.94	3.97	3.52	2.95	2.05
777	3.61	3.9	2.6	4.1	3.94	3.28	2.66	2.10	3.87	3.48	3.01	2.24
778	4.9	5	3.07	5.06	4.92	4.21	3.55	2.96	4.81	4.29	3.7	2.7
779	4.73	4.7	2.61	4.67	4.51	3.72	2.94	2.24	4.39	3.8	3.11	1.96
780	3.6	3.88	2.33	4	3.85	3.10	2.36	1.68	3.77	3.3	2.73	1.76
781	3.89	4.06	2.53	4.09	3.93	3.22	2.51	1.87	3.87	3.44	2.91	2.04
782	4.88	4.98	2.96	4.99	4.79	4.03	3.29	2.61	4.72	4.16	3.49	2.44
783	xxx	5.13	2.79	5.23	5.00	4.01	3.09	2.27	4.87	4.22	3.4	2.05
784	3.68	3.56	2.09	3.73	3.51	2.70	1.92	1.27	3.43	2.99	2.38	1.33
785	4.16	4.39	3	4.55	4.37	3.62	2.87	2.28	4.36	4.01	3.58	2.82
786	5.3	5.24	3.27	5.25	5.07	4.21	3.34	2.61	4.98	4.5	3.93	3
787	4.86	4.92	3	4.95	4.77	3.99	3.17	2.48	4.66	4.15	3.53	2.53
788	3.57	4	2.55	4.04	3.93	3.17	2.41	1.76	3.85	3.43	2.9	2.06
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
789	4.05	4.45	3.07	4.55	4.48	3.84	3.21	2.70	4.40	4.04	3.57	2.82
790	5.2	5.29	3.47	5.41	5.29	4.62	3.95	3.38	5.19	4.73	4.18	3.26
791	5.08	4.97	3.07	5.03	4.88	4.21	3.52	2.96	4.75	4.22	3.58	2.55
792	3.69	3.83	2.49	3.93	3.80	3.14	2.49	1.97	3.73	3.31	2.79	1.97
793	3.93	4.16	3.1	4.53	4.45	xxx	3.40	3.00	4.32	4.04	3.62	2.9
794	5.21	5.05	3.54	5.38	5.27	xxx	4.19	3.77	5.08	4.71	4.2	3.28
795	4.45	4.62	3.03	4.67	4.59	4.06	3.53	3.08	4.46	4.01	3.49	2.57
796	3.67	4.03	2.78	4.11	4.04	3.54	3.02	2.59	3.95	3.6	3.15	2.39
797	3.88	4.23	2.97	4.4	4.31	3.82	3.37	2.99	4.21	3.86	3.41	2.64
798	5.09	5.09	3.4	5.2	5.08	4.54	4.06	3.66	4.96	4.5	3.98	3.09
799	3.98	4.36	2.64	4.5	4.37	3.82	3.31	2.88	4.24	3.76	3.21	2.28

800	3.77	4.31	2.69	4.48	4.33	3.79	3.27	2.84	4.21	3.76	3.23	2.34
801	3.7	3.75	2.19	3.84	3.72	3.25	2.77	2.39	3.55	3.14	2.64	1.84
802	3.71	3.83	2.29	3.94	3.82	3.32	2.83	2.43	3.70	3.3	2.79	2
803	4.97	4.87	2.89	5	4.81	4.20	3.60	3.13	4.70	4.18	3.52	2.46
804	3.74	3.81	2.35	3.96	3.84	3.28	2.73	2.30	3.74	3.29	2.72	1.8
805	3.85	4.15	2.82	4.35	4.27	xxx	3.36	3.00	4.19	3.83	3.41	2.62
806	4.65	4.7	3.04	4.86	4.76	xxx	3.84	3.47	4.63	4.2	3.7	2.78
807	4.07	4.21	2.77	4.29	4.24	3.77	3.29	2.88	4.14	3.74	3.27	2.51
808	4.48	4.59	2.93	4.68	4.63	4.15	3.65	3.23	4.49	4.06	3.55	2.72
809	4.45	4.42	2.73	4.59	4.43	3.81	3.23	2.70	4.29	3.83	3.26	2.33
810	4.14	4.36	2.74	4.56	4.39	3.78	3.20	2.67	4.26	3.82	3.28	2.38
811	4.1	4.48	2.85	4.61	4.49	3.86	3.18	2.61	4.38	3.94	3.42	2.55
812	4.42	4.62	2.88	4.72	4.60	3.96	3.29	2.71	4.49	4.02	3.48	2.58
813	4.56	4.67	2.84	4.86	4.64	3.87	3.15	2.47	4.54	4.02	3.41	2.41
814	3.96	4.28	2.66	4.47	4.24	3.47	2.76	2.12	4.17	3.7	3.14	2.24
815	4.32	4.57	2.97	4.67	4.49	3.75	3.02	2.39	4.43	4	3.5	2.65
816	4.94	5.02	3.16	5.12	4.95	4.21	3.46	2.78	4.85	4.37	3.81	2.84
817	4.71	4.87	2.96	5.01	4.78	3.93	3.14	2.40	4.66	4.15	3.52	2.51
818	3.91	4.3	2.72	4.49	4.27	3.42	2.66	1.97	4.17	3.73	3.16	2.27
819	4.38	4.63	3.08	4.79	4.61	3.82	3.04	2.38	4.54	4.11	3.57	2.7
820	5.56	5.44	3.38	5.49	5.31	4.51	3.69	2.97	5.21	4.68	4.04	2.99
821	4.97	4.97	2.96	5.02	4.83	4.01	3.20	2.45	4.72	4.17	3.52	2.46

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
822	4.16	4.44		4.58	4.38	3.56	2.76	2.05	4.29	3.82	3.24	2.3
823	4.67	4.83		4.97	4.75	3.94	3.14	2.47	4.67	4.19	3.61	2.65
824	5.71	5.55		5.59	5.37	4.53	3.71	3.01	5.26	4.69	4.03	2.92
825	5.05	5.28		5.37	5.10	4.21	3.39	2.62	4.99	4.4	3.69	2.5
826	4.08	4.61		4.79	4.53	3.67	2.85	2.12	4.44	3.93	3.3	2.23
827	4.63	4.7		4.76	4.56	3.84	3.08	2.44	4.48	4.01	3.44	2.47
828	5.22	5.87		5.82	5.56	4.74	3.94	3.26	5.47	4.87	4.17	3
829	4.63	5.49		5.41	5.13	4.17	3.27	2.50	4.99	4.3	3.46	2.05
830	4.41	4.38		4.4	4.18	3.32	2.48	1.76	4.09	3.56	2.87	1.73
831	4.85	5.11		5.11	4.92	xxx	3.32	2.65	4.83	4.33	3.69	2.64
832	6.02	5.89		5.77	5.58	xxx	3.88	3.18	5.44	4.8	4.05	2.8
833	5.78	5.38		5.3	5.10	4.22	3.43	2.70	4.95	4.29	3.52	2.22
834	4.7	4.57		4.61	4.40	3.58	2.78	2.09	4.29	3.75	3.08	1.96

835	4.63	4.74		4.85	4.67	3.97	3.29	2.70	4.57	4.1	3.51	2.52
836	6.36	6.09		6.03	5.81	4.96	4.20	3.55	5.67	5	4.22	2.94
837	5.78	5.3		5.25	5.01	4.10	3.28	2.58	4.87	4.15	3.31	1.91
838	4.27	4.09		4.18	4.00	3.22	2.47	1.82	3.89	3.37	2.72	1.6
839	4.77	4.81		4.88	4.72	3.99	3.23	2.59	4.61	4.12	3.5	2.45
840	5.83	5.62		5.59	5.39	4.60	3.83	3.18	5.26	4.65	3.9	2.67
841	5.39	5.15	2.65	5.14	4.91	4.06	3.24	2.53	4.79	4.14	3.35	2.04
842	4.12	4.25	2.34	4.41	4.19	3.40	2.61	1.92	4.10	3.58	2.94	1.82
843	4	4.32	2.61	4.45	4.29	3.61	2.91	2.28	4.20	3.75	3.21	2.27
844	5.35	5.35	2.98	5.35	5.18	4.42	3.68	3.02	5.05	4.44	3.75	2.57
845	5.35	5.09	2.56	5.12	4.88	3.99	3.30	2.43	4.74	4.06	3.25	1.86
846	3.88	4	2.17	4.12	3.91	3.11	2.48	1.66	3.82	3.33	2.69	1.59
847	4.07	4.4	2.66	4.52	4.35	3.66	2.98	2.40	4.26	3.81	3.25	2.3
848	4.89	4.96	2.83	5	4.81	4.09	3.38	2.76	4.69	4.13	3.48	2.38
849	4.77	4.78	2.63	4.81	4.67	3.94	3.20	2.58	4.54	3.96	3.28	2.09
850	2.57	2.96	1.67	3.02	2.91	2.27	1.66	1.20	2.85	2.46	1.97	1.09
851	3.31	3.9	xxx	4.06	4.00	xxx	3.08	2.78	3.93	3.74	3.45	2.91
852	4.79	4.96	xxx	5.14	5.05	xxx	4.00	3.59	4.90	4.56	4.1	3.32
853	4.1	4.22	2.81	4.29	4.21	3.70	3.20	2.82	4.10	3.67	3.15	2.34
854	3.64	4.1	2.84	4.24	4.17	3.65	3.14	2.75	4.10	3.72	3.27	2.53
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
855	3.58	3.91	2.69	4.05	3.96	3.48	3.04	2.68	3.86	3.48	3.03	2.26
856	3.64	3.9	2.66	4.01	3.90	3.42	2.99	2.63	3.81	3.43	2.97	2.22
857	3.33	3.76	2.58	3.89	3.78	3.38	2.99	2.67	3.71	3.33	2.89	2.19
858	3.24	3.75	2.6	3.9	3.82	3.40	3.01	2.69	3.74	3.38	2.95	2.24
859	3.32	3.77	2.64	3.94	3.87	3.52	3.18	2.91	3.77	3.43	3.02	2.3
860	3.35	3.76	2.61	3.94	3.86	3.51	3.16	2.91	3.82	3.41	2.99	2.25
861	3.21	3.65	2.5	3.68	3.62	3.34	3.04	2.83	3.53	3.2	2.82	2.16
862	3.18	3.62	2.47	3.63	3.58	3.29	2.98	2.78	3.49	3.16	2.78	2.13
863	2.88	3.36	2.37	3.49	3.44	3.20	2.93	2.77	3.35	3.04	2.7	2.13
864	2.43	2.84	2.07	2.96	2.90	2.67	2.43	2.27	2.85	2.58	2.29	1.82
865	3.03	3.53	2.63	3.67	3.65	3.42	3.17	3.00	3.58	3.3	2.96	2.45
866	3.29	3.84	2.72	3.97	3.93	3.65	3.35	3.18	3.84	3.48	3.06	2.42
867	2.46	2.98	2.17	3.13	3.09	2.86	2.65	2.56	3.01	2.71	2.42	2
868	2.57	3.01	2.24	3.21	3.16	2.93	2.73	2.66	3.10	2.83	2.57	2.15
869	3.04	3.52	2.57	3.72	3.64	3.35	3.09	2.97	3.55	3.22	2.87	2.29

870	3.09	3.48	2.54	3.61	3.53	3.24	2.98	2.86	3.46	3.14	2.79	2.24
871	3.41	3.89	2.82	4.14	4.01	3.72	3.46	3.32	3.93	3.62	3.22	2.56
872	2.99	3.45	2.52	3.73	3.65	3.37	3.13	2.99	3.57	3.28	2.92	2.31
873	3.05	3.45	2.58	3.63	3.60	3.40	3.18	3.08	3.54	3.27	2.94	2.39
874	3.66	4.01	2.92	4.17	4.10	3.87	3.60	3.49	4.05	3.74	3.34	2.67
875	3.2	3.56	2.58	3.71	3.62	3.39	3.14	3.04	3.59	3.3	2.94	2.33
876	2.42	2.97	2.2	3.14	3.11	2.90	2.68	2.57	3.07	2.83	2.52	2.03
877	3.34	3.8	2.8	3.93	3.96	xxx	3.44	3.30	3.88	3.59	3.22	2.6
878	3.88	4.15	3.02	4.28	4.24	xxx	3.68	3.55	4.17	3.85	3.45	2.76
879	3.24	3.62	2.67	3.77	3.71	3.46	3.23	3.12	3.67	3.39	3.03	2.45
880	2.89	3.4	2.53	3.56	3.52	3.28	3.08	2.99	3.47	3.22	2.9	2.36
881	3.19	3.6	2.65	3.76	3.71	3.45	3.21	3.10	3.65	3.36	3	2.39
882	3.55	3.78	2.76	3.87	3.79	3.51	3.24	3.10	3.77	3.43	3.02	2.38
883	3.65	4	2.95	4.13	4.06	xxx	3.55	3.44	4.02	3.72	3.35	2.72
884	3.13	3.75	2.76	3.94	3.90	xxx	3.43	3.32	3.84	3.57	3.23	2.6
885	3.38	3.9	2.87	4.03	3.99	xxx	3.46	3.34	3.94	3.64	3.28	2.61
886	4.41	4.58	3.33	4.68	4.60	xxx	4.02	3.91	4.54	4.2	3.79	3.03
887	4.14	4.31	3.04	4.41	4.30	4.00	3.69	3.55	4.26	3.9	3.45	2.68

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
888	3.57	4.11	2.95	4.25	4.18	3.87	3.57	3.42	4.12	3.78	3.36	2.64
889	3.81	4.25	2.99	4.41	4.32	3.92	3.67	3.52	4.24	3.89	3.43	2.63
890	4.63	4.63	3.17	4.74	4.58	4.17	3.90	3.74	4.52	4.13	3.62	2.75
891	4.62	4.65	3.17	4.8	4.64	4.17	3.91	3.73	4.57	4.15	3.64	2.77
892	3.8	4.06	2.84	4.27	4.19	3.72	3.48	3.28	4.10	3.71	3.25	2.46
893	4.29	4.37	3.17	4.65	4.60	xxx	3.89	3.70	4.47	4.11	3.65	2.83
894	5.43	5.19	3.61	5.38	5.27	xxx	4.53	4.34	5.15	4.73	4.19	3.26
895	4.85	4.73	3.14	4.78	4.62	4.24	3.85	3.65	4.55	4.1	3.54	2.67
896	4.27	4.34	2.96	4.47	4.34	3.96	3.56	3.35	4.27	3.84	3.31	2.49
897	4.76	4.76	3.32	4.88	4.80	xxx	4.05	3.07	4.70	4.29	3.79	2.94
898	4.93	4.92	3.38	4.98	4.88	xxx	4.17	3.20	4.80	4.39	3.88	3.02
899	5.08	4.96	3.35	5.09	4.96	xxx	4.13	3.93	4.86	4.39	3.83	2.88
900	4.1	4.17	2.88	4.36	4.30	xxx	3.51	3.31	4.20	3.77	3.28	2.43
901	4.46	4.18	3.29	4.67	4.62	xxx	3.97	3.85	4.38	4.17	3.76	2.97
902	5.32	xxx	3.74	5.51	5.37	xxx	4.65	4.49	5.13	4.84	4.34	3.38
903	5.13	5	3.46	5.23	5.08	xxx	4.23	4.03	4.97	4.5	3.93	2.95
904	4.2	xxx	3	4.4	4.32	xxx	3.60	3.41	4.24	3.84	3.38	2.54

905	4.74	4.22	3.44	5.05	4.75	xxx	4.25	4.07	4.43	4.48	3.94	3.11
906	5.7	xxx	3.87	5.81	5.42	xxx	4.81	4.61	5.11	5.06	4.42	3.47
907	5.17	4.93	3.42	5.23	5.08	xxx	4.20	3.97	4.97	4.5	3.92	2.94
908	4.51	xxx	3.05	4.51	4.43	xxx	3.59	3.37	4.31	3.91	3.4	2.57
909	4.33	4.24	3.19	4.61	4.56	xxx	3.89	3.72	4.40	4.11	3.66	2.91
910	5.3	xxx	3.64	5.35	5.26	xxx	4.56	4.39	5.09	4.75	4.24	3.34
911	5.06	4.89	3.26	4.92	4.81	xxx	3.99	3.79	4.71	4.25	3.7	2.77
912	4.9	4.71	3.22	4.8	4.70	xxx	3.89	3.70	4.60	4.18	3.66	2.78
913	4.41	4.5	3.1	4.69	4.58	4.16	3.88	3.71	4.52	4.1	3.62	2.79
914	4.44	4.13	2.89	4.22	4.13	3.70	3.42	3.22	4.09	3.67	3.22	2.45
915	4.69	4.48	3.22	4.49	4.44	xxx	3.80	xxx	4.37	4.03	3.61	2.92
916	4.05	4.22	2.91	4.22	4.18	xxx	3.54	xxx	4.12	3.79	3.34	2.64
917	4.93	4.27	3.36	4.89	4.64	xxx	4.05	xxx	4.37	4.36	3.8	3
918	4.9	xxx	3.33	4.91	4.65	xxx	4.09	xxx	4.37	4.38	3.84	3.01
919	4.22	4.16	3.09	4.3	4.27	xxx	3.66	xxx	4.24	3.91	3.5	2.77
920	4.85	4.87	3.57	5.05	4.96	xxx	4.33	xxx	4.91	4.54	4.08	3.27
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
921	4.36	4.52	xxx	4.71	4.51	4.16	3.99	xxx	4.49	4.07	3.6	2.75
922	3.32	3.79	xxx	3.97	3.90	3.58	3.29	xxx	3.87	3.52	3.14	2.46
923	xxx	4.05	xxx	4.17	4.17	xxx	3.69	3.58	4.14	3.83	3.5	2.89
924	4.44	4.98	3.53	5.07	4.95	xxx	4.34	4.22	4.92	4.51	4.07	3.27
925	4.67	4.67	3.16	4.76	4.62	4.24	3.82	3.64	4.58	4.1	3.57	2.7
926	3.29	3.66	2.61	3.78	3.75	3.42	3.10	2.95	3.70	3.35	2.96	2.33
927	4.02	4.07	3.16	4.53	4.51	xxx	3.94	1.70	4.31	4.11	3.72	3.02
928	xxx	xxx	3.4	4.95	4.85	xxx	4.15	1.87	4.67	4.39	3.89	3.02
929	xxx	4.49	3.44	5.04	4.89	xxx	4.19	4.03	4.69	4.48	4.02	3.17
930	4.05	xxx	3.01	4.48	4.37	xxx	3.70	3.55	4.17	3.99	3.57	2.78
931	4.09	3.86	3.08	4.34	4.29	xxx	3.69	xxx	4.15	3.92	3.52	2.83
932	5.22	xxx	3.81	5.43	5.30	xxx	4.67	xxx	5.15	4.85	4.39	3.58
933	4.75	4.68	3.2	4.8	4.61	4.26	3.86	3.61	4.58	4.12	3.62	2.76
934	3.75	3.97	2.86	4.17	4.05	3.72	3.37	3.21	4.01	3.65	3.23	2.51
935	4.04	4.3	3.12	4.52	4.43	xxx	3.78	3.64	4.37	4.01	3.59	2.83
936	5	5.04	3.53	5.22	5.07	xxx	4.39	4.21	5.02	4.59	4.08	3.2
937	4.96	4.86	3.3	4.92	4.74	4.39	4.00	3.81	4.68	4.24	3.71	2.84
938	4.04	4.11	2.88	4.22	4.12	3.77	3.41	3.24	4.06	3.67	3.23	2.46
939	4.53	4.33	3.27	4.8	4.71	xxx	3.97	3.79	4.59	4.23	3.77	2.94

940	5.62	xxx	3.7	5.54	5.38	xxx	4.58	4.39	5.24	4.82	4.27	3.32
941	4.98	4.92	3.27	5.05	4.87	xxx	4.06	3.84	4.80	4.33	3.76	2.81
942	4.32	4.34	3	4.51	4.38	xxx	3.58	3.35	4.31	3.88	3.37	2.51
943	4.73	4.59	3.33	4.95	4.85	xxx	4.08	3.88	4.73	4.34	3.85	2.99
944	5.5	xxx	3.6	5.47	5.32	xxx	4.51	4.31	5.18	4.75	4.19	3.26
945	5.38	5	3.3	5.14	4.95	xxx	4.07	3.83	4.86	4.35	3.76	2.81
946	4.6	xxx	3.06	4.67	4.52	xxx	3.70	3.49	4.45	4	3.48	2.59
947	4.46		3.22	4.75	4.64	xxx	3.92	3.76	4.54	4.17	3.71	2.88
948	5.58	5.4	3.59	5.54	5.37	xxx	4.55	4.35	5.29	4.79	4.22	3.24
949	5.26	5.13	3.26	5.2	5.01	4.56	4.08	3.79	4.96	4.41	3.78	2.74
950	4.22	4.34	2.96	4.51	4.37	3.97	3.56	3.32	4.30	3.86	3.34	2.47
951	4.89	4.7	3.28	4.9	4.78	xxx	3.96	3.76	4.68	4.24	3.74	2.86
952	5.61	5.29	3.54	5.4	5.29	xxx	4.47	4.26	5.18	4.68	4.11	3.12
953	5	4.77	3.1	4.85	4.69	4.24	3.78	3.51	4.62	4.12	3.52	2.55
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
954	4.2	4.18	2.86	4.36	4.23	3.83	3.43	3.19	4.14	3.71	3.19	2.36
955	4.49	4.53	3.16	4.71	4.61	4.17	3.81	3.58	4.51	4.09	3.59	2.77
956	5	4.97	3.34	5.09	4.99	4.54	4.16	3.90	4.89	4.43	3.87	2.96
957	4.9	4.79	3.11	4.82	4.68	4.23	3.77	3.47	4.59	4.1	3.5	2.55
958	4	4.15	2.82	4.29	4.19	3.75	3.33	3.06	4.07	3.67	3.15	2.32
959	4.01	4.15	2.99	4.25	4.18	3.86	3.52	3.33	4.08	3.75	3.31	2.59
960	4.89	4.9	3.34	4.98	4.83	4.46	4.07	3.86	4.76	4.32	3.81	2.94
961	5.22	5.09	3.32	5.28	5.11	4.58	4.10	3.81	5.01	4.44	3.82	2.75
962	3.72	3.65	2.47	3.82	3.74	3.29	2.87	2.61	3.63	3.21	2.73	1.94
963	3.68	3.83	2.99	4.23	4.22	xxx	3.64	3.48	4.05	3.83	3.47	2.86
964	4.26	4.16	3.15	4.53	4.47	xxx	3.86	3.69	4.32	4.02	3.59	2.87
965	4.33	4.15	3.14	4.53	4.47	xxx	3.77	3.57	4.30	3.99	3.55	2.83
966	3.81	3.78	2.84	4.17	4.17	xxx	3.51	3.32	3.99	3.71	3.3	2.6
967	3.59	3.78	2.91	4.1	4.12	xxx	3.59	3.43	4.00	3.74	3.38	2.76
968	4.15	4.03	3.04	4.28	4.28	xxx	3.71	3.56	4.15	3.87	3.5	2.84
969	3.71	3.81	2.78	3.95	3.92	xxx	3.39	3.16	3.84	3.53	3.19	2.56
970	3.82	4.02	3.06	4.22	4.18	xxx	3.67	3.42	4.11	3.81	3.48	2.85
971	3.55	3.77	2.77	4.02	3.92	3.63	3.36	3.19	3.86	3.53	3.18	2.55
972	3.15	3.48	2.52	3.68	3.59	3.30	3.03	2.87	3.55	3.21	2.89	2.26
973	3.81	3.93	2.85	4	3.98	xxx	3.44	3.27	3.95	3.64	3.29	2.61
974	3.71	3.87	2.84	4.02	3.99	xxx	3.47	3.29	3.94	3.68	3.31	2.71

975	3.17	3.52	2.62	3.75	3.72	3.41	3.17	2.99	3.66	3.39	3.06	2.49
976	3.14	3.47	2.6	3.72	3.69	3.41	3.16	2.99	3.61	3.35	3.03	2.47
977	2.84	3.33	2.4	3.4	3.36	3.12	2.84	2.63	3.30	3.06	2.74	2.21
978	3.38	3.87	2.81	3.9	3.89	3.64	3.34	3.13	3.82	3.55	3.2	2.61
979	3.24	3.71	2.66	3.81	3.77	3.45	3.09	2.82	3.68	3.4	3.04	2.41
980	2.62	3.44	2.4	3.45	3.42	3.10	2.76	2.49	3.33	3.05	2.73	2.18
981	2.66	3.35	2.44	3.42	3.41	3.09	2.75	2.45	3.34	3.06	2.75	2.24
982	3.29	3.62	2.71	3.75	3.73	3.41	3.05	2.75	3.64	3.39	3.06	2.52
983	2.95	3.24	2.29	3.38	3.34	2.97	2.60	2.31	3.25	2.99	2.64	2.1
984	2.53	3.08	2.19	3.2	3.18	2.78	2.42	2.11	3.12	2.83	2.45	1.94
985	2.96	3.64	2.68	3.75	3.68	3.32	2.95	2.68	3.61	3.34	3.01	2.49
986	3.33	3.81	2.76	3.93	3.89	3.55	3.20	2.95	3.80	3.52	3.19	2.58

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
987	3.07	3.5	2.49	3.65	3.66	3.28	2.83	xxx	3.55	3.25	2.84	2.19
988	2.15	2.9	2.09	3.09	3.07	2.69	2.35	2.08	3.00	2.74	2.41	1.94
989	2.46	3.26	2.36	3.33	3.33	3.04	2.72	2.50	3.29	3.05	2.77	2.32
990	3.28	3.06	2.75	3.9	3.89	3.61	3.29	3.05	3.81	3.52	3.15	2.54
991	3.34	3.56	2.77	4.02	3.96	3.60	3.22	2.93	3.85	3.55	3.15	2.51
992	2.48	3.08	2.21	3.26	3.20	2.83	2.46	2.19	3.14	2.87	2.56	2.06
993	2.96	3.46	2.68	3.75	3.72	xxx	2.97	2.69	3.68	3.42	3.13	2.62
994	4.19	4.55	3.31	4.75	4.70	xxx	3.94	3.67	4.59	4.24	3.82	3.08
995	3.74	4.13	2.92	4.29	4.24	3.77	3.30	2.94	4.14	3.76	3.28	2.51
996	2.78	3.49	2.53	3.66	3.64	3.17	2.73	2.35	3.59	3.28	2.89	2.3
997	3.7	3.95	3	4.4	4.34	xxx	3.28	2.87	4.19	3.91	3.47	2.76
998	4.39	4.38	3.28	4.82	4.74	xxx	3.67	3.26	4.54	4.24	3.76	2.96
999	4.09	4.36	3.1	4.62	4.48	3.94	3.39	2.97	4.37	3.99	3.52	2.73
1000	3.72	4.07	2.88	4.35	4.23	3.70	3.18	2.76	4.15	3.75	3.28	2.52
1001	3.96	4.09	3.09	4.53	4.44	xxx	3.40	2.98	4.31	3.99	3.51	2.76
1002	4.87	4.89	3.6	5.29	5.16	xxx	4.04	3.61	4.99	4.64	4.11	3.24
1003	4.81	4.84	3.29	5.03	4.86	4.25	3.62	3.14	4.74	4.26	3.67	2.71
1004	4.16	4.32	2.98	4.49	4.35	3.75	3.14	2.68	4.24	3.8	3.26	2.4
1005	4.74	4.38	3.42	5.2	4.93	xxx	3.88	3.42	4.56	4.54	3.98	3.05
1006	5.91	5.09	3.83	5.89	5.56	xxx	4.42	3.93	5.17	5.08	4.44	3.37
1007	4.89	4.75	3.11	4.97	4.84	4.24	3.70	3.25	4.71	4.2	3.58	2.55
1008	4.81	4.76	3.21	5	4.85	4.25	3.70	3.25	4.76	4.28	3.69	2.71
1009	5.09	4.94	3.1	5.12	4.94	4.35	3.81	3.37	4.82	4.31	3.66	2.55

1010	5.84	5.59	3.39	5.62	5.46	4.80	4.21	3.75	5.34	4.76	4.04	2.84
1011	5.53	5.34	3.25	5.35	5.17	4.44	3.84	3.34	5.03	4.4	3.61	2.31
1012	4.85	4.83	2.67	4.95	4.79	4.11	3.55	3.07	4.66	4.09	3.37	2.19
1013	5.46	5.22	2.55	5.36	5.20	4.52	3.95	3.50	5.07	4.48	3.75	2.53
1014	5.77	5.5	3.23	5.65	5.46	4.76	4.16	3.70	5.30	4.69	3.93	2.65
1015	5.57	5.27	3.09	5.41	5.20	4.55	3.91	3.42	5.04	4.42	3.65	2.38
1016	5.29	5.04	2.66	5.19	4.99	4.36	3.74	3.28	4.83	4.25	3.52	2.31
1017	5.45	5.19	2.9	5.34	5.17	4.54	3.93	3.49	5.01	4.42	3.69	2.49
1018	5.84	5.5	2.76	5.6	5.41	4.76	4.12	3.67	5.26	4.62	3.86	2.58
1019	5.57	5.32	xxx	5.39	5.24	4.53	3.89	3.41	5.05	4.41	3.65	2.36

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1020	5.44	5.23	2.95	5.33	5.19	4.48	3.85	3.36	4.99	4.37	3.62	2.37
1021	5.43	5.21	2.96	5.34	5.14	4.45	3.81	3.31	4.99	4.37	3.61	2.35
1022	5.28	5.06	2.89	5.19	4.98	4.32	3.69	3.21	4.83	4.24	3.5	2.28
1023	5.31	5.23	3.05	5.37	5.17	4.45	3.80	3.29	5.02	4.41	3.68	2.46
1024	5.43	5.27	3.05	5.41	5.22	4.51	3.86	3.34	5.06	4.45	3.71	2.49
1025	4.97	4.94	2.92	5.08	4.88	4.22	3.57	3.04	4.75	4.19	3.5	2.32
1026	4.92	4.9	2.89	5.04	4.85	4.19	3.56	3.04	4.71	4.16	3.48	2.3
1027	4.86	4.73	2.81	4.87	4.66	4.00	3.35	2.82	4.54	3.97	3.3	2.17
1028	5.35	5.24	3.05	5.33	5.13	4.41	3.73	3.18	4.99	4.38	3.65	2.42
1029	5	4.83	2.63	4.88	4.68	3.89	3.16	2.53	4.54	3.91	3.13	1.82
1030	4.29	4.46	2.5	4.69	4.50	3.76	3.05	2.44	4.40	3.81	3.07	1.82
1031	4.19	4.25	2.47	4.39	4.24	3.54	2.86	2.27	4.13	3.58	2.9	1.74
1032	5.05	5	2.81	5.01	4.83	4.03	3.31	2.68	4.69	4.06	3.29	2.01
1033	5.03	4.63	xxx	4.57	4.35	3.52	2.75	2.11	4.19	3.57	2.8	1.41
1034	2.6	2.5	xxx	2.43	2.28	1.69	1.13	0.71	2.22	1.84	1.32	0.4
1035	3.67	4.11	2.83	4.18	4.07	3.51	2.96	2.55	4.08	3.74	3.31	2.56
1036	4.94	5.09	3.23	5.19	5.04	4.38	3.68	3.10	4.93	4.46	3.91	2.91
1037	4.08	4.35	2.78	4.43	4.26	3.63	2.98	2.40	4.14	3.66	3.1	2.16
1038	3.25	3.91	2.57	4.09	3.94	3.32	2.68	2.14	3.86	3.41	2.9	2.02
1039	3.66	4.26	2.92	4.44	4.31	3.64	2.94	2.36	4.24	3.82	3.3	2.46
1040	4.31	4.6	3.07	4.68	4.54	3.86	3.13	2.53	4.45	4.01	3.45	2.58
1041	4.38	4.66	3.06	4.81	4.61	3.78	3.00	2.31	4.53	4.05	3.46	2.57
1042	3.53	3.71	2.64	4.13	3.97	3.20	2.48	1.86	3.92	3.47	2.93	2.08
1043	2.76	3.96	2.84	4.04	3.95	3.28	2.63	2.05	3.95	3.6	3.22	2.55
1044	4.45	4.75	3.29	4.82	4.68	3.94	3.23	2.57	4.61	4.21	3.77	3.04

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1045	4.03	4.34	2.85	4.47	4.28	3.46	2.67	1.93	4.18	3.71	3.16	2.25
1046	3.36	3.9	2.65	4.11	3.92	3.14	2.40	1.72	3.86	3.43	2.91	2.06
1047	3.45	3.97	2.79	4.18	4.01	3.23	2.49	1.19	3.97	3.59	3.12	2.37
1048	4.96	5.06	3.25	5.13	4.97	4.13	3.32	1.93	4.87	4.38	3.79	2.82
1049	4.44	4.54	2.67	4.6	4.39	3.49	2.63	1.80	4.30	3.73	3.07	1.99
1050	3.48	3.91	2.47	4.08	3.84	2.99	2.19	1.46	3.79	3.32	2.74	1.81
1051	4.3	4.43	2.83	4.64	4.39	3.44	2.52	1.72	4.33	3.83	3.22	2.2
1052	4.82	4.77	2.98	4.91	4.69	3.70	2.73	1.87	4.60	4.07	3.44	2.36
1053	4.6	4.67	2.83	4.79	4.52	3.52	2.55	1.66	4.44	3.9	3.23	2.1
1054	4.15	4.42	2.73	4.59	4.35	3.38	2.46	1.62	4.28	3.76	3.12	2.02
1055	4.29	4.58	2.85	4.75	4.53	3.49	2.54	1.66	4.46	3.94	3.29	2.25
1056	5.26	5.19	3.1	5.29	5.07	3.98	2.95	1.99	4.95	4.35	3.62	2.46
1057	4.82	4.93	2.76	5.02	4.77	3.66	2.59	1.62	4.66	4.02	3.27	2.01
1058	4.53	4.79	2.72	4.84	4.60	3.53	2.51	1.59	4.52	3.93	3.21	1.99
1059	4.29	4.43	2.45	4.45	4.22	3.25	2.28	1.38	4.13	3.6	2.9	1.74
1060	4.85	4.86	2.7	4.9	4.68	3.69	2.66	1.70	4.56	3.98	3.21	1.96
1061	5.41	5.19	2.68	5.22	4.95	3.74	2.55	1.49	4.82	4.14	3.27	1.8
1062	4.53	4.52	2.4	4.64	4.34	3.19	2.13	1.25	4.26	3.67	2.92	1.59
1063	4.34	4.63	2.67	4.78	4.51	3.36	2.33	1.25	4.45	3.92	3.25	2.06
1064	4.77	4.78	2.73	4.86	4.58	3.42	2.36	1.24	4.51	3.94	3.23	2.03
1065	4.9	4.74	2.63	4.76	4.61	3.29	2.20	1.29	4.40	3.81	3.1	1.91
1066	4.57	4.55	2.54	4.58	4.40	3.17	2.12	1.26	4.24	3.68	3	1.84
1067	4.56	4.63	2.72	4.7	4.43	3.24	2.21	1.34	4.38	3.86	3.22	2.15
1068	4.99	4.81	2.78	4.87	4.62	3.40	2.34	1.41	4.55	3.99	3.32	2.2
1069	4.8	4.8	2.73	4.84	4.57	3.32	2.22	1.28	4.51	3.92	3.2	2.02
1070	4.33	4.51	2.64	4.6	4.30	3.11	2.08	1.23	4.27	3.73	3.04	1.94
1071	4.26	4.4	2.62	4.48	4.19	3.11	2.05	1.20	4.15	3.64	3.02	1.94
1072	4.07	4.4	2.6	4.48	4.19	3.12	2.06	1.22	4.17	3.64	3.02	1.93
1073	4.63	4.86	2.96	4.9	4.58	3.40	2.22	1.30	4.58	4.04	3.4	2.3
1074	4.3	4.61	2.82	4.7	4.36	3.21	2.08	1.21	4.35	3.82	3.2	2.13
1075	3.59	4.1	2.67	4.15	3.87	2.87	1.76	1.06	3.86	3.43	2.92	2.07
1076	3.69	4.22	2.68	4.21	3.97	2.95	1.84	1.12	3.97	3.5	2.98	2.1
1077	4.19	4.47	2.82	4.51	4.23	3.09	1.99	1.09	4.22	3.72	3.15	2.18
1078	4.07	4.26	2.72	4.29	4.03	2.93	1.87	1.04	4.01	3.53	2.99	2.11
1079	3.52	4.44	2.9	4.51	4.27	3.05	1.99	1.09	4.27	3.82	3.29	2.43

1080	xxx	4.35	2.84	4.47	4.21	3.02	1.97	1.07	4.21	3.75	3.2	2.29
1081	3.53	3.97	2.61	4.15	3.90	2.78	1.80	0.97	3.89	3.45	2.95	2.08
1082	3.97	4.38	2.82	4.56	4.26	3.09	2.05	1.16	4.25	3.79	3.26	2.36
1083	3.48	3.95	2.46	4.05	3.94	2.66	1.70	0.90	3.74	3.28	2.72	1.84
1084	3.62	3.66	2.37	3.76	3.68	2.48	1.61	0.89	3.50	3.1	2.61	1.79
1085	2.56	3.64	2.29	3.74	3.48	2.46	1.52	0.77	3.45	3.03	2.53	1.64
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1086	2.96	4.08	2.57	4.14	3.89	2.82	1.83	1.05	3.85	3.41	2.88	1.94
1087	3.16	3.6	2.04	3.66	3.48	2.29	1.41	0.69	3.39	2.92	2.35	1.37
1088	2.48	3.11	1.83	3.12	2.96	1.92	1.18	0.60	2.90	2.51	2.03	1.17
1089	2.56	3.14	1.92	3.15	2.96	1.99	1.22	0.54	2.97	2.63	2.2	1.39
1090	3.31	3.67	2.2	3.73	3.51	2.43	1.56	0.78	3.50	3.09	2.57	1.64
1091	3.06	3.53	2.01	3.62	3.36	2.22	1.40	0.68	3.36	2.92	2.38	1.4
1092	3.17	2.71	1.6	2.83	2.57	1.64	0.99	0.42	2.59	2.25	1.82	1.01
1093	1.7	2.69	1.79	2.81	2.60	1.68	1.10	0.53	2.65	2.4	2.08	1.51
1094	3.12	3.45	2.1	3.52	3.33	2.21	1.45	0.76	3.34	2.97	2.53	1.78
1095	2.73	3.04	1.74	3.15	2.92	1.93	1.17	0.56	2.91	2.52	2.02	1.22
1096	1.86	2.53	1.57	2.62	2.39	1.56	0.92	0.43	2.42	2.13	1.72	1.04
1097	2.87	3.57	2.22	3.61	3.36	2.27	1.40	0.74	3.41	3.05	2.61	1.83
1098	3.11	3.69	2.27	3.8	3.53	2.37	1.45	0.72	3.55	3.15	2.67	1.85
1099	2.72	3.27	2.02	3.41	3.13	2.18	1.32	0.69	3.14	2.79	2.36	1.61
1100	1.72	2.46	1.56	2.6	2.41	1.62	0.91	0.39	2.43	2.15	1.8	1.15
1101	2.08	2.87	2.05	2.92	2.76	1.97	1.19	0.69	2.83	2.64	2.4	1.9
1102	3.32	3.94	2.53	3.98	3.72	2.68	1.66	0.93	3.78	3.45	3.06	2.38
1103	2.98	3.55	2.17	3.61	3.35	2.37	1.47	0.78	3.35	2.96	2.51	1.77
1104	2.32	2.97	1.92	3.08	2.86	1.97	1.17	0.56	2.87	2.55	2.17	1.51
1105	2.67	3.49	2.29	3.59	3.39	2.42	1.50	0.82	3.44	3.04	2.63	1.92
1106	3.25	3.87	2.44	3.86	3.63	2.58	1.59	0.82	3.66	3.22	2.76	2.04
1107	3.19	4.12	2.61	4.16	3.92	2.80	1.82	1.03	3.94	3.52	3.01	2.26
1108	xxx	3.85	2.44	3.97	3.68	2.59	1.63	0.87	3.72	3.29	2.8	2.07
1109	xxx	3.59	2.38	3.8	3.49	2.52	1.66	0.99	3.54	3.12	2.68	2
1110	xxx	4.52	2.84	4.7	4.47	3.29	2.24	1.33	4.43	3.94	3.39	2.5
1111	3.97	4.3	2.4	4.37	4.12	2.96	1.96	1.11	4.04	3.51	2.84	1.75
1112	3.64	4.07	2.35	4.18	3.91	2.80	1.85	1.06	3.89	3.41	2.79	1.74
1113	3.82	4.14	2.31	4.26	3.97	2.86	1.90	1.14	3.96	3.43	2.77	1.7
1114	4.7	4.88	2.61	4.9	4.66	3.46	2.37	1.41	4.55	3.93	3.16	1.93

1115	5.12	5.03	2.54	5.08	4.79	3.56	2.43	1.48	4.67	3.99	3.15	1.77
1116	4.43	4.58	2.39	4.7	4.37	3.17	2.09	1.20	4.31	3.7	2.94	1.68
1117	5.04	5.09	2.64	5.18	4.89	3.69	2.63	1.74	4.79	4.13	3.35	2.01
1118	5.48	5.33	2.74	5.36	5.07	3.84	2.72	1.73	4.96	4.25	3.44	2.04

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1119	5.09	5.29	2.65	5.33	5.04	3.89	2.88	1.97	4.92	4.23	3.42	2.05
1120	5.37	5.15	2.61	5.18	4.88	3.73	2.73	1.82	4.79	4.11	3.32	1.98
1121	5.64	5.32	2.62	5.37	5.10	3.93	2.93	2.03	4.98	4.29	3.47	2.08
1122	5.57	5.74	2.79	5.76	5.44	4.22	3.18	2.25	5.31	4.55	3.66	2.19
1123	5.18	5.52	2.51	5.48	5.17	4.01	2.94	2.01	5.01	4.26	3.38	1.93
1124	5.78	5.69	2.6	5.64	5.33	4.15	3.06	2.14	5.17	4.4	3.51	2.01
1125	5.87	5.59	2.52	5.64	5.29	4.06	2.94	1.99	5.16	4.37	3.44	1.9
1126	5.95	5.47	2.49	5.52	5.21	4.01	2.91	1.95	5.07	4.32	3.4	1.89
1127	6.21	5.71	2.6	5.72	5.42	4.15	3.01	2.00	5.27	4.51	3.58	2.02
1128	6.4	5.84	2.65	5.88	5.53	4.24	3.10	2.10	5.39	4.6	3.65	2.05
1129	5.9	5.31	2.32	5.28	4.92	3.71	2.65	1.71	4.81	4.08	3.16	1.68
1130	5.69	5.48	2.54	5.56	5.20	4.03	2.99	2.12	5.11	4.36	3.5	2.01
1131	6.05	5.42	1.9	5.37	4.92	3.41	2.32	1.35	4.83	3.96	2.99	1.26
1132	6.67	5.71	2.19	5.52	5.12	3.60	2.50	1.50	4.99	4.13	3.14	1.52
1133	6.74	5.73	1.41	5.6	5.16	3.60	2.36	1.32	4.99	4.07	2.98	1.21
1134	5.49	4.89	1.46	4.81	4.43	2.97	1.83	0.96	4.32	3.57	2.63	1.12
1135	5.37	5.09	1.07	5	4.67	3.25	2.08	1.13	4.55	3.78	2.84	1.31
1136	5.85	5.5	1.57	5.38	5.01	3.56	2.34	1.29	4.85	4.01	3.01	1.38
1137	5.94	5.51	1.06	5.39	4.98	3.46	2.18	1.12	4.85	3.99	2.96	1.3
1138	4.76	4.62	0.7	4.58	4.15	2.75	1.65	0.83	4.11	3.39	2.49	1.03
1139	4.46	4.54	0.89	4.53	4.18	2.93	1.80	0.97	4.14	3.51	2.73	1.38
1140	5.15	5	1.06	4.93	4.61	3.28	2.05	1.14	4.49	3.8	2.92	1.41
1141	4.91	4.9	1.19	4.85	4.50	3.03	1.89	0.96	4.42	3.75	2.86	1.42
1142	4.11	4.19	0.67	4.2	3.84	2.50	1.53	0.78	3.80	3.22	2.44	1.14
1143	3.85	4.09	1.09	4.1	3.80	2.63	1.57	0.80	3.78	3.29	2.66	1.51
1144	4.77	4.8	1.38	4.77	4.48	3.19	2.01	1.12	4.40	3.79	3.02	1.66
1145	4.58	4.63	1.42	4.66	4.35	2.85	1.71	0.81	4.25	3.62	2.83	1.44
1146	3.39	3.74	0.77	3.76	3.43	2.16	1.25	0.61	3.44	2.9	2.26	1.1
1147	3.13	3.63	1.3	3.61	3.31	2.17	1.26	0.60	3.34	2.94	2.44	1.47
1148	4.43	4.59	1.68	4.57	4.31	2.98	1.86	1.04	4.24	3.68	3	1.77
1149	4.36	4.46	1.6	4.47	4.10	2.64	1.48	0.63	4.05	3.43	2.67	1.34

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1150	3.03	3.51	1.08	3.6	3.22	2.00	1.09	0.50	3.24	2.77	2.19	1.1
1151	3.26	3.75	1.68	3.74	3.43	2.18	1.21	0.53	3.47	3.05	2.53	1.53
1152	4.12	4.39	1.86	4.34	4.05	2.65	1.57	0.80	4.03	3.51	2.85	1.68
1153	4.15	4.26	1.79	4.24	3.87	2.38	1.27	0.52	3.86	3.31	2.6	1.34
1154	3.15	3.6	1.44	3.62	3.26	1.97	1.05	0.47	3.31	2.86	2.27	1.18
1155	3.17	3.8	1.88	3.78	3.44	2.12	1.13	0.47	3.49	3.07	2.54	1.51
1156	4.15	4.43	2.07	4.33	3.97	2.53	1.41	0.66	3.99	3.47	2.83	1.64
1157	3.93	4.24	2.05	4.23	3.86	2.34	1.24	0.50	3.89	3.36	2.67	1.47
1158	4.15	3.69	1.78	3.74	3.34	1.98	1.04	0.43	3.40	2.95	2.36	1.29
1159	3.56	3.9	2.06	3.93	3.54	2.10	1.12	0.47	3.61	3.16	2.6	1.52
1160	4.55	4.52	2.29	4.52	4.15	2.54	1.42	0.65	4.18	3.64	2.97	1.73
1161	4.15	4.21	2.09	4.11	3.74	2.24	1.19	0.48	3.77	3.23	2.54	1.34
1162	3.44	3.81	1.91	3.72	3.35	1.98	1.04	0.41	3.42	2.95	2.35	1.27
1163	2.54	4.18	2.26	4.13	3.74	2.26	1.22	0.53	3.81	3.31	2.71	1.55
1164	4.36	4.5	2.35	4.46	4.07	2.47	1.34	0.56	4.11	3.55	2.87	1.6
1165	4.42	4.49	2.36	4.39	3.97	2.41	1.31	0.59	4.01	3.45	2.74	1.5
1166	3.92	4.11	2.19	4.02	3.60	2.12	1.09	0.43	3.65	3.16	2.52	1.37
1167	4	4.25	2.38	4.23	3.84	2.38	1.31	0.58	3.89	3.4	2.78	1.61
1168	4.37	4.53	2.49	4.5	4.10	2.55	1.39	0.56	4.15	3.59	2.9	1.66
1169	4.73	4.81	2.6	4.82	4.45	2.78	1.55	0.74	4.50	3.88	3.15	1.81
1170	4.23	4.23	2.26	4.17	3.74	2.20	1.10	0.40	3.82	3.28	2.65	1.44
1171	4.26	4.35	2.65	4.25	3.85	2.45	1.38	0.74	3.93	3.52	3.03	2.04
1172	4.33	4.46	2.7	4.36	4.00	2.53	1.37	0.61	4.08	3.62	3.07	2.04
1173	4.38	4.47	2.73	4.43	4.05	2.64	1.55	xxx	4.10	3.62	3.03	1.98
1174	4.62	4.75	2.82	4.76	4.38	2.84	1.66	xxx	4.41	3.89	3.25	2.1
1175	3.7	4.57	2.78	4.54	4.22	2.61	1.72	xxx	4.23	3.7	3.08	1.97
1176	4.27	4.5	2.76	4.47	4.17	2.56	1.64	xxx	4.18	3.66	3.06	1.95
1177	4.56	4.39	2.65	4.27	3.97	2.72	1.64	xxx	3.95	3.44	2.83	1.76
1178	4.62	4.61	2.73	4.49	4.18	2.87	1.72	xxx	4.16	3.63	2.98	1.85
1179	4.97	5.1	3.02	5.02	4.76	3.28	2.05	xxx	4.67	4.07	3.36	2.1
1180	4	4.23	2.61	4.17	3.91	2.58	1.48	xxx	3.85	3.36	2.75	1.66
1181	4.28	4.46	3	4.4	4.10	2.98	1.90	1.13	4.13	3.73	3.23	2.36
1182	4.74	4.9	3.14	4.83	4.49	3.23	2.01	1.09	4.52	4	3.43	2.47
1183	4.45	4.82	3.13	4.82	4.51	3.32	2.20	1.29	4.51	4	3.42	2.49
1184	3.95	4.35	2.88	4.39	4.09	2.95	1.86	0.98	4.10	3.62	3.06	2.17

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1185	3.93	4.3	3	4.25	4.00	3.02	2.05	1.28	3.71	3.58	3.12	2.38
1186	4.47	4.74	3.22	4.69	4.42	3.34	2.24	1.35	4.44	3.94	3.45	2.63
1187	4.26	4.61	3.07	4.67	4.40	3.37	2.33	1.51	4.36	3.87	3.32	2.41
1188	3.78	4.2	2.87	4.24	3.99	3.00	2.03	1.26	3.99	3.54	3.03	2.21
1189	3.64	4.02	2.82	4.02	3.82	2.96	2.12	1.42	3.80	3.39	2.93	2.22
1190	3.81	4.67	3.12	4.62	4.42	3.46	2.48	1.62	4.36	3.89	3.36	2.52
1191	4.16	4.39	2.81	4.39	4.19	3.29	2.34	1.51	4.10	3.62	3.04	2.15
1192	3.88	3.89	2.6	3.96	3.77	2.91	2.03	1.28	3.71	3.27	2.75	1.96
1193	3.45	3.92	2.68	4.03	3.83	3.04	2.20	1.51	3.78	3.36	2.89	2.15
1194	4.02	4.26	2.86	4.29	4.08	3.23	2.33	1.57	4.01	3.58	3.09	2.28
1195	3.85	4.28	2.83	4.3	4.13	3.25	2.44	1.69	4.06	3.62	3.1	2.29
1196	3.46	3.52	2.43	3.54	3.38	2.61	1.88	1.25	3.34	2.96	2.53	1.83
1197	3.1	3.49	2.53	3.62	3.48	2.82	2.21	1.66	3.46	3.15	2.82	2.27
1198	xxx	4.44	3.02	4.58	4.41	3.60	2.83	2.08	4.36	3.95	3.5	2.78
1199	2.96	3.69	2.3	3.8	3.65	2.97	2.29	1.64	3.55	3.1	2.58	1.78
1200	2.6	3.33	2.21	3.58	3.43	2.79	2.14	1.55	3.36	2.96	2.51	1.82
1201	3.26	3.92	2.44	4.15	3.98	3.27	2.61	2.00	3.89	3.43	2.95	2.16
1202	3.55	3.89	2.45	4	3.83	3.08	2.41	1.78	3.74	3.29	2.79	2.01
1203	3.15	3.65	2.36	3.79	3.69	3.06	2.54	2.04	3.56	3.19	2.77	2.11
1204	2.58	3.12	2.11	3.32	3.24	2.66	2.14	1.66	3.14	2.8	2.4	1.78
1205	2.58	3.11	2.14	3.34	3.25	2.77	2.30	1.86	3.18	2.86	2.47	1.85
1206	4.07	4.18	2.78	4.31	4.22	3.70	3.19	2.70	4.15	3.79	3.34	2.62
1207	3.08	3.26	1.58	3.36	3.20	2.62	2.07	1.54	3.09	2.69	2.14	1.2
1208	2.05	2.44	1.35	2.59	2.44	1.93	1.47	1.06	2.36	2.06	1.66	0.92
1209	2.47	2.91	1.4	3.01	2.86	2.32	1.82	1.38	2.81	2.48	2.09	1.37
1210	3.96	3.9	2.18	3.9	3.75	3.13	2.57	2.00	3.64	3.26	2.77	1.89
1211	2.09	3.07	0.77	3.16	2.96	2.21	1.57	0.93	2.84	2.45	1.86	0.85
1212	2.76	3.14	1.17	3.28	3.16	2.44	1.82	1.21	3.00	2.65	2.09	1.15
1213	2.46	3.59	0.68	3.72	3.45	2.55	1.72	0.93	3.28	2.8	2.14	0.95
1214	3.69	3.95	1.08	4.06	3.75	2.83	2.00	1.23	3.59	3.03	2.35	1.14
1215	3.28	3.59	0.65	3.6	3.37	2.34	1.51	0.70	3.22	2.67	2	0.86
1216	2.56	3.01	0.49	3.09	2.87	1.93	1.26	0.69	2.79	2.32	1.72	0.76
1217	3.23	3.87	0.68	3.63	3.38	2.34	1.43	0.70	3.32	2.81	2.14	1.03
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1218	3.78	4.36	0.85	4.13	3.89	2.79	1.81	1.04	3.76	3.15	2.42	1.17

1219	3.71	4.15	0.95	4.22	3.95	2.70	1.59	0.76	3.86	3.2	2.44	1.11
1220	3.31	3.93	0.72	3.97	3.69	2.51	1.52	0.82	3.60	3.01	2.29	1.04
1221	3.78	4.33	0.93	4.17	3.84	2.49	1.42	0.63	3.77	3.14	2.38	1.09
1222	4.04	4.44	0.92	4.28	3.97	2.64	1.58	0.84	3.88	3.23	2.45	1.13
1223	4.44	4.64	1.19	4.53	4.15	2.62	1.44	0.62	4.11	3.42	2.58	1.2
1224	4.09	4.36	0.9	4.26	3.87	2.45	1.39	0.72	3.84	3.19	2.39	1.08
1225	4.41	4.51	1.24	4.48	4.06	2.52	1.33	0.50	4.07	3.43	2.63	1.27
1226	4.71	4.71	1.18	4.66	4.25	2.72	1.55	0.79	4.26	3.57	2.72	1.3
1227	5.15	4.99	1.51	4.93	4.42	2.59	1.30	0.40	4.48	3.75	2.85	1.37
1228	5.34	4.9	1.33	4.83	4.28	2.55	1.40	0.68	4.31	3.62	2.74	1.29
1229	5.19	5	1.71	4.87	4.30	2.43	1.10	0.25	4.39	3.72	2.88	1.41
1230	5.33	5.08	1.63	4.94	4.45	2.63	1.38	1.34	4.51	3.8	2.94	1.43
1231	5.66	5.2	1.9	4.98	4.39	2.28	0.97	0.17	4.51	3.78	2.91	1.39
1232	6.03	5.5	1.93	5.31	4.73	2.66	1.38	0.62	4.80	4.02	3.1	1.52
1233	5.85	5.26	1.92	5.11	4.49	2.28	0.93	0.15	4.59	3.81	2.88	1.3
1234	5.66	5.09	1.79	4.95	4.35	2.30	1.07	0.44	4.45	3.71	2.82	1.31
1235	5.74	5.24	2.04	4.9	4.29	2.09	0.83	0.15	4.44	3.69	2.81	1.31
1236	6.63	5.95	2.26	5.61	4.97	2.67	1.32	0.50	5.06	4.16	3.17	1.51
1237	6.38	5.47	2	5.29	4.59	2.25	0.96	0.21	4.66	3.78	2.8	1.16
1238	5.67	4.92	1.79	4.74	4.08	1.97	0.84	0.25	4.19	3.44	2.58	1.11
1239	5.81	5.08	2.09	4.91	4.22	2.04	0.88	0.23	4.36	3.59	2.69	1.22
1240	xxx	5.79	2.32	5.59	4.87	2.52	1.17	0.35	4.95	4.05	3.02	1.37
1241	6.02	5.6	2.15	5.42	4.72	2.27	1.10	0.36	4.80	3.89	2.85	1.2
1242	5.64	4.74	1.82	4.58	3.91	1.68	0.69	0.13	4.07	3.33	2.45	1.01
1243	5.31	4.77	2.09	4.62	4.00	1.96	0.91	0.36	4.15	3.45	2.63	1.24
1244	6.41	5.64	2.4	5.48	4.82	2.45	1.15	0.32	4.88	4.01	3.01	1.38
1245	6.47	5.45	2.15	5.31	4.65	2.38	1.19	0.45	4.69	3.8	2.8	1.18
1246	5.21	4.46	1.76	4.33	3.69	1.65	0.64	0.10	3.84	3.14	2.32	0.94
1247	4.93	4.66	2.11	4.46	3.88	1.99	0.97	0.42	4.02	3.38	2.63	1.3
1248	6.12	5.6	2.47	5.38	4.76	2.55	1.24	0.36	4.82	3.98	3.05	1.45
1249	5.72	5.14	2.12	5.06	4.46	2.43	1.26	0.52	4.47	3.65	2.71	1.19
1250	4.62	4.28	1.76	4.22	3.64	1.77	0.75	0.15	3.74	3.09	2.3	0.99
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1251	4.58	4.36	1.97	4.27	3.76	2.08	1.03	0.44	3.84	3.23	2.51	1.24
1252	5.71	5.33	2.38	5.2	4.66	2.70	1.39	0.46	4.66	3.87	2.96	1.42
1253	5.34	4.92	1.91	4.79	4.26	2.48	1.31	0.55	4.20	3.43	2.54	1.07

1254	4.13	3.95	1.54	3.89	3.38	1.76	0.77	0.19	3.41	2.83	2.12	0.89
1255	3.81	3.96	1.8	3.91	3.50	2.02	1.08	0.49	3.53	2.97	2.3	1.15
1256	4.93	4.92	2.17	4.8	4.36	2.63	1.43	0.55	4.31	3.56	2.71	1.3
1257	4.87	4.8	1.92	4.71	4.25	2.55	1.44	0.64	4.17	3.42	2.56	1.15
1258	3.41	3.57	1.41	3.52	3.09	1.61	0.72	0.18	3.12	2.59	1.93	0.81
1259	3.48	3.86	1.88	3.81	3.48	2.11	1.17	0.58	3.52	3.02	2.41	1.35
1260	3.97	3.93	1.87	3.82	3.45	2.01	0.99	0.33	3.49	2.95	2.29	1.12
1261	3.98	4.09	2.07	4.02	3.68	2.30	1.33	0.66	3.71	3.22	2.6	1.51
1262	3.56	3.92	1.95	3.88	3.55	2.15	1.16	0.42	xxx	3.09	2.48	1.34
1263	3.18	3.56	1.89	3.52	3.27	2.14	1.23	0.61	xxx	2.86	2.34	1.39
1264	3.62	3.89	2.01	3.85	3.59	2.35	1.32	0.57	xxx	3.09	2.49	1.45
1265	4	4.27	2.21	4.24	3.92	2.48	1.52	0.78	xxx	3.37	2.72	1.59
1266	3.28	3.72	1.94	3.76	3.42	2.07	1.19	0.50	xxx	2.98	2.4	1.36
1267	3.03	3.53	2.01	3.53	3.30	2.28	1.35	0.74	xxx	2.92	2.45	1.6
1268	3.68	3.99	2.19	3.94	3.71	2.56	1.51	0.75	xxx	3.22	2.67	1.71
1269	3.79	4.15	2.2	4.17	3.88	2.58	1.59	0.79	xxx	3.34	2.69	1.59
1270	3.79	4.3	2.31	4.32	4.05	2.72	1.69	0.85	xxx	3.49	2.83	1.71
1271	3.81	4.17	2.08	4.16	3.88	2.67	1.64	0.84	xxx	3.31	2.68	1.56
1272	3.62	3.9	2	3.89	3.59	2.41	1.44	0.68	xxx	3.09	2.5	1.44
1273	3.99	4.25	2.07	4.16	3.89	2.69	1.66	0.88	xxx	3.35	2.72	1.65
1274	3.82	4.16	2.05	4.1	3.81	2.61	1.57	0.77	xxx	3.28	2.65	1.6
1275	3.65	4.11	1.99	4.06	3.82	2.64	1.67	0.88	xxx	3.3	2.7	1.68
1276	3.61	3.97	1.95	3.86	3.63	2.46	1.50	0.72	xxx	3.13	2.56	1.57
1277	3.75	4.11	2.09	4.11	3.86	2.73	1.75	0.97	xxx	3.38	2.83	1.88
1278	3.99	4.29	2.15	4.32	4.07	2.88	1.83	0.95	xxx	3.52	2.93	1.92
1279	3.85	4.13	2.03	4.13	3.90	2.81	1.82	0.99	xxx	3.35	2.77	1.79
1280	3.69	4.03	1.99	4.04	3.79	2.71	1.72	0.89	xxx	3.28	2.71	1.75
1281	4.15	4.46	2.21	4.51	4.19	3.05	1.97	1.12	xxx	3.62	2.99	1.97
1282	4.12	4.46	2.2	4.52	4.21	3.05	1.94	1.05	xxx	3.62	2.99	1.97
1283	4.13	4.49	2.31	4.5	4.26	3.17	2.08	1.20	xxx	3.67	3.06	2.04
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1284	3.81	4.34	2.16	4.27	4.01	2.94	1.88	1.02	xxx	3.46	2.87	1.89
1285	4.15	4.47	2.34	4.36	4.08	3.08	2.07	1.24	xxx	3.55	3	2.11
1286	4.55	4.71	2.45	4.66	4.40	3.34	2.24	1.29	xxx	3.8	3.2	2.23
1287	4.4	4.71	2.5	4.72	4.47	3.37	2.29	1.36	xxx	3.84	3.2	2.14
1288	3.77	4.15	2.25	4.21	3.92	2.90	1.90	1.10	xxx	3.41	2.84	1.9

1289	4.04	4.39	2.49	4.31	4.02	3.10	2.15	1.37	xxx	3.54	3.02	2.19
1290	4.68	4.94	2.69	4.8	4.53	3.51	2.44	1.50	xxx	3.94	3.35	2.41
1291	4.37	4.67	1.65	4.68	4.44	3.44	2.02	1.50	xxx	3.8	3.16	2.13
1292	3.67	4.1	2.32	4.17	3.92	2.97	2.43	1.21	xxx	3.38	2.82	1.9
1293	3.75	4.25	2.62	4.34	4.12	3.26	2.74	1.73	xxx	3.62	3.11	2.28
1294	4.59	4.86	2.85	4.87	4.66	3.71	2.90	1.86	xxx	4.05	3.46	2.49
1295	4.21	4.61	2.66	4.64	4.47	3.68	2.38	2.17	xxx	3.81	3.2	2.18
1296	3.52	4.02	2.4	4.11	3.92	3.14	2.65	1.70	xxx	3.39	2.84	1.94
1297	3.34	3.71	2.32	3.84	3.69	3.18	3.22	2.20	xxx	3.17	2.69	1.93
1298	4.38	4.56	2.67	4.59	4.40	3.81	3.39	2.73	xxx	3.77	3.2	2.29
1299	4.53	4.81	2.67	4.85	4.66	4.01	2.70	2.89	xxx	3.9	3.19	2.1
1300	3.37	3.87	2.25	4	3.84	3.26	3.28	2.25	xxx	3.21	2.61	1.72
1301	3.61	4.11	2.63	4.24	4.13	3.71	3.75	2.97	xxx	3.55	3.04	2.24
1302	4.63	4.79	2.99	4.88	4.72	4.25	3.28	3.40	xxx	4.05	3.46	2.5
1303	4.2	4.32	2.38	4.46	4.31	3.78	2.83	2.89	xxx	3.61	2.96	1.92
1304	3.4	3.67	2.1	3.84	3.74	3.26	3.21	2.48	xxx	3.17	2.6	1.69
1305	3.34	3.83	2.38	3.96	3.89	3.53	3.64	2.96	xxx	3.39	2.93	2.21
1306	4.24	4.54	2.65	4.6	4.48	4.04	3.21	3.35	xxx	3.87	3.31	2.43
1307	4	4.26	2.3	4.23	4.10	3.63	2.73	2.91	xxx	3.49	2.87	1.91
1308	2.94	3.48	2	3.53	3.47	3.07	3.14	2.47	xxx	2.97	2.46	1.66
1309	3.37	3.8	2.34	3.93	3.84	3.47	3.67	2.91	xxx	3.31	2.83	2.08
1310	4.18	4.52	2.67	4.63	4.49	4.07	3.24	3.38	xxx	3.87	3.3	2.4
1311	4.62	4.33	2.37	4.36	4.20	3.72	2.34	2.91	xxx	3.52	2.9	1.88
1312	3.37	3.19	1.83	3.24	3.14	2.74	3.27	2.04	xxx	2.64	2.14	1.36
1313	3.17	3.79	2.5	3.88	3.83	3.55	3.90	3.06	xxx	3.41	3.01	2.39
1314	3.85	4.61	2.8	4.64	4.56	4.23	3.69	3.68	xxx	3.97	3.47	2.65
1315	4.05	4.68	2.76	4.7	4.61	4.15	2.73	3.34	xxx	3.94	3.35	2.38
1316	2.9	3.42	2.17	3.55	3.51	3.11	2.74	2.42	xxx	2.98	2.52	1.81

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1317	xxx	3.06	2.28	3.22	3.23	2.98	3.56	2.57	xxx	2.86	2.54	2.1
1318	xxx	4.01	2.71	4.14	4.10	3.83	3.34	3.36	xxx	3.62	3.2	2.59
1319	xxx	4.06	2.66	4.17	4.09	3.72	2.75	3.05	xxx	3.53	3.07	2.38
1320	xxx	3.33	2.29	3.47	3.44	3.09	3.07	2.49	xxx	2.96	2.56	1.96
1321	xxx	3.6	2.61	3.73	3.73	3.41	3.52	2.82	xxx	3.3	2.93	2.38
1322	3.68	4.11	2.84	4.21	4.19	3.87	3.21	3.26	xxx	3.69	3.27	2.63
1323	3.43	3.96	2.74	4.09	4.00	3.62	3.06	2.89	xxx	3.52	3.11	2.44

1324	2.19	3.72	2.59	3.9	3.81	xxx	3.03	2.75	xxx	3.33	2.95	2.34
1325	2.1	3.64	2.59	3.82	3.76	xxx	3.31	2.68	xxx	3.3	2.93	2.31
1326	3.49	4.01	2.79	4.15	4.09	xxx	3.34	2.93	xxx	3.6	3.2	2.53
1327	3.97	4.3	2.9	4.48	4.33	xxx	3.28	2.92	xxx	3.78	3.31	2.52
1328	3.62	4.18	2.82	4.37	4.28	xxx	3.17	2.86	xxx	3.71	3.22	2.44
1329	3.27	3.9	2.69	4.03	4.00	xxx	3.40	2.82	xxx	3.49	3.03	2.35
1330	3.87	4.27	2.88	4.38	4.29	xxx	3.58	3.04	xxx	3.75	3.27	2.53
1331	4.28	4.56	2.96	4.7	4.57	xxx	3.43	3.20	xxx	3.92	3.37	2.49
1332	4.07	4.46	2.89	4.55	4.42	xxx	3.51	3.05	xxx	3.8	3.27	2.43
1333	4.12	4.38	2.85	4.42	4.33	xxx	3.43	3.20	xxx	3.73	3.21	2.38
1334	4.17	4.29	2.83	4.38	4.26	xxx	4.09	3.13	xxx	3.68	3.17	2.35
1335	4.95	4.99	3.32	5.16	5.05	xxx	4.14	3.81	xxx	4.36	3.81	2.88
1336	xxx	5.17	3.34	5.29	5.16	4.42	4.07	3.86	xxx	4.43	3.86	2.88
1337	5	5.09	3.31	5.18	5.06	4.42	3.79	3.81	xxx	4.35	3.76	2.81
1338	4.7	4.73	3.16	4.88	4.77	4.14	4.04	3.53	xxx	4.09	3.53	2.63
1339	4.64	4.8	3.3	4.98	4.84	4.16	4.65	3.81	xxx	4.23	3.73	2.88
1340	5.63	5.72	3.67	5.83	5.63	4.85	4.28	4.35	xxx	4.91	4.3	3.26
1341	5.74	5.62	3.42	5.7	5.49	4.82	3.76	3.91	xxx	4.68	3.95	2.78
1342	4.94	4.85	3.13	4.98	4.84	4.25	4.00	3.46	xxx	4.14	3.51	2.5
1343	4.92	4.87	3.29	4.99	4.84	4.27	4.62	3.79	xxx	4.22	3.7	2.82
1344	6.15	5.89	3.68	5.93	5.68	4.98	4.26	4.31	xxx	4.93	4.26	3.18
1345	6.17	5.79	3.39	5.82	5.56	4.89	3.73	3.88	xxx	4.72	3.91	2.67
1346	5.08	4.86	3.07	4.98	4.82	4.26	4.30	3.43	xxx	4.12	3.45	2.4
1347	5.43	5.18	3.42	5.37	5.23	4.36	4.81	4.04	xxx	4.56	3.96	2.95
1348	6.61	6.13	3.75	6.2	5.96	4.98	4.41	4.46	xxx	5.16	4.42	3.22
1349	6.43	5.95	3.46	5.97	5.71	4.96	3.82	4.00	xxx	4.85	4.04	2.78
Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1350	5.13	4.98	3.1	5.11	4.94	4.29	4.27	3.50	xxx	4.2	3.52	2.45
1351	5.3	5.18	3.46	5.36	5.21	4.31	4.88	4.04	xxx	4.53	3.94	2.98
1352	6.73	6.23	3.84	6.3	6.03	5.01	4.35	4.55	5.89	5.23	4.51	3.33
1353	6.32	5.98	3.41	5.92	5.64	4.95	3.67	3.95	5.50	4.8	3.98	2.7
1354	5	6.11	3	4.89	4.73	4.17	3.98	3.37	4.59	4.03	3.37	2.33
1355	4.91	4.18	3.21	4.99	4.83	4.23	4.80	3.75	4.71	4.21	3.65	2.76
1356	6.65	6.19	3.75	6.21	5.93	5.18	3.99	4.45	5.82	5.14	4.39	3.23
1357	6.02	5.51	3.09	5.52	5.22	4.57	3.51	3.60	5.13	4.42	3.63	2.4
1358	4.89	4.62	2.76	4.73	4.51	4.00	3.81	3.19	4.43	3.87	3.2	2.14

1359	4.98	4.76	2.94	4.88	4.71	4.25	4.37	3.54	4.60	4.08	3.46	2.46
1360	6.19	5.76	3.34	5.75	5.52	4.92	3.76	4.02	5.40	4.72	3.98	2.8
1361	6.32	5.41	2.82	5.42	5.14	4.41	3.08	3.34	5.02	4.27	3.43	2.11
1362	4.86	4.21	2.39	4.31	4.14	3.58	3.71	2.78	4.03	3.49	2.82	1.77
1363	4.69	4.5	2.84	4.61	4.50	4.08	4.24	3.44	4.38	3.9	3.32	2.37
1364	4.47	5.33	3.16	5.36	5.18	4.68	3.64	3.90	5.07	4.45	3.76	2.63
1365	5.41	4.97	2.77	4.94	4.73	4.16	3.11	3.29	4.66	4.01	3.27	2.12
1366	4.51	4.02	2.4	4.12	4.00	3.53	3.48	4.83	3.91	3.41	2.8	1.83
1367	4.2	4.25	2.75	4.36	4.26	3.87	3.85	3.25	4.14	3.7	3.16	2.27
1368	4.7	4.72	2.94	4.8	4.66	4.27	3.70	3.58	4.56	4.04	3.43	2.45
1369	4.83	4.94	2.94	4.87	4.68	4.19	3.11	3.36	4.60	4.02	3.39	2.35
1370	3.57	4.01	2.52	4.07	3.96	3.52	3.34	2.83	3.84	3.36	2.84	1.96
1371	3.5	3.85	2.75	4.04	4.00	3.68	3.77	3.14	3.88	3.51	3.11	2.43
1372	4.35	4.49	3	4.59	4.49	4.14	3.57	3.52	4.37	3.93	3.45	2.65
1373	4.35	4.5	2.86	4.61	4.46	4.00	3.18	3.21	4.36	3.86	3.32	2.46
1374	3.57	3.92	2.67	4.08	3.99	3.58	3.18	2.86	3.88	3.44	2.96	2.22
1375	3.35	3.7	2.59	3.87	3.84	3.50	3.57	2.92	3.71	3.34	2.9	2.22
1376	4.05	4.2	2.9	4.34	4.27	3.91	2.88	3.28	4.17	3.76	3.28	2.57
1377	3.84	3.77	2.15	3.88	3.76	3.30	2.47	2.50	3.59	3.08	2.47	1.48
1378	3.35	3.35	2.02	3.42	3.32	2.87	3.05	2.10	3.18	2.75	2.24	1.4
1379	3.57	3.8	2.45	3.92	3.83	3.44	3.37	2.70	3.70	3.28	2.78	1.83
1380	3.82	4.11	2.58	4.26	4.16	3.77	3.11	3.02	4.01	3.56	3.01	2.01
1381	3.82	4.1	2.51	4.24	4.08	3.59	3.12	2.69	3.94	3.45	2.86	1.83
1382	3.68	4.06	2.51	4.21	4.08	3.59	2.70	2.71	3.92	3.45	2.87	1.84

Station	**P01**	**P02**	**P03**	**P04**	**P06**	**P07**	**P08**	**P09**	**P11**	**P12**	**P13**	**P14**
1383	3.29	3.64	2.23	3.75	3.69	3.22	2.77	2.25	3.55	3.13	2.59	1.66
1384	3.4	3.75	2.28	3.85	3.77	3.29	2.77	2.30	3.64	3.2	2.66	1.71
1385	3.69	4.04	2.36	4.12	3.98	3.39	2.96	2.19	3.88	3.39	2.79	1.75
1386	3.87	4.22	2.47	4.3	4.18	3.58	2.57	2.38	4.07	3.56	2.94	1.85
1387	3.48	3.78	2.15	3.85	3.77	3.16	2.38	1.89	3.65	3.16	2.57	1.53
1388	3.22	3.62	2.07	3.68	3.59	2.98	2.65	1.70	3.48	3.03	2.47	1.48
1389	3.79	4.15	2.42	4.27	4.13	3.43	2.84	1.96	4.04	3.53	2.91	1.8
1390	4.06	4.37	2.5	4.49	4.34	3.63	2.55	2.13	4.26	3.69	3.01	1.87
1391	3.82	4.21	2.39	4.29	4.16	3.39	2.31	1.67	4.08	3.51	2.81	1.64
1392	3.4	3.91	2.24	4.01	3.86	3.12	2.29	1.48	3.78	3.27	2.65	1.54
1393	3.61	4.02	2.36	4.11	3.93	3.14	2.66	1.57	3.85	3.34	2.74	1.65

1394	4.2	4.44	2.58	4.5	4.34	3.54	2.45	1.88	4.23	3.67	3	1.85
1395	3.99	4.33	2.47	4.42	4.42	3.36	2.19	1.60	4.14	3.54	2.83	1.58
1396	3.45	3.9	2.26	4.05	4.05	3.02	2.63	1.43	3.80	3.24	2.62	1.48
1397	3.51	3.92	2.35	4.06	3.87	3.05	xxx	1.40	3.79	3.28	2.68	1.56
1398	4.38	4.72	2.68	4.81	4.61	3.72	xxx	1.90	4.46	3.87	3.15	1.87
1399	4.37	4.62	2.48	4.68	4.44	3.41	xxx	1.36	4.31	3.64	2.83	1.45
1400	3.32	3.83	2.15	3.94	3.72	2.80	xxx	1.11	3.60	3.09	2.42	1.24
1401	3.58	3.91	2.32	3.91	3.83	2.80	2.31	1.08	3.69	3.16	2.55	1.45
1402	4.53	4.58	2.61	4.49	4.42	3.32	1.88	1.41	4.18	3.63	2.92	1.7
1403	4.44	4.71	2.53	4.57	4.32	3.18	1.46	1.06	4.23	3.59	2.81	1.44
1404	3.46	3.91	2.18	3.81	3.55	2.56	1.68	0.89	3.50	2.98	2.34	1.15
1405	3.48	3.84	2.43	3.91	3.69	2.61	2.28	0.89	3.62	3.16	2.6	1.53
1406	4.46	4.71	2.77	4.77	4.58	3.36	1.88	1.32	4.42	3.83	3.11	1.83
1407	4.24	4.56	2.53	4.53	4.33	3.05	1.51	0.89	4.18	3.53	2.74	1.39
1408	3.21	3.81	2.21	3.82	3.60	2.49	1.27	0.75	3.43	2.99	2.35	1.18
1409	3.41	3.61	2.25	3.54	3.28	2.30	2.19	0.51	3.78	2.81	2.22	1.15
1410	4.85	4.96	2.85		4.60	3.41	3.93	1.22	4.35	3.8	3.02	

APPENDIX B

LIST OF VASCULAR PLANT SPECIES, COMMON NAMES AND AUTHORITIES FOR PLANTS APPEARING IN POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

APPENDIX B.

A list of vascular plant species used in text and tables with accompanying authorities and common names follows. Both common and scientific names follow Kartesz and Meachum 1999. Species considered sensitive herbaceous species are marked with an asterisk (*).

**Alternanthera philoxeroides* (Mart.) Griseb. Alligator-Weed
Amaranthus cannabinus (L.) Sauer Tidal-Marsh Amaranth
**Aster* sp. Probably *Symphyotrichum sp.*
**Boehmeria cylindrica* (L.) Sw. Small-Spike False Nettle
**Boltonia asteroides* (L.) L'Hér. White Doll's-Daisy
**Carex* L. Sedge
**Carex crinita* Lam. Fringed Sedge
**Carex crinita* var. *brevicrinis* Fern.. Fringed Sedge
**Carex hyalinolepis* Steud. Shoreline Sedge
**Carex lupulina* Muhl. Ex Willd. Hop Sedge
**Cicuta maculata* L. Spotted Water-Hemlock
**Cinna arundinacea* L. Sweet Wood-Reed
**Commelina virginica* L. Virginia Dayflower
**Decodon verticillatus* (L.) Ell. Swamp-Loosestrife
**Dulichium arundinaceum* (L.) Britt. Three-Way Sedge
**Eryngium aquaticum* L. Rattlesnake-Master
**Galium* L. Bedstraw
**Hymenocallis floridana* (Raf.) Morton Florida Spider-Lily
Impatiens capensis Meerb. Spotted Touch-Me-Not
**Ludwigia grandiflora* (M. Micheli) Greuter & Burdet Large-Flower Primrose-Willow
**Ludwigia palustris* (L.) Ell. Marsh Primrose-Willow
**Lycopus virginicus* L. Virginia Water-Horehound
**Orontium aquaticum* L. Goldenclub
**Peltandra virginica* (L.) Schott Green Arrow-Arum
**Phanopyrum gymnocarpon* (Ell.) Nash Savannah-Panic Grass
Pluchea odorata (L.) Cass. Sweetscent
**Polygonum arifolium* L. Halberd-Leaf Tearthumb
**Polygonum hydropiper* L. Mild Water-Pepper
**Polygonum punctatum* Ell. Dotted Smartweed
**Pontederia cordata* L. Pickerelweed
**Rhynchospora corniculata* (Lam.) Gray Short-Bristle Horned Beak Sedge
**Rhynchospora inundata* (Oakes) Fern. Narrow-Fruit Horned Beak Sedge
Rosa palustris Marsh. Swamp Rose
**Rumex verticillatus* L. Swamp Dock
**Sagittaria lancifolia* L. Bull-Tongue Arrowhead
**Saururus cernuus* L. Lizard's-Tail
**Scutellaria lateriflora* L. Mad Dog Skullcap
**Schoenoplectus americanus* (Pers.) Volk. Ex Schinz & R. Keller Chairmaker's Club-Rush
**Sium suave* Walt. Hemlock Water-Parsnip
Spartina cynosuroides (L.) Roth Big Cord Grass

**Symphyotrichum elliotii* (Torr. & Gray) Nesom Marsh American-Aster
Symphyotrichum subulatum (Michx.) Nesom Seaside American-Aster
**Triadenum walteri* (J.G. Gmel.) Gleason Greater Marsh-St. John's-Wort
**Typha latifolia* L. Broad-Leaf Cat-Tail
**Zizania aquatica* L. Indian Wild Rice
**Zizaniopsis miliacea* (Michx.) Doell & Aschers. Marsh-Millet

Kelley, C.A., C.S. Marten, and W. Ussler III. 1995. Methane dynamics across a tidally flooded riverbank margin. Limnology and Oceanography 40:1112-1129.

APPENDIX C

METADATA COVERING GIS/GPS FILES USED IN TEXT FIGURES IN SENSITIVE HERBACEOUS VEGETATION POLYGONS: FIRST YEAR ASSESSMENT AT SEVEN STATIONS ESTABLISHED FOR THE WILMINGTON HARBOR MONITORING PROJECT IN THE CAPE FEAR RIVER ESTUARY, NORTH CAROLINA

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P3, TOWN CREEK

FIGURE 1

CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR
MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**13ben.shp 13ben.dbf 13ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**13pil.shp 13pil.dbf 13pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P3, TOWN CREEK

FIGURE 1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**13poly.shp 13poly.dbf 13poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (13poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**13sub.shp 13sub.dbf 13sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P3, TOWN CREEK

FIGURE 1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site9.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P3, TOWN CREEK

FIGURE 1

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**13tra.shp 13tra.dbf 13tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**R081315A.shp,.dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8 and Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	13 August, 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P7, INDIAN CREEK

FIGURE 2

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**15ben.shp 15ben.dbf 15ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**15pil.shp 15pil.dbf 15pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P7, INDIAN CREEK

FIGURE 2

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**15poly.shp 15poly.dbf 15poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (15poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**15sub.shp 15sub.dbf 15sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P7, INDIAN CREEK

FIGURE 2

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site8.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1” = 250’ Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272’ based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P7, INDIAN CREEK

FIGURE 2

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**15tra.shp 15tra.dbf 15tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P8, DOLLISON LANDING

FIGURE 3

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**16ben.shp 16ben.dbf 16ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**16pil.shp 16pil.dbf 16pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P8, DOLLISON LANDING

FIGURE 3

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**16poly.shp 16poly.dbf 16poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (16poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**16sub.shp 16sub.dbf 16sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P8, DOLLISON LANDING

FIGURE 3

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site3.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns):
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P8, DOLLISON LANDING

FIGURE 3

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**16tra.shp 16tra.dbf 16tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P9, BLACK RIVER

FIGURE 4

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**17ben.shp 17ben.dbf 17ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**17pil.shp 17pil.dbf 17pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P9, BLACK RIVER

FIGURE 4

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**17poly.shp 17poly.dbf 17poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (17poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**17sub.shp 17sub.dbf 17sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P9, BLACK RIVER

FIGURE 4

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site4.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1” = 250’ Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272’ based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P9, BLACK RIVER

FIGURE 4

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**17tra.shp 17tra.dbf 17tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**BLACKRIV.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.8, Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 September, 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P12, RAT ISLAND

FIGURE 5

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**Cam2.shp Came2.dbf Cam2.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**19pil.shp 19pil.dbf 19pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P12, RAT ISLAND

FIGURE 5

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**19poly.shp 19poly.dbf 19poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (19poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**19sub.shp 19sub.dbf 19sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P12, RAT ISLAND

FIGURE 5

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site5.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1” = 250’ Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272’ based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P12, RAT ISLAND

FIGURE 5

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**19tra.shp 19tra.dbf 19tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**RATISL.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8, Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 August, 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P13, FISHING CREEK

FIGURE 6

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**20ben.shp 20ben.dbf 20ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

FILE NAMES:	**20pil.shp 20pil.dbf 20pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P13, FISHING CREEK

FIGURE 6

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**20poly.shp 20poly.dbf 20poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (20poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**20sub.shp 20sub.dbf 20sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P13, FISHING CREEK

FIGURE 6

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site2b.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1" = 250' Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272' based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P13, FISHING CREEK

FIGURE 6

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**20tra.shp 20tra.dbf 20tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**FISHINGC.shp,.dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8, Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 August, 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P14, PRINCE GEORGE CREEK

FIGURE 7

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**21ben.shp 21ben.dbf 21ben.shx**
DESCRIPTION OF LAYER:	Point depicting concrete benchmark
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**21pil.shp 21pil.dbf 21pil.shx**
DESCRIPTION OF LAYER:	Point depicting data collect platform piling
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Point
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P14, PRINCE GEORGE CREEK

FIGURE 7

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**21poly.shp 21poly.dbf 21poly.shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2000 (21poly.ssf GPS file from CZR Incorporated)
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**21sub.shp 21sub.dbf 21sub.shx**
DESCRIPTION OF LAYER:	Points depicting substation survey points
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P14, PRINCE GEORGE CREEK

FIGURE 7

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**site1.tif**
DESCRIPTION OF LAYER:	True color aerial photography was flown on March 25, 2000 at an altitude of 1500 feet.
SOURCE:	Wild RC20 Aerial Mapping Camera Scale: 1” = 250’ Resolution: 1100 DPI (23.1 microns)
DATA TYPE:	The image source consisted of color contact prints and diapositives were created and the negative film then digitally scanned on a Vexcell 4000 to create raw digital images to be rectified and produce digital orthophotos. This produced an original raw pixel size of .2272’ based on the scale of the negative film.
SOFTWARE:	Tif/Tfw file format
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	25 March 2000
SOURCE:	3Di, LLC Wilmington NC, Office
SOURCE CONTACT:	Scott C. Williams, PLS
SOURCE ADDRESS:	2704-A Exchange Drive Wilmington, NC 28405
SOURCE PHONE:	910/392-1496
SOURCE FAX:	910/392-7326

METADATA

POSITIONS OF MONITORING STATION COMPONENTS AND SENSITIVE HERBACEOUS PLANT SPECIES POLYGONS WITHIN THE BELT TRANSECT AT MONITORING STATON P14, PRINCE GEORGE CREEK

FIGURE 7

CAPE FEAR RIVER ESTUARY,
WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE NAMES:	**21tra.shp 21tra.dbf 21tra.shx**
DESCRIPTION OF LAYER:	Points depicting belt transect markers
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Points
SOFTWARE:	Pathfinder Office 2.1 and Arcview version 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	20 December 2000
SOURCE:	CZR Incorporated
SOURCE CONTACT:	Samuel Cooper
SOURCE ADDRESS:	4709 College Acres, Suite 2 Wilmington, NC 28403
SOURCE PHONE:	910/392-9253
SOURCE FAX:	910/392-9139
FILE NAMES:	**PRGEORGE.shp, .dbf, .shx**
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2001
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.8, Arcview 3.2
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 August 2001
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

APPENDIX D

AREAS AND LOCATIONS OF YEAR 2001 SENSITIVE HERBACEOUS SPECIES POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

APPENDIX D.

Areas and locations of year 2001 sensitive herbaceous species polygons at sampling stations in the Cape Fear River Estuary, Wilmington Harbor Monitoring Project, North Carolina.

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft^2)	Easting* (ft^2)
Town Creek/ P3	1772.49	TC-1	140219.051	2304171.805
		TC-2	140207.082	2304191.344
		TC-3	140221.659	2304206.404
		TC-4	140227.839	2304209.772
		TC-5	140237.031	2304214.119
		TC-6	140242.445	2304215.836
		TC-7	140249.946	2304215.409
		TC-8	140270.182	2304212.486
		TC-9	140266.858	2304204.850
		TC-10	140256.540	2304191.699
		TC-11	140248.723	2304191.674
		TC-12	140236.591	2304178.099
		TC-13 (TC2-7a)	140260.872	2304211.829
		TC-14 (TC2-7b)	140263.278	2304227.086
		TC-15 (TC2-7c)	140262.762	2304231.769
		TC-16 (TC2-7d)	140260.772	2304234.450
		TC-17 (TC2-7e)	140280.231	2304228.285
Black River/P9	1119.58	1	216657.779	2286244.325
		2	216651.492	2286251.095
		3	216658.827	2286246.468
		4	216657.269	2286251.898
		5	216651.754	2286247.472
		6	216650.042	2286249.262
		7	216645.799	2286253.674
		8	216649.888	2286259.088
		9	216657.317	2286262.581
		10	216648.954	2286263.880
		11	216659.557	2286262.102
		12	216656.757	2286273.002
		13	216653.079	2286288.044
		14	216668.689	2286296.701
		15	216690.333	2286320.841
		16	216681.126	2286288.855
		17	216679.751	2286276.252
		18	216666.266	2286267.250
		19	216665.348	2286262.663
		20	216664.587	2286259.601
		21	216669.094	2286251.539
		22	216662.925	2286243.089

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft^2)	Easting* (ft^2)
Rat Island/P12	532.94	1	203317.736	2313777.913
		2	203308.772	2313777.549
		3	203300.868	2313779.229
		4	203291.969	2313780.256
		5	203191.671	2313784.565
		6	203286.449	2313794.021
		7	203292.794	2313803.441
		8	203303.896	2313802.231
		9	203309.117	2313784.687
		10	203317.219	2313784.437
Fishing Creek/P13	1646.10	1	215434.539	2303604.659
		2	215433.148	2303593.142
		3	215422.842	2303588.528
		4	215443.926	2303577.863
		5	215451.578	2303569.614
		6	215464.474	2303570.360
		7	215463.540	2303566.543
		8	215464.940	2303561.667
		9	215476.415	2303554.937
		10	215477.821	2303565.921
		11	215485.052	2303562.581
		12	215497.650	2303561.666
		13	215507.769	2303571.186
		14	215496.683	2303576.106
		15	215490.616	2303574.817
		17(16 missed)	215482.008	2303579.455
		18	215476.137	2303576.585
		19	215471.856	2303583.992
		20	215461.894	2303589.648
		21	215460.313	2303596.880
		22	215461.579	2303608.001
Prince George Creek/P14	3669.31	1	227256.418	2320219.063
		2	227254.446	2320221.629
		3	227255.706	2320220.961
		4	227258.228	2320225.326
		5	227264.379	2320234.730
		6	227242.143	2320230.564
		7	227234.911	2320234.787
		8	227222.362	2320230.472
		9	227219.785	2320237.000
		10	227214.661	2320252.072
		11	227224.243	2320251.647
		12	227232.224	2320251.944
		13	227230.942	2320242.688

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft^2)	Easting* (ft^2)
		14	227221.085	2320259.271
		15	227220.999	2320256.085
		16	227218.673	2320265.466
		17	227225.300	2320272.352
		18	227219.657	2320270.658
		19	227210.593	2320266.917
		20	227217.691	2320270.768
		21	227220.796	2320277.818
		22	227221.646	2320287.355
		23	227210.243	2320285.915
		24	227203.635	2320289.840
		25	227214.513	2320300.367
		26	227220.349	2320291.940
		27	227221.394	2320297.383
		28	227225.410	2320292.784
		Blank	227237.424	2320297.455
		29	227237.487	2320297.765
		30	227235.813	2303283.380
		31	227233.304	2320286.955
		32	227243.738	2320286.983
		33	227247.470	2320288.567
		34	227280.347	2320298.250
		35	227256.899	2320280.853
		36	227260.654	2320288.981
		37	227262.018	2320286.084
		38	227267.985	2320285.138
		39	227276.378	2320277.400
		40	227285.637	2320269.304
		41	227304.780	2320284.690

*North Carolina State Coordinate System, Region 3200, North American Datum, 1983.