Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina
Year 8: June 1, 2007 – May 31, 2008

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Acronyms Used in this Report

ANOSIM	Analysis of Similarity
ANOVA	Analysis of Variance
DCP	Data Collection Platform
ECSU	Elizabeth City State University
M	Methanogenic
MPSR	Methanogenic with evidence of past sulfate reduction
MSL	Mean Sea Level
PPT	Parts Per Thousand
SR	Sulfate Reducing
SRNS	Sulfate reducing with non-seawater source of sulfate
UNCW	University of North Carolina Wilmington
UNF	University of North Florida
USACE	United States Army Corps of Engineers
USGS	United States Geological Survey
ND	No Data Recorded

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ABSTRACT

Data reporting from all twelve stations was similar between years 06-07 and 07-08 with only a slight increase in data loss, mainly due to drought associated under-ranging events. The station with the greatest loss of tidal range data was P7 (Indian Creek), which lost 9.6% of tides due to under-ranging events. This was an increase from last years 1.4% of total tides lost, most likely a result of clear cutting in the adjacent swamp, which has caused sediment runoff and accumulation around the DCP. Compared to last year data loss due to mechanical problems at P3 (Inner Town Creek) was relatively low at 0.3% versus 3.1%. The main issue at P3 was associated with the analog modem (2.5%), which has since been replaced. Overall, the data loss this reporting period was lower in comparison to historical data loss. There were more than 1,400 tide ranges measured between June 1, 2007 and May 31, 2008.

Tidal ranges within the estuary were fairly constant. Tidal ranges within the lowermost of the upstream stations were higher than tidal ranges measured at stations further upstream of the estuary. A good correlation between measured tidal range from the base station at Ft Caswell and the predicted tidal range for this station continues to exist. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by precipitation and discharge rates in the river, but to a lesser degree than 2006-2007. The mean tidal range at P1 was not significantly different from the mean reported in the previous monitoring period, but was significantly lower than the range reported in Year 2000-2001. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded significant greater slopes between this reporting period and the previous reporting period at all sites. This is an increase from the previous reporting period when differences were detected for almost one-half of the stations.

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 5 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. For much of this reporting period, drought conditions existed in the region and the mean discharge fell below the 30-year mean, but was comparable to the mean discharge that existed during another drought year, Year 6 (2005-2006). Consistent with previous drought years, high salinities were measured at several upstream stations. For example, site P8 exhibited salinities as high as 10.5 ppt in October 2007 when river discharge was very low. At site P13 on the Northeast Cape Fear River, salinities as high as 20 ppt were reported in October 2007. River salinities as high as 5.8 ppt were measured at P8 and exceeded 14 ppt at P13 in previous drought years. During this reporting period, salinities frequently exceeded maximum values reported previously for upstream stations. This was

particularly the case from June 2007 to December 2007 when river discharge reported for the Cape Fear mainstem was quite low.

During this reporting period twelve cruises were conducted to determine the degree that ocean-derived saline water extended upstream in the mainstem of the Cape Fear River. During this same period (1 June 2007 and 30 May 2008) stream flow on the Cape Fear River at Lock and Dam 1 ranged from 283 cfs to 18,200 cfs. The highest flow rate during a river cruise averaged 8,920 cfs, in May and no saline water was detected during that cruise. The lowest flow rate over Lock and Dam 1 during a river cruise was 334 cfs recorded in October. During this cruise, saline water was detected at Site 1 (near P7) at 9.8 ppt in surface waters and 11.2 ppt in maximum depth waters. During this cruise saline water further upstream, at Site 2, was measured less than 1 ppt and was not detected at Site 3. Thus saline water did not reach farther than 40 miles upstream (lat/long: 34.20187, -78.02900).

The flooding frequency within swamps and marshes at approximately half the DCP stations was lower this year than in previous years. This effect was more pronounced in the fall during drought conditions when the river discharge rates were below average. However, during spring 2008 flooding conditions had returned to levels comparable to previous years. Salinity levels in the fall also reflected the drought and low flow regime. In fall 2007, salinity was detected at all stations except P9. Also similar to flood patterns, salinity measurements in spring 2008 returned to levels comparable to previous years.

Within the study sites, this year proved to be the saltiest year since the beginning of the monitoring project and this was reflected in the biogeochemistry data. During low flow periods, all porewater chemistry stations except those most upstream (P8 Dollisons Landing, P9 Black River, P13 Fishing Creek, P14 Prince George) experienced the highest salinities and subsequent effects since monitoring began in 2002. The most upstream stations had elevated salinities similar to the summer of 2002 when previous low river flow conditions were present. The high salinities resulted in a shift in soils towards sulfate reduction. Generally methanogenic conditions were replaced by sulfate reducing conditions.

Neither infaunal species richness nor diversity showed consistent patterns for the 2007 infauna sampling year. Note that the higher salinities occurred after samples were taken in June 2007. Oligochaetes dominated most sites representing between 20% and 80% of the total number of individuals at a site. The Dollisons Landing site (P8) and the site at the mouth of Town Creek (P2) had greater numbers of species present compared to sites in the Northeast Cape Fear. During the 2007 sampling year, diversity showed only one significant difference with P13 (Fishing Creek site) being significantly less than P2, P3A, P6, or P8. Comparisons among current, previous year and initial sampling showed no consistent pattern for diversity or species richness. Likewise, comparisons of functional groups and major taxonomic groups showed few differences among years.

While benthic infauna respond more slowly to changes in physical factors, the epibenthic community responds quickly to physical changes, due to their highly motile nature, and need for refuge and forage habitat. Breder traps (a passive sampling device) deployed at multiple tidal positions within the marsh and Drop traps (an active density-based sampling method) deployed along the shallow subtidal marsh edge habitat, collected data on the presence of these organisms in various portions of the estuary. Previous findings indicated changes in epibenthic species patterns consistent with developing drought conditions in 2001 and 2002, though this period was also coincident with the initial construction activity (Hackney et al. 2004). The period covered by this report (fall 2007 and spring 2008) also experienced lower than normal rainfall, although not as severe as the previous year. Evaluations of total epibenthic abundance among years found that more fish utilized fringing marshes in fall 2007 compared to fall 2006 and the first season (1999). Total abundances were higher in 2008 and 2007 compared to the initial sampling period where differences were detected in the spring data. Similar patterns in the spring data were evident for diversity measurements and overall species richness. Nearly all sites showed higher species richness in fall 2007 and spring 2008. Fall 2007 diversity measures were generally higher than 2006 or 1999, and nearly all differences detected in spring 2008 were greater than spring 2007 or spring 2000.

Monitoring at seven sites for sensitive herbaceous vegetation revealed that plant species varied widely in respone to salinity changes driven by drought and also by direct human manipulation. Salinity events (above the mean salinity for the site) at two of the seven sites, Inner Town Creek (P3) and Fishing Creek (P13) strongly influenced the character of plant growth within the sensitive herbaceous vegetation polygons. These changes are reflected in the area of the sensitive herbaceous vegetation polygons and by changes in contributed cover by the primary sensitive herbaceous species, *Zizaniopsis miliacea* at Inner Town Creek and *Pontederia cordata* at Fishing Creek. Other changes noted were recent death of woody plants and lack of growth in knees associated with *Taxodium* sp. Individuals of *Pinus* sp. well away from the creek at Inner Town Creek were browning. Scattered individuals of *Fraxinus caroliniana* and *Taxodium* sp. at Fishing Creek showed a few examples of apparent salinity death.

There were no significant effects evident at any of the five other sensitive herbaceous vegetation monitoring stations though stream monitoring indicated salinity events were present in adjacent waters. Evaluation of sensitive species occurred in August 2007 before the high salinity in fall. However, vegetation conditions at Indian Creek (P7) station have been strongly influenced by selective removal of swamp forest shrub and canopy species relative to commercial development in the area. Here the potential effects of salinity have been masked by the more destructive removal of woody vegetation and subsequent opportunistic growth of a different set of herbaceous species. Other sensitive herbaceous vegetation monitoring stations seem relatively free of any significant damage due to salt or humans.

Two periods of salinity events occurring within the project area were compared using data gathered during the two years of strong concentrations. Sensitive herbaceous species polygons were smaller at both Town Creek and Fishing Creek in 2002 (Hackney et al. 2003) because the drought apparently persisted for a longer period of time. Salinity strengths during May, June, and July of 2002 and 2007 are comparable, but those of 2002 were higher and did affect sensitive herbaceous species, namely *Saururus cernuus*, as far up stream as Dollisons Landing and Prince George Creek. Both events seem more relative to conditions in the diminished freshwater watershed rather than to any effects associated with modified tidal surge from further downstream.

This report includes data from project year June 1, 2007 – May 31, 2008. Previous year's data may be obtained from USACE or the project webpage (http://people.uncw.edu/culbertsonj). Comparisons will be made among and between data from all project years following project construction.

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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 examine 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 June 2007 through May 2008. During this period, problems of communication with instruments or minor instrument malfunction were solved as they occurred. Mechanical errors were slightly higher at some sites this year than during previous reporting periods, and this may reflect the age of some of the equipment. As was the case in previous monitoring years, each tide has been examined for each station and a determination made as to whether data collected are reliable.

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 sampled by a UNIDATA shaft-encoded water level recorder housed in an aluminum stilling well at 1-second intervals. A UNIDATA Starlogger logs the average, maximum, and minimum values every 3 minutes. Conductivity and temperature are also sampled by a UNIDATA conductivity instrument and recorded by the Starlogger every 3 minutes. Data are downloaded to a PC housed in the laboratory every 2 weeks via modem. In instances when the modem has not functioned properly, technicians on site download data loggers using a laptop. 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 problems identified can be rectified immediately. Data are then compiled into files each of which contains 1 month of data for each station. Data files are then sorted at 6 minutes intervals and the resulting data set is stored for subsequent data analysis. As in previous reporting periods, the terms used to describe general mechanisms through which data are lost or compromised are defined below:

<u>Loss at Station P1</u>: 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).

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	0.1	0.1	0	0	4.3	4.5
P2	4.5	0.1	2.1	0	0	0.1	6.8
P3	4.5	0.5	0	2.8	0	0.3	8.1
P4	4.5	0	0	0	0	0	4.5
P6	4.5	0.3	0	1	0	1	6.8
P7	4.5	0.1	9.6	1.5	0	0.3	16.0
P8	4.5	0.3	0	0.3	0	4.3	9.4
P9	4.5	0.7	0.1	3.9	0	2.7	11.9
P11	4.5	0.9	0	0	0	0.7	6.1
P12	4.5	0	0	0	0	0.3	4.8
P13	4.5	0.2	0.3	0	0	2.1	7.2
P14	4.5	0.2	0	0.0	0	2.8	7.5

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 station. This station functioned well during the reporting period. The total percentage of lost tides at this station from June 2007 to May 2008 (4.5%) was approximately the same as the last reporting period (4.0%), which was lower than the previous three reporting periods (6.9%, 10.2%, and 8.0%). Data collected at this station still show occasional irregularities in the shape of the water level curves but these variations do not affect the reported minimum and maximum water level values (i.e. reported tidal range). The station was mostly affected by passing weather systems that caused erroneous data collection during high wind and wave action. Monthly QA/QC checks and cleaning of probes and the well interior seem to prevent most minor problems before they occur. Corrosion of the beaded cable also affects data quality; therefore, cable integrity is assessed each month and the cable replaced when necessary.

1.4 Town Creek Mouth (P2)

Water level curves at this station can be noisy due to periods of what appear to be high frequency variations in water level. These episodes do not occur with any regular periodicity and are believed to be associated with nearby ship traffic. Nonetheless, the data are of sufficient quality to regularly identify maximum and minimum water levels and these data correspond well with the data from P1. The total percentage of lost tides at this station (6.8%) was higher than during 2006-2007 reporting period (4.9%). P2 experienced just a few mechanical errors this reporting period. Minor data loss also occurred during QA/QC resets. The main reason for the increase in lost tides during this reporting period was under-ranging events (2.1%). This problem was non-existent during the 2005-2006 reporting period, and a minor problem during 2006-2007 reporting period (0.4%).

1.5 Inner Town Creek (P3)

This station generally experiences few problems and continues to generate smooth tidal curves. Data loss during this reporting period was comparable to the previous year (8.1%). In contrast to the previous reporting period (3.1%), mechanical problems during this period were relatively low (0.3%). The largest loss of data occurred in June (2.8%) when the phone box and starlogger experienced problems. ,

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 only a few problems over the reporting period.

1.7 Eagle Island (P6)

During this reporting period, data loss at this station was slightly less (6.8%) than during the 2006 to 2007 project year (8.8%). The data loss at this station was fairly equally divided between QA/QC water level resets (0.3%), minor mechanical issues (1.0%), and data loss from absence of data (1.0%).

1.8 Indian Creek (P7)

Under-ranging continued to be problematic during the 2007-2008 sampling period (9.6% of total tides). This was much greater than the percentage of under ranging events reported during the 2006-2007 sampling period (1.4% of total tides). The increase was most likely a result of clear cutting in the adjacent swamp, which caused some high sediment runoff and accumulation around the DCP site. Tides lost to the absence of data (1.5%) were also an issue, as were mechanical errors resulting in a loss of 0.3% of total tides.

1.9 Dollisons Landing (P8)

Like station P1, this station also experienced a large number of mechanical issues during the 2007-2008 reporting period. Similar to previous years, this continued to be the factor contributing to the most data loss (4.3% of total tides). This value was essentially the same as the value reported for the previous reporting period (3.9%). The mechanical problems at P8 were usually associated with the water level cable getting snagged in the stilling well. Minor tide loss to the absence of data (0.3%) and QA/QC water level resets (0.3%) also affected this site.

1.10 Black River (P9)

Site P9 experienced a loss of 11.9% of total tides for the 2007-2008 reporting period which is equivalent to loss the previous reporting period (11.0%). Similar to previous years, data loss at the station was primarily associated with mechanical errors (2.7%) resulting from periodic river flooding that interrupted operation of the water level recorder. Tide loss from the absence data was also fairly substantial for this reporting period (3.9%) and constituted an increase from the previous year (1.3%). During this reporting period, this station required many water level resets due to a gradual drift in the water level recorder (0.7%).

1.11 Smith Creek (P11)

Similar to the previous reporting period, P11 has operated with very few problems during 2007-2008, although the percentage of total tides lost (6.1%) was slightly higher than the previous reporting period (5.3%). Approximately 0.9% and 0.7% of the total tides were lost due to QA/QC and minor mechanical problems, respectively.

1.12 Rat Island (P12)

During the current reporting period, the percentage of total tides lost (4.8%) from this site was slightly less than the 2006-2007 reporting period (6.2%). The only tides lost during the entire reporting period were a result of minor mechanical problems (0.3%).

1.13 Fishing Creek (P13)

The percentage of lost tides at this site (7.2%) was greater than the previous reporting period (4.5%). This increase in lost tides was primarily due to an increase in minor mechanical errors (+1.7%) relative to the previous year. Similar to P9, the mechanical errors were a result of periodic river flooding that interrupted operation of the water level recorder. This site also experienced some under-ranging events which were not seen the previous year.

1.14 Prince George Creek (P14)

Total tides lost at this station (7.8%) were approximately one-half of the percentage of tides lost during the 2006-2007 reporting period (15.3%). A sizable decrease in mechanical errors was the main reason for the improvement. During the 2006-2007 periods the loss was 10.1% as opposed to the current year's loss of 2.8%. The observed mechanical losses were associated with periods of major flooding and were also observed at P9 and P13.

2.0 MONUMENT AND STATION SURVEY VERIFICATION

2.1 Summary

All of the elevation monuments are intact and stable. The subsite elevation monuments and primary monument at P7 appear to be intact following last year's extensive vegetation clearing by adjacent development. All of the sites, including P7, require future resurveying at the end of the project by professional surveyors to ensure we are relying on accurate NAVD88 elevations determined at the beginning of the study have not changed.

3.0 PART A - RIVER WATER LEVEL/SALINITY MONITORING

3.1A Summary

More than 1,400 tide ranges measured between June 1, 2007 and May 31, 2008 (Appendix A) were used to conduct analyses of changes in tidal amplitude as well as changes of ebb and flood duration. A good correlation between measured tidal range from the base station at Ft Caswell and the predicted tidal range for this station continues to exist. The mean tidal range at P1 was not significantly different from the mean reported in the previous monitoring period, but was significantly lower than the range reported in Year 1. Tidal ranges within the estuary were fairly constant, including the lowermost of the upstream stations, and were higher than tidal ranges measured at most upstream stations. Water levels in the most upstream sites and the inner Town Creek station continued to be affected by precipitation and discharge rates in the river, but to a lesser degree than 2006-2007. All of the sites, except P1, P6, and P11 exhibited a significant difference in yearly mean tidal ranges between this reporting period and 2006-2007. Mean tidal range at five out of eleven of the river monitoring stations were significantly different from the mean tidal range reported in Year 1 of monitoring. The observation that mean tidal range observed at P1 (Ft Caswell) is again significantly less than in Year 1 continues to complicate interpretation of the results as this station was initially expected to be unimpacted by river widening activities. Mean monthly maximum water levels for this reporting period were significantly different from the values reported for the previous monitoring period at six of the stations. There also was no significant difference in mean monthly minimum water level between this reporting period and last year with the exception of site P7. Comparisons of the regression slopes when tidal range at each site was regressed against P1 tidal range yielded significant differences between this reporting period and the previous reporting period at all sites. This is an increase from the previous reporting period when differences were detected for almost one-half of the stations. When the slopes from this reporting period were compared to slopes calculated for Year 1 (2000-2001), all sites exhibited a significantly different slope except for station P14.

With the exception of site P3 (which remained unchanged), the mean high tide lags increased at all sites this reporting period. Fewer changes were noted in mean low tide lag values with most stations showing low tide lag values that were comparable to those reported last year; particularly in the Northeast Cape Fear River. The largest difference noted occurred at P3. During this reporting period, mean flood duration increased by less than 1% at all stations. Mean ebb duration also varied little from those values reported in the last monitoring period (<1%). With the exception of site P7, ebb durations decreased relative to 2006-2007.

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 5 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. As reported by Hackney et al. (2001-2007), these effects are confounded by the shortened data set for Year 1 which included data collected from October to June, only, and covered a period when monthly river discharge was below the long-term average (~5,531 ft^3/s) reported by the USGS at Lock and Dam 1 on the Cape Fear mainstem. This reporting period, the mean discharge fell below the 30-year mean, but was comparable to the mean discharge that existed during Year 6 (2005-2006). The similarity in discharge rates between this project year and Year 6, may explain the greater similarity in mean tidal range values between these two years (See Hackney et al. 2006 for values).

Harmonic analysis of tidal constituents has continued during this reporting period. For all of the stations, the M2 component is the dominant constituent as expected. A longer water level time series exists at station P4, allowing for examination of tidal harmonics for several years prior to the initiation of dredging. Over the 12 year period between 1994 and 2008, however, neither the amplitude nor the phase of the M2 constituent has changed appreciably. For the most part, the amplitude of the M2 constituent at P4 has varied between 2.03 and 2.09 with this year's value being 2.07. As expected, the M2 amplitude at sites just upstream and downstream of P4 (e.g. P2, P6, and P11) are more similar to P4 than to other sites in the river. Like mean water level, changes in harmonic amplitude appear to be linked to variations in discharge. This relationship will be examined in greater detail following completion of dredging activities.

For much of this reporting period, drought conditions existed in the region and upstream releases in the Cape Fear River were reduced. Consistent with previous drought years, high salinities were recorded at several upstream stations. For example, site P8 exhibited salinities as high as 10.5 ppt in October 2007 when river discharge was very low. At site P13 on the Northeast Cape Fear River, salinities as high 20 ppt were reported in October 2007. In fact, a maximum salinity of 9.4 ppt was reported at site P14 also in October 2007. These results are consistent with other drought years where, salinities as high as 5.8 ppt were measured at P8 while salinities exceeding 14 ppt were measured at P13. During this reporting period, salinities frequently exceeded maximum values reported previously for upstream stations. This was particularly the case from June 2007 to December 2007 when river discharge reported for the Cape Fear mainstem was quite low. In December 2007/January 2008, river discharge began to increase, and salinities at most upstream stations decreased to values expected for average to above average flow.

Although discharge data are not available for the Northeast Cape Fear to enable a direct comparison of salinity to discharge, salinity patterns measured in this branch are consistent with discharge and salinity patterns reported in the Cape Fear mainstem.

3.2A Database

Water level, conductivity, and temperature data collected at DCP stations from June 2007 through May 2008 are incorporated in this report. This year's database includes approximately 1400 tides of sufficient quality to be used in the analyses of each of the 11 DCP stations. Specific problems associated with each station have been described in Section 1 of this report. Table 1.1-1 summarizes the percentage of tides unavailable for analysis due to the various reasons cited above.

3.3A Data Analyses Methods

Maximum, minimum, and mean 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 and 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 (Table 3.3A-1). The mean tidal ranges measured during this reporting period were significantly different ($P<0.05$) than the means reported during the first year of monitoring (2000-2001), or pre-dredging, at more than one-half of the stations (Table 3.3A-2). These differences were evident at all estuarine stations and all mainstem stations. At ten out of the twelve stations, the mean tidal range measured during this reporting period also was significantly different ($P<0.05$) than the means reported during the previous reporting period. This result differs from the 2006-2007 reporting period when only five out of 12 stations showed such differences.

Yearly comparisons of mean monthly maximum and minimum water levels collected at the 11 DCP stations are shown in Table 3.3A-3. Significant differences in mean monthly maximum water level between this reporting period and Year 1 only were observed at stations P2, P9, and P13. However, when mean monthly maximum water levels from this reporting period were compared to the 2006-2007 reporting period, significant differences existed at stations P2, P3, P7, P11, P13, and P14. These differences were lower maximum water levels at P2, P3, P7, and P11. Even though maximum water levels were significantly higher at the two most upstream sites on the Northeast Cape Fear River, there does not appear to be any consistent spatial pattern to these results (i.e. estuary, mainstem, or northeast stem). When mean monthly minimum water levels for this reporting period were compared to Year 1, the means were significantly different at stations P2, P3, P7, and P9. Only P7 showed a significant difference (lower) when this reporting period was compared to 2006-2007.

Table 3.3A-1. Monthly maximum, minimum, and range of salinity values 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. "XXX" indicates periods of extended data loss due to mechanical failure of water level instrument.

		Salinity (ppt)			Water Level (ft)		
Site	**Month**	**Maximum**	**Minimum**	**Range**	**Maximum**	**Minimum**	**Range**
P1	Jun-07	39.1	19.1	20.0	3.21	-3.47	6.68
	Jul-07	39.4	7.5	31.9	2.39	-3.78	6.17
	Aug-07	39.9	8.5	31.4	2.53	-3.84	6.37
	Sep-07	36.1	20.1	16.0	2.99	-3.82	6.81
	Oct-07	36.0	20.9	15.1	3.35	-3.68	7.03
	Nov-07	36.7	26.2	10.5	2.70	-4.29	6.99
	Dec-07	35.8	7.7	28.1	3.59	-4.16	7.75
	Jan-08	33.9	0.1	33.8	2.59	-4.38	6.97
	Feb-08	34.4	1.4	33.0	1.8	-4.74	6.54
	Mar-08	38.6	1.5	37.1	1.83	-5.09	6.92
	Apr-08	30.8	2.0	28.8	3.05	-4.33	7.38
	May-08	39.7	8.6	31.1	3.04	-3.95	6.99
P2	Jun-07	24.2	0.0	24.2	4.17	-2.11	6.28
	Jul-07	23.1	0.2	22.9	3.63	-2.38	6.01
	Aug-07	26.0	0.2	25.8	3.52	-2.50	6.02
	Sep-07	27.4	2.6	24.8	3.71	-2.48	6.19
	Oct-07	29.3	0.1	29.2	4.00	-2.15	6.15
	Nov-07	23.5	0.1	23.4	3.51	-2.74	6.25
	Dec-07	20.5	0.1	20.4	3.92	-2.76	6.68
	Jan-08	14.0	0.1	13.9	3.17	-2.71	5.88
	Feb-08	14.5	0.0	14.5	3.43	-2.72	6.15
	Mar-08	8.8	0.0	8.8	3.46	-2.73	6.19
	Apr-08	11.6	0.0	11.6	4.37	-2.54	6.91
	May-08	17.3	0.0	17.3	4.11	-2.57	6.68
P3	Jun-07	22.1	1.5	20.6	2.08	-2.02	4.10
	Jul-07	23.2	0.7	22.5	1.96	-1.96	3.92
	Aug-07	24.9	4.1	20.8	2.01	-2	4.01
	Sep-07	26.1	6.8	19.3	2.06	-1.80	3.86
	Oct-07	27.9	6.6	21.3	2.23	-1.61	3.84
	Nov-07	19.8	1.5	18.3	2.07	-2.53	4.60
	Dec-07	15.8	1.0	14.8	2.21	-2.78	4.99
	Jan-08	4.8	0.0	4.8	1.80	-2.77	4.57
	Feb-08	6.2	0.0	6.2	1.82	-2.60	4.42
	Mar-08	1.2	0.2	1.0	1.82	-2.57	4.39
	Apr-08	3.3	0.2	3.1	2.32	-2.29	4.61
	May-08	8.2	0.3	7.9	2.04	-1.80	3.84
P4	Jun-07	21.6	6.7	14.9	3.51	-2.83	6.34
	Jul-07	22.7	4.6	18.1	2.96	-3.09	6.05
	Aug-07	22.0	7.8	14.2	2.88	-3.04	5.92
	Sep-07	26.1	4.5	21.6	3.01	-3.21	6.22
	Oct-07	27.0	4.9	22.1	3.28	-2.83	6.11
	Nov-07	22.7	6.5	16.2	2.83	-3.64	6.47
	Dec-07	23.0	6.6	16.4	3.23	-4.05	7.28
	Jan-08	16.2	0.1	16.1	2.53	-4.28	6.81
	Feb-08	8.1	0.1	8.0	2.82	-3.81	6.63
	Mar-08	8.0	0.1	7.9	2.96	-3.99	6.95
	Apr-08	13.5	0.1	13.4	3.78	-3.21	6.99

Table 3.3A-1. (continued)

Site	Month	Salinity (ppt) Maximum	Minimum	Range	Water Level (ft) Maximum	Minimum	Range
	May-08	21.2	0.8	20.4	3.46	-3.21	6.67
P6	Jun-07	13.1	7.1	6.0	3.13	-2.92	6.05
	Jul-07	18.9	0.4	18.5	2.84	-3.02	5.86
	Aug-07	22.8	0.3	22.5	3.05	-2.72	5.77
	Sep-07	26.6	1.3	25.3	4.21	-2.97	7.18
	Oct-07	26.3	0.2	26.1	3.39	-2.56	5.95
	Nov-07	22.0	0.0	22.0	2.91	-3.44	6.35
	Dec-07	23.3	0.0	23.3	3.23	-3.87	7.10
	Jan-08	14.8	0.0	14.8	2.54	-4.06	6.60
	Feb-08	15.4	0.1	15.3	2.86	-3.63	6.49
	Mar-08	11.2	0.1	11.1	3.00	-3.73	6.73
	Apr-08	8.7	0.0	8.7	3.82	-3.06	6.88
	May-08	12.6	0.1	12.5	3.34	-2.68	6.02
P7	Jun-07	1.7	0.1	1.6	3.27	-2.17	5.44
	Jul-07	3.3	0.1	3.2	2.87	-2.22	5.09
	Aug-07	8.1	0.2	7.9	2.77	-2.3	5.07
	Sep-07	7.4	0.3	7.1	2.90	-2.29	5.19
	Oct-07	9.8	0.1	9.7	3.40	-2.12	5.52
	Nov-07	2.8	0.0	2.8	2.67	-2.33	5.00
	Dec-07	6.3	0.0	6.3	3.11	-2.34	5.45
	Jan-08	0.9	0.1	0.8	2.59	-2.35	4.94
	Feb-08	1.4	0.0	1.4	2.85	-2.43	5.28
	Mar-08	0.1	0.0	0.1	3.04	-2.42	5.46
	Apr-08	0.1	0.0	0.1	3.85	-2.41	6.26
	May-08	3.0	0.1	2.9	3.21	-2.53	5.74
P8	Jun-07	1.8	0.1	1.7	3.12	-1.87	4.99
	Jul-07	3.0	0.1	2.9	2.79	-2.16	4.95
	Aug-07	6.3	0.1	6.2	2.84	-2.18	5.02
	Sep-07	8.3	0.2	8.1	2.94	-2.00	4.94
	Oct-07	10.5	0.1	10.4	3.51	-1.65	5.16
	Nov-07	2.8	0.1	2.7	2.83	-2.82	5.65
	Dec-07	5.2	0.1	5.1	2.86	-3.07	5.93
	Jan-08	0.2	0.1	0.1	2.16	-3.41	5.57
	Feb-08	0.1	0.1	0.0	2.75	-2.34	5.09
	Mar-08	0.1	0.0	0.1	3.00	-2.79	5.79
	Apr-08	0.1	0.0	0.1	4.27	-1.85	6.12
	May-08	0.1	0.1	0.0	3.42	-2.41	5.83
P9	Jun-07	0.1	0.1	0.0	3.82	-0.71	4.53
	Jul-07	0.1	0.1	0.0	3.84	-1.18	5.02
	Aug-07	0.2	0.1	0.1	3.40	-1.56	4.96
	Sep-07	0.2	0.0	0.2	2.93	-1.66	4.59
	Oct-07	0.3	0.0	0.3	3.79	-1.21	5.00
	Nov-07	0.2	0.0	0.2	3.94	-1.28	5.22
	Dec-07	0.2	0.0	0.2	2.91	-2.73	5.64
	Jan-08	0.1	0.0	0.1	2.45	-2.78	5.23
	Feb-08	0.1	0.0	0.1	3.39	-1.73	5.12
	Mar-08	0.2	0.1	0.1	2.88	-1.99	4.87
	Apr-08	0.1	0.0	0.1	3.98	-1.89	5.87
	May-08	0.1	0.1	0.0	3.45	-2.78	6.23
P11	Jun-07	13.2	7.3	5.9	3.24	-2.69	5.93
	Jul-07	18.5	1.1	17.4	2.83	-3.29	6.12
	Aug-07	25.3	8.5	16.8	2.02	-3.04	5.06
	Sep-07	28.6	11.6	17.0	0.99	-4.91	5.90
	Oct-07	32.2	1.8	30.4	2.94	-2.82	5.76
	Nov-07	26.9	5.1	21.8	2.73	-3.34	6.07
	Dec-07	30.7	1.9	28.8	4.23	-3.50	7.73
	Jan-08	25.0	0.4	24.6	2.43	-3.43	5.86
	Feb-08	13.5	0.1	13.4	2.36	-3.17	5.53
	Mar-08	11.7	0.1	11.6	1.83	-2.74	4.57
	Apr-08	10.0	0.0	10.0	4.24	-3.00	7.24
	May-08	12.2	0.1	12.1	2.55	-3.03	5.58

Table 3.3A-1. (continued)

Site	Month	Salinity (ppt) Maximum	Salinity (ppt) Minimum	Salinity (ppt) Range	Water Level (ft) Maximum	Water Level (ft) Minimum	Water Level (ft) Range
P12	Jun-07	16.9	0.2	16.7	2.8	-2.45	5.25
	Jul-07	16.0	0.2	15.8	2.41	-2.76	5.17
	Aug-07	18.7	1.0	17.7	2.33	-2.75	5.08
	Sep-07	24.5	9.3	15.2	2.44	-2.83	5.27
	Oct-07	23.2	8.7	14.5	2.65	-2.48	5.13
	Nov-07	19.1	2.6	16.5	2.40	-3.45	5.85
	Dec-07	22.7	0.8	21.9	2.61	-3.86	6.47
	Jan-08	11.0	0.2	10.8	2.33	-3.67	6.00
	Feb-08	11.4	0.1	11.3	2.66	-3.16	5.82
	Mar-08	9.0	0.1	8.9	2.77	-3.22	5.99
	Apr-08	7.6	0.1	7.5	3.42	-2.64	6.06
	May-08	9.5	0.1	9.4	3.06	-3.86	6.92
P13	Jun-07	12.9	0.3	12.6	2.64	-1.92	4.56
	Jul-07	6.1	0.2	5.9	2.44	-1.99	4.43
	Aug-07	16.9	0.4	16.5	2.56	-1.89	4.45
	Sep-07	19.5	3.5	16.0	2.56	-2.36	4.92
	Oct-07	20.1	5.7	14.4	2.41	-1.95	4.36
	Nov-07	14.4	0.9	13.5	2.24	-3.01	5.25
	Dec-07	16.9	0.0	16.9	2.34	-3.09	5.43
	Jan-08	3.4	0.0	3.4	1.87	-3.07	4.94
	Feb-08	3.2	0.1	3.1	2.23	-2.86	5.09
	Mar-08	0.8	0.1	0.7	2.35	-2.85	5.20
	Apr-08	0.6	0.1	0.5	2.97	-2.50	5.47
	May-08	3.1	0.0	3.1	2.61	-3.09	5.70
P14	Jun-07	2.5	0.1	2.4	2.04	-1.45	3.49
	Jul-07	2.1	0.1	2.0	1.79	-1.57	3.36
	Aug-07	4.6	0.1	4.5	1.8	-1.7	3.50
	Sep-07	8.1	0.5	7.6	1.80	-1.40	3.20
	Oct-07	9.4	0.4	9.0	2.07	-1.50	3.57
	Nov-07	1.9	0.1	1.8	1.96	-2.39	4.35
	Dec-07	2.8	0.2	2.6	1.66	-2.86	4.52
	Jan-08	0.5	0.0	0.5	1.29	-2.96	4.25
	Feb-08	0.2	0.1	0.1	1.57	-2.49	4.06
	Mar-08	0.1	0.1	0.0	1.68	-2.25	3.93
	Apr-08	0.1	0.0	0.1	2.34	-2.20	4.54
	May-08	0.1	0.1	0.0	1.86	-2.08	3.94

Table 3.3A-2. Summary of statistical analyses of mean annual water level comparisons for each of the 11 DCP stations. Yearly mean tidal ranges were compared using Tukey-Kramer highest significant difference ($p<0.05$). Years with different letter superscripts were significantly different. Asterisks denote where significant differences occurred between this reporting period (2007-2008) and Year 1 (2000-2001). Ampersands denote where significant differences exist between this reporting period and the previous reporting period (2006-2007) as reported in Hackney et al. (2007). Note that the Year 1 reporting period only included the period of October to May and all subsequent periods have included a complete calendar year. No data (NA) were available for Year 1 for station P12.

Station	Significant	Effect (Year)
P1	*	1^a 7^b 8^b
P2	@	1^a 7^b 8^a
P3	*@	1^a 7^a 8^a
P4	@	1^a 7^b 8^a
P6		1^a 7^a 8^a
P7	*@	1^a 7^a 8^b
P8	*@	1^a 7^b 8^c
P9	*@	1^a 7^b 8^c
P11	*	1^a 7^{ab} 8^b
P12	@	NA 7^a 8^b
P13	@	1^a 7^b 8^a
P14	@	1^a 7^b 8^a

Table 3.3A-3. 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. Additional yearly comparisons are available in previous reports (Hackney et al. 2007; Hackney et al. 2006 etc.).

Station	Yr1/Yr8 Mean Monthly Maximum WL	Yr7/Yr8 Mean Monthly Maximum WL	Yr1/Yr8 Mean Monthly Minimum WL	Yr7/Yr8 Mean Monthly Minimum WL
P1	NS	NS	NS	NS
P2	*(0.0026)	*(0.0094)	*(0.0026)	NS
P3	NS	*(0.0179)	*(0.0166)	NS
P4	NS	NS	NS	NS
P6	NS	NS	NS	NS
P7	NS	*(0.0282)	*(0.0034)	*(0.0261)
P8	NS	NS	NS	NS
P9	*(0.0308)	NS	*(0.0087)	NS
P11	NS	*(0.0377)	NS	NS
P12	N/A	NS	N/A	NS
P13	*(0.0307)	*(0.0376)	NS	NS
P14	NS	*(0.0013)	NS	NS

Tidal lags were determined by measuring the difference in time for high (or low) tide at 2 different stations as described in Hackney et al. (2001). 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 3.3A-4. During this reporting period, both the high tide and low tide lag values were comparable to those reported in 2006-2007. The greatest difference between years occurred at station P2 where the mean high tide lag increased by 0.15 hr. Stations P9 and P14, the two most upstream stations in each branch; also experienced increases in mean high tide lag (0.14 hr). During this reporting period, the mean flood duration and the mean ebb duration varied little (< 0.25 %) from the previous reporting period (Table 3.3A-4). For the changes that were observed, flood durations increased at almost all stations whereas ebb duration tended to decrease at upstream stations and decrease or remain unchanged lower in the estuary. These results are the opposite of those observed in 2006-2007 and may suggest conditions more similar to those in the 2005-2006 reporting period (Hackney et al. 2006).

Table 3.3A-4. 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 (Hackney et al. 2007). 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 for the previous reporting period 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) ('06-'07 lag time)	Mean Low Tide Lag From P1 (hr) ('06-'07 lag time)
P1	4.19 ± 21.27%	6.32 (+0.02)	6.01 (-0.11)	N/A	N/A
P2	4.27 ± 16.11%	5.71 (+0.08)	6.66 (-0.07)	1.50 (1.35)	1.88 (1.88)
P3	2.89 ± 14.42%	6.41 (+0.08)	5.98 (-0.10)	2.98 (2.98)	2.85 (2.93)
P4	4.39 ± 15.67%	5.75 (+0.09)	6.65 (-0.08)	1.65 (1.55)	2.20 (2.18)
P6	4.28 ± 15.01%	5.96 (+0.16)	6.43 (-0.15)	2.18 (2.07)	2.52 (2.53)
P7	3.84 ± 13.67%	5.88 (+0.13)	6.48 (+0.10)	2.77 (2.62)	3.15 (3.08)
P8	3.53 ± 14.31%	5.93 (+0.15)	6.48 (-0.15)	3.05 (2.97)	3.41 (3.48)
P9	3.26 ± 15.63%	5.90 (+0.12)	6.50 (-0.13)	3.46 (3.32)	3.87 (3.86)
P11	4.20 ± 14.76%	6.00 (+0.22)	6.40 (-0.21)	2.18 (2.12)	2.61 (2.62)
P12	3.78 ± 14.37%	5.92 (+0.12)	6.48 (-0.12)	2.55 (2.45)	2.95 (2.93)
P13	3.22 ± 14.80%	5.93 (+0.12)	6.47 (-0.11)	3.07 (2.98)	3.43 (3.45)
P14	2.35 ± 17.66%	5.98 (+0.10)	6.43 (-0.15)	4.15 (4.01)	4.47 (4.52)

Statistical differences between tidal range values for upstream stations, before versus after channel deepening for specified tidal changes at the river mouth (P1) comprise one key approach to determining if the project has resulted in detectable changes in tidal range upstream. One assumption of this approach is that the tidal range at the base station at Ft Caswell (P1) is in equilibrium with open ocean tides and not subject to changes associated with dredging activities. To verify this condition, the observed tidal range at P1 for each reporting period is regressed against the predicted (astronomical) range. Analysis of Covariance (ANCOVA) is then used to determine if significant differences exist between the each yearly regression (i.e. slope). The tidal ranges observed at each upstream station are then regressed on the corresponding tidal range for P1. Comparisons of the resultant regression slopes are then conducted between subsequent reporting periods using ANCOVA ($p<0.05$). These results are shown in Table 3.3A-5.

Table 3.3A-5. Summary of statistical tests for yearly data collected at the 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 given. N/A indicates insufficient data to complete analyses.

Station	Y1/Y8 Regression Slope	Y7/Y8 Regression Slope

P2	* (<0.0001)	* (0.0020)
P3	*(0.0244)	* (0.0003)
P4	* (<0.0001)	* (<0.0001)
P6	* (<0.0001)	* (<0.0001)
P7	* (<0.0001)	* (0.0033)
P8	* (<0.0001)	* (0.0002)
P9	* (0.0006)	* (<0.0001)
P11	* (<0.0001)	* (<0.0001)
P12	N/A	* (<0.0001)
P13	* (0.0078)	* (<0.0001)
P14	NS	* (0.0003)

3.4A 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.

3.41A 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 3.41A-1). When observed tidal ranges are regressed against the predicted tidal ranges, the r^2 value is similar to those documented in previous reports. The mean tidal range at P1 was not significantly different from the mean reported in the previous monitoring period, but was significantly lower than the range reported in Year 1 Table 3.3-2. There was no significant difference in either the mean monthly maximum or minimum water levels relative to last year's reporting period or relative to Year 1 Table 3.3-5. The mean tidal range at the Outer Town Creek (P2) site was significantly lower from means reported in 2006-2007. The mean tidal range at P2 was not significantly different from the mean reported in Year 1. As seen in Figure 3.41A-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 different from the slope reported during the 2006-2007 reporting period

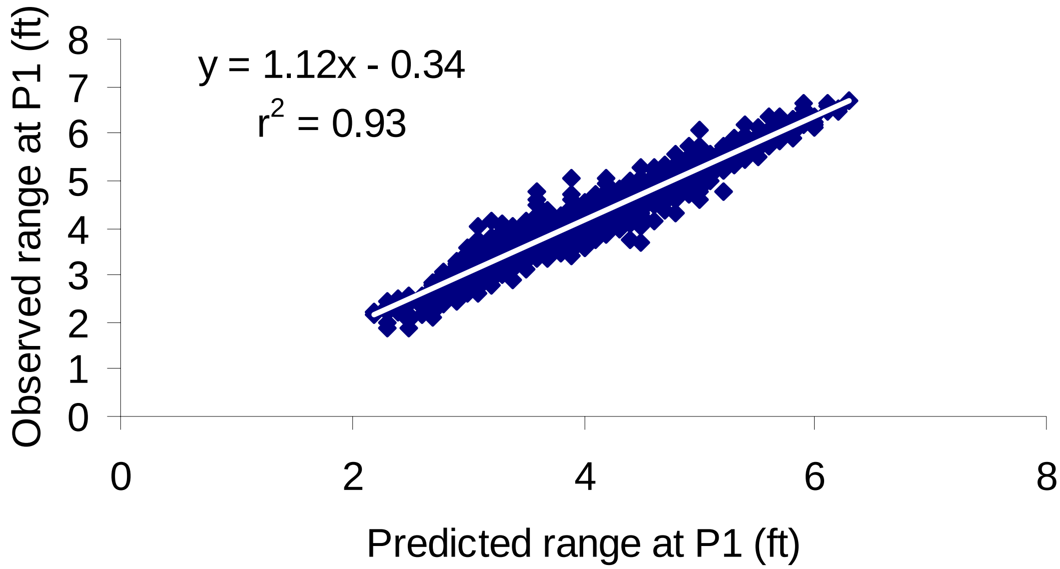


Figure 3.41A-1. Plot of predicted tidal range at P1 relative to measured tidal range at P1 for June 2007 to May 2008.

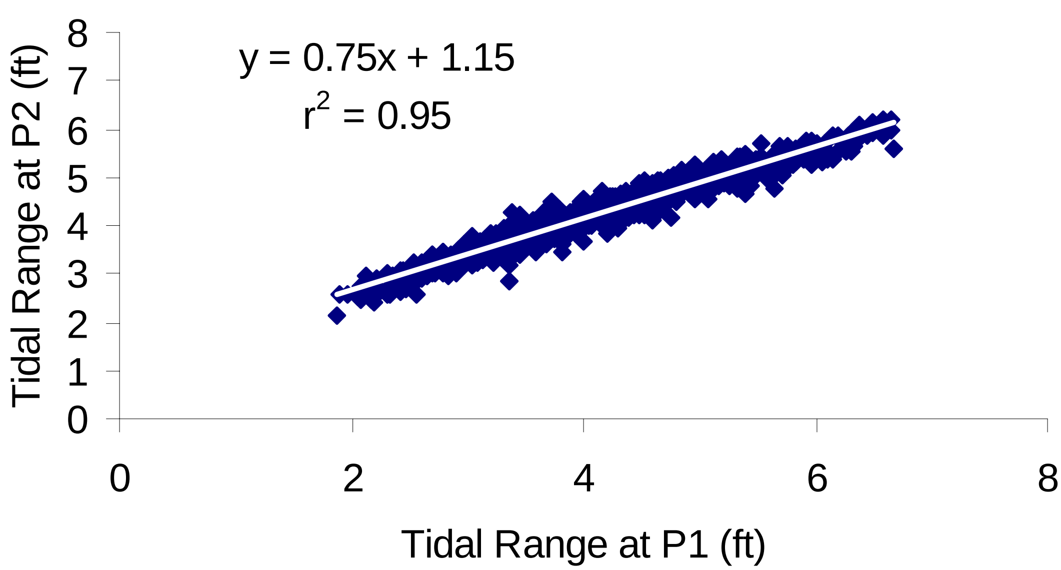


Figure 3.41A-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Outer Town Creek (P2).

(Year 1 Table 3.3-5). The slope measured during this reporting period at P2 also was significantly different from the slope measured in the first monitoring period ($p<0.0001$) at the $p<0.05$ significance level. Although tidal fluctuations at this station are impacted by factors such as drought and flooding, P2 was not appreciably affected by climatological events this year as evidenced by the low range in water level variability ($r^2 = 0.95$).

The water level curve at P1 continues to show less evidence of the time asymmetries measured at other stations as evidenced by the unequal flood and ebb durations shown in Table 3.3A-3. These asymmetries begin at site P2 and continue up river to all monitoring sites. Neither the duration of flooding nor ebbing tide at P2 reported for this reporting period changed relative to the duration reported in 2006-2007. The mean high tide lag increased slightly since the last reporting period; however, the mean low tide lag has not changed.

3.42A Inner Town Creek (P3)

The mean tidal range observed at P3 during this reporting period was approximately 1.4 feet less than the tidal range observed at the creek mouth (Table 3.3A-4) and lower than the mean tidal ranges of all other sites except P14. This result is consistent with the results of the previous 3 reporting periods. The mean tidal range from June 2007 to May 2008 was significantly higher than the mean tidal range reported for the previous reporting period and for Year 1 (Figure 3.42A-1). The duration of mean flood increased slightly this reporting period whereas the mean ebb duration decreased slightly relative to the previous reporting period (Table 3.3A-4). There was no significant difference in either mean monthly maximum water level compared to Year 1 or the mean monthly minimum water level compared to the previous reporting period. The mean monthly maximum water level was significantly different from that reported in 2006-2007 as was the mean monthly minimum water level when compared to Year 1 (Table 3.3A-3).

The correlation between tides at P3 and P1 this year was much higher than the values reported in 2006 – 2007 ($r^2 < 0.22$). The slope of the P1 versus P3 regression for this monitoring period was significantly different from the slope reported in 2006-2007 and significantly different from the slope reported for Year 1 (Table 3.3A-5).

3.43A Corps Yard (P4)

The mean tidal range observed at P4 is considerably higher than the mean tidal range at the P1 base station (Figure 3.43A-1). The mean tidal range during this reporting period was significantly lower than the mean reported for 2006-2007, but not significantly different from the mean reported in Year 1 (Hackney et al. 2001). The slope (0.73) of the P1/P4 regression was significantly greater than the slope reported for the first monitoring period (Table 3.3A-3), as well as significantly different from the slope reported last year (0.71). Water level curves generated for P4 continue to show a slight

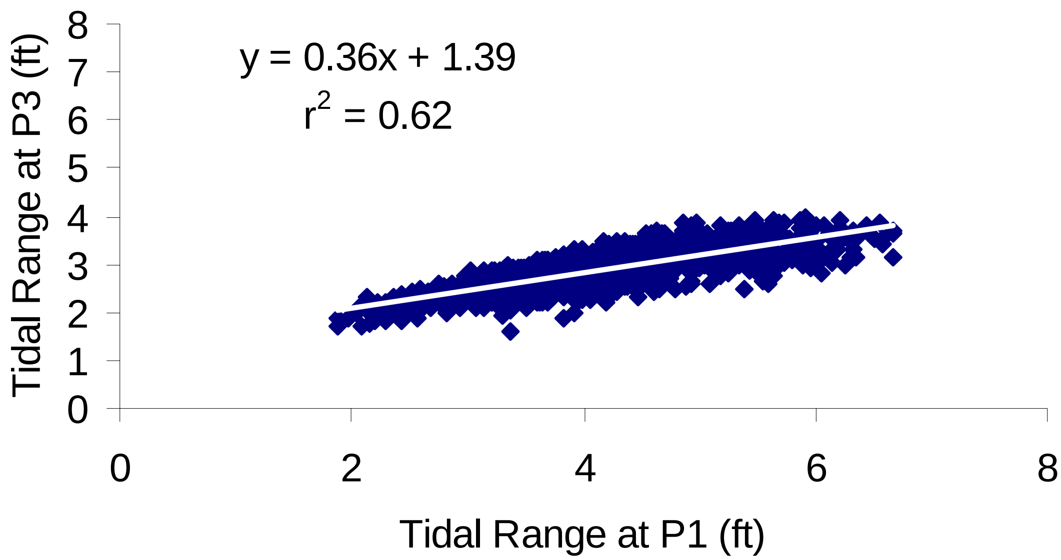


Figure 3.42A-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Inner Town Creek (P3).

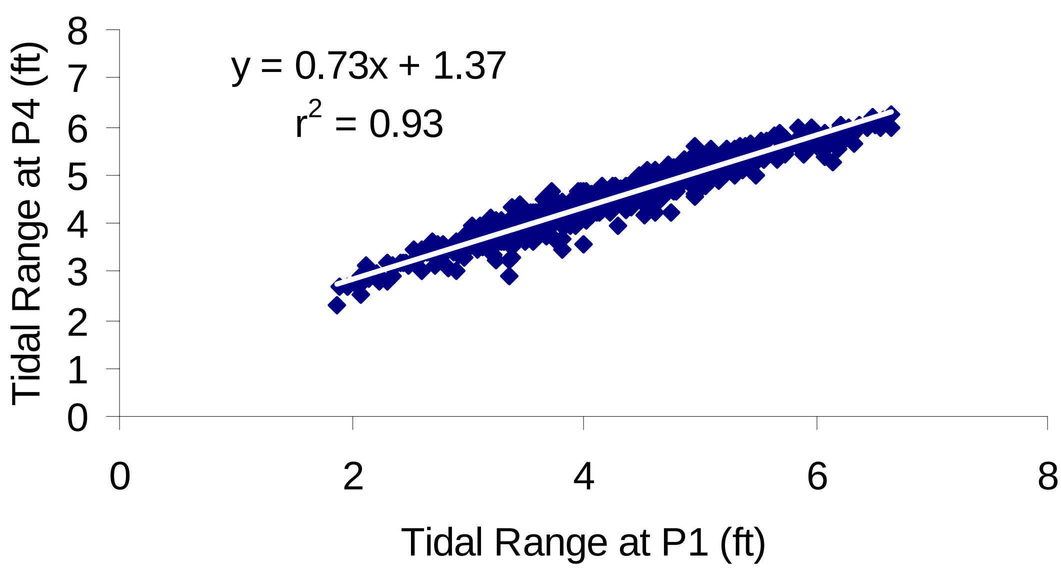


Figure 3.43A-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and the Corps Yard station (P4).

time asymmetry that does not occur at P1. The mean ebb and flood durations, 6.65 and 5.75 hours, respectively, are comparable to those reported previously. These durations have changed by less than 0.1% since the previous reporting period. The mean low tide lag has increased by 6 minutes since the last reporting period; however, the mean high tide lag has increased only slightly (Table 3.3A-4). Mean maximum and minimum water levels at this station are not significantly different from those reported in 2006-2007 or Year 1 (Table 3.3A-3). Water levels at the Corps yard continue to be impacted by changes in river discharge, but to a much lesser degree than stations further upstream.

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

With the exception of P6, mean tidal ranges computed for mainstem river sites were lower than the mean determined for P1. Consistent with previous years, tidal range decreased with distance upriver (Table 3.3A-4) with P9 exhibiting the lowest tidal range of these sites. With the exception of P6, the mean tidal range for this reporting period was significantly higher than the mean reported in 2006-2007 (Table 3.3A-2). The mean tidal ranges for this reporting period also were significantly higher than the means reported for these sites in Year 1 (Table 3.3A-2). There were no significant differences in mean monthly maximum or mean monthly minimum water level between this reporting period and 2006-2007 and this period and Year 1 at sites P6 and P8. At P7, the only non-significant result was the comparison between mean monthly maximum water level during this reporting period and Year 1. At site 9, there were no differences in the maximum and minimum water levels between this year and the previous reporting period. However, both the mean monthly maximum and minimum water levels were significantly different when compared to Year 1 (Table 3.3A-3).

Figures 3.44A-1, 3.44A-2, 3.44A-3, and 3.44A-4 illustrate the relationship between tidal range at these Cape Fear River sites and tidal range at Ft Caswell (P1). In general, tidal range at each upriver site is positively correlated with tidal range at the mouth. During this reporting period, the r^2 values were higher than those reported in 2006-2007. This pattern likely reflects fewer periods of increased precipitation and generally lower discharge (Figure 3.5A-1). Comparisons of the regression slopes between this reporting period and Year 7 were significantly different at all of the mainstem sites (Table 3.3A-5). This result is consistent with last year's report (Hackney et al. 2007). In contrast to the last reporting period, all regression slopes for this reporting period were significantly different from Year 1 (Table 3.3A-5).

The mainstem upriver sites continue to exhibit pronounced time asymmetries as described in previous reports (e.g. Hackney et al. 2001, 2002, etc). In general, mean flood duration is less than mean ebb duration. The duration of flooding tide at these stations has increased very slightly (by less than 0.2 %), since the last reporting period (Table 3.3A-4). This increase is consistent with that reported by Hackney et al. (2007). The duration of ebb tide also changed very little during this reporting period (also less than 0.2%). With the exception of P7, the duration of ebb tide decreased, *albeit* minimally, at all stations. At station P7, the duration of ebb tide increased by 0.10%. The mean high tide lag from P1 increased slightly at all stations relative to the 2006-2007 reporting period. Changes in mean low tide lag relative to the previous reporting period were either very minimal or non-existent (Table 3.3A-4).

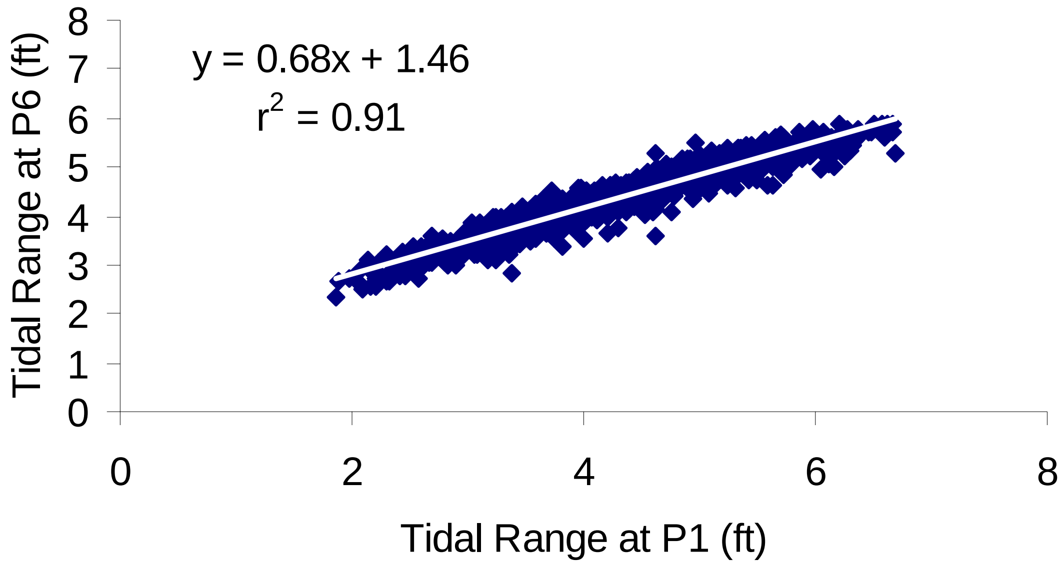


Figure 3.44A-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Eagle Island (P6).

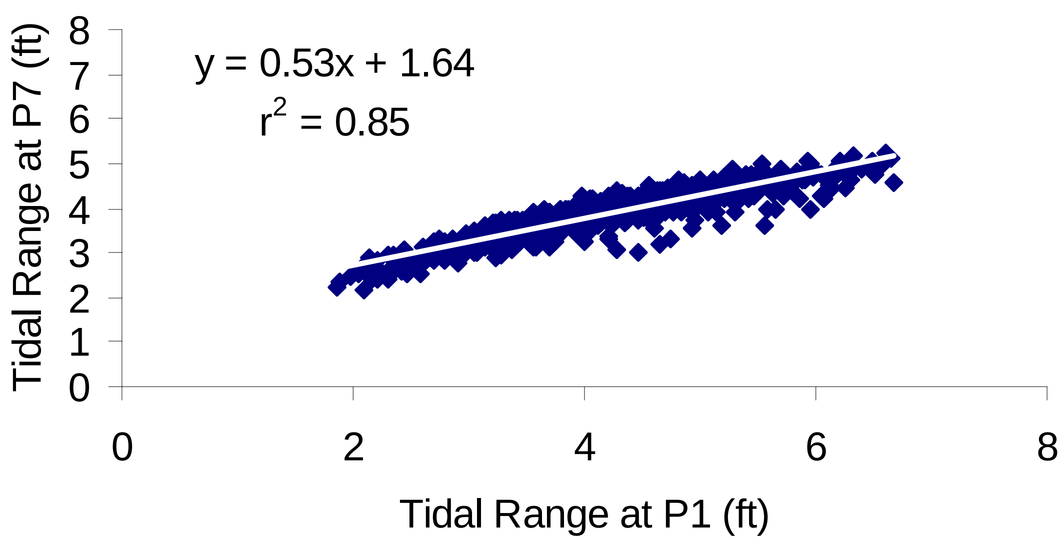


Figure 3.44A-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Indian Creek (P7).

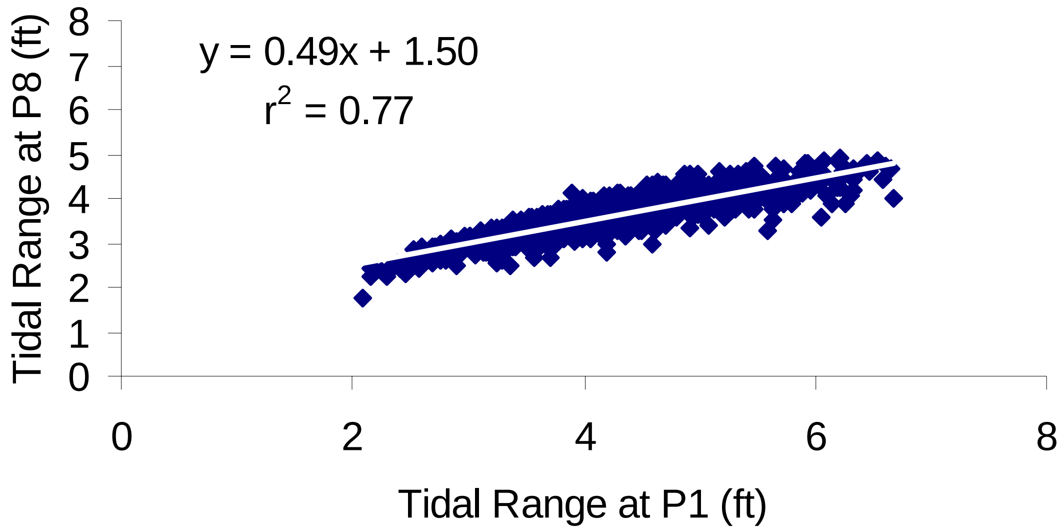


Figure 3.44A-3. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Dollisons Landing (P8).

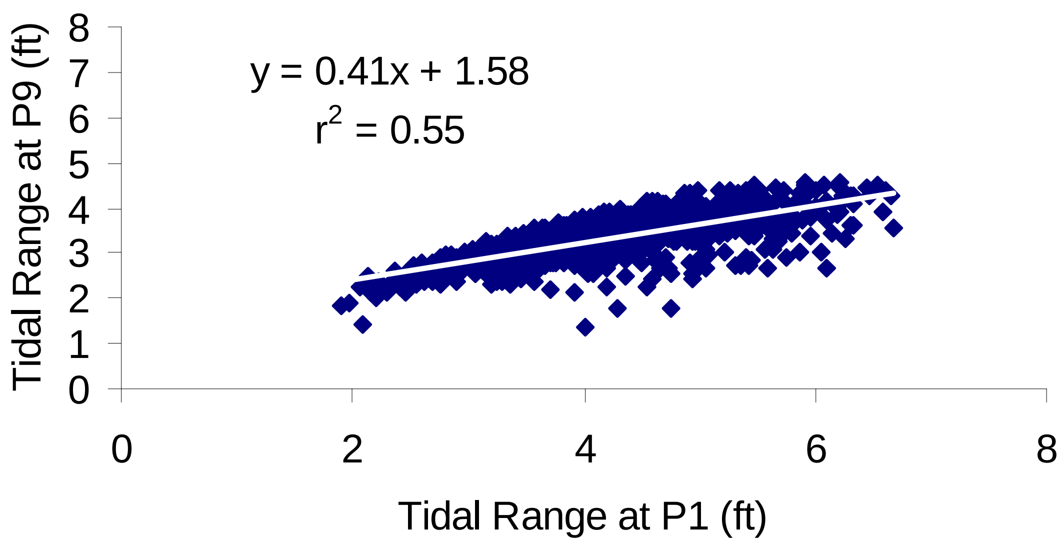


Figure 3.44A-4. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Black River (P9).

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

The mean tidal ranges computed for northeast Cape Fear sites over the current reporting period were significantly different from those reported in 2006-2007 at all sites (Table 3.3A-2). At sites P13 and P14, there was no difference in mean tidal range between this reporting period and Year 1. A similar comparison is unavailable for site P12 due to an incomplete data set at that station during the first year of monitoring (see Hackney et al. 2001). These results are different from those reported by Hackney et al. 2007 and may reflect discharge variability in the river. Although discharge data are no longer publically available for the Northeast Cape Fear, discharge on the Cape Fear mainstem decreased during this reporting period; falling again below the 30-year average (Figure 3.5A-1). Mean tidal ranges for all of the Northeast Cape Fear River stations decrease upstream and continue to be lower than the mean determined for P1 with the exception of station P11 which was slightly higher (0.01 ft) than station P1 (Table 3.3A-4). There were no significant differences in the mean monthly minimum water levels reported during this period and the 2006-2007 values or the Year 1 value (Table 3.3A-3). The mean monthly maximum water levels at all sites were significantly different from those reported in 2006-2007. When compared to Year 1 values, the only difference detected occurred at P13 (no Year 1 data are available for such a comparison at P12; see Hackney et al. 2001). All of the sites in the Northeast Cape Fear River continue to exhibit time asymmetries. Mean flood durations are shorter than ebb durations and show little variability among the sites (Table 3.3A-4). During this monitoring period, mean flood duration increased slightly relative to the previous reporting period. Mean ebb durations decreased slightly (<0.25%) at all stations during this reporting period (Table 3.3A-4).

Tidal ranges at upstream stations in the Northeast Cape Fear are positively correlated with the tidal range at P1 (Figures 3.45A-1, 3.45A-2, 3.45A-3, and 3.45-4). The mean tidal range at P14 on the Northeast Cape Fear River continues to be less than the mean range measured at P9, 12 mi from convergence on the Cape Fear River. Consistent with previous reports, 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 continue to be impacted strongly by other types of events; especially increased rainfall and upriver discharge as suggested by the lower r^2 values for the most upstream stations (Figures 3.45A-3 and 3.45A-4). Comparisons of the regression slopes between this reporting period and last year yielded significant differences at all sites. With the exception of the most upstream site (P14), significant differences in slope also were detected when this reporting period was compared to Year 1 (Table 3.3A-4). As noted earlier and in previous reports, no Year 1 data were available for P12 with which to make a similar comparison.

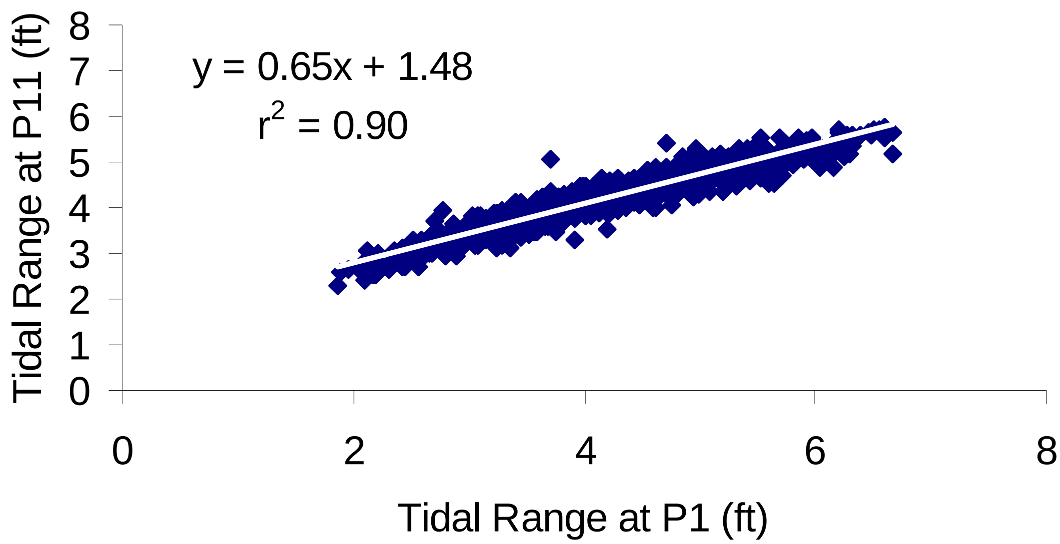


Figure 3.45A-1. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Smith Creek (P11).

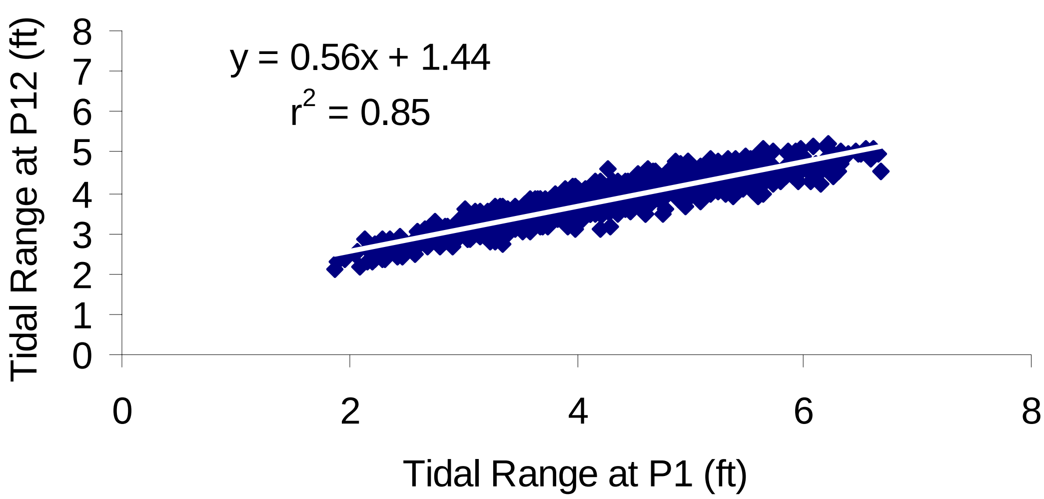


Figure 3.45A-2. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Smith Creek (P12).

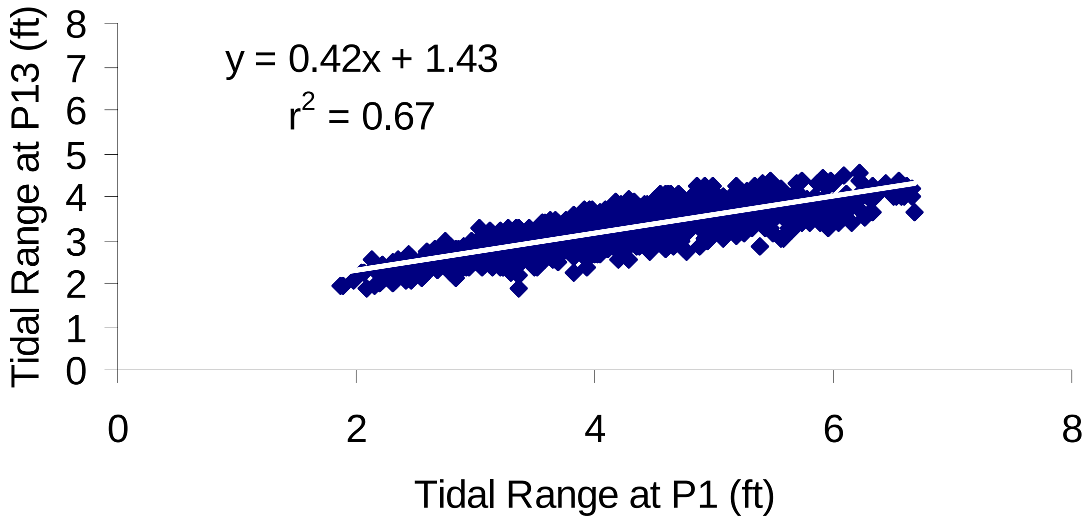


Figure 3.45A-3. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Fishing Creek (P13).

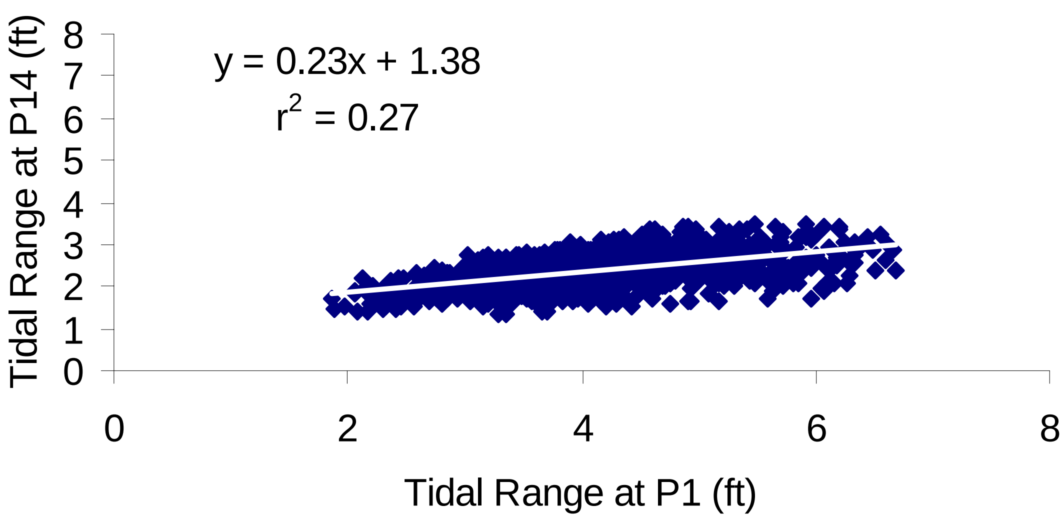


Figure 3.45A-4. Plot showing relationship between tidal ranges observed at Ft Caswell (P1) and Prince George Creek (P14).

3.5A Influence of Upstream Flow

Periods of lower, drought-induced water levels and extreme flooding in the system over the last 5 years have contributed to differing tidal conditions in the Cape Fear and Northeast Cape Fear Rivers between monitoring years. These effects are confounded by the shortened data set for Year 1 which included data collected from October to June, only, and covered a period when monthly river discharge was below the long-term average (~5,531 ft^3/s) reported by the USGS at Lock and Dam 1 on the Cape Fear mainstem (Figure 3.5A-1). Interpretations related to discharge are also complicated by the fact that the discharge time series for the Northeast Cape Fear River is no longer available. As noted in Hackney et al. (2006), streamflow data collection at this station was only funded for a short term project. As previously reported, we strongly encourage the Corps to pursue a dialog with the USGS to ensure that discharge data are available in the future. During this reporting period, the mean discharge in the Cape Fear mainstem was again lower than the 30-year average. The mean discharge for this reporting period is similar to the mean discharge reported for 2005-2006. This similarity in discharge may account for the greater similarity in mean tidal ranges between this reporting period and 2005-2006 than between this reporting period and the last at most upstream stations (Table 3.5A-1).

Table 3.5A-1. Mean tidal ranges for upriver stations in both the Cape Fear River and Northeast Cape Fear River for this reporting period as well as 2005-2006 and 2006-2007.

Station Number	Mean Tidal Range (ft) This period	Mean Tidal Range (ft) 2005-2006	Mean Tidal Range (ft) 2006-2007
P6	4.28 ± 15.01%	4.22 ± 13.92%	4.29 ± 15.00%
P7	3.84 ± 13.67%	3.84 ± 14.05%	3.72 ± 16.53%
P8	3.53 ± 14.31%	3.46 ± 15.22%	3.21 ± 22.42%
P9	3.26 ± 15.63%	3.21 ± 15.89%	2.93 ± 24.35%
P11	4.20 ± 14.76%	4.21 ± 14.32%	4.17 ± 15.91%
P12	3.78 ± 14.37%	3.75 ± 14.53%	3.72 ± 14.46%
P13	3.22 ± 14.80%	3.18 ± 14.92%	3.13 ± 15.85%
P14	2.35 ± 17.66%	2.31 ± 18.18%	2.24 ± 20.06%

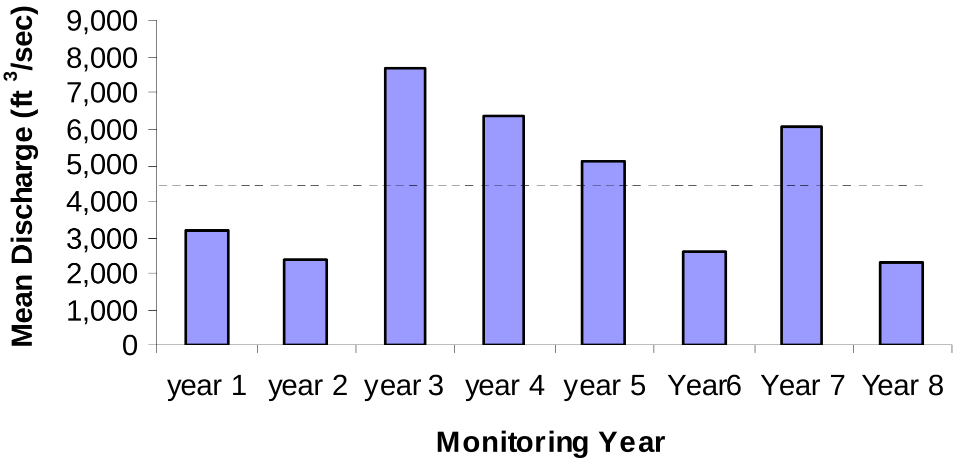


Figure 3.5A-1. Mean discharge for each monitoring period. Monitoring Year 1 is October 2000 to May 2001; monitoring Year 2 in June 2001 to May 2002; monitoring Year 3 is June 2002 to May 2003; monitoring Year 4 is June 2003 to May 2004; monitoring Year 5 is June 2004 to May 2005; monitoring Year 6 is June 2005 to May 2006; and monitoring Year 7 is June 2006 to May 2007. The line denotes the long-term mean discharge for the Cape Fear River as measured at Lock 1 by a USGS gauging station.

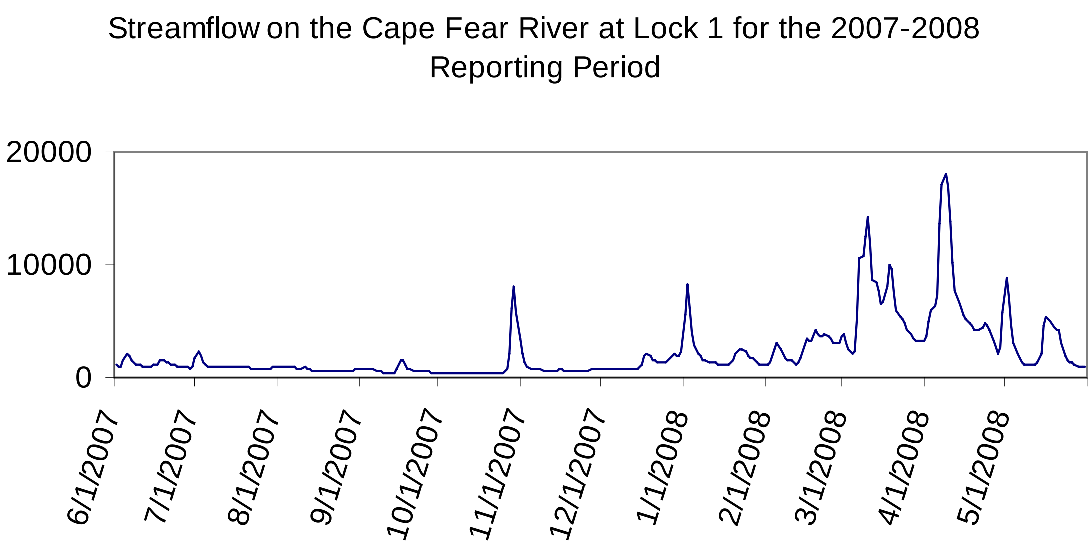


Figure 3.5A-2. Plot showing discharge in the Cape Fear River at Lock 1 for the current monitoring period. Data available at http://nwis.waterdata.usgs.gov/nc/nwis site number 02105769.

3.6A Tidal Harmonics

Because tides are resonance phenomena, any changes in cross sectional area will affect propagation frequency such that some harmonic components may be altered to a greater or lesser degree. In the CFR, it is anticipated that the tidal amplitudes and phases of the six primary harmonics, as monitored and defined by the National Ocean Service of the National Oceanic and Atmospheric Administration, will change after dredging. By focusing on the primary harmonics for the Lower Cape Fear, we are attempting to resolve differences in water levels resulting from tides versus upstream inputs.

A classical tidal harmonics analysis was performed 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. Constituents were considered significant if the signal-to-noise ratio was greater than 1. As expected the M2 component is the dominant constituent at every station. This result is consistent with previous reporting periods. 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 once dredging is complete. Table 3.6A-1 is a summary of tidal harmonics for reporting period 2007-2008. Table 3.6A-2 shows yearly tidal harmonics for station P4 in 2007 and Figure 3.6A-1 shows the tidal amplitude for years 1994 to present. Station P4 was selected because water level time series data were available for several years prior to the initiation of dredging activities and because harmonic constituents have been well-established. T-tide was used to determine the phase and amplitude of the dominant tidal constituents by year. While the relative dominance of the lesser constituents varied among years, the M2 component was the dominant constituent every year. Neither the amplitude nor the phase of the M2 constituent has changed appreciably over the years examined. For the most part, the amplitude has varied between 2.03 and 2.09. Higher amplitudes were noted in 1997 (pre-dredging) and in 2003 and 2004 (during dredging modifications). Lower amplitudes occurred in 1994, 1995 and 1998 (prior to dredging activities) and again in 2001 and 2002 after dredging had been initiated. There does not appear to be a consistent pattern in amplitude change over the 11 year period examined. The amplitude of the M2 constituent for the current reporting period is lower than last year, but this difference is not significant. Changes in harmonic amplitude may be more closely linked to variations in discharge than dredging activities. As expected, the M2 amplitude at sites P2, P6 and P11 (sites just upstream and downstream of P4) are more similar to the P4 M2 amplitude than other monitoring sites.

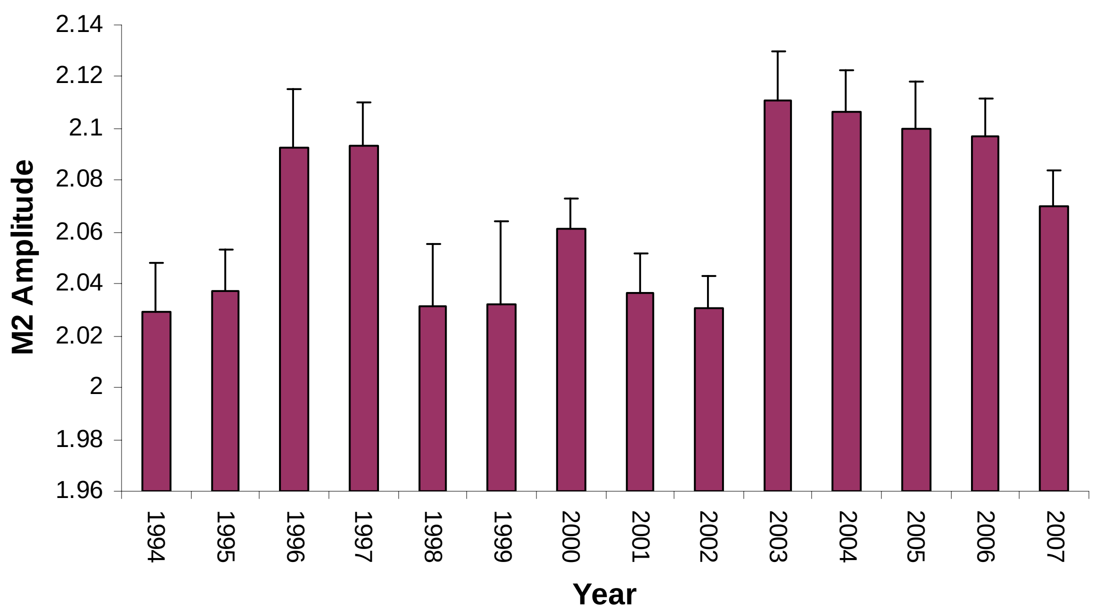
Table 3.6A-1. Summary of tidal harmonics for reporting period 2007-2008. Errors shown represent the standard error association with each respective data set.

site	tide	amp	amp_err	pha	pha_err
P01	M2	1.9939	0.078	215.21	2.17
	K1	0.4254	0.022	124.27	3.23
	N2	0.3712	0.078	201.34	11.29
	O1	0.2588	0.024	128.26	5.44
	S2	0.2207	0.08	238.43	19.92
P02	M2	2.0096	0.024	265.96	0.7
	K1	0.4019	0.026	152.47	4.04
	N2	0.3238	0.027	252.98	4.33
	O1	0.2535	0.029	157.89	6.14
	S2	0.2166	0.026	312.65	7.56
P03	M2	1.2277	0.069	20.57	2.63
	K1	0.2682	0.028	196.88	6.02
	O1	0.1965	0.027	252.54	7.78
	N2	0.1617	0.064	32.84	21.88
	M4	0.1403	0.02	237.92	6.83
P06	M2	2.0069	0.026	279.29	0.73
	K1	0.4012	0.023	160.94	3.87
	N2	0.3065	0.023	268.51	5.22
	O1	0.2475	0.03	170.94	6.79
	S2	0.207	0.027	328.73	6.16
P07	M2	1.7842	0.1	272.93	3.87
	K1	0.3633	0.026	162.03	4.2
	N2	0.2696	0.112	271.49	21.18
	O1	0.24	0.026	169.73	7.01
	S2	0.1641	0.098	326.31	36.71
P08	M2	1.6207	0.022	302.89	0.74
	K1	0.346	0.028	177.27	4.03
	O1	0.2273	0.025	188.23	7.01
	N2	0.2184	0.025	290.68	5.66
	S2	0.126	0.02	358.45	8.85
P09	M2	1.4795	0.027	310.91	0.89
	K1	0.322	0.032	186.08	6.22
	O1	0.2197	0.031	193.37	8.56
	N2	0.1856	0.026	306.52	7.08
	S2	0.1157	0.025	8.11	11.73
P11	M2	1.961	0.023	280.74	0.78
	K1	0.3692	0.04	162.32	5.79
	N2	0.297	0.026	270.56	4.35
	O1	0.2421	0.038	167.29	7.62
	S2	0.1994	0.023	333.67	6.88
P12	M2	1.7375	0.023	289.64	0.75
	K1	0.3468	0.026	169.85	3.89
	N2	0.2515	0.021	279.24	4.83
	O1	0.2278	0.026	178.43	6.6
	S2	0.1692	0.021	341.4	8.23
P13	M2	1.2331	0.257	321.24	11.24
	K1	0.2949	0.044	180.41	8.14
	S2	0.2084	0.251	354.19	73.15
	O1	0.1881	0.039	213.47	13.69
	N2	0.0816	0.188	356.32	146.49
P14	M2	0.9771	0.023	325.15	1.42
	K1	0.2374	0.021	205.3	5.04
	O1	0.1796	0.02	214.62	6.39
	N2	0.1067	0.023	328.29	12.5
	S2	0.067	0.023	22.01	19.36

Table 3.6A-2 Summary of yearly tidal harmonics for station P4 in 2007. Errors shown represent the standard error association with each respective data set. Data from previous years are available in Hackney et al. (2007).

year	tide	amp	amp_err	pha	pha_err
2007	M2	2.07	0.014	274.22	0.44
	N2	0.4132	0.014	263.32	1.99
	K1	0.3104	0.02	148.45	3.61
	S2	0.2817	0.014	305.37	3.08
	O1	0.2394	0.019	163.63	4.33

Figure 3.6A-1. Plot of the amplitude of the M2 tidal constituent at station P4 from 1994 to present. Error bars represent the amplitude error.



PART B – SALINITY PROFILES IN THE CAPE FEAR RIVER TO LOCK AND DAM 1

3.1B Summary

During the annual reporting period twelve cruises were conducted to monitor vertical salinity profiles from the surface to a maximum depth, at twelve locations on the main stem of the Cape Fear River (Figure 3.2B-1). Stream flow on the Cape Fear River at Lock and Dam 1 ranged from 283 cfs to 18,200 cfs between 1 June 2007 and 30 May 2008 (Figure 3.5A-2). The highest flow rate during a river cruise averaged 8,920 cfs, in May and no saline water was detected during that cruise (Appendix C). The lowest flow rate over Lock and Dam 1 during a river cruise was 334 cfs recorded in October. During this cruise, salinity was measured at P7 (site 1) ranging from 9.8 ppt at the surface increasing to 11.2 ppt at maximum depth (Figure 3.1B-1). Salinity was detected upstream at site 2 but less than 1 ppt. No salinity was observed at site 3 during this low flow rate cruise. This low flow rate is reflected by the higher salinities seen at sites closest to the ocean (Figure 3.1B-1).

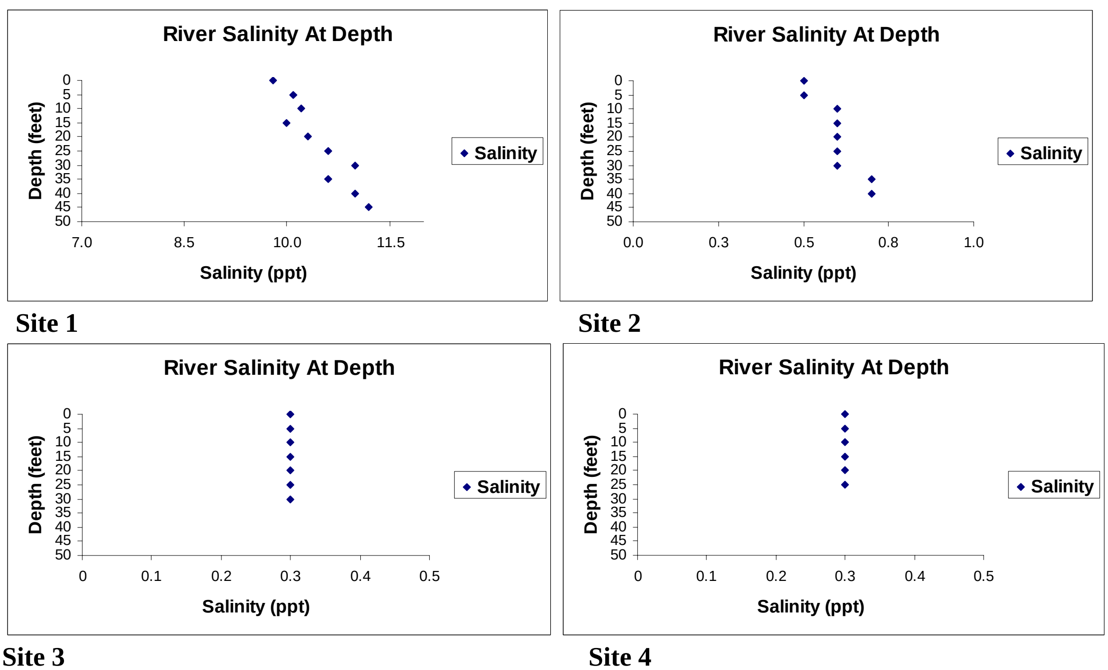
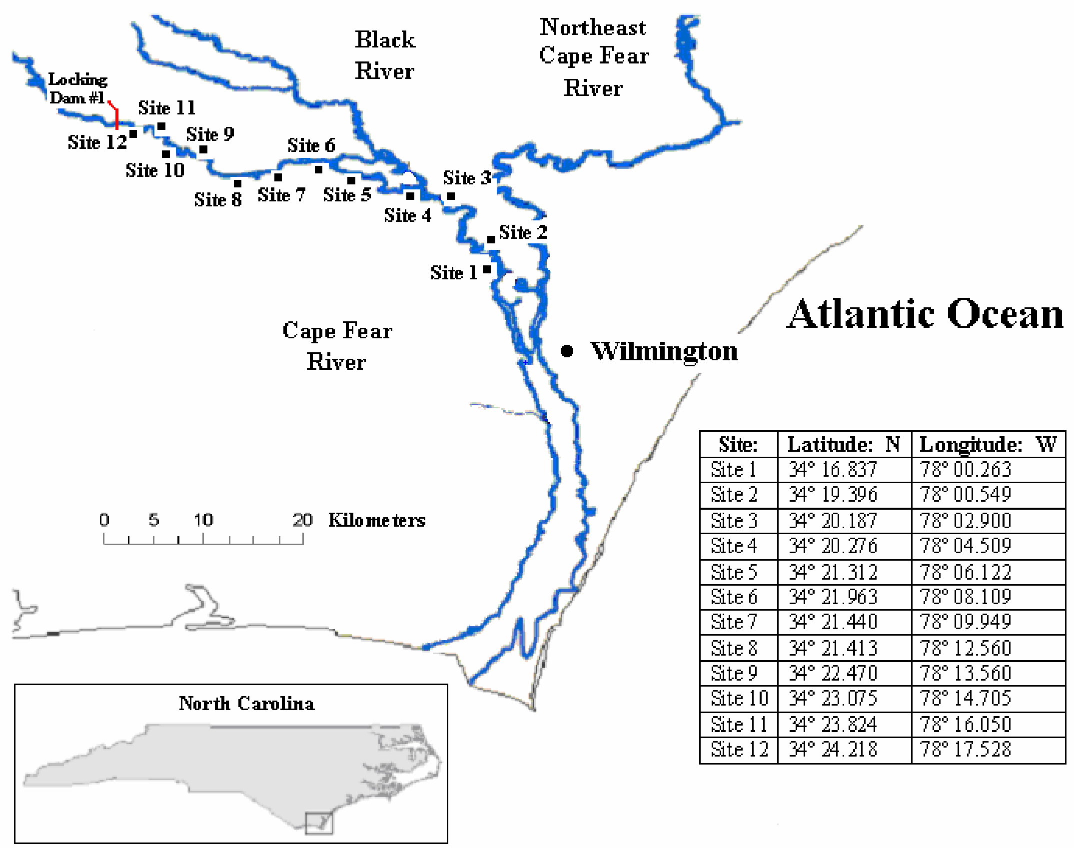


Figure 3.1B-1. River cruise salinity data at Sites 1 through 4, those that are closest to the ocean, during period of lowest stream flow over Lock and Dam 1. Data collected October 2007.

3.2B Methods

Each cruise began on or close to high tide and followed the high tide as it proceeded upstream. Water characteristics were measured at 12 collection sites starting at the surface, continuing at 5- foot depth intervals until 45 ft or the bottom was reached

(Figure 3.2B-1). Data were collected using an YSI 85 equipped with a 50 ft cable and multi-parameter probe measuring dissolved oxygen, temperature, conductivity, and salinity. The multi-parameter instrument was calibrated prior to the beginning of each sampling day. Water samples were taken with a Van Dorn water bottle at the surface and lowest 5-foot increment possible, at Site 1 and the last site sampled. If a change of conductivity was observed that might indicate ocean-derived salt water another collection was made. Immediately after collection, the samples were capped and placed on ice. In the lab, samples were added to a 20 ml serum vial (1:10 Milli Q water dilution). Samples were analyzed on a DX–1500 chromatograph (calibrated using a Dionex seven anion standard) for both chloride and sodium. Milli Q water was run through the chromatograph as a control. The ratio of chloride to sodium is constant and expected in samples where an increase in conductivity was caused by ocean derived salt water.



Site:	Latitude: N	Longitude: W
Site 1	34° 16.837	78° 00.263
Site 2	34° 19.396	78° 00.549
Site 3	34° 20.187	78° 02.900
Site 4	34° 20.276	78° 04.509
Site 5	34° 21.312	78° 06.122
Site 6	34° 21.963	78° 08.109
Site 7	34° 21.440	78° 09.949
Site 8	34° 21.413	78° 12.560
Site 9	34° 22.470	78° 13.560
Site 10	34° 23.075	78° 14.705
Site 11	34° 23.824	78° 16.050
Site 12	34° 24.218	78° 17.528

Figure 3.2B-1. Location of salinity depth sampling stations.

3.3B Results

During the annual reporting period a total of twelve salinity profile detection cruises were conducted. Cruises deployed Mid-July through December detected ocean derived saline water, albeit dilute, ranging from 2.3 to 15.4 parts per thousand. High salinities detected during these cruises coincided with unusually low flow rates (below 1000cfs) over Lock and Dam1 (Figure 3.3B-1). Ocean derived salt water was not observed past station 2 during low stream flow cruises. The months of June 2007 and January through May 2008 flow rates increased to average flows (above 1000 cfs). During this time the natural fresh water flow regime was observed and no ocean derived salt water was found at any station during cruises. Additional data can be found in Appendices B and C.

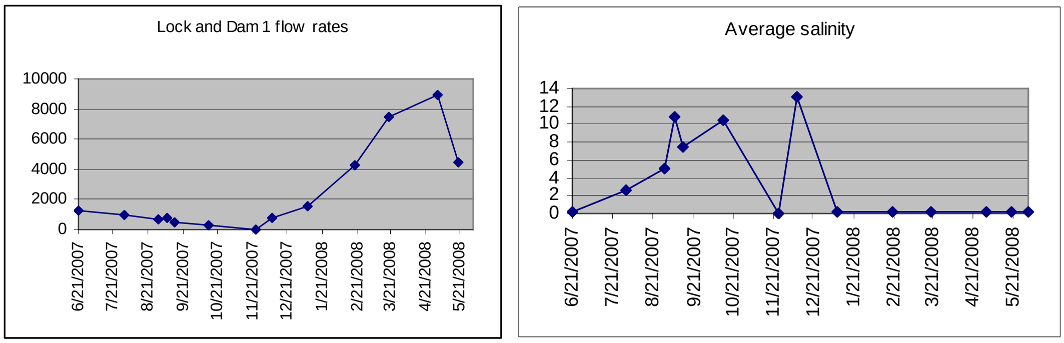


Figure 3.3B-1. Lock and Dam 1 flow rates (cfs) and salinities (ppt) during cruise collections. (There was no sample collection in November while waiting for USACE approval for additional cruises)

4.0 MARSH/SWAMP FLOOD AND SALINITY LEVELS

4.1 Summary

There were some marked differences in flooding frequency at a number of upstream stations. Significant differences (see Section 3) in tidal ranges occurred in 2006-2007 compared to both the previous reporting year and the initial year (2000-2001). Most of these differences occurred at upstream stations .

4.2 Data Base

Flood data collections went smoothly this reporting year with only a few exceptions, P6 (Eagle Island) and P11 (Smith Creek) (Tables 4.2-1 and 4.2-2). Station P6 experienced erosion due to an increase in boat traffic from a boat manufacturing operation in Leland, North Carolina, as noted in last year's report. Boats are tested at high speeds adjacent to P6. The placement of instruments at subsite 1 at P6 has been abandoned due to this erosion, therefore no data (flood or salinity) was collected for fall 2007 or spring 2008. During fall 2007, at P11, there was a loss of flood data due to equipment failure. Aside from P6, a few subsites at other stations do not have salinity data (Tables 4.2-3 and 4.2-4) due to equipment failure, but these data losses were minor.

Table 4.2-1. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during fall 2007. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to the 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 07	10/25/2007	11/8/2007	26/27	5.3	2.1	0.66	1.4
	2	Fall 07	10/25/2007	11/8/2007	26/27	5.1	1.9	0.83	1.1
	3	Fall 07	10/25/2007	11/8/2007	26/27	6.8	2.0	0.52	1.5
	4	Fall 07	10/25/2007	11/8/2007	25/27	5.7	2.1	1.49	0.6
	5	Fall 07	10/25/2007	11/8/2007	23/27	5.2	1.9	0.99	0.9
	6	Fall 07	10/25/2007	11/8/2007	22/27	3.8	4.2	3.31	0.9
P6	1	Fall 07	ND	ND	ND	ND	ND	ND	ND
	2	Fall 07	10/18/2007	11/1/2007	21/27	4.6	3.4	1.56	1.8
	3	Fall 07	10/18/2007	11/1/2007	22/27	5.2	3.4	0.85	2.6
	4	Fall 07	10/18/2007	11/1/2007	24/27	5.2	3.7	1.13	2.6
	5	Fall 07	10/18/2007	11/1/2007	27/27	6.0	3.7	1.92	1.8
	6	Fall 07	10/18/2007	11/1/2007	23/27	4.8	3.2	1.74	1.5
P7	1	Fall 07	11/27/2007	12/11/2007	18/27	6.5	2.2	1.76	0.4

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)
	2	Fall 07	11/27/2007	12/11/2007	14/27	5.7	2.8	2.23	0.6
	3	Fall 07	11/27/2007	12/11/2007	19/27	5.5	2.5	2.26	0.2
	4	Fall 07	11/27/2007	12/11/2007	15/27	5.2	2.6	2.43	0.2
	5	Fall 07	11/27/2007	12/11/2007	17/27	5.1	2.5	2.31	0.2
	6	Fall 07	11/27/2007	12/11/2007	16/27	5.9	2.6	2.37	0.2
P8	1	Fall 07	10/4/2007	10/18/2007	20/27	4.9	2.6	2.14	0.5
	2	Fall 07	10/4/2007	10/18/2007	25/27	4.1	2.6	1.54	1.1
	3	Fall 07	10/4/2007	10/18/2007	27/27	4.6	2.8	1.46	1.3
	4	Fall 07	10/4/2007	10/18/2007	21/27	3.6	2.6	1.98	0.6
	5	Fall 07	10/4/2007	10/18/2007	10/27	4.5	2.6	2.24	0.4
	6	Fall 07	10/4/2007	10/18/2007	0/27	0.0	0.0	2.38	-2.4
P9	1	Fall 07	9/20/2007	10/4/2007	27/27	7.1	2.8	0.58	2.2
	2	Fall 07	9/20/2007	10/4/2007	27/27	4.9	2.6	2.21	0.4
	3	Fall 07	9/20/2007	10/4/2007	17/27	4.7	2.6	1.22	1.4
	4	Fall 07	9/20/2007	10/4/2007	14/27	5.6	2.6	2.06	0.5
	5	Fall 07	9/20/2007	10/4/2007	9/27	6.2	2.4	2.20	0.2
	6	Fall 07	9/20/2007	10/4/2007	10/27	6.1	2.5	1.92	0.6
P11	1	Fall 07	10/11/2007	10/25/2007	27/27	4.5	2.6	1.44	1.2
	2	Fall 07	ND	ND	ND	ND	ND	ND	ND
	3	Fall 07	10/11/2007	10/25/2007	16/27	5.2	2.6	1.76	0.8
	4	Fall 07	10/11/2007	10/25/2007	14/27	4.5	2.6	1.85	0.8
	5	Fall 07	10/11/2007	10/25/2007	13/27	5.5	2.5	1.91	0.6
	6	Fall 07	10/11/2007	10/25/2007	16/27	5.3	2.6	2.04	0.6
P12	1	Fall 07	11/1/2007	11/15/2007	26/27	5.5	2.6	0.90	1.7
	2	Fall 07	11/1/2007	11/15/2007	18/27	4.6	2.6	1.62	1.0
	3	Fall 07	11/1/2007	11/15/2007	14/27	4.8	2.6	2.00	0.6
	4	Fall 07	11/1/2007	11/15/2007	11/27	4.3	2.4	1.90	0.5
	5	Fall 07	11/1/2007	11/15/2007	11/27	4.6	2.3	2.08	0.2
	6	Fall 07	11/1/2007	11/15/2007	3/27	5.4	2.4	2.44	0.0
P13	1	Fall 07	11/29/2007	12/13/2007	17/27	6.3	1.6	1.43	0.2
	2	Fall 07	11/29/2007	12/13/2007	13/27	5.4	1.5	1.08	0.4
	3	Fall 07	11/29/2007	12/13/2007	21/27	4.7	1.7	0.75	1.0
	4	Fall 07	11/29/2007	12/13/2007	23/27	6.0	2.6	1.00	1.6
	5	Fall 07	11/29/2007	12/13/2007	15/27	4.7	1.5	1.21	0.3
	6	Fall 07	11/29/2007	12/13/2007	15/27	4.6	1.6	1.64	0.0
P14	1	Fall 07	9/27/2007	10/11/2007	27/27	6.7	2.0	0.70	1.3
	2	Fall 07	9/27/2007	10/11/2007	27/27	5.5	1.9	0.87	1.0
	3	Fall 07	9/27/2007	10/11/2007	27/27	6.6	1.9	1.08	0.8
	4	Fall 07	9/27/2007	10/11/2007	27/27	5.6	1.8	1.22	0.6
	5	Fall 07	9/27/2007	10/11/2007	27/27	5.8	1.8	1.28	0.5
	6	Fall 07	9/27/2007	10/11/2007	11/27	4.3	1.8	1.49	0.3

ND=No data available

Table 4.2-2. Flooding frequency, duration, depth, and actual water level of marsh/swamp substations during spring 2008. Actual water level is calculated using the maximum depth and marsh/swamp surface elevation relative to the 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 08	5/13/2008	5/27/2008	25/27	6.5	2.0	0.66	1.3
	2	Spr 08	5/13/2008	5/27/2008	26/27	5.5	1.8	0.83	1.0
	3	Spr 08	5/13/2008	5/27/2008	27/27	6.1	1.7	0.52	1.2
	4	Spr 08	5/13/2008	5/27/2008	27/27	5.8	1.9	1.49	0.4
	5	Spr 08	5/13/2008	5/27/2008	21/27	5.0	1.8	0.99	0.8
	6	Spr 08	5/13/2008	5/27/2008	16/27	4.7	4.0	3.31	0.7
P6	1	Spr 08	ND	ND	ND	ND	ND	ND	ND
	2	Spr 08	3/27/2008	4/10/2008	17/27	4.7	3.5	1.56	1.9
	3	Spr 08	3/27/2008	4/10/2008	26/27	5.4	3.5	0.85	2.7
	4	Spr 08	3/27/2008	4/10/2008	20/27	4.7	3.7	1.13	2.6
	5	Spr 08	3/27/2008	4/10/2008	15/27	4.6	3.8	1.92	1.9
	6	Spr 08	3/27/2008	4/10/2008	13/27	4.3	3.3	1.74	1.6
P7	1	Spr 08	4/10/2008	4/24/2008	26/27	5.1	3.7	1.76	1.9
	2	Spr 08	4/10/2008	4/24/2008	16/27	5.0	3.6	2.23	1.4
	3	Spr 08	4/10/2008	4/24/2008	15/27	4.8	3.5	2.26	1.2
	4	Spr 08	4/10/2008	4/24/2008	15/27	4.5	3.6	2.43	1.2
	5	Spr 08	4/10/2008	4/24/2008	13/27	4.9	3.5	2.31	1.2
	6	Spr 08	4/10/2008	4/24/2008	8/27	5.1	3.5	2.37	1.1
P8	1	Spr 08	3/11/2008	3/25/2008	18/27	4.0	2.9	2.14	0.8
	2	Spr 08	3/11/2008	3/25/2008	24/27	4.8	2.9	1.54	1.4
	3	Spr 08	3/11/2008	3/25/2008	26/27	5.5	3.0	1.46	1.5
	4	Spr 08	3/11/2008	3/25/2008	18/27	4.5	2.8	1.98	0.8
	5	Spr 08	3/11/2008	3/25/2008	13/27	3.9	2.9	2.24	0.7
	6	Spr 08	3/11/2008	3/25/2008	11/27	4.4	2.8	2.38	0.4
P9	1	Spr 08	2/26/2008	3/11/2008	26/27	6.4	2.7	0.58	2.1
	2	Spr 08	2/26/2008	3/11/2008	20/27	5.6	3.1	2.21	0.9
	3	Spr 08	2/26/2008	3/11/2008	10/27	5.0	3.1	1.22	1.9
	4	Spr 08	2/26/2008	3/11/2008	5/27	6.5	3.0	2.06	0.9
	5	Spr 08	2/26/2008	3/11/2008	3/27	6.2	3.0	2.20	0.8
	6	Spr 08	2/26/2008	3/11/2008	4/27	6.1	2.2	1.92	0.3
P11	1	Spr 08	4/3/2008	4/17/2008	27/27	5.2	3.5	1.44	2.1
	2	Spr 08	4/3/2008	4/17/2008	26/27	4.8	3.7	1.82	1.9
	3	Spr 08	4/3/2008	4/17/2008	27/27	4.6	3.5	1.76	1.7
	4	Spr 08	4/3/2008	4/17/2008	24/27	4.7	3.6	1.85	1.8
	5	Spr 08	4/3/2008	4/17/2008	24/27	4.2	3.5	1.91	1.6
	6	Spr 08	4/3/2008	4/17/2008	21/27	4.5	3.6	2.04	1.6

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)
P12	1	Spr 08	4/17/2008	5/1/2008	27/27	5.1	2.6	0.90	1.7
	2	Spr 08	4/17/2008	5/1/2008	21/27	4.9	2.6	1.62	1.0
	3	Spr 08	4/17/2008	5/1/2008	13/27	4.0	2.7	2.00	0.7
	4	Spr 08	4/17/2008	5/1/2008	10/27	5.3	2.6	1.90	0.7
	5	Spr 08	4/17/2008	5/1/2008	14/27	4.6	2.5	2.08	0.4
	6	Spr 08	4/17/2008	5/1/2008	4/27	4.6	2.5	2.44	0.1
P13	1	Spr 08	2/28/2008	3/13/2008	18/27	6.3	2.4	1.43	1.0
	2	Spr 08	2/28/2008	3/13/2008	20/27	4.5	2.4	1.08	1.3
	3	Spr 08	2/28/2008	3/13/2008	22/27	4.8	1.8	0.75	1.1
	4	Spr 08	2/28/2008	3/13/2008	24/27	5.5	3.3	1.00	2.3
	5	Spr 08	2/28/2008	3/13/2008	20/27	5.1	2.3	1.21	1.1
	6	Spr 08	2/28/2008	3/13/2008	5/27	4.1	2.2	1.64	0.6
P14	1	Spr 08	3/13/2008	3/27/2008	26/27	6.9	2.0	0.70	1.3
	2	Spr 08	3/13/2008	3/27/2008	26/27	4.5	2.0	0.87	1.1
	3	Spr 08	3/13/2008	3/27/2008	23/27	5.5	1.9	1.08	0.8
	4	Spr 08	3/13/2008	3/27/2008	22/27	3.9	1.9	1.22	0.7
	5	Spr 08	3/13/2008	3/27/2008	21/27	4.7	1.9	1.28	0.6
	6	Spr 08	3/13/2008	3/27/2008	8/27	5.6	1.8	1.49	0.3

ND=No data available

Table 4.2-3. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in fall 2007.

Station Number	Station Name	Substation Number	Fall 2007 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1 - 25	26/27
		2	<1 - 25	26/27
		3	<1 - 26	26/27
		4	<1 - 20	26/27
		5	<1 - 22	26/27
		6	<1 - 19	20/27
P6	Eagle Island	1	ND	ND
		2	<1 - 26	23/27
		3	<1 - 19	23/27
		4	<1 - 25	23/27
		5	<1 - 20	23/27
		6	<1 - 20	21/27
P7	Indian Creek	1	<1 - 10	7/27
		2	<1	0/27
		3	<1	0/27
		4	<1	0/27
		5	<1	0/27

Table 4.2-3. (continued)

Station Number	Station Name	Substation Number	Fall 2007 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
		6	<1	0/27
P8	Dollisons Landing	1	ND	ND
		2	<1 - 4	16/27
		3	<1 - 3	13/27
		4	<1 - 3	5/27
		5	<1	0/27
		6	<1	0/27
P9	Black River	1	<1	0/27
		2	<1	0/27
		3	ND	ND
		4	<1	0/27
		5	<1	0/27
		6	<1	0/27
P11	Smith Creek	1	<1 - 24	13/27
		2	<1 - 24	12/27
		3	<1 - 19	12/27
		4	<1 - 23	12/27
		5	<1 - 23	8/27
		6	<1 - 23	8/27
P12	Rat Island	1	<1 - 19	23/27
		2	<1 - 15	18/27
		3	<1 - 13	11/27
		4	<1 - 12	8/27
		5	<1 - 10	6/27
		6	<1	0/27
P13	Fishing Creek	1	ND	ND
		2	<1 - 10	9/27
		3	<1 - 10	15/27
		4	<1 - 9	15/27
		5	<1 - 7	8/27
		6	<1	0/27
P14	Prince George	1	<1 - 7	27/27
		2	<1 - 8	27/27
		3	<1 - 7	27/27
		4	<1 - 7	27/27
		5	<1 - 7	24/27
		6	<1 - 6	16/27

ND=No data available

Table 4.2-4. Summary of salinity data from nine substations collected along the Cape Fear River and its tributaries in spring 2008.

Station Number	Station Name	Substation Number	Spring 2008 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P3	Town Creek	1	<1 - 9	27/27
		2	<1 - 9	27/27
		3	<1 - 8	27/27
		4	<1 - 7	27/27
		5	<1 - 5	23/27
		6	<1 - 4	17/27
P6	Eagle Island	1	ND	ND
		2	<1 - 2	3/27
		3	<1	0/27
		4	<1 - 1	0/27
		5	<1 - 1	0/27
		6	<1 - 1	0/27
P7	Indian 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
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 - 6	9/27
		2	<1 - 8	10/27
		3	<1 - 8	10/27
		4	<1 - 8	10/27
		5	<1 - 6	9/27
		6	<1 - 5	9/27
P12	Rat Island	1	<1 - 2	5/27
		2	<1 - 1	0/27
		3	<1 - 1	0/27
		4	<1 - 1	0/27
		5	<1 - 1	0/27
		6	<1 - 1	0/27

Table 4.2-4. (continued)

Station Number	Station Name	Substation Number	Spring 2008 Salinity Range (ppt)	Proportion of flood events containing > 1 ppt salinity
P13	Fishing Creek	1	<1	0/27
		2	<1	0/27
		3	<1 - 1	0/27
		4	<1 - 1	0/27
		5	<1 - 1	0/27
		6	<1	0/27
P14	Prince George	1	<1	0/27
		2	<1	0/27
		3	<1	0/27
		4	<1 - 1	0/27
		5	<1 - 1	0/27
		6	<1 - 1	0/27

ND=No data available

4.3 Marsh/Swamp Flooding

The general pattern of flooding within about half the stations was lower this year than previous years, i.e. some subsites flooded less frequently than adjacent subsites (Tables 4.2-1 and 4.2-2). For example, station P13 subsite 2 flood events decreased from 23/27 in fall 2006 to 13/27 in fall 2007. This effect is more pronounced in the fall during drought conditions when the river discharge rates were below average (Fig. 3.5A-2). During spring 2008, the number of flood events at most stations were comparable to previous years. This was not the case at station P6 which continued to have fewer flood events at most of the subsites. Subsite 2 decreased from 24/27 flood events in spring 2007 to 17/27 events in spring 2008. At this station (P6) mean flood durations were also lower in spring 2008. Each subsites mean was approximately 1 hour shorter than last year's duration. Note that when tides did flood the marsh/swamp surface the average depth and duration of flooding at all sites was not very different than previous years (Hackney et al. 2002, 2003, 2004, 2005, 2006, 2007). These data are collected for two-week periods, but all stations are not collected during the same two-week time frame. Typically, each two-week period includes either a new moon or full moon tide, which are usually higher than average. There is no attempt to schedule these two-week collection periods with high or low river flow so it is not unusual for any one station to have a lower frequency of flooding from chance alone.

4.4 Water Salinity in Marshes and Swamps

Salinity of surface water flooding swamps and marshes reflected the overall state of river flows relative to previous reporting periods. This reporting year was similar to 2001-2002 in that tidal ranges at DCP stations and the flow of water through Lock and Dam 1 were much lower than the mean. As expected, this was reflected in the salinity measured on the marsh/swamp surface. Salinity was detected at all stations except P9 during fall 2007 (Table 4.2-3). At P7, salinity was detected only at subsite 1 (Table 4.2-3). The maximum salinity measured was at P3 with 26 ppt an increase of the maximum at this site (subsite 3) of 21 ppt from fall 2006 (Table 4.2-3). Note these samples were taken during a regional drought. Following the period of drought, measurements taken in spring 2008 reflect much lower salinity values. Only two sites (P3 and P11) show salinities above 2 ppt (Table 4.2-4). The highest salinity was measured at P3 of 9 ppt (Table 4.2-4).

5.0 MARSH/SWAMP BIOGEOCHEMISTRY

5.1 Summary

Geochemical data were collected at nine stations along the lower Cape Fear River and Estuary beginning in winter of 2000. Data from the winters of 2000-2007 and the summers of 2000-2006 was presented in the previous annual reports for this project (CZR Incorporated 2001; Hackney et al. 2002, 2003, 2004, 2005, 2006, 2007). Data presented in the current report includes summer 2007 and winter 2008. 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 sub-depths per substation. Samples were collected during the winter and summer at eight sites and monthly at P6 (Eagle Island). These data were used to classify the geochemical setting of each substation at each station 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.

The current year proved to be the saltiest year since 2000. All stations except those located most upstream (P8 Dollisons Landing; P9 Black River; P13 Fishing Creek; P14 Prince George) experienced the highest salinities and subsequent effects since monitoring began. The most upstream stations had elevated salinities similar to the summer of 2002 when previous low river flow conditions were present (Hackney et al. 2004). The high salinities resulted in a shift towards classifications expected for higher input of sulfate. Generally the microbial mode of organic matter remineralization shifted from methanogenic conditions typical of freshwater systems to sulfate reducing conditions typical of marine influenced systems.

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 plant 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 300 μM 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 which may also indicate oxidation of hydrogen sulfide in the porewaters. 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 associated with river dredging, drought, or other factors.

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. In addition, porewater is collected from the Eagle Island station (P6) every month 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.

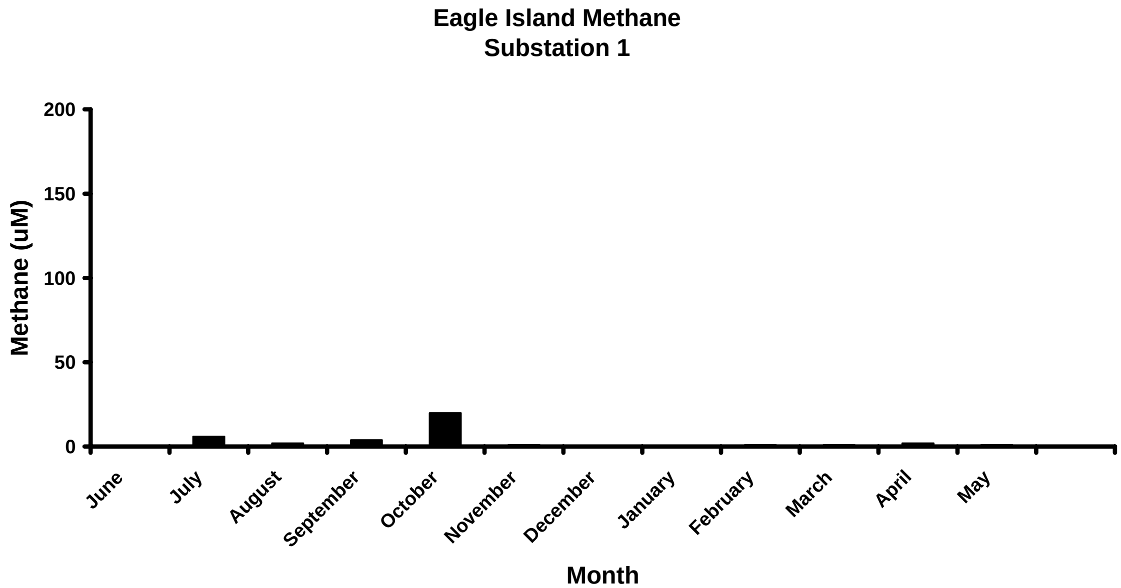
5.4 Eagle Island (P6) Annual Cycles of Sulfate, Chloride, and Methane

Eagle Island's previous and current general classifications are based on the following observations: 1) Methane is typically 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 4000 μM indicating sufficient sulfate to support sulfate reduction (Figure 5.4-2). The 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). Some lower ratios also occur, possibly indicating oxidation of hydrogen sulfide from previous sulfate reduction.

Salinity values at Eagle Island (P6) for the average year (Hackney et al. 2005) were typically less than 1.5 ppt at the creek bank location S1 and less than 0.1 ppt at the upland site S6. The low river flow high salinity year (Hackney et al. 2004) had salinity values as high as 14 ppt at S1 and 8 ppt at S6. The salinity values observed during the current year were the highest recorded since the beginning of this monitoring project approaching 16 ppt at both S1 and S6 (Figure 5.4-4). Sulfate concentrations reflected the high salinities with many values in the 6,000-8,000 μM range (Figure 5.4-2). These values were similar to those measured during the low river flow year (~10,000 μM at S1 and 500-4,000 μM at S6). Average year sulfate concentrations are typically 200-1000 μM at S1 and 100-500 μM at S6. The Chloride to sulfate ratios were at or above those expected for seawater for the majority of the months at S1. Ratios near that of seawater indicate a recent resupply of sea salts while those above the chloride to sulfate ratio indicate active sulfate reduction. At S6 the chloride to sulfate ratios were highly elevated. Chloride concentrations were high due to the high salinity floodwater, while sulfate concentrations were often highly depleted relative to seawater and in the range of the sulfate reducing threshold. This indicates that S6 likely received a pulse of salinity followed by rapid sulfate reduction. The low sulfate concentrations suggest that sulfate was not ressupplied and that the high salinity flood events may not have been too numerous. The chloride to sulfate ratios at S6, along with the salinity and sulfate concentration data, support the idea that the salinity input was high during the current year and resupply was enough to maintain sulfate reducing conditions.

Methane concentrations during the current year were extremely low at S1 and relatively low at S6. Average year methane concentrations vary but typically reach values approaching 400μM. During the low river flow year, methane concentrations were <70μM. During the current year methane concentrations were all below 25μM at S1 and ranged between 20 and 200μM at S6 (Figure 5.4-1). The lack of methane at S1 reflects the high supply of sulfate from the high salinity floodwaters. The sulfate reducers had a sufficient supply of sulfate that remained above the threshold concentration resulting in the sulfate reducer's outcompeting the methanogens. The higher levels of methane at S6 is consistent with the salinity, sulfate and sulfate to chloride ratios described above. The high pulse of salinity supplied a large amount of sulfate which was rapidly consumed by highly labile organic material. The sulfate was not resupplied often by subsequent floodwaters resulting in the shift to methanogenesis following depletion of sulfate to the threshold concentration. This process is evident in comparisons between the monthly sulfate and methane data. Methane concentrations were elevated during the summer and fall when sulfate concentrations were relatively low. During the winter when concentrations of sulfate rebounded at S6, methane concentrations decreased.

The classifications of Eagle Island during the current year are consistent with the high salinity year described above (Table 5.4-1). During an average year, the majority of the classifications were methanogenic with evidence of past sulfate reduction (MPSR) (Hackney et al. 2005). This is consistent with an occasional pulse of relatively low salinity water followed by temporary sulfate reducing conditions until the sulfate is reduced to the threshold concentration. After the low levels of sulfate are depleted, the site returns to methanogenic conditions recording in the sediments, evidence of the prior sulfate reduction in the chloride to sulfate ratios. During the low flow year, classifications were evenly divided between SR and MPSR (Hackney et al. 2004). During the current year, for the first time, the majority of classifications were SR with a few MPSR illustrating the magnitude of the salt intrusion into the Cape Fear River this past year.



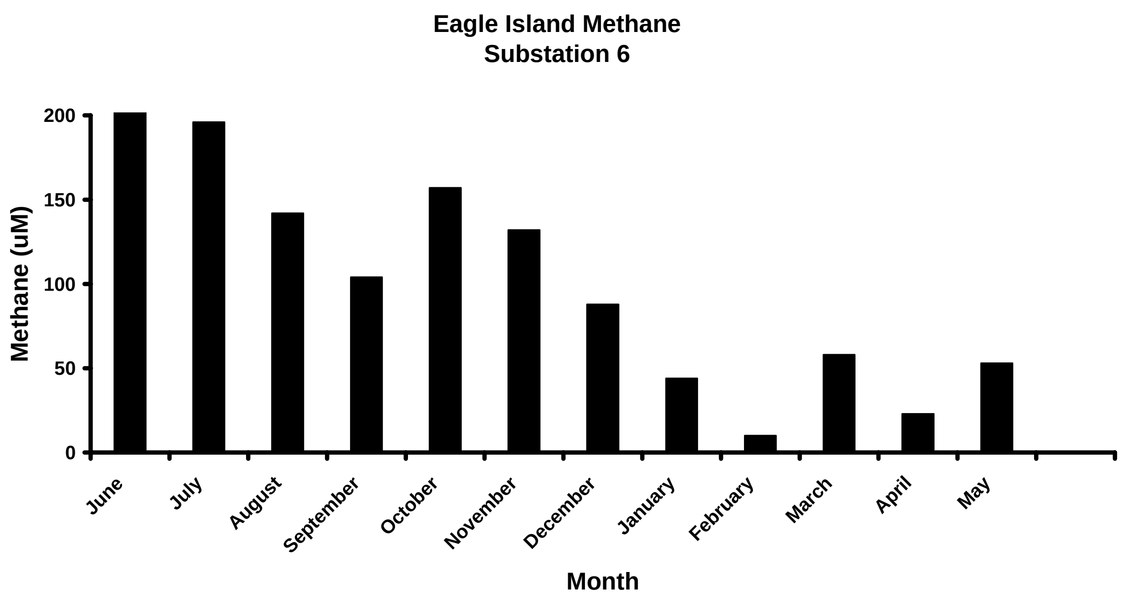
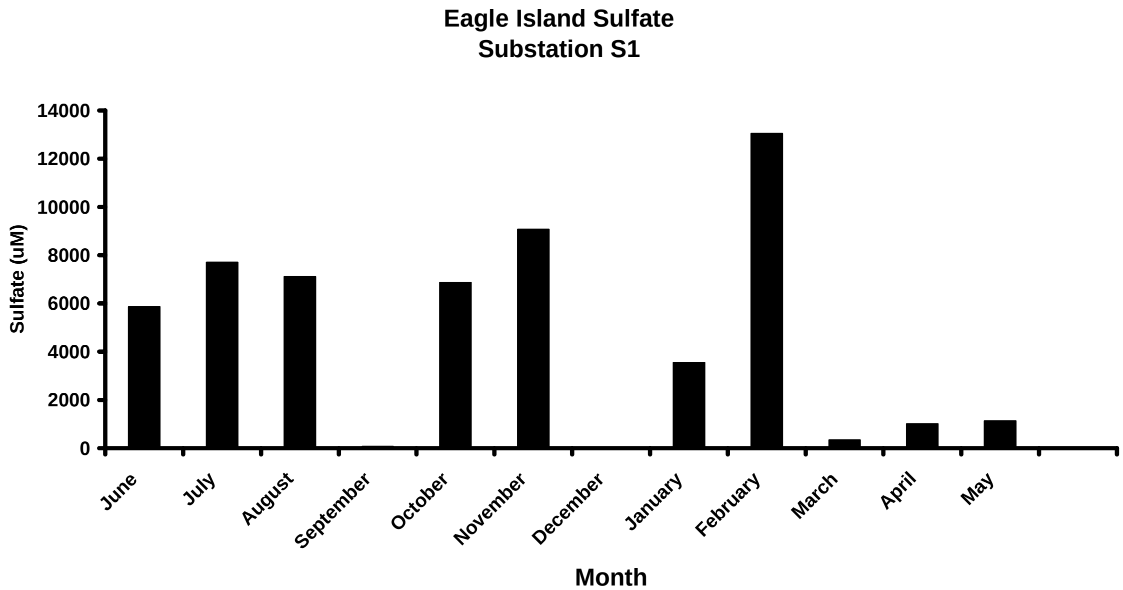


Figure 5.4-1. Methane concentrations of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows site closest to upland (S6).



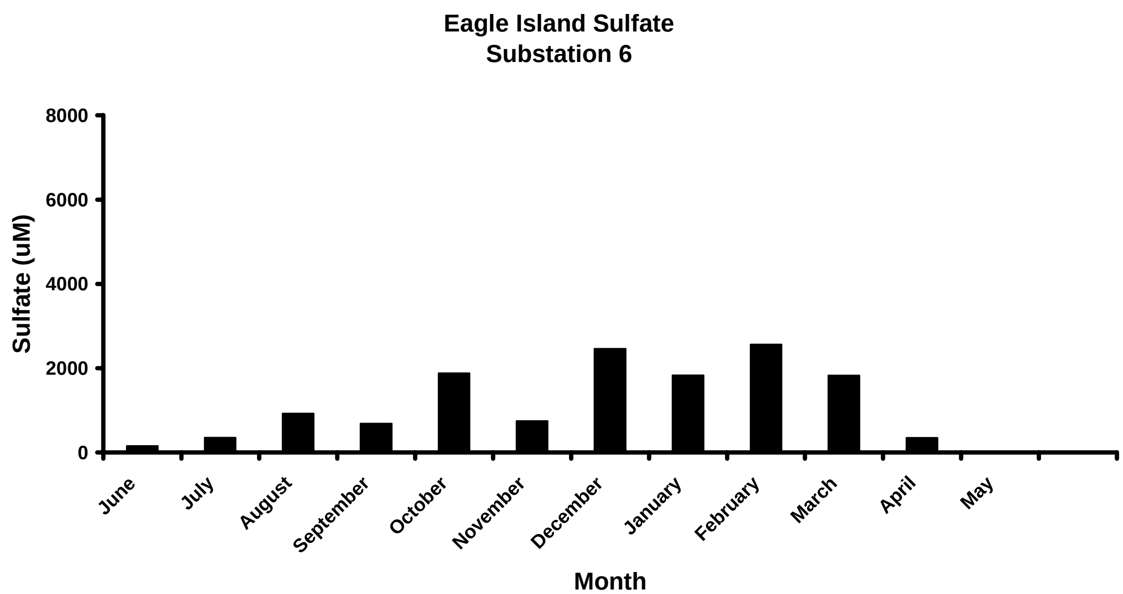
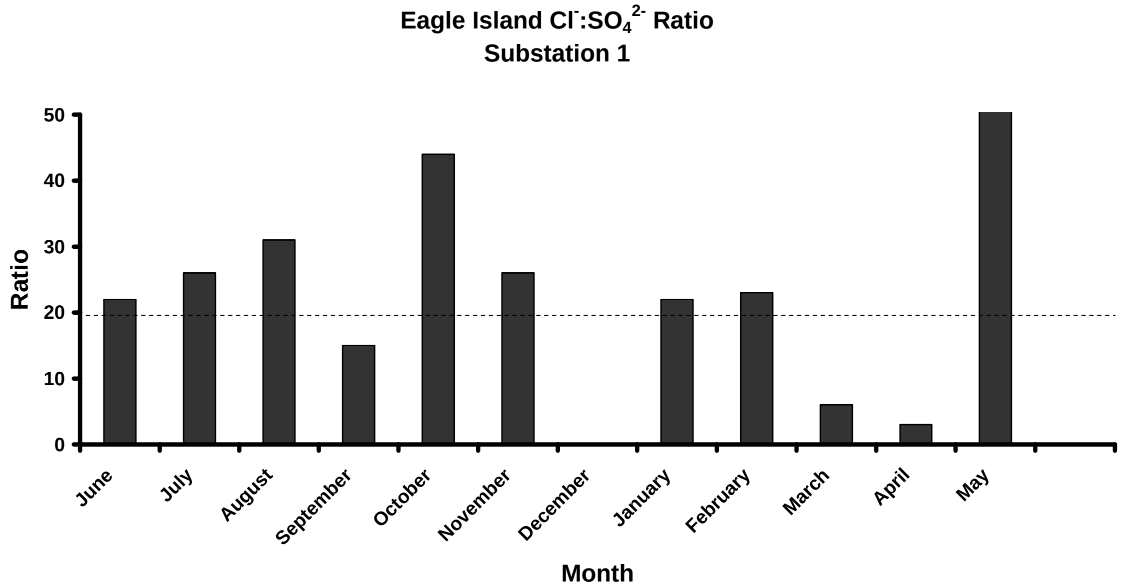


Figure 5.4-2. Sulfate concentrations of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows site closest to upland (S6).



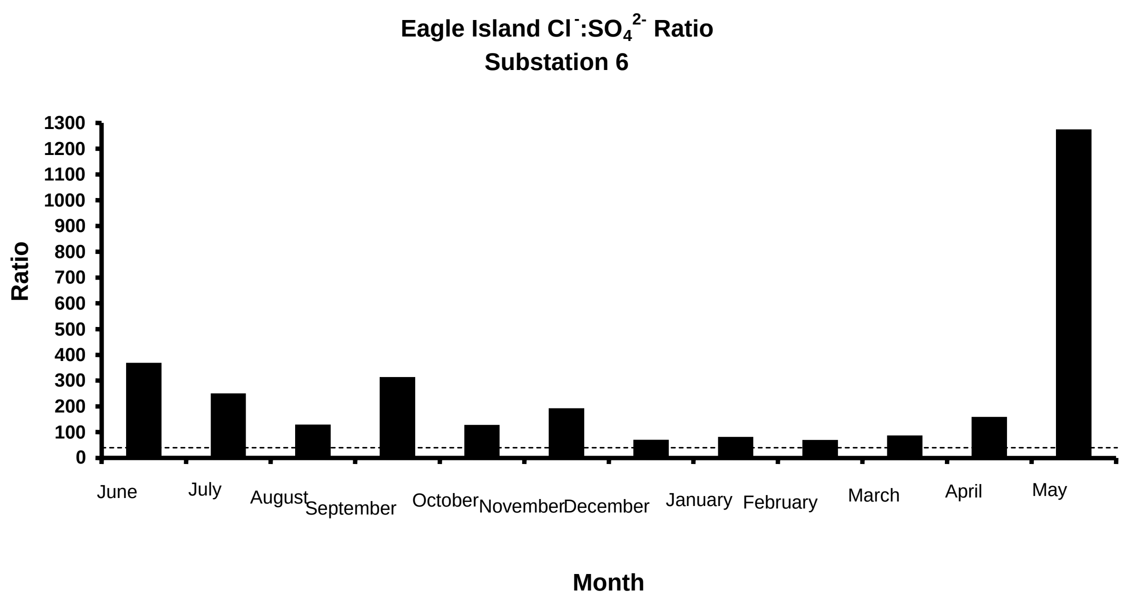
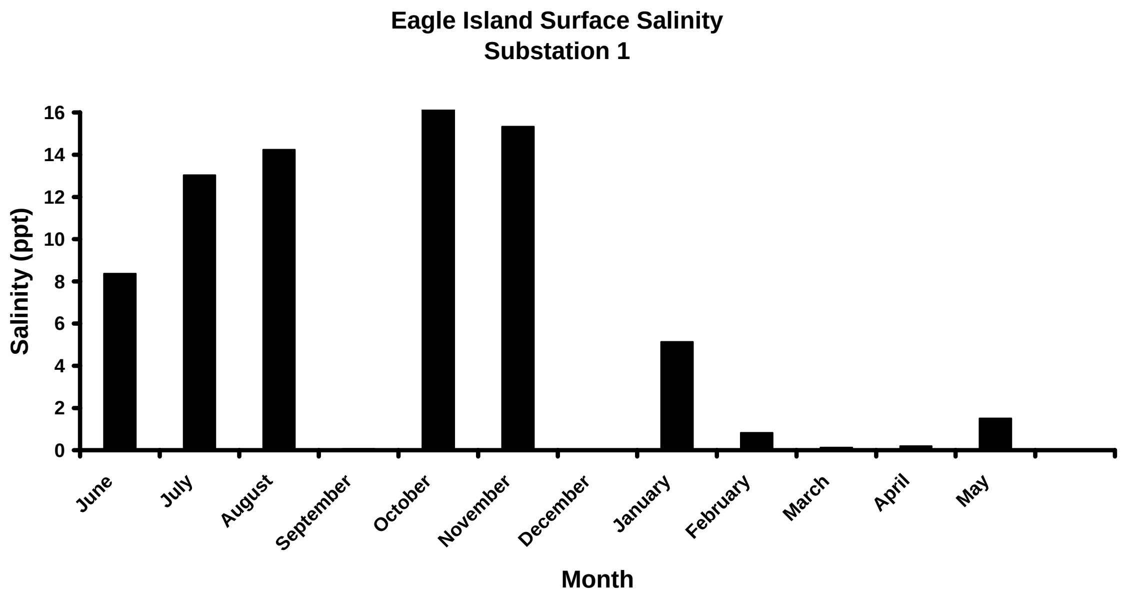


Figure 5.4-3. Chloride to sulfate ratios of Eagle Island porewaters vs. month. Dashed line shows ratio for seawater. Top shows nearshore site (S1) and bottom shows site closest to upland (S6).



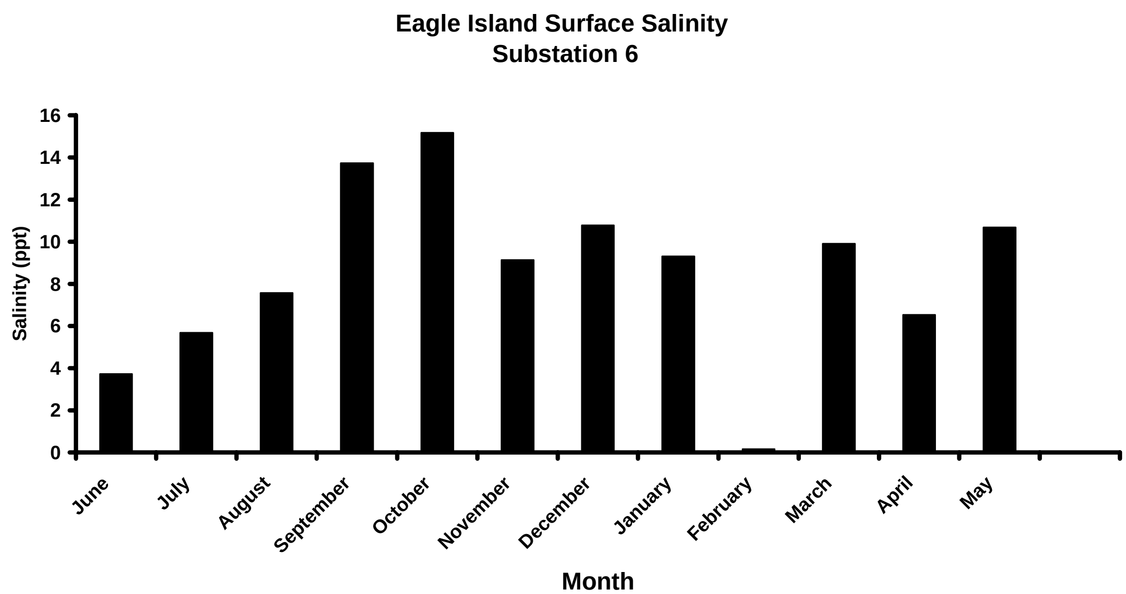


Figure 5.4-4. Salinities of Eagle Island porewaters vs. month. Top shows nearshore site (S1) and bottom shows site closest to upland (S6).

Table 5.4-1. Eagle Island (P6) Geochemical Classifications by month. 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 07	July	August	September	October	November	December	January	February	March	April	May 08
S1-1	II	II	II	I	II	II	ns	II	II	II	II	II
S1-2	II	II	II	II	II	II	ns	II	II	II	II	II
S1-3	II	II	II	II	II	II	II	II	II	II	II	II
S1-4	I*	II	I*	II	II	II	II	II	II	I*	I*	I*
S1-5	I*	I*	I*	II	II	II	II	II	II	I*	I*	I*
S1-6	I*	I*	I*	II	II	II	II	II	II	I*	I*	I*
S2-1	II	II	II	II	II	II	II	II	II	I*	I*	I*
S2-2	II	II	II	II	II	II	II	II	II	I*	I*	I*
S2-3	II	II	II	II	II	II	II	II	II	I*	II	I
S2-4	I*	II	II	II	II	II	II	II	II	ns	II	I
S2-5	I*	II	I*	II	II	II	II	II	II	ns	II	I
S2-6	I*	II	I*	II	II	II	II	II	II	II	I*	I
S3-1	II	II	II	II	II	II	II	II	II	II	II	II
S3-2	II	II	II	II	II	II	II	II	II	II	II	I
S3-3	II	II	II	II	II	II	II	II	II	I*	II	I
S3-4	II	II	II	II	II	II	II	II	II	I*	II	I*
S3-5	II	II	II	II	II	II	II	II	II	I*	II	I*
S3-6	II	II	II	I*	II	II	II	II	II	I*	II	I*
S4-1	II	II	II	II	II	II	II	II	II	II	II	I*
S4-2	II	II	II	II	I*	I*	II	II	II	II	II	I*
S4-3	II	II	II	II	I*	I*	II	II	II	II	II	I*
S4-4	II	II	II	II	I*	I*	II	II	II	II	II	I
S4-5	I*	I*	II	II	II	I*	II	II	II	II	II	I*
S4-6	I*	I*	II	II	I*	I*	II	II	II	II	II	I*
S5-1	II	II	II	II	II	II	II	II	II	II	I*	I*
S5-2	II	II	II	II	II	II	II	II	II	II	II	I*
S5-3	II	II	II	II	II	II	II	II	II	I*	II	I*
S5-4	II	II	II	II	II	II	II	II	II	ns	II	I*
S5-5	II	II	II	II	II	I	II	I*	II	I*	II	I*
S5-6	I*	I*	I*	II	II	I	II	I*	II	II	I*	I*
S6-1	I	II	II	II	II	II	II	II	II	II	II	I*
S6-2	II	II	II	II	II	II	II	II	II	II	II	I*
S6-3	I*	I*	I*	I*	II	II	II	II	II	II	II	I*
S6-4	I*	I*	I*	I*	II	II	I*	II	II	II	II	I*
S6-5	I*	I*	I*	I*	II	II	I*	II	II	II	II	I*
S6-6	I*	II	I*	I*	II	II	I*	II	II	II	II	I*

5.5 Marsh/Swamp Transect Stations Geochemistry, Annual Variability

The previous seven reports of this monitoring project have provided enough information to establish what will be referred to as an "average year". On the basis of the seven reports and river flow data, the authors have established the report year four (Hackney et al. 2005) as a year representing average conditions and will be referred to as the "average year" in this report. Year three (Hackney et al. 2004) has been identified as a low river flow year representing a year with high salinity intrusion into the monitoring sites. This year will be referred to as the "low river flow year" in the current report. The current year's data will be compared to the average year and the low river flow year to put the current year's data in context.

5.51 Town Creek (P3)

Salinity at Town Creek during the average year ranged between 0.5 and 2.5 ppt (Hackney et al. 2005). During the low river flow year salinities reached values as high as 17 ppt (Hackney et al. 2004). The current year salinities (Table 5.51-1), based on chloride concentrations (Table 5.51-2), were the highest recorded during the monitoring project reaching values of 36 ppt which is essentially full seawater salinity. The majority of sulfate concentrations were in the 3,000–7,000 µM range (Table 5.51-3) well above the average year concentrations of 100–300 µM and the low river flow year concentrations of 500–3,000 µM. Methane concentrations as low as 10 µM (Table 5.51-4) were observed during the current year due to the dominance of sulfate reduction resulting from the high levels of sulfate in the flood waters. The lower range of methane concentrations in the low river flow year was the same 10 µM, while average year low range concentrations were approximately 100 µM. These biogeochemical conditions resulted in all SR classifications (Table 5.51-5). Both average year and low river flow year classifications were mainly SR with some MPSR. The presence of all SR classifications reflect the high salinity conditions observed at Town Creek during the current year.

Table 5.51-1. Salinity of Sites. Salinity in parts per thousand calculated from chloride concentrations in porewaters. A [---] indicates no data. A [nd] means not determined.

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Town Creek	1	1	26.27	1.03
P3	1	6	25.23	1.16
	1	11	23.97	1.98
	1	16	22.28	2.61
	1	21	20.37	2.62
	1	26	20.18	2.39
	2	1	22.43	2.95
	2	6	21.94	3.97
	2	11	20.10	4.03

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Town Creek (continued)	2	16	17.85	4.17
	2	21	15.30	4.17
	2	26	14.31	4.27
	3	1	35.25	1.14
	3	6	34.40	1.67
	3	11	31.37	2.34
	3	16	22.18	3.04
	3	21	26.34	3.53
	3	26	71.02	3.70
	4	1	16.50	1.59
	4	6	15.22	2.09
	4	11	14.70	2.41
	4	16	14.42	2.69
	4	21	13.69	2.68
	4	26	12.61	2.67
	5	1	21.73	1.16
	5	6	19.45	1.11
	5	11	18.37	1.44
	5	16	18.00	1.54
	5	21	19.61	1.62
	5	26	19.61	1.83
	6	1	37.25	3.32
	6	6	35.34	3.90
	6	11	31.56	4.10
	6	16	22.02	4.13
	6	21	16.53	4.19
	6	26	13.64	4.03
Eagle Island P6	1	1	13.03	5.14
	1	6	12.81	5.50
	1	11	10.17	6.23
	1	16	6.70	7.40
	1	21	4.07	9.67
	1	26	3.00	11.81
	2	1	13.60	10.03
	2	6	12.45	11.20
	2	11	11.07	12.58
	2	16	7.93	13.62
	2	21	5.13	12.62
	2	26	4.43	12.26
	3	1	11.60	9.24
	3	6	11.57	9.68
	3	11	11.12	9.91
	3	16	10.75	9.76
	3	21	9.01	10.07

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	**Winter 2008**
Eagle Island (continued)	3	26	6.33	8.98
	4	1	7.11	8.45
	4	6	6.47	8.32
	4	11	5.22	10.84
	4	16	3.70	12.26
	4	21	2.34	12.35
	4	26	1.68	12.68
	5	1	7.67	7.50
	5	6	7.53	6.21
	5	11	7.19	5.62
	5	16	7.20	5.07
	5	21	5.62	5.00
	5	26	3.55	3.95
	6	1	5.69	9.31
	6	6	6.57	8.10
	6	11	4.81	9.72
	6	16	3.88	10.76
	6	21	3.30	10.74
	6	26	3.16	11.01
Indian Creek P7	1	1	8.46	0.20
	1	6	13.97	2.73
	1	11	13.63	4.19
	1	16	13.71	4.66
	1	21	6.98	5.10
	1	26	5.29	5.34
	2	1	11.29	6.21
	2	6	7.42	7.05
	2	11	5.31	7.69
	2	16	4.11	6.89
	2	21	3.65	5.98
	2	26	2.19	4.78
	3	1	6.96	2.71
	3	6	8.82	2.23
	3	11	0.22	2.49
	3	16	7.83	2.55
	3	21	5.10	2.73
	3	26	1.68	2.84
	4	1	0.06	1.94
	4	6	0.05	2.07
	4	11	0.04	2.07
	4	16	0.04	2.14
	4	21	0.04	2.14
	4	26	0.03	2.20
	5	1	0.08	0.35

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Indian Creek (continued)	5	6	0.08	0.27
	5	11	0.08	0.25
	5	16	0.10	0.26
	5	21	0.10	0.27
	5	26	0.11	0.25
	6	1	0.13	0.08
	6	6	0.12	0.05
	6	11	0.12	0.05
	6	16	0.12	0.06
	6	21	0.15	0.07
	6	26	0.15	0.04
Dollisons Landing P8	1	1	0.07	0.09
	1	6	0.08	0.10
	1	11	0.09	0.15
	1	16	0.10	0.22
	1	21	0.09	0.27
	1	26	0.10	0.37
	2	1	0.04	0.05
	2	6	0.03	0.05
	2	11	0.03	0.05
	2	16	0.03	0.04
	2	21	0.03	0.05
	2	26	0.03	0.05
	3	1	0.05	0.09
	3	6	0.05	0.09
	3	11	0.05	0.08
	3	16	0.05	0.08
	3	21	0.04	0.07
	3	26	0.04	0.07
	4	1	0.06	0.05
	4	6	0.05	0.06
	4	11	0.04	0.08
	4	16	0.04	0.09
	4	21	0.04	0.09
	4	26	0.03	0.08
	5	1	0.08	0.08
	5	6	0.08	0.08
	5	11	0.08	0.09
	5	16	0.10	0.09
	5	21	0.10	0.08
	5	26	0.11	0.07
	6	1	0.13	0.05
	6	6	0.12	0.04
	6	11	0.12	0.05

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Dollisons Landing (continued)	6	16	0.12	0.06
	6	21	0.15	0.05
	6	26	0.15	0.04
Black River P9	1	1	0.06	0.05
	1	6	0.05	0.05
	1	11	0.04	0.04
	1	16	0.04	0.05
	1	21	0.04	0.05
	1	26	0.04	0.05
	2	1	0.07	0.05
	2	6	0.07	0.06
	2	11	0.06	0.05
	2	16	0.06	0.05
	2	21	0.05	0.05
	2	26	0.05	0.05
	3	1	0.07	0.05
	3	6	0.05	0.05
	3	11	0.03	0.05
	3	16	0.03	0.05
	3	21	0.03	0.06
	3	26	0.03	0.04
	4	1	0.03	0.05
	4	6	0.03	0.06
	4	11	0.03	0.06
	4	16	0.03	0.05
	4	21	0.02	0.05
	4	26	0.03	0.06
	5	1	0.03	0.06
	5	6	0.03	0.07
	5	11	0.03	0.07
	5	16	0.04	0.08
	5	21	0.05	0.07
	5	26	0.04	0.06
	6	1	0.01	0.05
	6	6	0.00	0.06
	6	11	0.00	0.06
	6	16	0.01	0.06
	6	21	0.00	0.05
	6	26	0.00	0.06
Smith Creek P11	1	1	20.61	13.81
	1	6	19.08	13.81
	1	11	17.28	12.78
	1	16	11.75	10.97
	1	21	8.60	9.72

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Smith Creek	1	26	13.98	11.33
(continued)	2	1	19.46	16.24
	2	6	19.09	15.47
	2	11	16.20	15.28
	2	16	13.67	14.85
	2	21	12.11	13.66
	2	26	15.29	12.13
	3	1	19.21	15.31
	3	6	18.87	15.87
	3	11	17.05	14.90
	3	16	14.64	13.73
	3	21	12.02	11.90
	3	26	9.03	10.83
	4	1	14.60	13.94
	4	6	10.93	17.23
	4	11	12.97	17.98
	4	16	11.30	17.28
	4	21	8.44	14.32
	4	26	3.67	13.04
	5	1	19.04	9.65
	5	6	16.42	10.86
	5	11	14.38	11.78
	5	16	12.83	10.68
	5	21	10.03	9.46
	5	26	7.25	9.01
	6	1	14.93	10.60
	6	6	15.30	12.46
	6	11	16.78	12.39
	6	16	15.93	12.75
	6	21	13.97	12.46
	6	26	13.51	12.87
Rat Island	1	1	10.70	13.81
P12	1	6	10.49	13.81
	1	11	7.48	12.78
	1	16	5.28	10.97
	1	21	3.72	9.72
	1	26	2.52	11.33
	2	1	12.46	16.24
	2	6	10.70	15.47
	2	11	8.02	15.28
	2	16	5.68	14.85
	2	21	4.12	13.66
	2	26	2.55	12.13
	3	1	9.72	15.31

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Rat Island (continued)	3	6	7.49	15.87
	3	11	5.52	14.90
	3	16	4.72	13.73
	3	21	4.74	11.90
	3	26	2.89	10.83
	4	1	10.06	13.94
	4	6	6.70	17.23
	4	11	4.70	17.98
	4	16	3.99	17.28
	4	21	3.48	14.32
	4	26	3.86	13.04
	5	1	7.55	9.65
	5	6	6.40	10.86
	5	11	5.44	11.78
	5	16	3.30	10.68
	5	21	3.07	9.46
	5	26	2.70	9.01
	6	1	1.03	10.60
	6	6	0.73	12.46
	6	11	0.75	12.39
	6	16	0.73	12.75
	6	21	0.92	12.46
	6	26	0.67	12.87
Fishing Creek P13	1	1	6.86	0.60
	1	6	7.84	0.66
	1	11	7.59	1.01
	1	16	7.47	2.00
	1	21	6.81	2.43
	1	26	6.18	2.48
	2	1	4.83	1.44
	2	6	4.22	1.69
	2	11	3.98	2.31
	2	16	3.73	2.99
	2	21	3.56	3.80
	2	26	3.17	4.43
	3	1	3.00	4.98
	3	6	2.44	4.90
	3	11	2.42	4.97
	3	16	2.40	5.22
	3	21	2.22	4.78
	3	26	2.06	4.74
	4	1	2.89	1.89
	4	6	3.31	1.60
	4	11	3.24	1.67

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Fishing Creek (continued)	4	16	3.42	1.64
	4	21	0.01	1.62
	4	26	0.01	1.73
	5	1	3.26	0.99
	5	6	3.29	1.00
	5	11	3.22	1.12
	5	16	3.15	1.49
	5	21	2.46	1.76
	5	26	2.68	2.77
	6	1	0.10	0.27
	6	6	0.06	0.10
	6	11	0.03	0.09
	6	16	0.03	0.09
	6	21	0.03	0.09
	6	26	0.04	0.21
Prince George P14	1	1	0.18	0.10
	1	6	0.28	0.31
	1	11	0.33	0.40
	1	16	0.36	0.53
	1	21	0.33	0.65
	1	26	0.21	0.74
	2	1	0.12	0.24
	2	6	0.08	0.29
	2	11	0.06	0.36
	2	16	0.04	0.45
	2	21	0.04	0.52
	2	26	0.04	0.57
	3	1	0.11	0.20
	3	6	0.14	0.25
	3	11	0.32	0.49
	3	16	0.54	0.73
	3	21	0.59	1.03
	3	26	0.59	1.09
	4	1	0.24	0.73
	4	6	0.27	0.89
	4	11	0.24	0.97
	4	16	0.15	1.01
	4	21	0.11	0.98
	4	26	0.08	0.89
	5	1	0.30	0.88
	5	6	0.38	1.22
	5	11	0.42	1.48
	5	16	0.45	1.67
	5	21	0.45	1.93

Table 5.51-1. (continued)

Station	Substation	Depth (cm)	Salinity	
			Summer 2007	Winter 2008
Prince George (continued)	5	26	0.44	2.47
	6	1	0.36	0.86
	6	6	0.61	1.29
	6	11	0.60	1.64
	6	16	0.51	1.94
	6	21	0.39	2.23
	6	26	0.26	2.44

Table 5.51-2. Chloride Concentrations of Sites. Chloride concentrations of porewaters in μM.

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Town Creek P3	1	1	410487	16077
	1	6	394192	18058
	1	11	374471	30986
	1	16	348081	40818
	1	21	318252	41009
	1	26	315273	37326
	2	1	350399	46140
	2	6	342862	62000
	2	11	314134	62988
	2	16	278867	65159
	2	21	239022	65138
	2	26	223650	66744
	3	1	550745	17849
	3	6	537425	26064
	3	11	490080	36486
	3	16	346560	47531
	3	21	411583	55094
	3	26	1109631	57809
	4	1	257871	24780
	4	6	237886	32636
	4	11	229666	37710
	4	16	225382	41973
	4	21	213969	41947
	4	26	197061	41677
	5	1	339464	18081
	5	6	303861	17291
	5	11	287009	22427
	5	16	281206	24059

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Town Creek (continued)	5	21	306417	25390
	5	26	306397	28596
	6	1	582083	51817
	6	6	552141	60905
	6	11	493061	64117
	6	16	344140	64482
	6	21	258234	65477
	6	26	213139	62920
Eagle Island P6	1	1	203525	80379
	1	6	200155	86001
	1	11	158854	97411
	1	16	104637	115702
	1	21	63614	151147
	1	26	46836	184569
	2	1	212527	156740
	2	6	194469	175002
	2	11	173034	196554
	2	16	123890	212765
	2	21	80127	197194
	2	26	69273	191499
	3	1	181178	144413
	3	6	180795	151218
	3	11	173811	154896
	3	16	167909	152552
	3	21	140714	157372
	3	26	98834	140318
	4	1	111140	132077
	4	6	101171	130034
	4	11	81588	169363
	4	16	57759	191622
	4	21	36591	192912
	4	26	26210	198122
	5	1	119781	117169
	5	6	117582	97060
	5	11	112373	87791
	5	16	112464	79181
	5	21	87771	78110
	5	26	55476	61770
	6	1	88868	145446
	6	6	102702	126499
	6	11	75192	151898
	6	16	60580	168078
	6	21	51612	167785
	6	26	49396	172004

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Indian Creek	1	1	132180	3057
P7	1	6	218245	42615
	1	11	213023	65531
	1	16	214277	72823
	1	21	109082	79741
	1	26	82623	83473
	2	1	176443	97038
	2	6	115911	110191
	2	11	82950	120204
	2	16	64242	107663
	2	21	57096	93480
	2	26	34162	74666
	3	1	108775	42341
	3	6	137886	34788
	3	11	3430	38852
	3	16	122267	39914
	3	21	79753	42697
	3	26	26296	44345
	4	1	891	30238
	4	6	748	32332
	4	11	672	32345
	4	16	592	33457
	4	21	571	33489
	4	26	543	34388
	5	1	1225	5525
	5	6	1259	4288
	5	11	1324	3925
	5	16	1579	4031
	5	21	1640	4151
	5	26	1664	3969
	6	1	2035	1195
	6	6	1951	708
	6	11	1911	785
	6	16	1869	1013
	6	21	2287	1163
	6	26	2345	640

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Dollisons	1	1	1121	1375
Landing P8	1	6	1282	1498
	1	11	1374	2289
	1	16	1505	3473
	1	21	1478	4261
	1	26	1534	5787
	2	1	641	778
	2	6	526	770
	2	11	473	726
	2	16	449	687
	2	21	435	729
	2	26	406	711
	3	1	838	1468
	3	6	836	1420
	3	11	772	1318
	3	16	799	1250
	3	21	683	1106
	3	26	603	1077
	4	1	891	819
	4	6	748	961
	4	11	672	1244
	4	16	592	1398
	4	21	571	1435
	4	26	543	1182
	5	1	1225	1196
	5	6	1259	1256
	5	11	1324	1386
	5	16	1579	1435
	5	21	1640	1269
	5	26	1664	1163
	6	1	2035	807
	6	6	1951	669
	6	11	1911	710
	6	16	1869	952
	6	21	2287	836
	6	26	2345	697

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Black River	1	1	861	813
P9	1	6	748	727
	1	11	669	694
	1	16	648	748
	1	21	634	785
	1	26	646	806
	2	1	1057	849
	2	6	1036	873
	2	11	887	833
	2	16	888	772
	2	21	772	787
	2	26	817	715
	3	1	1157	739
	3	6	747	725
	3	11	528	778
	3	16	484	706
	3	21	458	873
	3	26	446	625
	4	1	496	855
	4	6	444	895
	4	11	423	907
	4	16	420	812
	4	21	354	711
	4	26	403	940
	5	1	495	940
	5	6	455	1052
	5	11	482	1118
	5	16	571	1189
	5	21	806	1083
	5	26	573	997
	6	1	96	812
	6	6	49	878
	6	11	66	906
	6	16	231	926
	6	21	60	857
	6	26	61	934

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Smith Creek	1	1	322025	215775
P11	1	6	298101	215818
	1	11	269990	199632
	1	16	183525	171341
	1	21	134361	151929
	1	26	218363	176959
	2	1	303995	253808
	2	6	298217	241657
	2	11	253191	238679
	2	16	213531	232066
	2	21	189162	213390
	2	26	238934	189470
	3	1	300079	239211
	3	6	294889	247912
	3	11	266356	232823
	3	16	228770	214582
	3	21	187817	185876
	3	26	141082	169254
	4	1	228171	217752
	4	6	170753	269158
	4	11	202697	280889
	4	16	176619	269980
	4	21	131878	223693
	4	26	57281	203739
	5	1	297502	150814
	5	6	256513	169636
	5	11	224734	184037
	5	16	200537	166863
	5	21	156748	147743
	5	26	113312	140717
	6	1	233273	165602
	6	6	239134	194721
	6	11	262160	193654
	6	16	248860	199231
	6	21	218240	194751
	6	26	211061	201131

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Rat Island	1	1	167178	215775
P12	1	6	163845	215818
	1	11	116928	199632
	1	16	82577	171341
	1	21	58103	151929
	1	26	39407	176959
	2	1	194727	253808
	2	6	167149	241657
	2	11	125386	238679
	2	16	88695	232066
	2	21	64326	213390
	2	26	39797	189470
	3	1	151942	239211
	3	6	116963	247912
	3	11	86249	232823
	3	16	73744	214582
	3	21	74030	185876
	3	26	45162	169254
	4	1	157254	217752
	4	6	104698	269158
	4	11	73492	280889
	4	16	62394	269980
	4	21	54361	223693
	4	26	60267	203739
	5	1	117989	150814
	5	6	99951	169636
	5	11	84923	184037
	5	16	51494	166863
	5	21	48004	147743
	5	26	42222	140717
	6	1	16042	165602
	6	6	11457	194721
	6	11	11711	193654
	6	16	11389	199231
	6	21	14402	194751
	6	26	10531	201131

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Fishing Creek	1	1	107135	9441
P13	1	6	122542	10309
	1	11	118616	15761
	1	16	116698	31280
	1	21	106345	37964
	1	26	96502	38750
	2	1	75449	22523
	2	6	65986	26329
	2	11	62120	36119
	2	16	58333	46793
	2	21	55581	59342
	2	26	49557	69147
	3	1	46876	77864
	3	6	38126	76635
	3	11	37868	77657
	3	16	37569	81532
	3	21	34650	74701
	3	26	32265	74110
	4	1	45133	29509
	4	6	51678	25021
	4	11	50643	26059
	4	16	53408	25630
	4	21	131	25262
	4	26	190	27102
	5	1	50936	15394
	5	6	51394	15639
	5	11	50325	17456
	5	16	49264	23239
	5	21	38367	27533
	5	26	41911	43343
	6	1	1485	4150
	6	6	978	1608
	6	11	484	1358
	6	16	452	1362
	6	21	537	1365
	6	26	558	3323

Table 5.51-2. (continued)

Station	Substation	Depth (cm)	Chloride	
			Summer 2007	Winter 2008
Prince George	1	1	2851	1522
P14	1	6	4316	4787
	1	11	5136	6192
	1	16	5658	8258
	1	21	5225	10093
	1	26	3354	11590
	2	1	1928	3816
	2	6	1322	4582
	2	11	884	5647
	2	16	674	7083
	2	21	629	8074
	2	26	574	8895
	3	1	1695	3131
	3	6	2149	3902
	3	11	5075	7715
	3	16	8407	11466
	3	21	9235	16097
	3	26	9185	17077
	4	1	3711	11386
	4	6	4194	13896
	4	11	3791	15144
	4	16	2345	15775
	4	21	1697	15289
	4	26	1263	13887
	5	1	4729	13693
	5	6	5891	19115
	5	11	6563	23115
	5	16	6976	26119
	5	21	7089	30110
	5	26	6802	38621
	6	1	5605	13381
	6	6	9493	20092
	6	11	9301	25571
	6	16	8006	30285
	6	21	6065	34890
	6	26	4091	38090

Table 5.51-3. Sulfate Concentrations of Sites. Porewater sulfate concentrations are µM. A [---] indicates no data. A [nd] means not determined.

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Town Creek	1	1	7644	499
P3	1	6	6722	490
	1	11	5968	561
	1	16	2774	451
	1	21	2538	347
	1	26	2569	187
	2	1	6266	397
	2	6	6589	547
	2	11	6258	611
	2	16	5401	695
	2	21	4515	723
	2	26	4423	714
	3	1	14709	457
	3	6	13862	676
	3	11	10401	952
	3	16	4399	1218
	3	21	7207	1355
	3	26	22905	1329
	4	1	3619	404
	4	6	3385	564
	4	11	3756	626
	4	16	3876	690
	4	21	3851	670
	4	26	3718	673
	5	1	5493	512
	5	6	4659	398
	5	11	4566	448
	5	16	5556	411
	5	21	6279	430
	5	26	6184	445
	6	1	14638	976
	6	6	13555	1297
	6	11	11352	1402
	6	16	5692	1406
	6	21	2775	1445
	6	26	798	1362
Eagle Island	1	1	7706	3557
P6	1	6	7397	3775
	1	11	2571	4171
	1	16	383	4385
	1	21	54	3045

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Eagle Island (continued)	1	26	145	2192
	2	1	2671	4285
	2	6	2288	4076
	2	11	1713	3617
	2	16	470	2805
	2	21	306	1962
	2	26	356	1686
	3	1	6126	2618
	3	6	5909	1944
	3	11	5546	1627
	3	16	5198	1551
	3	21	3719	1522
	3	26	1304	1320
	4	1	2957	3215
	4	6	2658	2944
	4	11	1726	3525
	4	16	750	3759
	4	21	105	3432
	4	26	58	3685
	5	1	2470	1492
	5	6	2715	544
	5	11	1839	506
	5	16	1320	371
	5	21	739	295
	5	26	158	242
	6	1	358	1835
	6	6	722	1406
	6	11	206	1347
	6	16	248	1465
	6	21	226	1273
	6	26	2602	1056
Indian Creek P7	1	1	5143	183
	1	6	9220	1202
	1	11	8768	1544
	1	16	7960	1509
	1	21	2223	1520
	1	26	1102	1414
	2	1	6858	1246
	2	6	3613	400
	2	11	1098	340
	2	16	630	175
	2	21	504	193
	2	26	361	192
	3	1	3165	201

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Indian Creek (continued)	3	6	3681	93
	3	11	120	299
	3	16	4094	316
	3	21	2424	324
	3	26	476	267
	4	1	253	29
	4	6	81	51
	4	11	49	49
	4	16	31	74
	4	21	62	96
	4	26	87	48
	5	1	142	86
	5	6	100	75
	5	11	97	56
	5	16	95	47
	5	21	132	44
	5	26	95	52
	6	1	227	35
	6	6	125	30
	6	11	91	28
	6	16	91	63
	6	21	121	37
	6	26	29	20
Dollisons Landing P8	1	1	244	433
	1	6	125	438
	1	11	70	514
	1	16	25	560
	1	21	16	498
	1	26	0	332
	2	1	40	129
	2	6	24	54
	2	11	25	39
	2	16	26	31
	2	21	25	32
	2	26	28	31
	3	1	34	63
	3	6	21	55
	3	11	32	32
	3	16	34	44
	3	21	22	47
	3	26	24	69
	4	1	253	78
	4	6	81	50
	4	11	49	49

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Dollisons Landing (continued)	4	16	31	61
	4	21	62	93
	4	26	87	71
	5	1	142	148
	5	6	100	107
	5	11	97	93
	5	16	95	96
	5	21	132	99
	5	26	95	35
	6	1	227	146
	6	6	125	155
	6	11	91	147
	6	16	91	202
	6	21	121	125
	6	26	29	79
Black River P9	1	1	92	428
	1	6	31	365
	1	11	25	283
	1	16	20	215
	1	21	23	154
	1	26	38	92
	2	1	459	304
	2	6	235	246
	2	11	78	138
	2	16	23	107
	2	21	17	82
	2	26	24	49
	3	1	1405	351
	3	6	482	324
	3	11	108	250
	3	16	212	180
	3	21	137	70
	3	26	197	59
	4	1	1063	145
	4	6	1077	115
	4	11	728	108
	4	16	363	90
	4	21	263	46
	4	26	47	167
	5	1	247	544
	5	6	526	625
	5	11	448	603
	5	16	480	520
	5	21	516	348

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Black River (continued)	5	26	275	231
	6	1	0	470
	6	6	0	417
	6	11	0	259
	6	16	0	208
	6	21	0	216
	6	26	0	193
Smith Creek P11	1	1	9114	9401
	1	6	6375	9155
	1	11	4559	7449
	1	16	2077	4645
	1	21	1290	2261
	1	26	2565	2793
	2	1	3622	6074
	2	6	2972	4716
	2	11	1699	3997
	2	16	806	3479
	2	21	675	2883
	2	26	4832	2064
	3	1	8932	3725
	3	6	7986	3079
	3	11	7056	2275
	3	16	5666	1580
	3	21	3801	981
	3	26	1989	813
	4	1	3298	6291
	4	6	892	6603
	4	11	916	4643
	4	16	435	2713
	4	21	538	1741
	4	26	302	1577
	5	1	9355	4241
	5	6	5182	4712
	5	11	3769	4160
	5	16	2310	2397
	5	21	780	1790
	5	26	366	1492
	6	1	7781	5759
	6	6	7204	6636
	6	11	6540	5892
	6	16	4270	5168
	6	21	1842	4893
	6	26	1257	4278

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Rat Island	1	1	2987	9401
P12	1	6	1896	9155
	1	11	812	7449
	1	16	371	4645
	1	21	415	2261
	1	26	280	2793
	2	1	2330	6074
	2	6	426	4716
	2	11	264	3997
	2	16	368	3479
	2	21	289	2883
	2	26	257	2064
	3	1	5591	3725
	3	6	4541	3079
	3	11	3183	2275
	3	16	2564	1580
	3	21	2343	981
	3	26	1439	813
	4	1	5263	6291
	4	6	2061	6603
	4	11	903	4643
	4	16	622	2713
	4	21	535	1741
	4	26	938	1577
	5	1	3718	4241
	5	6	3052	4712
	5	11	2302	4160
	5	16	1097	2397
	5	21	659	1790
	5	26	369	1492
	6	1	359	5759
	6	6	232	6636
	6	11	232	5892
	6	16	251	5168
	6	21	408	4893
	6	26	195	4278
Fishing Creek	1	1	4012	623
P13	1	6	4181	673
	1	11	2946	849
	1	16	1957	1376
	1	21	376	1454
	1	26	34	1319
	2	1	2775	889
	2	6	1754	832

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Fishing Creek (continued)	2	11	1421	873
	2	16	1143	899
	2	21	732	1095
	2	26	553	1178
	3	1	1157	2260
	3	6	782	2295
	3	11	685	2326
	3	16	501	2252
	3	21	249	2267
	3	26	194	2149
	4	1	1227	1132
	4	6	1390	1056
	4	11	1238	1065
	4	16	1358	1084
	4	21	64	1016
	4	26	78	941
	5	1	1442	590
	5	6	1357	574
	5	11	1297	554
	5	16	1219	561
	5	21	775	479
	5	26	953	519
	6	1	143	173
	6	6	153	156
	6	11	156	147
	6	16	134	143
	6	21	162	145
	6	26	196	322
Prince George P14	1	1	85	323
	1	6	55	676
	1	11	63	709
	1	16	65	766
	1	21	64	825
	1	26	66	883
	2	1	50	552
	2	6	36	539
	2	11	33	607
	2	16	33	660
	2	21	28	687
	2	26	29	703
	3	1	71	491
	3	6	43	718
	3	11	42	901
	3	16	33	859

Table 5.51-3. (continued)

Station	Substation	Depth (cm)	Sulfate	
			Summer 2007	Winter 2008
Prince George	3	21	32	923
(continued)	3	26	18	775
	4	1	52	220
	4	6	39	191
	4	11	32	194
	4	16	36	205
	4	21	42	177
	4	26	38	107
	5	1	36	1384
	5	6	28	1650
	5	11	23	1519
	5	16	19	1326
	5	21	18	1177
	5	26	17	1010
	6	1	213	756
	6	6	71	1077
	6	11	46	1143
	6	16	36	1193
	6	21	11	1159
	6	26	21	1078

Table 5.51-4. Methane Concentrations of Sites. Porewater methane concentrations are µM. A [nd] means not determined.

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Town Creek	1	1	14	36
P3	1	6	21	58
	1	11	27	71
	1	16	66	118
	1	21	92	107
	1	26	98	96
	2	1	11	212
	2	6	21	334
	2	11	29	306
	2	16	17	365
	2	21	19	301
	2	26	43	273
	3	1	11	20
	3	6	26	57
	3	11	46	83
	3	16	94	72

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Town Creek (continued)	3	21	112	88
	3	26	120	83
	4	1	48	103
	4	6	44	167
	4	11	69	187
	4	16	71	177
	4	21	79	214
	4	26	77	192
	5	1	34	28
	5	6	30	110
	5	11	45	172
	5	16	53	198
	5	21	54	178
	5	26	69	199
	6	1	36	49
	6	6	16	63
	6	11	11	82
	6	16	30	80
	6	21	56	71
	6	26	78	74
Eagle Island P6	1	1	6	0
	1	6	61	1
	1	11	186	0
	1	16	207	0
	1	21	229	27
	1	26	210	79
	2	1	128	97
	2	6	127	179
	2	11	nd	282
	2	16	177	278
	2	21	144	296
	2	26	130	332
	3	1	22	4
	3	6	55	16
	3	11	243	21
	3	16	250	20
	3	21	213	26
	3	26	177	24
	4	1	29	2
	4	6	31	13
	4	11	29	19
	4	16	17	19
	4	21	23	31
	4	26	24	20

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Eagle Island (continued)	5	1	nd	90
	5	6	107	122
	5	11	156	144
	5	16	158	213
	5	21	136	318
	5	26	130	330
	6	1	196	44
	6	6	213	69
	6	11	249	64
	6	16	234	101
	6	21	254	138
	6	26	nd	158
Indian Creek P7	1	1	nd	nd
	1	6	1	1
	1	11	1	3
	1	16	2	37
	1	21	11	84
	1	26	12	150
	2	1	4	1
	2	6	34	7
	2	11	69	20
	2	16	55	49
	2	21	50	14
	2	26	nd	nd
	3	1	27	nd
	3	6	25	nd
	3	11	36	nd
	3	16	87	15
	3	21	152	46
	3	26	201	83
	4	1	nd	56
	4	6	nd	61
	4	11	nd	109
	4	16	nd	125
	4	21	nd	113
	4	26	nd	102
	5	1	nd	nd
	5	6	nd	5
	5	11	nd	24
	5	16	nd	48
	5	21	nd	108
	5	26	nd	162
	6	1	nd	1
	6	6	nd	4

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Indian Creek (continued)	6	11	nd	14
	6	16	nd	48
	6	21	nd	73
	6	26	nd	129
Dollisons Landing P8	1	1	nd	2
	1	6	71	0
	1	11	110	3
	1	16	na	6
	1	21	117	12
	1	26	111	20
	2	1	179	7
	2	6	121	53
	2	11	106	44
	2	16	123	56
	2	21	150	58
	2	26	193	67
	3	1	143	23
	3	6	115	28
	3	11	97	28
	3	16	107	21
	3	21	109	26
	3	26	126	19
	4	1	na	61
	4	6	184	200
	4	11	313	234
	4	16	272	241
	4	21	245	13
	4	26	294	na
	5	1	94	24
	5	6	177	50
	5	11	274	122
	5	16	250	118
	5	21	224	126
	5	26	296	117
	6	1	10	7
	6	6	162	3
	6	11	200	2
	6	16	267	na
	6	21	298	15
	6	26	357	19

Table 5.51-4. (continued)

Station	**Substation**	**Depth (cm)**	**Methane**	
			Summer 2007	**Winter 2008**
Black River	1	1	151	3
P9	1	6	214	18
	1	11	273	31
	1	16	296	40
	1	21	294	32
	1	26	237	34
	2	1	4	27
	2	6	107	23
	2	11	252	46
	2	16	239	102
	2	21	255	98
	2	26	130	90
	3	1	11	14
	3	6	99	38
	3	11	144	117
	3	16	146	176
	3	21	152	297
	3	26	109	264
	4	1	nd	26
	4	6	nd	60
	4	11	5	58
	4	16	81	89
	4	21	nd	114
	4	26	279	106
	5	1	nd	6
	5	6	nd	22
	5	11	nd	43
	5	16	nd	105
	5	21	11	179
	5	26	62	199
	6	1	nd	2
	6	6	nd	12
	6	11	nnd	18
	6	16	nd	11
	6	21	nd	93
	6	26	nd	95

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Smith Creek	1	1	29	50
P11	1	6	108	57
	1	11	194	155
	1	16	284	236
	1	21	303	409
	1	26	231	476
	2	1	51	187
	2	6	71	235
	2	11	74	308
	2	16	125	329
	2	21	142	271
	2	26	201	349
	3	1	44	514
	3	6	28	632
	3	11	148	576
	3	16	161	622
	3	21	238	550
	3	26	286	574
	4	1	135	47
	4	6	nd	244
	4	11	275	399
	4	16	215	423
	4	21	274	391
	4	26	299	437
	5	1	12	13
	5	6	100	157
	5	11	192	299
	5	16	204	378
	5	21	202	405
	5	26	205	433
	6	1	nd	3
	6	6	13	21
	6	11	35	44
	6	16	41	92
	6	21	83	106
	6	26	156	119

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Rat Island	1	1	52	2
P12	1	6	66	2
	1	11	107	4
	1	16	163	17
	1	21	209	51
	1	26	120	71
	2	1	71	2
	2	6	125	2
	2	11	134	4
	2	16	122	20
	2	21	134	32
	2	26	159	43
	3	1	103	321
	3	6	97	333
	3	11	126	362
	3	16	153	330
	3	21	115	281
	3	26	178	314
	4	1	88	434
	4	6	144	445
	4	11	173	507
	4	16	244	503
	4	21	236	494
	4	26	238	507
	5	1	4	211
	5	6	98	226
	5	11	184	185
	5	16	220	185
	5	21	157	176
	5	26	146	144
	6	1	71	1
	6	6	200	5
	6	11	255	8
	6	16	226	11
	6	21	238	26
	6	26	172	20

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Fishing Creek	1	1	1	1
P13	1	6	1	nd
	1	11	8	nd
	1	16	48	1
	1	21	91	2
	1	26	69	3
	2	1	109	3
	2	6	179	7
	2	11	32	12
	2	16	102	22
	2	21	163	24
	2	26	nd	28
	3	1	57	0
	3	6	81	nd
	3	11	75	1
	3	16	123	2
	3	21	145	3
	3	26	138	10
	4	1	31	1
	4	6	127	1
	4	11	152	1
	4	16	145	2
	4	21	68	2
	4	26	nd	3
	5	1	1	3
	5	6	3	1
	5	11	3	3
	5	16	13	6
	5	21	22	9
	5	26	13	21
	6	1	14	3
	6	6	13	nd
	6	11	26	1
	6	16	19	1
	6	21	25	1
	6	26	15	2

Table 5.51-4. (continued)

Station	Substation	Depth (cm)	Methane	
			Summer 2007	Winter 2008
Prince George	1	1	89	2
P14	1	6	126	0
	1	11	185	3
	1	16	196	6
	1	21	156	12
	1	26	160	20
	2	1	249	7
	2	6	202	53
	2	11	239	44
	2	16	191	56
	2	21	181	58
	2	26	nd	67
	3	1	50	23
	3	6	147	28
	3	11	185	28
	3	16	195	21
	3	21	176	26
	3	26	191	19
	4	1	135	61
	4	6	127	200
	4	11	172	234
	4	16	169	241
	4	21	182	13
	4	26	170	nd
	5	1	147	24
	5	6	207	50
	5	11	269	122
	5	16	217	118
	5	21	133	126
	5	26	180	117
	6	1	nd	6
	6	6	72	3
	6	11	163	2
	6	16	233	nd
	6	21	223	15
	6	26	236	19

Table 5.51-5. 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*. A [---] indicates no data. A [nd] means not determined.

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Town Creek	1	1	II	II	II	I*	II	II*	II	II
P3	1	6	II	II	II	I*	I*	II*	II	II
	1	11	II	II	II	I*	I*	II*	II	II
	1	16	II	II	II	I*	I*	II	II	II
	1	21	II	II	II	I*	I*	II	I*	II
	1	26	I*	II	II	I*	I*	II	II	II
	2	1	II	II	II	II	II	II	II	II
	2	6	II	II	II	II	I	II*	II	II
	2	11	II	II	I*	II	I	II	I*	II
	2	16	II	II	I*	II	I	II	I*	II
	2	21	II	II	I*	I*	I*	II	I*	II
	2	26	II	II	I*	II	I	II	I*	II
	3	1	II	II	II	I*	II	II*	II	II
	3	6	II	II	II	I*	II	II*	II	II
	3	11	II	II	II	I*	II	II	I*	II
	3	16	II	II	II	I*	I*	II	I*	II
	3	21	II	II	II	I*	I*	II	I*	II
	3	26	II	II	II	I*	I*	II	II	II
	4	1	II	II	II	I	II	I*	II	II
	4	6	II	II	II	I*	II	II*	II	II
	4	11	II	II	II	I*	II	II	II	II
	4	16	II	II	II	I*	II	II	II	II
	4	21	II	II	II	I*	II	II	I*	II
	4	26	II	II	II	I*	II	II	I*	II
	5	1	II	II	I*	I*	I*	I	II	II
	5	6	II	II	II	I*	I*	I*	II	II
	5	11	II	II	II	I	I*	I*	I*	II
	5	16	II	II	II	I*	I*	I*	I*	II
	5	21	II	II	II	I*	I*	I*	I*	II
	5	26	II	II	II	I*	I*	I*	I*	II
	6	1	II	II	II	I	II	II*	II	II
	6	6	II	II	II	I*	I*	II	II	II
	6	11	II	II	II	I*	I*	II	II	II
	6	16	II	II	II	I*	I*	II	I*	!!
	6	21	II	II	II	I*	I*	II	II	II
	6	26	I*	II	II	I*	I*	II	II	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Eagle Island	1	1	II	II	II	I	II	II	I	II
P6	1	6	II	II	II	nd	II	II	II	II
	1	11	II	II	II	nd	I*	II	I*	II
	1	16	II	II	II	I*	I*	II	I*	II
	1	21	II	II	II	I*	I*	I*	I*	I*
	1	26	II	II	I*	I*	I*	II	I*	I*
	2	1	II	II	II	I	I*	II	II	II
	2	6	II	II	II	I	I*	II	II	II
	2	11	II	II	II	I	I*	II	I*	II
	2	16	II	I*	II	I	I*	II	I*	II
	2	21	II	I*	II	I*	I*	II	I*	II
	2	26	II	I*	I*	I*	I*	I*	I*	II
	3	1	I*	II	II	I*	II	II	II	II
	3	6	I*	I*	II	I*	I*	II	II	II
	3	11	I*	I*	II	I*	I*	II	II	II
	3	16	I*	I*	II	I*	I*	II	I*	II
	3	21	I*	I*	II	I*	I*	II	I*	II
	3	26	I*	I*	II	I*	I*	II	I	I
	4	1	II	II	I*	I*	I*	II	I	I
	4	6	II	I*	I*	I*	I*	I*	I*	II
	4	11	II	I*	I*	I*	I*	I*	I*	II
	4	16	II	I*	I*	I*	I*	I*	I*	II
	4	21	II	I*	I*	I*	I*	I*	I*	I*
	4	26	I*	I*	I*	I*	I*	I*	II	I*
	5	1	II	I*	II	I*	I	II	II	II
	5	6	I*	I*	II	I*	I*	II	I	II
	5	11	II	I*	I*	I*	I*	II	I*	II
	5	16	I*	I*	I*	I*	I*	I*	I*	II
	5	21	I*	I*	I*	I*	I*	I*	I*	II
	5	26	I*	I*	I*	I*	I*	I*	I*	I*
	6	1	II	I*	II	I	I	II	I	II
	6	6	I*	I*	II	I	I	I*	I	II
	6	11	---	I*	II	I	I*	I*	I	I*
	6	16	II	I*	II	I*	I	I*	I*	I*
	6	21	I*	I*	II	I*	I	I*	I*	I*
	6	26	I*	I*	I*	I*	II	I	I*	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Indian Creek	1	1	II	II	II	I	II	II	I	II
P7	1	6	II	II	II	I*	I	II	I	II
	1	11	II	II	II	I*	I	I	I	II
	1	16	II	II	II	I*	I*	I*	I	II
	1	21	II	II	II	I*	I*	I*	I*	II
	1	26	I	I*	II	I*	I*	I*	I*	II
	2	1	I	II	II	I	I	I	I	II
	2	6	I	I	II	I*	I	I	I	II
	2	11	I	I	II	I	I*	I	I	II
	2	16	I	I*	II	I*	I*	I*	I	II
	2	21	I	I*	II	I*	I*	I	I	II
	2	26	I	I	II	I*	I*	I	I	II
	3	1	II	II	I*	I	I	I	I	II
	3	6	II	I	I*	I	I	I	I	II
	3	11	I	I*	I*	I	I	II*	I	I
	3	16	I	I	I*	I	I*	I	I	II
	3	21	II	I	I*	I	I*	I	I	II
	3	26	I	II	I*	I*	I*	I	I	II
	4	1	I	I	II	I	I	I	I	I
	4	6	II	I	II	I	I*	I	I	I
	4	11	II	I	II	I	I	I	I	I
	4	16	I	I	II	I	I*	I	I*	I
	4	21	I	I	II	I	I*	I	I*	I
	4	26	I	I	II	I	I*	I	I*	I
	5	1	II	I	I*	I	I	I	I	I
	5	6	I	I	I*	I	I	I	I	I
	5	11	II	I	I*	I	I	I	I	I
	5	16	II	---	I*	I	I	I	I	I
	5	21	I	I*	I*	I	I	I	I	I
	5	26	I	I	I*	I	I	I	I	I
	6	1	II	---	I	I	I	I	I	I
	6	6	I	---	I	I	I	I	I	I
	6	11	I	I	I	I	I	I	I	I
	6	16	I	I	I	I	I	I	I	I
	6	21	I	---	I	I	I	I	I	I
	6	26	II	I	I	I	I	I	I	I

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Dollisons	1	1	I	---	II	I	I	I	I	I
Landing P8	1	6	II*	II	II	I	I	I	I	I
	1	11	II*	II	I	I	I	I	I	I
	1	16	II*	II	I	I	I	I	I	I*
	1	21	II	I	II	I	I*	I	I	I*
	1	26	II	I	I	I	I*	I	I	ns
	2	1	II*	II	I	I	I	I	I	I
	2	6	II	I	I*	I	I	I	I	I
	2	11	I	II	I*	I*	I	I	I	I
	2	16	I	I*	I*	I*	I	I	I	I
	2	21	I	II	I*	I*	I	I	I	I
	2	26	I	I	I*	I*	I	I	I	I
	3	1	II	I	I	I	I	I	I	I
	3	6	I	---	I*	I	I	I	I	I*
	3	11	I	I	I*	I*	I	I	I	I
	3	16	I	I	I*	I	I*	I*	I	I
	3	21	I	I	I*	I*	I	I*	I	I*
	3	26	I	II	I*	I	I	I*	I	I
	4	1	I	I	II*	I	I	I	I	I
	4	6	I	I	I	I	I	I	I	I
	4	11	I	II	I*	I	I*	I	I	I
	4	16	I	I	---	I	I	I	I	I
	4	21	I	II	I*	I	I	I	I	I
	4	26	I	II	I*	I*	I	I	I	I
	5	1	I	I	I	I	I	I	I	I
	5	6	I	I	I	I	I*	I	I	I
	5	11	I	I	I*	I	I*	I	I	I
	5	16	I	I*	I*	I	I*	I*	I	I
	5	21	I	II	I*	I	I*	I*	I	I
	5	26	I	II	I*	I	I*	I*	I*	I
	6	1	I	I	I	I	I*	I*	I	I
	6	6	I	I*	I	I	I*	I*	I	I
	6	11	I	I*	I*	I	I*	I*	I*	I
	6	16	I	I*	I*	I	I*	I*	I	I
	6	21	I	I	I*	I	I*	I*	I*	I
	6	26	I	I	I*	I	I*	I*	I*	I*

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Black River	1	1	I	---	I*	I	I	I	I	I
P9	1	6	---	---	I*	I	I	I	I	I
	1	11	I	---	I	I	I*	I	I	I
	1	16	I	---	II*	I	I*	I	I	I*
	1	21	II	---	I*	I	I	I	I	I
	1	26	I	II	I*	I	I*	I	I	I
	2	1	I	I*	I*	I	I	I	I	II
	2	6	I	I*	I*	I	I	I	I	I
	2	11	I	I	I*	I	I	I	I	I
	2	16	I	I	II*	I	I	I*	I	I*
	2	21	I	I	I	I	I	I*	I	I*
	2	26	I	I*	I*	I	I	I	I*	I*
	3	1	I	II	I*	I	I	I	I	II
	3	6	I	II*	I*	I	I	I	I	II
	3	11	I	I	I	---	I	I	I	I
	3	16	I	I	II*	I	I	I*	I	I
	3	21	I	I	I	I	I*	I*	I	I
	3	26	I	I	I	I	I*	I	I*	I
	4	1	I	II	I*	I	II	I	I	II
	4	6	II	II*	I	I	I	I	I	II
	4	11	I	II	II*	I	I	I	I	II
	4	16	I	I	II*	I	I*	I	I	II
	4	21	I	I	II*	I	I	I	I	I
	4	26	I	I	II*	---	I	I	I	I
	5	1	II*	II*	I	I	I	I	II*	I
	5	6	II	II	I	I	I	I	II*	II
	5	11	I	II	II*	I	I	I	I	II
	5	16	I	I	II*	I*	I	I	I	II
	5	21	II	I	II*	I	I*	I	I	II
	5	26	II	I	I	I	I*	I	I	I
	6	1	II*	---	I	I	---	I	II*	ns
	6	6	II*	II	II*	I	I	I	I	ns
	6	11	II*	I	II*	I	I	I*	I	ns
	6	16	I	I*	II*	I	I	I*	I	ns
	6	21	I	I	I	I	I	I*	I	ns
	6	26	I	I	I	I	I	I*	I	ns

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Smith Creek	1	1	II	II	II	II	II	II	II	II
P11	1	6	II	I*	II	II	II	II	II	II
	1	11	---	II	II	II	II	II	II	II
	1	16	II	II	II	II	II	II	II	II
	1	21	---	II	II	II	I	II	I*	II
	1	26	---	II	II	II	I	II	I*	II
	2	1	II	II	II	II*	II	II	I*	II
	2	6	---	I*	II	II	II	II	I*	II
	2	11	II	II	II	II	II	II	I*	II
	2	16	II	II	II	II	II	II	I*	II
	2	21	II	II	II	II	II	II	I*	II
	2	26	II	II	II	II	II	II	I*	II
	3	1	II	II	II	II	II	II	II	II
	3	6	II	II	II	I*	II	II	II	II
	3	11	II	II	II	I*	II	II	II	II
	3	16	II	II	II	II	I	II	I*	II
	3	21	II	II	II	I*	I*	II	I*	II
	3	26	II	II	II	II	I	II	II	II
	4	1	II	II	II	II	II	II	II	II
	4	6	II	II	II	II	II	II	II	II
	4	11	II	II	II	II	II	II	II	II
	4	16	II	II	II	II	I	II	I*	II
	4	21	II	II	II	II	---	II	I*	II
	4	26	II	II	II	II	I	II	I*	II
	5	1	II	I*	II	---	I	II	I	II
	5	6	II	II	II	II	I	II	II	II
	5	11	II	II	II	II	I	II	II	II
	5	16	II	II	II	II	I	II	II	II
	5	21	II	II	II	II	I	II	I*	II
	5	26	II	II	II	II	I	II	I*	II
	6	1	II	II	II	I	II	II	II	II
	6	6	II	I*	II	I	II	II	II	II
	6	11	II	I*	II	I*	II	II	I*	II
	6	16	II	I*	II	II	I	II	I*	II
	6	21	II	---	II	II	II	II	I*	II
	6	26	II	II	II	II	II	II	I*	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Rat Island	1	1	II	II	II	I	I*	II	I*	II
P12	1	6	II	II	II	I	II	II	I*	II
	1	11	II	II	II	I	I*	I*	II	II
	1	16	II	II	II	I	I*	II	II	II
	1	21	II	II	II	I*	I*	II	I*	II
	1	26	I	II	II	I*	I*	I*	II	I*
	2	1	II	I*	II	I	II	I	I*	II
	2	6	II	I*	II	II	II	I*	II	II
	2	11	II	I*	II	II	I	I*	II	I*
	2	16	II	II	II	II	I	I*	I*	II
	2	21	II	II	I*	I*	I*	I*	II	I*
	2	26	I*	---	II	I*	I*	I*	I	I*
	3	1	II	II	II	I	I	II	I*	II
	3	6	II	I	II	I	II	II	II	II
	3	11	II	I	II	I	II	II	II	II
	3	16	II	I	II	I	II	I	I*	II
	3	21	II	I*	II	I	II	I	I*	II
	3	26	II	I*	II	I	II	I	I	II
	4	1	II	I*	II	I	II	I	I*	II
	4	6	I*	II	II	I	II	I	I*	II
	4	11	I*	I*	II	I	I*	I*	II	II
	4	16	II	I*	II	I*	II	I	I*	II
	4	21	II	I*	I*	I*	II	I	I*	II
	4	26	I*	I*	I*	I*	II	I	I	II
	5	1	II	I	II	I*	I*	I*	I*	II
	5	6	II	I	II	I*	I*	I*	I*	II
	5	11	I	I*	II	I*	I*	I*	II	II
	5	16	II	I*	II	I*	I*	I*	I*	II
	5	21	II	I*	II	I*	I*	I*	I*	II
	5	26	I*	I*	II	I*	I*	I*	I	II
	6	1	I	---	II	II	I	II*	I*	II
	6	6	I	I	II	II	II	I	I*	I*
	6	11	I	I	II	I*	I	I	I*	I*
	6	16	I	I*	II	I*	I	I	I*	I*
	6	21	I	I	II	I*	I	I	I*	II
	6	26	I	I	II	I*	I*	I	I	I*

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Fishing Creek	1	1	II	---	II	I	I	I	I	II
P13	1	6	II	---	II	I	I	I	I	II
	1	11	II	I*	II	I	I*	I*	I	II
	1	16	II	II	II	I	I*	I*	I	II
	1	21	II	I*	II	I	I*	I*	I	II
	1	26	I*	II	II	I	I*	I*	I*	I*
	2	1	II	I	II	I	I*	I	I	II
	2	6	II	I	II	I	I*	I	I	II
	2	11	II	I	II	I	I*	I	I	II
	2	16	II	II	II	I	I*	I	I	II
	2	21	II	II	II	I	I*	I	I	II
	2	26	I*	II	II	I	I*	I	I	II
	3	1	II	II	II	I	I*	I	I	II
	3	6	I	I*	II	I	I*	I	I	II
	3	11	II	I*	II	I	I*	I	I	II
	3	16	II	I*	II	I	I*	I*	I	II
	3	21	II	II	II	I*	I*	I*	I	I*
	3	26	I	I*	II	I*	I*	I*	I*	I*
	4	1	I	I	II	I	I	I	I	II
	4	6	I	II	II	I	I	I	I	II
	4	11	I	I	II	I	I*	I	I	II
	4	16	I	I	II	I	I*	I	I	II
	4	21	I	I	II	I	I*	I	I	I
	4	26	I	I	---	I	I*	I	I	I
	5	1	II	I	II	II	I	I	I	II
	5	6	II	I	II	I	I	I	I	II
	5	11	II	I	II	I	I	I	I	II
	5	16	II	I	II	I	I	I	I	II
	5	21	II	II	II	I*	I*	I	I	II
	5	26	II	I	II	I	I	I	I	II
	6	1	I	II	II	I	I	I	I	I
	6	6	II*	I	I	II*	I	I	II	I
	6	11	I	I	I	I	I	I	I	I
	6	16	II	II	I	I	I	I	I	I
	6	21	I	I*	I	I	I	I	I	I
	6	26	I	I	I	I	I	I	I	I

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	SUMMER 2000	2001	2002	2003	2004	2005	2006	2007
Prince George	1	1	I	I	II	I	I	I	I	I*
P14	1	6	I	I	II	I	I	I	I	I*
	1	11	I	I*	II	I	I	II*	I	I*
	1	16	I	I	II	I	I	I	I	I*
	1	21	I	I	I*	I	I	II*	I	I*
	1	26	I	I*	I*	I	I	I	I	I*
	2	1	I	I	II	I*	I	I	I	I*
	2	6	I	I	II	I*	I	I	I*	I*
	2	11	I	I	II	I*	I	I	I	I
	2	16	I	I	I*	I*	I	I	I*	I
	2	21	I	I*	I*	I*	I	I	I	I
	2	26	I	I*	I*	I*	I	I	I	I
	3	1	I	I	II	I	I	I	I	I
	3	6	I	II*	II	I	I	I	I	I*
	3	11	I	I	II	I	I	I	I	I*
	3	16	I	I*	II	I	I	I	I	I*
	3	21	I	I	I*	I	I	I	I	I*
	3	26	I	I	I*	I	I	I	I	I*
	4	1	I	I	II	I	I	I	I	I*
	4	6	I	I	II	I*	I	I	I	I*
	4	11	I*	I	II	I*	I	I	I	I*
	4	16	I	I	II	I*	I	I	I	I*
	4	21	I	I	I*	I*	I*	I	I	I*
	4	26	I	I	I*	I*	I*	I	I	I*
	5	1	I	II	II	I	I	I	I	I*
	5	6	II	II	II	I	I	II*	I	I*
	5	11	I	I	II	I	I	I	I	I*
	5	16	I	I	II	I	I	I	I	I*
	5	21	I	I	II	I	I	I	I	I*
	5	26	I	I*	I*	I	I	I	I	I*
	6	1	I	I	I	I	I	I	I	I
	6	6	I	I	II	I	I	I	I	I*
	6	11	I	I	I*	I	I	I	I	I*
	6	16	I	I	I*	I	I	I	I	I*
	6	21	I	I	I*	I	I	I	I	I*
	6	26	I	II	I*	I	I	I	I	I*

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Town Creek	1	1	---	II	II	II	I	II	I*	I*	II
P3	1	6	---	II	II	II	I*	II	I*	I*	II
	1	11	---	II	II	II	I*	II	I*	I*	II
	1	16	---	I*	II	II	I*	II	I*	I*	II
	1	21	---	I*	II	I*	I*	II	I*	I*	II
	1	26	I*	I*	II	I*	I*	II	I*	I*	I*
	2	1	II	II	II	II	I*	II	I*	I*	II
	2	6	II	II	II	I*	I*	II	I*	I*	II
	2	11	I*	II	II	I*	I*	I*	I*	I*	II
	2	16	I	II	II	I*	I*	II	I*	I*	II
	2	21	I*	II	II	I*	I*	I*	I*	I*	II
	2	26	I*	II	II	II	I*	I*	I*	I*	II
	3	1	II	I	II	II	II	II	I*	I*	II
	3	6	I	II	II	II	I	II	I*	I*	II
	3	11	I	II	II	II	I*	II	I*	I*	II
	3	16	I*	I*	II	II	I*	II	I*	I*	II
	3	21	I*	II	II	II	I*	II	I*	I*	II
	3	26	I*	II	II	II	I*	II	I*	I*	II
	4	1	I	II	II	II	II	II	I*	I*	II
	4	6	I*	I*	II	II	I*	II	I*	I*	II
	4	11	II	I*	II	II	I*	I*	I*	I*	II
	4	16	II	I*	II	II	I*	II	I*	I*	II
	4	21	II	II	II	II	I*	II	I*	I*	II
	4	26	II	II	II	II	II	II	I*	I*	II
	5	1	---	II	II	II	I	II	II	I	II
	5	6	I	II	II	II	I	II	I*	I*	II
	5	11	I	II	II	II	I*	II	I*	I*	II
	5	16	II	II	II	II	I*	II	I*	I*	II
	5	21	---	II	II	II	I*	II	I*	I*	II
	5	26	II	II	II	II	II	II	I*	I*	II
	6	1	II	II	II	II	II	II	I*	I*	II
	6	6	II	II	II	II	I*	II	I*	I*	II
	6	11	II	II	II	II	I*	II	I*	I*	II
	6	16	II	II	II	II	I*	II	I*	I*	II
	6	21	II	II	II	II	I*	I*	I*	I*	II
	6	26	II	II	II	II	I*	II	I*	I*	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Eagle Island	1	1	---	II	II	II	II	II	II*	II*	II
P6	1	6	---	II	II	II	II	II	II*	II*	II
	1	11	---	II	II	II	II	II	II*	II	II
	1	16	I	II	II	I	II	II	II*	I*	II
	1	21	I	II	II	I	II	II	II	I*	II
	1	26	I*	II	II	I*	II	II	II	I*	II
	2	1	I	II	II	II	II	II	II	I*	II
	2	6	I	II	II	II	II	II	II	I*	II
	2	11	---	II	II	II	II	II	II	I*	II
	2	16	---	II	II	II	I*	I*	I*	I*	II
	2	21	I	II	II	II	I*	I*	II	I*	II
	2	26	I	II	II	II	I*	I*	I*	I*	II
	3	1	I	II	II	II	II	II	II	II	II
	3	6	---	II	II	II	II	II	II	II	II
	3	11	I*	II	II	II	II	II	II	II	II
	3	16	I*	I*	II	II	II	II	II	I*	II
	3	21	I*	II	II	I*	I*	II	II	I*	II
	3	26	II	II	II	I*	I*	I*	II	I*	II
	4	1	I	II	II	II	II	II	II	II	II
	4	6	I*	II	II	I*	I*	I*	II	I	II
	4	11	I*	II	II	I*	I*	I*	II	I	II
	4	16	II	I*	II	I*	I*	II	I	I*	II
	4	21	I*	II*	II	I*	I*	I*	I*	I*	II
	4	26	I*	II	II	I*	I*	I*	I*	I*	II
	5	1	I	II	II	II	II	II	II	I	II
	5	6	I*	II	I*	I*	II	II	II	I*	II
	5	11	I	II	I*	I*	II	I	II	I*	II
	5	16	I*	II	I*	I*	II	I	I*	I*	II
	5	21	I*	II	II	I*	I	I*	II	I*	I*
	5	26	I*	II	I*	I*	II	I	II	I*	I*
	6	1	I	I*	I*	II	II	II	II	I*	II
	6	6	I*	I*	I*	I*	II	I	II	I*	II
	6	11	I	I*	I*	I*	I	I	II	I*	II
	6	16	I	I*	I*	I*	I	I	II	I*	II
	6	21	I	I*	I*	I*	I	I	II	I*	II
	6	26	I	I*	I*	I*	I	I	II	I*	II
	1	1	I	I	I	I	I	I	II*	I	I
	1	6	I	I	I	II*	II*	I	II*	I	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Indian Creek	1	11	I	I	I	II	II*	---	II	I	II
P7	1	16	---	I	I	II	II*	0	I	I	II
	1	21	I	I	I	II	I	I	I	I*	II
	1	26	I	I	I	II	I	I*	I*	I*	II
	2	1	I	I	I*	I*	I	I	I	I	II
	2	6	I	I	I*	I*	I	I	I	I	II
	2	11	I	I	I*	I*	I	I	I	I	II
	2	16	I	I	I*	I*	I*	I	I	I*	I*
	2	21	I*	I	I*	I*	I*	I	I*	I*	I*
	2	26	I*	I	I*	I*	I*	I	I*	I	I*
	3	1	I	I	I	I*	I	I	I	I	I*
	3	6	I*	I	I	I*	I	I	I	I	I*
	3	11	I*	I	I*	I*	I*	I	I	I*	I*
	3	16	I	I	I*	I*	I*	I	I	I	II
	3	21	I*	I	I*	I*	I	I*	I	I*	II
	3	26	I	I	I*	I*	I	I	I	I*	I*
	4	1	I	I	I	I	I	I	I	I	I*
	4	6	I	I	I	I*	I	I	I	I	I*
	4	11	I	I	I	I*	I*	I	I	I	I*
	4	16	I*	I	I	I*	I*	I	I	I	I*
	4	21	I*	I	I	I*	I*	I	I	I	I*
	4	26	I	I	I	I*	I*	I	I	---	I*
	5	1	I	I	I	---	I	I	I	I	I*
	5	6	I	I	I	I	I	I	I	I	I*
	5	11	I	I	I	I	I	I	I	II*	I*
	5	16	I*	I	I	I	I	I	I	I	I*
	5	21	I	I	I	I	I	I	I	I	I*
	5	26	I*	I	I	I	I	I	I	I	I*
	6	1	I	I	I	I	I	I	I	I	I*
	6	6	I	I	I	I	I	I	I	I	I
	6	11	I	I	I	I	I	I	I	I	I
	6	16	I	I	I	I	I	I	I	I	I
	6	21	I	I	I	I	I	I	I	I	I
	6	26	II*	I	I	I	I	I	I	I	I
	1	1	---	II*	I	I	I	I	I	I	II
	1	6	I	II*	II*	I	II	I	I	I	II
	1	11	II	II*	II*	I	II	I	I	I	II
	1	16	I	II*	II*	I	I	I	I	I	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Dollisons	1	21	I*	II	II*	I	I	I	I	I	II
Landing P8	1	26	II*	II*	I	I	I	I	I	I	II
	2	1	---	I	I	I	I	I	I	I	I
	2	6	---	I	I	I	I	I	I	I	I
	2	11	II	I	I	I	I	I	I	I	I
	2	16	II	I	I	I	II*	I	I	I	I
	2	21	I	I	I	I*	II*	I	I	I*	I
	2	26	I	I	I	I	I	I	I	I*	I
	3	1	II	I	I	I	I	I	I	I*	I
	3	6	I	I	I	I	I	I	I	I*	I
	3	11	II*	II*	I	I	I	I	I	I*	I*
	3	16	I	II*	I	I	I	I	I	I*	I
	3	21	II	I	I	I	II*	I	I	I*	I
	3	26	I	I	I	I	I	I	I	I*	I
	4	1	II	I	I	I	I	I	I	I*	I
	4	6	I	I	I	I	I	I	I	I*	I
	4	11	I*	I	I	I	I	I	I	I*	I
	4	16	---	I	I	I	I	I	I	I*	I
	4	21	---	I	I	I	I	I	I	I*	I
	4	26	I	I	I	I*	I	I	I	I*	I
	5	1	I	I	I	I	I	I	I	I*	I
	5	6	II	I	I	I	I	I*	I	I*	I
	5	11	---	I	I	I	I	I*	I*	I*	I
	5	16	II	I	I	I	I	I*	I*	I*	I
	5	21	I	II*	I	I	I	I*	I*	I*	I
	5	26	II	I	I	I	II*	I	I*	I*	I*
	6	1	I*	I	I	I	I	I	I*	I	I
	6	6	I	I	I	I	I	I*	I*	I	I
	6	11	II*	I	I*	I	I	I*	I*	I	I
	6	16	II	I	I	I*	I	I	II	I	I
	6	21	---	I	I	I	I	I	I*	I	I
	6	26	I	I	I	I	I	I*	I*	I	I
	1	1	---	I	I	I*	II	I	I	I	II
	1	6	I	I	I	I	II	I	I	I	II
	1	11	I	I	I	I	I	I	I*	I	I
	1	16	I	I	I	I	I	I	I*	I	I
	1	21	I	II	I	I	I	I	I*	I	I
	1	26	I*	II	I	I	I	I	I	I	I

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Black River	2	1	I	II*	I	I	I	I	I	I	II
P9	2	6	I	II*	I	I	I	I	I	I	I
	2	11	I	I	I	I	I	I	I	I	I
	2	16	I*	I	I	I	I	I	I	I*	I
	2	21	I	II	I	I	I	I	I	I*	I
	2	26	I	I	I	I*	I	I	I	I	I
	3	1	I	II*	I	I	I	I	I	I	I
	3	6	I	II*	I	I	I	I	I	I	I
	3	11	I	II*	I	I	I	I	I	I	I
	3	16	I	I	I	I	I	I	I	I	I
	3	21	I	II	I	I	I	I	I*	I*	I
	3	26	I	II*	I	I	I	I	I*	I*	I
	4	1	I	II*	I	I	I	I	I	I*	I
	4	6	I*	I	I	I	I	I	I	I*	I
	4	11	I*	II*	I	I	I	I	I	I*	I
	4	16	I*	II*	I	I	I	I	I*	I*	I
	4	21	I*	II*	I	I	I	I	I*	I*	I
	4	26	I*	II*	I	I	I	I	I	I*	I
	5	1	I*	II*	I	I	I	I	I	I*	II
	5	6	I	II*	I	I	I	I	I	I*	II
	5	11	I	II*	I	I*	I	I	I	I	II
	5	16	I*	II*	I	I*	I	I	I	I*	II
	5	21	I*	II*	I*	I	I	I	I	I*	II
	5	26	I*	II*	I	I*	I	I	I	I*	I
	6	1	I	I	I	I	I	I	I	I	II
	6	6	I	I	I	I	I	I	I	I*	II
	6	11	I*	I	I	I	I	I	I	I*	I
	6	16	I*	I	I	I	I	I	I*	I	I
	6	21	I	II*	I	I	I	I	II*	I*	I
	6	26	I	II*	I	I	I	I	I*	I*	I
	1	1	I	II	II	II	II	II	II	II	II
	1	6	I*	I*	II	II	II	II	II	II	II
	1	11	---	II	II	II	II	II	II	I*	II
	1	16	I*	II	II	II	II	II	II	I*	II
	1	21	I*	II	II	II	II	II	I*	I*	II
	1	26	---	II	II	II	II	II	I*	I*	II
	2	1	II	II	---	II	II	II	II	I*	II
	2	6	I*	II	II	II	II	II	II	I*	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Smith Creek	2	11	I*	II	II	II	II	II	II	I*	II
P11	2	16	I*	II	II	II	II	II	II	I*	II
	2	21	I*	II	II	II	II	II	II	I*	II
	2	26	---	II	II	II	II	II	II	I*	II
	3	1	---	II	II	II	II	II	II	I*	II
	3	6	I*	II	II	II	II	II	II	I*	II
	3	11	I*	II	II	II	II	II	I*	I*	II
	3	16	I*	II	II	II	II	II	I*	I*	II
	3	21	I*	II	II	II	II	II	I*	I*	II
	3	26	I*	II	II	II	II	II	I*	I*	II
	4	1	I	II	II	II	II	II	II	I*	II
	4	6	II	I	II	II	II	I*	II	I*	II
	4	11	II	II	II	II	II	I*	I*	I*	II
	4	16	II	II	II	II	II	I*	I*	I*	II
	4	21	II	II	II	II	II	I*	I*	I*	II
	4	26	II	II	II	II	II	II	I*	I*	II
	5	1	II	II	II	II	II	II	II	I*	II
	5	6	II	II	II	II	II	II	I*	I*	II
	5	11	I*	II	II	II	II	II	I*	I*	II
	5	16	I*	II	II	II	I*	I*	I*	I*	II
	5	21	I*	II	II	II	I*	I*	I*	I*	II
	5	26	---	II	II	II	I*	I*	II	I*	II
	6	1	---	II	II	II	II	II	II	I*	II
	6	6	---	II	II	II	II	II	I*	I*	II
	6	11	---	II	II	II	II	II	I*	I*	II
	6	16	---	II	II	II	I*	II	I	I*	II
	6	21	---	II	II	II	II	II	I*	I*	II
	6	26	---	II	II	II	II	II	I*	I*	II
	1	1	---	II	II	II	II	II	II	II*	II
	1	6	---	II	II	II	II	II	II	II*	II
	1	11	I*	II	II	II	II	II	I*	I	II
	1	16	I*	II	II	II	II	II	I*	I	II
	1	21	I*	II	II	II	I*	II	I	I*	II
	1	26	I*	II	II	II	II	II	II*	I*	II
	2	1	I*	II	II	II	II	II	II*	II*	II
	2	6	I*	I	II	II	II	II	II	II	II
	2	11	I*	II	II	II	II	II	II	I	II
	2	16	I*	II	II	II	II	II	II	I*	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Rat Island	2	21	I*	II	II	II	II	II	I*	I*	II
P12	2	26	I*	II	II	II	II	II	I*	I*	II
	3	1	II	II	II	II	II	II	II	II	II
	3	6	I	II	II	II	II	II	I*	I*	II
	3	11	I*	II	II	II	II	II	I*	I*	II
	3	16	I	II	II	II	II	I	I*	I*	II
	3	21	I	II	II	II	I	II	I	I*	II
	3	26	I	II	II	II	I*	I	I*	I*	II
	4	1	I*	II	II	II	II	II	I	I*	II
	4	6	I*	I*	II	II	II	I	I*	I*	II
	4	11	I*	I*	II	II	II	I	I*	I*	II
	4	16	I*	I*	II	I*	I	I*	I*	I*	II
	4	21	I*	I*	II	I*	I	I*	I*	I*	II
	4	26	I*	I*	II	II	I	I*	I*	I*	II
	5	1	I	II	II	II	I*	I*	I	I	II
	5	6	I	I*	I	II	I*	I*	I	I	II
	5	11	I	I*	II	II	II	II	I	I	II
	5	16	I	I*	II	II	I*	II	I	I	II
	5	21	I	I*	I*	II	I*	II	I	I*	II
	5	26	I	I*	I*	II	I*	II	I	I	II
	6	1	I	I	---	II	II*	II*	II*	II*	II
	6	6	I	I	---	II	II*	II*	II*	II*	II
	6	11	I	I	II	II	II*	II*	II*	I	II
	6	16	I	II	II	II	II	II	II*	II*	II
	6	21	I	I	II	II	I	II	II*	I	II
	6	26	I	I	II	II	I	I*	II*	I	II
	1	1	II	II	I	I	I	I	I	I	II
	1	6	II	II	I	I	I	I	II*	I	II
	1	11	I	II	II	II*	I	I*	II*	I	II
	1	16	I	II	II	II*	II*	I	II*	I	II
	1	21	I	II	II	II*	I	I	II*	I	II
	1	26	I	II	II	II*	I	I	II*	I	II
	2	1	---	II	I	II*	I	I*	I	I	II
	2	6	I	II	II	I	I	I*	I	I	II
	2	11	I	II	II	I	I	I	I	I	II
	2	16	I	I	II	I	I	I*	I	I	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Fishing Creek	2	21	I*	I	II	I	I	I*	I	I	II
P13	2	26	I*	I	II	I*	I*	I*	I	I	II
	3	1	I	I	II	I*	I*	II	I	I	II
	3	6	I	I	II	II	I*	I	I*	I*	II
	3	11	I*	I	II	I*	I*	I*	I*	I*	II
	3	16	I	I	II	I*	I*	I*	I*	I*	II
	3	21	I*	I	II	I*	I*	I*	I*	I*	II
	3	26	I	II	II	I*	I*	I*	I*	I*	II
	4	1	II*	II	II	I	I	I	I	I	II
	4	6	I	II	II	II	I	I	I	I	II
	4	11	I	II	II	II	I	I	I	I	II
	4	16	I	II	II	II	I	I	I	I	II
	4	21	I	I	II	II	I	I	I	I	II
	4	26	I	I	II	II	I	I	I	I	II
	5	1	I	I	---	I	I	I	I	I	II
	5	6	I	I	II	I	I	I	I	I	II
	5	11	I	I	II	I	I	I	I	I	II
	5	16	I	I	II	I	I	I	I	I	II
	5	21	I	I	I*	I*	I	I	I	I	II
	5	26	I	I	---	I*	I	I	I	I	II
	6	1	II	I	I	I	I	I	I	I	I
	6	6	I*	I	I*	I	I	I	I	I	I
	6	11	II	I	I	I	I	I	I	I	I
	6	16	---	I	I	I	I	I	I	I	I
	6	21	II	I	I	I	I	I	I	I	I
	6	26	I	I	I	I	I	I	I	I	II

Table 5.51-5. (continued)

Station	Sub-station	Depth (cm)	WINTER 2000	2001	2002	2003	2004	2005	2006	2007	2008
Prince George	1	1	I	II*	II*	---	I	I	I	I	II
P14	1	6	I	I	II*	II*	I	I	I	I	II
	1	11	I	I	II	II*	I	I	I*	I*	II
	1	16	I	I	II	II*	I	I	I	I	II
	1	21	I	I	II	II*	I	I	I	I	II
	1	26	I	I	II*	II*	I	I	I	I	II
	2	1	I	I	II*	I	I	I	I	I*	II
	2	6	I	I	II*	I	I*	I	I	I*	II
	2	11	I	I	II*	I	I*	I	I	I*	II
	2	16	I	II	II*	I	I*	I	I	I*	II
	2	21	I	I*	II*	I	I*	I*	I	I	II
	2	26	I	I*	II*	I	I*	I*	I	I	II
	3	1	II	I	II*	---	I	I	I*	I*	II
	3	6	II	I	II*	II*	I	I	I*	I*	II
	3	11	I	I	II	I	I	I	I	I	II
	3	16	I	I	II*	I	I	I	I	I*	II
	3	21	I	I	II	I	I*	I	I	I	II
	3	26	I	I	II	I	I*	I*	I	I	II
	4	1	I	I	II*	I	I	I	I	I*	II
	4	6	I	II*	II*	I	I	I*	I	I	I*
	4	11	I	I	II	I*	I*	I*	I	I	I*
	4	16	I	I	II*	I*	I*	I*	I	I*	I*
	4	21	I	I	II	I*	I*	I	I	I	I*
	4	26	I	I	II	I*	I*	I*	I	I	I*
	5	1	I	I	II	II*	I	I	I	I	I*
	5	6	I	I	II*	I	I*	I	I	I	II
	5	11	I	I	II	I	I	I	I	I	II
	5	16	I	II	II	I	I*	I	I	I	II
	5	21	I	I	II	I	I	I*	I	I	II
	5	26	I	I	II	I	I	I	I	I	II
	6	1	II*	II	II*	II*	I	I	I	I	II
	6	6	I	I	II	II*	I	I	I	I	II
	6	11	I	I	II	II*	I	I	I	I	II
	6	16	I	I	II	II*	I	I*	I	I	II
	6	21	I	I	I	II*	I	I	I	I	II
	6	26	I	I	I	I	I	I*	I	I	II

5.52 Indian Creek (P7)

Salinity at Indian Creek during the average year ranged between 0.01 and 1 ppt (Hackney et al. 2005). During the low river flow year salinities reached values as high as 3 ppt (Hackney et al. 2004). The current year salinities (Table 5.51-1), based on chloride concentrations (Table 5.51-2), were the highest recorded during the monitoring project with values ranging between 4 - 7 ppt near the creek bank. The site adjacent to the upland did not appear to be as highly impacted with values less than 0.3 ppt. The majority of sulfate concentrations were in the 2,000 - 9,000 μM range near the creek bank and 50 - 200 μM at the upland sites (Table 5.51-3). These values were well above the average year concentrations of 10 - 350 μM and the low river flow year concentrations of 50-2,000 μM. Methane concentrations were all less than 100 μM with many below the detection limit of approximately 1 μM reflecting the dominance of sulfate reduction during the current year. Most methane concentrations in the low river flow year were 50 -250 μM while average year concentrations reached values of 300 μM. These biogeochemical conditions resulted in all SR classifications with the exception of the upland site, which was M. Both average year and low river flow year classifications were a combination of SR and MPSR with M at the upland station. The presence of all SR classifications at most sites compared to a combination of SR and MPSR reflect the high salinity conditions observed at Indian Creek this year.

5.53 Dollisons Landing (P8)

Dollisons Landing did not appear to be as affected by the high salinity conditions observed in other locations along the river. Salinity at Dollisons Landing during the average year and the low river flow year ranged between 0.02 and 1 ppt (Hackney et al. 2005; Hackney et al. 2004). The current year salinities (Table 5.51-1), based on chloride concentrations (Table 5.51-2), were only slightly elevated 0.05 – 0.4 ppt. The majority of sulfate concentrations were in the 20 – 200 μM range (Table 5.51-3). These values were similar to the average year concentrations of 10 – 600 μM and the low river flow year concentrations of 10 – 400 μM. Methane concentrations were similar for the current year, the low river flow year and the average year (1 – 350 μM). Average year, low river flow year, and the current year classifications were a combination of M and MPSR. The similarity in the biogeochemical conditions and classifications for Dollisons Landing during various years indicates this site may not be as susceptible to salinity intrusions as other locations along the river.

5.54 Black River (P9)

Salinity at Black River during the average year, low river flow year, and the current year were consistently low and range between 0.04 – 0.08 ppt (Table 5.51-1; Hackney et al. 2004; Hackney et al. 2005). The lower range of sulfate concentrations for this site in all three years was similar (~10 μM), however, the upper range of sulfate concentrations was elevated in the low river flow year and the current year (~1,600 μM). Methane concentrations did not reflect the intrusion of salt into this site because of the high variability of methane concentrations (0 – 300 μM). Biogeochemical classifications indicated the relative influx of saltwater between the three years. During the average year classifications were mainly M and some MPSR. During the low river flow year classifications were mainly MPSR and some M. During the current year classifications were similar but had some SR classifications reflecting the higher salinity conditions.

5.55 Smith Creek (P11)

Salinity at Smith Creek during the average year ranged between 1 - 4 ppt (Hackney et al. 2005). During the low river flow year salinities ranged between 8 - 14 ppt (Hackney et al. 2004). The current year salinities (Table 5.51-1), were the highest recorded during the monitoring project with values ranging between 10 – 20 ppt. Sulfate concentrations were in the 1,000 – 9,000 μM range (Table 5.51-3) and were well above the average year concentrations of 200 – 5,000 μM and were similar to the low river flow year concentrations of 2,000 – 12,000 μM. Several methane concentrations were below the detection limit of approximately 1 μM, reflecting the dominance of sulfate reduction during the current year. Most methane concentrations in the low river flow year and average year were 10 – 400 μM. The biogeochemical conditions at Smith Creek during the average year were all SR due to the influence of salinity at this site. The Classifications during the current year and the low river flow year remained SR.

5.56 Rat Island (P12)

Salinity at Rat Island during the average year ranged between 0.2 – 0.8 ppt (Hackney et al. 2005). During the low river flow year salinities ranged between 1 – 8 ppt (Hackney et al. 2004). The current year salinities (Table 5.51-1) were the highest recorded during the monitoring project with values ranging between 3 – 18 ppt. Sulfate concentrations were in the 200 – 3,000 μM range during the current summer, but reached values between 1,000 – 9,000 μM during the winter (Table 5.51-3). These winter values were well above the average year sulfate concentrations of 50 – 900 μM and the low river flow year sulfate concentrations of 100 – 6,000 μM. Average year methane concentrations reached values of 500 μM. Methane concentrations were all less than 350 μM during the current year and the low river flow year with many below the detection limit of approximately 1 μM reflecting the impact of high salinities during these years. The biogeochemical conditions at Rat Island during the average year and low river flow year, and the current summer were a combination of SR and MPSR. The current winter classifications were all SR reflecting the impact of higher sulfate concentrations during this time of the current year.

5.57 Fishing Creek (P13)

Salinity at Fishing Creek during the average year ranged between 0.02 – 0.1 ppt (Hackney et al. 2005). During the low river flow year salinities reached values of 2 - 7 ppt (Hackney et al. 2004). The current year salinities (Table 5.51-1) were similar to the low river flow year with values ranging between 1 – 8 ppt with the exception of the upland site S6, which had values less than 0.3 ppt. The majority of sulfate concentrations were in the 50 – 300 μM range during the average year. Sulfate concentrations during the current year were elevated compared to the average year with values ranging between 100 – 4,000 μM (Table 5.51-3), similar to values observed during the low river flow year (1,000 – 5,000μM). Methane concentrations in the average year were 10 – 300 μM. Methane concentrations during the current year and the low river flow year were all less than 170 μM with many below the detection limit of approximately 1 μM reflecting the dominance of sulfate reduction during these years. Average year classifications were mainly M with a few MPSR, SR, and SRNS. The classifications at most sites during the current year and the low river flow year transitioned spatially from SR at the near creek bank locations to MPSR and M classifications at adjacent to the upland. This indicates that sites adjacent to the upland at Fishing Creek are somewhat insulated from changing floodwater chemistry compared to the other locations in this site.

5.58 Prince George Creek (P14)

Salinity at Prince George during the average year ranged between 0.02 – 0.2 ppt (Hackney et al. 2005). During the low river flow year salinities reached values of 1 ppt (Hackney et al. 2004). The current year salinities (Table 5.51-1), were similar to the low river flow year with values ranging between 0.5 – 2 ppt during the winter when the salt impact was greatest. The majority of sulfate concentrations were in the 30 – 120 μM range during the average year. Sulfate concentrations during the current year were elevated compared to the average year, with values ranging between 100 – 1,500 μM during the winter (Table 5.51-3), similar to values observed during the low river flow year (100 – 1,000 μM). Methane concentrations in the average year were 100 – 400 μM. The majority of methane concentrations during the current year and the low river flow year were less than 100 μM reflecting the dominance of sulfate reduction. Average year classifications were mainly M with a few MPSR, SR, and SRNS. The classifications at most sites during the winter of the current year and the low river flow year were SR with some MPSR.

5.6 Long Term Trends and Change

The patterns of variations for the current year and previous years follow.

Year 1 (winter 2000, 2001, summer 2000):

During the first year of the study general geochemical classifications were established for the sites in order to compare with future conditions. 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).

Year 2 (winter 2002, summer 2001):

In the second report, which included the summer of 2001 and the winter of 2002 (Hackney et al. 2002, 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 resulting from an increase in salinity. 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 methanogenic classifications converted to sulfate reducing. Smith Creek (P11), which was already a sulfate reducing system, recorded higher salinities in porewaters.

The summer 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 2002 and saltier conditions in summer 2001 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.

Year 3 (winter 2003, summer 2002):

Increases in porewater salinities observed during previous summers continued through the summer of 2002 in the Northeast Cape Fear River (Fishing Creek, Prince George, Rat Island, and Smith Creek). 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 was 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 the 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 and Eagle Island) all sites had lower winter porewater salinities than previous winters. For the upper Cape Fear River stations (Black River and Dollisons Landing), winter conditions showed a steady decrease in salinity since 2000. 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, and Smith Creek), 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 upstream stations (Fishing Creek and Prince George), several substations that previously converted to sulfate reducing returned to a methanogenic geochemical classification in 2003. Porewater salinities of Town Creek, Indian Creek, and Eagle Island increased during the winter (2003). The changes in geochemical classifications were relatively small for these sites with only slight changes towards higher salinity classifications.

Year 4: (winter 2004, summer 2003)

Low salinity conditions characterize Year 4, summer 2003 and winter 2004. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. Several sites had conditions that were the lowest in salinity since the study began in 2000. For the most seaward station, Town Creek, both the winter and summer were the freshest on record. The Cape Fear River sites (Indian Creek, Dollisons Landing, and Black River) had a relatively low salinity winter and a summer that was the freshest observed during this study. While all Northeast Cape Fear River sites had relatively fresher conditions during the current year, there was more variability in the extent to which they experienced low salinities. Fishing Creek had the freshest winter and summer on record, Prince George had the freshest winter on record, and Rat Island had the freshest summer on record. Smith Creek had fresh conditions during both the summer and winter, but not the freshest on record.

Year 5: (winter 2005, summer 2004)

Low salinity conditions characterize Year 5 of the study, summer 2004 and winter 2005. In general, all sites experienced conditions that would be considered low salinity on the basis of previous winters and summers. However, conditions were not as fresh as the previous year. Five stations experienced slightly saltier conditions during the current summer (2004) compared to last summer (Town Creek, Indian Creek, Black River, Smith Creek, and Fishing Creek), while Prince George experienced slightly fresher conditions. The remainder of sites had either no change or a mix of fresher and saltier conditions within the site. Two stations experienced slightly saltier conditions during the current winter (2005) compared to last winter (Town Creek and Rat Island), while Indian Creek experienced slightly fresher conditions. Five sites were essentially the same as the previous winter (Eagle Island, Black River, Smith Creek, Fishing Creek, and Prince George) and Dollisons Landing had both saltier and fresher conditions within the site.

Year 6: (winter 2006, summer 2005)

In general, fresher conditions continued though Year 6 of this monitoring study, although slight differences were noted between the current year and the previous one. During the current winter, these slight changes in salinity and mode of organic matter remineralization varied systematically with river location. NECF river sites (Prince George, Fishing Creek, Rat Island, and Smith Creek) displayed a slight freshening, while all but one (Indian Creek) main stream CFR sites showed slightly saltier conditions (Eagle Island, Black River, and Dollisons Landing). Town Creek, which is the most sea ward location monitored for geochemistry was noticeable fresher.

During the summer, there were no consistent patterns with some sites showing slightly saltier conditions (Rat Island creek bank, Smith Creek, Eagle Island, and Town Creek) and some showing slightly fresher conditions (Fishing Creek, Rat Island upland, and Indian Creek). Generally conditions remained fairly fresh during this summer.

Year 7: (winter 2007, summer 2006)

Fresher conditions continued throughout both the winter and summer of Year 7 of the monitoring project. Classifications at most sites were essentially the same as Year 6 with the exception of very slightly fresher conditions.

Year 8: (winter 2008, summer 2007)

The current year proved to be the saltiest year since the beginning of the monitoring project. All stations except ones located most upstream (Dollisons Landing, Black River, Fishing Creek, and Prince George) experienced the highest salinities and subsequent effects since monitoring began. The most upstream stations had elevated salinities similar to the summer of 2002 when previous low river flow conditions were present. The high salinities resulted in a shift towards classifications expected for higher salinities and input of sulfate. Generally methanogenic conditions were replaced by sulfate reducing conditions.

6.0 BENTHIC INFAUNA COMMUNITIES

6.1 Summary

There are nine stations in the Cape Fear River, Northeast Cape Fear, and Town Creek watersheds that were assessed for infaunal community structure each June, in addition to physical, chemical and water level monitoring described in other sections. This report covers from June 2007 to May 2008. The nine stations have all been continuously monitored as part of a long-term effort to evaluate potential impacts of deepening and widening the Cape Fear River since 1999. This report presents data on several community characteristics including comparison of diversity, species richness, functional groups, and major taxonomic groups among stations, and mean abundances of all taxa present by station during the 2007 sampling season. For comparative purposes, mean abundances are presented with analogous data from both 1999 (the first year of sampling) and from the previous (2006-2007) sampling period (Hackney et al. 2007). It is important to note, that conditions prior to the annual collection period are likely responsible for the invertebrate settling in this (2007-2008) report.

Since the initiation of the preconstruction sampling, this system has experienced three major potential system-level impacts: a developing drought in 2001-2002 (Hackney et al. 2003), a period of recovery and relatively higher freshwater input late in 2003 and in 2004 (Hackney et al. 2005), as well as the initiation of channel widening construction in 2001-2002 (Hackney et al. 2003). In order to understand the potential changes to the Cape Fear system, these communities must be followed through a post-construct period that reflects average conditions the system will experience. This project design allows for influences such as normal system variation to be estimated and accommodated in the final analysis of all data.

Nineteen species were considered common, representing the majority of individuals collected among all nine sites. Oligochaetes dominated most sites representing between 20% and 80% of the total number of individuals at a site. Neither species richness nor diversity showed consistent patterns for the 2007 sampling year. The Dollisons Landing site (P8) and the site at the mouth of Town Creek (P2) had greater numbers of species present compared to sites in the Northeast Cape Fear. During the 2007 sampling year, diversity showed only one significant difference with P13 (Fishing Creek site) being significantly less than P2, P3A, P6, or P8. Comparisons between current, previous year and initial sampling showed no consistent pattern for diversity or species richness. Likewise, comparisons of functional groups and major taxonomic groups showed few differences among years.

6.2 Background

Benthic infaunal community patterns integrate environmental changes at a specific site over time. Most infaunal groups have limited post-larval mobility or dispersal, with abundances at a site reflecting a combination of recruitment patterns and site-specific processes and post-settlement mortality. While many infaunal species have short generation times, colonizing and reproducing on the order of months, others are relatively long-lived with life spans of months to years. Infaunal groups generally occupy an intermediate trophic position, consuming detrital or planktonic food sources (although some species are definitely predatory or omnivorous), and being prey for larger fish and decapods. As a result, the infaunal community present in an area represents cumulative impacts of varying environmental factors over a several month period. Changes in the composition of the infaunal community in response to changing environmental conditions may occur more rapidly for more motile organisms that can migrate to optimal locations. However, changes in the infaunal groups may also have fundamental importance for local ecosystem function because of their key position in near shore and estuarine food webs.

The ship traffic into and out of the Cape Fear River port is essential to the economic development of the Cape Fear regions. Trends over the last two decades have been to reduce cost by building larger ships. These ships require deeper channels to operate safely; therefore, the U.S. Army Corps of Engineers initiated a project to deepen the Cape Fear River shipping channel from the mouth of the river to Wilmington. This deepening activity has several potential impacts including the shifting of the tidal salt wedge upstream, changes in tidal amplitude, subsequent shifts in wetland flooding frequency, and changes in inundation time. Benthic infaunal communities have been monitored at stations distributed along the Cape Fear River, Northeast Cape Fear River, and Town Creek where impacts were predicted. Alterations in salinity, flow, and tidal currents are the most likely impacts predicted by numeric models of the Cape Fear River system. Any of these changes would have significant effects on the critical nursery habitats in the Cape Fear River estuary, potentially altering physical and chemical characteristics of the sediment, or the inundation period, leading to alterations in the vegetation along the fringing marsh, shifts in dominant infauna and utilization of habitats by resident and transient fishes.

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, or changes in salinity regime and other physical factors may alter species composition and abundance. These physical changes can 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 coincident with the timing of deepening of the Cape Fear River shipping channel. Current working hypotheses are: 1) Changes in salinity and/or tidal amplitude and/or inundation period will lead to changes in the intertidal and shallow subtidal benthic community composition; 2) If alterations of the Cape Fear River shipping channel significantly 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. Although decapods, bivalves, and gastropods are also present at some sites, previous work in the Cape Fear estuary reported consistently low abundance or absence of bivalves and gastropods throughout portions of the estuary or entirely absent during some years (Mallin et al. 1999 and 2001). Infaunal groups demonstrate a variety of reproductive, dispersal, and functional strategies that can directly relate to timing and magnitude of their response to shifting environmental conditions. 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 that generally lack specialized appendages, have a burrowing habit, and exhibit direct development. Direct development and dispersal through adult movement in this group can result in locally dense patches, and the ability to respond quickly to local environmental changes. The deeper burrowing habit of oligochaetes 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. Amphipods serve as a critical food resource in fringing wetlands during certain time periods, especially during the periods of spring and fall recruitment. 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. Like other infaunal groups, this group includes a number of living strategies including near-surface, tube-dwelling, and free-living species that would be susceptible to predation especially by juvenile fish that recruit into the system in the spring and to a lesser extent in the fall of each year.

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 within the inner Town Creek), three stations in the main stem Cape Fear above the City of Wilmington [Eagle Island (P6), Indian Creek (P7), and Dollisons Landing (P8)], and three stations in the Northeast Cape Fear River [Smith Creek (P11), Rat Island (P12), and Fishing Creek (P13). These stations are also monitored for epifauna patterns (Section 7.0) and are monitored for hydrological characteristics typically thought to impact infauna.

Infaunal core samples (10 cm diameter x 15 cm deep) were collected at two upper intertidal subsites and two lower intertidal subsites at each station. These subsites 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 were collected at all stations in June 2007. All samples were fixed in a 10% formalin solution (~ 4% formaldehyde), with Rose Bengal dye added, 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 genus or species. All sites were compared based on species richness, diversity (Shannon diversity index), total abundance, major taxonomic groups, and functional groupings. All data were log transformed to meet the assumption of homogeneous variances for Analysis of Variance (ANOVA).

6.4 Faunal Patterns

While four locations (two upper intertidal and two lower intertidal subsites) were sampled at each station, mean total abundances for all infaunal species present at a specific station are given by tidal position. In order to more easily compare the relative abundance and shifts in composition among years and tidal positions, abundance data is presented in three year blocks: 1999 (initial sampling year), 2006 (previous sampling year) and 2007 (current sampling year), by tidal position and only for taxa that were present at that site/substation combination. Tables 6.4-1a and 6.4-1b represent the mouth of Town Creek (P2) located in the mesohaline region of the Cape Fear River, while Tables 6.4-2a and 6.4-2b and Tables 6.4-3a and 6.4-3b represent the two inner Town Creek sites, P3A and P3B respectively. Shifts in species composition and relative abundance were evident in the main stem Cape Fear sites: Eagle Island (P6) (Tables 6.4-4a and 6.4-4b), Indian Creek (P7) (Tables 6.4-5a and 6.4-5b), and Dollisons Landing (P8) (Tables 6.4-6a and 6.4-6b). Most of these individual species shifts follow changes in major taxonomic groups, as similar patterns were reported in the 2006 sampling year (Hackney et al. 2007). Many of the changes observed among years represent considerable species replacement within a guild or higher taxonomic grouping. Mean abundances for the three Northeast Cape Fear River stations, Smith Creek (P11) (Tables 6.4-7a and 6.4-7b), Rat Island (P12) (Tables 6.5-8a and 6.4-8b), and Fishing Creek (P13) (Tables 6.4-9a and 6.4-9b) also show a high degree of variability among years, generally following the shifts in major guild or taxonomic groups.

Table 6.4-1a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0(0)	0.25(0.25)	0(0)
amphipod sp.	0.17(0.17)	0(0)	0(0)
Apocorophium louisianum	0(0)	0(0)	166.00(147.07)
Apocorophium sp.	0(0)	0(0)	7.75(7.75)
Bezzia/Palpomyia	0.50(0.50)	0.50(0.29)	0(0)
juv. Bivalve	1.00(0.36)	2.00(0.71)	0.25(0.25)
Boccardiella sp.	0(0)	0.25(0.25)	0(0)
Cassidinidea lunifrons	0.17(0.17)	0.75(0.48)	0(0)
Corophium lacustre	0(0)	25.00(9.23)	0(0)
Corophium sp.	0.17(0.17)	0.50(0.50)	0(0)
Curculionidae sp.	0(0)	1.00(0.58)	0(0)
Cyathura polita	0(0)	0(0)	0.75(0.75)
Dicrotendipes nervosa	0(0)	0(0)	0.50(0.29)
Dicrotendipes sp.	2.00(0.93)	0.50(0.50)	0(0)
(*Dumosus* sp.)	0(0)	0.75(0.75)	0(0)
Eteone heteropoda	0(0)	0.25(0.25)	0.50(0.29)
Fabriciola trilobata	0(0)	0(0)	68.00(33.48)
Gammarus tigrinus	0(0)	4.75(3.82)	1.50(0.64)
Hargeria rapax	0(0)	55.00(26.69)	85.25(79.32)
Hobsonia florida	3.67(2.01)	0.25(0.25)	3.00(1.78)
insect sp.	0.17(0.17)	0(0)	0(0)
Laeonereis culveri	0.17(0.17)	0.25(0.25)	0.50(0.29)
Marenzelleria viridis	1.67(1.67)	0(0)	0.25(0.25)
Neanthes succinea	0(0)	0.50(0.50)	1.25(0.95)
Nereis riisei	0.67(0.49)	0(0)	0(0)
Oligochaete	36.50(11.55)	0(0)	0(0)
Orchestia uhleri	0(0)	0(0)	0.25(0.25)
Owenia sp.	0.17(0.17)	0(0)	0(0)
Palaemonetes pugio	0.17(0.17)	0(0)	0(0)
Parandalia sp.	1.00(0.63)	0(0)	0(0)
Parandalia sp. A	0(0)	0.75(0.48)	1.00(1.00)
Polydora ligni/cornuta	12.17(10.83)	1.50(1.50)	8.25(7.92)
Polydora socialis	5.50(4.11)	0(0)	0(0)
Polypedilum sp.	1.50(0.72)	0(0)	0(0)
Streblospio benedicti	0.83(0.31)	0(0)	7.75(3.06)
Tanais sp.	0.33(0.33)	0(0)	0(0)
Tubificidae spp.	0(0)	6.50(4.63)	101.75(39.13)
Tubificoides heterochaetus	0(0)	0.25(0.25)	7.50(3.80)

Table 6.4-1b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected on the Town Creek mouth site (P2) during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
amphipod sp.	0.17(0.17)	0(0)	0(0)
Apocorophium sp.	0(0)	0(0)	0.25(0.25)
Anurida maritima	0(0)	0.25(0.25)	0(0)
juv. Bivalve	0(0)	0.25(0.25)	0(0)
Cerapus tubularis	0(0)	0.25(0.25)	0(0)
Collembola sp.	0.17(0.17)	0(0)	0(0)
Corophium lacustre	0(0)	0.50(0.50)	0(0)
Edotea (*montosa*)	0.17(0.17)	0(0)	0(0)
Gammarus tigrinus	0.33(0.33)	0(0)	0(0)
Hargeria rapax	0(0)	0.50(0.29)	0(0)
Hobsonia florida	0.83(0.83)	0(0)	0(0)
Laeonereis culveri	0.17(0.17)	0(0)	0.25(0.25)
Mediomastus ambiseta	1.17(0.83)	1.75(1.75)	3.00(2.38)
Mediomastus sp.	1.67(0.99)	1.25(0.95)	3.00(2.12)
Neanthes succinea	0(0)	0(0)	0.25(0.25)
Nemertea sp.	0.17(0.17)	0(0)	0(0)
Oligochaete	4.83(2.21)	0(0)	0(0)
Palaemonetes (pugio)	0(0)	0.25(0.25)	0(0)
Parandalia sp.	2.50(0.85)	0(0)	0(0)
Parandalia sp. A	0(0)	0(0)	2.00(0.71)
Paraprionospio pinnata	0.17(0.17)	0(0)	0(0)
Polydora ligni/cornuta	0.83(0.83)	0(0)	0(0)
Rangia cuneata	0(0)	0(0)	0.25(0.25)
Sphenia antillensis	0(0)	0.25(0.25)	0(0)
Streblospio benedicti	3.00(1.69)	0(0)	5.25(0.75)
Syllidae sp.	0.17(0.17)	0(0)	0(0)
Tubificidae spp.	0(0)	1.00(0.71)	0(0)
Tubificoides heterochaetus	0(0)	3.50(1.89)	13.75(3.77)

Table 6.4-2a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 1999, 2006 and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0.17(0.17)	0(0)	0(0)
Americorophium aquafuscum	0(0)	0(0)	0.50(0.50)
Apocorophium lacustre	0(0)	0(0)	0.25(0.25)
Bezzia/Palpomyia	0(0)	0.25(0.25)	0.25(0.25)
juv. Bivalve	0.17(0.17)	0(0)	0.25(0.25)
Cassidinidea lunifrons	0(0)	0.25(0.25)	0.25(0.25)
Collembola sp.	0.33(0.21)	0(0)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0.50(0.50)
Diptera sp.	0(0)	0.25(0.25)	0(0)
Dolichopodidae sp.	0(0)	0.50(0.50)	0.25(0.25)
Dolichopus sp.	1.83(1.83)	0(0)	0(0)
Gammarus tigrinus	0.33(0.33)	0(0)	0(0)
juv. Gastropod	0(0)	0.25(0.25)	0(0)
insect pupae	0.17(0.17)	0(0)	0(0)
insect sp.	0.17(0.17)	0(0)	0(0)
insect sp. b	0.17(0.17)	0(0)	0(0)
insect sp. g	0.33(0.33)	0(0)	0(0)
Laeonereis culveri	0.67(0.67)	0(0)	0(0)
(*Limnophyes* sp.)	0(0)	0.50(0.29)	0(0)
(Lumbriculidae sp.)	0(0)	0.25(0.25)	0(0)
Oligochaete	36.67(24.02)	0(0)	0(0)
Orchestia uhleri	0(0)	1.75(0.25)	0.75(0.48)
Orthocladinae sp.	0(0)	0(0)	0.25(0.25)
Tubificidae spp.	0(0)	29.75(9.80)	31.00(8.61)
Uca minax	0.17(0.17)	0(0)	0(0)
Uca pugilator	0.50(0.34)	0(0)	0(0)
Uca pugnax	0.17(0.17)	0(0)	0(0)

Table 6.4-2b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3A upper Town Creek sites during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
Ampharetidae sp.	0.17(0.17)	0(0)	0(0)
amphipod sp.	0.67(0.33)	0(0)	0(0)
Anurida maritima	0(0)	0.25(0.25)	0(0)
Americorophium aquafuscum	0(0)	0(0)	2.75(0.85)
Apocorophium lacustre	0(0)	0(0)	8.25(5.26)
Apocorophium louisianum	0(0)	0(0)	1.00(1.00)
Apocorophium sp.	0(0)	0(0)	1.25(1.25)
juv. Bivalve	0.17(0.17)	0(0)	0(0)
Cassidinidea lunifrons	0.17(0.17)	0.25(0.25)	0.50(0.50)
Coleoptera sp.	0(0)	0.25(0.25)	0(0)
Cyathura (madelinae)	0(0)	0(0)	1.50(0.87)
Cyathura polita	0(0)	0(0)	1.00(1.00)
Dicrotendipes nervosus	0(0)	0(0)	1.75(0.63)
Dolichopodidae sp.	0(0)	2.25(1.11)	0.25(0.25)
Gammarus plumosa	0.17(0.17)	0(0)	0(0)
Gammarus tigrinus	2.67(2.12)	0(0)	0(0)
juv. Gastropod	0.17(0.17)	0.25(0.25)	0(0)
Hargeria rapax	0(0)	0(0)	0.25(0.25)
Hemiptera sp.	0(0)	0.25(0.25)	0(0)
Hobsonia florida	3.17(1.33)	0(0)	4.25(2.59)
insect larva b	0.17(0.17)	0(0)	0(0)
insect pupae	0.17(0.17)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	2.00(0.91)
(*Limnophyes* sp.)	0(0)	0.25(0.25)	0(0)
Marenzelleria viridis	0.33(0.33)	0(0)	0(0)
Mediomastus ambiseta	0.17(0.17)	0(0)	0(0)
Mediomastus califoriensis	0.17(0.17)	0(0)	0(0)
Melita nitida	0(0)	0(0)	0.50(0.50)
Munna sp.	0.17(0.17)	0(0)	0(0)
Oligochaete	5.00(3.85)	0(0)	0(0)
Orchestia uhleri	0(0)	0.75(0.25)	0(0)
Palaemonetes pugio	0(0)	0(0)	0.25(0.25)
Polydora ligni/cornuta	0.17(0.17)	0(0)	0(0)
Polydora sp.	0.17(0.17)	0(0)	0(0)
Polypedilum sp.	1.00(0.36)	0(0)	0(0)
Procladius sp.	2.50(0.92)	0(0)	0(0)
Streblospio benedicti	0.17(0.17)	0(0)	0.50(0.50)
Tanytarsus sp.	0.50(0.34)	0(0)	0(0)
Tubificidae spp.	0(0)	113.00(94.18)	27.25(10.78)
Uca pugilator	0.17(0.17)	0(0)	0.25(0.25)
Uca sp.	0.17(0.17)	0(0)	0.25(0.25)

Table 6.4-3a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Americorophium aquafuscum	0(0)	0(0)	0.50(0.29)
Anurida maritima	0(0)	0(0)	0.75(0.75)
Apocorophium lacustre	0(0)	0(0)	0.25(0.25)
Bezzia/Palpomyia	0(0)	1.00(0.71)	1.00(0.71)
juv. Bivalve	0.40(0.24)	0(0)	0(0)
Cassidinidea lunifrons	0(0)	0.25(0.25)	0.75(0.48)
Collembola sp.	0.40(0.24)	0(0)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0.25(0.25)
Cyathura polita	0(0)	0.25(0.25)	0(0)
Diptera sp.	0(0)	0.50(0.50)	0(0)
Dolichopodidae sp.	0(0)	1.00(0.71)	0(0)
Dolichopus sp.	0.40(0.40)	0(0)	0(0)
juv. Gastropod	0(0)	0.25(0.25)	0(0)
Hargeria rapax	0(0)	0(0)	0.25(0.25)
*Hobsonia flori*da	0(0)	0(0)	0.25(0.25)
insect larva c	0.40(0.24)	0(0)	0(0)
Laeonereis culveri	0(0)	1.00(0.41)	0.75(0.48)
Lumbriculidae sp.	0(0)	0.50(0.50)	0(0)
Marenzelleria viridis	0.20(0.20)	0(0)	0(0)
Munna sp.	0.20(0.20)	0(0)	0(0)
Oligochaete	16.40(6.24)	0(0)	0(0)
Orchestia sp.	0.20(0.20)	0(0)	0(0)
Orthocladinae sp.	0(0)	0(0)	0.50(0.29)
Paratendipes sp.	0(0)	0.50(0.50)	0(0)
Tubificidae spp.	0(0)	37.50(12.30)	29.75(16.38)
Uca sp.	0.20(0.20)	0(0)	0.25(0.25)

Table 6.4-3b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P3B upper Town Creek sites during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
Americorophium aquafuscum	0(0)	0(0)	1.25(0.75)
Americorophium sp. A	0(0)	0(0)	1.50(0.96)
amphipod sp.	0.33(0.21)	0(0)	0(0)
Apocorophium louisianum	0(0)	0(0)	0.50(0.50)
Cassidinidea lunifrons	0.17(0.17)	0(0)	0(0)
Chironomidae sp.	0(0)	0.25(0.25)	0(0)
Corophium volutator	0(0)	0.25(0.25)	0(0)
Cryptochironomous sp.	0(0)	0.25(0.25)	0(0)
Cyathura (madelinae)	0(0)	0(0)	0.25(0.25)
Cyathura polita	0(0)	0.25(0.25)	0(0)
Dicrotendipes sp.	0.17(0.17)	0(0)	0(0)
Gammarus lawrencianus	0.83(0.83)	0(0)	0(0)
Gammarus sp.	0.17(0.17)	0(0)	0(0)
Gammarus tigrinus	1.83(1.83)	0(0)	0(0)
Heteromastus filiformis	0.17(0.17)	0(0)	0(0)
Hobsonia florida	2.50(0.88)	0(0)	0(0)
Hydracarina spp.	0(0)	0(0)	0.25(0.25)
Laeonereis culveri	0(0)	1.50(0.87)	4.25(2.29)
(*Limnophyes* sp.)	0(0)	0.25(0.25)	0(0)
Marenzelleria viridis	0.17(0.17)	0(0)	0(0)
Marinogammarus sp.	0.17(0.17)	0(0)	0(0)
Munna sp.	0.50(0.34)	0(0)	0(0)
Nimbocera sp.	0.50(0.50)	0(0)	0(0)
Oligochaete	4.83(2.36)	0(0)	0(0)
Polydora sp.	0.33(0.33)	0(0)	0(0)
Polypedilum sp.	0.67(0.49)	1.25(1.25)	0(0)
Procladius sp.	0.50(0.34)	0(0)	0(0)
Streblospio benedicti	0(0)	0(0)	0.25(0.25)
Tubificidae spp.	0(0)	117.00(26.57)	26.50(11.49)

Table 6.4-4a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0(0)	1.50(1.50)	0(0)
Americorophium aquafuscum	0(0)	0(0)	0.25(0.25)
Anurida maritima	0(0)	17.25(7.05)	0(0)
Bezzia/Palpomyia	0.60(0.24)	1.50(0.64)	0.50(0.29)
juv. Bivalve	0.20(0.20)	0(0)	0(0)
Cassidinidea lunifrons	1.00(1.00)	0(0)	0.50(0.29)
Collembola sp.	1.60(0.75)	1.00(0.71)	0(0)
Curculionidae sp.	0.40(0.40)	0(0)	0(0)
Cyathura (*madelinae*)	0.40(0.40)	0(0)	0.50(0.29)
Cyathura polita	0.80(0.58)	0(0)	0(0)
Diptera sp.	0(0)	0.50(0.29)	0(0)
Dolichopodidae sp.	0(0)	0.25(0.25)	0.50(0.29)
Dolichopus sp.	0.80(0.80)	0(0)	0(0)
Eukiefferiella (*claripennis*)	0.20(0.20)	0(0)	0(0)
juv. Gastropod	0.20(0.20)	0(0)	0(0)
Hemipodus roseus	0.80(0.80)	0(0)	0(0)
insect larva c	0.20(0.20)	0(0)	0(0)
insect sp. h	1.00(1.00)	0(0)	0(0)
insect sp. i	0.40(0.40)	0(0)	0(0)
Laeonereis culveri	3.20(2.03)	1.75(1.03)	2.00(1.08)
(Lumbriculidae sp.)	0(0)	0(0)	0.50(0.29)
Oligochaete	9.60(4.84)	0(0)	0(0)
Orchestia sp.	1.20(0.97)	0(0)	0(0)
Orchestia uhleri	1.00(0.55)	0(0)	0(0)
(*Ormosia* sp.)	0(0)	0.25(0.25)	0(0)
Procladius sp.	0.20(0.20)	0(0)	0(0)
Tubificidae spp.	0(0)	19.00(5.21)	9.00(6.39)
Uca pugilator	0.40(0.40)	0.25(0.25)	0(0)
Uca sp.	0.20(0.20)	0(0)	0.50(0.29)

Table 6.4-4b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at the lowest main-stem Cape Fear site P6 during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0.20(0.20)	0(0)	0(0)
amphipod sp.	0.80(0.58)	0(0)	0(0)
Bezzia/Palpomyia	0.60(0.40)	0(0)	0(0)
juv. Bivalve	0.60(0.40)	0(0)	0(0)
Boccardiella sp.	0(0)	4.75(1.84)	0.50(0.29)
Cassidinidea lunifrons	1.00(0.77)	0(0)	0.25(0.25)
Ceratopogonidae sp.	0(0)	0.75(0.75)	0(0)
Collembola sp.	0.20(0.20)	0.25(0.25)	0(0)
Cyathura polita	5.00(5.00)	0(0)	0(0)
Dicrotendipes sp.	0(0)	1.00(0.41)	0(0)
Diptera sp.	0(0)	0(0)	0.25(0.25)
Dolichopus sp.	0.20(0.20)	0(0)	0(0)
Dolichopodidae sp.	0(0)	0(0)	0.25(0.25)
Eukiefferiella (*claripennis*)	0.40(0.40)	0(0)	0(0)
Gammarus daiberi	0.20(0.20)	0(0)	0(0)
juv. Gastropod	0.40(0.24)	0(0)	0(0)
Hargeria rapax	0(0)	0(0)	0.25(0.25)
Hobsonia florida	0.20(0.20)	0.25(0.25)	0(0)
insect pupae	1.80(1.11)	0(0)	0(0)
insect sp.	0.20(0.20)	0(0)	0(0)
Marenzelleria viridis	0(0)	3.75(2.84)	0(0)
Melita nitida	0(0)	0(0)	0.50(0.50)
Melita sp.	1.00(1.00)	0(0)	0(0)
Munna sp.	1.00(1.00)	0(0)	0(0)
Nemertea sp.	0(0)	0(0)	0.25(0.25)
Oligochaete	49.60(18.88)	0(0)	0(0)
Polydora socialis	2.60(2.60)	1.00(0.71)	0(0)
Polypedilum sp.	0.40(0.40)	0.75(0.25)	0(0)
Procladius sp.	0.60(0.60)	0(0)	0(0)
Tubificidae spp.	0(0)	6.25(1.49)	3.50(1.04)
Tubificoides heterochaetus	0(0)	0.25(0.25)	0(0)
Uca sp.	0.40(0.40)	0(0)	0.75(0.75)

Table 6.4-5a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0(0)	0.75(0.75)	0(0)
Anurida maritima	0(0)	0.25(0.25)	0(0)
Asellus sp.	0(0)	2.00(2.00)	0.25(0.25)
Bezzia/Palpomyia	0.20(0.20)	1.25(0.48)	0(0)
juv. Bivalve	0(0)	0.25(0.25)	0(0)
Celina sp.	0.20(0.20)	0(0)	0(0)
Chrysops sp.	0.20(0.20)	0(0)	0(0)
Coleoptera sp.	0(0)	0(0)	0.25(0.25)
Collembola sp.	0.40(0.24)	0.50(0.50)	0.25(0.25)
Crangonyx pseudogracilis	0(0)	0.75(0.75)	0(0)
Cryptochironomus sp.	0.20(0.20)	0(0)	0(0)
Cyathura (*madelinae*)	0.40(0.40)	0(0)	0(0)
Diptera sp.	0(0)	0.25(0.25)	0(0)
Dolichopodidae sp.	0(0)	2.25(0.75)	0.50(0.50)
Dolichopus sp.	1.60(0.51)	0(0)	0(0)
Erioptera sp.	0(0)	0.25(0.25)	0(0)
juv. Gastropod	0.20(0.20)	0(0)	0(0)
Hargeria rapax	0(0)	0(0)	0.25(0.25)
Hydracarina spp.	0(0)	0(0)	0.25(0.25)
insect pupae	0.20(0.20)	0(0)	0(0)
Isochaetides sp.	0(0)	2.00(1.68)	0(0)
Laeonereis culveri	0(0)	2.00(1.68)	0.75(0.75)
(*Limnophyes* sp.)	0(0)	0.75(0.75)	0(0)
Lirceus sp.	1.40(1.17)	0(0)	0(0)
Lumbriculidae sp.	7.40(3.32)	3.25(2.14)	0(0)
(Lumbriculidae sp.)	0(0)	1.75(1.03)	2.75(1.55)
Micropsectra sp.	0.80(0.37)	0(0)	0(0)
(*Netamelita* sp.)	0(0)	1.25(1.25)	0(0)
Oligochaete	52.20(15.47)	0(0)	0(0)
Orchestia (platensis)	0.20(0.20)	0(0)	0(0)
Orchestia uhleri	0.60(0.60)	1.00(1.00)	1.50(0.87)
Paratendipes sp.	0(0)	1.25(0.75)	0(0)
Pristinella sp.	0.40(0.40)	0(0)	0(0)
Spirosperma carolinensis	0(0)	10.75(4.30)	8.75(3.42)
Tabanus sp.	0.20(0.20)	0(0)	0(0)
Tubificidae spp.	0(0)	22.50(5.20)	11.50(4.56)
Tubificoides heterochaetus	0.20(0.20)	0(0)	0(0)
Uca pugilator	0.40(0.40)	0(0)	0(0)

Table 6.4-5b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P7 on the main-stem Cape Fear during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0(0)	0.50(0.50)	0(0)
Anurida maritima	0(0)	0.25(0.25)	0(0)
Asellus sp.	0(0)	0.25(0.25)	0(0)
Bezzia/Palpomyia	0.20(0.20)	0.25(0.25)	0(0)
juv. Bivalve	0.60(0.40)	0.50(0.29)	0(0)
Cassidinidea lunifrons	0.60(0.24)	0.50(0.50)	0(0)
Chironomus sp.	0.20(0.20)	0(0)	0(0)
Cryptochironomous sp.	0.60(0.60)	0(0)	0(0)
Cyathura (*madelinae*)	0.40(0.24)	0(0)	0(0)
Cyathura polita	0(0)	1.25(0.95)	0(0)
Dicrotendipes sp.	0(0)	0.25(0.25)	0(0)
Diptera sp.	0(0)	0.25(0.25)	0(0)
Dolichopus sp.	0.20(0.20)	0(0)	0(0)
Gammarus daiberi	0.20(0.20)	0(0)	0(0)
Gammarus tigrinus	0.60(0.40)	0(0)	0(0)
juv. Gastropod	1.00(0.45)	0(0)	0(0)
insect pupae	0.40(0.24)	0(0)	0(0)
insect sp. a	0.40(0.24)	0(0)	0(0)
Laeonereis culveri	0(0)	0.50(0.29)	0(0)
Lumbriculidae sp.	0(0)	3.00(1.00)	0(0)
(Lumbriculidae sp.)	0(0)	0.25(0.25)	0.50(0.29)
Megalops spp.	0.20(0.20)	0(0)	0(0)
Oligochaete	17.80(4.55)	0(0)	0(0)
Paratendipes sp.	0.20(0.20)	0.50(0.50)	0(0)
Polypedilum sp.	1.00(1.00)	0(0)	0(0)
Procladius sp.	0.20(0.20)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0.50(0.50)	0.25(0.25)
Tanytarsus sp.	0(0)	0.25(0.25)	0(0)
Tubificidae spp.	0(0)	60.50(16.78)	71.75(42.76)

Table 6.4-6a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0.17(0.17)	0(0)	0(0)
Anurida maritima	0(0)	2.00(1.15)	2.00(1.08)
Bezzia/Palpomyia	0.33(0.33)	0(0)	0.25(0.25)
juv. Bivalve	11.17(4.32)	1.00(0.58)	0.50(0.29)
Coleoptera sp.	0.33(0.33)	0(0)	1.00(1.00)
Collembola sp.	1.50(0.43)	0(0)	0(0)
Diptera sp.	0(0)	0.50(0.50)	0.50(0.29)
Dolichopodidae sp.	0(0)	2.50(1.19)	2.50(1.85)
Dolichopus sp.	2.17(0.75)	0(0)	0(0)
Fabriciola trilobata	0(0)	0(0)	0.25(0.25)
Gammarus tigrinus	1.33(1.33)	0(0)	0(0)
juv. Gastropod	0.50(0.34)	1.25(0.63)	0(0)
Hydaticus larvae	0.33(0.21)	0(0)	0(0)
insect sp.	0.17(0.17)	1.25(0.75)	0(0)
Isochaetides curvisetosus	0(0)	0(0)	6.25(3.61)
Isochaetides sp.	0(0)	2.25(2.25)	0(0)
Lumbriculidae sp.	5.00(2.89)	3.25(2.62)	0(0)
(Lumbriculidae sp.)	0(0)	1.25(0.75)	7.25(2.14)
Micropsectra sp.	3.17(3.17)	0(0)	0(0)
Nemertea sp.	0(0)	0.25(0.25)	0(0)
Noterus (*capricornis*)	0.17(0.17)	0(0)	0(0)
Oligochaete	73.50(14.07)	0(0)	0(0)
Orchestia uhleri	3.50(1.48)	1.25(0.48)	0.75(0.25)
Paratendipes sp.	0(0)	0(0)	0.25(0.25)
Pericoma sp.	0(0)	4.50(2.22)	0(0)
Pericoma/Telmatoscopus sp.	0(0)	0(0)	3.50(3.18)
Polypedilum sp.	0.17(0.17)	0(0)	0(0)
Rheotanytarsus sp.	0.33(0.33)	0(0)	0(0)
Spirosperma carolinensis	0(0)	7.75(2.93)	7.25(3.01)
Stratiomya sp.	0.17(0.17)	0(0)	0(0)
Tanytarsus sp.	1.00(1.00)	0(0)	0(0)
Tipula sp.	0(0)	0(0)	0.50(0.50)
Tipulidae sp.	0(0)	1.00(1.00)	0.50(0.50)
Tubificidae spp.	0(0)	47.75(8.38)	64.00(8.18)
Tubificoides heterochaetus	0.17(0.17)	0(0)	0(0)
Uca pugilator	0.17(0.17)	0.25(0.25)	0(0)

Table 6.4-6b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P8 on the main-stem Cape Fear during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
Anurida maritima	0(0)	0.50(0.50)	4.50(4.50)
Asellus sp.	0(0)	0(0)	0.50(0.50)
Bezzia/Palpomyia	0.33(0.33)	0(0)	0.25(0.25)
juv. Bivalve	1.67(0.56)	1.25(0.75)	0(0)
Cassidinidea lunifrons	0.83(0.83)	0.25(0.25)	0(0)
Coelotanypus sp.	0(0)	0(0)	0.50(0.29)
Collembola sp.	0.17(0.17)	0(0)	2.75(2.75)
Corophium lacustre	0(0)	0.25(0.25)	0(0)
Cryptochironomous sp.	0.33(0.33)	0(0)	0.75(0.48)
Cyathura (*madelinae*)	0.67(0.67)	0(0)	0(0)
Dolichopodidae sp.	0(0)	1.50(0.64)	0.75(0.48)
Dolichopus sp.	1.00(0.82)	0(0)	0(0)
Gammarus tigrinus	1.50(1.15)	0(0)	0(0)
juv. Gastropod	0.17(0.17)	0(0)	0(0)
Hydracarina spp.	0(0)	0(0)	0.25(0.25)
insect sp. b	0.17(0.17)	0(0)	0(0)
Isochaetides curvisetosus	0(0)	0(0)	0.25(0.25)
Laeonereis culveri	0(0)	0.25(0.25)	0(0)
Lumbriculidae sp.	3.00(1.61)	7.25(6.60)	0(0)
(Lumbriculidae sp.)	0(0)	2.00(1.41)	5.50(2.60)
Megalops spp.	0.17(0.17)	0(0)	0(0)
Micropsectra sp.	0.17(0.17)	0(0)	0(0)
Oligochaete	122.83(31.34)	0(0)	0(0)
Paratendipes sp.	0.17(0.17)	0.25(0.25)	0(0)
Polypedilum/Haterale	2.33(2.33)	0(0)	0(0)
Polypedilum sp.	1.33(0.56)	0(0)	0(0)
Pristinella sp.	0.67(0.67)	0(0)	0(0)
Rheotanytarsus sp.	0.17(0.17)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0(0)	6.50(4.27)
Tanytarsus sp.	0.33(0.33)	0(0)	0(0)
Tribelos sp.	0.33(0.33)	0(0)	0(0)
Tubificidae spp.	0(0)	37.25(3.70)	48.25(17.06)
Uca pugilator	0(0)	0.25(0.25)	0(0)

Table 6.4-7a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P11 on the NE Cape Fear River during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Americorophium sp. A	0(0)	0(0)	0.25(0.25)
Bezzia/Palpomia	0(0)	0.25(0.25)	1.75(1.75)
juv. Bivalve	0.25(0.25)	0(0)	0(0)
Cassidinidea lunifrons	1.00(0.71)	0.25(0.25)	0(0)
Chironomus sp.	0.50(0.50)	0(0)	0(0)
Curculionidae sp.	0.75(0.75)	1.00(0.71)	0.75(0.75)
Cyathura polita	0(0)	0.25(0.25)	0(0)
Dicrotendipes lobus	1.00(1.00)	0(0)	0(0)
Dicrotendipes nervosa	0.50(0.50)	0(0)	0(0)
Dicrotendipes sp.	0(0)	0.25(0.25)	0(0)
Diptera sp.	0(0)	0.25(0.25)	0(0)
Gammarus mucronatus	0.25(0.25)	0(0)	0(0)
Hobsonia florida	7.50(4.33)	1.00(0.58)	2.25(1.44)
insect larvae	1.25(1.25)	0(0)	0(0)
insect pupae	1.00(1.00)	0(0)	0(0)
Oligochaete	10.50(3.68)	0(0)	0(0)
Polydora ligni/cornuta	0.25(0.25)	0(0)	0(0)
Polydora socialis	0.25(0.25)	0(0)	0(0)
Polypedilium sp.	0.50(.50)	0(0)	0(0)
Tubificidae spp.	0(0)	10.25(5.51)	55.25(26.72)
Tubificoides heterochaetus	0(0)	0.50(0.29)	0(0)

Table 6.4-7b. 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, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
amphipod sp.	0.20(0.20)	0(0)	0(0)
juv. Bivalve	0(0)	0(0)	0.50(0.29)
Collembola sp.	0(0)	0.20(0.20)	0(0)
Corophium lacustre	0(0)	0.20(0.20)	0(0)
Cryptochironomous (*fulvens*)	0.20(0.20)	0(0)	0(0)
Gammarus tigrinus	0.60(0.40)	0(0)	0(0)
Hobsonia florida	0.60(0.24)	0(0)	0(0)
Laeonereis culveri	0(0)	3.40(1.08)	16.00(1.47)
Marenzelleria viridis	1.00(0.77)	0(0)	23.00(4.65)
Megalops spp.	0.20(0.20)	0(0)	0(0)
Nemertea sp.	0.20(0.20)	0(0)	0(0)
Oligochaete	3.60(1.86)	0(0)	0(0)
Polypedilum sp.	0.40(0.40)	0.20(0.20)	0(0)
Rangia cuneata	0(0)	0(0)	0.25(0.25)
Tubificoides heterochaetus	6.20(6.20)	1.60(1.60)	1.75(1.11)

Table 6.4-8a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P12 on the NE Cape Fear River during June 1999, 2006, and 2007. The means presented here represent the combination of two sub-sites for high intertidal areas.

High Intertidal	**June 99**	**June 06**	**June 07**
Apedilum sp.	0(0)	0(0)	0.25(0.25)
Apocorophium lacustre	0(0)	0(0)	0.50(0.50)
Bezzia/Palpomyia	1.80(0.37)	1.00(0.41)	4.50(0.96)
Cassidinidea lunifrons	0.20(0.20)	0(0)	0.25(0.25)
Chironomus sp.	0.20(0.20)	0(0)	0(0)
Coleoptera sp.	0(0)	0(0)	0.25(0.25)
Collembola sp.	0.20(0.20)	0.50(0.29)	0(0)
Corophium (*lacustre*)	0.20(0.20)	0(0)	0(0)
Cricotopus sp.	0.20(0.20)	0(0)	0(0)
Dolichopodidae sp.	0(0)	1.00(0.41)	1.00(0.71)
Dolichopus sp.	0.60(0.40)	0(0)	0(0)
Donacia sp.	0.20(0.20)	0(0)	0(0)
juv. Gastropod	0.20(0.20)	0(0)	0(0)
Homoptera sp.	0(0)	0.50(0.50)	0(0)
insect larvae g	0.40(0.40)	0(0)	0(0)
insect larvae h	1.20(1.20)	0(0)	0(0)
Laeonereis culveri	1.40(0.51)	0(0)	0(0)
(*Limnophyes* sp.)	0(0)	0.25(0.25)	0(0)
Monopylephorus irroratus	1.00(1.00)	0(0)	0(0)
Ocypode quadrata	0.20(0.20)	0(0)	0(0)
Oligochaete	47.80(9.60)	0(0)	0(0)
Orchestia uhleri	0.20(0.20)	0.25(0.25)	0.25(0.25)
Orthocladiinae sp.	0(0)	0.25(0.25)	0(0)
Pristinella sp.	0.20(0.20)	0(0)	0(0)
Tubificidae spp.	0(0)	9.75(4.09)	19.75(8.04)
Uca minax	0.20(0.20)	0(0)	0(0)
Uca pugilator	0.20(0.20)	0.75(0.48)	0.25(0.25)
Uca sp.	0(0)	0(0)	0.25(0.25)

Table 6.4-8b. 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, 2006, and 2007. The means presented here represent the combination of two sub-sites for low intertidal areas.

Low Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0(0)	1.00(0.71)	0(0)
amphipod sp.	0.20(0.20)	0(0)	0(0)
Apocorophium lacustre	0(0)	0(0)	0.25(0.25)
Apocorophium sp.	0(0)	0(0)	0.75(0.75)
Bezzia/Palpomyia	0.20(0.20)	0(0)	0(0)
Boccardiella sp.	0(0)	5.00(2.34)	3.25(3.25)
Cassidinidea lunifrons	0(0)	1.00(0.71)	0(0)
Corophium lacustre	0(0)	0.25(0.25)	0(0)
Corophium volutator	0(0)	7.00(6.35)	0(0)
Dicrotendipes nervosus	0(0)	0(0)	0.25(0.25)
Edotea sp.	0(0)	0.25(0.25)	0(0)
Gammarus tigrinus	0.20(0.20)	0(0)	0(0)
Geukensia demissa	0(0)	0.25(0.25)	0(0)
Hargeria rapax	0(0)	0(0)	0.25(0.25)
Hobsonia florida	0(0)	0.50(0.50)	0.50(0.50)
Idoteidae sp.	0(0)	0.50(0.50)	0(0)
Laeonereis culveri	0(0)	1.25(1.25)	0(0)
Limnodrilus hoffmeisteri	0(0)	0(0)	0.25(0.25)
Mediomastus sp.	0.20(0.20)	0(0)	0(0)
Nemertea sp.	0(0)	0.25(0.25)	0(0)
Oligochaete	1.60(0.51)	0(0)	0(0)
Paracladopelma sp.	0.20(0.20)	0(0)	0(0)
Polydora ligni/cornuta	0.20(0.20)	0(0)	0(0)
Polydora socialis	0(0)	0(0)	0.25(0.25)
Polydora sp.	0.20(0.20)	0(0)	0(0)
Polypedilum sp.	0.20(0.20)	0(0)	0(0)
Tubificidae spp.	0(0)	8.25(4.61)	4.00(2.48)

Table 6.4-9a. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P13 on the NE Cape Fear River during June 1999, 2006, and 2007. The means presented here represent the combination of two subsites for high intertidal areas at each station.

High Intertidal	**June 99**	**June 06**	**June 07**
Acarina spp.	0(0)	0.25(0.25)	0(0)
Anurida maritima	0(0)	0.50(0.50)	0(0)
Bezzia/Palpomyia	0(0)	0.25(0.25)	0(0)
Collembola sp.	0.20(0.20)	0(0)	0(0)
Cyathura polita	0.20(0.20)	0(0)	0(0)
Diptera sp.	0(0)	0(0)	0.25(0.25)
Dolichopodidae sp.	0(0)	0.25(0.25)	0.25(0.25)
Dolichopus sp.	0.40(0.24)	0(0)	0(0)
Erioptera sp.	0(0)	0.25(0.25)	0(0)
Haliplidae sp.	0.20(0.20)	0(0)	0(0)
Helophorus sp.	0(0)	0.50(0.50)	0(0)
Hydrophilidae larvae	0(0)	0.25(0.25)	0(0)
insect pupae	0.20(0.20)	0(0)	0(0)
Laeonereis culveri	0.40(0.24)	0(0)	0.25(0.25)
Lumbriculidae sp.	1.40(1.40)	1.50(1.19)	0(0)
(Lumbriculidae sp.)	0(0)	5.25(3.35)	2.00(0.82)
Mediomastus sp.	0.20(0.20)	0(0)	0(0)
Oligochaete	29.40(6.90)	0(0)	0(0)
Orchestia uhleri	0(0)	0.25(0.25)	0(0)
Paratendipes sp.	0(0)	0.25(0.25)	0(0)
Polypedilium sp.	0.60(0.40)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0.25(0.25)	0.50(0.29)
Tubificidae spp.	0(0)	49.25(12.97)	31.50(1.76)
Uca pugilator	0(0)	0.25(0.25)	0(0)

Table 6.4-9b. Mean (no. per 0.01 m^2) and (standard error) for all taxa collected at P13 on the NE Cape Fear River during June 1999, 2006, and 2007. The means presented here represent the combination of two subsites for low intertidal areas at each station.

Low Intertidal	**June 99**	**June 06**	**June 07**
Anurida maritima	0(0)	0.25(0.25)	0(0)
Bezzia/Palpomyia	0(0)	0.50(0.29)	0(0)
Chiridotea caeca	0.25(0.25)	0(0)	0(0)
Chironomidae sp.	0(0)	0.25(0.25)	0(0)
Cryptochironomous (*fulvens*)	0.50(0.50)	0(0)	0(0)
Cryptochironomous sp.	0(0)	0.75(0.75)	0(0)
Cyathura polita	0(0)	0.25(0.25)	0(0)
Diptera sp.	0(0)	0.25(0.25)	0(0)
insect pupae	0.25(0.25)	0(0)	0(0)
insect sp. d	0.25(0.25)	0(0)	0(0)
insect sp. e	0.50(0.50)	0(0)	0(0)
Laeonereis culveri	0(0)	0(0)	0.50(0.50)
Larval fish	0.25(0.25)	0(0)	0(0)
Lumbriculidae sp.	0(0)	0.25(0.25)	0(0)
(Lumbriculidae sp.)	0(0)	0(0)	0.25(0.25)
Oligochaete	34.25(11.13)	0(0)	0(0)
Polypedilum sp.	0.25(0.25)	0(0)	0(0)
Procladius sp.	0.75(0.48)	0(0)	0(0)
Spirosperma carolinensis	0(0)	0(0)	0.50(0.50)
Tubificidae spp.	0(0)	14.00(4.38)	17.00(5.05)

Any taxa that represented 3% of the total abundance were considered common. In the 2007 sampling period, this included 19 taxa. The oligochaete family Tubificidae represented between 20% and 80% of the number of individuals present at most sites. This grouping was comprised of several species, since many of the individuals placed within the Tubificidae family were small or incomplete. This group was by far the most abundant in the 2007 sampling year. Lumbriculidae was another common oligochaete family. *Isochaetides curvisetosus* and *Tubificoides heterochaetus* were also other common oligochaete species. The remaining common taxa were *Americorophium aquafuscum* (amphipod), *Anurida maritima* (insect), *Apocorophium lacustre* (amphipod), *Apocorophium louisianum* (amphipod), *Bezzia/Palpomyia* (insect), *Boccardiella* sp. (polychaete), *Cassidinidea lunifrons* (isopod), Dolichopodidae sp. (insect), *Fabriciola trilobata* (polychaete), *Hargeria rapax* (amphipod), *Hobsonia florida* (polychaete), *Laeonereis culveri* (polychaete), *Marenzellaria viridis* (polychaete), *Spirosperma carolinensis* (isopod), and *Uca* sp. (decapod) (Figure 6.4.1).

Comparison of total abundance among sites during 2007 shows that only the site at the mouth of Town Creek (P2) differed from all other sites with mean total abundances nearly twice that of the next closest site (Figure 6.4.2). Comparisons (ANOVA) of among-year abundances for major taxonomic groups and functional guilds show few differences among years (Table 6.4-10). Only 10 of 68 comparisons among major taxonomic groups differed among years, with 2007 having significantly fewer numbers of insects for the Eagle Island (P6), Indian Creek (P7), and Fishing Creek (P13) sites. The year 2007 was a drought year, with 23+ inches less rainfall than normal. Insect larvae did not differ at the Town Creek sites, most likely due to increasing salinity and a relatively low abundance of insects at these sites in general. Salinity responses may also explain the increase in polychaete taxa in 2007. Functional guild comparisons showed significant differences for 9 of 26 comparisons (Table 6.4-11). Interestingly, the site at the mouth of Town Creek (P2) showed an increase in deep burrowing organisms in 2007 compared to 2006 or 1999, driven mainly by oligochaete taxa. This is somewhat counterintuitive since this site tends to experience higher salinity measures than more upstream sites. The only generally consistent pattern observed in these analyses was that 1999 represented an intermediate year for 5 of the 9 differences detected.

Species richness exhibited only one significant variation among years (Table 6.4-12), with Indian Creek (P7) showing a distinct reduction in species richness in 2007 compared to previous years. Species diversity exhibited two significant variations among years (Table 6.4-12), with Smith Creek (P11) showing a reduction in diversity in 2006, and Fishing Creek (P13) showing a reduction in diversity in 2007. The Indian Creek site has experienced changes in vegetation coverage (and potentially drainage) associated with the development of adjacent upland, as well as logging and removal of the understory in the immediate vicinity, which most likely explains the reduction in species richness. The reductions in diversity at Smith Creek (P11) and Fishing Creek (P13) most likely reflect a change in dominance at a site with low overall abundance. The among site comparison for 2007 shows an identical pattern, as Fishing Creek (P13) differs from all other sites with significantly lower diversity measures (Figure 6.4-3). The among site comparison for species richness also shows an interesting trend between three sites: the mouth of Town Creek (P2), Inner Town Creek (P3A), and Dollisons Landing (P8). These sites demonstrated significantly greater species richness than any of the sites on the Northeast Cape Fear River (Figure 6.4-4). Previous work in this system has shown a different pattern with greater species richness and diversity in the Northeast Cape Fear compared to the main stem Cape Fear River, but an overall greater total abundance in the main stem of the Cape Fear (Mallin et al. 1999). While a single year response may only reflect localized effects in the tributary, if this trend continues in subsequent years, it may indicate a change in the factors structuring these critical communities.

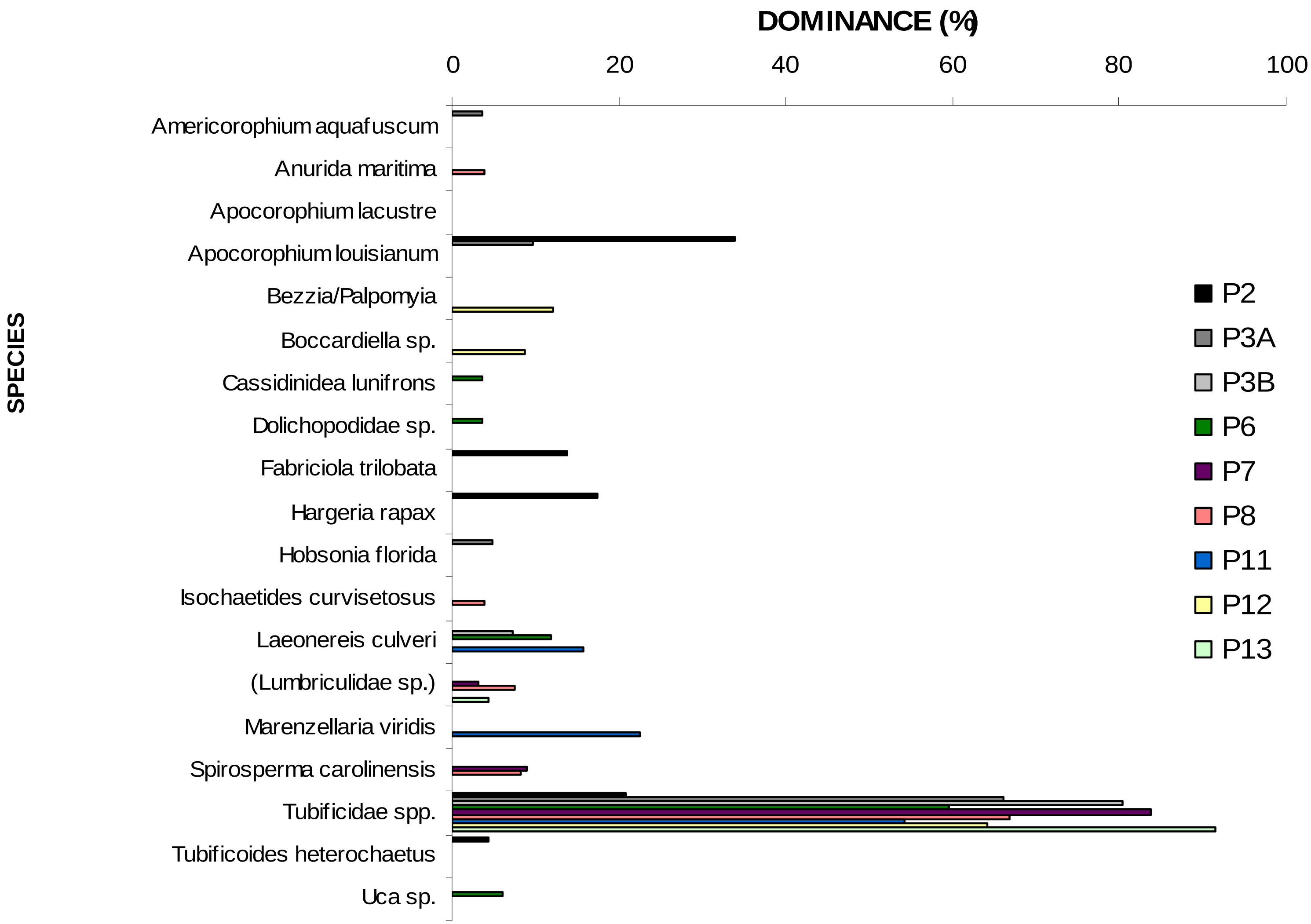


Figure 6.4-1. Common species representing ≥ 3% of the total abundance among sites sampled in 2007. This data represents both upper intertidal and lower subtidal substations.

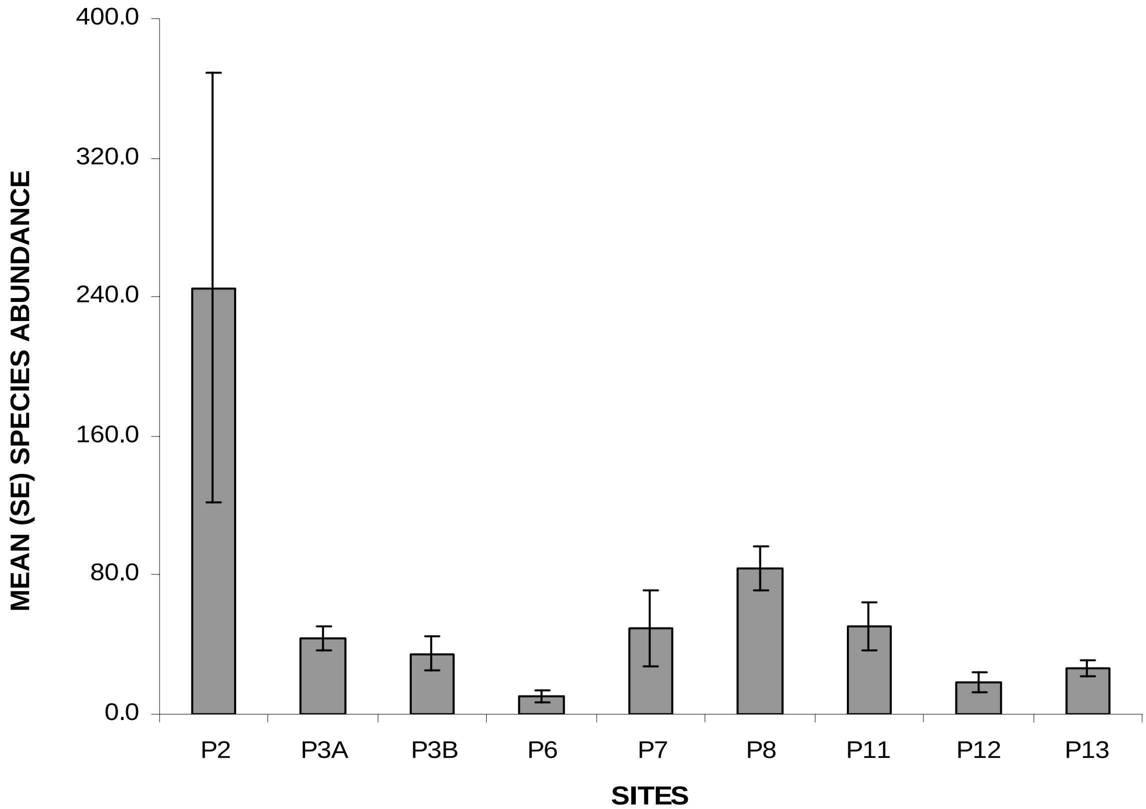


Figure 6.4-2. Mean species abundance among sites sampled in 2007. This data represents both upper intertidal and lower subtidal substations. Bars represent standard error (SE) of the mean.

Table 6.4-10. Among-year comparison of abundance by taxonomic group for each site. Years are listed from greatest abundance to least. F (and p) values are from Analysis of Variance. Where ANOVA indicated a significant year effect, year differences were tested using a SNK post-hoc test. Years with the same superscript do not vary significantly ($p<0.05$). Years with two letter superscripts were not different from either year.

Site	Group	F(p)	SNK(where ANOVA significant)
P2	Amphipoda	4.11(0.0287)	NS
	Bivalvia	2.92(0.0726)	NS
	Decapoda	0.46(0.6385)	NS
	Insecta	1.48(0.2463)	NS
	Isopoda	0.19(0.8272)	NS
	Oligochaeta	5.06(0.0142)	07^{a} 99^{ab} 06^{b}
	Polychaeta	13.17(0.0001)	07^{a} 99^{a} 06^{b}
P3A	Amphipoda	3.33(0.0524)	NS
	Bivalvia	0.67(0.5190)	NS
	Decapoda	3.16(0.0600)	NS
	Gastropoda	1.35(0.2763)	NS
	Insecta	3.05(0.0652)	NS
	Isopoda	6.04(0.0072)	07^{a} 06^{b} 99^{b}
	Oligochaeta	4.82(0.0169)	06^{a} 07^{a} 99^{b}
	Polychaeta	3.10(0.0630)	NS
P3B	Amphipoda	2.25(0.1271)	NS
	Bivalvia	1.58(0.2266)	NS
	Decapoda	0.46(0.6393)	NS
	Gastropoda	1.21(0.3168)	NS
	Insecta	0.95(0.4008)	NS
	Isopoda	0.15(0.8579)	NS
	Oligochaeta	10.11(0.0007)	06^{a} 07^{b} 99^{c}
	Polychaeta	0.70(0.5058)	NS
P6	Amphipoda	7.63(0.0029)	99^{a} 07^{b} 06^{b}
	Bivalvia	2.82(0.0804)	NS
	Decapoda	0.79(0.4656)	NS
	Gastropoda	3.03(0.0678)	NS
	Insecta	7.82(0.0026)	06^{a} 99^{a} 07^{b}
	Isopoda	2.53(0.1015)	NS
	Oligochaeta	3.18(0.0604)	NS
	Polychaeta	1.38(0.2718)	NS

Table 6.4-10. (continued)

Site	Group	F(p)	SNK(where ANOVA significant)
P7	Amphipoda	0.29(0.7531)	NS
	Bivalvia	1.45(0.2560)	NS
	Decapoda	1.66(0.2116)	NS
	Gastropoda	4.35(0.0250)	NS
	Insecta	8.36(0.0019)	99^a 06^a 07^b
	Isopoda	1.87(0.1769)	NS
	Oligochaeta	1.00(0.3817)	NS
	Polychaeta	2.65(0.0918)	NS
P8	Amphipoda	2.56(0.0971)	NS
	Bivalvia	6.09(0.0070)	99^a 06^b 07^b
	Decapoda	1.03(0.3704)	NS
	Gastropoda	1.71(0.2018)	NS
	Insecta	0.41(0.6654)	NS
	Isopoda	0.42(0.6620)	NS
	Oligochaeta	2.25(0.1262)	NS
	Polychaeta	0.77(0.4758)	NS
P11	Amphipoda	2.10(0.1448)	NS
	Bivalvia	1.46(0.2534)	NS
	Decapoda	0.94(0.4052)	NS
	Insecta	0.58(0.5677)	NS
	Isopoda	0.87(0.4330)	NS
	Oligochaeta	1.55(0.2329)	NS
	Polychaeta	2.84(0.0791)	NS
P12	Amphipoda	0.83(0.4488)	NS
	Bivalvia	1.14(0.3380)	NS
	Decapoda	0.04(0.9597)	NS
	Gastropoda	0.79(0.4674)	NS
	Insecta	0.25(0.7790)	NS
	Isopoda	2.45(0.1085)	NS
	Oligochaeta	0.16(0.8561)	NS
	Polychaeta	0.87(0.4336)	NS
P13	Amphipoda	1.07(0.3607)	NS
	Decapoda	1.07(0.3607)	NS
	Insecta	7.31(0.0037)	99^a 06^a 07^b
	Isopoda	0.95(0.4028)	NS
	Oligochaeta	0.16(0.8540)	NS
	Polychaeta	1.03(0.3746)	NS

Table 6.4-11. Among-year comparison of abundance by functional group for each site. Years are listed from greatest abundance to least. F (and p) values are from Analysis of Variance. Where ANOVA indicated a significant year effect, year differences were tested using a SNK post-hoc test. Years with the same superscript do not vary significantly ($p<0.05$).

Site	Group	F(p)	SNK(where ANOVA significant)
P2	Deep burrowing	8.15(0.0019)	07^{a} 99^{b} 06^{b}
	Surface/mobile	0.31(0.7381)	NS
	Sedentary/tube builder	2.09(0.1446)	NS
P3A	Deep burrowing	4.58(0.0202)	06^{a} 07^{a} 99^{b}
	Surface/mobile	0.27(0.7689)	NS
	Sedentary/tube builder	5.56(0.0101)	07^{a} 99^{ab} 06^{b}
P3B	Deep burrowing	9.98(0.0007)	06^{a} 07^{b} 99^{c}
	Surface/mobile	0.52(0.6010)	NS
	Sedentary/tube builder	4.62(0.0201)	07^{a} 99^{a} 06^{b}
P6	Deep burrowing	2.98(0.0708)	NS
	Surface/mobile	1.90(0.1723)	NS
	Sedentary/tube builder	1.63(0.2179)	NS
P7	Deep burrowing	1.00(0.3817)	NS
	Surface/mobile	6.02(0.0079)	06^{a} 99^{a} 07^{b}
	Sedentary/tube builder	1.55(0.2339)	NS
P8	Deep burrowing	2.23(0.1281)	NS
	Surface/mobile	0.65(0.5302)	NS
	Sedentary/tube builder	5.32(0.0119)	99^{a} 06^{ab} 07^{b}
P11	Deep burrowing	1.59(0.2252)	NS
	Surface/mobile	1.24(0.3086)	NS
	Sedentary/tube builder	6.83(0.0047)	07^{a} 99^{ab} 06^{b}
P12	Deep burrowing	0.18(0.8403)	NS
	Surface/mobile	0.42(0.6618)	NS
	Sedentary/tube builder	1.89(0.1738)	NS
P13	Deep burrowing	0.16(0.8505)	NS
	Surface/mobile	8.09(0.0023)	99^{a} 06^{a} 07^{b}

Table 6.4-12. Among-year comparison of diversity and species richness for each site. Years are listed from greatest abundance to least. F (and p) values are from Analysis of Variance. Where ANOVA indicated a significant year effect, year differences were tested using a SNK post-hoc test. Years with the same superscript do not vary significantly ($p<0.05$). Years with two letter superscripts were not different from either year.

Site	Metric	F(p)	SNK (where ANOVA significant)
P2	Diversity	0.01(0.9917)	NS
	Species Richness	0.54(0.5877)	NS
P3A	Diversity	1.89(0.1717)	NS
	Species Richness	0.64(0.5336)	NS
P3B	Diversity	2.28(0.1239)	NS
	Species Richness	0.17(0.8454)	NS
P6	Diversity	0.37(0.6924)	NS
	Species Richness	1.16(0.3300)	NS
P7	Diversity	1.87(0.1766)	NS
	Species Richness	6.07(0.0077)	06^{a} 99^{a} 07^{b}
P8	Diversity	1.54(0.2347)	NS
	Species Richness	0.10(0.9013)	NS
P11	Diversity	3.47(0.0482)	99^{a} 07^{ab} 06^{b}
	Species Richness	3.11(0.0638)	NS
P12	Diversity	2.86(0.0780)	NS
	Species Richness	0.75(0.4840)	NS
P13	Diversity	4.14(0.0298)	06^{a} 99^{ab} 07^{b}
	Species Richness	3.31(0.0554)	NS

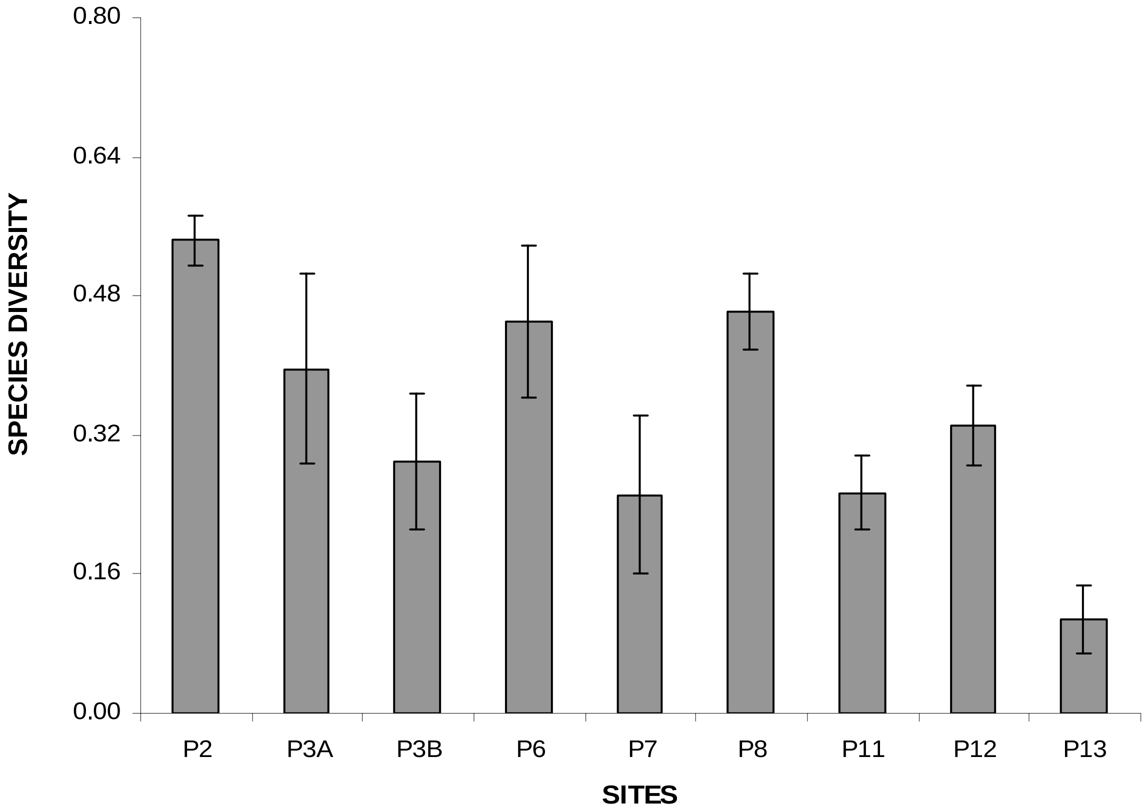


Figure 6.4-3. Mean species diversity among sites sampled in 2007. This data represents both the upper intertidal and lower subtidal substations. Diversity was calculated using the Shannon diversity index.

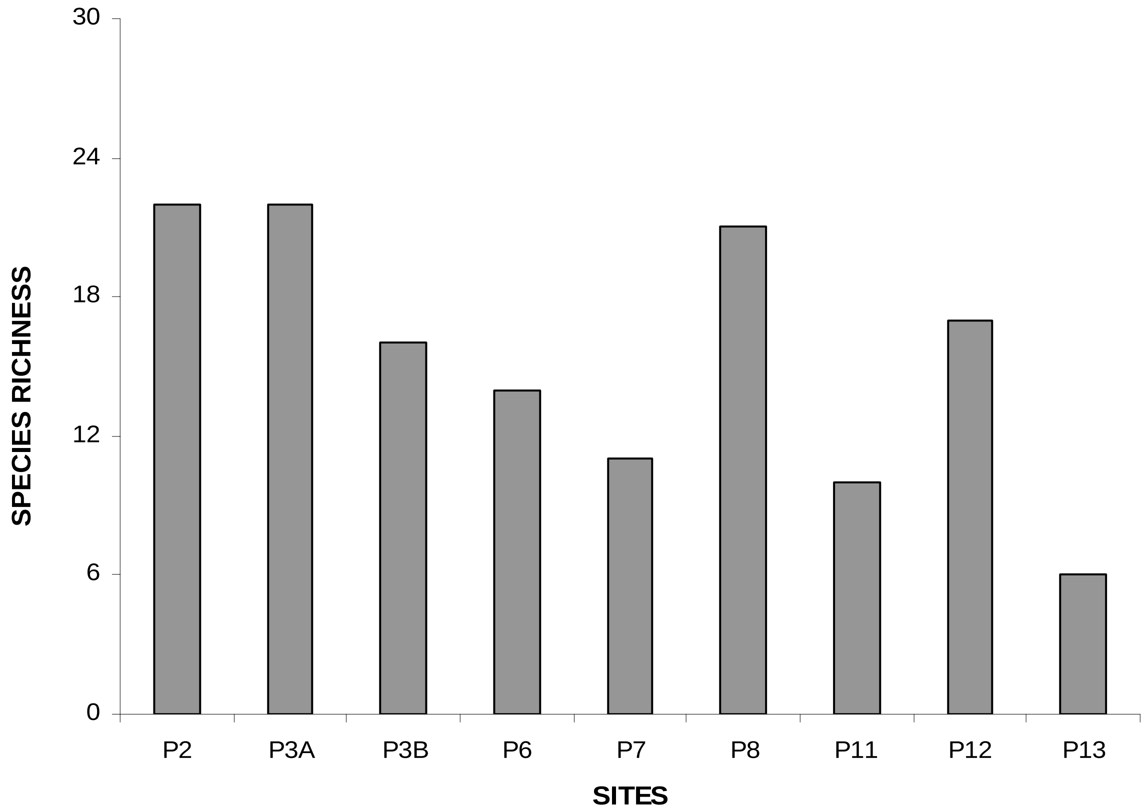


Figure 6.4-4. Mean species richness among sites sampled in 2007. These data represents both upper intertidal and lower subtidal substations.

7.0 EPIBENTHIC STUDIES: DECAPODS AND EPIBENTHIC FISH

7.1 Summary

Many of the commercially important fishery species in North Carolina waters spend at least a portion of their lives either living on or associated with the bottom habitats (benthic) in estuarine and near-shore systems. The connection between benthic, epibenthic organisms, and more pelagic species forms the basis for the trophic transfer of energy. Factors that alter or influence these benthic habitats have the potential to cause upward cascade effects. Although there are a number of organisms that live their entire lives associated with the benthos, by and large, the epibenthic community is composed of species with benthic associated larval and/or juvenile stages, such as many finfish (*Lagodon rhomboides*, *Leiostomus xanthurus*, and *Paralichthys* spp.), but there are a number of finfish with benthic associated adult stages. There are also a number of crustacean species (*Farfantepenaeus aztecus*, *Callinectes sapidus*, among others) that dominate the epibenthic community during some time periods. This study focuses on evaluating the abundance, diversity, and species richness of the epibenthic organisms that utilize both fringing marsh interior and edge habitats along the mesohaline to oligohaline portion of the Cape Fear River estuary. For many taxa, distinct life history strategies depend on these marsh and tidal swamp habitats for refuge and foraging during vulnerable early developmental stages. The abundance and diversity of this community influences the link between benthic secondary production and higher trophic levels. Utilization patterns during critical recruitment periods in the spring and fall provide the best indication of potential impacts from deepening activities in the lower Cape Fear estuary.

Seasonal studies, in fall 2007 and spring 2008, focused on community measures such as composition, dominance, diversity, species richness, and abundance of the highly motile epibenthos. While benthic infauna respond more slowly to the changes in physical factors, the epibenthic community responds more quickly to physical changes as they mature, due to their highly motile nature, and need for refuge and forage habitat. The distribution and abundance of epibenthic organisms is affected by the distribution and species composition of the benthic infauna (critical prey for most of the taxa collected as part of this study), as discussed in Section 6.0.

Two methods were employed to sample epibenthos, Breder traps (a passive sampling device) deployed at multiple tidal positions within the marsh and Drop traps (an active density based sampling method) deployed along the shallow subtidal marsh edge habitat. Previous findings indicated changes in species patterns consistent with developing drought conditions in 2001 and 2002, though this period was also coincident with the initial construction activity (Hackney et al. 2004). The period from 2006 to 2007, including fall 2006 and spring 2007 sampling period, were characterized by increasing drought conditions (rainfall records < 20 inches below annual average), and lower water levels at some stations, but few indications of a response by the epibenthic fish community (Hackney et al. 2007). The period covered by this report (fall 2007 and spring 2008) also experienced lower than normal rainfall, although not as severe as the previous year. The majority of the channel deepening of the Cape Fear River was downstream of Wilmington between 2002 and 2004. Planned construction upstream has not been completed. Evaluations of total abundance among years shows that more fish utilized the fringing marshes in fall 2007 compared to the previous fall 2006 or the initial sampling season (1999). Total abundances were higher in 2008 and 2007 compared to the initial sampling period where differences were detected in the spring data. Similar patterns in the spring data were evident for diversity measurements and overall species richness. Nearly all sites showed higher species richness in fall 2007 and spring 2008. Fall 2007 diversity measures were generally higher than 2006 or 1999, and nearly all differences detected in spring 2008 were greater than spring 2007 or spring 2000.

7.2 Background

The presence of refuges and sufficient forage habitat are critical to maintaining community diversity and ecosystem function. Shifts in salinity or tidal inundation period have been shown to effect community dynamics and could have an upward cascade effect on prey composition and density. These increased tidal inundation periods or changes in salinity could lead to shifts in vegetation type, dominance, or coverage directly altering habitat quality. Tidal fringing marsh and swamps provide essential habitat for juvenile fishes and crustaceans across the estuarine gradient. The maintenance of these habitats supports the commercial and recreational shrimp fishery (both *Farfantepanaeus aztecus* and *Litopanaeus setiferus)* in the lower Cape Fear River and provides essential refuge for juvenile blue crabs, *Callinectes sapidus*, several species of scianids, and a large number of prey fishes. These are critical fisheries species for the Cape Fear region. Changes in the epibenthic organisms (either composition or abundance) could cause significant impacts to these fisheries, either through direct impacts to juvenile stages or through the shift in available forage species. Epibenthos are sensitive to changes associated with shifts in salinity and/or tidal inundation. The ingress of juvenile stages of many fishery species is closely dependent on the recruitment of prey species. In general, benthic fauna such as annelids tend towards highest abundances in early spring, following a winter relatively free of predator influence and abundant benthic production. Juvenile fish and crustaceans that depend on this benthic resource start invading the estuary by mid February with full recruitment of multi-species assemblages by early March. There is also a slightly smaller recruitment of benthos in the fall of each year and this too is closely followed by benthic feeding fishes and crustaceans. These annual cycles of species recruitment were the basis for our focus on spring and fall sampling events.

As part of the long-term project to monitor potential changes in communities that depend on these habitats, we examined 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 whose natural cycle leads them to 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 fishery species such as the blue crab (*Callinectes sapidus*), spot (*Leiostomus xanthurus*), flounder (*Paralichthys dentatus*), and commercial shrimp (*Farfantepanaeus* sp. and *Litopanaeus* sp). Many epibenthos occupy critical intermediate trophic roles, being predators on benthos or plankton, and prey for larger fish [e.g. grass shrimp (*Palaemonetes* spp.), killifish (*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.

Epibenthic taxa represent indicators of ecosystem level changes for three reasons: 1) their motile lifestyles allow 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 the distribution of certain epifaunal organisms, including shifts in dominance at a site or along the upstream/downstream gradient, may indicate changes in tidal amplitude or salinity regimes. 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/egress 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 resource (including benthic fauna) and refuge (structural habitat within the marsh system) are important for determining population levels and survivorship.

The objective is to evaluate abundance of organisms utilizing the fringing tidal marshes and wetlands at stations along the Cape Fear River estuary where benthic infaunal assemblages are also being monitored. This report covers sampling in fall 2007 and spring 2008. Data from previous reporting periods (2006-2007 and the initial sampling period 1999-2000) is included here for comparative purposes (Hackney et al. 2007).

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. We used two sampling methods, Breder traps and Drop traps, to target epifauna with different utilization patterns. Breder trap sampling targets bottom oriented organisms that utilize the intertidal marsh or swamp habitat during the period of tidal 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 a variety of structures. 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 heavily structured environments, e.g. marshes.

Breder traps are constructed of clear acrylic (31 cm length X 16 cm height X 15 cm width). When submerged, these traps are transparent and catch epibenthic fish and crustaceans, passively, as they move into the tidal wetlands. At each station, traps are placed at three tidal heights; lower intertidal (near mean low water), mid intertidal (submerged ~ 1 m depth at mean high water), and upper intertidal (submerged ~ 0.5 m at mean high water). Two sets of five traps are set at each tidal height with the opening oriented towards the channel or downstream. The orientation of the traps is based on preliminary data that indicates this channel or downstream 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, predation, or cannibalism among organisms within the traps. All organisms caught are measured for total length, identified to lowest possible taxon, and representative specimens are preserved for verification. Breder trap sampling is conducted at nine sites: P11 (Smith Creek), P12 (Rat Island) and P13 (Fishing Creek) in the Northeast Cape Fear River, P6 (Eagle Island), P7 (Indian Creek), and P8 (Dollisons Landing) in the Cape Fear River, and P2 (at the mouth of Town Creek), and two 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 1 m on a side and 1 m 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 10 m apart, and at least 20 minutes are allowed between each sample. Once the trap is secured, the contents are removed using a steel frame sweep net with a 2 mm 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 for 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 because of edge area limitations.

Drop trap and Breder trap sampling was conducted during the same time window for all stations. At least 24 hours separated the use of each method at a site. While Breder traps were deployed on a single day per site, drop trap samples were collected over a 3+ day period for each site. The collection of drop trap data over a multi-day sampling period gives a more accurate evaluation of the use of the subtidal areas adjacent to each site.

Epibenthos were monitored from two distinct sub-habitats with methods specific for each habitat. Mean abundance data is presented by sampling methodology. Breder trap data that targets those species that move into the fringing marsh with the flooding tide is presented with fall and spring data concurrent for each site (Tables 7.4-1a through 7.4-9b). Drop trap data that targets lower marsh edge or shallow sub-tidal habitats is presented likewise (Tables 7.4-10a through 7.4-17b). Analyses for this report focused on differences in diversity, species richness, and total epifauna by season, and across years for both Breder and Drop trap data separately, to evaluate potential trends and community level responses. Because of interactions between seasons and among sites, these data were analyzed among years by site for each season on log transformed data using a One-way Analysis of Variance to meet the assumptions of homogeneous variances. Where significant year effects were found, an SNK test was used to distinguish among years by site. The Shannon diversity index was used to describe diversity patterns at each site. The Shannon diversity index accounts for both species abundance and evenness among species. Overall community comparisons, including all species present, were analyzed using an Analysis of Similarity with Primer 6.0, a multivariate statistical package. Community comparison results are presented in a separate multidimensional scaling plot for each data period (fall 2007 and spring 2008).

Table 7.4-1a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P2 (Mouth of Town Creek).

	Fall 1999			Fall 2006			Fall 2007		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.25(0.16)	0.44(0.44)	0(0)
Ctenogobius boleosoma	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)
Ctenogobius shufeldti	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Cynoscion nebulosus	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(0)	0(0)	0(0)	0.62(0.32)	0.33(0.33)	0.80(0.36)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Gambusia affinis	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Gobiosoma bosc	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.11(0.11)	0(0)
insect sp.	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0.70(0.26)	0.40(0.16)	0.50(0.17)	1.88(0.69)	2.33(0.50)	3.80(0.88)
Lutjanus griseus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.12(0.12)	0(0)	0(0)
Palaemonetes pugio	0(0)	0.30(0.15)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	0.12(0.12)	0.11(0.11)	1.00(0.21)
Palaemonetes vulgaris	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.33(0.17)	1.20(0.51)
Paralichthys dentatus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Symphurus plagiusa	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.12(0.12)	0.11(0.11)	0.10(0.10)
Syngathus fuscus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Uca pugnax	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 7.4-1b. Mean abundance (SE) for epibenthic fauna collected during spring (2000, 2007, and 2008) Breder trap samples at station P2 (Mouth of Town Creek).

	Spring 2000			**Spring 2007**			**Spring 2008**		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Anchoa mitchelli	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Callinectes sapidus	0(0)	0(0)	0(0)	0(0)	0.11(0.11)	0(0)	0.20(0.20)	0.10(0.10)	0.10(0.10)
Clupeidae	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)
Ctenogobius shufeldti	0.10(0.10)	0.20(0.13)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Fundulus heteroclitus	0.10(0.10)	0.10(0.10)	0(0)	0(0)	0(0)	0.20(0.13)	0.10(0.10)	0.40(0.30)	0.80(0.33)
Hirudinea	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Lagodon rhomboides	0.20(0.13)	0(0)	0(0)	0.40(0.22)	0.22(0.15)	0(0)	0.10(0.10)	0(0)	0.10(0.10)
Leiostomas xanthurus	9.90(2.66)	5.00(1.62)	5.30(2.33)	11.50(1.53)	21.44(2.30)	29.10(6.92)	5.90(1.72)	9.40(5.12)	24.0(6.15)
Mugil cephalus	0(0)	0(0)	0(0)	0(0)	0(0)	0.40(0.40)	0(0)	0.10(0.10)	0(0)
Palaemonetes pugio	1.50(0.43)	1.40(0.52)	2.30(1.04)	3.70(0.91)	3.44(1.00)	0.40(0.22)	18.40(4.51)	19.40(3.17)	11.50(2.31)

Table 7.4-2a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P3A (Town Creek).

	Fall 1999			Fall 2006			Fall 2007		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0(0)	0.10(0.10)	0.10(0.10)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)
Eucinostomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Farfantepenaeus aztecus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.30(0.15)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.30(0.15)
Gambusia holbrooki	0(0)	0(0)	0(0)	0(0)	0(0)	0.40(0.22)	0.14(0.14)	0.10(0.10)	1.10(0.60)
Lepomis macrochirus	0(0)	0.10(0.10)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.28(0.28)	3.00(1.08)	1.00(0.36)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0.20(0.13)
Syngnathus fuscus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Uca pugnax	0.20(0.20)	0.40(0.22)	0.80(0.25)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 7.4-2b. Mean abundance (SE) for epibenthic fauna collected during spring (2000, 2007, and 2008) Breder trap samples at station P3A (Town Creek).

	Spring 2000			Spring 2007			Spring 2008		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0(0)	0.10(0.10)	0.20(0.13)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0.80(0.51)	0(0)	0.22(0.15)
Gambusia affinis	0.10(0.10)	0.50(0.27)	0.50(0.31)	0(0)	0(0)	0(0)	0(0)	0(0)	0.11(0.11)
Gambusia holbrooki	0(0)	0(0)	0(0)	0(0)	0.60(0.43)	0.10(0.10)	0(0)	0(0)	0(0)
Lagodon rhomboides	0(0)	0(0)	0(0)	0(0)	0.50(0.34)	0(0)	0.30(0.15)	1.00(0.29)	0.33(0.24)
Leiostomus xanthurus	0(0)	0(0)	0(0)	0.20(0.13)	0.10(0.10)	0(0)	42.40(12.78)	61.56(24.12)	13.56(6.09)
Mugil cephalus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)	0(0)	0(0)
Palaemonetes pugio	0(0)	0(0)	0(0)	0.20(0.13)	0(0)	0(0)	4.90(2.03)	13.89(6.29)	1.11(0.87)
Paralichthys sp.	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)
Uca pugnax	1.50(0.62)	2.10(0.57)	2.00(0.67)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 7.4-3a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P3B (Town Creek).

		Fall 1999			**Fall 2006**			**Fall 2007**	
	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(0)
Ctenogobius shufeldti	0(0)	0.10(0.10)	0.10(0.10)	0.30(0.30)	0.10(0.10)	0.20(0.20)	0(0)	0(0)	0(0)
Eucinostomus sp.	0(0)	0(0)	0(0)	0.20(0.20)	0(0)	0.70(0.47)	0(0)	0(0)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Gambusia holbrooki	0(0)	0(0)	0(0)	0(0)	0(0)	0.60(0.27)	0(0)	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)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.50(0.34)	1.50(0.62)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Sesarma cinereum	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)	0.20(0.13)	0(0)	0(0)	0(0)
Uca pugnax	0.50(0.22)	0.20(0.13)	0.40(0.16)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 7.4-3b. Mean abundance (SE) for epibenthic fauna collected during spring (2000, 2007, and 2008) Breder trap samples at station P3B (Town Creek).

	Spring 2000			Spring 2007			Spring 2008		
	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)	0.20(0.13)	0(0)
Ctenogobius shufeldti	0.10(0.10)	0.10(0.10)	0(0)	0.20(0.13)	0(0)	0(0)	0(0)	0(0)	0(0)
Dormitator maculatus	0(0)	0.10(0.10)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0(0)	0(0)	0.14(0.14)	0.20(0.13)	0.30(0.21)	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)
Gambusia holbrooki	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0.14(0.14)	0(0)	0(0)	0(0)
Lagodon rhomboides	0(0)	0(0)	0(0)	0(0)	0.50(0.31)	0(0)	1.90(0.78)	2.60(0.88)	1.40(0.64)
Leiostomus xanthurus	0(0)	0(0)	0(0)	1.50(0.70)	3.30(1.30)	0.14(0.14)	91.70(29.37)	84.70(30.06)	165.10(50.38)
Menidia beryllina	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)
Micropogonias undulatus	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(0)	0.20(0.13)
Palaemonetes pugio	0(0)	0(0)	0(0)	0.50(0.27)	0.30(0.21)	0.14(0.14)	0.90(0.41)	1.80(0.71)	2.90(1.29)
Paralichthys sp.	0(0)	0(0)	0(0)	0.20(0.13)	0(0)	0(0)	0(0)	0(0)	0(0)
Rhithropanopeus harrisii	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0.43(0.20)	0(0)	0(0)	0.10(0.10)
Uca pugnax	0.70(0.26)	1.20(0.49)	0.60(0.34)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

Table 7.4-4a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P6 (Eagle Island).

	Fall 1999			Fall 2006			Fall 2007		
	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)	0.10(0.10)
Ctenogobius shufeldti	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	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)
Farfantepenaeus aztecus	0(0)	0(0)	0(0)	0(0)	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(0)	0(0)	0.10(0.10)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1.00(0.26)	0.60(0.22)	2.00(0.45)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0.30(0.21)	0(0)	0.10(0.10)	0.30(0.15)
Paralichthys dentatus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0.10(0.10)
Symphurus plagiusa	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
U/I larval fish	0.10(0.10)	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 (2000, 2007. amd 2008) Breder trap samples at station P6 (Eagle Island).

	Spring 2000			Spring 2007			Spring 2008		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0(0)	0.10(0.10)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Clupeidae	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Ctenogobius boleosoma	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)
Ctenogobius shufeldti	0(0)	0.10(0.10)	0.10(0.10)	0.10(0.10)	0.20(0.13)	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)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0.10(0.10)	0.10(0.10)	0(0)	0(0)	0(0)	0.10(0.10)
Lagodon rhomboides	0(0)	0.10(0.10)	0.20(0.13)	0(0)	0(0)	0(0)	0.30(0.15)	0.30(0.21)	0.50(0.22)
Leiostomus xanthurus	0(0)	0(0)	0.20(0.13)	1.80(0.96)	0.60(0.22)	2.20(1.16)	1.50(0.76)	2.70(0.82)	71.20(46.98)
Mugil cephalus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.60(0.27)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0.90(0.31)	0.70(0.21)
Paralichthys dentatus	0.30(0.30)	0.40(0.22)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Paralichthys sp.	0(0)	0(0)	0(0)	0.70(0.21)	0.50(0.22)	0(0)	0.20(0.13)	0.10(0.10)	0.10(0.10)
Uca minax	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)

Table 7.4-5a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P7 (Indian Creek).

	Fall 1999			Fall 2006			Fall 2007		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0(0)	0(0)	0.10(0.10)	0.10(0.10)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Dormitator maculatus	0(0)	0.20(0.13)	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)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.44(0.24)	0.40(0.16)	0.20(0.13)
Palaemonetes pugio	0(0)	0(0)	0(0)	0.10(0.10)	0.20(0.20)	0(0)	0.33(0.24)	0.10(0.10)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Uca pugnax	0.60(0.34)	0.20(0.13)	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 (2000, 2007, and 2008) Breder trap samples at station P7 (Indian Creek).

	Spring 2000			Spring 2007			Spring 2008		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0.40(0.16)	1.10(0.28)	4.33(3.85)	0.20(0.20)	0.33(0.24)	0(0)	0.20(0.13)	0.11(0.11)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0.11(0.11)	0.20(0.20)	0(0)	0.11(0.11)
Gambusia holbrooki	0(0)	0(0)	0(0)	0(0)	0.22(0.15)	0.11(0.11)	0(0)	0(0)	0(0)
Lagodon rhomboides	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)
Leiostomus xanthurus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	1.00(0.67)
Lepomis macrochirus	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mugil cephalus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	1.70(1.01)	0.44(0.44)	17.56(17.43)
Paralichthys lethostigma	0(0)	0.30(0.15)	0.67(0.44)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Paralichthys sp.	0(0)	0(0)	0(0)	0.60(0.34)	0.11(0.11)	0(0)	0.10(0.10)	0(0)	0(0)
Uca minax	0(0)	0(0)	0(0)	0.10(0.10)	0.55(0.44)	2.22(1.22)	0(0)	0(0)	0(0)

Table 7.4-6a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P8 (Dollisons Landing).

	Fall 1999			Fall 2006			Fall 2007		
	Low	Mid	Upper	Low	Mid	Upper	Low	Mid	Upper
Cambarus robustus	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Ctenogobius shufeldti	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	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)
Eucinostomus sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.30(0.21)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0.20(0.13)	0.20(0.13)	0(0)	0.20(0.13)	0(0)	0(0)
Gambusia holbrooki	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.20)	0.20(0.13)
Gobiosoma bosc	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(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)
Micropterus salmoides	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Sternotherus odoratus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)
Trinectes maculatus	0.20(0.13)	0.20(0.20)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Uca minax	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0.10(0.10)	0.40(0.22)	0.10(0.10)	0.10(0.10)

Table 7.4-6b. Mean abundance (SE) for epibenthic fauna collected during spring (2000, 2007, and 2008) Breder trap samples at station P8 (Dollisons Landing).

	Spring 2000			Spring 2007			Spring 2008		
	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)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0(0)	0.20(0.13)	0.20(0.13)	0(0)	0(0)	0.10(0.10)
Lepomis macrochirus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.11(0.11)	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)
Mugil cephalus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.13)

Table 7.4-7a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P11 (Smith Creek).

	Fall 1999			Fall 2006			Fall 2007		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0.10(0.10)	0.10(0.10)	0(0)	0.20(0.20)	0(0)	0.40(0.16)	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)
Etropus crossotus	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(0)	0.10(0.10)	0.10(0.10)
Fundulus heteroclitus	0(0)	0.10(0.10)	0(0)	0(0)	0.20(0.20)	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)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	2.89(0.68)	2.60(0.50)	3.80(0.93)
Menidia beryllina	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Palaemonetes pugio	0(0)	0(0)	0(0)	0.10(0.10)	0.20(0.13)	0(0)	0(0)	0(0)	0(0)
Paralichthys dentatus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)
Trinectes maculatus	0(0)	0.10(0.10)	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)
Uca pugnax	0.10(0.10)	0.20(0.13)	8.50(4.17)	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 (2000, 2007, and 2008) Breder trap samples at station P11 (Smith Creek).

	Spring 2000			Spring 2007			Spring 2008		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Callinectes sapidus	0(0)	0(0)	0(0)	0.11(0.11)	0(0)	0(0)	0.20(0.13)	0.20(0.13)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Lagodon rhomboides	0.10(0.10)	0(0)	0(0)	0.33(0.24)	0.70(0.26)	0.10(0.10)	1.90(0.48)	1.40(0.34)	0.60(0.27)
Leiostomus xanthurus	1.30(0.76)	0.30(0.21)	1.00(0.39)	13.56(2.96)	44.30(9.24)	62.50(17.35)	71.80(17.44)	98.90(27.78)	141.30(32.69)
Mugil cephalus	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)	0.10(0.10)	0(0)	0.20(0.20)	0(0)	0.20(0.13)
Paralichthys sp.	0(0)	0(0)	0(0)	0.11(0.11)	0.10(0.10)	0(0)	0(0)	0.10(0.10)	0(0)

Table 7.4-8a. Mean abundance (SE) for epibenthic fauna collected during fall (1999, 2006, and 2007) Breder trap samples at station P12 (Rat Island).

	Fall 1999			Fall 2006			Fall 2007		
	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)	0.11(0.11)	0(0)
Ctenogobius shufeldti	0(0)	0(0)	0(0)	1.10(0.28)	0.55(0.29)	0.10(0.10)	0(0)	0(0)	0.12(0.12)
Dormitator maculatus	0.60(0.34)	0(0)	0.40(0.22)	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(0)	0.11(0.11)	0(0)
Lepomis macrochirus	0(0)	0.20(0.13)	0.10(0.10)	0(0)	0.11(0.11)	0(0)	0(0)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0.11(0.11)	0(0)	0(0)	0.89(0.31)	1.38(0.65)
Palaemonetes pugio	0.10(0.10)	0 (0)	0 (0)	0(0)	0(0)	0(0)	0(0)	0.22(0.15)	0(0)
Syngnathus fuscus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.13)	0(0)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Uca pugnax	0(0)	0.20(0.13)	0.10(0.10)	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)	0.11(0.11)	0(0)

Table 7.4-8b. Mean abundance (SE) for epibenthic fauna collected during spring (2000, 2007, and 2008) Breder trap samples at station P12 (Rat Island).

	Spring 2000			Spring 2007			Spring 2008		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius boleosoma	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Ctenogobius shufeldti	0.60(0.31)	0.60(0.31)	0.10(0.10)	0.60(0.16)	0.70(0.15)	0.20(0.20)	0.90(0.28)	0.30(0.15)	0.10(0.10)
Fundulus heteroclitus	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Lagodon rhomboides	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)
Leiostomas xanthurus	0.20(0.20)	0.20(0.13)	0.10(0.10)	0.30(0.15)	0.10(0.10)	2.50(1.86)	0(0)	0.20(0.13)	0.50(0.50)
Lepomis macrochirus	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Macrobranchium acanthurus	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)
Mugil curema	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.30(0.15)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)
Palaemonetes vulgaris	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)
Paralichthys lethostigma	0(0)	0.30(0.21)	0.30(0.15)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)
Paralichthys sp.	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.13)	0.10(0.10)	0(0)
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.20(0.13)
Uca pugnax	0.10(0.10)	0(0)	0.10(0.10)	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(1999, 2006, and 2007) Breder trap samples at station P13 (Fishing Creek).

	Fall 1999			Fall 2006			Fall 2007		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Ctenogobius shufeldti	0(0)	0(0)	0(0)	0.20(0.13)	0.33(0.24)	0(0)	0(0)	0(0)	0(0)
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)
Lepomis macrochirus	0.60(0.60)	0.30(0.30)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.80(0.36)	0.75(0.31)	1.00(0.26)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.40(0.16)	0(0)	0.60(0.50)
Palaemonetes vulgaris	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.100
Uca minax	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.12(0.12)	0.40(0.16)
Uca pugnax	0(0)	0.40(0.30)	0.40(0.30)	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 (2000, 2007, and 2008) Breder trap samples at station P13 (Fishing Creek).

	Spring 2000			Spring 2007			Spring 2008		
	Low	**Mid**	**Upper**	**Low**	**Mid**	**Upper**	**Low**	**Mid**	**Upper**
Centrarchidae	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)
Clupeidae	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)
Ctenogobius shufeldti	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0.11(0.11)	0(0)	0(0)
Fundulus heteroclitus	0(0)	0(0)	0(0)	0.50(0.34)	0.30(0.21)	0.20(0.13)	0.11(0.11)	0(0)	0(0)
Gambusia holbrooki	0(0)	0(0)	0(0)	0.20(0.13)	0.20(0.13)	0.20(0.13)	0(0)	0(0)	0(0)
Lagodon rhomboides	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0(0)	0.22(0.15)	0(0)	0(0)
Leiostomus xanthurus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	4.11(1.70)	14.60(9.92)	4.20(2.82)
Lepomis macrochirus	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)
Mugil cephalus	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.22(0.15)	0(0)	0.50(0.34)
Palaemonetes pugio	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)	0.10(0.10)	0.20(0.13)
Uca minax	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)	0.10(0.10)	0(0)	0(0)	0(0)	0(0)	0(0)	0(0)

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

	1999	**2006**	**2007**
Anchoa mitchilli	0.44(0.44)	1.28(0.69)	2.22(0.76)
Bairdiella chrysoura	0(0)	0(0)	0.11(0.08)
Callinectes sapidus	0.33(0.14)	0.78(0.17)	1.94(0.46)
Chaetodipterus faber	0(0)	0(0)	0.06(0.06)
Ctenogobius boleosoma	0(0)	0.17(0.09)	0(0)
Ctenogobius shufeldti	0.44(0.20)	0.06(0.06)	0(0)
Cynoscion nebulosus	0(0)	0(0)	0.17(0.09)
Dorosoma petenense	0(0)	0(0)	0.06(0.06)
Etropus crossotus	0(0)	0(0)	0.17(0.09)
Eucinostomus sp.	0(0)	0.11(0.11)	0(0)
Farfantepenaeus aztecus	0(0)	0(0)	1.33(0.59)
Fundulus heteroclitus	0(0)	0(0)	0.06(0.06)
Gobiosoma bosc	0(0)	0(0)	0.06(0.06)
Litopenaeus setiferus	0(0)	0.56(0.29)	2.06(0.88)
Palaemonetes pugio	1.39(0.88)	0.28(0.22)	0.17(0.12)
Palaemonetes vulgaris	0(0)	0(0)	0.89(0.83)
Panopeus herbstii	0.06(0.06)	0(0)	0(0)
Paralichthys sp.	0(0)	0.06(0.06)	0(0)
Rhithropanopeus harrisii	0.06(0.06)	0.06(0.06)	0(0)
Symphurus plagiusa	0(0)	0(0)	0.78(0.29)
Syngnathus fuscus	0(0)	0(0)	0.11(0.08)
Uca pugnax	0.06(0.06)	0(0)	0(0)

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

	2000	2007	2008
Anchoa mitchilli	0(0)	0.06(0.06)	0(0)
Anguilla rostrata	0(0)	0.06(0.06)	0.11(0.08)
Callinectes sapidus	0.06(0.06)	0.39(0.14)	0.28(0.14)
Clupeidae	0(0)	0.17(0.12)	0.28(0.18)
Ctenogobius boleosoma	0(0)	0.22(0.13)	0.11(0.08)
Ctenogobius shufeldti	0.17(0.09)	0(0)	0.06(0.06)
Lagodon rhomboides	0.44(0.23)	0.06(0.06)	0(0)
Leiostomus xanthurus	7.00(2.41)	10.22(4.82)	3.28(1.29)
Leptocephalus larvae	0(0)	0(0)	0.06(0.06)
Menidia beryllina	5.61(3.20)	0(0)	0(0)
Micropogonias undulatus	0(0)	0.56(0.28)	0(0)
Palaemonetes pugio	5.56(1.35)	2.78(1.50)	7.06(2.26)
Panopeus herbstii	0.06(0.06)	0(0)	0(0)
Paralichthys dentatus	0.11(0.08)	0(0)	0(0)
Paralichthys albigutta	0(0)	0.06(0.06)	0(0)
Paralichthys sp.	0(0)	0.11(0.08)	0.06(0.06)
Rhithropanopeus harrisii	0(0)	0.17(0.12)	0(0)

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

	1999	**2006**	**2007**
Anchoa mitchilli	1.36(0.66)	0(0)	1.39(0.74)
Anguilla rostrata	0.06(0.04)	0(0)	0.06(0.06)
Callinectes sapidus	0.11(0.07)	0.39(0.22)	0.39(0.12)
Cambarus robustus	(0.03)(0.03)	0(0)	0(0)
Ctenogobius boleosoma	0(0)	0.06(0.06)	0(0)
Ctenogobius shufeldti	0.53(0.24)	0.56(0.20)	0.39(0.14)
Cynoscion nebulosus	0(0)	0(0)	0.11(0.08)
Eucinostomus sp.	0(0)	0.17(0.09)	0(0)
Evorthodus lyricus	0(0)	0.06(0.06)	0(0)
Fundulus heteroclitus	0.11(.05)	0(0)	0.06(0.06)
Gambusia holbrooki	0.80(0.60)	0.78(0.49)	0.06(0.06)
Gobionellus oceanicus	0(0)	0.28(0.14)	0.06(0.06)
Lepomis macrochirus	0.08(0.05)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	12.61(2.54)
Lutjanus mahogoni	0(0)	0(0)	0.06(0.06)
Menidia beryllina	0.06(0.04)	0.33(0.28)	0.17(0.12)
Micropogonias undulatus	0.11(0.05)	0(0)	0(0)
Palaemonetes pugio	0(0)	4.28(3.38)	2.44(1.20)
Panopeus herbstii	0.06(0.06)	0(0)	0(0)
Paralichthys lethostigma	0(0)	0(0)	0.06(0.06)
Rhithropanopeus harrisii	0(0)	0(0)	0.06(0.06)
Sesarma cinereum	0(0)	0(0)	0.06(0.06)
Symphurus plagiusa	0(0)	0(0)	1.00(0.41)
Syngnathus fuscus	0(0)	0(0)	0.06(0.06)
Trinectes maculatus	2.14(0.76)	0.56(0.24)	0(0)
Uca pugnax	0.92(0.46)	0(0)	0(0)

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

	2000	**2007**	**2008**
Anguilla rostrata	0.08(0.05)	0(0)	0.06(0.06)
Callinectes sapidus	0.19(0.08)	0.17(0.12)	1.17(0.29)
Clupeidae	0(0)	0(0)	0.06(0.06)
Ctenogobius boleosoma	0(0)	0(0)	0.44(0.20)
Ctenogobius shufeldti	0.28(0.08)	0.17(0.09)	0.06(0.06)
Fundulus heteroclitus	0(0)	0(0)	0.06(0.06)
Gambusia holbrooki	2.00(0.93)	0(0)	0(0)
Lagodon rhomboides	0.33(0.14)	0.44(0.20)	2.67(1.11)
Leiostomus xanthurus	0(0)	20.28(5.91)	121.44(41.51)
Lepomis macrochirus	1.58(0.84)	0(0)	0(0)
Menidia beryllina	0.06(0.06)	0(0)	0(0)
Micropogonias undulatus	0(0)	0(0)	2.33(1.50)
Mugil cephalus	0(0)	0(0)	3.61(1.94)
Mugil curema	0(0)	0(0)	0.17(0.12)
Palaemonetes pugio	0(0)	5.28(1.73)	112.72(24.49)
Panopeus herbstii	0.06(0.04)	0(0)	0(0)
Paralichthys dentatus	0.45(0.12)	0(0)	0(0)
Paralichthys sp.	0(0)	0.11(0.11)	0.17(0.12)
Trinectes maculatus	0.30(0.14)	0(0)	0(0)
Uca pugnax	0.03(0.03)	0(0)	0(0)

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

	1999	**2006**	**2007**
Anchoa mitchilli	0(0)	0.22(0.22)	0.50(0.27)
Callinectes sapidus	0.22(0.10)	0.17(0.09)	0.28(0.11)
Corbicula fluminea	0.06(0.06)	0(0)	0(0)
Ctenogobius boleosoma	0(0)	0.11(0.11)	0.06(0.06)
Ctenogobius shufeldti	0.06(0.06)	0.11(0.08)	0.22(0.13)
Eucinostomus sp.	0(0)	0.11(0.11)	0.39(0.29)
Leiostomus xanthurus	0(0)	0(0)	0.11(0.08)
Litopenaeus setiferus	0(0)	0.06(0.06)	3.72(0.88)
Macrobrachium sp.	0(0)	0.11(0.08)	0(0)
Menidia beryllina	0.11(0.08)	0.50(0.40)	1.11(1.11)
Palaemonetes pugio	0(0)	0.06(0.06)	0.17(0.17)
Palaemonetes vulgaris	0(0)	0(0)	0.06(0.06)
Paralichthys albigutta	0(0)	0(0)	0.06(0.06)
Rhithropanopeus harrisii	0(0)	0(0)	0.17(0.12)
Symphurus plagiusa	0(0)	0(0)	0.67(0.20)
Syngnathus fuscus	0(0)	0(0)	0.11(0.08)
Trinectes maculatus	0.44(0.20)	0.06(0.06)	0(0)

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

	2000	**2007**	**2008**
Callinectes sapidus	0(0)	0.06(0.06)	0.44(0.14)
Clupeidae	0(0)	1.67(0.72)	1.83(0.92)
Ctenogobius boleosoma	0(0)	0(0)	0.06(0.06)
Ctenogobius shufeldti	0.11(0.11)	0.33(0.11)	0.39(0.14)
Lagodon rhomboides	0(0)	0.11(0.11)	0.22(0.15)
Leiostomus xanthurus	0(0)	74.94(23.79)	43.67(16.93)
Mugil cephalus	0(0)	0(0)	0.56(0.24)
Palaemonetes pugio	0(0)	0.44(0.24)	10.39(4.98)
Paralichthys dentatus	0.17(0.12)	0(0)	0(0)
Paralichthys sp.	0(0)	0.17(0.09)	0.56(0.23)
Rhithropanopeus harrisii	0(0)	0(0)	0.06(0.06)

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

	1999	**2006**	**2007**
Anchoa mitchilli	0(0)	0(0)	0.67(0.67)
Anguilla rostrata	0(0)	0.06(0.06)	0(0)
Callinectes sapidus	0.06(0.06)	0.11(0.11)	0.06(0.06)
Ctenogobius shufeldti	0.06(0.06)	0.17(0.12)	0.33(0.11)
Dorosoma pretense	0.06(0.06)	0(0)	0(0)
Esox lucius	0.06(0.06)	0(0)	0(0)
Eucinostomus sp.	0(0)	0.11(0.11)	0.06(0.06)
Fundulus heteroclitus	0.06(0.06)	0(0)	0(0)
Gambusia holbrooki	0.06(0.06)	0(0)	0(0)
Gobionellus oceanicus	0(0)	0(0)	0.11(0.08)
Leiostomus xanthurus	0(0)	0(0)	0.06(0.06)
Litopanaeus setiferus	0(0)	0.06(0.06)	0.89(0.20)
Menidia beryllina	0(0)	0(0)	0.33(0.20)
Palaemonetes pugio	0(0)	0(0)	0.28(0.16)
Paralichthys lethostigma	0(0)	0(0)	0.06(0.06)
Rhithropanopeus harrisii	0(0)	0.11(0.11)	0(0)
Symphurus plagiusa	0(0)	0(0)	0.06(0.06)
Trinectes maculatus	0(0)	0.33(0.18)	0(0)
Uca pugnax	0.06(0.06)	0(0)	0(0)
Uca sp.	0(0)	0.06(0.06)	0(0)

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

	2000	**2007**	**2008**
Anguilla rostrata	0.71(0.34)	0.17(0.09)	0.11(0.08)
Callinectes sapidus	0(0)	0.06(0.06)	0(0)
Clupeidae	0(0)	1.22(0.77)	0.61(0.41)
Ctenogobius shufeldti	0.29(0.14)	0.22(0.13)	0.17(0.12)
Lagodon rhomboides	0.35(0.35)	0.06(0.06)	0.06(0.06)
Leiostomus xanthurus	0(0)	1.00(0.36)	0.78(0.40)
Mugil cephalus	0(0)	0(0)	1.72(1.61)
Palaemonetes pugio	0(0)	0(0)	0.06(0.06)
Paralichthys dentatus	0.47(0.28)	0(0)	0(0)
Paralichthys sp.	0(0)	2.83(0.82)	2.72(0.93)
Rangia sp.	0.06(0.06)	0(0)	0(0)
Trinectes maculatus	0(0)	0(0)	0.11(0.08)
Uca pugnax	0.06(0.06)	0(0)	0(0)

Table 7.8-14a. Mean abundance (SE) for epibenthic fauna collected in Fall Drop trap sampling at station P8 (Dollisons Landing).

	1999	**2006**	**2007**
Callinectes sapidus	0(0)	0.11(0.08)	0(0)
Ctenogobius shufeldti	0.11(0.08)	0.17(0.09)	0.28(0.11)
Eucinostomus sp.	0(0)	0.06(0.06)	0.44(0.24)
Gambusia holbrooki	0.22(0.22)	0(0)	0(0)
Lepomis macrochirus	0.06(0.06)	0(0)	0.06(0.06)
Litopenaeus setiferus	0(0)	0(0)	1.22(0.56)
Menidia beryllina	0(0)	0(0)	0.28(0.28)
Notropis chalybaeus	2.94(1.98)	0(0)	0(0)
Palaemonetes pugio	0(0)	0(0)	0.17(0.17)
Trinectes maculatus	0.17(0.12)	0.94(0.35)	0.22(0.17)

Table 7.8-14b. Mean abundance (SE) for epibenthic fauna collected in Spring Drop trap sampling at station P8 (Dollisons Landing).

	2000	**2007**	**2008**
Anguilla rostrata	0(0)	0(0)	0.11(0.11)
Callinectes sapidus	0(0)	0(0)	0.06(0.06)
Clupeidae	0(0)	0.67(0.40)	13.94(13.94)
Ctenogobius shufeldti	0(0)	0.11(0.08)	0.17(0.12)
Gambusia holbrooki	0(0)	0.17(0.17)	0(0)
Leiostomus xanthurus	0(0)	0.11(0.11)	0(0)
Menidia beryllina	0.61(0.39)	0(0)	0(0)
Mugil cephalus	0(0)	0(0)	0.44(0.30)
Paralichthys dentatus	0.11(0.11)	0(0)	0(0)
Paralichthys sp.	0(0)	2.22(0.60)	0.17(0.12)
Trinectes maculatus	0(0)	0.06(0.06)	0(0)
Uca pugnax	0.06(0.06)	0(0)	0(0)

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

	1999	**2006**	**2007**
Anchoa mitchilli	0(0)	0(0)	1.11(0.75)
Callinectes sapidus	0(0)	0.17(0.09)	0.50(0.17)
Ctenogobius boleosoma	0(0)	0.06(0.06)	0(0)
Ctenogobius shufeldti	0.22(0.13)	0.06(0.06)	0(0)
Eucinostomus sp.	0(0)	0.06(0.06)	0(0)
Farfantepenaeus aztecus	0(0)	0(0)	0.22(0.13)
Gobionellus oceanicus	0(0)	0.11(0.11)	0(0)
Litopenaeus setiferus	0(0)	0.28(0.14)	3.06(0.93)
Menidia beryllina	0(0)	0.11(0.08)	0.06(0.06)
Mugil cephalus	0(0)	0(0)	0.06(0.06)
Mugil curema	0(0)	0(0)	0.11(0.08)
Palaemonetes pugio	0(0)	0.22(0.22)	0.06(0.06)
Paralichthys sp.	0(0)	0.06(0.06)	0(0)
Rhithropanopeus harrisii	0.06(0.06)	0(0)	0(0)
Symphurus plagiusa	0(0)	0(0)	0.17(0.17)
Syngnathus fuscus	0(0)	0(0)	0.06(0.06)
Trinectes maculatus	0.22(0.17)	0(0)	0(0)

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

	2000	**2007**	**2008**
Anguilla rostrata	0.33(0.16)	0(0)	0(0)
Callinectes sapidus	0.11(0.08)	0.11(0.08)	0.67(0.21)
Clupeidae	0(0)	3.28(1.87)	1.83(0.95)
Ctenogobius boleosoma	0(0)	0(0)	0.17(0.12)
Ctenogobius shufeldti	0.17(0.12)	0(0)	0(0)
Lagodon rhomboides	0.72(0.50)	0(0)	0.17(0.12)
Leiostomus xanthurus	14.83(9.79)	63.06(21.15)	40.67(8.11)
Menidia beryllina	0.22(0.17)	0(0)	0(0)
Mugil cephalus	0(0)	0(0)	0.06(0.06)
Palaemonetes pugio	0.06(0.06)	0.06(0.06)	0.50(0.18)
Paralichthys dentatus	1.17(0.44)	0(0)	0(0)
Paralichthys sp.	0(0)	0.61(0.30)	0.06(0.06)
Rangia sp.	0.17(0.12)	0(0)	0(0)

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

	1999	**2006**	**2007**
Anchoa mitchilli	0(0)	0.06(0.06)	10.22(10.10)
Callinectes sapidus	0(0)	0(0)	0.72(0.22)
Ctenogobius boleosoma	0(0)	0.22(0.13)	0(0)
Ctenogobius shufeldti	0.11(0.08)	0.61(0.24)	0.06(0.06)
Eucinostomus sp.	0(0)	0.06(0.06)	0.22(0.17)
Fundulus heteroclitus	0(0)	0.67(0.61)	0(0)
Gambusia holbrooki	0(0)	0.06(0.06)	0(0)
Leiostomus xanthurus	0(0)	0(0)	0.11(0.11)
Lepomis macrochirus	0.11(0.08)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0.72(0.26)	1.72(0.51)
Menidia beryllina	0(0)	0.11(0.08)	0.39(0.39)
Palaemonetes pugio	0(0)	0.72(0.39)	0(0)
Palaemonetes vulgaris	0(0)	0.06(0.06)	0(0)
Paralichthys sp.	0(0)	0.06(0.06)	0(0)
Rhithropanopeus harrisii	0(0)	0(0)	0.11(0.08)
Symphurus plagiusa	0(0)	0(0)	0.83(0.30)
Trinectes maculatus	0(0)	0.06(0.06)	0(0)
Uca pugnax	0.06(0.06)	0(0)	0(0)

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

	2000	2007	2008
Anguilla rostrata	0(0)	0.06(0.06)	0(0)
Callinectes sapidus	0(0)	0(0)	0.17(0.09)
Clupeidae	0(0)	4.56(2.70)	11.78(7.69)
Ctenogobius boleosoma	0(0)	0(0)	0.06(0.06)
Ctenogobius shufeldti	0.06(0.06)	0.44(0.24)	0.17(0.12)
Fundulus heteroclitus	0(0)	0.06(0.06)	0.17(0.09)
Lagodon rhomboides	0(0)	0.11(0.08)	0.11(0.08)
Leiostomus xanthurus	0.11(0.08)	88.11(22.81)	102.67(28.63)
Micropogonias undulatus	0(0)	0.72(0.61)	0(0)
Menidia beryllina	0.17(0.12)	0(0)	0(0)
Mugil cephalus	0(0)	0(0)	1.28(0.55)
Palaemonetes pugio	0.06(0.06)	0.06(0.06)	2.94(1.21)
Paralichthys dentatus	0.17(0.12)	0(0)	0(0)
Paralichthys sp.	0(0)	0.44(0.22)	0.22(0.13)
Rhithropanopeus harrisii	0(0)	0(0)	0.06(0.06)
U/I larval fish	0.06(0.06)	0(0)	0(0)

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

	1999	2006	2007
Anchoa mitchilli	0(0)	0(0)	0.11(0.08)
Callinectes sapidus	0(0)	0.06(0.06)	0.11(0.08)
Ctenogobius shufeldti	0(0)	0.67(0.28)	0(0)
Eucinostomus sp.	0(0)	0(0)	0.11(0.11)
Lepomis macrochirus	0.06(0.06)	0(0)	0(0)
Litopenaeus setiferus	0(0)	0(0)	1.22(0.48)
Membras martinica	0(0)	0(0)	0.06(0.06)
Palaemonetes pugio	0(0)	0(0)	0.06(0.06)
Rhithropanopeus harrisii	0(0)	0.11(0.11)	0.06(0.06)
Symphurus plagiusa	0(0)	0(0)	0.06(0.06)
Trinectes maculatus	0(0)	0.78(0.25)	0(0)
Uca pugnax	0.11(0.11)	0(0)	0(0)

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

	2000	2007	2008
Anguilla rostrata	0.17(0.17)	0(0)	0(0)
Callinectes sapidus	0(0)	0(0)	0.11(0.08)
Clupeidae	0(0)	2.50(2.27)	2.83(1.54)
Ctenogobius shufeldti	0.22(0.15)	0.06(0.06)	0.06(0.06)
Gobiidae sp.	0(0)	0(0)	0.06(0.06)
Lagodon rhomboides	0(0)	0.06(0.06)	0(0)
Leiostomus xanthurus	0(0)	3.50(1.23)	6.50(2.00)
Lepomis macrochirus	0.11(0.11)	0(0)	0(0)
Menidia beryllina	1.39(0.97)	0(0)	0(0)
Mugil cephalus	0(0)	0.17(0.17)	0.06(0.06)
Paralichthys dentatus	0.33(0.16)	0(0)	0(0)
Paralichthys sp.	0(0)	2.06(0.48)	0.17(0.12)
Trinectes maculatus	0.33(0.20)	0.11(0.08)	0.06(0.06)

7.4 Community Evaluation

Dominance Patterns

Previous studies show that species accumulation (that amount of new species accounted for in any given year) peaked in 2002-2004 (Hackney et al. 2004, 2005). Total species richness for the Drop traps and Breder traps were 40 and 30, respectively. During the fall 2007 to spring 2008 sampling period, Drop traps captured 33 and 18 taxa, respectively whereas, Breder traps captured 20 and 17 taxa over the same time period. Several species were numerically dominant (comprising >10% of the total number of individuals collected) and were collected consistently among sites and/or seasons, among years, and across habitats. While absent from the list of common taxa for fall 2007 (Figure 7.4-1), *Leiostomus xanthurus* (spot) was the most common taxa collected in the shallow subtidal habitats (drop trap) as well as in the intertidal marsh habitats (breder trap) during spring 2008, comprising 30% to 90% of the total catch for nearly all sites (Figures 7.4-2 and 7.4-4). The commercial shrimp, *Litopenaeus setiferus*, was the most common species collected for both habitat types in fall 2007 (Figures 7.4-1 and 7.4-3). Other dominant taxa for both habitat types during the fall sampling period included three species, *Eucinostomus* sp. (mojarra), *Farfantepenaeus aztecus* (brown shrimp), and *Palaemonetes pugio* (grass shrimp) (Figures 7.4-1 and 7.4-3). There were four other species common to the marsh edge habitats (Drop trap) in fall 2007, including *Anchoa mitchilli* (bay anchovy), *Callinectes sapidus* (blue crab), *Ctenogobius shufeldti* (freshwater goby), and *Menidia beryllina* (inland silverside) (Figure 7.4-1). In fall 2007, there were also four other species common to the intertidal marsh habitats (Breder trap), including *Fundulus heteroclitus* (killifish), *Gambusia holbrooki* (eastern mosquitofish), *Palaemonetes vulgaris* (grass shrimp), and *Uca minax* (fiddler crab) (Figure 7.4-3). During the spring sampling period, two species were dominant for both drop and breder habitat types, *Mugil cephalus* (striped mullet) and *Palaemonetes pugio* (grass shrimp) (Figures 7.4-2 and 7.4-4). There were two other species common to the marsh edges (Drop trap) in spring 2008, Clupeidae (herring), and *Paralichthys* sp. (flounder) (Figure 7.4-2). In spring 2008, there were also three other species common to the intertidal marsh habitats (breder trap), including *Ctenogobius shufeldti* (freshwater goby), *Fundulus heteroclitus* (killifish), and *Lepomis macrochirus* (bluegill) (Figure 7.4-4).

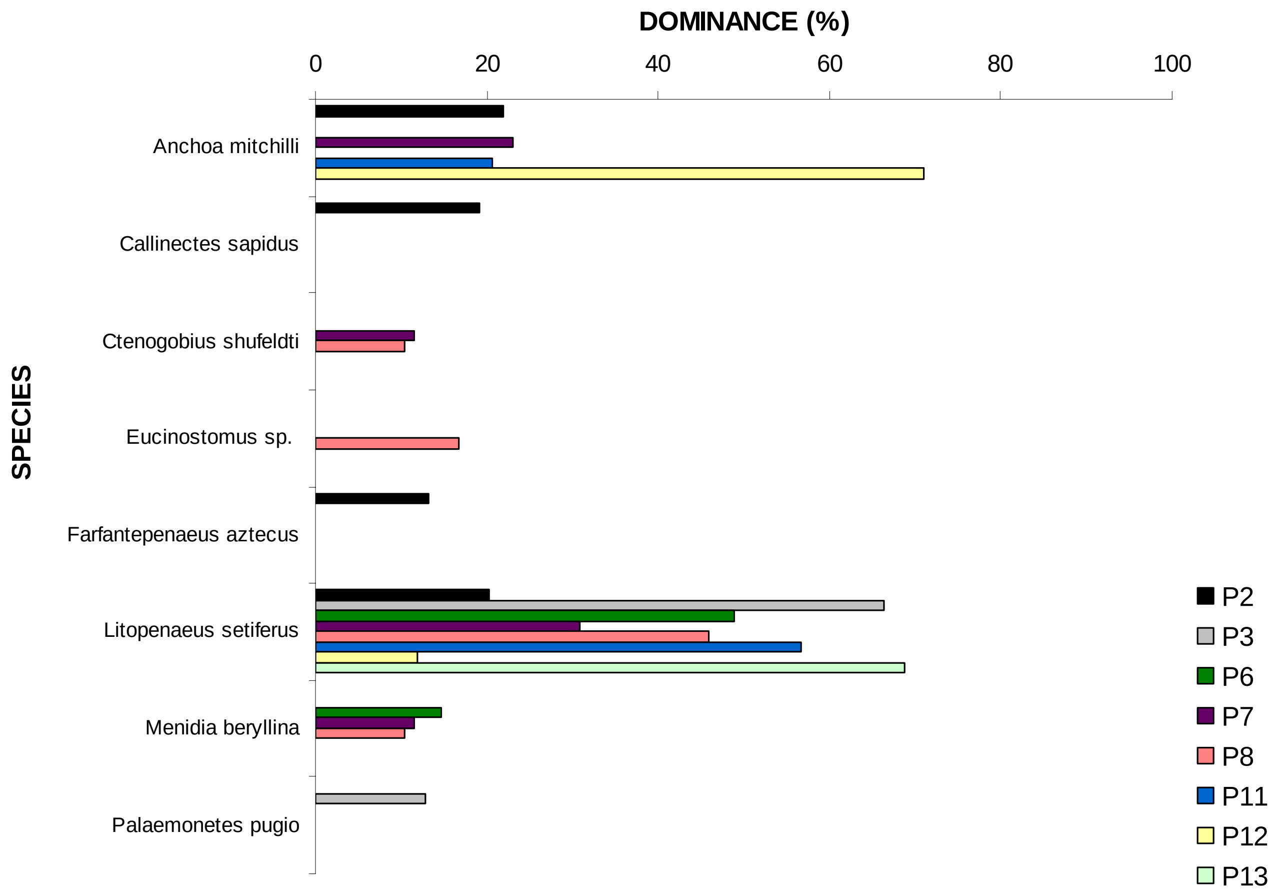


Figure 7.4-1. Common species representing ≥ 10% of the total abundance among sites sampled by Drop trap in fall 2007.

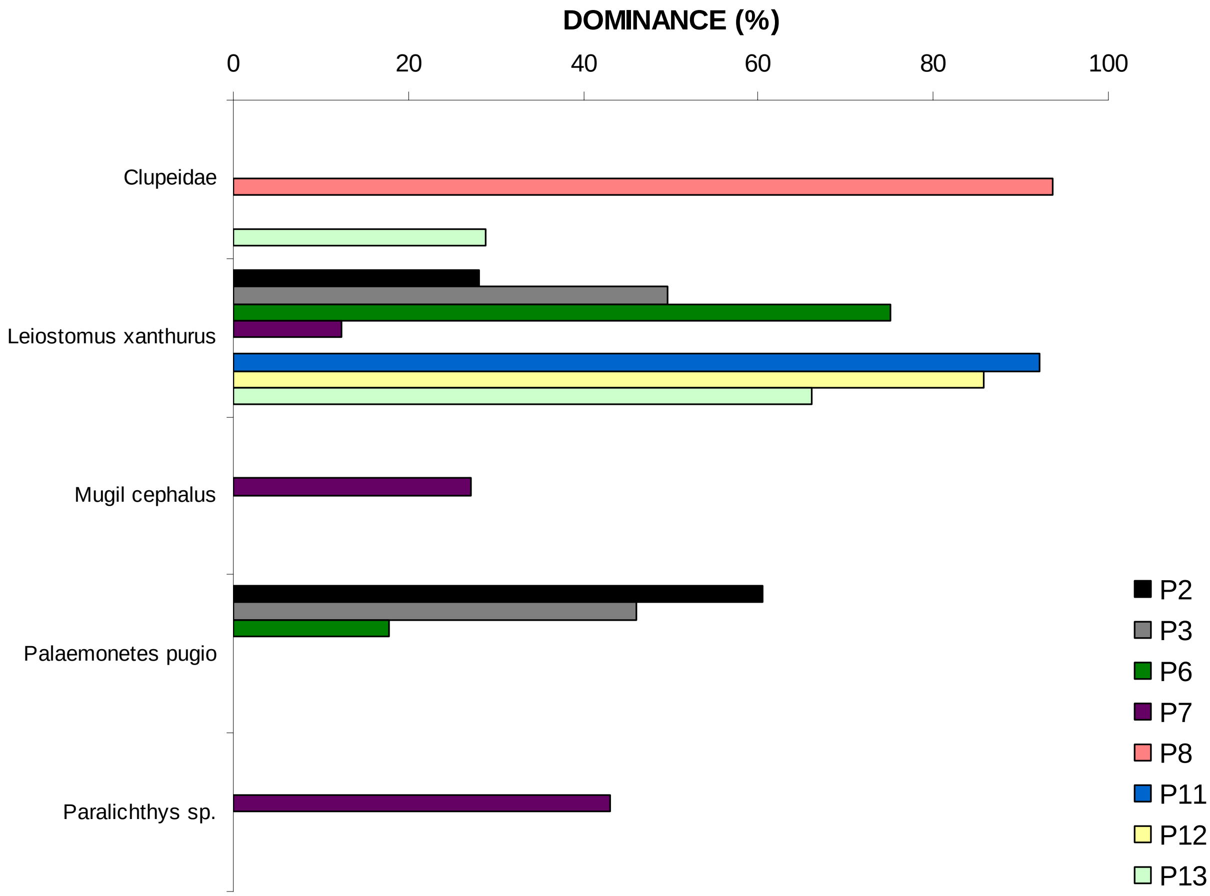


Figure 7.4-2. Common species representing ≥ 10% of the total abundance among sites sampled by Drop trap in spring 2008.

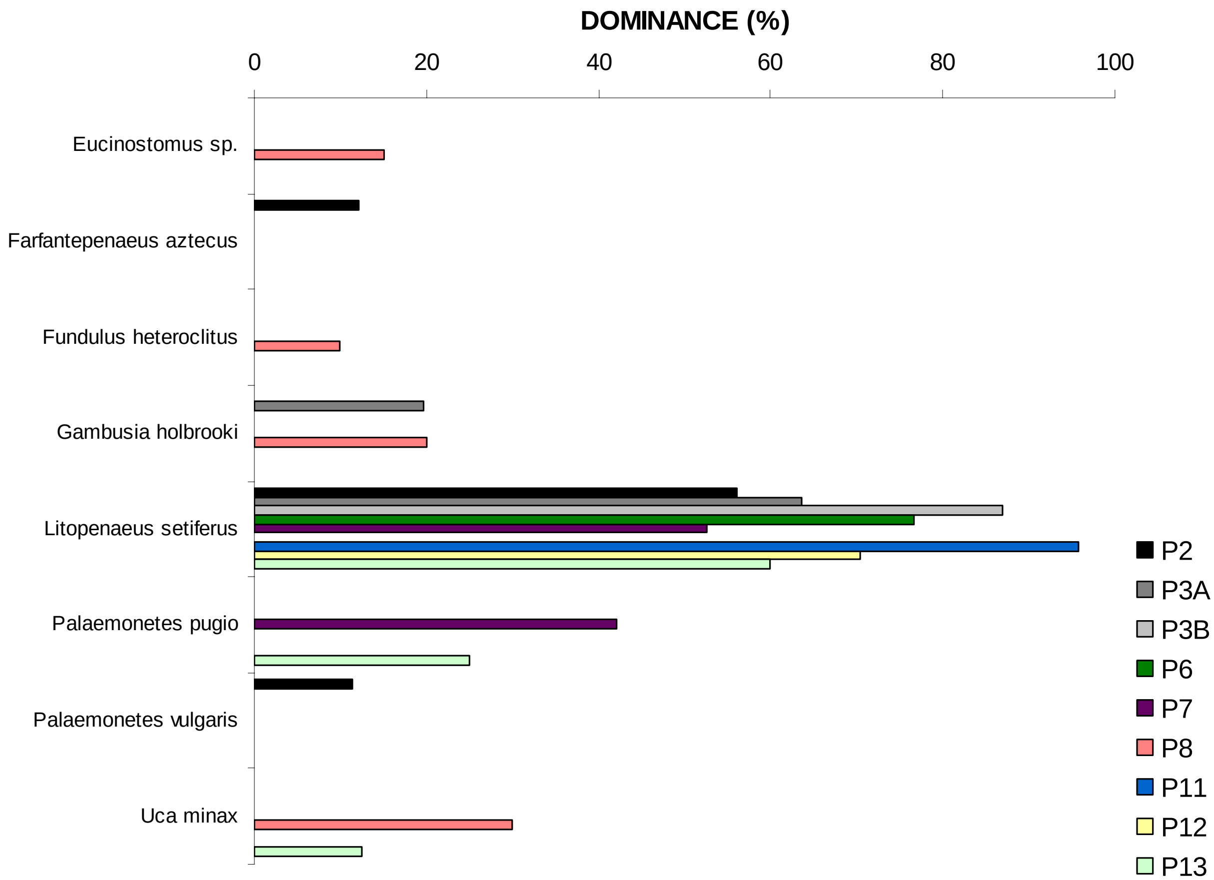


Figure 7.4-3. Common species representing ≥ 10% of the total abundance among sites sampled by Breder trap in fall 2007.

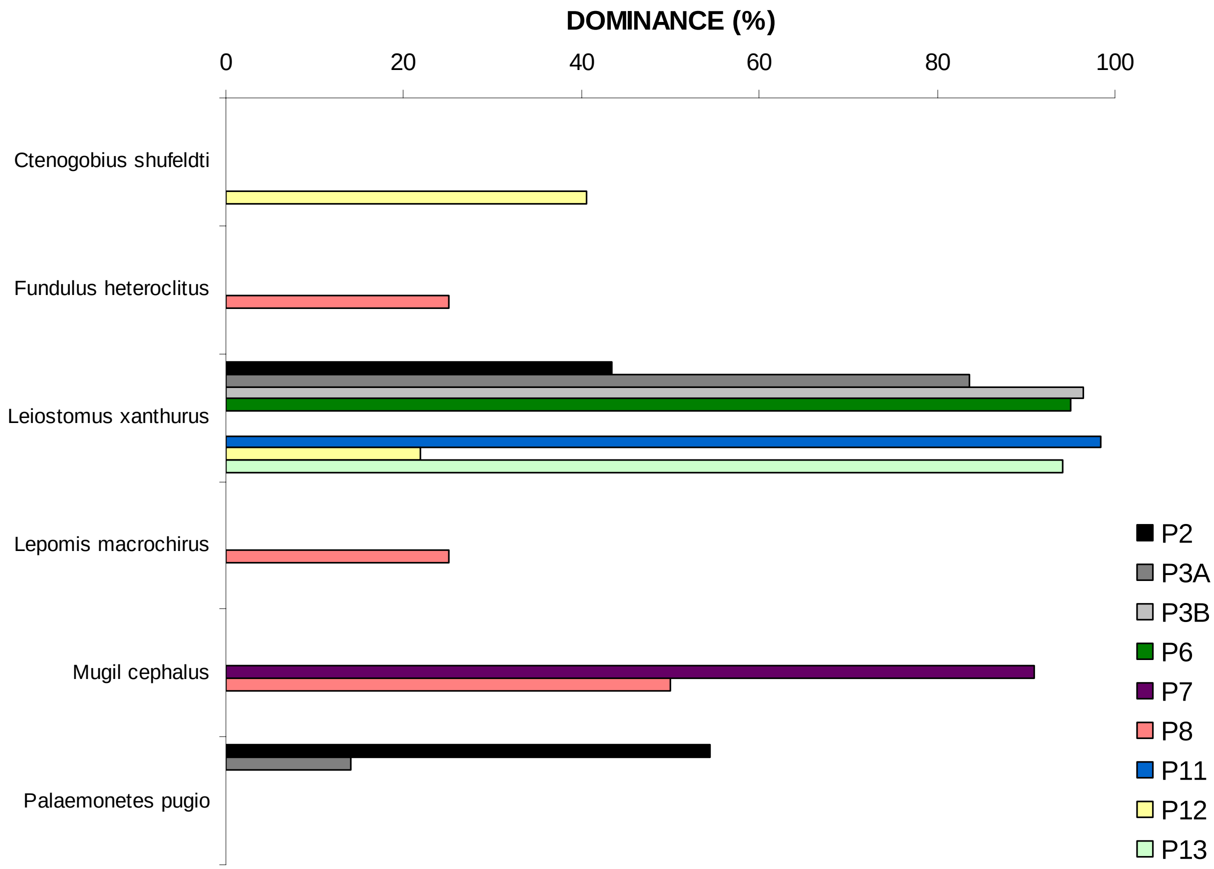


Figure 7.4-4. Common species representing ≥ 10% of the total abundance among sites sampled by Breder trap in spring 2008.

Community Measures

Analysis of species richness data from both the marsh interior (Breder trap) and marsh edge (Drop trap) samples detected significant differences in utilization among years, across both sampling seasons, and at most sites. Six significant comparisons from nine analyses for the marsh interior (Table 7.4-18), and seven significant comparisons of eight analyses for the marsh edge (Table 7.4-24) during fall 2007 showed this period to have greater species richness than the fall of 2006 and the initial sampling year, 1999. Spring data showed similar patterns with 2008 showing greater species richness than the previous spring (2007), and the initial spring sampling (2000) period, which indicated six significant comparisons from nine analyses (Table 7.4-19) in the marsh interior, and five out of six significant comparisons for the marsh edge (Table 7.4-25).

Comparisons of mean total abundance showed consistent differences among the current, previous, and initial year comparisons. Marsh interior sampling (Breder trap) and marsh edge sampling (Drop trap) showed six significant comparisons from nine and eight analyses, respectively (Tables 7.4-22 and 7.4-23), with higher mean total abundance in the current sampling period than in the previous fall or spring of the initial sampling period. Sampling along the shallow subtidal areas of the marsh edge (drop trap) for the fall showed six significant comparisons from eight analyses among years (Table 7.4-28), with greater mean total abundance in the current year (2007). Mean total abundance in the marsh edge for spring showed seven significant comparisons from eight analyses among years (Table 7.4-29), with greater mean total abundance in the current year (2008) relative to the initial sampling period (2008) for six out of the seven significant comparisons. Diversity measures for the two sampling types showed similar patterns, although not as strong for some sites. Diversity was greatest in the fall sampling periods, with five significant comparisons from nine analyses in the marsh interior (Table 7.4-20), and five significant comparisons from eight analyses for the marsh edge (Table 7.4-26). Spring 2008 was greater than the previous and initial spring sampling for the marsh interior, with five significant comparisons from nine analyses (Table 7.4-21), but only two sites (Eagle Island-P6 and Dollisons Landing-P8) showed differences for the marsh edge sampling (Table 7.4-27).

Table 7.4-18. Comparison of species richness by year for Fall Breder trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek Mouth (P2)	61.77(0.0001)	07[a] 06[b] 99[b]
Inner Town Creek (P3A)	10.43(0.0001)	07[a] 99[b] 06[b]
Inner Town Creek (P3B)	0.14(0.8670)	NS
Eagle Island (P6)	33.45(0.0001)	07[a] 99[b] 06[b]
Indian Creek (P7)	6.04(0.0035)	07[a] 99[b] 06[b]
Dollisons Landing (P8)	3.11(0.0496)	NS
Smith Creek (P11)	13.73(0.0001)	07[a] 99[b] 06[b]
Rat Island (P12)	0.62(0.5405)	NS
Fishing Creek (P13)	14.49(0.0001)	07[a] 99[b] 06[b]

Table 7.4-19. Comparison of species richness by year for Spring Breder trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek Mouth (P2)	6.88(0.0017)	08[a] 07[b] 00[b]
Inner Town Creek (P3A)	43.55(0.0001)	08[a] 00[b] 07[c]
Inner Town Creek (P3B)	25.38(0.0001)	08[a] 07[b] 00[b]
Eagle Island (P6)	14.05(0.0001)	08[a] 07[a] 00[b]
Indian Creek (P7)	0.89(0.4157)	NS
Dollisons Landing (P8)	0.11(0.8923)	NS
Smith Creek (P11)	63.27(0.0001)	08[a] 07[b] 00[c]
Rat Island (P12)	0.24(0.7886)	NS
Fishing Creek (P13)	13.66(0.0001)	08[a] 07[b] 00[c]

Table 7.4-20. Comparison of species diversity by year for Fall Breder trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek Mouth (P2)	70.26(0.0001)	07^{a} 99^{b} 06^{b}
Inner Town Creek (P3A)	8.20(0.0006)	07^{a} 99^{b} 06^{b}
Inner Town Creek (P3B)	0.53(0.5878)	NS
Eagle Island (P6)	6.72(0.0019)	07^{a} 06^{b} 99^{b}
Indian Creek (P7)	1.01(0.3676)	NS
Dollisons Landing (P8)	5.79(0.0044)	07^{a} 06^{b} 99^{b}
Smith Creek (P11)	0.67(0.5159)	NS
Rat Island (P12)	2.35(0.1018)	NS
Fishing Creek (P13)	6.80(0.0018)	07^{a} 99^{b} 06^{b}

Table 7.4-21. Comparison of species diversity by year for Spring Breder trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek Mouth (P2)	6.39(0.0026)	08^{a} 00^{b} 07^{b}
Inner Town Creek (P3A)	7.09(0.0014)	08^{a} 00^{b} 07^{b}
Inner Town Creek (P3B)	1.94(0.1502)	NS
Eagle Island (P6)	4.86(0.0100)	08^{a} 07^{ab} 00^{b}
Indian Creek (P7)	0.16(0.8523)	NS
Dollisons Landing (P8)	0	NS
Smith Creek (P11)	6.59(0.0022)	08^{a} 07^{a} 00^{b}
Rat Island (P12)	0.55(0.5792)	NS
Fishing Creek (P13)	4.02(0.0215)	08^{a} 07^{a} 00^{b}

Table 7.4-22. Comparison of total abundance by year for fall Breder trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek Mouth (P2)	83.37(0.0001)	07^a 06^b 99^b
Inner Town Creek (P3A)	13.28(0.0001)	07^a 99^b 06^b
Inner Town Creek (P3B)	0.19(0.8236)	NS
Eagle Island (P6)	33.60(0.0001)	07^a 99^b 06^b
Indian Creek (P7)	4.76(0.0110)	07^a 99^b 06^b
Dollisons Landing (P8)	3.18(0.0463)	NS
Smith Creek (P11)	15.48(0.0001)	07^a 99^b 06^c
Rat Island (P12)	0.91(0.4064)	NS
Fishing Creek (P13)	10.78(0.0001)	07^a 99^b 06^b

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Table 7.4-23. Comparison of total abundance by year for spring Breder trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek Mouth (P2)	26.56(0.0001)	08^a 07^a 00^b
Inner Town Creek (P3A)	82.20(0.0001)	08^a 00^b 07^c
Inner Town Creek (P3B)	135.76(0.0001)	08^a 07^b 00^b
Eagle Island (P6)	16.06(0.0001)	08^a 07^b 00^c
Indian Creek (P7)	0.02(0.9766)	NS
Dollisons Landing (P8)	0.11(0.8923)	NS
Smith Creek (P11)	189.22(0.0001)	08^a 07^b 00^c
Rat Island (P12)	0.32(0.7289)	NS
Fishing Creek (P13)	21.83(0.0001)	08^a 07^b 00^b

Table 7.4-24. Comparison of species richness by year for fall Drop trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek mouth (P2)	14.99(0.0001)	07^{a} 06^{b} 99^{b}
Town Creek Inner (P3)	4.34(0.0213)	07^{a} 99^{b} 06^{b}
Eagle Island (P6)	17.40(0.0001)	07^{a} 06^{b} 99^{b}
Indian Creek (P7)	11.22(0.0001)	07^{a} 06^{b} 99^{b}
Dollisons Landing (P8)	1.80(0.1762)	NS
Smith Creek (P11)	7.79(0.0001)	07^{a} 06^{b} 99^{b}
Rat Island (P12)	14.04(0.0001)	07^{a} 06^{a} 99^{b}
Fishing Creek (P13)	8.46(0.0007)	06^{a} 07^{a} 99^{b}

Table 7.4-25. Comparison of species richness by year for spring Drop trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek mouth (P2)	0.01(0.9924)	NS
Town Creek Inner (P3)	9.10(0.0007)	08^{a} 00^{b} 07^{b}
Eagle Island (P6)	91.86(0.0001)	08^{a} 07^{b} 00^{c}
Indian Creek (P7)	4.13(0.0219)	08^{a} 07^{ab} 00^{b}
Dollisons Landing (P8)	7.11(0.0019)	07^{a} 08^{b} 00^{b}
Smith Creek (P11)	2.74(0.0744)	NS
Rat Island (P12)	28.34(0.0001)	08^{a} 07^{a} 00^{b}
Fishing Creek (P13)	4.59(0.0147)	07^{a} 08^{a} 00^{b}

Table 7.4-26. Comparison of species diversity by year for fall Drop trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek mouth (P2)	21.30(0.0001)	07^{a} 06^{b} 99^{b}
Town Creek Inner (P3)	0.69(0.5086)	NS
Eagle Island (P6)	18.39(0.0001)	07^{a} 06^{b} 99^{b}
Indian Creek (P7)	5.31(0.0080)	07^{a} 06^{b} 99^{b}
Dollisons Landing (P8)	2.05(0.1397)	NS
Smith Creek (P11)	6.53(0.0030)	07^{a} 06^{b} 99^{b}
Rat Island (P12)	9.96(0.0002)	07^{a} 06^{a} 99^{b}
Fishing Creek (P13)	2.91(0.0638)	NS

Table 7.4-27. Comparison of species diversity by year for spring Drop trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek mouth (P2)	0.23(0.7922)	NS
Town Creek Inner (P3)	1.04(0.3638)	NS
Eagle Island (P6)	35.60(0.0001)	08^{a} 07^{b} 00^{c}
Indian Creek (P7)	1.79(0.1782)	NS
Dollisons Landing (P8)	6.68(.0027)	07^{a} 08^{b} 00^{b}
Smith Creek (P11)	1.98(0.1488)	NS
Rat Island (P12)	2.37(0.1037)	NS
Fishing Creek (P13)	1.76(0.1818)	NS

Table 7.4-28. Comparison of total abundance by year for fall Drop trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek mouth (P2)	10.23(0.0002)	07^{a} 06^{b} 99^{b}
Town Creek Inner (P3)	11.19(0.0001)	07^{a} 99^{b} 06^{b}
Eagle Island (P6)	23.68(0.0001)	07^{a} 06^{b} 99^{c}
Indian Creek (P7)	12.15(0.0001)	07^{a} 06^{b} 99^{b}
Dollisons Landing (P8)	0.73(0.4863)	NS
Smith Creek (P11)	13.01(0.0001)	07^{a} 06^{b} 99^{b}
Rat Island (P12)	13.17(0.0001)	07^{a} 06^{a} 99^{b}
Fishing Creek (P13)	6.92(0.0022)	07^{a} 06^{a} 99^{b}

Table 7.4-29. Comparison of total abundance by year for spring Drop trap samples.

SITE	F(p)	SNK OF F SIGNIFICANCE (high to low)
Town Creek mouth (P2)	0.38(0.6852)	NS
Town Creek Inner (P3)	70.36(0.0001)	08^{a} 07^{b} 00^{c}
Eagle Island (P6)	35.73(0.0001)	07^{a} 08^{a} 00^{b}
Indian Creek (P7)	4.72(0.0132)	08^{a} 07^{a} 00^{b}
Dollisons Landing (P8)	2.93(0.0622)	07^{a} 08^{ab} 00^{b}
Smith Creek (P11)	7.76(0.0011)	08^{a} 07^{a} 00^{b}
Rat Island (P12)	49.72(0.0001)	08^{a} 07^{a} 00^{b}
Fishing Creek (P13)	4.14(0.0215)	07^{a} 08^{a} 00

8.0 SENSITIVE HERBACEOUS VEGETATION SAMPLING

8.1 Summary

Monitoring of sensitive herbaceous vegetation at seven stations in the Cape Fear River estuary was completed for the eighth year in 2007. Conditions this year at each of the seven sites have varied widely not only in response to salinity changes driven by drought, but also by direct human manipulation. Events during the growing season this year have set the stage for potential changes in the coming growing season.

Salinity spikes (increase above average salinity) at both Inner Town Creek (P3) and Fishing Creek (P13) strongly influenced plant growth within the sensitive herbaceous vegetation polygons. These influences have been documented by changes in area of the polygons and by changes in cover of the primary sensitive herbaceous species, *Zizaniopsis miliacea* at Inner Town Creek and *Pontederia cordata* at Fishing Creek. Other sensitive herbaceous vegetation species showed changes in cover at these stations, as well. Other changes noted were recent death of woody plants and lack of growth in knees associated with *Taxodium* sp. Individuals of *Pinus* sp. well away from the creek at Inner Town Creek were browning. Scattered individuals of *Fraxinus caroliniana* and *Taxodium* sp. at Fishing Creek showed a few examples of apparent salinity death.

While stream monitoring data indicated salinity events were present in adjacent waterways, there were no significant effects at any of the five other sensitive herbaceous vegetation monitoring stations. Vegetation conditions at Indian Creek (P7) station have been influenced by selective removal of swamp forest shrub and canopy species by adjacent development. The potential effects of salinity have been masked by the removal of woody vegetation and opportunistic growth of a different set of herbaceous species. Other sensitive herbaceous vegetation monitoring stations seem relatively free of any significant damage due to salt or humans.

Two years of increased salinity within the project area were compared using data gathered from 2002 and 2007. Data from these years showed that salinity can come in the form of multiple medium concentration events or fewer, but higher concentrations of seawater. The former appeared to affect Fishing Creek during 2002 and the latter were more effective in affecting sensitive herbaceous vegetation during 2007. In 2002, concentrations were less than 20 ppt, while in 2007 seawater concentrations ranged from 20 to 25 ppt.

8.2 Introduction and Background

It has been assumed that the effects of flooding and salinity influence the health, occurrence, and distribution of plants within the Cape Fear River Estuary. Salt sensitive plant species have been examined annually at seven stations. These stations remain largely as defined earlier (Table 8.2-1). The current report is the eighth year of sensitive herbaceous vegetation monitoring.

Each of the monitoring stations is subject to astronomical tides characteristic of the lower Cape Fear River estuarine system. During previous years seven stations have experienced exposure to ocean-derived salts carried by tidal flooding. Ocean-derived salts have not been documented at Black River, the uppermost Cape Fear River station. Generalized vegetation zones along a 50-meter wide transect extending from a riverine shore line to uplands at each station were defined and described as a part of an earlier report (CZR Incorporated 2001). Methods and results from past years of sensitive herbaceous species sampling and observations at the seven stations are covered in earlier reports (CZR Incorporated 2001, 2002; Hackney et al. 2002, 2003, 2004, 2005, 2006, 2007).

The Cape Fear region, as well as more interior portions of the watersheds that make up the major tributaries of the lower Cape Fear estuary, have undergone yet another season of drought in 2007. Mean monthly stream flow data at US Geological Survey gauging stations (http://waterdata.usgs.gov/nc/nwis/current/?type=flow) along tributaries of the Cape Fear estuary, including the Cape Fear, the Northeast Cape Fear and the Black Rivers show similar trends between January and August of 2002 and 2007 (Figures 8.2-1, 8.2-2, and 8.2-3). Periods of low freshwater flow from higher in the watersheds result in increases in salinity as ocean-derived salt born by astronomical tides enter further into the tributaries of the estuary. Salinity values monitored at stations on the Cape Fear and the Northeast Cape Fear Rivers during 2002 and 2007 reflect these flow trends as well as drought conditions elsewhere within their water sheds (Tables 8.2-2 and 8.2-3). River salinities in a previous report indicate ocean-derived salt in 2002 actually increased more slowly over a two-year period (Hackney et al. 2003, Figure 8.31-2).

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

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

Figure 8.2-1. Cape Fear River flow at Lock #1 near Kelly, North Carolina during the years 2002 and 2007 data from US Geological Survey gauging stations. (http://waterdata.usgs.gov/nc/nwis/current/?type=flow)

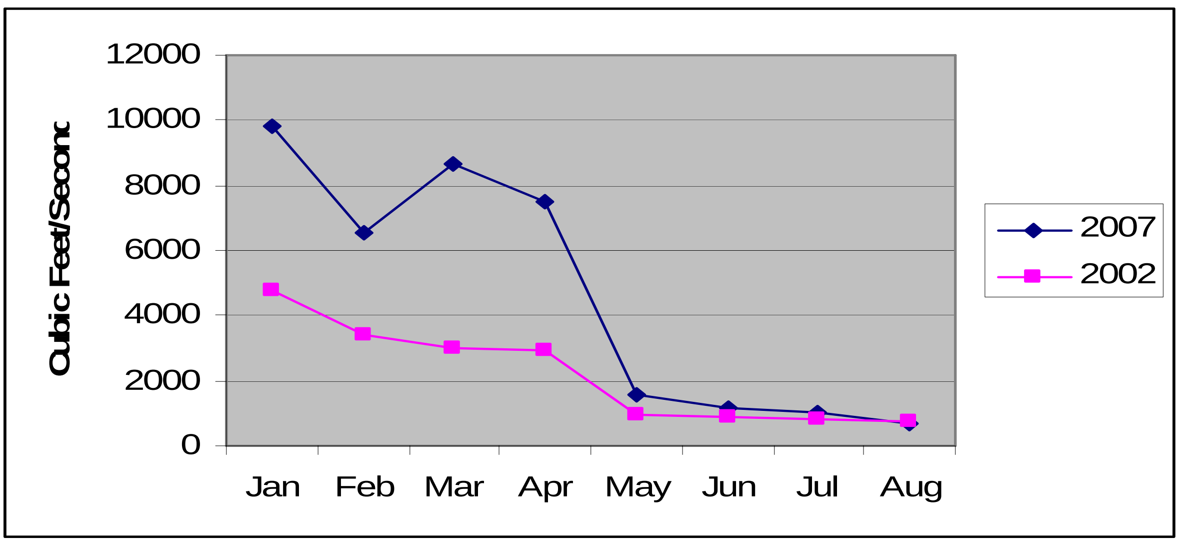


Figure 8.2-2. Northeast Cape Fear River near Chinquapin, North Carolina during the years 2002 and 2007 data from US Geological Survey gauging stations. (http://waterdata.usgs.gov/nc/nwis/current/?type=flow)

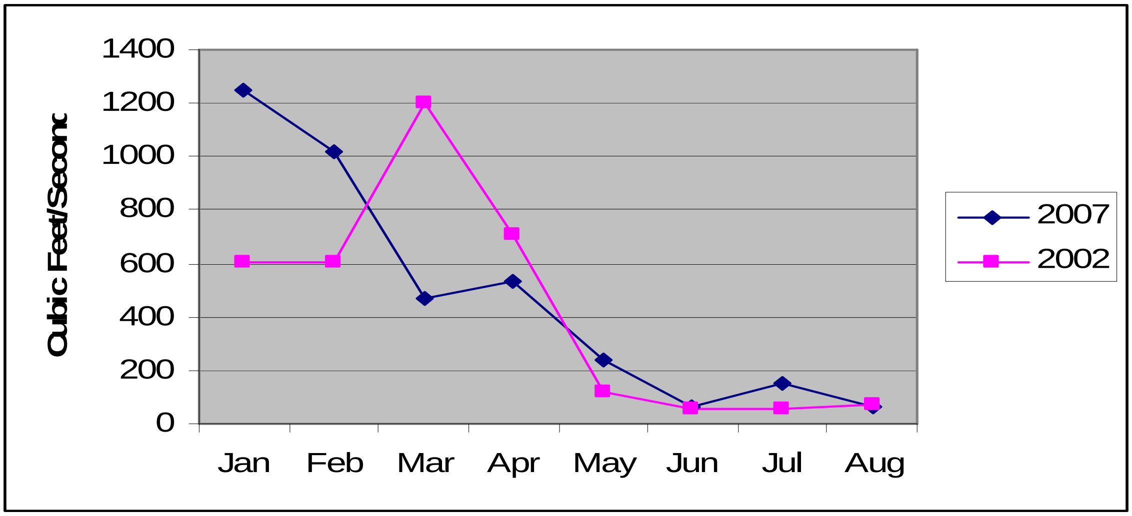


Figure 8.2-3. Black River flow near Tomahawk, North Carolina during the years 2002 and 2007 data from US Geological Survey gauging stations. (http://waterdata.usgs.gov/nc/nwis/current/?type=flow)

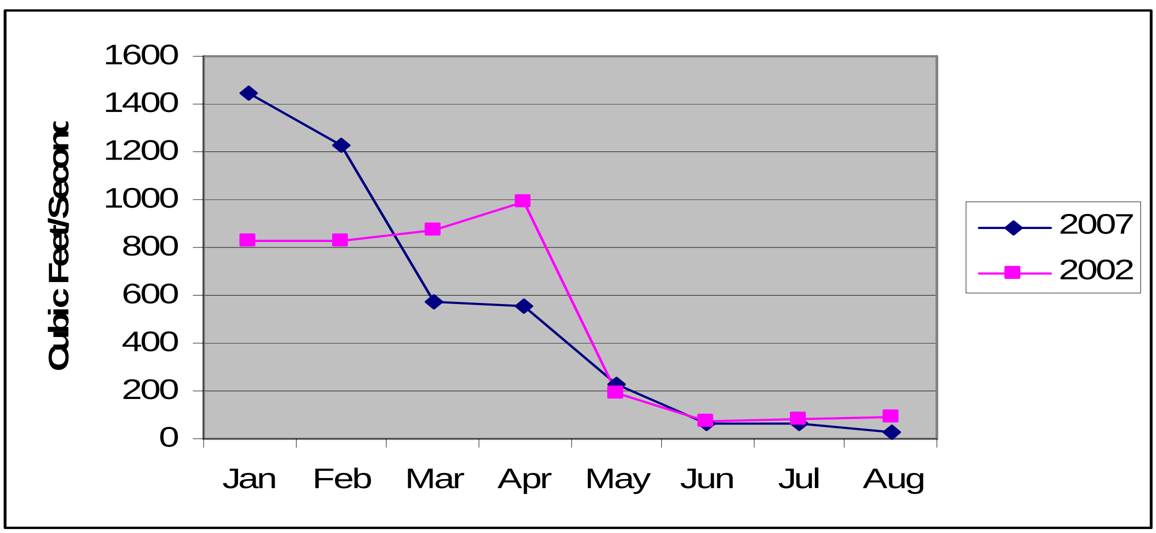


Table 8.2-2. Mean maximum monthly stream salinity values (ppt) near sensitive herbaceous vegetation sampling stations for January-August 2002, Wilmington Harbor monitoring project, North Carolina. (Data from Hackney et al. 2003.)

Month	Station						
	P3	**P7**	**P8**	**P9**	**P12**	**P13**	**P14**
Jan	17.6	0.2	0.4	0.1	18.1	10.2	0.9
Feb	10.7	0.2	0.1	0.1	10.4	1.6	0.1
Mar	9.6	0.1	0.1	0.1	6.8	1.5	0.1
Apr	13.0	0.1	0.1	0.1	7.9	1.8	0.1
May	21.7	3.5	1.6	0.1	19.2	14.1	1.9
Jun	24.5	6.9	4.0	0.7	20.3	16.4	5.1
Jul	18.7	5.9	4.6	0.7	17.2	14.7	2.8
Aug	19.3	10.0	5.7	0.2	16.9	10.4	3.5

Table 8.2-3. Mean maximum monthly stream salinity values (ppt) near sensitive herbaceous vegetation sampling stations for January-August 2007, Wilmington Harbor monitoring project, North Carolina. (Data from Hackney et al. 2007 and unpublished Wilmington Harbor monitoring data for the 2007-2008 sampling period.)

Month	Station						
	P3	**P7**	**P8**	**P9**	**P12**	**P13**	**P14**
Jan	2.7	0.1	0.1	0.0	3.9	0.1	0.0
Feb	3.1	0.1	0.1	0.0	6.3	0.1	0.1
Mar	6.4	0.1	0.1	0.1	5.6	1.2	0.1
Apr	13.5	0.2	0.1	0.1	10.3	7.0	0.1
May	18.7	0.1	0.5	0.3	17.6	8.4	0.1
Jun	22.1	1.7	1.8	0.1	16.9	12.9	2.5
Jul	23.2	3.3	3.0	0.1	16.0	6.1	2.1
Aug	24.9	8.1	6.3	0.2	18.7	16.9	4.6

8.3 Methodology

Data collection methods remain largely the same as those used during previous years of sensitive herbaceous vegetation sampling (CZR Incorporated 2002, Hackney et al. 2002, 2003, 2004, 2005, 2006, 2007). This year's data for plant species presence and percent cover were gathered from four variable plots and three fixed plots. Percent cover data from previous years were not consulted immediately prior to assessment of conditions for the current year. Assessments are made in the field independent of pre-existing data.

Variable polygon data were taken at Inner Town Creek (P3), Rat Island (P12), Fishing Creek (P13), and Prince George Creek (P14) and are used below to demonstrate yearly changes in size, shape, and plant species cover. These variable-size plots have boundaries created by on-site delineations of recognizable assemblages of sensitive herbaceous species. Polygons at three stations with fixed, four-sided plots were chosen because they best represented larger, more widespread sensitive herbaceous vegetation assemblages. Methods and reasons for abandonment and re-establishment of a fixed-sided plot at the Black River site (P9) are covered in an earlier report (Hackney et al. 2005). Permanent plots also occur at Indian Creek (P7) and Dollisons Landing (P8) (CZR Incorporated 2001). The sampling station at Indian Creek (P7) may change during the coming season due to modifications associated with development. Although the plot at Rat Island (P12) is a variable plot, its shape, and size have remained unchanged since it became dominated by salt-tolerant plant species.

Sampling stations were visited August 6 and 7, 2007, during which time wetland herbaceous vegetation was at its optimum seasonal development. Polyvinyl chloride (PVC) stakes were added, moved, or removed at three sites in order to relocate polygon vertices (Appendix F). Each stake was renumbered and flagged as necessary. At each station plant species seen in each polygon were listed (Appendix D) and their contributed cover percentages were estimated and recorded. Position data of the PVC stakes were recorded using GPS (Global Positioning System) January 7 and 8, 2007 at stations with variable plots (Appendix E). Details of the GPS data gathering process are covered in earlier reports (Hackney et al. 2002, 2003). It appears that multipath problems (GPS errors associated with reflection of the GPS signals before reaching the antenna) are still being experience at forested sites.

Field personnel responsible for gathering sensitive herbaceous vegetation data and GPS data have not changed since the inception of the project. The same personnel are responsible for analysis and reporting.

8.4 Sensitive Herbaceous Vegetation

The effects of past hydrological events on habitats, growth, and distribution of sensitive herbaceous plant species are being monitored and assessed in tidal marsh and swamp forest communities (Hackney et al. 2005). Changes in growth, contraction, or expansion of several perennial species associated with salinity increases within various plots have been remarkable. This year changes resulting from salinity increases at two stations, Inner Town Creek (P3) and Fishing Creek (P13) have been noted with evidence of even more changes likely.

Polygon sizes are presented below for each site and monitoring year (Table 8.4-1). Data covering sensitive herbaceous vegetation are presented below for each of the sampling stations (Tables 8.41-1 through 8.47-1). Polygon configurations are presented for the baseline year (2000), the previous growing season (2006), and the season (2007) (Figures 8.41-1 through 8.47-1). Data from past years are presented in previous reports (CZR Incorporated 2001, 2002; Hackney et al. 2002, 2003, 2004, 2005, 2006, 2007).

Additional variables considered important during collection and presentation of the data are discussed for each station. Some of these variables include (1) changes in sensitive herbaceous species, (2) shifts in dominance of sensitive herbaceous species, (3) changes in cover contributions of sensitive herbaceous species within delineated polygons, (4) variations in shapes and sizes of polygons, (5) habitat-related hydrological factors and (6) plant characteristics of special importance in vegetation change within the plots.

Table 8.4-1. Comparisons of areas (ft^2) of sensitive herbaceous vegetation polygons for years 2000-2007 at sensitive herbaceous vegetation monitoring stations, Wilmington Harbor monitoring project, North Carolina.

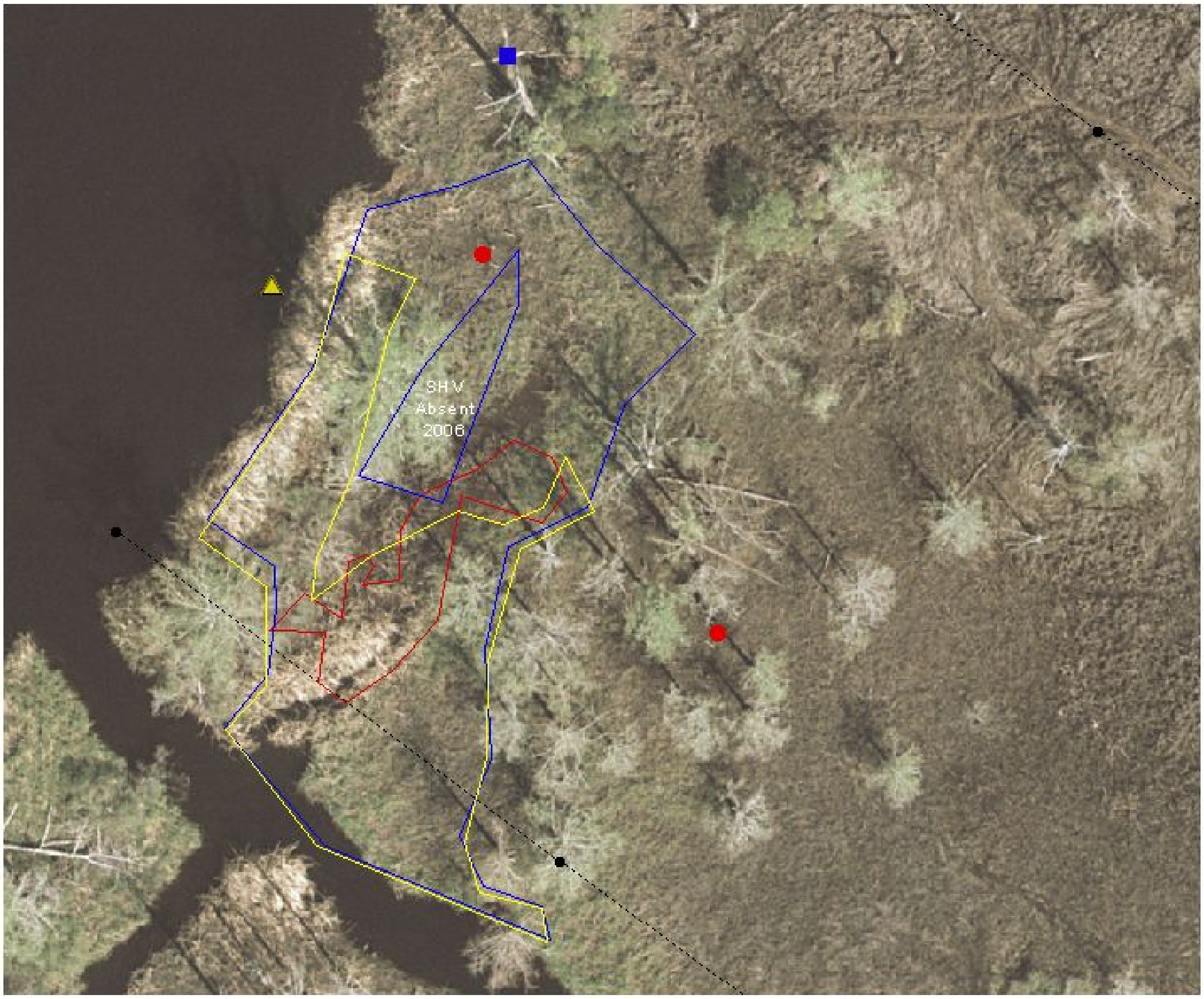
Station	Year							
	2000	2001	2002	2003	2004	2005	2006	2007
Inner Town Creek (P3)	710.0	1552.5	1311.0	1326.0	1518.1	3619.2	5595.4	3403.3
Indian Creek (P7)	129.8	129.8	281.9 [a]	281.9	281.9	281.9	281.9	281.9
Dollisons Landing (P8)	404.5	404.5	286.1 [a]	286.1	286.1	286.1	286.1	286.1
Black River (P9)	431.0	1120.0	913.0	567.8	69.5	251.8[b]	251.8	251.8
Rat Island (P12)	532.9	532.9	532.9	532.9	532.9	532.9	532.9	532.9
Fishing Creek (P13)	1522.2	1646.1	971.9	682.1	2506.3	2272.8	2305.3	1813.1
Prince George Creek (P14)	3931.2	36631.3	5190.2	5265.4	5227.2	5245.9	4654.3	4607.1

[a] Changes in area are an artifact of shift to winter GPS data collection (Hackney et al. 2003).
[b] Polygon moved to new location (Hackney et al. 2005).

8.41 Inner Town Creek

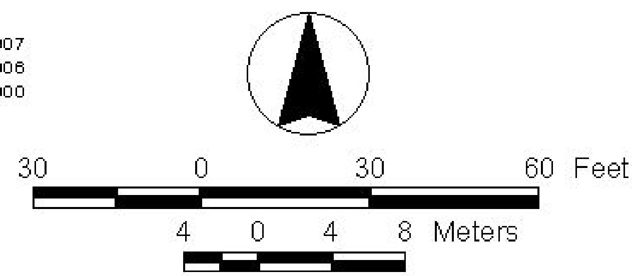
Cover by the dominant sensitive herbaceous species, *Zizaniopsis miliacea*, at the Inner Town Creek site in 2006 had expanded greatly beyond the area measurements obtained in previous years (Table 8.41-1, Figure 8.41-1). During the current year, 2007, there has been a decrease in subaerial coverage by this species, though it still far surpasses cover during the baseline year, 2000. An exclusion polygon used last year to delineate an area not occupied by *Zizaniopsis miliacea* occurred northeast of the current boundary the total area of coverage has decreased by nearly 2,200 ft^2. The northern extent of the polygon for the current year has receded southward following a significant salinity increase.

The apparent decrease is likely limited to subaerial changes including the occurrence of vertical stems rather than subsurface changes in rhizome extent. However, this assumed lag in rhizome die-back has been only indirectly established by past observation of rapid return of vertical stems when more favorable (less salty) growing conditions returned. Alternating rhizome productivity and quiescence are likely one strategy for dealing with variable substrate conditions. Importance and success of such a strategy in an estuarine environment may require further study. Last year's prediction of continued northerly expansion of *Zizaniopsis miliacea* was premature considering the intervention of a significant drought and accompanying salinity event. At the time of the January visit to gather GPS data, little remained of the usual standing, dead stems and



LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2007
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2006
- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2000
- DATA COLLECTION PLATFORM PILING
- CONCRETE BENCHMARK
- BELT TRANSECT BOUNDARY
- BELT TRANSECT MARKER
- SUBSTATION SURVEY POINT



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COMPARISON OF SENSITIVE HERBACEOUS VEGETATION POLYGONS FROM YEARS 2000, 2006 and 2007 AT STATION P3 (INNER TOWN CREEK), WILMINGTON HARBOR MONITORING PROJECT, TOWN CREEK, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

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DRAWN BY: DMD	DATE: 28 FEBRUARY 2008	FIGURE 8.41-1

Table 8.41-1. Comparisons of percent cover contributions by sensitive herbaceous species in major (and outlier) polygons at the Inner Town Creek Station (P3) for years 2000-2007, Wilmington Harbor monitoring project, Town Creek, North Carolina.

	Year							
Species	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Zizaniopsis miliacea	70	60	20	50	60 (20)	55 (5)	50	2
Sagittaria lancifolia	5	20	5	10	10	10 (30)	2	<1
Peltandra virginica	3	<1	<1	10	<1 (--)	<5 (<1)	1	<1
Carex hyalinolepis	1	10	10	40	1	<5	2	<1
Schoenoplectus americanus	--	--	10	10	10	>1 (<1)	1	1
Zizania aquatica	--	--	--	--	--	-- (<1)	1	<1

leaves of *Zizaniopsis miliacea* that characteristically demonstrate the extent of the previous season's growth. It appeared that high salinity tides had caused lysis of the living subaerial stems at or near the substrate. This lysis led to the eventual removal of dead material from the site by tidal action.

Mean maximum monthly salinity data from Inner Town Creek indicate a decided, steady increase in salinity values through the year near the sampling station (Table 8.2-3). Decreasing freshwater flow from the upper Town Creek watershed is most likely the cause of this trend. The effects of this increasing salinity at Inner Town Creek have likely been responsible for the reduction in growth of the dominant sensitive herbaceous vegetation including *Zizaniopsis miliacea* and other species. All sensitive herbaceous vegetation species listed last year are present in the current year, but general coverage of each species is reduced and all displayed weakened conditions as noted in the field.

Stems of previously listed species were present in the newer polygon for the current year, but were brown and/or dead. These species included *Schoenoplectus americanus*, *Zizania aquatica*, *Sagittaria lancifolia*, *Peltandra virginica,* and *Carex hyalinolepis*. *Zizaniopsis miliacea* showed similar signs of weakness as well as evidence of heavy grazing by grasshoppers. *Peltandra virginica* appeared to be sending up new leaves, but these were browning and withering. One specimen of mature *Taxodium ascendens* near the south end of the polygon showed signs of browning and dying. *Spartina cynosuroides* had increased in thickness and extent along the north and south ends of the polygon.

Herbaceous species not considered very sensitive to some saline water, including *Schoenoplectus tabernaemontani* and *Typha angustifolia* that make up a significant amount of the vegetation in the area show definite signs of subaerial browning and death. The results of a significant salt event are believed to be responsible for these symptoms, as well. As far as damage to vegetation is concerned this event appears to have been considerably more devastating than the drought of 2002. It is likely that an event of extreme salinity associated with a single or multiple high tide events has been responsible. Careful examination of daily salinity data for the period of the later growing season may reveal single or multiple consecutive high tides with salinities that could have been responsible for the observed damage during June or July.

Mucky substrates materials seemed to have consolidated by January. This consolidation was manifested by a general increase in consistency or firmness. Walking through the area was no longer as difficult. The muck was able to support a greater amount of weight without flowing away from the point of its application.

Additional indications of change noted during the January 2007 visit include:

1. *Pinus* in marsh away from the creek browning
2. Stems of *Zizaniopsis miliacea* dead and flattened or missing from substrate
3. Berm near center of polygon over-washing regularly
4. Woody plants on berm dead or dying
5. Signs of erosion along interior stream, outer stream bank, and old rice ditch
6. More bare muck substrate devoid of grass stems

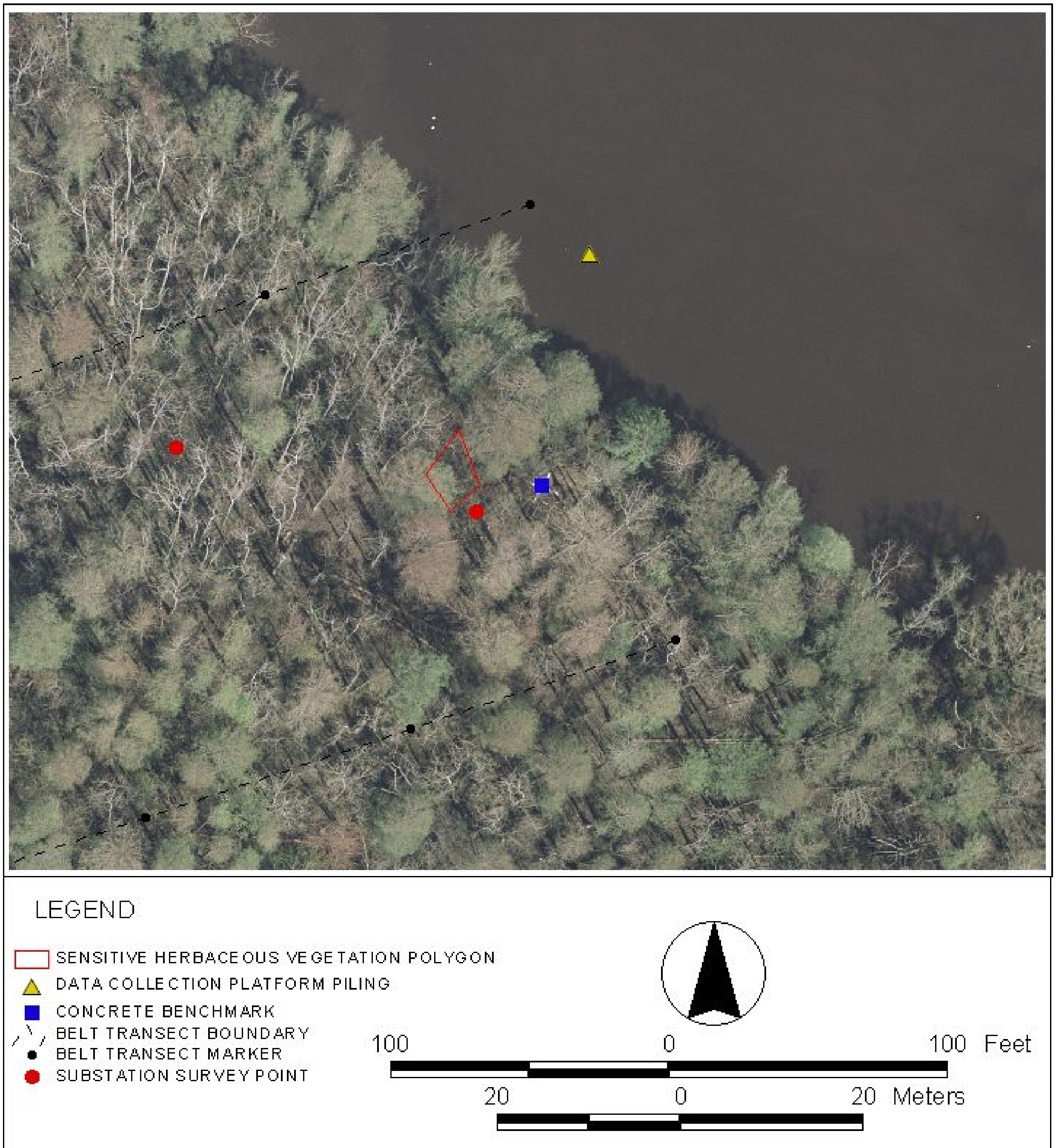
8.42 Indian Creek

Details of changes associated with adjacent development activities were outlined in last year's report (Hackney et al. 2007). This year there have been only minor physical changes relative to habitat manipulation, but these past changes are beginning to effect growth and recruitment of species within and adjacent to the permanent polygon. It is possible that changes following the disturbance by development can be documented. The table showing annual changes in sensitive herbaceous vegetation as well as the figure showing the location of the sensitive herbaceous vegetation polygon (Table 8.42-1 and Figure 8.42-1) should be consulted with care in view of these site-specific human-related changes.

Three species are new to the polygon, *Zizania aquatica, Physostegia leptophylla,* and *Mikania scandens*. *Physostegia leptophylla* and *Mikania scandens* are somewhat opportunistic species and disperse well in tidal fresh waters. *Physostegia leptophylla* has appeared within sample plots in the Cape Fear River only during the last three years, though it is a characteristic swamp forest species. It may or may not thrive in open sunlight. *Mikania scandens* is ubiquitous in open and newly disturbed habitats and may become a dominant. It has been noted that in other areas it responds somewhat to salt intrusion. *Zizania aquatica*, also an opportunistic species, spread by seed or more commonly by vegetative propagation and will likely flourish in the open shrubby, mixed-

Table 8.42-1. Comparisons of percent cover contributions by sensitive herbaceous species in the sampling polygon at the Indian Creek Station (P7) for years 2000-2007, Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species	Year							
	2000	2001	2002	2003	2004	2005	2006	2007
Saururus cernuus	2	1	--	2	20	1	5	2
Cicuta maculata	5	2	<1	2	1	1	2	1
Polygonum punctatum	<1	<1	--	--	<1	<1	<1	3
Commelina virginica	<1	2	1	<1	--	<1	<1	<1
Carex crinita var. *brevicrinus*	<1	<1	10	--	--	<1	1	--
Carex hyalinolepis	<1	2	--	1	<1	<1	<1	<1
Symphyotrichum elliottii	<1	--	--	--	--	<1	<1	<1
Triadenum walteri	<1	<1	--	--	--	--	--	--
Lycopus virginicus	<1	--	--	--	--	--	<1	1
Galium sp.	<1	--	--	--	--	--	--	--
Phanopyrum gymnocarpum	--	<1	2	1	1	1	2	5
Peltandra Virginica	--	--	<1	--	--	--	--	--
Boehmeria cylindrical	--	<1	--	--	--	<1	<1	--
Polygonum virginianum	--	--	--	1	--	<1	--	--
Chasmanthium latifolium	--	--	--	1	--	<1	2	--
Hymenocallis floridana	--	--	--	--	<1	<1	2	--
Cinna arundinacea	--	--	--	--	<1	<1	--	--
Physostegia leptophylla	--	--	--	--	--	--	--	<1
Zizania aquatica	--	--	--	--	--	--	--	1
Mikania scandens	--	--	--	--	--	--	--	<1



DAVID M. DUMOND ECOLOGICAL SERVICES AND CONSULTING 1600 HICKS ROAD BROADWAY, NC 27505 (919)258-3032	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: ic07.apr | APPROVED BY: JC | #CFRM-8
	DRAWN BY: DMD | DATE: 30 February 2008 | FIGURE 8.42-1

herb habit that is sure to develop at Indian Creek. The rhizomatous habit of this species should insure its developing importance in an oligohaline salinity regime.

The salinity regime at Indian Creek was unperturbed by salinity increases until the month of June 2007 (Table 8.2-3). Flow from the mouth of Indian Creek may have provided some buffering effect as its outflow empties between the Cape Fear channel and the swamp, reducing the likelihood of direct flow from the river into the adjacent swamp lands and promoting something of a deltaic deposit just off-shore of the sampling station. This station also experiences the least flooding among stations. Salinity increases in August following sensitive herbaceous vegetation sampling may be noted in next year's vegetation survey.

Within the polygon at Indian Creek, *Saururus cernuus* had reduced its cover compared to last year, and salty water or the sudden competition from less light-sensitive species may account for its lower cover value. *Polygonum punctatum* and *Phanopyrum gymnocarpum* have increased in cover compared to previous years. Several species have disappeared from the polygon, notably *Boehmeria cylindrica*, *Carex crinita* var. *brevicrinus,* and *Chasmanthium latifolium*. Sudden light changes or salty water may be partially responsible for the apparent loss of these species from the polygon.

Campsis radicans, not a sensitive herbaceous species, continues to be an important woody vine within the polygon. *Toxicodendron radicans* seems to have appeared, as well. *Bidens*, an annual, has likely shown up as a pioneer following substrate and light changes.

Growing conditions have likely been most influenced by the advent of selective tree clearing. During summer 07, investigations along the entire transect were not undertaken except to determine that some of the substations have been damaged or rendered inoperable by the workmen clearing the area. By spring 08, the substations at this site were rebuilt and spring data was successfully collected.

At the time of the field visit, the substrate within the polygon as well as the surrounding area was littered with woody debris generated by the clearing process. New herbaceous species were appearing in the vicinity of the old polygon. The old drainage line that had previously bisected the polygon had deepened, further changing the hydrologic characteristics and, hence, the habitat within the polygon.

8.43 Dollisons Landing

The Dollisons Landing sample plot showed little variation that could be attributed to changes in salinity or flooding (Table 8.43-1, Figure 8.43-1). Only minor increases in river salinity had been experienced at this site prior to August 2007 (Table 8.2-3). Later in August, river salinities reached a monthly mean maximum of 6.3 ppt. No spikes in salinity were detected in the spring 2007 swamp data (Hackney et al. 2007, Table 4.2-4).

Within the polygon, *Saururus cernuus* has lost its dominance, while *Pontederia cordata* has unexpectedly increased its cover. *Eryngium aquaticum* and *Lycopus virginicus* were not seen this year, while *Polygonum punctatum* and *Peltandra virginica* retain somewhat less cover than seen last year.

Table 8.43-1. Comparisons of percent cover contributions by sensitive herbaceous species in the sampling polygon at the Dollisons Landing Station (P8) for years 2000-2007, Wilmington Harbor monitoring project, Cape Fear River, North Carolina.

Species	**Year**							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Saururus cernuus	30	20	35	35	40	50	30	30
Boehmeria cylinidrica	<1	--	<1	<1	1	<1	<1	<1
Rumex verticillatus	<1	--	2	2	<1	<1	--	--
Cicuta maculata	2	--	2	2	<1	<1	<1	<1
Carex sp.	1	--	--	--	--	--	--	--
Polygonum punctatum	1	1	3	3	--	<1	1	>1
Peltandra virginica	2	1	3	3	<1	1	1	>1
Carex crinita	<1	2	--	--	--	--	--	--
Dulichium arundinaceum	<1	--	--	--	--	--	--	--
Triadenum walteri	<1	--	--	--	--	--	--	--
Eryngium aquaticum	--	3	1	1	--	--	<1	--
Pontederia cordata	--	<1	--	--	--	<1	<1	5
Hymenocallis floridana	--	--	<1	<1	<1	--	--	<1
Alternanthera philoxeroides	--	--	<1	<1	--	--	--	--
Proserpinaca palustris	--	--	--	--	<1	--	--	--
Ipomoea sp.	--	--	--	--	<1	--	--	--
Hydrocotyle verticillata	--	--	--	--	--	--	1	<1
Lycopus virginicus	--	--	--	--	--	--	<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 P8 (DOLLISONS LANDING),
WILMINGTON HARBOR MONITORING PROJECT,
CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

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DRAWN BY: DMD	DATE: 30 February 2008	FIGURE 8.43-1

8.44 Black River

Information included in the following table represents data obtained from both old and new sensitive herbaceous vegetation plots at Black River (P9). Data from 2005, 2006, and 2007 are most current and do not represent the previous variable plot which has now been abandoned (Table 8.44-1 and Figure 8.44-1). A bold vertical line separates old (right) and new (left) data. The species compositions of the old and new plots are similar, but the species of greatest interest, *Saururus cernuus*, never appeared in the old polygon. The old plot is no longer monitored.

Changes resulting from salinity incursions have not been noted at this plot, but several changes have occurred since examination during 2006. The cover contributed by *Saururus cernuus* has decreased. Contributions from *Polygonum punctatum* and *Cicuta maculata* have increased. *Mikania scandens* and *Lobelia cardinalis* have appeared in the polygon. It is likely that both were in the vicinity of the polygon in previous years.

Several species not considered sensitive herbaceous vegetation also occur within the polygon. *Impatiens capensis*, an annual, contributed 5% of the cover. *Platanthera flava*, characteristic on low hummocks, is often found in freshwater swamps. *Polygonum arifolium*, an annual, was scattered through the area as well as in the polygon. Woody species included *Leucothoe racemosa*, *Viburnum dentatum*, and *Campsis radicans*. Clump forming herbaceous species well above the substrate on hummocks and stumps were *Carex debilis* and *Osmunda regalis*. *Carex gigantea*, also present, is not considered a sensitive herbaceous species because of its customary habitat above muck substrate.

Presence of ocean-derived salt at this site during the growing season is not indicated in any of the current data (Tables 8.44-1 and 8.2-3, and Hackney et al. 2007, Table 4.2-3).

8.45 Rat Island

The sensitive herbaceous polygon at the Rat Island (P12) sampling station remains the same size and shape as in previous years (Figure 8.45-1), except for loss of a small portion of vegetated substrate paralleling the Northeast Cape Fear River. This small section occupies a portion of the bank along a shallow, sandy bottom that is subject to erosion by boat wakes. This erosion process is slowly moving westward into the polygon.

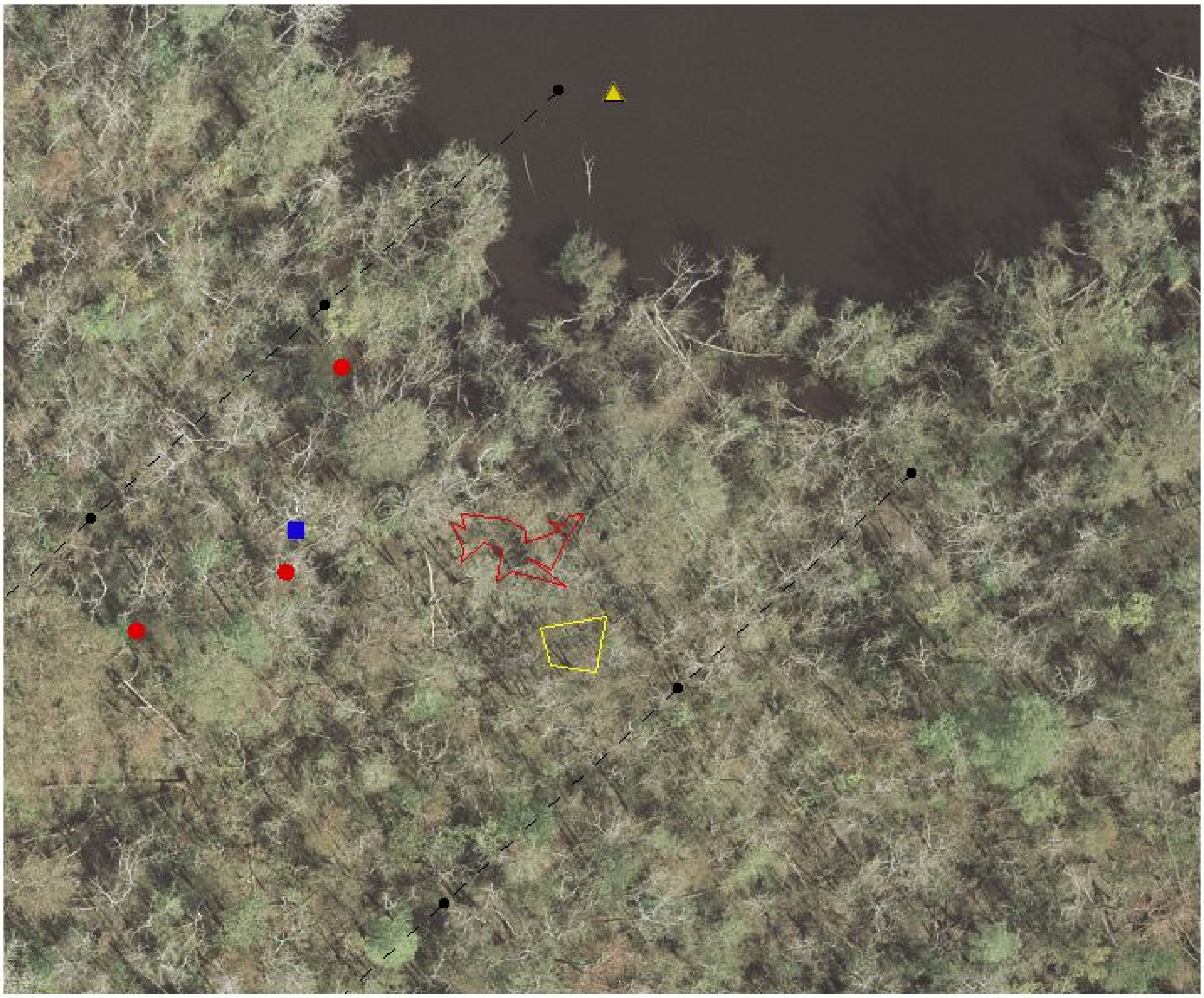
Table 8.44-1. Comparisons of percent cover contributions by sensitive herbaceous species in old polygons from years 2000-2004 and new sensitive herbaceous polygon for 2005-2007 at the Black River (P9), Wilmington Harbor monitoring project, Cape Fear River, North Carolina ([a] denotes new plots)

Species	Year							
	2000	**2001**	**2002**	**2003**	**2004**	**2005 [a]**	**2006 [a]**	**2007 [a]**
Ludwigia palustris	50	20	20	1	5	5	--	<1
Polygonum punctatum	--	15	1	--	1	<1	<1	5
Symphyotrichum elliottii	--	2	<1	1	<1	<1	<1	<1
Scutellaria lateriflora	--	--	<1	--	--	--	--	--
Boehmeria cylindrica	--	--	<1	--	<1	--	<1	1
Saururus cernuus	--	--	--	--	--	10	10	3
Physostegia leptophylla	--	--	--	--	--	<1	--	<1
Peltandra virginica	--	--	--	--	--	<1	1	<1
Cicuta maculata	--	--	--	--	--	--	<1	2
Mikania scandens	--	--	--	--	--	--	--	<1
Lobelia cardinalis	--	--	--	--	--	--	--	<1

[a]Plot relocated in 2005

Species present within the slowly eroding polygon remain about the same as during the previous year (Table 8.45.1). An above-ground stem of *Rumex verticillatus*, a fresh to lightly brackish water species, was noted once again after five years, but above-ground evidence of *Peltandra virginica* was not observed. Most sensitive herbaceous species within the polygon appear to be decreasing in subaerial cover, while the dominant in the polygon, *Spartina cynosuroides*, is becoming abundant along the outer edge of the site along the river berm as well as inside the polygon. Corms of *Hymenocallis floridana* continue to be visible, but may be less abundant than during the past since that part of the polygon is subject to erosion. *Schoenoplectus tabernaemontani*, not considered a sensitive herbaceous species, was noted in the polygon this year.

Mesohaline salinity regimes continue in the Northeast Cape Fear River in the vicinity of the Rat Island station (Table 8.2-3). The last strong influx of ocean-derived salt within the Cape Fear estuary in 2002 was only slightly more saline than that of the current year through August at Rat Island. Salinity gradients attenuate rapidly away from the river, and even at the levels seen in Table 8.2-3 through May, little or no salinity was detected in the marsh away from the river through May of 2007 (Hackney et al. 2007). .



LEGEND

- SENSITIVE HERBACEOUS VEGETATION POLYGON, 2005
- 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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SENSITIVE HERBACEOUS VEGETATION POLYGONS
FROM YEARS 2000 AND 2007 AT STATION P9 (BLACK RIVER),
WILMINGTON HARBOR MONITORING PROJECT,
NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: br07.apr	APPROVED BY: JC	#CFRM-8
DRAWN BY: DMD	DATE: 30 February 2008	FIGURE 8.44-1

LEGEND

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

100 0 100 Feet

20 0 20 Meters

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SENSITIVE HERBACEOUS VEGETATION POLYGON FROM YEAR 2000 AT STATION P12 (RAT ISLAND), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA		
FILE: ri07.APR	APPROVED BY: JC	#CFRM-8
DRAWN BY: DMD	DATE: 30 FEBRUARY 2008	FIGURE 8.45-1

Table 8.45-1. Comparisons of percent cover contributions by sensitive herbaceous species in the polygon for years 2000-2007 at the Rat Island (P12), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species	**Year**							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Schoenoplectus americanus	100	20	30	50	25	90	50	30
Carex hyalinolepis	20	8	10	<1	2	<1	2	10
Sagittaria lancifolia	10	30	--	5	10	<1	5	<1
Alternanthera philoxeroides	<1	--	<1	--	--	--	--	--
Boltonia asteroides	<1	<1	--	--	--	--	--	--
Symphyotrichum subulatum	<1	<1	<1	<1	--	--	--	--
Peltandra virginica	--	1	--	--	--	--	<1	--
Rumex verticillatus	--	1	--	--	--	--	--	<1
Hymenocallis floridana	--	<1	--	1	<1	<1	<1	<1
Polygonum punctatum	--	--	--	--	<1	--	--	--

8.46 Fishing Creek

The variable plot at Fishing Creek has undergone a significant change in shape and size as compared to the original polygon configuration in 2000 and the polygon for 2006 (Table 8.46-1, Figure 8.46-1). From last year to this year there has been a decrease of nearly 500 square feet. Following the previous salinity event in 2002, a similar change in area occurred: a reduction of over 600 square feet from that of the previous year's polygon. Changes in shape and size have come about as a result of disappearance of subaerial stems of *Pontederia cordata*, the primary sensitive herbaceous species used to delineate the polygon. High salinity conditions at the site are considered responsible.

The Fishing Creek sensitive herbaceous vegetation station has consistently been one of the most, if not the most, diverse of the seven sampling sites in terms of vascular plant species (Table 8.46-1). The simple diversity exhibited at this site is related to its complement of species adapted to withstand the wide fluctuations in salinity conditions experienced along this reach of the Northeast Cape Fear River. This year, concentrations of ocean-derived salts in the river have had mean monthly variations from near 0 to over 16 ppt (Table 8.2-3). By inspection, the same data set for the year 2002 show higher mean salinity values and longer duration for the 2002 period of low flow of fresh

Table 8.46-1. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000-2007 at the Fishing Creek Station (P13), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

Species	**Year**							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Pontederia cordata	20	40	50	30	30	35	20	2*
Symphyotrichum elliottii	<1	--	--	--	--	1	--	--
Polygonum punctatum	2	1	--	<1	10	2	3	1
Sium suave	<1	2	5	1	1	--	2	3*
Zizaniopsis miliacea	2	<1	<1	5	5	<1	--	--
Saururus cernuus	2	2	--	1	5	1	1	<1*
Cicuta maculate	<1	2	--	--	1	1	<1	--
Sagittaria lancifolia	2	20	5	20	5	1	3	3
Orontium aquaticum	<1	--	--	--	--	--	--	--
Peltandra virginica	<1	1	5	30	12	5	25	5*
Rhynchospora corniculata	<1	<1	--	--	<1	--	<1	<1
Carex sp.	<1	--	--	--	--	--	--	--
Alternanthera philoxeroides	--	5	<1	<1	--	1	<1	1
Zizania aquatica	--	2	<1	50	<1	<1	<1	<1
Boltonia asteroids	--	1	--	--	<1	<1	<1	<1
Rumex verticillatus	--	<1	2	1	--	<1	<1	<1
Cinna arundinacea	--	<1	--	<1	<1	--	<1	<1*
Eryngium aquaticum	--	<1	5	2	2	5	2	<1*
Schoenoplectus americanus	--	--	<1	--	--	--	--	--
Carex hyalinolepis	--	--	--	1	--	--	--	<1
Apios americana	--	--	--	<1	<1	<1	<1	--
Hymenocallis floridana	--	--	--	2	--	--	--	--
Ludwigia palustris	--	--	--	<1	<1	--	<1	--
Hypericum mutilum	--	--	--	--	<1	--	--	--
Boehmeria cylindrica	--	--	--	--	<1	<1	<1	--
Lycopus virginicus	--	--	--	--	--	<1	<1	--
Cyperus sp.	--	--	--	--	--	<1	--	--
Elymus virginicus	--	--	--	--	--	<1	--	<1
Lobelia cardinalis	--	--	--	--	--	--	<1	--
Carex crus-corvi	--	--	--	--	--	--	<1	--
Bidens laevis	--	--	--	--	--	--	<1	--
Mikania scandens	--	--	--	--	--	--	<1	<1
Leersia oryzoides	--	--	--	--	--	--	--	<1

*Visible salt damage on plant materials

LEGEND

SENSITIVE HERBACEOUS VEGETATION POLYGON, 2007
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2006
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 FOR YEARS 2000, 2006 AND 2007 AT STATION P13 (FISHING CREEK), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: fc07.apr	APPROVED BY: JC	#CFRM-8
DRAWN BY: DMD	DATE: 30 FEBRUARY 2008	FIGURE 8.46-1

Figure 8.46-2. Consecutive salinity data between June 1 and June 25, 2007 showing spikes above 20 parts per thousand near the middle of the month (last five days of data not available) from river water monitoring station at Fishing Creek (P13), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.

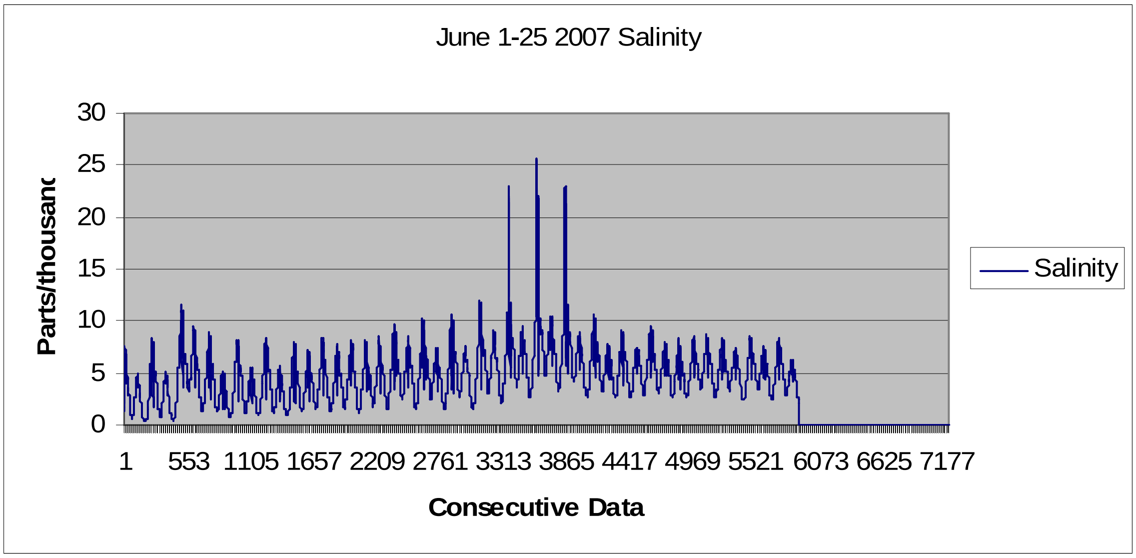
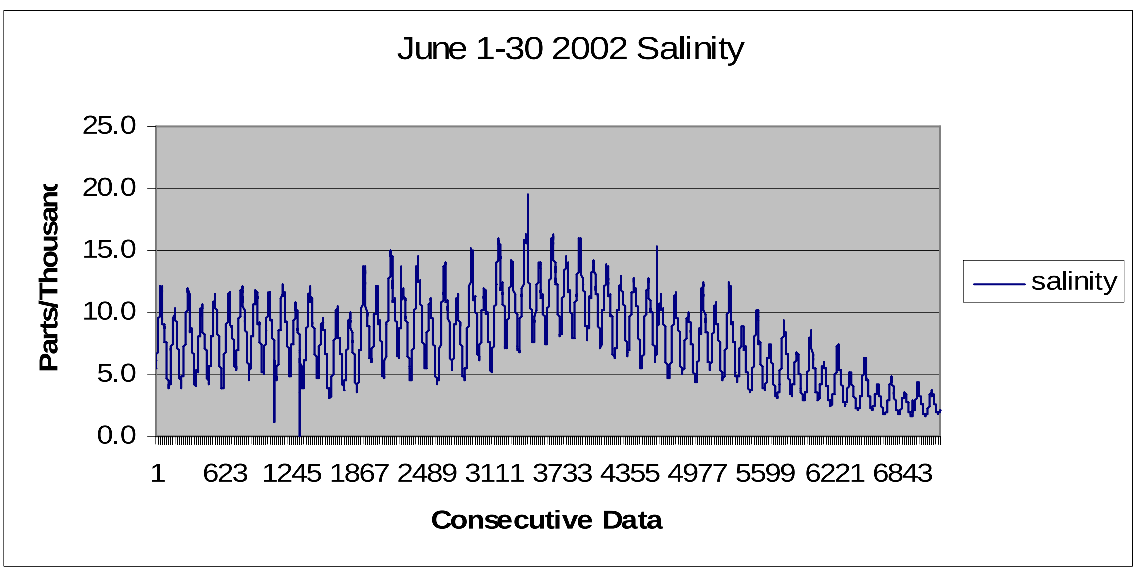


Figure 8.46-3. Salinity data from the Northeast Cape Fear River between June 1 and June 30, 2002 showing spikes above 15 parts per thousand near the middle of the month from river water monitoring station at Fishing Creek (P13), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina.



8.47 Prince George Creek

Shape, size and species content of the sensitive herbaceous vegetation polygon at Prince George Creek have remained similar to previous years including 2006 (Tables 4.41-1 and 8.47-1, Figure 8.47-1). No specific changes can be attributed to the effects of a salinity event. Apparent changes in shape are most directly related to the effects of GPS multipath anomalies.

Saururus cernuus has decreased somewhat in its contribution of total cover since last year following a year with salinity events occurring down stream. There is no evidence to indicate this reduction is related to a salinity event at the Prince George Creek station. A slight spike in salinity occurred in the river at the level being sampled at the DCP (Table 8-2.3). This spike was less than that experienced during 2002. The sudden reduction in importance of *Peltandra virginica* could be attributed to the salinity event, but there was no direct evidence to indicate that high salinities might have played a role in limiting growth of this species. Last year this species was denser than previously noted.

As was the case last year simple diversity stands at 11 species and remains high for this station. *Ludwigia palustris* was not seen this year, but *Triadenum walteri* was noted for the second time since sampling began. The mobility of *Ludwigia palustris* is related to flooding conditions, segmentation and the release of vegetative propagules as well as production and dispersal of seeds.

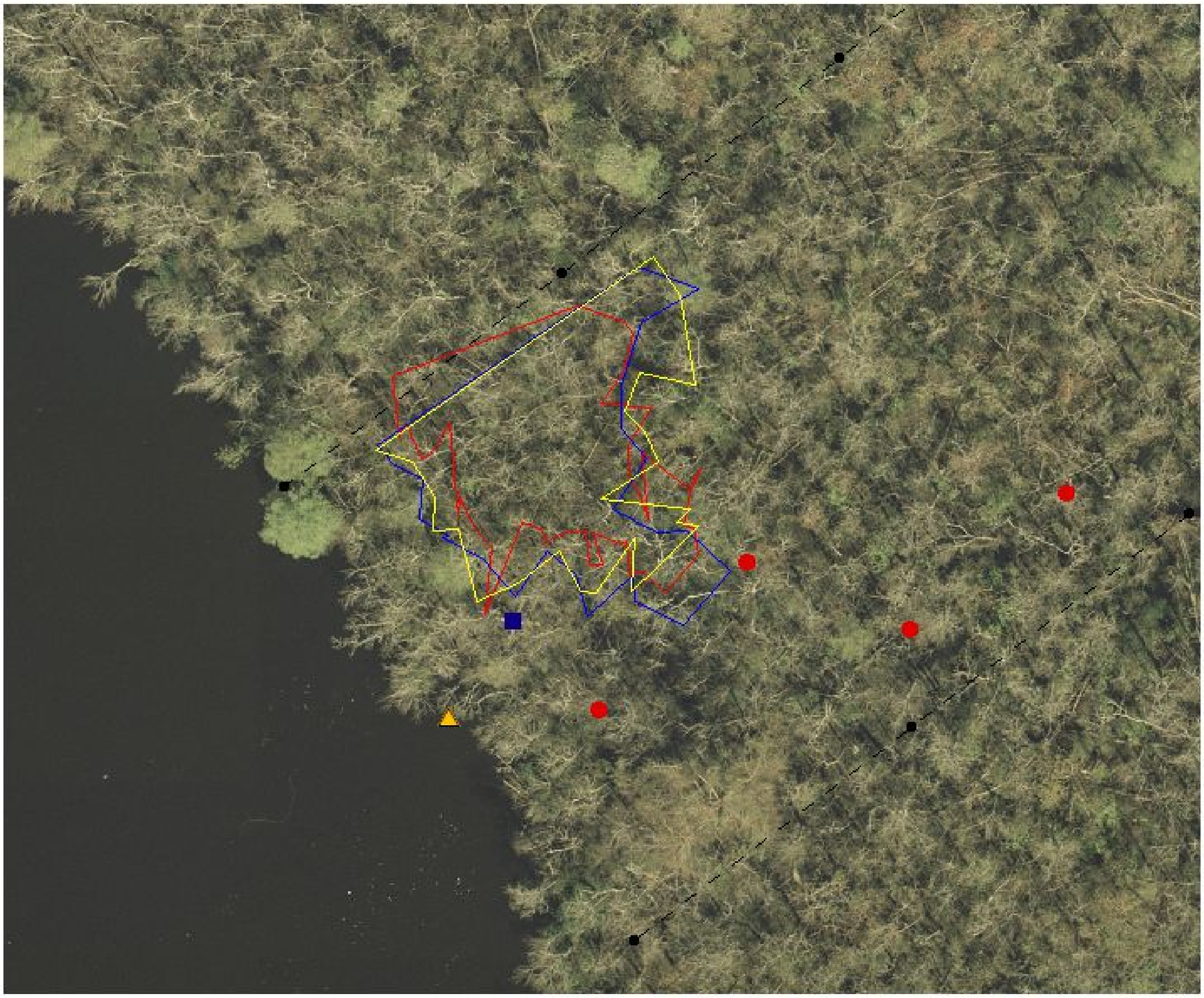
8.5 Discussion

Drought conditions within the watersheds of the Cape Fear River, the Northeast Cape Fear River, and the Black River this year have been responsible for low, freshwater flows into the Cape Fear River estuary, particularly during late spring and summer months (Figures 8.2-1, 8.2-2, and 8.2-3). Town Creek should also be added to this list of tributaries, but no discharge documentation is available. These low, freshwater flows have apparently resulted in the occurrence of salinity events, or spikes in the concentration of ocean-derived salts that occur primarily during rising or high tides. As freshwater flows decrease, dilution of salty tides is diminished. Two sensitive herbaceous vegetation sampling plots this year show direct evidence of salinity events which occurred during the summer of 2007. The effects of these salinity events were readily apparent at the Inner Town Creek (P3) and Fishing Creek (P13) stream and river sampling stations, respectively (Tables 8.2-2 and 8.2-3).

Table 8.47-1. Comparisons of percent cover contributions by sensitive herbaceous species in polygons from years 2000-2007 at the Prince George Creek Station (P14), Wilmington Harbor monitoring project, Northeast Cape Fear River, North Carolina

Species	**Year**							
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
Saururus cernuus	35	60	20	40	40	20	50	35
Polygonum punctatum[a]	20	15	--	<1	20	30	10	2
Peltandra virginica	10	8	1	5	10	5	30	1
Pontederia cordata	--	5	--	--	<1	--	<1	--
Cicuta maculata	--	<1	<1	<1	--	--	<1	<1
Zizania aquatica	--	<1	--	--	--	--	--	--
Cinna arundinacea	--	<1	--	--	<1	<1	<1	<1
Boehmeria cylindrica	--	<1	<1	--	--	1	--	<1
Carex lupulina	--	<1	<1	--	--	--	--	<1
Alternanthera philoxeroides	--	--	<1	--	--	--	--	--
Decodon verticillatus	--	--	<1	<1	<1	<1	<1	<1
Hymenocallis floridana	--	--	<1	<1	1	1	1	<1
Zizaniopsis miliacea	--	--	--	<1	<1	<1	<1	--
Triadenum walteri	--	--	--	<1	--	--	--	<1
Hydrocotyle sp.	--	--	--	--	<1	--	<1	--
Lobelia cardinalis	--	--	--	--	--	<1	--	--
Ludwigia palustris	--	--	--	--	--	--	<1	--
Lycopus virginicus	--	--	--	--	--	--	--	<1

[a] Previously identified as *Polygonum hydropiper* and *Polygonum hydropiperoides*.



LEGEND

SENSITIVE HERBACEOUS VEGETATION POLYGON, 2007
SENSITIVE HERBACEOUS VEGETATION POLYGON, 2006
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 FOR YEARS 2000, 2006 AND 2007 AT STATION P14 (PRINCE GEORGE CREEK), WILMINGTON HARBOR MONITORING PROJECT, NORTHEAST CAPE FEAR RIVER, NORTH CAROLINA

WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

FILE: pgc07.APR	APPROVED BY: JC	#CFRM-8
DRAWN BY: DMD	DATE: 30 February 2008	FIGURE 8.47-1

Damage at Town Creek has resulted in a considerable reduction in size of the sensitive herbaceous vegetation polygon as well as significant reduction in cover by individual species (Tables 8.4-1 and 8.41-1). At this station, increasingly more saline flood waters are influencing a shift in dominance from *Zizaniopsis miliacea* to *Spartina cynosuroides*, particularly along the shore of the Town Creek site. The sharply reduced cover by the former species from that reported during 2006 demonstrates this vegetation change. During the January visit in 2008, the ordinary standing remains of *Zizaniopsis miliacea* were largely absent within the polygon, having been subjected to lysis at or near their bases during the growing season. Stems fell and were removed by tides.

While the salinity events at Town Creek have not been related in this report to any specific time of year, those at Fishing Creek may have been caused by rather specific events during June of 2007. Mean monthly salinity values do not allow demonstration of specific critical events. Daily, consecutive salinity data suggest that a few salinity events in excess of 20 parts per thousand may have been responsible for observed damage at Fishing Creek during 2007 (Figure 8.45-3). The observed damage at Fishing Creek this year is significantly worse than that observed during 2002. The damage to vegetation at Fishing Creek during 2002 must be related to a milder series of salinity spikes that slightly exceeded only 15 parts per thousand. One spike approached 20 ppt.

Differences in damage occurring in 2002 as opposed to 2007 may relate to the stronger, though fewer, salinity events that occurred during 2007. These observations seem to indicate that damage to sensitive herbaceous species can occur with either numerous milder events or fewer more severe events and that the critical range within vegetation such as that found at Fishing Creek is around 15-25 ppt, based on data from the river DCP. However, damage may also be dependent on species, the consecutive number of flooding tides, depth, etc.

Substrate conditions in and around the polygons at both Town Creek and Fishing Creek seem to have changed. During January organic mucks at both sites seemed not to flow outward under weight as if their consistency and ability to hold water had been reduced. If this apparent condition is real and if it persists, penetration of plant rhizomes may be impeded.

Data and observations at other sensitive vegetation polygons seem to show little or no significant effects of salinity spikes. River water data available at each station indicate increases in salinity within the river water column of the Indian Creek, Dollisons Landing, and Prince George Creek stations (Table 8.2-3). There was no indication that these changes in salinity had a visible effect on plant growth at these stations. However, significant increases in salinity in the river occurred after the August 2007 sampling of sensitive vegetation. This may influence data in the next annual report.

No precise comparison could be made between the effects of salinity events that occurred during 2002 and those noted during the current year. Sensitive herbaceous species polygons were smaller at both Town Creek and Fishing Creek at that time (Hackney et al. 2003). Because the drought apparently persisted for a longer period of time during the years 2001 and 2002, the period of time during which salinity events could occur was also longer. Salinity during May, June, and July of 2002 and 2007 are comparable, but floodwater in 2002 was more saline and did affect sensitive herbaceous species, namely *Saururus cernuus*, as far upstream as Dollisons Landing and Prince George Creek. Both events seem more relative to conditions in the diminished freshwater watershed rather than to any effects associated with modified tidal surge from further downstream. At both times, it appears that the most damaging effects may have taken place either with several repeated moderate salinity spikes or with a few extreme salinity spikes. The 2007 event at Fishing Creek seems likely to have occurred during a few rather strong spikes between 15 and 25 ppt, while the 2002 events at the same station were most likely associated with several lesser spikes less than 20 ppt.

9.0 LITERATURE CITED

CZR Incorporated. 2001. Monitor Potential Effects of Increased Tidal Range on the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina. Part B. Initial Baseline Monitoring. Prepared for U. S. Army Corps of Engineers, Wilmington District, Wilmington, NC.

CZR Incorporated. 2002. Monitor Potential Effects of Increased Tidal Range on the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina. Part B. Initial Baseline Monitoring. Prepared for U. S. Army Corps of Engineers, Wilmington District, Wilmington, NC.

Hackney, C. T., M. Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., and others. 2002. Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina Year 1: August 1, 2000 – July 31, 2001. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hackney, C. T., M. Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., and others. 2003. Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina Year 2: June 1, 2001 – May 31, 2002. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hackney, C. T., M. Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., and others. 2004. 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. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hackney, C. T., M. Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., D.M. DuMond, and others. 2005. Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina Year 4: June 1, 2003 – May 31, 2004. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hackney, C. T., Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., D.M. DuMond, and others. 2006. Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina Year 5: June 1, 2004 – May 31, 2005. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hackney, C. T., Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., D.M. DuMond, and others. 2007. Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina Year 6: June 1, 2005 – May 31, 2006. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hackney, C. T., Posey, L.L. Leonard, T Alphin, G.B. Avery Jr., D.M. DuMond, and others. 2008. Monitoring Effects of a Potential Increased Tidal Range in the Cape Fear River Ecosystem Due to Deepening Wilmington Harbor, North Carolina Year 6: June 1, 2006 – May 31, 2007. Unpublished report prepared for the U. S. Army Corps of Engineers, Wilmington District. University of North Carolina at Wilmington Department of Biological Sciences, Wilmington, NC.

Hesslein, R.H. 1976. An in situ sampler for close interval pore water studies. Limnology and Oceanography 21:912-914.

Hoehler, T.M., M.J. Alperin, D.B. Albert and C.S. Martens. 1994. Field and laboratory studies of methane oxidation in an anoxic marine sediment: Evidence for a methanogen-sulfate reducer consortium. Global Biogeochemical Cycles 8:451-463.

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.

Mallin, M., M. Posey, G. Shank, M. McIver, S. Ensign, and T. Alphin. 1999. Hurricane effects on water-quality and benthos in the Cape Fear watershed: Natural and anthropogenic impacts. Ecological Applications 9(1): 350-362.

Mallin, M., M.H. Posey, T.E. Lankford, M.R. McIver, S.H. Ensign, T.D. Alphin, M.S. Williams, M.L. Moser, and J.F. Merritt. 2001. Environmental assessment of the lower Cape Fear River system 2000-2001. CMS Report No. 01-02.

Pawlowicz, R., B. Beardsley, and S. Lentz. 2002. Classical tidal harmonic analysis including error estimates in MATLAB using T_TIDE. Computers and Geosciences 28: 929-937.

APPENDIX A

LIST OF TIDAL RANGE DATA FOR ALL 14 STATIONS USED TO GENERATE FIGURES AND TABLES IN SECTION 3.0 (1 June 2007 – 31 May 2008)

Appendix A. List of tidal range data for all 14 stations used to generate figures and tables in Section 3.0.

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1	3.26	3.52	2.51	3.63	3.62	3.3	3	2.79	3.55	3.15	2.69	1.96
2	3.53	3.87	2.81	3.97	3.94	3.72	3.45	3.20	3.88	3.54	3.15	2.54
3	4.81	4.99	3.39	5.05	4.92	4.61	4.31	4.10	4.85	4.39	3.85	3.02
4	4.62	4.71	3.07	4.77	4.65	4.23	3.87	3.62	4.57	4.05	3.43	2.49
5	3.2	3.52	2.52	3.65	3.61	3.30	2.98	2.79	3.55	3.15	2.69	1.98
6	3.49	3.78	2.81	3.97	3.92	3.68	3.40	3.24	3.87	3.51	3.10	2.47
7	5.27	5.15	3.61	5.21	5.16	4.85	4.57	4.37	5.06	4.62	4.10	3.29
8	4.2	3.85	2.19	3.74	3.65	3.31	2.97	2.69	3.55	3.09	2.52	1.51
9	3.29	3.36	1.94	3.35	3.25	2.96	2.63	2.39	3.18	2.77	2.27	1.35
10	3.76	3.99	2.53	4.07	4.01	3.63	3.31	3.10	3.91	3.46	2.92	2.04
11	4.26	4.29	2.64	4.33	4.23	3.81	3.46	3.22	4.16	3.64	3.02	2.08
12	4.52	4.45	xxx	4.50	4.39	3.92	3.50	3.22	4.30	3.75	3.06	2.07
13	3.2	3.42	xxx	3.54	3.50	3.10	2.73	2.51	3.40	2.95	2.39	1.61
14	3.3	3.45	xxx	3.51	3.46	3.26	3.01	2.86	3.39	3.08	2.69	2.09
15	4.69	4.56	xxx	4.54	4.43	4.15	3.86	3.66	4.46	3.93	3.38	2.52
16	4.68	4.58	xxx	4.63	4.52	4.05	3.65	3.37	4.43	3.90	3.23	2.22
17	3.55	3.75	xxx	3.87	3.81	3.41	3.05	2.83	3.54	3.27	2.71	1.87
18	3.12	3.39	xxx	3.49	3.45	3.20	2.96	2.82	3.44	3.04	2.65	1.99
19	4.34	4.26	xxx	4.29	4.18	3.88	3.58	3.39	4.12	3.69	3.18	2.35
20	4.75	4.62	xxx	4.70	4.54	4.08	3.67	3.39	4.47	3.93	3.24	2.18
21	3.72	3.83	xxx	3.91	3.81	3.40	3.03	xxx	3.73	3.28	2.71	1.83
22	3.28	3.54	xxx	3.64	3.56	3.34	3.06	2.92	3.49	3.14	2.72	2.08
23	4.26	4.30	xxx	4.39	4.26	3.98	3.67	3.46	4.20	3.76	3.23	2.40
24	4.48	4.50	xxx	4.60	4.43	3.98	3.60	3.30	4.36	3.83	3.16	2.14
25	3.87	4.09	xxx	4.28	4.15	3.74	3.39	3.17	4.07	3.59	2.98	2.04
26	3.52	3.70	xxx	3.84	3.75	3.45	3.14	2.94	3.69	3.26	2.72	1.88
27	3.98	4.06	xxx	4.09	3.96	3.62	3.28	3.06	3.94	3.45	2.87	2.00
28	4.45	4.57	xxx	4.65	4.45	4.04	3.64	3.39	4.41	3.86	3.19	2.19
29	4.19	4.39	xxx	4.54	4.36	3.97	3.57	3.32	4.30	3.79	3.13	2.12
30	3.73	3.97	xxx	3.96	3.86	3.57	3.22	3.01	3.81	3.38	2.80	1.88

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
31	3.87	4.07	xxx	4.01	3.90	3.60	3.25	3.03	3.84	3.40	2.83	1.92
32	xxx	4.70	xxx	4.81	4.63	4.19	3.81	3.50	4.55	4.01	3.34	2.29
33	xxx	4.82	xxx	4.90	4.71	4.24	3.85	3.58	4.62	4.07	3.38	2.31
34	4.1	4.23	xxx	4.28	4.17	3.76	3.39	3.12	4.07	3.59	2.95	1.96
35	4.23	4.20	xxx	4.28	4.17	3.77	3.40	3.11	4.09	3.61	2.95	1.97
36	4.52	4.56	xxx	4.67	4.49	4.07	3.69	3.42	4.43	3.90	3.22	2.21
37	5.01	4.95	xxx	5.03	4.84	4.34	3.92	3.62	4.76	4.17	3.44	2.33
38	4.56	4.52	xxx	4.57	4.44	3.96	3.54	3.23	4.34	3.80	3.08	1.96
39	4.09	4.09	xxx	4.16	4.04	3.64	3.25	2.98	3.95	3.48	2.83	1.82
40	4.75	4.68	xxx	4.78	4.60	4.16	3.76	3.49	4.53	3.99	3.31	2.28
41	5.43	5.24	xxx	5.32	5.09	4.55	4.12	3.80	5.01	4.39	3.62	2.45
42	5.13	4.93	xxx	4.88	4.73	4.18	3.74	3.41	4.63	4.04	3.26	2.06
43	4.12	4.13	2.48	4.12	4.04	3.60	3.22	2.95	3.95	3.46	2.81	1.80
44	4.79	4.72	3.01	4.83	4.65	4.22	3.86	3.58	4.58	4.06	3.42	2.43
45	5.92	5.66	3.37	5.71	5.44	4.87	4.43	4.11	5.36	4.72	3.92	2.71
46	5.6	5.29	2.95	5.31	5.10	4.45	3.93	3.53	4.99	4.32	3.45	2.14
47	4.23	4.12	2.50	4.20	4.09	3.62	3.20	2.89	3.99	3.47	2.81	1.77
48	4.71	4.69	xxx	4.83	4.68	4.29	3.94	3.71	4.61	4.12	3.51	2.57
49	6.61	6.11	xxx	6.14	5.86	5.23	4.75	4.41	5.77	5.09	4.23	2.97
50	5.8	5.28	xxx	5.30	5.05	4.39	3.86	3.45	4.94	4.27	3.39	2.07
51	4.47	4.21	xxx	4.30	4.17	3.70	3.27	2.96	4.07	3.56	2.87	1.80
52	4.89	4.71	xxx	4.77	4.62	4.17	3.79	3.53	4.54	4.04	3.38	2.36
53	6.2	5.81	xxx	5.83	5.55	4.93	4.42	4.06	5.47	4.81	3.96	2.68
54	5.73	5.32	xxx	5.35	5.09	4.42	3.85	3.43	4.97	4.29	3.40	2.02
55	4.35	4.18	xxx	4.27	4.14	3.65	3.23	2.90	4.03	3.52	2.83	1.72
56	4.81	4.59	xxx	4.69	4.50	4.06	3.70	3.43	4.43	3.95	3.29	2.26
57	6.19	5.84	xxx	5.91	5.56	4.92	4.41	4.04	5.47	4.80	3.95	2.62
58	5.63	5.26	xxx	5.30	5.01	4.32	3.75	3.31	4.88	4.18	3.30	1.88
59	4.05	3.99	2.27	4.10	3.97	3.50	3.08	2.76	3.87	3.37	2.69	1.58
60	4.63	4.48	2.81	4.56	4.40	3.99	3.61	3.36	4.32	3.83	3.20	2.18
61	5.82	5.43	3.15	5.42	5.18	4.61	4.12	3.78	5.09	4.46	3.66	2.41

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
62	5.65	5.28	2.89	5.31	5.08	4.44	3.90	3.50	4.99	4.32	3.44	2.11
63	3.93	3.88	2.33	4.02	3.88	3.44	3.03	2.73	3.85	3.31	2.65	1.63
64	4.3	4.26	2.86	4.41	4.24	3.94	3.62	3.40	4.18	3.76	3.23	2.40
65	5.41	5.17	3.19	5.26	5.05	4.61	4.22	3.95	4.97	4.42	3.73	2.67
66	5.26	5.10	3.01	5.06	4.93	4.38	3.92	3.59	4.84	4.25	3.48	2.32
67	3.92	4.08	2.58	4.10	4.02	3.60	3.22	2.96	3.94	3.48	2.86	1.93
68	3.97	4.10	2.84	4.19	4.09	3.80	3.47	3.25	4.02	3.63	3.12	2.35
69	4.95	4.83	3.10	4.87	4.72	4.36	3.96	3.70	4.65	4.16	3.53	2.57
70	4.87	4.87	3.07	4.87	4.71	4.28	3.88	3.61	4.66	4.14	3.48	2.49
71	4.01	4.24	2.80	4.32	4.22	3.85	3.48	3.25	4.16	3.70	3.13	2.25
72	3.72	3.86	2.67	3.98	3.90	3.62	3.27	3.06	3.84	3.43	2.93	2.17
73	4.26	4.26	2.88	4.33	4.21	3.91	3.57	3.35	4.16	3.73	3.19	2.39
74	4.33	4.56	2.91	4.48	4.36	3.97	3.64	3.40	4.29	3.83	3.24	2.33
75	3.82	4.13	2.74	4.09	4.03	3.67	3.35	3.16	3.94	3.53	2.99	2.18
76	3.78	3.90	2.64	4.05	4.01	3.72	3.41	3.23	3.93	3.55	3.04	2.30
77	4.23	4.20	2.75	4.28	4.20	3.88	3.54	3.33	4.14	3.72	3.16	2.34
78	3.79	4.02	2.70	4.13	4.01	3.73	3.45	3.26	3.98	3.60	3.08	2.30
79	3.74	3.98	2.69	4.13	4.01	3.74	3.47	3.28	3.97	3.60	3.09	2.30
80	3.27	3.52	2.31	3.56	3.54	3.30	3.00	2.80	3.48	3.11	2.63	1.89
81	3.06	3.39	2.29	3.44	3.42	3.20	2.93	2.74	3.37	3.02	2.58	1.91
82	3.67	3.98	2.76	4.14	4.00	3.73	3.47	3.29	3.94	3.55	3.07	2.35
83	3.62	4.05	2.73	4.17	4.03	3.75	3.47	3.29	3.98	3.57	3.07	2.32
84	3.43	3.60	2.43	3.69	3.62	3.36	3.09	2.90	3.57	3.20	2.72	2.00
85	3.05	3.27	2.24	3.28	3.23	2.98	2.72	2.54	3.17	2.84	2.42	1.80
86	3.29	3.78	2.67	3.78	3.73	3.51	3.28	3.15	3.67	3.35	2.96	2.38
87	3.85	4.23	2.91	4.29	4.23	3.98	3.73	3.61	4.17	3.79	3.32	2.58
88	3.17	3.52	2.36	3.57	3.54	3.28	3.02	2.84	3.48	3.12	2.67	1.94
89	2.58	2.92	2.10	3.02	3.00	2.79	2.55	2.40	2.95	2.65	2.29	1.72
90	3.24	3.59	2.65	3.74	3.66	3.47	3.25	3.13	3.61	3.31	2.95	2.37
91	3.81	4.07	2.85	4.20	4.09	3.87	3.64	3.60	4.04	3.70	3.27	2.58
92	3.38	3.67	2.50	3.73	3.69	3.44	3.17	2.97	3.64	3.27	2.80	2.08

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
93	2.49	2.89	2.11	2.98	3.00	2.78	2.54	2.37	2.94	2.65	2.27	1.71
94	3.14	3.50	2.67	3.63	3.58	3.41	3.19	3.07	3.53	3.27	2.88	2.23
95	3.91	4.23	3.03	4.35	4.24	4.04	3.79	3.65	4.19	3.86	3.38	2.57
96	3.54	3.83	2.67	3.94	3.89	3.65	3.37	3.19	3.83	3.45	2.98	2.25
97	2.64	2.98	2.19	3.13	3.12	2.91	2.63	2.48	3.08	2.76	2.36	1.79
98	3	3.41	2.59	3.55	3.49	3.32	3.11	2.99	3.46	3.21	2.87	2.39
99	4.13	4.44	3.12	4.53	4.41	4.18	3.96	3.87	4.37	4.02	3.57	2.87
100	3.77	4.01	2.75	4.12	4.05	3.74	3.45	3.26	3.99	3.57	3.09	2.30
101	2.65	3.00	2.26	3.17	3.15	2.89	2.64	2.50	3.10	2.77	2.42	1.85
102	3.04	3.42	2.62	3.56	3.50	3.30	3.11	2.92	3.46	3.18	2.86	2.37
103	4.37	4.60	3.20	4.68	4.56	4.29	4.03	3.88	4.51	4.12	3.64	2.89
104	4.09	4.29	2.87	4.35	4.27	3.96	3.65	3.43	4.22	3.77	3.25	2.39
105	2.82	3.15	2.31	3.27	3.24	3.01	2.74	2.58	3.20	2.86	2.49	1.87
106	3.41	3.57	2.71	3.67	3.61	3.43	3.19	3.07	3.57	3.27	2.94	2.40
107	4.72	4.76	3.29	4.79	4.69	4.41	4.14	3.97	4.60	4.21	3.74	2.96
108	4.5	4.49	2.95	4.54	4.48	4.08	3.73	3.49	4.39	3.91	3.31	2.38
109	3.13	3.30	2.38	3.42	3.41	3.10	2.80	2.61	3.40	2.98	2.53	1.85
110	3.57	3.72	2.82	3.82	3.77	3.56	3.30	3.16	3.72	3.40	3.04	2.46
111	4.97	4.94	3.40	4.97	4.86	4.54	4.23	4.03	4.68	4.33	3.81	2.97
112	4.56	4.68	3.07	4.69	4.58	4.17	3.84	3.61	4.50	4.00	3.41	2.50
113	3.27	3.55	2.51	3.61	3.58	3.27	2.96	2.77	3.54	3.14	2.68	1.99
114	3.68	3.85	2.84	4.00	3.95	3.69	3.38	3.19	3.91	3.54	3.11	2.42
115	5.2	5.22	3.47	5.21	5.06	4.71	4.36	4.14	5.00	4.51	3.93	3.02
116	4.92	4.95	3.08	4.89	4.77	4.30	3.87	3.57	4.70	4.13	3.44	2.36
117	3.65	3.73	2.59	3.81	3.78	3.41	3.05	2.84	3.71	3.27	2.74	1.90
118	3.69	3.89	2.86	4.04	3.95	3.69	3.41	3.25	3.90	3.55	3.13	2.48
119	5.44	5.28	3.46	5.32	5.15	4.76	4.42	4.19	5.07	4.57	3.95	3.00
120	4.9	4.76	2.93	4.78	4.62	4.11	3.69	3.36	4.55	4.01	3.31	2.23
121	3.96	4.06	2.66	4.10	4.01	3.62	3.27	3.01	3.94	3.50	2.93	2.03
122	3.98	4.14	2.77	4.20	4.06	3.74	3.42	3.22	4.02	3.60	3.08	2.27
123	4.93	4.91	3.09	4.97	4.77	4.34	3.94	3.66	4.73	4.20	3.55	2.55

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
124	5.04	4.91	2.96	4.94	4.76	4.22	3.77	3.42	4.70	4.12	3.38	2.23
125	3.9	4.01	2.60	4.09	3.99	3.57	3.17	2.92	3.92	3.46	2.87	1.93
126	3.97	4.14	2.81	4.24	4.12	3.82	3.47	3.28	4.08	3.67	3.12	2.32
127	4.98	5.00	3.16	5.03	4.83	4.42	4.02	3.75	4.80	4.29	3.60	2.63
128	4.98	4.85	2.90	4.89	4.72	4.18	3.72	3.39	4.64	4.05	3.30	2.16
129	3.93	3.97	2.58	4.12	4.01	3.57	3.19	2.93	3.94	3.46	2.85	1.89
130	4	4.18	2.86	4.30	4.19	3.87	3.55	3.32	4.14	3.71	3.15	2.31
131	4.69	4.76	3.08	4.83	4.66	4.29	3.90	3.64	4.63	4.12	3.46	2.49
132	4.99	4.88	3.08	4.99	4.80	4.33	3.91	3.63	4.74	4.18	3.46	2.39
133	4.2	4.30	2.84	4.49	4.35	3.92	3.54	3.32	4.27	3.78	3.15	2.18
134	3.96	4.09	2.84	4.22	4.11	3.83	3.51	3.34	4.06	3.64	3.12	2.30
135	4.37	4.37	2.93	4.45	4.30	3.99	3.64	3.43	4.27	3.80	3.23	2.36
136	4.73	4.79	3.18	4.92	4.73	4.32	3.95	3.71	4.68	4.16	3.52	2.54
137	4.42	4.67	3.12	4.82	4.64	4.24	3.87	3.64	4.59	4.09	3.46	2.48
138	4.05	4.29	2.88	4.37	4.27	3.96	3.59	3.37	4.22	3.77	3.18	2.30
139	4.08	4.14	2.81	4.20	4.11	3.81	3.47	3.24	4.06	3.63	3.07	2.24
140	4.62	4.65	3.18	4.84	4.65	4.27	3.93	3.69	4.59	4.12	3.51	2.62
141	4.88	4.89	3.31	5.05	4.85	4.43	4.08	3.87	4.65	4.29	3.66	2.73
142	4.09	4.26	2.84	4.32	4.23	3.88	3.55	3.33	4.16	3.72	3.15	2.28
143	3.98	4.18	2.78	4.23	4.15	3.82	3.47	3.24	4.12	3.66	3.07	2.23
144	4.36	4.43	2.96	4.51	4.41	4.01	3.63	xxx	4.36	3.85	3.22	2.37
145	4.9	4.92	3.17	4.98	4.87	4.41	4.01	xxx	4.78	4.24	3.56	2.59
146	xxx	4.32	2.67	4.36	4.28	3.88	3.48	3.21	4.19	3.68	3.02	2.02
147	xxx	3.71	2.46	3.82	3.76	3.43	3.08	2.85	3.67	3.24	2.68	1.84
148	4.36	4.32	2.93	4.46	4.35	3.99	3.64	xxx	4.27	3.81	3.21	2.34
149	5.28	5.20	3.25	5.23	5.21	4.61	4.19	xxx	4.99	4.42	3.69	2.62
150	4.72	4.63	2.74	4.58	4.48	4.03	3.60	3.30	4.39	3.83	3.11	2.02
151	3.67	3.64	2.35	3.68	3.65	3.32	2.95	2.70	3.58	3.14	2.55	1.68
152	4.57	4.55	xxx	4.66	4.49	4.20	3.87	3.69	4.47	4.02	3.45	2.58
153	5.54	5.45	3.50	5.55	5.35	4.87	4.48	4.24	5.23	4.68	3.98	2.88
154	5.22	4.86	2.97	4.91	4.77	4.28	3.84	3.53	4.67	4.08	3.36	2.27

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
155	3.59	3.47	2.38	3.61	3.54	3.20	2.84	2.62	3.47	3.04	2.52	1.73
156	4.15	xxx	2.99	4.37	4.25	3.88	3.67	3.50	4.21	3.81	3.35	2.60
157	5.92	xxx	3.66	5.85	5.62	5.08	4.78	4.54	xxx	4.98	4.28	3.19
158	xxx	5.15	3.02	5.11	4.95	4.33	3.84	3.48	4.87	4.22	3.40	2.20
159	xxx	3.40	2.26	3.47	3.42	3.00	2.58	2.33	3.34	2.91	2.35	1.55
160	xxx	4.23	3.12	4.41	4.28	xxx	3.68	3.51	4.21	3.85	3.20	2.71
161	5.93	5.73	3.76	5.80	5.59	xxx	4.76	4.51	5.50	4.96	4.28	3.23
162	5.32	5.09	3.18	5.16	4.99	4.45	3.99	3.68	4.89	4.31	3.55	2.42
163	4.17	4.14	2.79	4.29	4.18	3.76	3.35	3.09	4.09	3.62	3.01	2.09
164	4.46	4.41	3.09	4.54	4.41	4.06	3.72	3.51	4.35	3.91	3.38	2.57
165	5.84	5.52	3.53	5.51	5.31	4.82	4.42	4.14	5.24	4.67	3.97	2.93
166	5.48	5.36	3.28	5.38	5.18	4.60	4.15	3.81	5.09	4.49	3.69	2.51
167	4.25	4.29	2.85	4.44	4.31	3.87	3.47	3.20	4.22	3.76	3.11	2.14
168	xxx	4.56	3.17	4.73	4.63	4.22	3.85	3.55	4.52	4.08	3.49	2.61
169	xxx	5.42	3.53	5.52	5.36	4.84	4.43	4.16	5.24	4.69	3.98	2.93
170	xxx	5.06	3.18	5.13	4.96	4.47	4.03	3.75	4.86	4.30	3.57	2.47
171	4.28	4.26	2.87	4.41	4.29	3.92	3.53	3.29	4.23	3.76	3.15	2.21
172	4.64	4.52	3.11	4.65	4.49	4.15	3.76	3.52	4.44	3.97	3.38	2.51
173	5.48	5.23	3.39	5.29	5.11	4.67	4.23	3.95	5.01	4.47	3.78	2.77
174	5.24	5.02	3.20	5.07	4.92	4.40	3.98	3.71	4.82	4.26	3.55	2.46
175	4.21	4.21	2.85	4.32	4.21	3.80	3.44	3.21	4.25	3.67	3.08	2.15
176	4.33	4.31	2.97	4.36	4.24	3.94	3.59	3.37	4.18	3.75	3.16	2.36
177	5.16	4.92	3.25	4.97	4.83	4.44	4.03	3.79	4.74	4.24	3.60	2.63
178	5.08	4.97	3.20	4.99	4.91	4.44	4.00	3.74	4.82	4.26	3.56	2.52
179	4.12	4.21	2.87	4.30	4.24	3.85	3.46	3.23	4.18	3.70	3.10	2.19
180	4.11	4.14	2.95	4.27	4.18	3.88	3.53	3.32	4.11	3.70	3.18	2.35
181	4.74	4.65	3.19	4.74	4.63	4.29	3.92	3.69	4.55	4.09	3.50	2.59
182	4.5	4.45	3.01	4.57	4.46	4.08	3.73	3.50	4.39	3.90	3.30	2.39
183	3.91	4.00	2.80	4.16	4.16	3.70	3.38	3.18	3.32	3.54	3.01	2.19
184	3.79	3.85	2.73	3.98	3.87	3.59	3.27	3.08	3.83	3.42	2.92	2.16
185	4.04	4.06	2.85	4.16	4.07	3.79	3.47	3.27	4.01	3.60	3.08	2.30

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
186	4.28	4.47	3.11	4.60	4.48	4.13	3.80	3.59	4.41	3.94	3.35	2.44
187	4.08	4.33	3.00	4.46	4.33	3.98	3.64	3.43	4.23	3.81	3.23	2.34
188	3.49	3.63	2.56	3.73	3.65	3.39	3.07	2.88	3.60	3.20	2.70	1.92
189	3.6	3.71	2.65	3.80	3.74	3.49	3.20	3.03	3.67	3.29	2.81	2.06
190	3.83	4.00	2.79	4.06	4.03	3.71	3.39	3.19	3.93	3.50	2.95	2.10
191	3.76	4.08	2.81	4.05	4.01	3.68	3.36	3.16	3.92	3.49	2.95	2.11
192	xxx	3.79	2.59	3.78	3.77	3.47	3.17	2.96	3.68	3.27	2.74	1.97
193	xxx	3.64	2.49	3.66	3.69	3.38	3.05	2.83	3.61	3.19	2.64	1.84
194	xxx	3.88	2.76	3.96	3.94	3.70	3.43	3.26	3.88	3.50	3.03	2.30
195	xxx	4.17	2.89	4.20	4.15	3.90	3.62	3.44	4.08	3.68	3.16	2.39
196	3.22	3.56	2.30	3.42	3.35	3.10	2.85	2.70	3.30	2.99	2.54	1.81
197	2.83	3.29	2.23	3.24	3.18	2.98	2.75	2.62	3.13	2.86	2.47	1.81
198	3.4	3.63	2.58	3.79	3.73	3.49	3.22	3.06	3.67	3.29	2.80	2.09
199	3.67	3.80	2.66	3.88	3.81	3.54	3.27	3.10	3.75	3.35	2.85	2.11
200	3.08	3.25	2.24	3.29	3.25	2.99	2.76	2.61	3.19	2.90	2.48	1.76
201	2.48	2.82	2.06	2.94	2.93	2.71	2.49	2.36	2.86	2.64	2.27	1.64
202	3.01	3.40	2.55	3.57	3.52	3.33	3.10	2.98	3.43	3.16	2.77	2.14
203	3.58	3.92	2.75	4.03	3.95	3.73	3.48	3.34	3.89	3.54	xxx	2.30
204	3.2	3.48	2.40	3.53	3.47	3.22	2.97	2.83	3.44	3.13	xxx	1.91
205	2.24	2.69	2.00	2.82	2.80	2.59	2.35	2.23	2.76	2.53	xxx	1.59
206	2.8	3.24	2.44	3.34	3.34	3.16	2.94	2.81	3.26	3.02	xxx	2.12
207	3.77	4.07	2.87	4.14	4.10	3.87	3.65	3.52	4.02	3.69	xxx	2.49
208	3.37	3.63	2.48	3.71	3.68	3.44	3.16	2.99	3.62	3.27	xxx	1.96
209	2.42	2.78	2.04	2.91	2.88	2.69	2.40	2.24	2.83	2.57	xxx	1.55
210	2.86	3.33	2.58	3.50	3.43	3.28	3.07	2.96	3.36	3.14	xxx	2.31
211	3.79	4.12	2.95	4.23	4.15	3.95	3.73	3.68	4.08	3.76	xxx	2.61
212	3.67	3.92	2.74	4.00	3.94	3.70	3.43	3.26	3.89	3.55	xxx	2.28
213	2.56	2.94	2.19	3.07	3.07	2.86	2.59	2.42	3.02	2.77	xxx	1.76
214	3.02	3.42	2.67	3.55	3.53	3.37	3.15	3.02	3.47	3.26	xxx	2.41
215	4.21	4.50	3.24	4.58	4.49	4.27	4.04	3.91	4.45	4.11	xxx	2.93
216	3.95	4.18	2.87	4.27	4.20	3.86	3.55	3.36	4.16	3.72	xxx	2.34

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
217	2.76	3.13	2.34	3.31	3.28	2.99	2.71	2.54	3.22	2.90	xxx	1.87
218	3.23	3.52	2.71	3.63	3.60	3.41	3.18	3.01	3.53	3.29	xxx	2.39
219	4.72	4.80	3.35	4.81	4.73	4.45	4.18	3.99	4.64	4.26	xxx	2.95
220	4.42	4.48	2.97	4.49	4.42	4.03	3.70	3.44	4.35	3.86	xxx	2.34
221	3.21	3.49	2.53	3.57	3.54	3.23	2.94	2.74	3.49	3.12	xxx	1.94
222	3.74	3.80	2.81	4.01	3.91	3.63	3.34	2.78	3.83	3.46	xxx	2.37
223	5.05	4.90	3.33	5.02	4.87	4.50	4.17	3.99	4.77	4.28	xxx	2.86
224	4.84	4.83	3.14	4.85	4.74	4.29	3.91	3.65	4.66	4.12	xxx	2.42
225	3.6	3.75	2.64	3.86	3.83	3.46	3.10	2.87	3.75	3.32	xxx	1.95
226	3.89	4.10	3.06	4.24	4.21	3.89	3.64	3.39	4.12	3.75	xxx	2.63
227	5.23	5.21	3.53	5.27	5.14	4.72	4.42	4.19	5.05	4.55	xxx	3.04
228	5.07	4.96	3.20	5.04	4.88	4.39	3.97	3.69	4.79	4.22	xxx	2.49
229	4	4.09	2.86	4.24	4.13	3.74	3.37	3.15	4.06	3.60	xxx	2.19
230	4.36	4.41	2.96	4.55	4.44	4.07	3.72	3.01	4.35	3.91	xxx	2.54
231	5.41	5.25	3.33	5.32	5.17	4.70	4.31	4.03	5.05	4.51	3.87	2.86
232	5.24	5.11	3.29	5.21	5.04	4.56	4.13	xxx	4.95	4.38	3.69	2.58
233	4.64	4.56	3.04	4.68	4.54	4.13	3.73	xxx	4.46	3.97	3.34	2.34
234	4.44	4.45	3.02	4.59	4.45	4.09	3.71	xxx	4.37	3.93	3.36	2.49
235	5.4	5.30	3.38	5.37	5.20	4.73	4.30	xxx	5.11	4.56	3.87	2.83
236	5.4	5.19	3.16	5.23	5.05	4.51	4.04	xxx	4.96	4.35	3.58	2.38
237	4.78	4.65	2.96	4.76	4.60	4.15	3.73	3.46	4.52	3.98	3.30	2.23
238	4.53	4.63	2.97	4.61	4.46	4.06	3.70	3.46	4.38	3.90	3.31	2.36
239	5.14	5.16	3.21	5.10	4.92	4.45	4.05	4.02	4.83	4.29	3.63	2.56
240	5.51	5.21	3.18	5.28	5.09	4.52	4.05	3.71	4.99	4.39	3.60	2.40
241	4.92	4.67	2.95	4.79	4.63	4.14	3.71	3.44	4.52	3.99	3.29	2.21
242	4.63	4.57	2.98	4.67	4.52	4.11	3.71	3.44	4.43	3.93	3.31	2.37
243	4.7	4.69	3.03	4.78	4.64	4.20	3.80	3.78	4.55	4.03	3.38	2.41
244	5.3	5.06	3.25	5.18	5.01	4.51	4.08	3.71	4.91	4.35	3.63	2.52
245	5.04	4.90	3.17	5.05	4.87	4.40	3.96	3.41	4.78	4.23	3.53	2.44
246	4.67	4.61	3.04	4.71	4.58	4.20	3.80	3.38	4.49	3.99	3.38	2.42
247	4.56	4.38	2.93	4.49	4.36	4.01	3.63	3.53	4.29	3.81	3.23	2.32

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
248	5.1	4.72	3.22	4.88	4.73	4.34	3.97	3.77	4.66	4.17	3.55	2.64
249	5.21	4.91	3.27	5.04	4.84	4.49	4.09	3.66	4.82	4.31	3.65	2.67
250	4.53	4.55	3.06	4.62	4.48	4.20	3.81	3.54	4.46	3.99	3.41	2.48
251	3.99	4.22	2.88	4.25	4.15	3.85	3.49	3.37	4.08	3.67	3.15	2.32
252	4.44	4.65	3.24	4.76	4.59	xxx	3.91	3.72	4.52	4.09	3.56	2.72
253	5	5.07	3.47	5.27	5.12	xxx	4.33	3.84	5.02	4.51	3.91	2.93
254	4.28	4.32	2.90	4.42	4.34	4.00	3.63	3.56	4.26	3.77	3.23	2.32
255	3.6	3.75	2.66	3.86	3.80	3.53	3.20	3.28	3.74	3.33	2.87	2.11
256	4.07	4.24	3.05	4.41	4.31	4.00	3.68	3.69	4.25	3.85	3.34	2.56
257	4.79	4.82	3.29	4.93	xxx	4.43	4.09	4.11	4.74	4.26	3.66	2.77
258	4.33	4.44	2.96	4.47	4.41	4.05	3.69	3.40	4.34	3.86	3.29	2.40
259	3.38	3.66	2.58	3.71	3.68	3.40	3.06	2.99	3.62	3.23	2.78	2.04
260	3.87	4.13	3.02	4.30	4.18	3.92	3.61	3.49	4.12	3.75	3.30	2.61
261	4.87	4.92	3.42	5.07	4.92	4.58	4.25	xxx	4.85	4.39	3.82	2.97
262	4.35	4.37	2.90	4.41	4.35	4.00	3.65	xxx	4.27	3.80	3.24	2.37
263	3.24	3.50	2.50	3.61	3.59	3.31	2.99	2.80	3.52	3.15	2.71	2.01
264	3.93	4.13	3.05	4.32	4.22	3.91	3.64	3.45	4.16	3.78	3.30	2.64
265	5	5.04	3.45	5.16	5.03	4.65	4.33	4.11	4.28	4.48	3.91	3.02
266	4.5	4.57	3.04	4.61	4.54	4.19	3.82	3.58	4.47	3.98	3.39	2.47
267	3.31	3.54	2.55	3.66	3.63	3.35	3.02	2.81	3.57	3.18	2.72	1.99
268	4.09	4.23	3.16	4.39	4.32	3.85	3.74	3.55	4.26	3.88	3.45	2.74
269	5.21	5.19	3.59	5.30	5.16	4.61	4.26	4.24	4.37	4.61	4.05	3.14
270	4.81	4.68	3.15	4.74	4.64	4.26	3.65	3.65	4.55	4.06	3.48	2.55
271	3.76	3.89	2.77	3.97	3.92	3.62	3.07	3.06	3.88	3.44	2.97	2.19
272	4.31	4.41	3.22	4.57	4.47	3.97	xxx	3.62	4.44	4.01	3.54	2.76
273	5.53	5.35	3.71	5.47	5.29	4.74	xxx	4.36	4.65	4.71	4.12	3.20
274	xxx	4.96	3.17	5.10	4.90	4.45	xxx	3.67	4.78	4.24	3.53	2.47
275	xxx	4.19	2.84	4.38	4.24	3.83	xxx	3.12	4.16	3.67	3.07	2.17
276	xxx	4.48	3.17	4.67	4.54	4.12	xxx	3.63	4.48	4.05	3.53	2.75
277	xxx	5.28	3.49	5.37	5.21	4.70	xxx	4.15	5.11	4.61	3.98	3.02
278	5.07	4.80	3.09	4.88	4.74	4.32	xxx	3.64	4.65	4.15	3.51	2.50

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
279	4.36	4.24	2.88	4.37	4.24	3.90	xxx	3.30	4.19	3.75	3.19	2.32
280	4.33	4.35	3.02	4.49	4.33	4.03	xxx	3.47	4.29	3.86	3.34	2.55
281	5.21	5.21	3.38	5.30	5.11	4.70	xxx	4.03	5.04	4.52	3.88	2.89
282	4.93	4.82	3.00	4.86	4.72	4.27	xxx	3.52	4.63	4.08	3.39	2.31
283	4.09	4.17	2.77	4.28	4.18	3.83	xxx	3.20	4.11	3.65	3.07	2.15
284	4.42	4.33	2.88	4.43	4.28	3.95	xxx	3.34	4.21	3.76	3.20	2.30
285	5.04	4.82	3.08	4.87	4.70	4.30	xxx	3.62	4.61	4.10	3.47	2.48
286	4.93	4.82	3.04	4.91	4.76	4.31	xxx	3.59	4.67	4.13	3.43	2.33
287	4.35	4.33	2.83	4.43	4.31	3.94	xxx	3.28	4.23	3.76	3.14	2.14
288	4.3	4.33	2.88	4.41	4.29	3.96	xxx	3.35	4.22	3.76	3.18	2.29
289	4.72	4.70	3.03	4.77	4.64	4.25	xxx	3.59	4.57	4.05	3.40	2.43
290	4.63	4.62	2.98	4.69	4.58	4.18	xxx	3.52	4.50	3.99	3.33	2.33
291	4.22	4.33	2.86	4.43	4.33	3.98	xxx	3.38	4.24	3.78	3.18	2.24
292	4.39	4.19	2.74	4.24	4.14	3.83	xxx	3.17	4.05	3.58	3.00	2.09
293	4.43	4.24	2.77	4.27	4.18	3.86	xxx	3.22	4.10	3.62	3.02	2.13
294	4.47	4.49	2.98	4.53	4.47	4.10	xxx	3.50	4.39	3.90	3.28	2.36
295	3.96	4.13	2.80	4.21	4.16	3.83	xxx	3.25	4.06	3.64	3.06	2.19
296	3.98	3.97	2.76	3.99	3.94	3.71	xxx	3.15	3.87	3.48	2.97	2.20
297	3.93	3.89	2.72	3.92	3.87	3.64	xxx	3.10	3.80	3.41	2.92	2.16
298	4.16	4.22	2.97	4.25	4.19	3.92	xxx	3.43	4.12	3.71	3.23	2.47
299	4.15	4.23	2.97	4.31	4.23	3.96	xxx	3.46	4.19	3.75	3.26	2.46
300	3.86	3.89	2.75	3.98	3.92	3.67	xxx	3.13	3.86	3.44	2.98	2.21
301	3.33	3.42	2.47	3.46	3.46	3.23	xxx	2.71	3.47	3.01	2.60	1.96
302	3.67	4.30	3.07	4.22	4.21	xxx	xxx	3.55	4.15	3.80	3.37	2.73
303	3.9	4.30	3.04	4.24	4.20	xxx	xxx	3.52	4.14	3.77	3.31	2.60
304	3.31	3.58	2.72	3.72	3.68	3.47	xxx	3.05	3.63	3.32	2.95	2.34
305	3.33	3.75	2.78	3.83	3.79	3.56	xxx	3.13	3.73	3.41	3.04	2.40
306	3.11	3.46	2.56	3.55	3.53	3.30	xxx	2.88	3.46	3.16	2.81	2.22
307	3.47	3.78	2.82	3.93	3.91	3.70	xxx	3.41	3.84	3.53	3.15	2.52
308	3.19	3.46	2.51	3.57	3.54	3.32	xxx	2.89	3.47	3.12	2.73	2.07
309	2.53	2.84	2.17	2.96	2.95	2.76	xxx	2.35	2.91	2.61	2.30	1.78

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
310	2.83	3.21	2.49	3.37	3.36	3.18	xxx	2.84	3.31	3.05	2.76	2.25
311	3.42	3.82	2.82	3.95	3.92	3.72	xxx	3.36	3.81	3.55	3.18	2.53
312	3.02	3.31	2.38	3.37	3.36	3.16	xxx	2.73	3.31	2.99	2.59	1.94
313	2.23	2.63	1.95	2.65	2.67	2.51	xxx	2.12	2.64	2.37	2.08	1.60
314	2.8	3.30	2.54	3.44	3.38	3.25	xxx	2.95	3.35	3.10	2.85	2.37
315	3.56	3.97	2.96	4.17	4.07	3.90	xxx	3.58	4.03	3.73	3.37	2.71
316	2.95	3.31	2.38	3.41	3.39	3.20	xxx	2.83	3.35	3.04	2.67	2.06
317	2.2	2.42	1.83	2.53	2.56	2.42	xxx	2.02	2.51	2.28	2.01	1.57
318	2.47	2.82	2.27	3.00	2.99	2.89	xxx	2.63	2.95	2.80	2.61	2.21
319	3.65	3.95	2.91	4.05	3.98	3.80	3.63	3.54	3.94	3.66	3.35	2.74
320	3.13	3.46	2.42	3.54	3.47	3.26	3.01	2.87	3.43	3.09	2.71	2.05
321	2.21	2.64	2.03	2.77	2.73	2.57	2.37	2.25	2.70	2.46	2.19	1.72
322	2.69	3.05	2.37	3.20	3.19	3.04	2.89	2.76	3.15	2.93	2.66	2.14
323	3.85	4.05	2.89	4.13	4.09	3.88	3.69	3.55	4.04	3.73	3.33	2.62
324	3.54	3.75	2.54	3.82	3.76	3.50	3.20	3.01	3.70	3.30	2.84	2.06
325	2.53	2.87	2.13	3.01	2.97	2.77	2.51	2.36	2.92	2.62	2.28	1.70
326	2.96	3.30	2.53	3.45	3.40	3.22	3.02	2.89	3.36	3.09	2.78	2.24
327	4.06	4.32	3.01	4.42	4.34	4.08	3.82	3.68	4.28	3.89	3.44	2.68
328	3.88	4.05	2.69	4.13	4.07	3.77	3.43	3.21	3.99	3.54	3.03	2.15
329	2.93	3.24	2.29	3.32	3.30	3.07	2.75	2.55	3.23	2.87	2.47	1.76
330	3.36	3.69	2.71	3.73	3.68	3.47	3.22	3.06	3.64	3.31	2.95	2.35
331	4.59	4.74	xxx	4.76	4.65	4.33	4.04	3.88	4.59	4.14	3.64	2.81
332	4.48	4.46	2.82	4.49	4.41	4.00	3.59	3.31	4.32	3.78	3.17	2.14
333	3.42	3.50	2.43	3.61	3.57	3.26	2.92	2.69	3.50	3.07	2.61	1.81
334	4.07	4.04	2.94	4.17	4.09	3.84	3.56	3.37	4.02	3.63	3.21	2.47
335	5.38	5.15	3.38	5.18	5.04	4.65	4.28	4.03	4.91	4.42	3.82	2.83
336	5.07	4.96	3.12	5.01	4.84	4.34	3.90	3.60	4.74	4.18	3.48	2.34
337	xxx	3.93	2.69	4.07	3.96	3.57	3.19	2.94	3.88	3.43	2.87	1.96
338	xxx	4.47	xxx	4.60	4.49	4.16	3.86	3.65	4.39	3.99	3.50	2.70
339	5.53	5.23	xxx	5.29	5.12	4.71	4.35	4.11	5.00	4.51	3.91	2.91
340	5.34	5.19	3.27	5.28	5.12	4.64	4.20	3.89	5.03	4.46	3.76	2.67

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
341	4.55	4.54	2.99	4.69	4.55	4.15	3.75	3.47	4.46	3.98	3.38	2.43
342	4.59	4.70	3.29	4.89	4.72	4.26	4.01	3.76	4.65	4.22	3.67	2.79
343	5.96	5.78	3.67	5.86	5.62	5.01	4.68	4.39	5.55	4.98	4.25	3.14
344	5.51	5.23	3.16	5.28	5.08	4.55	4.05	3.70	4.98	4.37	3.60	2.41
345	4.97	4.83	3.05	4.92	4.78	4.32	3.88	3.56	4.68	4.13	3.45	2.37
346	5.12	4.97	3.16	5.06	4.89	4.41	3.99	3.69	4.79	4.25	3.56	2.50
347	5.62	5.41	3.32	5.47	5.24	4.70	4.22	3.90	5.15	4.56	3.80	2.64
348	5.61	5.27	3.13	5.31	5.11	4.55	4.02	3.66	5.00	4.39	3.58	2.32
349	5.46	5.14	3.12	5.19	5.03	4.49	4.00	xxx	4.90	4.33	3.55	2.35
350	5.26	5.01	3.01	5.08	4.87	4.35	3.86	xxx	4.76	4.18	3.41	2.22
351	5.25	5.03	3.01	5.10	4.89	4.36	3.87	xxx	4.80	4.20	3.44	2.24
352	5.43	5.16	3.07	5.21	5.02	4.43	3.93	xxx	4.92	4.31	3.52	2.26
353	5.5	5.19	3.11	5.24	5.04	4.46	3.96	xxx	4.93	4.33	3.54	2.28
354	5.33	5.01	2.99	5.05	4.86	4.31	3.82	xxx	4.75	4.16	3.39	2.17
355	4.7	4.53	2.78	4.61	4.46	3.97	3.52	xxx	4.35	3.82	3.11	2.01
356	5.35	5.28	3.23	5.14	5.01	4.48	4.06	xxx	4.92	4.36	3.63	2.52
357	5.82	5.58	3.32	5.39	5.25	4.67	4.20	xxx	5.15	4.55	3.76	2.55
358	5.08	4.83	2.95	4.90	4.73	4.25	3.77	xxx	4.62	4.09	3.35	2.21
359	4.48	4.36	2.76	4.44	4.30	3.91	3.48	xxx	4.20	3.73	3.07	2.06
360	4.64	4.65	3.05	4.73	4.60	4.18	3.80	xxx	4.52	4.04	3.40	2.44
361	5.37	5.15	3.27	5.23	5.06	4.56	4.13	xxx	4.97	4.43	3.70	2.61
362	4.77	4.58	2.81	4.62	4.49	4.08	3.63	xxx	4.40	3.90	3.19	2.13
363	3.95	4.11	2.55	4.04	3.95	3.64	3.25	xxx	3.88	3.45	2.84	1.93
364	4.36	4.50	2.91	4.47	4.34	3.98	3.63	xxx	4.28	3.83	3.24	2.34
365	4.91	4.82	3.11	4.92	4.78	4.35	3.97	xxx	4.70	4.19	3.54	2.51
366	4.3	4.32	2.73	4.37	4.27	3.91	3.52	xxx	4.18	3.71	3.09	2.12
367	3.5	3.69	2.46	3.81	3.72	3.44	3.09	xxx	3.66	3.26	2.71	1.89
368	4.09	4.22	2.92	4.40	xxx	3.94	3.62	xxx	4.21	3.79	3.24	2.40
369	4.78	4.81	3.15	4.91	xxx	4.39	4.02	xxx	4.69	4.21	3.58	2.60
370	4.06	4.21	2.66	4.18	4.13	3.79	3.41	xxx	4.04	3.60	3.00	2.09
371	3.04	3.44	2.30	3.43	3.39	3.14	2.82	xxx	3.32	2.97	2.49	1.76

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
372	3.88	4.17	2.95	4.29	4.18	3.93	3.62	xxx	4.12	3.75	3.25	2.51
373	4.62	4.70	3.19	4.83	4.70	4.39	4.04	xxx	4.65	4.20	3.60	2.71
374	4.1	4.22	2.82	4.26	4.20	3.93	3.58	xxx	4.14	3.71	3.16	2.29
375	3.29	3.52	2.51	3.64	3.60	3.38	3.04	xxx	3.54	3.17	2.71	1.98
376	3.69	3.96	2.92	4.13	4.02	3.78	3.51	xxx	3.97	3.62	3.19	2.51
377	4.52	4.68	3.22	4.78	4.63	4.35	4.06	xxx	4.58	4.17	3.63	2.79
378	4.12	4.21	2.82	4.29	4.19	3.92	3.57	xxx	4.14	3.70	3.16	2.30
379	3.42	3.64	2.58	3.76	3.68	3.45	3.14	xxx	3.64	3.26	2.81	2.08
380	3.85	4.24	2.95	4.25	4.14	3.90	3.61	xxx	4.13	3.74	3.26	2.50
381	4.67	4.93	3.24	4.85	4.73	4.42	4.08	xxx	4.69	4.22	3.66	2.77
382	4.34	4.35	2.84	4.36	4.29	3.98	3.59	xxx	4.21	3.74	3.16	2.26
383	3.65	3.73	2.60	3.81	3.77	3.53	3.17	xxx	3.70	3.31	2.81	2.04
384	4.03	4.24	3.01	4.37	4.26	3.99	3.68	xxx	4.21	3.82	3.31	2.52
385	4.89	4.98	3.32	5.04	4.89	4.53	4.19	xxx	4.84	4.36	3.74	2.80
386	4.37	4.35	2.79	4.39	4.29	3.94	3.56	xxx	4.21	3.73	3.11	2.14
387	3.88	3.95	2.65	4.06	3.99	3.68	3.33	xxx	3.91	3.48	2.93	2.05
388	4.43	4.39	2.94	4.54	4.41	4.04	3.65	xxx	4.31	3.84	3.23	2.29
389	4.75	4.74	3.08	4.87	4.73	4.32	3.92	xxx	4.49	4.12	3.46	2.45
390	4.91	4.82	3.12	4.91	4.80	4.38	3.97	xxx	4.70	4.18	3.48	2.43
391	3.98	4.00	2.74	4.14	4.06	3.71	3.32	xxx	3.98	3.53	2.94	2.04
392	4.32	4.30	3.07	4.41	4.32	4.03	3.68	xxx	4.26	3.83	3.31	2.53
393	4.93	4.80	3.27	4.88	4.75	4.41	4.04	xxx	4.54	4.20	3.60	2.71
394	4.51	4.46	3.04	4.55	4.46	4.12	3.75	xxx	4.37	3.92	3.33	2.43
395	4.24	4.27	2.97	4.36	4.30	3.99	3.63	xxx	4.22	3.79	3.23	2.36
396	4.37	4.22	2.90	4.19	4.11	3.84	3.48	xxx	xxx	3.60	3.09	2.25
397	4.65	4.52	3.04	4.51	4.39	4.09	3.72	xxx	4.30	3.84	3.29	2.41
398	4.57	4.68	3.15	4.82	4.68	4.29	3.93	xxx	4.59	4.11	3.47	2.51
399	4.2	4.26	2.97	4.40	4.28	3.93	3.58	xxx	4.19	3.76	3.18	2.31
400	4.27	4.30	2.99	4.46	4.34	4.00	3.63	3.40	4.26	3.83	3.26	2.41
401	4.32	4.35	3.01	4.49	4.37	4.02	3.65	3.42	4.29	3.85	3.27	2.41
402	4	4.15	2.94	4.27	4.19	3.90	3.49	1.39	4.12	3.70	3.15	2.22

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
403	4.2	4.29	3.01	4.41	4.33	4.07	3.67	xxx	4.27	3.85	3.30	2.35
404	4.28	4.36	3.00	4.51	4.40	4.08	3.73	xxx	4.33	3.89	3.30	2.39
405	4.11	4.23	2.92	4.36	4.28	3.94	3.59	xxx	4.21	3.78	3.19	2.28
406	3.88	4.11	2.88	4.20	4.13	3.88	3.57	3.36	4.09	3.69	3.18	2.37
407	4.3	4.51	3.07	4.55	4.48	4.21	3.89	3.69	4.42	3.99	3.45	2.57
408	4.01	3.96	2.61	3.94	3.90	3.61	3.26	3.03	3.80	3.38	2.83	1.96
409	3.54	3.62	2.52	3.71	3.66	3.41	3.11	2.92	3.58	3.20	2.70	1.95
410	xxx	4.12	2.83	4.21	4.15	3.84	3.54	3.33	4.09	3.67	3.11	2.20
411	xxx	4.11	2.79	4.14	4.07	3.77	3.44	3.22	4.02	3.59	3.03	2.10
412	3.99	4.03	2.76	4.07	4.05	3.77	3.42	3.18	3.99	3.58	3.03	2.20
413	3.48	3.52	2.51	3.57	3.60	3.35	3.03	2.83	3.53	3.16	2.67	1.93
414	3.14	3.46	2.52	3.43	3.46	3.24	3.00	2.84	3.46	3.13	2.74	2.12
415	4.13	4.29	2.93	4.23	4.21	3.95	3.70	3.52	4.18	3.78	3.28	2.51
416	3.39	3.50	2.30	3.59	3.51	3.23	2.93	2.73	3.43	3.05	2.57	1.78
417	2.69	3.00	2.11	3.10	3.07	2.83	2.56	2.39	3.00	2.68	2.29	1.64
418	3.07	3.34	2.38	3.41	3.40	3.17	2.95	2.81	3.35	3.02	2.62	1.99
419	3.65	3.76	2.54	3.80	3.77	3.52	3.27	3.10	3.72	3.35	2.87	2.12
420	3.2	3.33	2.19	3.39	3.34	3.08	2.80	2.62	3.29	2.94	2.47	1.71
421	2.46	2.68	1.93	2.79	2.76	2.53	2.30	2.16	2.71	2.44	2.09	1.50
422	2.77	3.05	2.23	3.14	3.13	2.91	2.73	2.62	3.08	2.80	2.45	1.89
423	3.45	3.66	2.51	3.70	3.67	3.41	3.19	3.33	3.61	3.27	2.83	2.13
424	2.93	3.11	2.07	3.17	3.14	2.88	2.71	2.57	3.09	2.77	2.36	1.70
425	2.3	2.59	1.80	2.66	2.66	2.43	2.27	2.13	2.63	2.35	2.00	1.45
426	2.43	2.75	2.00	2.86	2.84	2.64	2.50	2.40	2.80	2.55	2.24	1.74
427	3.31	3.43	2.36	3.51	3.45	3.23	3.07	2.95	3.39	3.09	2.71	2.07
428	3.07	3.21	2.10	3.28	3.22	3.00	2.83	2.67	3.16	2.83	2.42	1.70
429	2.16	2.48	1.75	2.63	2.58	2.39	2.26	2.12	2.54	2.27	1.95	1.38
430	2.57	2.60	1.86	2.72	2.72	2.55	2.45	xxx	2.68	2.47	2.17	1.71
431	3.45	3.40	2.21	3.41	3.41	3.22	3.05	xxx	3.36	3.07	2.65	2.02
432	3.35	3.44	2.18	3.46	3.44	3.23	3.01	2.79	3.37	3.01	2.55	1.79
433	2.42	2.65	1.84	2.79	2.77	2.58	2.41	2.23	2.71	2.43	2.08	1.48

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
434	2.68	2.99	2.20	3.10	3.10	2.90	2.77	2.65	3.03	2.79	2.47	1.92
435	3.55	3.78	2.54	3.83	3.80	3.55	3.38	3.23	3.73	3.40	2.96	2.22
436	3.65	3.82	2.50	3.89	3.83	3.57	3.35	3.14	3.75	3.36	2.87	2.00
437	2.84	3.14	2.17	3.25	3.23	3.00	2.79	2.60	3.15	2.82	2.42	1.70
438	3.17	3.48	2.51	3.62	3.54	3.35	3.13	2.98	3.49	3.17	2.78	2.15
439	3.89	4.16	2.83	4.27	4.16	3.92	3.70	3.57	4.11	3.72	3.25	2.48
440	4.18	4.25	2.77	4.31	4.27	3.95	3.58	3.33	4.20	3.69	3.09	2.12
441	3.31	3.49	2.41	3.61	3.59	3.31	2.97	xxx	3.52	3.09	2.59	1.78
442	3.56	3.86	2.82	4.00	3.93	3.71	3.47	xxx	3.88	3.53	3.11	2.43
443	4.46	4.60	3.13	4.67	4.57	4.29	3.99	3.79	4.52	4.08	3.53	2.67
444	4.47	4.50	2.95	4.57	4.49	4.14	3.75	3.48	4.41	3.92	3.27	2.27
445	4.15	4.16	2.81	4.26	4.18	3.86	3.49	3.24	4.09	3.64	3.06	2.15
446	4.05	4.18	2.88	4.30	4.18	3.91	3.60	3.38	4.14	3.70	3.19	2.37
447	5.17	5.10	3.25	5.15	4.96	4.56	4.17	3.90	4.92	4.37	3.71	2.67
448	5.18	4.86	2.89	4.92	4.73	4.26	3.76	3.40	4.63	4.05	3.29	2.08
449	4.57	4.38	2.74	4.47	4.33	3.94	3.51	3.20	4.23	3.73	3.07	2.01
450	5.02	4.84	3.07	4.95	4.76	4.33	3.94	3.63	4.67	4.16	3.44	2.36
451	5.51	5.22	3.18	5.30	5.07	4.56	4.11	3.79	4.98	4.41	3.61	2.42
452	5.58	5.19	3.12	5.23	5.04	4.51	4.00	3.66	4.93	4.33	3.53	2.29
453	5.36	5.05	3.09	5.11	4.93	4.44	3.95	3.63	4.83	4.25	3.49	2.29
454	5.48	5.12	3.10	5.19	4.96	4.45	3.97	3.43	4.87	4.29	3.51	2.30
455	5.64	5.19	3.11	5.25	5.01	4.48	4.00	3.65	4.92	4.33	3.53	2.30
456	5.79	5.25	3.11	5.31	5.10	4.56	4.05	3.68	5.02	4.40	3.59	2.32
457	5.9	5.36	3.18	5.41	5.20	4.64	4.11	3.74	5.11	4.48	xxx	2.38
458	5.82	5.31	3.12	5.35	5.13	4.56	4.03	3.67	5.02	4.39	xxx	2.29
459	5.43	5.02	3.00	5.11	4.90	4.37	3.87	3.53	4.80	4.20	3.42	2.20
460	5.77	5.23	3.23	5.33	5.14	4.59	4.11	3.78	5.04	4.44	3.66	2.44
461	6.19	5.52	3.32	5.56	5.35	4.75	4.24	3.88	5.24	4.61	3.78	2.49
462	5.97	5.62	3.24	5.51	5.28	4.72	4.20	3.81	5.19	4.55	3.72	2.44
463	5	4.77	2.90	4.73	4.56	4.11	3.64	3.31	4.47	3.92	3.21	2.11
464	5.38	5.11	3.44	5.25	5.09	4.42	4.25	xxx	5.01	4.50	3.86	2.83

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
465	6.4	5.84	3.69	5.88	5.64	4.87	4.66	xxx	5.56	4.96	4.21	3.02
466	5.52	5.08	3.12	5.10	4.88	4.43	3.98	3.66	4.78	4.24	3.50	2.39
467	4.76	4.53	2.92	4.64	4.50	4.13	3.72	3.43	4.41	3.93	3.27	2.26
468	5.04	4.85	3.12	4.88	4.76	4.30	3.91	3.64	4.68	4.17	3.50	2.47
469	6.21	5.75	3.49	5.68	5.48	4.90	4.43	4.11	5.39	4.77	3.98	2.77
470	5.47	4.97	2.85	5.01	4.79	4.28	3.76	3.40	4.69	4.09	3.29	2.07
471	4.21	4.01	2.53	4.15	4.03	3.68	3.28	3.00	3.94	3.49	2.85	1.88
472	4.49	4.33	2.85	4.46	4.33	3.94	3.60	3.38	4.27	3.82	3.20	2.24
473	5.35	5.01	3.08	5.07	4.89	4.39	3.97	3.68	4.81	4.27	3.54	2.41
474	4.75	4.56	2.73	4.59	4.45	4.02	3.60	3.29	4.35	3.85	3.14	2.08
475	3.72	3.78	2.44	3.89	3.78	3.47	3.12	2.87	3.71	3.31	2.71	1.82
476	4.1	4.11	2.71	4.23	4.11	3.80	3.47	3.25	4.04	3.63	3.06	2.18
477	5.08	4.97	3.08	5.00	4.85	4.43	4.03	3.77	xxx	4.23	3.66	2.50
478	4.29	4.27	2.49	4.28	4.15	3.76	3.36	3.07	4.04	3.57	2.89	1.83
479	3.15	3.32	2.11	3.42	3.36	3.10	2.78	2.54	3.27	2.91	2.37	1.53
480	3.89	3.94	2.67	4.07	3.98	3.73	3.43	3.23	3.91	3.52	3.01	2.19
481	4.42	4.41	2.83	4.53	4.41	4.09	3.75	3.52	4.33	3.88	3.28	2.32
482	4.1	4.14	2.64	4.21	4.13	3.81	3.47	3.24	4.04	3.61	3.02	2.10
483	3.15	3.37	2.30	3.50	3.44	3.20	2.90	2.70	3.37	3.01	2.52	1.78
484	3.58	3.79	2.72	3.94	3.88	3.66	3.38	3.19	3.83	3.47	2.99	2.30
485	4.25	4.31	2.93	4.40	4.32	4.06	3.75	3.55	4.26	3.85	3.30	2.48
486	3.91	4.06	2.70	4.06	4.01	3.75	3.48	3.29	3.96	3.55	3.03	2.21
487	3.41	3.67	2.53	3.71	3.65	3.42	3.17	2.99	3.60	3.24	2.77	2.04
488	3.55	3.82	2.72	3.94	3.83	3.61	3.39	3.22	3.79	3.46	3.00	2.29
489	4.18	4.33	2.93	4.40	4.29	4.01	3.76	3.57	4.24	3.85	3.31	2.48
490	4.03	4.03	2.68	4.12	4.04	3.75	3.49	3.28	3.96	3.56	3.03	2.19
491	3.48	3.57	2.49	3.72	3.64	3.41	3.19	2.99	3.62	3.24	2.77	2.02
492	3.69	3.78	2.66	3.93	3.83	3.61	3.39	3.20	3.82	3.45	2.96	2.24
493	4.31	4.34	2.90	4.43	4.33	4.03	3.77	3.56	4.26	3.85	3.29	2.46
494	4.17	4.14	2.67	4.17	4.12	3.81	3.49	3.24	4.03	3.59	3.00	2.08
495	3.9	3.92	2.59	3.98	3.92	3.66	3.36	3.13	3.84	3.44	2.89	2.04

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
496	4.05	4.13	2.74	4.23	4.11	3.81	3.51	3.28	4.04	3.61	3.06	2.19
497	4.26	4.31	2.83	4.39	4.28	3.95	3.64	3.41	4.21	3.75	3.18	2.26
498	4.28	4.30	2.79	4.39	4.28	3.95	3.58	3.33	4.20	3.73	3.11	2.14
499	4.1	4.11	2.69	4.21	4.11	3.79	3.43	3.19	4.03	3.58	2.98	2.05
500	4.22	4.16	2.75	4.31	4.17	3.85	3.51	3.28	4.10	3.64	3.07	2.18
501	4.45	4.44	2.86	4.56	4.40	4.05	3.70	3.45	4.33	3.84	3.23	2.28
502	4.34	4.33	2.75	4.40	4.28	3.90	3.54	3.26	4.20	3.71	3.07	2.09
503	4.37	4.31	2.77	4.39	4.27	3.90	3.55	3.28	4.19	3.71	3.09	2.13
504	4.3	4.15	2.61	4.23	4.10	3.76	3.39	3.12	4.00	3.54	2.93	1.95
505	4.47	4.31	2.68	4.39	4.26	3.89	3.50	3.22	4.15	3.67	3.03	2.03
506	4.29	4.21	2.59	4.26	4.15	3.76	3.39	3.11	4.06	3.58	2.92	1.92
507	4.2	4.09	2.58	4.16	4.05	3.68	3.34	3.07	3.99	3.51	2.88	1.92
508	4.37	4.19	2.62	4.29	4.14	3.75	3.39	3.11	4.05	3.59	2.93	1.93
509	4.13	4.04	2.54	4.15	4.01	3.64	3.27	3.01	3.92	3.48	2.84	1.86
510	3.95	4.03	2.61	4.11	3.99	3.66	3.35	3.14	3.92	3.50	2.93	2.03
511	4.13	4.10	2.63	4.13	3.98	3.65	3.34	3.13	3.93	3.48	2.91	2.01
512	4.03	4.00	2.52	4.05	3.93	3.61	3.28	3.06	3.87	3.43	2.85	1.91
513	3.55	3.61	2.34	3.73	3.64	3.35	3.02	2.80	3.57	3.18	2.62	1.74
514	3.87	4.01	2.73	4.11	4.01	3.73	3.44	3.26	3.96	3.57	3.04	2.23
515	4.53	4.54	2.94	4.56	4.43	4.09	3.79	3.58	4.37	3.92	3.33	2.41
516	4.21	4.08	2.52	4.14	4.01	3.67	3.33	3.05	3.91	3.46	2.85	1.91
517	3.49	3.57	2.33	3.71	3.63	3.35	3.04	2.79	3.53	3.14	2.60	1.77
518	3.58	3.81	2.60	3.94	3.86	3.59	3.36	3.15	3.79	3.41	2.90	2.12
519	4.29	4.33	2.79	4.38	4.26	3.93	3.66	3.43	4.19	3.74	3.16	2.26
520	4.36	4.26	2.58	4.16	4.06	3.72	3.38	3.13	3.99	3.50	2.89	1.93
521	3.33	3.47	2.27	3.45	3.41	3.16	2.87	2.66	3.34	2.96	2.45	1.67
522	3.41	3.66	2.60	3.72	3.70	3.48	3.26	3.10	3.63	3.30	2.84	2.14
523	4.26	4.34	2.87	4.35	4.29	4.00	3.75	3.55	4.22	3.79	3.25	2.38
524	4.06	4.00	2.54	4.07	3.98	3.67	3.37	3.11	3.89	3.44	2.86	1.93
525	3.05	3.20	2.19	3.31	3.27	3.03	2.76	2.54	3.20	2.84	2.36	1.62
526	3.02	3.33	2.44	3.45	3.44	3.22	3.07	2.93	3.39	3.09	2.69	2.09

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
527	3.95	4.04	2.74	4.12	4.08	3.80	3.61	3.44	3.99	3.62	3.12	2.35
528	3.72	3.75	2.41	3.75	3.72	3.41	3.16	2.96	3.61	3.23	2.70	1.84
529	2.8	2.99	2.10	3.04	3.04	2.82	2.63	2.48	2.96	2.67	2.26	1.60
530	2.86	3.13	2.30	3.25	3.25	3.07	2.91	2.78	3.19	2.90	2.52	1.91
531	3.57	3.67	2.54	3.74	3.73	3.51	3.33	xxx	3.66	3.32	2.87	2.13
532	3.52	3.60	2.37	3.62	3.61	3.33	3.11	2.92	3.53	3.15	2.63	1.84
533	2.56	2.84	2.01	2.94	2.93	2.70	2.51	2.33	2.87	2.55	2.12	1.50
534	2.71	3.05	2.35	3.20	3.16	3.00	2.90	2.79	3.12	2.87	2.55	2.07
535	3.48	3.66	2.60	3.75	3.73	3.49	3.35	3.22	3.65	3.33	2.92	2.26
536	3.21	3.41	2.37	3.47	3.44	3.23	3.04	2.88	3.39	3.06	2.63	1.94
537	2.39	2.77	2.06	2.90	2.90	2.72	2.57	2.43	2.85	2.58	2.23	1.67
538	2.59	2.97	2.28	3.09	3.09	2.93	2.83	2.71	3.05	2.79	2.50	2.00
539	3.34	3.63	2.62	3.74	3.69	3.49	3.36	3.24	3.65	3.33	2.96	2.32
540	3.13	3.39	2.36	3.48	3.45	3.23	3.05	2.91	3.38	3.04	2.64	1.98
541	2.46	2.76	2.04	2.87	2.87	2.69	2.53	2.37	2.81	2.52	2.19	1.66
542	2.66	2.94	2.26	3.07	3.06	2.91	2.77	2.62	3.02	2.75	2.44	1.93
543	3.35	3.67	2.63	3.78	3.75	3.54	3.39	3.25	3.70	3.37	2.97	2.32
544	3.35	3.59	2.50	3.65	3.63	3.42	3.27	3.12	3.56	3.22	2.80	2.08
545	2.32	2.59	1.93	2.64	2.66	2.51	2.38	2.24	2.77	2.36	2.05	1.53
546	3.01	3.28	2.56	3.43	3.42	3.26	3.15	3.01	3.40	3.13	2.81	2.30
547	3.65	3.84	2.85	3.96	3.91	3.71	3.56	3.46	3.86	3.54	3.14	2.48
548	3.78	4.02	2.96	4.11	4.07	3.87	3.64	3.47	4.01	3.67	3.23	2.55
549	3.26	3.51	2.62	3.66	3.62	3.42	3.20	3.00	3.58	3.25	2.84	2.20
550	3.07	3.37	2.62	3.58	3.50	3.31	3.17	3.01	3.48	3.21	2.87	2.33
551	3.79	4.15	3.01	4.20	4.10	3.89	3.74	3.60	4.06	3.76	3.36	2.72
552	4.07	4.33	3.05	4.35	4.27	4.02	3.77	3.58	4.20	3.83	3.33	2.54
553	3.87	4.06	2.99	4.21	4.13	3.88	3.61	3.43	4.06	3.70	3.22	2.46
554	3.77	3.89	2.87	4.02	3.94	3.71	3.47	3.31	3.90	3.54	3.10	2.41
555	4.41	4.40	3.11	4.48	4.40	4.13	3.89	3.71	4.34	3.94	3.44	2.67
556	4.63	4.52	3.09	4.65	4.54	4.16	3.83	3.59	4.44	3.98	3.38	2.45
557	4.6	4.51	3.11	4.63	4.52	4.13	3.80	3.57	4.42	3.97	3.38	2.48

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
558	4.65	4.55	3.11	4.56	4.47	4.14	3.84	3.62	4.37	3.95	3.39	2.51
559	4.78	4.69	3.15	4.72	4.60	4.26	3.95	3.74	4.51	4.06	3.49	2.57
560	5	4.75	3.13	4.83	4.67	4.25	3.87	3.62	4.57	4.07	3.42	2.42
561	5.28	5.02	3.28	5.07	4.92	4.47	4.09	3.82	4.81	4.31	3.63	2.58
562	5.25	4.83	3.05	4.77	4.62	4.19	3.82	3.54	4.51	4.01	3.33	2.25
563	5.32	4.79	3.03	4.73	4.58	4.15	3.78	3.51	4.47	3.96	3.29	2.25
564	5.72	5.03	3.05	5.03	4.82	4.28	3.86	3.53	4.73	4.19	3.44	2.25
565	6.11	5.35	3.24	5.28	5.06	4.49	4.05	3.71	4.98	4.41	3.63	2.39
566	6.04	5.52	3.31	5.53	5.32	4.76	4.31	3.97	5.23	4.63	3.82	2.57
567	5.47	5.00	3.05	5.06	4.87	4.38	3.95	3.64	4.77	4.23	3.47	2.30
568	5.52	5.07	3.20	5.12	4.95	4.45	4.05	3.74	4.86	4.36	3.66	2.58
569	6.48	5.94	3.57	5.92	5.71	5.08	4.61	4.24	5.60	4.99	4.16	2.90
570	6.3	5.55	3.12	5.53	5.31	4.64	4.08	3.64	5.18	4.53	3.64	2.28
571	5.43	4.82	2.86	4.89	4.73	4.20	3.74	3.36	4.60	4.06	3.30	2.11
572	5.64	4.78	2.78	4.80	4.62	4.00	3.51	3.09	4.52	3.97	3.23	2.08
573	6.68	5.59	3.14	5.50	5.27	4.56	4.02	3.57	5.16	4.51	3.66	2.37
574	6.26	5.51	2.99	5.46	5.20	4.46	3.86	3.33	5.10	4.43	3.52	2.10
575	5.08	4.57	2.61	4.63	4.46	3.92	3.42	2.99	4.37	3.81	3.05	1.84
576	5.24	4.95	3.07	5.00	4.82	4.39	3.88	3.45	4.83	4.29	3.58	2.41
577	6.59	5.89	3.43	5.82	5.58	5.05	4.44	3.94	5.52	4.86	4.01	2.64
578	6.05	5.29	2.84	5.22	4.96	4.30	3.59	3.00	4.91	4.25	3.38	1.98
579	4.6	4.12	2.41	4.19	4.06	3.52	2.95	2.44	4.00	3.50	2.81	1.72
580	4.7	4.43	2.84	4.53	4.38	3.92	3.38	2.90	4.37	3.89	3.25	2.20
581	6.33	5.73	3.31	5.70	5.43	4.88	4.21	3.64	5.42	4.75	3.91	2.54
582	5.59	4.91	2.57	4.84	4.61	3.95	3.26	2.65	4.54	3.92	3.04	1.68
583	4.2	4.05	2.28	4.10	3.98	3.37	2.78	2.25	3.91	3.45	2.72	1.57
584	4.5	4.43	2.67	4.48	4.35	3.80	3.25	2.76	4.30	3.78	3.04	1.83
585	5.21	4.98	2.89	5.00	4.77	4.20	3.56	3.01	4.77	4.18	3.34	2.00
586	4.92	4.68	2.58	4.69	4.50	3.93	3.33	2.81	4.43	3.88	3.01	1.67
587	3.7	3.76	2.18	3.77	3.67	3.14	2.65	2.19	3.60	3.17	2.48	1.38
588	4.01	4.15	2.65	4.20	4.10	3.70	3.33	2.98	4.04	3.59	2.98	1.93

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
589	4.95	4.75	2.88	4.77	4.59	4.16	3.71	3.33	4.55	4.03	3.31	2.09
590	4.36	4.29	2.52	4.31	4.16	3.73	3.30	2.95	4.09	3.62	2.89	1.74
591	3.32	3.57	2.22	3.69	3.57	3.16	2.78	2.49	3.52	3.12	2.48	1.50
592	3.76	3.95	2.58	4.10	3.97	3.61	3.27	3.04	3.90	3.48	2.87	1.93
593	4.35	4.38	2.74	4.46	4.29	3.92	3.53	3.25	4.23	3.75	3.08	2.01
594	3.94	4.11	2.58	4.18	4.05	3.72	3.37	3.11	3.98	3.54	2.92	1.96
595	3.53	3.55	2.35	3.63	3.51	3.16	2.86	2.64	3.44	3.06	2.51	1.69
596	3.64	3.84	2.62	4.00	3.89	xxx	3.33	3.16	3.81	3.44	2.94	2.18
597	4.12	4.10	2.69	4.08	3.93	xxx	3.36	3.17	3.87	3.46	2.94	2.14
598	4.01	3.99	2.62	3.97	3.87	xxx	3.32	3.14	3.80	3.40	2.90	2.13
599	4.15	4.39	2.78	4.44	4.30	xxx	3.70	3.46	4.29	3.82	3.23	2.32
600	3.59	3.69	2.20	3.66	3.52	xxx	2.91	2.65	3.52	3.12	2.60	1.63
601	3.78	4.02	2.42	4.04	3.93	xxx	3.26	2.98	3.89	3.49	2.94	1.90
602	4.1	4.18	2.40	4.13	4.05	xxx	3.26	2.95	3.98	3.48	2.86	1.70
603	3.83	3.91	2.30	3.91	3.86	xxx	3.11	2.81	3.81	3.32	2.74	1.65
604	3.63	3.77	2.19	3.81	3.73	xxx	3.01	2.71	3.69	3.21	2.63	1.58
605	3.74	3.93	2.29	3.96	3.86	xxx	3.12	2.82	3.79	3.32	2.74	1.66
606	4.28	4.27	2.42	4.30	4.18	xxx	3.30	2.97	4.08	3.56	2.86	1.66
607	4.17	4.12	2.37	4.19	4.08	xxx	3.20	2.88	3.96	3.46	2.78	1.62
608	3.96	4.17	2.40	4.07	3.99	xxx	3.25	2.96	3.94	3.45	2.80	1.69
609	3.73	4.06	2.33	3.94	3.86	xxx	3.17	2.89	3.83	3.35	2.72	1.64
610	3.96	4.10	2.44	4.11	4.03	xxx	3.26	2.99	3.94	3.47	2.80	1.77
611	3.95	4.06	2.45	4.13	4.06	xxx	3.27	3.00	3.97	3.48	2.81	1.76
612	4.23	4.12	2.52	4.20	4.12	xxx	3.37	xxx	4.02	3.54	2.90	1.85
613	3.36	3.19	2.07	3.24	3.20	xxx	2.50	2.29	3.11	2.73	2.20	1.35
614	4.39	4.51	3.19	4.65	4.55	xxx	3.96	3.78	4.49	4.09	3.60	2.79
615	4.74	4.86	3.24	4.99	4.84	xxx	4.20	3.97	4.79	4.32	3.73	2.77
616	4.01	4.23	2.91	4.36	4.26	xxx	3.64	xxx	4.20	3.79	3.26	2.42
617	3.56	3.83	2.69	4.02	3.95	3.68	3.33	3.13	3.88	3.51	3.01	2.21
618	3.87	4.07	2.98	4.22	4.15	3.92	3.58	3.42	4.09	3.74	3.29	2.55
619	4.59	4.62	3.24	4.71	4.61	4.35	4.02	3.83	4.55	4.16	3.65	2.81

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
620	4.39	4.42	3.03	4.54	4.44	4.08	3.72	3.48	4.37	3.94	3.38	2.47
621	3.75	4.03	2.81	4.14	4.07	3.73	3.38	3.16	4.00	3.60	3.10	2.26
622	3.83	4.15	2.97	4.24	4.15	3.89	3.58	3.39	4.09	3.74	3.27	2.49
623	4.54	4.70	3.26	4.78	4.67	4.38	4.06	3.85	4.61	4.20	3.66	2.79
624	4.43	4.48	3.01	4.55	4.46	4.10	3.74	3.49	4.38	3.92	3.36	2.40
625	3.56	3.80	2.71	3.98	3.90	3.59	3.24	3.02	3.83	3.44	2.97	2.12
626	3.57	3.79	2.80	3.94	3.89	3.66	3.36	3.18	3.84	3.49	3.08	2.36
627	4.06	4.13	2.94	4.18	4.10	3.85	3.53	3.32	4.06	3.67	3.21	2.45
628	4.08	4.38	3.10	4.51	4.37	4.14	3.85	3.64	4.33	3.96	3.48	2.68
629	3.45	3.79	2.77	4.01	3.91	3.69	3.40	3.21	3.85	3.53	3.10	2.34
630	3.4	3.65	2.76	3.85	3.81	3.57	3.27	3.10	3.74	3.43	3.03	2.38
631	4.46	4.58	3.25	4.65	4.58	4.30	4.01	3.83	4.51	4.13	3.65	2.89
632	4.27	4.34	2.92	4.38	4.30	3.96	3.63	3.41	4.22	3.78	3.27	2.36
633	3.23	3.56	2.55	3.70	3.67	3.39	3.05	2.84	3.60	3.23	2.81	2.03
634	3.36	3.72	2.77	3.82	3.82	3.61	3.32	3.16	3.76	3.46	3.08	2.41
635	4.33	4.50	3.14	4.53	4.49	4.23	3.95	3.76	4.43	4.05	3.57	2.77
636	4.38	4.36	2.92	4.40	4.33	3.99	3.65	3.40	4.25	3.80	3.26	2.35
637	3.14	3.35	2.43	3.49	3.46	3.17	2.86	2.65	3.38	3.04	2.63	1.91
638	3.28	3.62	2.77	3.74	3.75	3.54	3.30	3.15	3.68	3.41	3.07	2.46
639	4.26	4.47	3.16	4.53	4.49	4.24	3.97	3.79	4.41	4.05	3.60	2.07
640	4.08	4.20	2.90	4.28	4.22	3.91	3.59	3.37	4.14	3.73	3.23	xxx
641	2.61	2.89	2.15	3.02	3.02	2.79	2.53	2.37	2.95	2.67	2.34	xxx
642	2.76	3.18	2.50	3.32	3.32	3.19	3.00	2.91	3.26	3.07	2.83	xxx
643	4.05	4.33	3.18	4.46	4.39	4.19	3.94	3.80	4.33	4.02	3.61	xxx
644	3.8	3.93	2.77	4.03	3.99	3.72	3.41	3.20	3.93	3.54	3.07	xxx
645	2.71	3.01	2.24	3.13	3.15	2.94	2.70	2.52	3.25	2.81	2.49	xxx
646	2.74	3.10	2.41	3.22	3.21	3.06	2.88	2.76	3.16	2.96	2.71	xxx
647	3.89	4.16	3.05	4.25	4.18	3.92	3.68	3.53	4.35	3.79	3.39	xxx
648	xxx	4.86	3.34	4.92	4.90	4.44	4.09	3.83	4.83	4.33	3.71	xxx
649	xxx	2.91	1.96	2.91	3.07	xxx	xxx	xxx	2.98	xxx	2.21	xxx
650	xxx	2.76	2.24	2.85	2.96	xxx	xxx	xxx	2.90	xxx	2.65	xxx

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
651	xxx	4.42	3.39	4.57	4.47	4.17	4.09	3.98	4.43	4.18	3.85	xxx
652	3.67	3.82	2.79	3.91	3.85	3.63	3.34	3.16	3.83	3.50	3.09	xxx
653	2.9	3.33	2.54	3.44	3.43	3.26	3.02	2.88	3.40	3.15	2.84	xxx
654	2.78	3.20	2.43	3.36	3.32	3.13	2.90	2.76	3.28	3.04	2.72	xxx
655	3.39	3.77	2.82	3.93	3.90	3.70	3.49	3.34	3.85	3.57	3.20	xxx
656	3.79	4.04	2.89	4.13	4.10	3.82	3.56	3.39	4.04	3.67	3.23	xxx
657	2.93	3.22	2.39	3.34	3.32	3.06	2.79	2.63	3.28	2.95	2.60	xxx
658	2.97	3.38	2.67	3.59	3.52	3.36	3.15	3.03	3.48	3.24	2.97	xxx
659	3.55	3.89	2.95	4.08	3.99	3.81	3.57	3.43	3.95	3.67	3.31	xxx
660	4	4.30	3.19	4.48	4.40	4.05	3.85	3.65	4.35	3.99	3.53	xxx
661	3.66	3.96	2.96	4.14	4.07	3.72	3.52	3.32	4.01	3.68	3.25	xxx
662	3.48	3.81	2.90	4.02	3.93	3.71	3.45	3.28	3.87	3.59	3.22	xxx
663	3.65	4.02	3.04	4.24	4.15	3.94	3.66	3.49	4.09	3.79	3.40	1.42
664	4.09	4.39	xxx	4.59	4.51	3.96	3.94	3.75	4.46	4.11	3.67	2.88
665	4.4	4.61	xxx	4.77	4.67	4.09	4.07	3.86	4.61	4.23	3.77	2.96
666	3.94	4.16	3.07	4.34	4.23	4.00	3.67	3.46	4.16	3.80	3.38	2.63
667	4.01	4.25	3.13	4.43	4.33	4.10	3.77	3.57	4.17	3.90	3.48	2.71
668	4.61	4.67	3.36	4.82	4.73	4.19	4.04	3.82	4.65	4.24	3.73	2.82
669	5.06	5.00	3.52	5.13	5.00	4.42	4.27	4.04	4.91	4.47	3.92	2.97
670	4.69	4.66	3.24	4.72	4.61	4.28	3.93	3.70	4.52	4.09	3.57	2.69
671	4.44	4.52	3.17	4.60	4.51	4.21	3.87	3.65	4.42	4.01	3.52	2.68
672	4.82	4.74	3.31	4.88	4.73	4.33	4.00	3.75	4.65	4.20	3.65	2.75
673	5.66	5.48	3.61	5.45	5.26	4.78	4.43	4.15	5.18	4.65	4.02	3.01
674	5.38	5.18	3.31	5.09	4.91	4.47	4.20	3.79	4.80	4.28	3.64	2.58
675	4.63	4.46	3.05	4.53	4.42	4.06	3.68	3.43	4.30	3.87	3.31	2.38
676	5.28	5.00	3.45	5.24	5.11	4.40	4.27	3.99	5.02	4.52	3.87	2.85
677	6.11	5.51	3.63	5.58	5.38	4.61	4.46	4.15	5.32	4.74	4.04	2.94
678	5.74	5.39	3.51	5.45	5.25	4.62	4.37	4.06	5.19	4.64	3.96	2.86
679	xxx	4.91	3.30	5.09	4.91	4.32	4.07	3.78	4.83	4.34	3.69	2.65
680	xxx	5.04	3.47	5.19	5.03	4.32	4.22	3.94	4.94	4.46	3.85	2.88
681	6.55	5.91	3.87	5.95	5.77	4.96	4.82	4.50	5.68	5.10	4.37	3.25

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
682	6.19	5.54	3.47	5.54	5.34	4.80	4.32	3.99	5.25	4.66	3.86	2.69
683	5.08	4.71	3.13	4.85	4.69	4.26	3.83	3.54	4.62	4.12	3.44	2.42
684	5.43	5.09	3.47	5.25	5.08	xxx	4.26	3.98	5.02	4.51	3.88	2.87
685	6.45	5.89	3.81	5.96	5.73	xxx	4.76	4.44	5.64	5.05	4.32	3.16
686	6	5.54	3.48	5.57	5.35	4.81	4.35	4.01	5.25	4.68	3.89	2.72
687	4.86	4.73	3.14	4.86	4.71	4.28	3.86	3.55	4.61	4.14	3.46	2.44
688	5.31	4.95	3.36	5.01	4.87	4.42	4.06	3.77	4.78	4.30	3.68	2.71
689	6.24	5.75	3.70	5.74	5.54	4.99	4.60	4.29	5.45	4.88	4.15	3.03
690	6.33	5.65	3.54	5.67	5.45	4.89	4.40	4.09	5.34	4.73	3.94	2.73
691	4.63	4.29	2.94	4.45	4.33	3.92	3.47	3.22	4.24	3.77	3.15	2.19
692	4.99	4.76	3.51	5.04	4.94	xxx	4.22	3.99	4.82	4.43	3.91	3.02
693	6	5.55	3.81	5.73	5.53	xxx	4.68	4.39	5.40	4.92	4.28	3.22
694	5.69	5.44	3.69	5.52	5.36	xxx	4.47	4.18	5.26	4.76	4.10	3.05
695	3.88	3.81	2.70	3.96	3.91	xxx	3.17	2.95	3.84	3.44	2.97	2.18
696	3.97	xxx	3.13	4.29	4.24	xxx	3.71	3.52	4.13	3.88	3.49	2.88
697	5.48	xxx	3.93	5.51	5.37	xxx	4.75	4.50	5.23	4.90	4.36	3.49
698	5.14	4.93	3.54	5.09	4.95	xxx	4.21	3.94	4.87	4.45	3.90	2.97
699	4.24	4.19	3.11	4.36	4.31	xxx	3.65	3.41	4.25	3.89	3.43	2.64
700	4.17	4.19	3.17	4.38	4.32	xxx	3.75	3.56	4.26	3.95	3.54	2.81
701	4.94	4.91	3.59	5.08	4.95	xxx	4.29	4.08	4.87	4.51	4.01	3.16
702	4.81	4.77	3.46	4.88	4.77	xxx	4.10	3.88	4.70	4.31	3.82	2.98
703	3.81	4.08	2.92	4.12	4.13	xxx	3.46	3.24	4.08	3.71	3.24	2.54
704	4.02	4.34	3.18	4.47	4.48	xxx	3.83	3.60	4.42	4.08	3.60	2.89
705	4.54	4.54	3.46	4.77	4.69	xxx	4.12	3.91	4.63	4.31	3.86	3.10
706	3.89	3.96	3.04	4.10	4.07	3.83	3.56	3.37	4.02	3.72	3.35	2.67
707	3.48	3.67	2.83	3.79	3.82	3.60	3.34	3.15	3.76	3.49	3.16	2.53
708	3.58	3.77	2.89	3.94	3.94	3.61	3.45	3.27	3.88	3.61	3.27	2.62
709	3.84	4.01	3.10	4.19	4.14	3.81	3.66	3.49	4.08	3.80	3.46	2.79
710	3.86	3.91	3.02	4.10	4.03	3.80	3.60	3.44	3.98	3.72	3.41	2.77
711	4.03	4.03	3.08	4.22	4.13	3.89	3.66	3.49	4.09	3.81	3.47	2.79
712	3.59	3.75	2.85	3.92	3.87	3.64	3.34	3.15	3.82	3.52	3.15	2.46

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
713	3.21	3.55	2.77	3.74	3.73	3.51	3.26	3.09	3.67	3.41	3.08	2.49
714	3.54	3.78	2.95	3.91	3.86	3.68	3.46	3.32	3.81	3.58	3.26	2.70
715	3.7	4.00	3.04	4.16	4.09	3.91	3.65	3.49	5.03	3.78	3.42	2.77
716	3.9	4.15	3.12	4.29	4.22	4.00	4.11	3.56	4.18	3.86	3.50	2.79
717	2.9	3.01	2.21	3.02	2.98	2.77	2.50	2.38	2.95	2.69	2.39	1.87
718	4.05	xxx	3.07	4.29	4.26	xxx	3.65	xxx	3.80	3.91	xxx	2.89
719	4.61	xxx	3.51	4.98	4.94	xxx	4.31	xxx	4.48	4.54	xxx	3.31
720	3.28	3.52	2.70	3.68	3.70	3.43	xxx	xxx	3.66	3.43	3.14	xxx
721	3.33	3.58	2.82	3.78	3.79	3.54	xxx	3.21	xxx	3.52	3.23	xxx
722	3.25	3.56	2.77	3.75	3.74	3.53	3.31	3.16	3.69	3.45	3.15	2.55
723	4.32	4.55	3.40	4.70	4.61	4.35	4.12	3.96	4.56	4.25	3.87	3.14
724	3.62	3.71	2.68	3.83	3.68	3.46	3.25	3.10	3.65	3.33	2.98	2.35
725	3	3.28	2.51	3.43	3.35	3.19	3.02	2.90	3.32	3.07	2.79	2.28
726	3.99	4.16	3.08	4.33	4.36	4.08	3.80	3.64	4.30	3.94	3.51	2.73
727	3.81	3.61	2.71	3.68	3.72	3.46	3.21	3.07	3.66	3.34	3.00	2.36
728	3.49	3.57	2.73	3.63	3.61	3.42	3.20	3.07	3.56	3.30	3.00	2.47
729	3.37	3.74	2.78	3.81	3.81	3.59	3.32	3.15	3.78	3.45	3.10	2.47
730	3.27	3.62	2.75	3.74	3.72	3.51	3.29	3.13	3.69	3.40	3.11	2.52
731	4.39	4.50	3.29	4.62	4.54	4.28	4.04	3.86	4.47	4.15	3.74	3.01
732	4.07	4.15	2.94	4.24	4.16	3.91	3.62	3.42	4.08	3.71	3.28	2.52
733	3.2	3.46	2.61	3.64	3.61	3.40	3.13	2.95	3.54	3.22	2.88	2.24
734	3.85	3.79	2.87	3.96	3.95	3.71	3.43	3.23	3.88	3.55	3.15	2.49
735	4.59	4.44	3.22	4.55	4.49	4.23	3.94	3.73	4.42	4.05	3.58	2.84
736	4.53	4.44	3.15	4.59	4.46	4.17	3.84	3.63	4.38	3.98	3.48	2.67
737	3.38	3.47	2.56	3.66	3.60	3.35	3.03	2.83	3.54	3.20	2.80	2.11
738	xxx	3.77	2.92	3.93	3.92	3.60	3.47	3.30	3.87	3.60	3.27	2.66
739	xxx	4.70	3.44	4.80	4.73	4.36	4.20	4.01	4.65	4.31	3.87	3.09
740	4.62	4.63	3.30	4.71	4.62	4.33	4.00	3.78	4.53	4.14	3.64	2.81
741	3.3	3.48	2.58	3.64	3.60	3.37	3.07	2.87	3.54	3.22	2.84	2.20
742	3.53	3.78	2.93	3.95	3.93	3.40	3.50	3.31	3.89	3.61	3.28	2.69
743	4.55	4.66	3.50	4.78	4.72	4.14	4.21	4.01	4.66	4.33	3.89	3.15

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
744	4.64	4.65	3.39	4.71	xxx	4.14	4.06	3.84	4.59	4.22	3.73	2.91
745	3.35	3.51	2.58	3.63	xxx	3.15	3.10	2.91	3.56	3.25	2.88	2.23
746	3.53	3.81	2.97	3.99	xxx	xxx	3.56	3.41	3.92	3.67	3.36	2.81
747	4.55	4.73	3.63	4.87	xxx	xxx	4.33	4.14	4.77	4.46	4.05	3.32
748	4.59	4.66	3.40	4.69	xxx	3.95	4.01	3.78	4.57	4.20	3.73	2.92
749	3.55	3.77	2.69	3.79	xxx	3.15	3.21	3.00	3.75	3.40	2.99	2.34
750	3.3	3.65	2.79	3.72	xxx	3.15	3.32	3.17	3.72	3.46	3.16	2.64
751	4.59	4.78	3.64	4.87	xxx	4.15	4.33	4.16	4.76	4.46	4.07	3.37
752	4.65	4.65	3.41	4.78	xxx	4.15	4.09	3.84	4.63	4.24	3.76	2.91
753	3.32	3.56	2.57	3.61	xxx	3.19	3.11	2.91	3.68	3.30	2.94	2.23
754	3.36	3.71	2.81	3.77	xxx	3.19	3.42	3.27	3.86	3.56	3.27	2.69
755	4.63	4.74	3.61	4.89	3.57	4.11	4.34	4.17	4.77	4.45	4.06	3.34
756	4.46	4.39	3.21	4.49	4.44	4.09	3.78	3.55	4.36	3.96	3.49	2.69
757	3.39	3.53	2.61	3.62	3.64	3.35	3.08	2.88	3.59	3.25	2.89	2.29
758	3.37	3.63	2.76	3.79	3.80	3.37	3.36	3.20	3.77	3.46	3.16	2.59
759	4.19	4.27	3.27	4.46	4.39	3.94	3.90	3.71	4.33	4.00	3.63	2.93
760	4.21	4.31	3.24	4.49	4.41	3.93	3.81	3.60	4.34	3.99	3.56	2.81
761	3.55	3.69	2.80	3.84	3.83	3.36	3.25	3.07	3.76	3.44	3.08	2.44
762	3.21	3.58	2.78	3.76	3.74	3.36	3.32	3.18	3.69	3.44	3.17	2.61
763	4.44	4.45	3.36	4.58	4.49	4.08	4.02	3.84	4.45	4.14	3.76	3.05
764	4	4.09	2.96	4.14	4.08	3.82	3.53	3.32	4.03	3.68	3.26	2.55
765	3.98	4.51	3.29	4.64	4.57	4.28	4.00	3.82	4.50	4.13	3.70	3.00
766	xxx	3.69	2.50	3.63	xxx	3.26	3.27	2.77	2.84	3.07	2.64	1.85
767	xxx	2.84	2.02	2.75	xxx	2.55	2.23	2.04	3.42	2.39	2.04	1.39
768	xxx	4.56	3.52	4.87	xxx	xxx	4.43	4.20	xxx	4.51	4.10	3.47
769	xxx	3.93	2.92	4.23	4.23	xxx	3.74	3.55	4.11	3.85	3.43	2.74
770	3.8	3.94	3.11	4.18	4.19	xxx	3.66	3.49	4.12	3.87	3.48	2.86
771	4.51	4.55	3.52	4.77	4.71	xxx	4.20	4.02	4.64	4.35	3.92	3.22
772	4.14	4.16	3.13	4.27	4.20	xxx	3.62	3.40	4.18	3.84	3.43	2.71
773	4.41	4.52	3.43	4.68	4.60	xxx	4.06	3.85	4.56	4.23	3.81	3.08
774	4.06	4.21	3.10	4.39	4.28	4.04	3.69	3.45	4.24	3.89	3.46	2.70

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
775	3.81	4.03	3.01	4.18	4.14	3.91	3.56	3.35	4.09	3.76	3.37	2.66
776	4.39	4.53	3.37	4.65	4.63	xxx	4.03	3.82	4.58	4.22	3.77	2.99
777	4.81	4.84	3.53	4.96	4.88	xxx	4.22	3.98	4.83	4.44	3.93	3.08
778	4.33	4.46	3.24	4.60	4.48	4.19	3.86	3.65	4.44	4.07	3.60	2.81
779	3.58	3.86	2.88	4.05	3.99	3.71	3.38	3.18	3.94	3.60	3.21	2.52
780	4.45	4.42	3.41	4.74	4.70	xxx	4.04	3.81	4.59	4.26	3.81	3.02
781	5.34	5.10	3.80	5.37	5.25	xxx	4.57	4.31	5.15	4.78	4.24	3.33
782	4.72	4.68	3.38	4.82	4.67	4.26	4.03	3.78	4.63	4.24	3.74	2.87
783	3.91	4.02	2.97	4.19	4.12	3.71	3.50	3.27	4.08	3.72	3.30	2.54
784	4.45	4.43	3.32	4.68	4.61	xxx	3.96	3.71	4.55	4.19	3.73	2.92
785	5.92	5.54	3.98	5.65	5.49	xxx	4.77	4.50	5.42	5.00	4.42	3.47
786	4.83	4.90	3.31	5.01	4.85	4.54	4.11	3.86	4.81	4.36	3.78	2.87
787	4.69	4.40	3.08	4.57	4.41	4.12	3.68	3.44	4.37	3.96	3.43	2.59
788	4.95	4.64	3.25	4.85	4.68	4.15	3.89	3.61	4.62	4.18	3.63	2.74
789	6.21	5.76	3.77	5.88	5.68	5.06	4.78	4.44	5.62	5.06	4.39	3.33
790	5.67	5.24	3.24	5.30	5.09	4.60	4.07	3.68	5.00	4.42	3.66	2.50
791	4.51	4.39	2.89	4.53	4.39	4.00	3.54	3.21	4.31	3.85	3.22	2.26
792	4.76	4.66	3.12	4.73	4.57	4.25	3.82	3.53	4.52	4.08	3.48	2.57
793	6.33	5.97	3.70	5.92	5.68	5.19	4.65	4.28	5.61	5.02	4.24	3.06
794	6.15	5.39	3.04	5.24	5.03	4.48	3.87	3.41	4.90	4.24	3.41	2.10
795	4.61	4.23	2.59	4.23	4.11	3.73	3.25	2.87	4.00	3.49	2.86	1.83
796	5.55	5.21	3.40	5.32	5.15	4.64	4.26	3.94	5.08	4.53	3.84	2.74
797	6.66	5.97	3.68	5.97	5.73	5.10	4.64	4.27	5.64	4.99	4.17	2.90
798	5.89	5.41	3.25	5.40	5.18	4.66	4.11	3.73	5.08	4.47	3.67	2.44
799	4.79	4.54	2.90	4.65	4.49	4.09	3.59	3.27	4.41	3.90	3.22	2.15
800	5.22	5.00	3.33	5.10	4.94	4.51	4.12	3.82	4.89	4.38	3.74	2.72
801	6.31	5.87	3.65	5.81	5.60	5.05	4.61	4.25	5.52	4.91	4.15	2.96
802	5.89	5.43	3.26	5.40	5.20	4.64	4.10	3.73	5.10	4.47	3.67	2.42
803	4.95	4.54	2.95	4.63	4.48	4.04	3.58	3.27	4.41	3.89	3.22	2.18
804	4.55	4.32	2.81	4.45	4.32	3.97	3.53	3.23	4.25	3.78	3.18	2.23
805	xxx	5.64	3.37	5.69	5.45	4.93	4.37	3.98	5.37	4.73	3.93	2.70

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
806	xxx	5.62	3.11	5.62	5.34	4.67	4.00	3.52	5.24	4.53	3.59	2.18
807	4.37	4.17	2.56	4.30	4.18	3.70	3.18	2.83	4.07	3.57	2.87	1.78
808	4.41	4.38	2.94	4.50	4.41	4.11	3.70	3.44	4.34	3.91	3.33	2.40
809	5.29	5.05	3.17	5.11	4.95	4.61	4.12	3.80	4.89	4.37	3.66	2.55
810	5.16	4.84	2.97	4.86	4.69	4.30	3.79	3.44	4.62	4.11	3.39	2.28
811	4.4	4.28	2.75	4.35	4.24	3.89	3.45	3.15	4.16	3.72	3.09	2.11
812	4.17	4.30	2.81	4.35	4.24	3.95	3.56	3.29	4.19	3.77	3.18	2.25
813	4.87	4.84	3.04	4.85	4.70	4.37	3.93	3.62	4.65	4.16	3.50	2.44
814	4.51	4.41	2.73	4.47	4.34	3.94	3.47	3.13	4.27	3.76	3.09	2.01
815	3.91	4.03	2.60	4.16	4.06	3.71	3.29	2.99	3.99	3.55	2.95	1.98
816	4.14	4.10	2.65	4.20	4.11	3.78	3.36	3.07	4.02	3.58	2.95	1.97
817	4.07	4.03	2.60	4.15	4.05	3.71	3.28	2.99	4.20	3.53	2.90	1.93
818	3.94	4.04	2.70	4.18	4.04	3.74	3.37	3.13	3.99	3.58	3.00	2.13
819	3.87	3.92	2.62	4.06	3.90	3.60	3.22	2.99	3.85	3.44	2.87	2.02
820	3.63	3.82	2.57	3.93	3.85	3.56	3.18	2.94	3.76	3.36	2.82	1.98
821	3.51	3.78	2.53	3.84	3.80	3.52	3.15	2.92	3.70	3.31	2.78	1.95
822	3.39	3.62	2.50	3.71	3.62	3.38	3.08	2.90	3.56	3.22	2.76	2.13
823	3.67	3.83	2.58	3.92	3.81	3.56	3.24	3.04	3.76	3.40	2.88	2.19
824	4.02	4.18	2.81	4.34	4.19	3.87	3.47	3.20	4.12	3.71	3.13	2.19
825	3.4	3.61	2.55	3.79	3.71	3.40	3.06	2.85	4.09	3.28	2.80	1.97
826	3.09	3.36	2.45	3.44	3.44	3.22	2.94	2.77	3.84	3.10	2.71	2.06
827	3.6	3.79	2.65	3.84	3.79	3.58	3.29	3.10	3.74	3.42	2.96	2.22
828	3.71	3.83	2.60	3.92	3.84	3.53	3.11	2.80	3.81	3.44	2.90	2.03
829	2.76	3.14	2.22	3.28	3.25	2.98	2.61	2.32	3.22	2.86	2.40	1.71
830	3.76	4.19	3.17	4.33	4.22	3.93	3.52	3.22	4.15	3.87	3.47	2.85
831	3.84	4.16	3.07	4.35	4.23	3.97	3.58	3.29	4.16	3.86	3.42	2.69
832	3.24	3.66	2.73	3.85	3.77	3.48	3.21	2.72	3.71	3.44	3.04	2.33
833	2.09	2.47	1.73	2.53	2.50	2.18	1.75	1.42	2.44	2.20	1.90	1.40
834	3.45	xxx	2.91	3.89	3.88	xxx	3.18	2.89	xxx	3.56	xxx	2.77
835	4.36	xxx	3.45	4.73	4.67	xxx	4.00	3.70	4.42	4.29	xxx	3.19
836	3.16	3.68	2.78	3.83	3.79	3.52	3.23	3.00	3.74	3.46	3.09	2.48

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
837	2.75	3.33	2.62	3.55	3.51	3.27	2.98	2.77	3.49	3.27	2.96	2.43
838	3.05	3.38	2.61	3.55	3.55	3.29	3.08	2.90	3.49	3.26	2.92	2.34
839	4.28	4.61	3.50	4.77	4.68	4.37	4.10	3.89	4.65	4.56	3.91	3.13
840	3.7	4.10	2.97	4.21	4.10	3.82	3.49	3.27	4.08	3.71	3.27	2.50
841	2.65	3.31	2.43	3.39	3.36	3.08	2.77	2.55	3.34	3.05	2.72	2.08
842	3.43	3.92	2.91	4.01	3.99	3.64	3.43	3.24	3.95	3.62	3.22	2.55
843	4.2	4.44	3.33	4.60	4.50	4.13	3.88	3.71	4.49	4.14	3.66	2.88
844	4.01	4.35	3.21	4.49	4.36	4.07	3.74	3.56	4.32	3.97	3.51	2.73
845	3.09	3.56	2.62	3.72	3.65	3.36	3.04	2.84	3.61	3.29	2.90	2.22
846	3.33	3.85	2.91	4.02	3.98	xxx	3.42	3.24	3.93	3.63	3.24	2.60
847	4.22	4.59	3.44	4.72	4.63	xxx	4.03	3.84	4.58	4.25	3.79	3.03
848	4.28	4.52	3.31	4.64	4.56	xxx	3.87	3.64	4.49	4.13	3.62	2.79
849	3.36	3.73	2.73	3.89	3.85	xxx	3.17	2.95	3.79	3.46	3.01	2.29
850	3.68	3.98	3.07	4.21	4.15	xxx	3.60	3.45	4.09	3.84	3.41	2.73
851	4.68	4.83	3.66	5.01	4.89	xxx	4.30	4.11	4.83	4.52	4.01	3.18
852	4.53	4.75	3.47	4.87	4.74	xxx	4.00	3.77	xxx	4.28	3.76	2.89
853	3.37	3.82	2.73	3.92	3.84	xxx	3.11	2.91	3.82	3.42	2.99	2.28
854	3.68	xxx	3.11	4.29	4.24	xxx	3.65	3.49	4.16	3.87	3.46	2.82
855	4.86	xxx	3.86	5.29	5.17	xxx	4.54	4.34	5.09	4.76	4.24	3.41
856	4.7	4.87	3.52	5.02	4.87	xxx	4.05	3.79	4.82	4.41	3.82	2.87
857	3.82	4.04	2.96	4.26	4.17	xxx	3.36	3.13	4.09	3.74	3.24	2.44
858	3.68	4.04	3.07	4.25	4.18	xxx	3.58	3.42	4.12	3.81	3.42	2.76
859	4.92	5.15	3.80	5.33	5.17	xxx	4.53	4.32	5.12	4.73	4.23	3.39
860	5.06	5.03	3.50	5.18	4.98	4.40	4.10	3.80	4.92	4.39	3.81	2.82
861	3.79	3.95	2.84	4.12	4.02	3.45	3.18	2.93	3.96	3.55	3.05	2.26
862	3.82	xxx	3.22	4.42	4.35	xxx	3.75	3.59	4.29	3.99	3.58	2.90
863	4.98	xxx	3.84	5.35	5.20	xxx	4.56	4.36	5.13	4.76	4.25	3.38
864	4.97	4.99	3.56	5.07	4.96	4.30	4.13	3.88	4.88	4.44	3.87	2.90
865	4.28	4.37	3.19	4.48	4.43	3.76	3.60	3.40	4.35	3.95	3.45	2.60
866	4.07	4.16	3.09	4.27	4.22	3.76	3.54	3.38	4.16	3.79	3.36	2.62
867	4.86	4.99	3.57	5.04	4.93	xxx	4.23	4.02	5.02	4.45	3.94	3.08

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
868	4.99	5.01	3.43	5.08	4.92	xxx	4.05	3.78	4.86	4.36	3.75	2.77
869	4.12	4.22	3.07	4.40	4.29	xxx	3.47	3.24	4.23	3.80	3.29	2.46
870	4.27	4.43	3.25	4.65	4.55	xxx	3.84	3.65	4.48	4.08	3.63	2.84
871	5.05	5.03	3.55	5.18	5.02	xxx	4.26	4.02	4.95	4.50	3.96	3.04
872	5.01	4.99	3.48	5.19	5.03	4.30	4.17	3.90	4.94	4.48	3.90	2.93
873	4.54	4.41	3.14	4.57	4.51	3.79	3.67	3.43	4.40	3.99	3.48	2.63
874	3.89	4.06	3.00	4.20	4.14	3.78	3.53	3.35	4.08	3.75	3.33	2.64
875	4.7	4.82	3.44	4.96	4.80	4.42	4.15	3.94	4.76	4.36	3.86	3.03
876	4.66	4.68	3.20	4.81	4.63	4.25	3.82	3.55	4.59	4.13	3.54	2.61
877	4.03	4.27	3.06	4.44	4.30	3.96	3.59	3.35	4.27	3.89	3.37	2.56
878	4.01	4.21	3.03	4.34	4.25	3.95	3.58	3.37	4.19	3.82	3.32	2.55
879	4.03	4.29	3.02	4.42	4.30	3.97	3.57	3.34	4.25	3.84	3.31	2.52
880	4.47	4.72	3.36	4.85	4.70	4.16	3.97	3.74	4.66	4.24	3.70	2.87
881	4.16	4.38	3.16	4.52	4.38	3.87	3.69	3.48	4.34	3.96	3.47	2.67
882	3.51	3.88	2.93	4.03	3.92	3.70	3.42	3.26	3.89	3.60	3.22	2.59
883	3.7	4.12	3.06	4.28	4.13	3.93	xxx	3.42	4.14	3.79	3.36	2.70
884	4.26	4.60	3.34	4.75	4.61	4.06	xxx	3.69	4.58	4.18	3.68	2.88
885	4.77	4.79	3.43	4.89	4.77	4.24	xxx	3.84	4.72	4.32	3.80	2.94
886	4.14	4.27	3.04	4.41	4.30	3.98	xxx	3.40	4.27	3.90	3.38	2.56
887	3.38	3.72	2.76	3.93	3.86	3.54	xxx	3.03	3.82	3.49	3.06	2.36
888	3.94	4.18	3.14	4.38	4.34	xxx	3.69	3.50	4.25	3.90	3.50	2.79
889	5.26	5.05	3.57	5.12	5.04	xxx	4.30	4.06	4.94	4.51	4.00	3.11
890	3.75	3.70	2.43	3.68	3.52	3.27	2.98	2.79	3.49	3.19	2.80	2.08
891	3.1	3.48	2.43	3.53	3.42	3.19	2.91	2.74	3.38	3.13	2.77	2.14
892	4.79	4.96	3.33	5.11	5.00	xxx	4.22	3.97	4.89	4.47	3.91	2.99
893	5.14	5.17	3.41	5.26	5.12	xxx	4.34	4.08	5.04	4.57	3.99	3.03
894	4.45	4.58	2.99	4.64	4.53	4.15	3.76	3.51	xxx	4.02	3.47	2.59
895	3.12	3.52	2.41	3.66	3.62	3.26	2.90	2.70	xxx	3.20	2.76	2.06
896	3.97	4.26	3.11	4.40	4.38	xxx	3.73	3.54	4.29	3.98	3.56	2.85
897	5.41	5.43	3.69	5.48	5.35	xxx	4.63	4.38	5.27	4.84	4.28	3.34
898	4.85	4.92	3.18	4.99	4.83	4.41	3.97	3.67	4.77	4.29	3.70	2.70

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
899	4.13	4.23	2.89	4.37	4.27	3.87	3.42	3.14	4.20	3.79	3.27	2.38
900	xxx	4.22	3.04	4.36	4.25	3.94	3.58	3.37	4.20	3.86	3.46	2.80
901	xxx	5.32	3.50	5.38	5.19	4.82	4.44	4.19	5.15	4.68	4.13	3.27
902	5.72	5.43	3.27	5.46	5.30	4.75	4.19	3.82	5.22	4.64	3.92	2.79
903	3.99	3.99	2.63	4.10	4.06	3.58	3.11	2.81	3.96	3.54	3.02	2.18
904	5.04	xxx	3.42	5.10	5.00	xxx	4.14	3.85	4.60	4.49	3.94	3.05
905	6.08	xxx	3.80	5.87	5.70	xxx	4.82	4.52	5.31	5.12	4.48	3.43
906	5.52	xxx	3.55	5.46	5.26	4.42	4.33	4.01	5.18	4.69	4.06	3.02
907	4.65	xxx	3.21	4.88	4.72	3.88	3.80	3.50	4.64	4.20	3.62	2.68
908	4.84	xxx	3.41	4.99	4.90	3.88	4.00	3.73	4.74	4.37	3.81	2.89
909	6.21	xxx	3.93	6.05	5.90	4.82	4.90	4.58	5.71	5.23	4.54	3.45
910	6.21	5.57	3.50	5.63	5.40	4.81	4.27	3.91	5.29	4.70	3.94	2.76
911	4.98	4.66	3.13	4.83	4.68	4.15	3.66	3.37	4.58	4.10	3.47	2.46
912	5.18	xxx	3.55	5.35	5.20	xxx	4.25	3.98	5.02	4.62	4.02	3.02
913	5.87	xxx	3.76	5.82	5.61	xxx	4.61	4.30	5.44	4.97	4.30	3.18
914	5.55	5.33	3.56	5.45	5.27	xxx	4.25	3.92	5.16	4.64	3.96	2.88
915	4.75	4.70	3.24	4.85	4.75	xxx	3.75	3.46	4.63	4.18	3.56	2.59
916	4.98	xxx	3.54	5.14	5.06	xxx	4.14	3.89	4.87	4.52	3.93	2.99
917	5.73	xxx	3.84	5.78	5.60	xxx	4.66	4.36	5.44	5.01	4.34	3.28
918	5.56	5.36	3.67	5.66	5.46	xxx	4.42	4.08	5.36	4.82	4.11	2.98
919	4.33	4.21	3.01	4.49	4.38	xxx	3.39	3.09	4.28	3.85	3.26	2.34
920	4.9	xxx	3.59	5.24	5.15	xxx	4.29	4.03	4.38	4.67	xxx	3.19
921	5.65	xxx	3.91	5.79	5.62	xxx	4.75	4.47	4.85	5.09	xxx	3.44
922	4.85	4.75	3.45	4.92	4.75	xxx	3.94	3.67	4.67	4.27	3.74	2.82
923	4.43	4.73	3.41	4.85	4.72	xxx	3.92	3.66	4.65	4.27	3.75	2.86
924	4.11	4.51	3.24	4.64	4.50	xxx	3.77	3.54	4.45	4.07	3.58	2.73
925	4.93	4.90	3.49	5.00	4.87	xxx	4.11	3.86	4.79	4.39	3.86	2.94
926	4.53	4.48	3.13	4.57	4.44	4.07	3.65	3.42	4.37	3.96	3.42	2.56
927	4.18	4.39	3.18	4.54	4.42	4.08	3.70	3.49	4.35	3.99	3.49	2.71
928	4.27	4.37	3.05	4.48	4.39	4.03	3.65	3.41	4.32	3.92	3.37	2.51
929	3.88	3.92	2.79	4.04	3.95	3.58	3.21	2.98	3.89	3.50	3.00	2.24

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
930	3.64	3.83	2.82	3.95	3.90	3.62	3.30	3.12	3.84	3.51	3.09	2.42
931	3.93	4.22	3.05	4.33	4.27	4.00	3.67	3.48	4.21	3.86	3.41	2.65
932	3.76	4.10	2.90	4.24	4.14	3.81	3.49	3.28	4.08	3.71	3.22	2.41
933	3.52	3.86	2.79	4.05	3.93	xxx	3.25	3.05	3.88	3.51	3.03	2.27
934	3.27	3.57	2.64	3.75	3.66	xxx	3.07	2.91	3.62	3.29	2.87	2.24
935	3.75	4.04	2.88	4.17	4.09	xxx	3.51	3.33	4.03	3.69	3.24	2.52
936	3.53	3.81	2.61	3.93	3.82	xxx	3.18	2.97	3.77	3.41	2.92	2.14
937	2.88	3.32	2.38	3.56	3.44	xxx	2.85	2.66	3.64	3.11	2.66	1.98
938	3.11	3.45	2.51	3.61	3.55	xxx	3.00	2.84	3.50	3.19	2.76	2.11
939	3.6	3.97	2.78	4.11	4.06	xxx	3.47	3.29	4.02	3.63	3.15	2.41
940	3.22	3.47	2.37	3.55	3.54	xxx	3.00	2.83	3.50	3.17	2.73	1.92
941	xxx	1.89	1.31	1.90	xxx	xxx	xxx	xxx	xxx	xxx	xxx	xxx
942	2.53	3.05	2.43	3.24	3.21	xxx	2.86	2.75	3.16	xxx	xxx	xxx
943	3.46	3.75	2.88	3.94	3.88	xxx	3.50	3.38	3.83	3.59	3.28	2.72
944	2.78	3.18	2.46	3.38	3.31	xxx	2.92	2.82	3.29	3.07	2.78	2.28
945	2.35	2.73	2.10	2.92	2.86	2.69	2.46	2.39	2.84	2.64	2.38	1.95
946	xxx	2.50	1.93	2.59	2.63	2.48	2.26	2.18	2.61	2.45	2.20	1.86
947	xxx	3.96	2.87	4.01	3.99	3.81	3.56	xxx	xxx	xxx	xxx	xxx
948	3.24	3.33	2.22	3.24	3.12	2.87	2.56	2.38	3.10	2.77	2.37	1.70
949	xxx	2.39	1.80	2.39	2.32	2.12	1.89	1.77	3.03	2.07	1.86	1.44
950	xxx	4.17	3.20	4.29	4.24	xxx	3.82	3.71	4.17	3.96	3.67	3.10
951	xxx	4.05	2.97	4.16	4.13	xxx	3.61	3.45	4.10	3.81	3.40	2.71
952	3.21	3.58	2.74	3.78	3.69	3.46	3.19	3.03	3.66	3.41	3.05	2.45
953	2.15	2.70	2.01	2.90	2.87	2.66	2.40	2.27	2.80	2.61	2.30	1.87
954	2.59	3.11	2.40	3.30	3.34	xxx	2.88	2.76	3.25	3.05	2.75	2.32
955	3.91	4.28	3.31	4.43	4.40	xxx	3.90	3.76	4.34	4.07	3.70	3.05
956	3.55	3.96	3.00	4.11	4.05	3.79	3.48	3.32	4.04	3.75	3.37	2.71
957	2.66	3.21	2.44	3.41	3.38	3.14	2.85	2.72	3.36	3.11	2.79	2.25
958	3.11	3.68	2.83	3.92	3.85	xxx	3.29	3.14	3.81	3.55	3.20	2.61
959	4.17	4.55	3.47	4.74	4.64	xxx	4.06	3.89	4.59	4.29	3.87	3.14
960	4.02	4.34	3.21	4.47	4.37	3.96	3.68	3.46	4.34	4.00	3.57	2.79

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
961	3.11	3.59	2.68	3.77	3.71	3.34	3.10	2.91	3.73	3.38	3.02	2.37
962	3.63	3.96	3.05	4.25	4.18	xxx	3.53	3.34	4.12	3.83	3.43	2.76
963	4.62	4.83	3.67	5.09	5.28	xxx	4.29	4.10	4.91	4.56	4.08	3.28
964	4.42	4.56	3.33	4.73	xxx	4.15	xxx	xxx	4.54	4.14	3.64	2.78
965	3.87	4.11	3.04	4.35	xxx	3.77	3.41	3.19	4.17	3.80	3.35	2.55
966	3.89	4.20	3.11	4.37	xxx	3.78	3.55	3.32	4.23	3.87	3.43	2.66
967	4.99	5.14	3.67	5.24	xxx	4.59	4.34	4.08	5.20	4.62	4.09	3.20
968	4.95	4.85	3.28	4.80	xxx	4.20	3.97	3.41	4.50	4.07	3.49	2.50
969	4.16	4.23	3.00	4.25	xxx	3.70	3.27	3.00	4.64	3.63	3.14	2.29
970	4.19	4.24	3.12	4.43	xxx	4.02	3.75	3.47	4.28	3.90	3.45	2.67
971	4.93	4.73	3.35	4.81	xxx	4.35	3.96	3.75	4.64	4.21	3.68	2.81
972	xxx	5.07	3.68	5.16	4.99	xxx	4.13	3.82	4.93	4.44	3.80	2.82
973	xxx	4.57	3.21	4.73	4.56	xxx	3.67	3.42	4.50	4.05	3.47	2.56
974	4.53	4.62	3.40	4.81	4.70	xxx	3.95	3.74	4.63	4.24	3.74	2.92
975	5.27	5.24	3.70	5.37	5.22	xxx	4.42	4.17	xxx	4.70	4.12	3.19
976	5.21	5.13	3.48	5.28	5.11	xxx	4.13	3.82	xxx	4.50	3.83	2.81
977	4.83	4.77	3.32	4.95	4.79	xxx	3.84	3.55	4.71	4.24	3.61	2.64
978	4.76	4.90	3.50	5.07	4.94	xxx	4.12	3.88	4.85	4.42	3.86	2.96
979	5.33	5.44	3.71	5.56	5.39	xxx	4.50	4.22	5.32	4.81	4.18	3.18
980	5.21	5.03	3.33	5.09	4.91	4.44	3.99	3.63	4.85	4.32	3.65	2.63
981	5.02	4.93	3.36	5.03	4.85	4.40	3.94	3.64	4.79	4.29	3.66	2.70
982	xxx	5.31	3.53	5.43	5.25	xxx	4.24	3.92	5.17	4.61	3.91	2.85
983	xxx	4.94	3.34	5.09	4.93	xxx	3.94	3.63	5.44	4.33	3.65	2.65
984	5.07	4.95	3.45	5.14	4.96	xxx	4.30	3.84	4.89	4.41	3.80	2.84
985	4.93	4.90	3.37	5.02	4.84	xxx	3.98	3.70	xxx	4.29	3.71	2.74
986	5.02	4.96	3.65	5.36	5.20	xxx	4.35	4.08	xxx	4.66	4.09	3.15
987	5.05	4.75	3.51	5.21	5.05	xxx	4.18	3.91	4.92	4.51	3.93	2.96
988	4.73	4.71	3.39	4.90	4.76	xxx	3.93	3.67	4.69	4.27	3.73	2.84
989	4.93	5.05	3.63	5.20	5.06	xxx	4.26	4.00	4.98	4.56	4.01	3.12
990	4.3	4.55	3.23	4.68	4.53	xxx	3.80	3.55	4.47	4.07	3.54	2.69
991	4.01	4.55	3.20	4.66	4.52	4.19	3.82	3.58	4.47	4.09	3.58	2.73

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
992	4.39	4.67	3.18	4.66	4.51	4.15	3.73	3.48	4.45	4.04	3.45	2.59
993	5.31	5.27	3.57	5.33	5.16	4.75	4.28	3.99	5.08	4.60	3.94	3.01
994	xxx	4.31	2.80	4.25	xxx	xxx	3.51	3.23	4.19	3.75	3.18	2.21
995	xxx	3.35	2.39	3.35	3.39	xxx	2.79	2.61	3.35	3.01	2.59	1.84
996	xxx	4.11	2.95	4.29	4.18	3.84	3.50	3.32	4.13	3.74	3.29	2.57
997	3.68	3.70	2.63	3.74	3.64	3.31	3.01	2.83	3.60	3.24	2.81	2.19
998	3.99	4.23	3.16	4.38	4.24	xxx	3.73	3.59	4.18	3.90	3.52	2.86
999	3.55	3.95	2.85	4.16	4.03	xxx	3.51	3.37	3.97	3.69	3.31	2.57
1000	3.67	3.98	3.02	4.09	4.05	xxx	3.50	3.34	4.00	3.73	3.36	2.69
1001	4.7	4.92	3.62	5.01	4.92	xxx	4.30	4.11	4.88	4.53	4.04	3.22
1002	4.09	4.42	3.17	4.54	4.36	4.02	3.64	3.42	4.36	3.97	3.48	2.67
1003	2.98	3.56	2.60	3.71	3.65	3.31	2.98	2.77	3.62	3.27	2.86	2.23
1004	3.59	4.10	3.07	4.24	4.23	xxx	3.57	3.35	4.16	3.84	3.41	2.74
1005	4.85	5.14	3.70	5.18	5.06	xxx	4.38	4.17	4.99	4.63	4.12	3.27
1006	4.31	4.64	3.23	4.73	4.56	4.16	3.77	3.52	4.52	4.10	3.55	2.70
1007	3.12	3.45	2.49	3.65	3.58	3.20	2.85	2.63	3.52	3.17	2.73	2.10
1008	3.34	3.78	2.87	3.97	3.93	xxx	3.38	3.22	3.84	3.58	3.20	2.61
1009	5.18	5.35	3.82	5.42	5.27	xxx	4.62	4.40	5.19	4.81	4.27	3.40
1010	4.5	4.55	3.01	4.55	4.37	3.93	3.49	3.19	4.33	3.85	3.23	2.28
1011	3.48	3.92	2.79	4.05	3.94	3.53	3.14	2.89	3.90	3.51	2.99	2.18
1012	4.35	4.49	3.13	4.60	4.47	4.05	3.62	3.34	4.36	3.93	3.34	2.43
1013	5.53	5.69	3.75	5.69	5.51	5.00	4.45	4.08	5.53	4.82	4.07	2.92
1014	4.97	4.99	2.99	4.95	4.81	4.26	3.92	3.27	4.72	4.13	3.38	2.19
1015	3.57	3.57	2.34	3.64	3.59	3.13	2.67	2.36	3.50	3.07	2.52	1.64
1016	4.97	4.73	3.40	5.16	5.08	xxx	4.08	3.77	4.88	4.50	3.90	2.94
1017	5.49	5.10	3.49	5.49	5.35	xxx	4.32	4.00	5.17	4.71	4.02	2.93
1018	5.23	5.10	3.44	5.26	5.13	xxx	4.07	3.81	4.99	4.54	3.92	2.87
1019	4.42	4.44	3.07	4.64	4.55	xxx	3.61	3.31	4.40	4.00	3.45	2.53
1020	4.65	4.44	3.44	5.00	4.96	xxx	4.10	3.84	4.66	4.43	3.88	3.02
1021	5.33	4.94	3.68	5.47	5.37	xxx	4.44	4.15	5.08	4.80	4.18	3.20
1022	5.22	4.94	3.45	5.09	4.95	xxx	xxx	3.69	4.81	4.35	3.73	2.72

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1023	5.01	4.93	3.45	5.13	4.99	xxx	4.04	3.74	5.17	4.40	3.80	2.82
1024	5.24	xxx	3.67	5.54	5.40	xxx	4.42	4.10	5.13	4.79	4.13	3.07
1025	5.24	xxx	3.40	5.05	4.93	xxx	3.96	3.65	4.66	4.34	3.74	2.76
1026	4.79	4.49	3.46	4.95	4.84	xxx	4.01	3.76	4.64	4.33	3.80	2.93
1027	5.07	4.71	3.62	5.21	5.06	xxx	4.23	4.00	4.86	4.55	4.00	3.11
1028	4.62	4.41	3.10	4.65	4.48	3.98	3.58	3.31	4.36	3.93	3.38	2.48
1029	5.25	5.20	3.53	5.35	5.18	4.65	4.24	3.93	5.05	4.56	3.93	2.92
1030	5.51	5.24	3.32	5.31	5.11	4.56	4.03	3.64	4.97	4.42	3.71	2.56
1031	4.87	4.77	3.15	4.89	4.76	4.25	3.76	3.40	4.62	4.14	3.49	2.44
1032	4.75	4.79	3.14	4.90	4.78	4.30	3.81	3.47	4.65	4.17	3.52	2.51
1033	4.85	4.92	3.20	4.99	4.88	4.40	3.91	3.55	4.75	4.26	3.60	2.58
1034	4.79	4.82	3.18	4.94	4.82	4.34	3.89	3.53	4.68	4.23	3.59	2.55
1035	4.54	4.65	3.13	4.81	4.65	4.18	3.74	3.41	4.51	4.07	3.47	2.49
1036	4.45	4.60	3.11	4.77	4.64	4.19	3.77	3.43	4.52	4.09	3.49	2.56
1037	4.58	4.48	3.03	4.62	4.54	4.10	3.69	3.36	4.41	4.00	3.41	2.50
1038	3.98	4.16	2.85	4.27	4.21	3.78	3.40	3.09	4.09	3.67	3.13	2.26
1039	4.65	4.93	3.21	4.99	4.88	4.42	4.00	3.62	4.75	4.26	3.64	2.64
1040	4.29	4.46	2.76	4.51	4.35	3.85	3.39	2.96	4.22	3.71	3.04	1.95
1041	3.47	3.86	2.55	4.02	3.89	3.42	3.00	2.62	3.78	3.34	2.75	1.79
1042	3.71	4.10	2.70	4.08	4.04	3.62	3.20	2.89	3.89	3.48	2.94	2.04
1043	4.09	4.40	2.82	4.33	4.29	3.86	3.43	3.10	4.13	3.70	3.12	2.18
1044	3.77	4.10	2.68	4.21	4.10	3.67	3.23	2.86	3.97	3.54	2.92	1.96
1045	3.25	3.86	2.60	4.08	3.98	3.56	3.14	2.80	3.88	3.47	2.88	1.95
1046	xxx	3.87	2.57	4.06	3.96	3.52	3.09	2.75	3.85	3.42	2.82	1.85
1047	xxx	3.85	2.59	3.98	3.84	3.42	2.99	2.62	3.72	3.31	2.75	1.85
1048	xxx	3.89	2.73	4.08	3.90	3.54	3.19	2.88	3.80	3.42	2.94	2.11
1049	xxx	3.14	2.20	3.31	3.20	2.83	2.49	2.19	3.12	2.76	2.30	1.56
1050	2.86	3.34	2.49	3.48	3.46	3.15	2.85	2.57	3.40	3.10	2.70	2.11
1051	2.91	3.30	2.40	3.44	3.40	3.08	2.74	2.49	3.31	3.00	2.63	2.04
1052	2.99	3.40	2.58	3.58	3.56	3.25	2.94	2.72	3.46	3.17	2.81	2.22
1053	2.46	3.02	2.20	3.16	3.11	2.90	2.61	2.38	3.12	2.82	2.45	1.90

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1054	2.22	2.88	2.23	2.98	3.04	2.84	2.59	2.40	2.99	2.74	2.44	2.04
1055	3.24	3.76	2.87	3.91	3.89	3.67	3.39	3.22	3.81	3.56	3.18	2.60
1056	2.92	3.39	2.48	3.56	3.49	3.20	2.88	2.65	3.40	3.11	2.66	2.01
1057	1.97	2.55	1.90	2.68	2.72	2.45	2.16	1.92	2.62	2.38	2.04	1.53
1058	2.15	2.80	2.16	2.84	2.90	2.70	2.47	2.27	2.82	2.63	2.37	1.95
1059	2.97	3.63	2.76	3.69	3.66	3.44	3.20	3.01	3.57	3.34	2.99	2.44
1060	3.1	3.61	2.68	3.76	3.68	3.38	3.17	2.86	3.55	3.27	2.86	2.22
1061	1.89	2.55	1.87	2.71	2.65	2.37	2.02	1.83	2.58	2.30	1.96	1.47
1062	2.13	2.96	2.33	3.12	3.09	2.91	2.67	2.50	3.04	2.83	2.57	2.21
1063	3.15	3.75	2.89	3.88	3.82	3.62	3.37	3.23	3.74	3.52	3.17	2.66
1064	2.6	3.26	2.48	3.45	3.36	3.11	2.88	2.74	3.28	3.04	2.68	2.19
1065	2.07	2.72	2.08	2.93	2.86	2.62	2.41	2.26	2.78	2.57	2.27	1.86
1066	2.36	2.98	2.32	3.15	3.12	2.93	2.73	2.60	3.03	2.84	2.54	2.13
1067	3.35	3.88	3.00	4.06	3.97	3.74	3.51	3.37	3.88	3.63	3.25	2.67
1068	3.35	3.75	2.77	3.86	3.74	3.42	3.15	2.98	3.68	3.36	2.93	2.26
1069	2.42	3.07	2.31	3.20	3.15	2.87	2.61	2.43	3.09	2.82	2.46	1.91
1070	3.04	3.60	2.74	3.78	3.75	3.51	3.25	3.08	3.64	3.40	3.03	2.43
1071	4.07	4.42	3.28	4.60	4.48	4.22	3.92	3.74	4.40	4.09	3.63	2.86
1072	3.82	4.02	2.90	4.05	3.88	3.57	3.26	3.06	3.80	3.46	2.98	2.25
1073	3.42	3.85	2.81	3.92	3.83	3.50	3.21	3.05	3.84	3.39	2.95	2.26
1074	3.38	3.33	2.39	3.31	3.32	3.04	2.95	2.59	xxx	2.92	2.50	1.78
1075	3.99	3.66	2.63	3.55	3.52	3.25	2.96	2.75	xxx	3.12	2.68	1.96
1076	4.53	4.60	3.16	4.76	4.64	4.22	3.82	3.53	xxx	4.05	3.46	2.52
1077	3.96	4.16	2.90	4.40	4.26	3.84	3.43	3.17	4.14	3.70	3.12	2.21
1078	4.02	4.37	3.18	4.60	4.50	4.06	3.75	3.52	4.40	4.02	3.52	2.72
1079	4.93	4.99	3.44	5.10	4.98	4.53	4.21	3.96	4.87	4.41	3.84	2.91
1080	5.11	5.07	3.35	5.16	4.93	4.41	3.88	3.47	4.86	4.34	3.68	2.66
1081	4.77	4.88	3.27	5.02	4.88	4.38	3.90	3.49	4.74	4.24	3.59	2.60
1082	4.89	4.99	3.40	5.08	4.97	4.36	3.78	3.27	4.85	4.37	3.75	2.74
1083	5.51	5.39	3.60	5.46	5.35	4.73	4.13	3.59	5.19	4.66	4.00	2.94
1084	4.95	4.68	2.90	4.53	4.38	3.71	3.05	2.45	4.25	3.65	3.00	2.03

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1085	xxx	5.01	3.10	4.90	4.74	4.04	3.36	2.75	4.63	4.00	3.32	2.28
1086	xxx	5.18	3.10	5.19	5.03	4.21	3.37	2.69	4.89	4.26	3.46	2.25
1087	5.74	5.46	3.26	5.50	5.34	4.47	3.61	2.92	5.21	4.53	3.70	2.44
1088	6.09	5.36	3.12	5.39	5.21	4.33	3.45	2.69	5.08	4.40	3.54	2.07
1089	4.75	4.17	2.58	4.23	4.07	3.29	2.49	1.78	4.16	3.46	2.77	1.58
1090	5.57	xxx	3.62	5.70	5.55	xxx	3.79	3.08	5.28	4.90	4.20	3.07
1091	5.42	xxx	3.35	5.33	5.17	xxx	3.44	2.74	4.90	4.46	3.74	2.62
1092	5.4	4.67	3.58	5.42	5.21	xxx	3.56	2.89	4.92	4.61	3.97	2.95
1093	5.97	5.24	3.84	5.99	5.76	xxx	4.11	3.40	5.43	5.08	4.38	3.26
1094	5.45	xxx	3.68	5.62	5.44	4.59	3.66	2.87	5.29	4.78	4.06	2.96
1095	5.06	xxx	3.54	5.36	5.20	4.34	3.41	2.64	5.06	4.57	3.90	2.84
1096	5.3	xxx	3.67	5.55	5.33	4.36	3.49	2.70	5.15	4.69	4.02	2.93
1097	5.86	xxx	3.89	5.97	5.74	4.75	3.87	3.05	5.54	5.05	4.32	3.16
1098	5.35	5.40	3.64	5.61	5.41	4.48	3.55	2.74	5.28	4.71	3.99	2.85
1099	4.55	4.80	3.35	5.07	4.87	3.95	3.05	2.28	4.77	4.26	3.60	2.58
1100	4.72	4.82	3.50	5.14	4.95	4.18	3.37	2.69	4.84	4.38	3.76	2.79
1101	5.69	5.62	3.88	5.84	5.66	4.86	4.00	3.28	5.53	4.99	4.30	3.19
1102	4.98	5.18	3.36	5.28	5.14	4.37	3.56	2.86	4.99	4.42	3.68	2.55
1103	3.93	4.24	2.93	4.46	4.28	3.54	2.76	2.11	4.19	3.72	3.09	2.15
1104	4.1	4.40	3.16	4.61	4.45	3.88	3.26	2.75	4.36	3.93	3.39	2.56
1105	4.97	5.23	3.57	5.31	5.16	4.56	3.92	3.36	5.04	4.54	3.94	2.97
1106	4.47	4.85	3.21	4.96	4.79	4.14	3.48	2.87	4.67	4.14	3.47	2.40
1107	3.46	4.10	2.87	4.37	4.21	3.60	2.96	2.41	4.12	3.67	3.06	2.13
1108	3.65	4.25	3.07	4.49	4.35	3.82	3.23	2.73	4.26	3.85	3.31	2.47
1109	4.78	5.06	3.44	5.16	5.02	4.45	3.83	3.28	4.89	4.39	3.77	2.78
1110	4.15	4.55	3.01	4.65	4.51	3.94	3.32	2.78	4.39	3.89	3.26	2.29
1111	3.21	3.85	2.69	4.09	3.95	3.40	2.82	2.31	3.87	3.44	2.87	2.01
1112	3.35	3.79	2.74	3.99	3.90	3.45	2.99	2.56	3.80	3.42	2.91	2.14
1113	4.19	4.45	3.09	4.53	4.44	3.96	3.45	2.99	4.31	3.88	3.33	2.47
1114	4.15	4.70	2.94	4.62	4.49	3.90	3.33	2.84	4.36	3.83	3.18	2.17
1115	3.45	4.21	2.69	4.19	4.07	3.51	2.97	2.52	3.95	3.49	2.89	1.99

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1116	xxx	3.44	2.34	3.48	3.52	3.16	2.76	2.40	3.40	3.09	2.65	1.93
1117	xxx	4.20	2.74	4.14	4.14	3.72	3.28	2.87	4.15	3.61	3.07	2.18
1118	5.05	5.14	3.11	5.24	5.09	4.35	3.68	3.09	4.94	4.33	3.59	2.39
1119	4.09	4.31	2.76	4.48	4.38	3.70	3.07	2.52	4.24	3.71	3.07	2.04
1120	3.59	3.99	2.73	4.14	4.06	3.58	3.09	2.63	3.96	3.54	3.03	2.21
1121	4.06	4.20	2.84	4.31	4.23	3.74	3.25	2.77	4.12	3.69	3.15	2.29
1122	4.25	4.46	2.98	4.57	4.49	3.94	3.38	2.87	4.38	3.94	3.37	2.50
1123	3.97	4.45	2.93	4.59	4.51	3.98	3.43	2.92	4.41	3.95	3.36	2.46
1124	3.96	4.38	2.91	4.53	4.41	3.86	3.26	2.70	4.31	3.85	3.25	2.35
1125	4.59	4.85	3.14	4.94	4.83	4.24	3.61	3.05	4.70	4.20	3.57	2.57
1126	4.37	4.60	2.88	4.70	4.52	3.85	3.17	xxx	4.41	3.89	3.22	2.18
1127	4.03	4.51	2.85	4.68	4.52	3.84	3.15	2.54	4.39	3.89	3.22	2.19
1128	4.36	4.62	2.90	4.74	4.58	3.90	3.15	2.51	4.46	3.94	3.25	2.18
1129	4.66	4.83	2.98	4.90	4.76	4.05	3.30	2.65	4.62	4.07	3.36	2.23
1130	4.76	4.86	2.99	4.75	4.58	3.88	3.16	2.52	4.04	3.90	3.19	2.08
1131	4.72	4.89	3.02	4.85	4.67	3.96	3.23	2.60	5.42	3.98	3.28	2.17
1132	4.93	4.67	2.82	4.79	4.64	3.90	3.18	2.55	4.48	3.91	3.18	1.96
1133	4.29	3.95	2.52	3.94	3.78	3.05	2.36	1.76	3.93	3.18	2.54	1.60
1134	5.06	4.94	3.41	5.34	5.19	4.28	3.80	3.26	4.99	4.55	3.89	2.88
1135	5.1	5.01	3.37	5.51	5.34	4.47	3.99	3.42	5.14	4.64	3.95	2.79
1136	4.72	5.01	3.37	5.19	5.06	4.45	3.88	3.40	4.91	4.40	3.77	2.77
1137	4.75	4.98	3.33	5.14	5.00	4.38	3.81	3.34	4.85	4.35	3.72	2.72
1138	4.38	4.63	3.15	4.73	4.57	4.09	3.60	3.21	4.44	3.99	3.42	2.55
1139	5.11	5.29	3.43	5.37	5.18	4.64	4.08	3.67	5.06	4.52	3.86	2.84
1140	5	5.12	xxx	5.24	5.06	4.44	3.84	3.36	4.92	4.33	3.61	2.47
1141	4.23	4.57	xxx	4.73	4.60	4.02	3.49	3.02	4.49	3.96	3.32	2.31
1142	4.52	4.72	3.16	4.78	4.66	4.18	4.20	3.31	4.54	4.04	3.44	2.47
1143	4.76	4.88	3.23	4.93	4.79	4.30	3.80	3.41	4.64	4.14	3.52	2.52
1144	4.97	5.25	3.58	5.61	5.47	xxx	4.34	3.92	5.31	4.77	4.11	3.06
1145	4.61	4.61	3.18	4.96	4.84	xxx	3.76	3.37	4.69	4.17	3.54	2.55
1146	4.12	4.29	3.05	4.48	4.38	3.95	3.56	3.26	4.26	3.84	3.30	2.48

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1147	4.78	4.99	3.44	5.15	5.02	4.54	4.12	3.79	4.89	4.43	3.85	2.94
1148	4.36	4.71	3.07	4.72	4.64	4.15	3.71	3.35	4.50	4.02	3.42	2.47
1149	3.52	3.90	2.67	3.94	3.88	3.44	3.03	2.69	3.79	3.38	2.87	2.09
1150	3.39	3.73	2.76	3.91	3.83	3.52	3.24	3.01	3.74	3.40	3.00	2.38
1151	3.75	4.11	2.95	4.22	4.13	3.78	3.50	3.26	4.05	3.67	3.22	2.51
1152	3.96	4.36	3.15	4.47	4.36	3.99	3.70	3.46	4.28	3.89	3.42	2.68
1153	3.55	4.00	2.94	4.22	4.12	3.77	3.47	3.25	4.03	3.69	3.23	2.49
1154	3.6	3.86	2.87	4.01	3.93	3.58	3.30	3.10	3.84	3.50	3.06	2.34
1155	4.21	4.58	3.27	4.67	4.57	4.21	3.91	3.68	4.48	4.09	3.61	2.79
1156	4.13	4.53	3.08	4.60	4.52	4.11	3.72	3.43	4.41	3.96	3.41	2.52
1157	2.78	3.43	2.42	3.58	3.56	3.17	2.81	2.57	3.93	3.09	2.64	1.95
1158	3.29	3.70	2.80	3.84	3.85	3.57	3.32	3.14	3.68	3.46	3.07	2.47
1159	3.98	4.13	3.07	4.25	4.22	3.94	3.66	3.49	4.13	3.80	3.37	2.67
1160	3.79	4.21	3.11	4.37	4.30	3.97	3.67	3.48	4.22	3.86	3.41	2.67
1161	2.7	3.39	2.43	3.60	3.59	3.27	2.99	2.80	3.71	3.18	2.77	2.14
1162	2.85	3.37	2.53	3.43	3.45	3.25	3.06	2.93	3.39	3.14	2.81	2.31
1163	3.73	4.05	3.09	4.06	4.03	3.82	3.60	3.47	4.19	3.69	3.33	2.74
1164	3.4	3.89	2.91	4.01	3.98	3.72	3.44	3.28	xxx	3.58	3.17	2.54
1165	2.3	3.02	2.21	3.19	3.22	2.97	2.73	2.58	xxx	2.87	2.51	1.98
1166	2.44	3.08	2.37	3.19	3.24	3.07	2.90	2.85	xxx	2.94	2.66	2.21
1167	3.35	3.71	2.88	3.76	3.74	3.56	3.37	3.31	3.69	3.42	3.09	2.57
1168	3.03	3.77	2.89	3.94	3.88	xxx	3.53	3.46	3.82	3.58	3.28	2.77
1169	2.21	2.72	2.00	2.87	2.87	xxx	2.54	2.47	2.80	2.58	2.34	1.91
1170	1.87	2.11	1.69	2.30	2.32	2.24	2.17	2.15	2.29	2.13	1.96	1.71
1171	3.29	3.45	2.78	3.60	3.56	3.44	3.32	3.28	3.52	3.33	3.07	2.66
1172	2.88	3.26	2.50	3.41	3.31	3.14	2.97	2.89	3.29	3.06	2.78	2.30
1173	2.24	2.62	2.04	2.78	2.73	2.58	2.42	2.34	2.70	2.52	2.28	1.88
1174	2.05	2.54	2.00	2.70	2.67	2.53	2.40	2.35	2.63	2.48	2.25	1.92
1175	3.21	3.81	2.87	3.92	3.80	3.65	3.50	3.44	3.76	3.56	3.24	2.75
1176	3.38	3.48	2.40	3.50	3.36	3.11	2.86	2.71	3.36	3.09	2.67	2.05
1177	2.3	2.67	2.00	2.82	2.75	2.53	2.31	2.18	2.71	2.54	2.24	1.78

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1178	2.75	3.34	2.54	3.53	3.48	3.29	3.08	2.97	3.42	3.22	2.92	2.40
1179	3.32	3.94	2.81	4.00	3.89	3.68	3.47	3.35	3.86	3.59	3.20	2.58
1180	3.71	4.15	2.86	4.03	3.89	3.63	2.42	3.21	3.84	3.52	3.12	2.43
1181	2.94	3.47	2.49	3.52	3.45	3.21	2.96	2.80	3.46	3.11	2.75	2.16
1182	3.28	3.82	2.89	4.03	3.98	3.73	3.48	3.31	3.92	3.64	3.25	2.64
1183	3.84	4.17	3.09	4.31	4.22	3.97	3.71	3.55	4.17	3.85	3.42	2.72
1184	3.96	4.41	3.28	4.67	4.58	4.03	3.91	3.72	4.49	4.13	3.70	2.94
1185	4.07	4.27	3.18	4.51	4.47	3.92	3.83	3.63	4.34	3.99	3.56	2.80
1186	3.61	3.99	2.97	4.19	4.15	3.86	3.59	3.37	4.08	3.78	3.36	2.65
1187	4.4	4.46	3.25	4.64	4.54	4.25	3.96	3.73	4.48	4.13	3.69	2.91
1188	4.47	4.41	3.10	4.59	4.45	4.05	3.68	3.37	4.38	3.96	3.42	2.54
1189	4.55	4.88	3.36	5.04	4.90	4.49	4.09	3.76	4.81	4.36	3.78	2.87
1190	xxx	4.93	3.26	5.03	4.88	4.37	3.87	3.49	4.76	4.23	3.60	2.58
1191	xxx	4.77	3.20	4.90	4.76	4.26	3.78	3.40	4.64	4.14	3.52	2.55
1192	5.16	5.15	3.40	5.16	5.01	4.51	3.97	3.56	4.85	4.33	3.67	2.65
1193	5.19	5.26	3.45	5.28	5.13	4.61	4.07	3.66	4.94	4.42	3.76	2.72
1194	5.11	4.99	3.27	5.04	4.90	4.38	3.86	3.45	4.75	4.22	3.56	2.49
1195	5.21	5.00	3.30	5.08	4.93	4.42	3.90	3.49	5.14	4.25	3.60	2.54
1196	xxx	5.10	3.27	5.10	4.97	4.36	3.78	3.34	4.79	4.22	3.52	2.37
1197	xxx	5.55	3.45	5.49	5.37	4.71	4.11	3.67	5.42	4.53	3.78	2.59
1198	5.67	5.37	3.23	5.45	5.26	4.46	3.65	3.00	5.09	4.43	3.60	2.27
1199	5.16	4.99	3.08	5.09	4.93	4.19	3.41	2.75	4.79	4.17	3.40	2.20
1200	5.31	5.15	3.23	5.35	5.15	4.26	3.38	2.59	5.02	4.39	3.60	2.33
1201	6.28	5.85	3.52	5.98	5.75	4.81	3.91	3.08	5.56	4.87	3.99	2.58
1202	5.85	5.49	3.15	5.58	5.31	4.24	3.25	2.31	5.14	4.42	3.51	2.06
1203	5.3	5.02	3.01	5.16	4.92	3.88	2.91	2.00	4.79	4.14	3.33	1.99
1204	5.15	5.07	3.08	5.21	4.98	3.92	2.92	1.99	4.86	4.23	3.41	2.07
1205	6.5	6.15	3.52	6.21	5.89	4.74	3.67	2.72	5.73	4.94	3.98	2.41
1206	5.96	5.59	2.90	5.58	5.21	3.97	2.85	xxx	5.07	4.27	3.30	1.68
1207	4.93	4.87	2.66	4.95	4.69	3.55	2.52	xxx	4.57	3.90	3.05	1.62
1208	5.18	4.96	2.76	5.08	4.80	3.61	2.52	xxx	4.69	3.99	3.11	1.64

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1209	6.07	5.71	3.12	5.77	5.45	4.20	3.04	xxx	5.30	4.50	3.51	1.91
1210	5.55	5.28	2.67	5.33	4.99	3.62	xxx	xxx	4.85	4.04	3.05	xxx
1211	4.47	4.45	2.33	4.59	4.30	3.02	xxx	xxx	4.21	3.55	2.72	xxx
1212	4.66	4.59	2.51	4.73	4.44	3.20	xxx	xxx	4.34	3.70	2.87	xxx
1213	5.9	5.65	2.98	5.72	5.35	4.02	xxx	xxx	5.19	4.38	3.38	xxx
1214	5.38	5.21	2.46	5.26	4.85	3.47	xxx	xxx	4.71	3.90	2.87	xxx
1215	3.93	4.03	1.99	4.17	3.85	2.60	xxx	xxx	3.78	3.18	2.38	xxx
1216	4.44	4.51	2.50	4.62	4.33	3.17	xxx	xxx	4.24	3.62	2.82	xxx
1217	5.25	5.25	2.80	5.28	4.95	3.72	xxx	xxx	4.81	4.06	3.13	xxx
1218	4.89	xxx	2.53	5.07	4.71	3.51	xxx	xxx	4.57	3.82	2.87	xxx
1219	3.5	xxx	2.07	4.12	3.79	2.67	xxx	xxx	3.72	3.15	2.36	xxx
1220	3.77	4.23	2.45	4.31	4.09	3.15	xxx	xxx	3.99	3.46	2.72	xxx
1221	4.74	4.97	2.77	5.01	4.76	3.73	xxx	xxx	4.61	3.95	3.07	xxx
1222	4.78	4.75	2.49	4.65	4.40	3.44	2.53	xxx	4.25	3.58	2.73	xxx
1223	3.52	3.98	2.16	3.94	3.70	2.79	1.95	xxx	3.64	3.08	2.36	xxx
1224	3.73	4.35	2.61	4.46	4.24	3.42	2.60	xxx	4.13	3.59	2.86	1.59
1225	4.43	4.58	2.65	4.61	4.39	3.53	2.65	xxx	4.29	3.66	2.88	1.52
1226	4.25	4.63	2.79	4.69	4.48	3.71	2.91	2.20	4.35	3.79	3.07	1.80
1227	3.39	4.25	2.57	4.32	4.10	3.35	2.56	1.88	4.06	3.46	2.78	1.56
1228	3.72	4.48	2.87	4.66	4.49	3.76	3.03	2.38	4.38	3.86	3.20	1.96
1229	4.02	4.36	2.80	4.54	4.36	3.63	2.89	2.23	4.25	3.74	3.06	1.83
1230	3.73	4.20	2.73	4.32	4.13	3.49	2.86	2.31	4.02	3.53	2.95	1.88
1231	3.73	4.15	2.70	4.27	4.11	3.47	2.83	2.27	3.98	3.48	2.90	1.83
1232	3.79	4.32	2.89	4.38	4.29	3.69	3.10	2.54	4.18	3.72	3.14	2.09
1233	4.03	4.31	2.89	4.37	4.25	3.65	3.07	2.51	4.15	3.68	3.10	2.07
1234	3.77	4.24	2.92	4.45	4.35	3.80	3.25	2.75	4.24	3.81	3.26	2.29
1235	4.11	4.37	2.93	4.54	4.44	3.88	3.33	2.81	4.32	3.86	3.28	2.24
1236	3.86	4.01	2.69	4.11	3.99	3.46	2.96	2.48	3.86	3.40	2.84	1.90
1237	4.04	4.33	2.85	4.42	4.30	3.74	3.21	2.72	4.18	3.69	3.09	2.08
1238	4.4	4.67	2.91	4.74	4.59	3.94	3.34	2.78	4.45	3.88	3.20	2.05
1239	4.53	4.95	3.03	5.00	4.83	4.15	3.54	2.97	4.69	4.10	3.38	2.15

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1240	4.29	4.56	2.72	4.59	4.42	3.77	3.14	2.58	4.27	3.71	2.98	1.80
1241	3.86	4.19	2.60	4.26	4.14	3.53	2.91	2.36	4.00	3.50	2.81	1.69
1242	4.34	4.63	2.92	4.72	4.56	3.96	3.37	2.85	4.43	3.90	3.24	2.10
1243	4.64	4.90	3.02	5.02	4.81	4.17	3.55	3.03	4.66	4.07	3.36	2.15
1244	4.65	4.80	2.93	4.87	4.71	4.08	3.40	2.86	4.57	3.99	3.23	2.05
1245	3.85	4.15	2.65	4.23	4.13	3.54	2.91	2.37	4.00	3.49	2.82	1.77
1246	4.06	4.32	2.90	4.48	4.34	3.85	3.34	2.89	4.22	3.75	3.18	2.25
1247	4.81	4.93	3.15	5.07	4.87	4.33	3.77	3.32	4.73	4.16	3.50	2.44
1248	4.68	4.82	2.97	4.92	4.75	4.12	3.50	3.00	4.60	3.99	3.27	2.16
1249	3.99	4.22	2.72	4.36	4.23	3.65	3.08	2.60	4.09	3.57	2.92	1.92
1250	4.04	4.26	2.86	4.29	4.19	3.74	3.26	2.87	4.06	3.61	3.04	2.19
1251	5	5.07	3.19	5.06	4.89	4.36	3.80	3.38	4.75	4.19	3.51	2.48
1252	4.73	4.62	2.66	4.66	4.46	3.79	3.17	2.63	4.32	3.73	2.99	1.82
1253	3.82	3.91	2.43	3.93	3.83	3.24	2.70	2.19	3.71	3.23	2.61	1.63
1254	3.91	4.17	2.71	4.23	4.15	3.68	3.21	2.81	4.01	3.56	2.98	2.08
1255	4.91	4.93	3.03	5.00	4.81	4.25	3.70	3.27	4.65	4.09	3.40	2.31
1256	4.76	4.93	2.89	5.03	4.83	4.14	3.53	3.02	4.68	4.06	3.30	2.08
1257	3.75	4.09	2.52	4.19	4.05	3.45	2.91	2.43	3.93	3.40	2.76	1.74
1258	3.69	4.11	2.68	4.24	4.13	3.67	3.26	2.89	4.00	3.55	3.00	2.17
1259	4.66	4.82	2.97	4.90	4.75	4.21	3.74	3.34	4.60	4.06	3.41	2.40
1260	4.63	4.63	2.74	4.71	4.52	3.94	3.41	2.96	4.39	3.82	3.15	2.05
1261	3.83	4.01	2.47	4.09	3.94	3.44	2.97	2.54	3.84	3.36	2.78	1.81
1262	3.46	3.99	2.58	4.12	4.00	3.59	3.21	2.88	3.89	3.47	2.96	2.14
1263	4.41	4.57	2.85	4.67	4.53	4.05	3.62	3.27	4.38	3.89	3.29	2.36
1264	4.45	4.45	2.64	4.52	4.37	3.80	3.32	2.89	4.22	3.68	3.01	1.97
1265	3.33	3.54	2.26	3.71	3.59	3.10	2.67	2.32	3.47	3.05	2.51	1.65
1266	3.4	3.79	2.57	3.87	3.78	3.40	3.06	2.62	3.67	3.28	2.81	2.07
1267	4.14	4.53	2.88	4.55	4.43	4.01	3.63	3.29	4.32	3.85	3.27	2.38
1268	4.2	4.42	2.74	4.51	4.36	3.86	3.41	3.00	4.23	3.72	3.08	2.06
1269	2.92	3.51	2.23	3.58	3.50	3.03	2.64	2.27	3.39	2.96	2.42	1.55
1270	3.28	3.75	2.66	3.80	3.78	3.47	3.19	2.98	3.68	3.35	2.94	2.31

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1271	4.06	4.30	2.96	4.43	4.34	4.02	3.71	3.48	4.23	3.85	3.36	2.62
1272	3.88	4.30	2.87	4.42	4.30	3.88	3.52	3.20	4.19	3.72	3.15	2.29
1273	2.69	3.37	2.34	3.54	3.49	3.11	2.77	2.50	3.37	2.98	2.51	1.79
1274	2.74	3.29	2.50	3.45	3.44	3.21	2.98	2.82	3.33	3.06	2.70	2.13
1275	3.72	4.12	2.95	4.22	4.14	3.88	3.63	3.42	4.05	3.71	3.28	2.59
1276	3.59	4.09	2.79	4.23	4.08	3.76	3.43	3.16	3.99	3.55	3.03	2.23
1277	2.53	3.24	2.32	3.46	3.35	3.03	2.73	2.50	3.32	2.88	2.44	1.79
1278	2.48	3.03	2.27	3.14	3.14	2.92	2.73	2.59	3.05	2.78	2.43	1.93
1279	3.43	3.94	2.71	3.82	3.78	3.55	3.33	3.16	3.69	3.38	2.96	2.33
1280	3.35	3.99	2.68	3.98	3.87	3.58	3.32	3.11	3.78	3.40	2.92	2.18
1281	2.69	3.36	2.42	3.55	3.48	3.19	2.92	2.73	3.39	3.05	2.60	1.94
1282	2.36	2.94	2.18	3.09	3.08	2.88	2.67	2.55	3.01	2.73	2.36	1.83
1283	3.31	3.61	2.55	3.69	3.63	3.42	3.20	3.05	3.56	3.23	2.81	2.17
1284	3.2	3.43	2.21	3.47	3.39	3.10	2.81	2.60	3.32	2.93	2.42	1.63
1285	2.7	3.28	2.18	3.35	3.30	3.01	2.74	2.55	3.25	2.87	2.39	1.64
1286	2.79	3.43	2.30	3.51	3.48	3.19	2.94	2.75	3.40	3.01	2.52	1.74
1287	3.41	3.64	2.37	3.69	3.62	3.31	3.03	2.82	3.53	3.12	2.59	1.78
1288	3.96	4.23	2.82	4.38	4.24	3.91	3.57	3.35	4.13	3.71	3.15	2.30
1289	3.3	3.59	2.48	3.73	3.64	3.34	3.01	2.83	3.54	3.15	2.69	1.91
1290	2.91	3.32	2.43	3.41	3.37	3.13	2.90	2.77	3.31	2.99	2.60	2.05
1291	3.43	3.74	2.63	3.84	3.78	3.53	3.32	3.16	3.69	3.35	2.90	2.26
1292	3.6	3.95	2.71	4.06	3.98	3.57	3.26	2.99	3.86	3.46	2.97	2.19
1293	3.57	4.09	2.79	4.23	4.14	3.79	3.49	3.20	4.03	3.62	3.12	2.30
1294	3.51	3.94	2.64	4.02	3.95	3.53	3.12	2.73	3.86	3.45	2.90	2.08
1295	3.5	3.90	2.65	3.99	3.93	3.52	3.12	2.74	3.83	3.42	2.89	2.09
1296	4.05	4.35	2.91	4.40	4.30	3.78	3.24	2.78	4.18	3.72	3.15	2.27
1297	4.22	4.61	2.99	4.67	4.57	4.05	3.48	3.02	4.44	3.94	3.33	2.37
1298	4.01	4.35	2.80	4.46	4.35	3.81	3.23	2.74	4.24	3.72	3.09	2.13
1299	3.93	4.19	2.75	4.29	4.17	3.63	3.07	2.57	4.07	3.57	2.96	2.05
1300	4.64	4.77	3.12	4.83	4.71	4.14	3.55	3.06	4.57	4.05	3.40	2.40
1301	4.89	5.07	3.23	5.13	4.98	4.38	3.76	3.26	4.85	4.27	3.58	2.52

Appendix A. (continued)

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1302	4.7	4.91	3.11	5.01	4.88	4.31	3.73	3.26	4.74	4.15	3.45	2.35
1303	4.44	4.57	2.96	4.67	4.56	3.98	3.43	2.97	4.41	3.87	3.21	2.18
1304	4.97	4.92	3.23	4.98	4.86	4.35	3.86	3.45	4.69	4.16	3.50	2.47
1305	5.77	5.64	3.53	5.67	5.48	4.89	4.29	3.86	5.34	4.69	3.94	2.75
1306	5.35	5.25	3.14	5.34	5.15	4.53	3.90	3.45	5.00	4.33	3.53	2.24
1307	4.75	4.71	2.90	4.77	4.62	4.06	3.50	3.08	4.50	3.90	3.19	2.03
1308	5.14	5.10	3.20	5.08	4.93	4.42	3.94	3.59	4.80	4.23	3.55	2.49
1309	6.37	6.08	3.61	6.04	5.77	5.11	4.49	4.07	5.62	4.91	4.08	2.80
1310	6	5.70	3.19	5.76	5.46	4.69	4.03	3.55	5.31	4.55	3.66	2.20
1311	4.91	4.78	2.85	4.90	4.70	4.05	3.50	3.13	4.57	3.97	3.21	1.97
1312	5.27	5.13	3.21	5.26	5.05	4.44	3.93	3.55	4.89	4.26	3.48	2.23
1313	6.66	6.20	3.64	6.23	5.90	5.16	4.52	4.04	5.74	4.95	4.03	2.57
1314	5.93	5.64	3.09	5.64	5.34	4.59	3.93	3.44	5.19	4.44	3.53	2.07
1315	4.73	4.67	2.72	4.75	4.56	3.93	3.38	2.99	4.43	3.82	3.07	1.81
1316	5.22	5.10	3.12	5.14	4.97	4.42	3.91	3.58	4.83	4.22	3.49	2.28
1317	6.58	6.20	3.54	6.15	5.87	5.16	4.50	4.05	5.71	4.93	4.03	2.58
1318	6.34	5.90	3.16	5.87	5.55	4.78	4.06	3.56	5.41	4.60	3.64	2.09
1319	4.63	4.60	2.67	4.70	4.49	3.90	3.34	2.98	4.38	3.78	3.01	1.74
1320	5.21	5.00	3.14	5.04	4.87	4.37	3.89	3.60	4.72	4.17	3.46	2.29
1321	6.52	6.07	3.55	6.03	5.75	5.10	4.48	4.08	5.59	4.87	3.99	2.59
1322	6	5.63	3.08	5.63	5.31	4.60	3.94	3.50	5.18	4.42	3.50	2.06
1323	4.28	4.33	2.57	4.47	4.26	3.71	3.21	2.89	4.15	3.58	2.86	1.69
1324	4.78	4.75	3.09	4.81	4.67	4.20	3.79	3.56	4.53	4.00	3.35	2.30
1325	6.14	5.84	3.52	5.81	5.59	4.99	4.45	4.12	5.44	4.75	3.94	2.64
1326	5.49	5.06	2.86	5.01	4.76	4.16	3.58	3.20	4.64	3.97	3.16	1.81
1327	4.03	4.02	2.45	4.08	3.92	3.45	3.01	2.70	3.97	3.30	2.64	1.54
1328	4.58	4.53	3.01	4.75	4.61	4.19	3.84	3.60	4.49	3.99	3.34	2.30
1329	5.44	4.96	3.13	5.07	4.88	4.40	3.98	3.70	4.75	4.17	3.44	2.29
1330	4.89	4.84	3.01	4.97	4.76	4.24	3.83	3.54	4.64	4.07	3.36	2.28
1331	4.1	4.29	2.77	4.44	4.25	3.78	3.41	3.18	4.14	3.64	2.99	2.03
1332	3.82	4.12	2.77	4.26	4.12	3.75	3.45	3.26	4.02	3.59	3.04	2.23

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1333	4.96	4.80	3.09	4.87	4.71	4.31	3.96	3.73	4.61	4.09	3.47	2.51
1334	3.94	3.85	2.20	3.95	3.72	3.30	2.94	2.66	3.66	3.17	2.55	1.50
1335	3.92	4.13	2.47	4.21	4.04	3.62	3.25	3.00	3.99	3.54	2.94	1.87
1336	3.82	3.43	1.86	3.44	3.36	2.92	2.57	2.39	3.29	2.83	2.26	1.28
1337	3.37	2.85	1.60	2.91	2.82	2.41	2.11	1.94	2.75	2.37	1.86	1.04
1338	4.46	4.59	2.83	4.67	4.56	4.19	3.95	3.62	4.41	3.99	3.38	2.30
1339	3.97	4.10	2.56	4.14	4.02	3.65	3.31	3.11	3.91	3.46	2.86	1.85
1340	3.95	4.17	2.74	4.26	4.14	3.79	3.50	3.33	4.06	3.65	3.12	2.35
1341	4.24	4.40	2.81	4.51	4.36	4.04	3.75	3.56	4.28	3.84	3.27	2.43
1342	3.89	4.12	2.63	4.23	4.07	3.74	3.44	3.24	4.02	3.59	3.03	2.16
1343	4.36	4.60	2.85	4.66	4.50	4.15	3.81	3.59	4.43	3.94	3.35	2.38
1344	3.65	3.79	2.20	3.78	3.68	3.28	2.95	2.71	3.64	3.16	2.56	1.61
1345	3.67	3.94	2.32	3.97	3.88	3.48	3.15	2.89	3.84	3.38	2.76	1.79
1346	3.96	4.14	2.38	4.19	4.05	3.62	3.20	2.90	3.98	3.47	2.81	1.73
1347	4.09	4.29	2.46	4.40	4.23	3.78	3.34	3.06	4.16	3.61	2.94	1.82
1348	3.98	4.08	2.27	4.15	3.98	3.50	3.03	2.70	3.92	3.38	2.69	1.55
1349	3.37	3.56	2.06	3.63	3.56	3.13	2.75	2.45	3.47	3.01	2.40	1.40
1350	3.89	4.06	2.46	4.09	3.99	3.55	3.14	2.82	3.90	3.41	2.79	1.82
1351	4.29	4.40	2.58	4.44	4.31	3.86	3.42	3.08	4.21	3.67	2.98	1.91
1352	4.12	4.19	2.38	4.24	4.11	3.61	3.11	2.69	4.02	3.47	2.77	1.64
1353	3.51	3.83	2.23	3.89	3.83	3.35	2.88	2.48	3.73	3.23	2.59	1.55
1354	3.98	4.03	2.41	4.06	4.02	3.54	3.11	2.73	3.88	3.40	2.76	1.71
1355	4.5	4.40	2.59	4.42	4.33	3.82	3.23	2.99	4.20	3.67	2.98	1.84
1356	4.46	4.72	2.78	4.77	4.70	4.12	3.59	3.15	4.58	3.97	3.21	1.99
1357	3.25	3.66	2.17	3.60	3.60	3.05	2.56	2.18	3.49	2.99	2.35	1.35
1358	3.18	3.63	2.43	3.58	3.55	3.23	2.93	2.73	3.45	3.13	2.70	2.05
1359	4.72	4.86	3.02	4.88	4.74	4.35	3.97	3.69	4.62	4.12	3.52	2.58
1360	4.51	4.51	2.59	4.52	4.40	3.86	3.34	2.94	4.29	3.71	2.97	1.83
1361	3.41	3.66	2.24	3.73	3.68	3.22	2.79	2.44	3.58	3.14	2.52	1.58
1362	3.55	3.72	2.44	3.73	3.65	3.31	3.00	2.71	3.55	3.14	2.64	1.85
1363	4.52	4.55	2.82	4.54	4.38	3.96	3.54	3.22	4.23	3.74	3.13	2.16

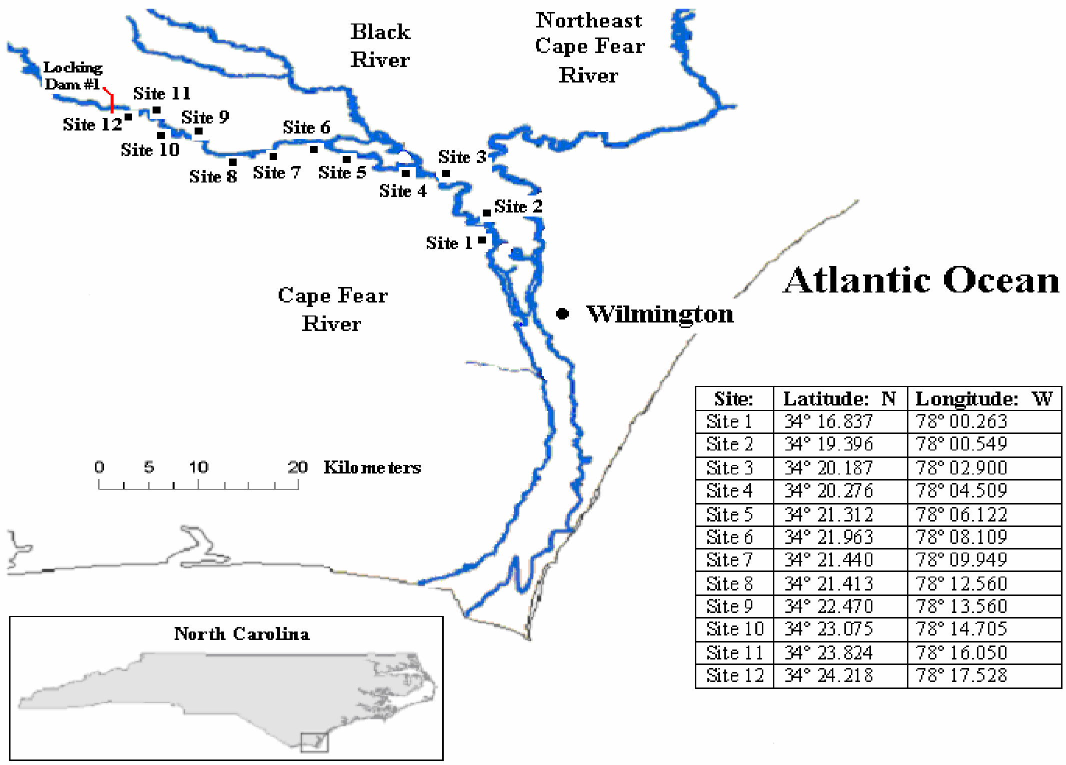
Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1364	4.71	4.81	2.79	4.89	4.72	4.12	3.58	3.15	4.59	3.96	3.18	1.97
1365	3.31	3.51	2.17	3.60	3.53	3.02	2.58	2.21	3.42	2.95	2.34	1.40
1366	3.18	3.47	2.47	3.54	3.08	3.31	3.10	2.84	3.40	3.09	2.71	2.11
1367	4.64	4.71	3.00	4.73	4.60	4.25	3.95	4.02	4.48	4.00	3.45	2.57
1368	4.41	4.54	2.67	4.58	4.42	3.89	3.40	3.03	4.32	3.72	3.00	1.91
1369	3.1	3.59	2.30	3.73	3.65	3.20	2.80	2.47	3.56	3.09	2.50	1.63
1370	3.22	3.26	2.25	3.32	3.29	3.02	2.75	2.55	3.19	2.83	2.37	1.69
1371	4.53	4.22	2.67	4.15	4.04	3.71	3.37	3.14	3.95	3.50	2.93	2.08
1372	4.61	4.73	2.81	4.75	4.56	4.03	3.55	3.16	4.46	3.89	3.15	1.97
1373	3.22	3.59	2.27	3.68	3.60	3.14	2.73	2.39	3.51	3.05	2.44	1.46
1374	3.08	3.47	2.42	3.59	3.58	3.31	3.04	2.85	4.46	3.13	2.67	1.99
1375	4.34	4.46	2.85	4.52	4.41	4.08	3.73	3.49	4.29	3.82	3.22	2.34
1376	4.26	4.47	2.72	4.50	4.38	3.92	3.49	3.19	4.28	3.73	3.03	2.02
1377	3.13	3.49	2.27	3.59	3.51	3.10	2.73	2.47	3.43	3.00	2.43	1.61
1378	3.07	3.38	2.41	3.51	3.46	3.22	3.01	2.87	3.37	3.05	2.61	2.00
1379	4.07	4.26	2.80	4.33	4.21	3.93	3.65	3.47	4.13	3.71	3.16	2.37
1380	4.21	4.36	2.70	4.46	4.29	3.87	3.49	3.24	4.23	3.68	3.00	2.02
1381	2.94	3.30	2.23	3.47	3.38	2.98	2.65	2.46	3.31	2.87	2.34	1.57
1382	2.91	3.42	2.49	3.56	3.49	3.23	3.02	2.90	3.42	3.08	2.70	2.09
1383	4.16	4.44	2.95	4.51	4.36	4.08	3.82	3.65	4.31	3.86	3.34	2.51
1384	3.85	4.16	2.53	4.24	4.10	3.71	3.37	3.14	4.06	3.55	2.91	1.98
1385	2.83	2.98	1.99	3.07	3.01	2.65	2.36	2.19	2.95	2.59	2.10	1.43
1386	2.96	3.17	2.39	3.27	3.22	3.01	2.84	2.76	3.14	2.89	2.55	2.07
1387	3.83	4.22	2.86	4.27	4.15	3.93	3.72	3.58	4.09	3.72	3.25	2.54
1388	4.08	4.48	2.84	4.42	4.29	3.96	3.68	3.46	4.24	3.78	3.19	2.26
1389	3.06	3.54	2.37	3.61	3.54	3.20	2.93	2.75	3.47	3.09	2.59	1.80
1390	2.82	3.25	2.43	3.39	3.32	3.12	2.92	2.83	3.27	2.99	2.64	2.12
1391	3.67	4.04	2.80	4.10	3.97	3.77	3.56	3.43	3.93	3.59	3.14	2.49
1392	3.97	4.30	2.85	4.39	4.26	3.91	3.61	3.40	4.19	3.74	3.15	2.30
1393	2.91	3.41	2.42	3.60	3.55	3.22	2.93	2.79	3.46	3.09	2.61	1.90
1394	2.78	3.17	2.40	3.32	3.31	3.11	2.91	2.83	3.26	2.97	2.61	2.07

Station	P01	P02	P03	P04	P06	P07	P08	P09	P11	P12	P13	P14
1395	3.52	3.80	2.73	3.89	3.81	3.60	3.40	3.28	3.79	3.43	3.01	2.39
1396	3.85	4.17	2.88	4.30	4.15	3.85	3.58	3.41	4.10	3.67	3.16	2.40
1397	3.18	3.66	2.60	3.86	3.74	3.43	3.17	3.02	3.68	3.30	2.82	2.12
1398	3.06	3.45	2.55	3.60	3.56	3.34	3.12	3.02	3.51	3.19	2.78	2.19
1399	3.44	3.74	2.70	3.84	3.77	3.57	3.33	3.21	3.73	3.38	2.95	2.33
1400	4.04	4.34	3.09	4.51	4.36	4.10	3.83	3.69	4.30	3.89	3.40	2.67
1401	3.72	3.93	2.81	4.07	3.93	3.63	3.33	3.18	3.86	3.46	2.99	2.27
1402	3.45	3.91	2.83	4.04	3.97	3.73	3.50	3.39	3.92	3.61	3.21	2.60
1403	3.91	4.20	3.01	4.33	4.26	4.04	3.80	3.68	4.22	3.88	3.45	2.78
1404	3.88	4.17	3.02	4.32	4.19	3.94	3.66	3.51	4.14	3.77	3.32	2.62
1405	4.13	4.52	3.19	4.61	4.49	4.14	3.95	3.80	xxx	4.04	3.55	2.83
1406	3.74	4.08	2.83	4.13	4.08	3.80	3.51	3.35	xxx	3.63	3.14	2.41
1407	3.52	3.86	2.75	3.98	3.91	3.62	3.35	3.19	3.87	3.48	3.02	2.32
1408	4.4	4.65	3.29	4.79	4.67	4.18	4.03	xxx	4.59	4.15	3.63	2.85
1409	4.61	4.90	3.39	5.07	4.93	4.45	4.29	xxx	4.84	4.36	3.81	2.97
1410	xxx	4.54	3.12	4.63	4.56	4.22	3.87	3.68	4.48	4.00	3.46	2.63
1411	xxx	3.98	2.82	4.06	4.04	3.70	3.35	3.19	3.97	3.55	3.07	2.32
1412	4.45	4.56	3.32	4.69	4.59	3.94	3.97	3.76	4.51	4.09	3.62	2.84
1413	5.4	5.50	3.77	5.61	5.45	4.74	4.75	4.54	5.19	4.83	4.25	3.30
1414	5.06	4.94	3.25	4.77	4.86	4.43	4.05	3.74	4.77	4.21	3.59	2.61
1415	4.02											

APPENDIX B

CRUISE DATABASE BY DATE AND SITE SHOWING ALL PARAMETERS COLLECTED BY DEPTH

Appendix B. Cruise database by date and site showing all parameters collected by depth.



Site:	Latitude: N	Longitude: W
Site 1	34° 16.837	78° 00.263
Site 2	34° 19.396	78° 00.549
Site 3	34° 20.187	78° 02.900
Site 4	34° 20.276	78° 04.509
Site 5	34° 21.312	78° 06.122
Site 6	34° 21.963	78° 08.109
Site 7	34° 21.440	78° 09.949
Site 8	34° 21.413	78° 12.560
Site 9	34° 22.470	78° 13.560
Site 10	34° 23.075	78° 14.705
Site 11	34° 23.824	78° 16.050
Site 12	34° 24.218	78° 17.528

Location of salinity depth sampling stations.

Physical Measurements Collected At Depth

Site: **1** **Date:** 6/21/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	433	uS	27.5	ºC	0.2	ppt	3.7	mg/L
5 ft	448	uS	27.5	ºC	0.2	ppt	3.67	mg/L
10 ft	440	uS	27.5	ºC	0.2	ppt	3.61	mg/L
15 ft	456	uS	27.5	ºC	0.2	ppt	3.72	mg/L
20 ft	455.4	uS	27.5	ºC	0.2	ppt	3.71	mg/L
25 ft	460	uS	27.5	ºC	0.2	ppt	3.65	mg/L
30 ft	469	uS	27.5	ºC	0.2	ppt	3.71	mg/L
35 ft	483	uS	27.5	ºC	0.2	ppt	3.7	mg/L
40 ft	480	uS	27.4	ºC	0.2	ppt	3.63	mg/L
45 ft	494	uS	27.4	ºC	0.2	ppt	3.71	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 6/21/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	271	uS	28.2	ºC	0.1	ppt	4.26	mg/L
5 ft	272	uS	28.1	ºC	0.1	ppt	4.18	mg/L
10 ft	273	uS	28	ºC	0.1	ppt	4.14	mg/L
15 ft	273	uS	27.9	ºC	0.1	ppt	4.13	mg/L
20 ft	273.6	uS	27.9	ºC	0.1	ppt	4.2	mg/L
25 ft	273.3	uS	27.9	ºC	0.1	ppt	4.14	mg/L
30 ft	273.4	uS	27.9	ºC	0.1	ppt	4.13	mg/L
35 ft	273.4	uS	27.9	ºC	0.1	ppt	4.22	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 6/21/2007

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	247.7	uS	27.8	ºC	0.1	ppt	4.5	mg/L
5 ft	247.6	uS	27.8	ºC	0.1	ppt	4.51	mg/L
10 ft	247.8	uS	27.8	ºC	0.1	ppt	4.4	mg/L
15 ft	247.9	uS	27.8	ºC	0.1	ppt	4.47	mg/L
20 ft	248	uS	27.8	ºC	0.1	ppt	4.48	mg/L
25 ft	248	uS	27.8	ºC	0.1	ppt	4.39	mg/L
30 ft	248	uS	27.8	ºC	0.1	ppt	4.5	mg/L
35 ft	248.1	uS	27.7	ºC	0.1	ppt	4.44	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: 4 **Way point:** 016 **Date:** 6/21/2007

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	254	uS	28.2	ºC	0.1	ppt	5.16	mg/L
5 ft	255.6	uS	28.1	ºC	0.1	ppt	4.97	mg/L
10 ft	255	uS	28.1	ºC	0.1	ppt	4.9	mg/L
15 ft	254	uS	28	ºC	0.1	ppt	4.88	mg/L
20 ft	254.3	uS	28	ºC	0.1	ppt	4.81	mg/L
25 ft	254.3	uS	28	ºC	0.1	ppt	4.76	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft		uS		ºC		ppt		mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 6/21/2007

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	262.1	uS	28.3	ºC	0.1	ppt	5.51	mg/L
5 ft	262.4	uS	28.3	ºC	0.1	ppt	5.52	mg/L
10 ft	262.8	uS	28.2	ºC	0.1	ppt	5.49	mg/L
15 ft	263.5	uS	28.2	ºC	0.1	ppt	5.44	mg/L
20 ft	263.6	uS	28.2	ºC	0.1	ppt	5.33	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 6/21/2007

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	315.5	uS	28.4	ºC	0.1	ppt	5.46	mg/L
5 ft	317.1	uS	28.3	ºC	0.1	ppt	5.36	mg/L
10 ft	317.4	uS	28.2	ºC	0.1	ppt	5.43	mg/L
15 ft	317.4	uS	28.2	ºC	0.1	ppt	5.47	mg/L
20 ft	317.2	uS	28.1	ºC	0.1	ppt	5.39	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 6/21/2007

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	309.4	uS	28.1	ºC	0.1	ppt	5.08	mg/L
5 ft	310.3	uS	28	ºC	0.1	ppt	5.13	mg/L
10 ft	311.6	uS	27.9	ºC	0.1	ppt	5.36	mg/L
15 ft	310.1	uS	27.9	ºC	0.1	ppt	5.15	mg/L
20 ft	309.1	uS	27.8	ºC	0.1	ppt	5.16	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 6/21/2007

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	177.5	uS	28.7	ºC	0.1	ppt	5.67	mg/L
5 ft	174.4	uS	28.3	ºC	0.1	ppt	5.65	mg/L
10 ft	182.5	uS	28.1	ºC	0.1	ppt	5.75	mg/L
15 ft	181.6	uS	28	ºC	0.1	ppt	5	mg/L
20 ft	182.2	uS	27.9	ºC	0.1	ppt	4.98	mg/L
25 ft	182.9	uS	27.8	ºC	0.1	ppt	4.82	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 6/21/2007

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	156	uS	29.3	ºC	0.1	ppt	6.66	mg/L
5 ft	151.5	uS	28.4	ºC	0.1	ppt	5.32	mg/L
10 ft	15.1	uS	27.9	ºC	0.1	ppt	4.66	mg/L
15 ft	150.8	uS	27.8	ºC	0.1	ppt	4.26	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 6/21/2007

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	151.1	uS	28.6	ºC	0.1	ppt	5.52	mg/L
5 ft	149.8	uS	28	ºC	0.1	ppt	4.91	mg/L
10 ft	149.5	uS	27.8	ºC	0.1	ppt	4.95	mg/L
15 ft	149.4	uS	27.8	ºC	0.1	ppt	4.53	mg/L
20 ft	149.4	uS	27.7	ºC	0.1	ppt	5.11	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 6/21/2007

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	155.1	uS	30.2	ºC	0.1	ppt	7.28	mg/L
5 ft	149.7	uS	28.7	ºC	0.1	ppt	6.73	mg/L
10 ft	149.3	uS	28.2	ºC	0.1	ppt	5.66	mg/L
15 ft	149.1	uS	28.1	ºC	0.1	ppt	5.25	mg/L
20 ft	149.2	uS	28	ºC	0.1	ppt	5.03	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: 12 **Way point:** 024 **Date:** 6/21/2007

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	149	uS	28.4	ºC	0.1	ppt	6.23	mg/L
5 ft	148.8	uS	28.3	ºC	0.1	ppt	6.13	mg/L
10 ft	148	uS	28.2	ºC	0.1	ppt	6.02	mg/L
15 ft	148.9	uS	28.3	ºC	0.1	ppt	6.11	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 7/31/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	4748	uS	28.4	ºC	2.3	ppt	3.72	mg/L
5 ft	4.99	mS	28.4	ºC	2.6	ppt	3.6	mg/L
10 ft	5.25	mS	28.5	ºC	2.5	ppt	3.5	mg/L
15 ft	5.03	mS	28.4	ºC	2.5	ppt	3.57	mg/L
20 ft	5.25	mS	28.5	ºC	2.8	ppt	3.65	mg/L
25 ft	5.17	mS	28.5	ºC	2.6	ppt	3.66	mg/L
30 ft	5.45	mS	28.4	ºC	2.7	ppt	3.54	mg/L
35 ft	5.28	mS	28.4	ºC	2.7	ppt	3.6	mg/L
40 ft	5.3	mS	28.4	ºC	2.6	ppt	3.64	mg/L
45 ft	5.42	mS	28.4	ºC	2.7	ppt	3.7	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 7/31/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	357.9	uS	28.6	ºC	0.2	ppt	3.86	mg/L
5 ft	357.3	uS	28.6	ºC	0.2	ppt	3.92	mg/L
10 ft	359.8	uS	28.6	ºC	0.2	ppt	4.01	mg/L
15 ft	360.8	uS	28.5	ºC	0.2	ppt	3.92	mg/L
20 ft	362	uS	28.5	ºC	0.2	ppt	3.91	mg/L
25 ft	363	uS	28.5	ºC	0.2	ppt	3.97	mg/L
30 ft	362	uS	28.5	ºC	0.2	ppt	3.98	mg/L
35 ft	361	uS	28.5	ºC	0.2	ppt	3.96	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 7/31/2007

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	324.1	uS	28.8	ºC	0.1	ppt	4.11	mg/L
5 ft	324	uS	28.7	ºC	0.1	ppt	4.2	mg/L
10 ft	323.9	uS	28.7	ºC	0.1	ppt	4.07	mg/L
15 ft	323.9	uS	28.6	ºC	0.1	ppt	4.09	mg/L
20 ft	324	uS	28.6	ºC	0.1	ppt	4.05	mg/L
25 ft	324.1	uS	28.6	ºC	0.1	ppt	4.05	mg/L
30 ft	323.8	uS	28.6	ºC	0.1	ppt	4	mg/L
35 ft	324	uS	28.6	ºC	0.1	ppt	4.02	mg/L
40 ft	323.8	uS	28.6	ºC	0.1	ppt	3.99	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 7/31/2007

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	343.3	uS	28.9	ºC	0.2	ppt	4.51	mg/L
5 ft	344	uS	28.8	ºC	0.2	ppt	4.26	mg/L
10 ft	344.5	uS	28.7	ºC	0.2	ppt	4.15	mg/L
15 ft	344.4	uS	28.7	ºC	0.2	ppt	4.08	mg/L
20 ft	342.9	uS	28.7	ºC	0.2	ppt	4.11	mg/L
25 ft	343.7	uS	28.7	ºC	0.2	ppt	4	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 7/31/2007

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	412.6	uS	28.9	ºC	0.2	ppt	4.53	mg/L
5 ft	412.5	uS	28.8	ºC	0.2	ppt	4.3	mg/L
10 ft	411.9	uS	28.8	ºC	0.2	ppt	4.31	mg/L
15 ft	412	uS	28.8	ºC	0.2	ppt	4.43	mg/L
20 ft	411.6	uS	28.7	ºC	0.2	ppt	4.31	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 7/31/2007

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	410	uS	28.9	ºC	0.2	ppt	4.59	mg/L
5 ft	410	uS	28.9	ºC	0.2	ppt	4.69	mg/L
10 ft	410.5	uS	28.8	ºC	0.2	ppt	4.68	mg/L
15 ft	410.7	uS	28.8	ºC	0.2	ppt	4.72	mg/L
20 ft	410.4	uS	28.8	ºC	0.2	ppt	4.15	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: 7 **Way point:** 019 **Date:** 7/31/2007

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	441	uS	29.6	ºC	0.2	ppt	5.35	mg/L
5 ft	440.3	uS	29.1	ºC	0.2	ppt	5.05	mg/L
10 ft	441.7	uS	29	ºC	0.2	ppt	5.1	mg/L
15 ft	441	uS	28.9	ºC	0.2	ppt	5.1	mg/L
20 ft	441.5	uS	28.9	ºC	0.2	ppt	4.92	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 7/31/2007

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	208.1	uS	29.6	ºC	0.1	ppt	6.16	mg/L
5 ft	197.9	uS	29.1	ºC	0.1	ppt	6.17	mg/L
10 ft	208.6	uS	29	ºC	0.1	ppt	5.15	mg/L
15 ft	209.8	uS	28.8	ºC	0.1	ppt	5.6	mg/L
20 ft	208.7	uS	28.8	ºC	0.1	ppt	5.45	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 7/31/2007

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	176.8	uS	29.3	ºC	0.1	ppt	5.9	mg/L
5 ft	175.8	uS	29	ºC	0.1	ppt	5.6	mg/L
10 ft	175.3	uS	28.8	ºC	0.1	ppt	5.56	mg/L
15 ft	175.2	uS	28.8	ºC	0.1	ppt	5.25	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 7/31/2007

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	179.9	uS	29.8	ºC	0.1	ppt	7.12	mg/L
5 ft	179.2	uS	29.5	ºC	0.1	ppt	6.5	mg/L
10 ft	177.1	uS	28.9	ºC	0.1	ppt	5.11	mg/L
15 ft	176.8	uS	28.8	ºC	0.1	ppt	4.87	mg/L
20 ft	176.3	uS	28.7	ºC	0.1	ppt	4.92	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 7/31/2007

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	184.6	uS	30.1	ºC	0.1	ppt	8.28	mg/L
5 ft	179.9	uS	28.9	ºC	0.1	ppt	6.66	mg/L
10 ft	179.2	uS	28.7	ºC	0.1	ppt	5.87	mg/L
15 ft	178.9	uS	28.6	ºC	0.1	ppt	5.43	mg/L
20 ft	179	uS	28.6	ºC	0.1	ppt	4.65	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 7/31/2007

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	182.7	uS	29	ºC	0.1	ppt	6.91	mg/L
5 ft	182.7	uS	28.9	ºC	0.1	ppt	6.53	mg/L
10 ft	182.6	uS	28.9	ºC	0.1	ppt	6.41	mg/L
15 ft	182.6	uS	28.9	ºC	0.1	ppt	6.11	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 8/30/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	8.9	uS	29.4	ºC	4.5	ppt	2.49	mg/L
5 ft	9.06	uS	29.6	ºC	4.6	ppt	2.44	mg/L
10 ft	9.46	uS	29.7	ºC	4.7	ppt	2.58	mg/L
15 ft	9.46	uS	29.7	ºC	4.8	ppt	2.67	mg/L
20 ft	10.04	uS	29.7	ºC	5.1	ppt	2.55	mg/L
25 ft	10.27	uS	29.7	ºC	5.1	ppt	2.65	mg/L
30 ft	10.21	uS	29.8	ºC	5.4	ppt	2.68	mg/L
35 ft	10.74	uS	29.7	ºC	5.2	ppt	2.67	mg/L
40 ft	11	uS	29.8	ºC	5.6	ppt	2.61	mg/L
45 ft	10.93	uS	29.8	ºC	5.7	ppt	2.61	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 8/30/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	6.17	uS	30	ºC	0.3	ppt	2.52	mg/L
5 ft	6.19	uS	30	ºC	0.3	ppt	2.52	mg/L
10 ft	6.2	uS	30	ºC	0.3	ppt	2.54	mg/L
15 ft	6.2	uS	30	ºC	0.3	ppt	2.53	mg/L
20 ft	6.22	uS	30	ºC	0.3	ppt	2.52	mg/L
25 ft	6.22	uS	30	ºC	0.3	ppt	2.58	mg/L
30 ft	6.21	uS	30	ºC	0.3	ppt	2.51	mg/L
35 ft	6.21	uS	30	ºC	0.3	ppt	2.47	mg/L
40 ft	6.23	uS	30	ºC	0.3	ppt	2.5	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 9/6/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	13	mS	28.1	ºC	7	ppt	2.96	mg/L
5 ft	14.99	mS	28.3	ºC	8.9	ppt	2.86	mg/L
10 ft	18.64	mS	28.4	ºC	10.2	ppt	2.76	mg/L
15 ft	19.04	mS	28.4	ºC	10.4	ppt	2.65	mg/L
20 ft	20.06	mS	28.4	ºC	11.2	ppt	2.64	mg/L
25 ft	20.68	mS	28.4	ºC	11.3	ppt	2.52	mg/L
30 ft	20.8	mS	28.4	ºC	11.5	ppt	2.71	mg/L
35 ft	21.45	mS	28.4	ºC	12.3	ppt	2.83	mg/L
40 ft	22	mS	28.4	ºC	12.3	ppt	2.8	mg/L
45 ft	22.31	mS	28.4	ºC	12.5	ppt	2.8	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 9/6/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	1608	uS	28.4	ºC	0.8	ppt	2.67	mg/L
5 ft	1763	uS	28.5	ºC	0.8	ppt	2.7	mg/L
10 ft	1997	uS	28.6	ºC	0.9	ppt	2.25	mg/L
15 ft	2023	uS	28.7	ºC	1	ppt	2.5	mg/L
20 ft	2059	uS	28.7	ºC	1	ppt	2.32	mg/L
25 ft	2125	uS	28.8	ºC	1	ppt	2.5	mg/L
30 ft	2190	uS	28.8	ºC	1	ppt	2.57	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 9/6/2007

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	524	uS	28.4	ºC	0.2	ppt	2.5	mg/L
5 ft	522	uS	28.4	ºC	0.2	ppt	2.52	mg/L
10 ft	521	uS	28.5	ºC	0.2	ppt	2.66	mg/L
15 ft	518	uS	28.5	ºC	0.2	ppt	2.65	mg/L
20 ft	517	uS	28.5	ºC	0.2	ppt	2.55	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 9/6/2007

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	509	uS	28.3	ºC	0.2	ppt	2.72	mg/L
5 ft	509	uS	28.4	ºC	0.2	ppt	2.58	mg/L
10 ft	509	uS	28.5	ºC	0.2	ppt	2.53	mg/L
15 ft	509	uS	28.5	ºC	0.2	ppt	2.7	mg/L
20 ft	509	uS	28.5	ºC	0.2	ppt	2.57	mg/L
25 ft	509	uS	28.5	ºC	0.2	ppt	2.67	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 9/6/2007

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	527	uS	28.2	ºC	0.2	ppt	2.6	mg/L
5 ft	528	uS	28.7	ºC	0.2	ppt	2.57	mg/L
10 ft	528	uS	28.7	ºC	0.2	ppt	2.53	mg/L
15 ft	528	uS	28.8	ºC	0.2	ppt	2.47	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 9/6/2007

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	509	uS	28.6	ºC	0.2	ppt	2.98	mg/L
5 ft	511	uS	28.8	ºC	0.2	ppt	2.92	mg/L
10 ft	511	uS	28.8	ºC	0.2	ppt	2.88	mg/L
15 ft	511	uS	28.8	ºC	0.2	ppt	2.88	mg/L
20 ft	511	uS	28.8	ºC	0.2	ppt	2.64	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 9/6/2007

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	566	uS	28.8	ºC	0.3	ppt	3.7	mg/L
5 ft	566	uS	28.9	ºC	0.3	ppt	3.69	mg/L
10 ft	570	uS	29	ºC	0.3	ppt	3.53	mg/L
15 ft	570	uS	29	ºC	0.3	ppt	3.59	mg/L
20 ft	571	uS	29	ºC	0.3	ppt	3.9	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 9/6/2007

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	243.3	uS	28.7	ºC	0.1	ppt	4.67	mg/L
5 ft	260.9	uS	28.8	ºC	0.1	ppt	4.62	mg/L
10 ft	262.2	uS	28.8	ºC	0.1	ppt	4.72	mg/L
15 ft	260.5	uS	28.9	ºC	0.1	ppt	4.82	mg/L
20 ft	265	uS	28.9	ºC	0.1	ppt	4.75	mg/L
25 ft	262.6	uS	28.9	ºC	0.1	ppt	4.73	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 9/6/2007

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	242.7	uS	28.8	ºC	0.1	ppt	5.05	mg/L
5 ft	242.7	uS	28.9	ºC	0.1	ppt	4.9	mg/L
10 ft	242.7	uS	28.9	ºC	0.1	ppt	5	mg/L
15 ft	242.6	uS	28.9	ºC	0.1	ppt	4.9	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 9/6/2007

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	242.9	uS	28.6	ºC	0.1	ppt	5.02	mg/L
5 ft	242.9	uS	28.6	ºC	0.1	ppt	5.34	mg/L
10 ft	243	uS	28.6	ºC	0.1	ppt	5.22	mg/L
15 ft	243.1	uS	28.7	ºC	0.1	ppt	5.57	mg/L
20 ft	243.1	uS	28.7	ºC	0.1	ppt	5.21	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 9/6/2007

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	242.6	uS	28.6	ºC	0.1	ppt	5.2	mg/L
5 ft	241.9	uS	28.5	ºC	0.1	ppt	5	mg/L
10 ft	241.9	uS	28.5	ºC	0.1	ppt	5.04	mg/L
15 ft	241.9	uS	28.5	ºC	0.1	ppt	4.6	mg/L
20 ft	241.8	uS	28.5	ºC	0.1	ppt	3.58	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 9/6/2007

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	246.15	uS	28.8	ºC	0.1	ppt	6.23	mg/L
5 ft	246.7	uS	28.8	ºC	0.1	ppt	5.95	mg/L
10 ft	246.6	uS	28.8	ºC	0.1	ppt	5.73	mg/L
15 ft	246.5	uS	28.8	ºC	0.1	ppt	4.53	mg/L
20 ft	246.6	uS	28.8	ºC	0.1	ppt	5.63	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 9/13/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	11.03	mS	27.9	ºC	6.2	ppt	3.27	mg/L
5 ft	13.31	mS	28	ºC	6.6	ppt	3.42	mg/L
10 ft	13.91	mS	28	ºC	6.9	ppt	3.37	mg/L
15 ft	13.8	mS	28	ºC	7.5	ppt	3.26	mg/L
20 ft	13.58	mS	28	ºC	7.5	ppt	3.23	mg/L
25 ft	14.2	mS	28	ºC	7.4	ppt	3.36	mg/L
30 ft	14.96	mS	28	ºC	8	ppt	3.32	mg/L
35 ft	14.35	mS	28	ºC	8.2	ppt	3.26	mg/L
40 ft	14.8	mS	28	ºC	8.1	ppt	3.28	mg/L
45 ft	15.51	mS	27.9	ºC	8.8	ppt	3.13	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 9/13/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	670	uS	28.1	ºC	0.3	ppt	3.64	mg/L
5 ft	668	uS	28.1	ºC	0.3	ppt	3.62	mg/L
10 ft	669	uS	28.1	ºC	0.3	ppt	3.73	mg/L
15 ft	666	uS	28.1	ºC	0.3	ppt	3.6	mg/L
20 ft	668	uS	28.1	ºC	0.3	ppt	3.6	mg/L
25 ft	663	uS	28.1	ºC	0.3	ppt	3.51	mg/L
30 ft	659	uS	28.1	ºC	0.3	ppt	3.55	mg/L
35 ft	664	uS	28.1	ºC	0.3	ppt	3.65	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 9/13/2007

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	504	uS	28.2	ºC	0.2	ppt	3.52	mg/L
5 ft	504	uS	28.2	ºC	0.2	ppt	3.5	mg/L
10 ft	504	uS	28.1	ºC	0.2	ppt	3.47	mg/L
15 ft	504	uS	28.1	ºC	0.2	ppt	3.5	mg/L
20 ft	504	uS	28.1	ºC	0.2	ppt	3.45	mg/L
25 ft	504	uS	28.1	ºC	0.2	ppt	3.52	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 9/13/2007

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	503	uS	28.1	ºC	0.2	ppt	3.64	mg/L
5 ft	503	uS	28.1	ºC	0.2	ppt	3.52	mg/L
10 ft	503	uS	28.1	ºC	0.2	ppt	3.58	mg/L
15 ft	503	uS	28	ºC	0.2	ppt	3.51	mg/L
20 ft	502	uS	28	ºC	0.2	ppt	3.5	mg/L
25 ft	502	uS	28	ºC	0.2	ppt	3.57	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 9/13/2007

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	571	uS	28.4	ºC	0.3	ppt	3.23	mg/L
5 ft	570	uS	28.3	ºC	0.3	ppt	3.16	mg/L
10 ft	570	uS	28.3	ºC	0.3	ppt	3.12	mg/L
15 ft	569	uS	28.3	ºC	0.3	ppt	3.1	mg/L
20 ft	569	uS	28.2	ºC	0.3	ppt	3.1	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 9/13/2007

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	616	uS	28.6	ºC	0.3	ppt	3.13	mg/L
5 ft	617	uS	28.5	ºC	0.3	ppt	3.13	mg/L
10 ft	619	uS	28.5	ºC	0.3	ppt	3.06	mg/L
15 ft	617	uS	28.5	ºC	0.3	ppt	3.04	mg/L
20 ft	621	uS	28.5	ºC	0.3	ppt	2.97	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 9/13/2007

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	646	uS	28.6	ºC	0.3	ppt	3.46	mg/L
5 ft	649	uS	28.6	ºC	0.3	ppt	3.43	mg/L
10 ft	649	uS	28.6	ºC	0.3	ppt	3.41	mg/L
15 ft	647	uS	28.5	ºC	0.3	ppt	3.36	mg/L
20 ft	647	uS	28.5	ºC	0.3	ppt	3.4	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 9/13/2007

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	370.9	uS	28.6	ºC	0.2	ppt	4.78	mg/L
5 ft	368.9	uS	28.5	ºC	0.3	ppt	5.23	mg/L
10 ft	378.1	uS	28.5	ºC	0.2	ppt	4.7	mg/L
15 ft	367.7	uS	28.5	ºC	0.2	ppt	5.27	mg/L
20 ft	420.8	uS	28.4	ºC	0.2	ppt	4.01	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 9/13/2007

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	248.5	uS	28.8	ºC	0.1	ppt	4.92	mg/L
5 ft	246.9	uS	28.6	ºC	0.1	ppt	4.95	mg/L
10 ft	246.5	uS	28.5	ºC	0.1	ppt	5	mg/L
15 ft	246.5	uS	28.4	ºC	0.1	ppt	4.77	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 9/13/2007

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	255.7	uS	28.5	ºC	0.1	ppt	5.8	mg/L
5 ft	255.7	uS	28.5	ºC	0.1	ppt	5.57	mg/L
10 ft	254.8	uS	28.4	ºC	0.1	ppt	5.33	mg/L
15 ft	255	uS	28.3	ºC	0.1	ppt	5.64	mg/L
20 ft	255.2	uS	28.3	ºC	0.1	ppt	5.24	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 9/13/2007

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	269.1	uS	29	ºC	0.1	ppt	7.22	mg/L
5 ft	266.3	uS	28.5	ºC	0.1	ppt	5.81	mg/L
10 ft	266.2	uS	28.1	ºC	0.1	ppt	4.41	mg/L
15 ft	265.9	uS	28	ºC	0.1	ppt	4.3	mg/L
20 ft	265.8	uS	28	ºC	0.1	ppt	4.15	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 9/13/2007

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	274.4	uS	28.8	ºC	0.1	ppt	6.66	mg/L
5 ft	273.2	uS	28.9	ºC	0.1	ppt	5.67	mg/L
10 ft	273.4	uS	28.6	ºC	0.1	ppt	6.06	mg/L
15 ft	272.8	uS	28.5	ºC	0.1	ppt	5.49	mg/L
20 ft	272.5	uS	28.4	ºC	0.1	ppt	5.54	mg/L
25 ft	272.6	uS	28.4	ºC	0.1	ppt	5.99	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 10/13/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	16.47	mS	23.7	ºC	9.8	ppt	3.8	mg/L
5 ft	16.83	mS	24	ºC	10.1	ppt	3.62	mg/L
10 ft	16.93	mS	24.1	ºC	10.2	ppt	3.89	mg/L
15 ft	16.86	mS	24.2	ºC	10	ppt	3.87	mg/L
20 ft	17.29	mS	24.3	ºC	10.3	ppt	3.75	mg/L
25 ft	17.52	mS	24.3	ºC	10.6	ppt	3.88	mg/L
30 ft	18.52	mS	24.3	ºC	11	ppt	3.83	mg/L
35 ft	17.85	mS	24.3	ºC	10.6	ppt	3.9	mg/L
40 ft	18.42	mS	24.3	ºC	11	ppt	3.91	mg/L
45 ft	18.62	mS	24.3	ºC	11.2	ppt	3.79	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 10/13/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	1001	uS	24.3	ºC	0.5	ppt	3.77	mg/L
5 ft	1097	uS	24.4	ºC	0.5	ppt	3.79	mg/L
10 ft	1148	uS	24.4	ºC	0.6	ppt	3.77	mg/L
15 ft	1170	uS	24.4	ºC	0.6	ppt	3.79	mg/L
20 ft	1200	uS	24.4	ºC	0.6	ppt	3.71	mg/L
25 ft	1238	uS	24.4	ºC	0.6	ppt	3.72	mg/L
30 ft	1255	uS	24.4	ºC	0.6	ppt	3.7	mg/L
35 ft	1274	uS	24.4	ºC	0.7	ppt	3.74	mg/L
40 ft	1294	uS	24.4	ºC	0.7	ppt	3.72	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 10/13/2007

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	574	uS	24.3	ºC	0.3	ppt	3.81	mg/L
5 ft	575	uS	24.3	ºC	0.3	ppt	3.83	mg/L
10 ft	575	uS	24.3	ºC	0.3	ppt	3.81	mg/L
15 ft	575	uS	24.3	ºC	0.3	ppt	3.81	mg/L
20 ft	575	uS	24.3	ºC	0.3	ppt	3.76	mg/L
25 ft	575	uS	24.3	ºC	0.3	ppt	3.73	mg/L
30 ft	575	uS	24.3	ºC	0.3	ppt	3.74	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 10/13/2007

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	578	uS	24.2	ºC	0.3	ppt	3.64	mg/L
5 ft	578	uS	24.1	ºC	0.3	ppt	3.63	mg/L
10 ft	578	uS	24.1	ºC	0.3	ppt	3.65	mg/L
15 ft	577	uS	24.1	ºC	0.3	ppt	3.56	mg/L
20 ft	577	uS	24.1	ºC	0.3	ppt	3.56	mg/L
25 ft	577	uS	24.1	ºC	0.3	ppt	3.51	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 10/13/2007

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	640	uS	24.4	ºC	0.3	ppt	3.34	mg/L
5 ft	640	uS	24.4	ºC	0.3	ppt	3.4	mg/L
10 ft	640	uS	24.4	ºC	0.3	ppt	3.37	mg/L
15 ft	640	uS	24.4	ºC	0.3	ppt	3.28	mg/L
20 ft	640	uS	24.3	ºC	0.3	ppt	3.27	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 10/13/2007

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	616	uS	24.4	ºC	0.3	ppt	4.02	mg/L
5 ft	618	uS	24.4	ºC	0.3	ppt	3.88	mg/L
10 ft	617	uS	24.4	ºC	0.3	ppt	3.88	mg/L
15 ft	616	uS	24.4	ºC	0.3	ppt	3.85	mg/L
20 ft	614	uS	24.4	ºC	0.3	ppt	3.74	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 10/13/2007

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	602	uS	24.3	ºC	0.3	ppt	4.81	mg/L
5 ft	602	uS	24.3	ºC	0.3	ppt	4.85	mg/L
10 ft	602	uS	24.3	ºC	0.3	ppt	4.84	mg/L
15 ft	602	uS	24.3	ºC	0.3	ppt	4.9	mg/L
20 ft	602	uS	24.3	ºC	0.3	ppt	4.79	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 10/13/2007

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	218	uS	24.2	ºC	0.1	ppt	5.32	mg/L
5 ft	234.2	uS	24.1	ºC	0.1	ppt	5.54	mg/L
10 ft	232	uS	24	ºC	0.1	ppt	5.52	mg/L
15 ft	232.7	uS	24	ºC	0.1	ppt	5.55	mg/L
20 ft	228.5	uS	23.9	ºC	0.1	ppt	5.5	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 10/13/2007

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	171.5	uS	24.2	ºC	0.1	ppt	4.37	mg/L
5 ft	170.4	uS	24	ºC	0.1	ppt	4.4	mg/L
10 ft	170	uS	23.8	ºC	0.1	ppt	4.3	mg/L
15 ft	169.9	uS	23.8	ºC	0.1	ppt	4.07	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 10/13/2007

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	169.8	uS	24.1	ºC	0.1	ppt	5.46	mg/L
5 ft	168.6	uS	24	ºC	0.1	ppt	5.16	mg/L
10 ft	168	uS	23.8	ºC	0.1	ppt	5.05	mg/L
15 ft	167.8	uS	23.7	ºC	0.1	ppt	4.91	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 10/13/2007

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	174.4	uS	24.3	ºC	0.1	ppt	5.69	mg/L
5 ft	172.6	uS	24.1	ºC	0.1	ppt	4.83	mg/L
10 ft	171.5	uS	23.8	ºC	0.1	ppt	4.62	mg/L
15 ft	170.9	uS	23.6	ºC	0.1	ppt	4.44	mg/L
20 ft	170.7	uS	23.6	ºC	0.1	ppt	4.22	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 10/13/2007

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	176.4	uS	24.1	ºC	0.1	ppt	5.79	mg/L
5 ft	176.9	uS	24.1	ºC	0.1	ppt	5.91	mg/L
10 ft	176.1	uS	24	ºC	0.1	ppt	5.54	mg/L
15 ft	175.3	uS	24	ºC	0.1	ppt	5.44	mg/L
20 ft	175	uS	24	ºC	0.1	ppt	5.55	mg/L
25 ft	174.8	uS	23.9	ºC	0.1	ppt	5.3	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: | **1** **Date:** 12/8/2007

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	12.24	mS	12.8	ºC	9.8	ppt	7.31	mg/L
5 ft	15.31	mS	12.6	ºC	11.4	ppt	7.13	mg/L
10 ft	16.23	mS	12.6	ºC	12.8	ppt	7.24	mg/L
15 ft	16.31	mS	12.6	ºC	12.9	ppt	7.28	mg/L
20 ft	16.42	mS	12.6	ºC	12.9	ppt	7.13	mg/L
25 ft	18.23	mS	12.6	ºC	14.4	ppt	7.22	mg/L
30 ft	17.76	mS	12.6	ºC	13.2	ppt	7.28	mg/L
35 ft	18.96	mS	12.6	ºC	14	ppt	7.34	mg/L
40 ft	18.82	mS	12.6	ºC	14.6	ppt	7.4	mg/L
45 ft	19.21	mS	12.6	ºC	15.4	ppt	7.39	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 12/8/2007

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	4236	uS	12.7	ºC	3	ppt	7.22	mg/L
5 ft	4478	uS	12.5	ºC	3.2	ppt	6.79	mg/L
10 ft	4.62	mS	12.4	ºC	3.3	ppt	6.9	mg/L
15 ft	4.68	mS	12.4	ºC	3.3	ppt	6.9	mg/L
20 ft	4.73	mS	12.4	ºC	3.4	ppt	6.87	mg/L
25 ft	4.73	mS	12.4	ºC	3.4	ppt	6.9	mg/L
30 ft	4.74	mS	12.4	ºC	3.4	ppt	6.9	mg/L
35 ft	4.74	mS	12.4	ºC	3.4	ppt	6.29	mg/L
40 ft	nd	mS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	mS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 12/8/2007

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	265	uS	13.9	ºC	0.2	ppt	8.47	mg/L
5 ft	264.4	uS	12.3	ºC	0.2	ppt	7	mg/L
10 ft	264.4	uS	12.2	ºC	0.2	ppt	7.05	mg/L
15 ft	264.4	uS	12.1	ºC	0.2	ppt	7.01	mg/L
20 ft	264.5	uS	12	ºC	0.2	ppt	7.04	mg/L
25 ft	264.3	uS	12	ºC	0.2	ppt	6.82	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 12/8/2007

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	248	uS	12.5	ºC	0.2	ppt	8.83	mg/L
5 ft	249.5	uS	12.1	ºC	0.2	ppt	7.33	mg/L
10 ft	249.7	uS	12	ºC	0.2	ppt	7.28	mg/L
15 ft	249.4	uS	11.9	ºC	0.2	ppt	7.08	mg/L
20 ft	249.5	uS	11.9	ºC	0.2	ppt	7.25	mg/L
25 ft	249.4	uS	11.8	ºC	0.2	ppt	7.26	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 12/8/2007

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	281.6	uS	12.2	ºC	0.2	ppt	8.82	mg/L
5 ft	281.4	uS	11.8	ºC	0.2	ppt	7.7	mg/L
10 ft	281.7	uS	11.7	ºC	0.2	ppt	7.65	mg/L
15 ft	284.3	uS	11.6	ºC	0.2	ppt	7.67	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 12/8/2007

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	279.2	uS	12.1	ºC	0.2	ppt	9.45	mg/L
5 ft	278.6	uS	11.6	ºC	0.2	ppt	8.01	mg/L
10 ft	278.5	uS	11.6	ºC	0.2	ppt	8.02	mg/L
15 ft	278.3	uS	11.5	ºC	0.2	ppt	7.9	mg/L
20 ft	278.4	uS	11.5	ºC	0.2	ppt	7.97	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 12/8/2007

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	308.4	uS	12	ºC	0.2	ppt	9.87	mg/L
5 ft	306.9	uS	11.6	ºC	0.2	ppt	8.35	mg/L
10 ft	306.1	uS	11.5	ºC	0.2	ppt	8.2	mg/L
15 ft	306.2	uS	11.5	ºC	0.2	ppt	8.26	mg/L
20 ft	306.5	uS	11.5	ºC	0.2	ppt	7.28	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 12/8/2007

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	168.8	uS	12.4	ºC	0.1	ppt	9.72	mg/L
5 ft	167.9	uS	11.5	ºC	0.1	ppt	8.85	mg/L
10 ft	184.2	uS	11.4	ºC	0.1	ppt	8.75	mg/L
15 ft	185.4	uS	11.3	ºC	0.1	ppt	8.79	mg/L
20 ft	193.4	uS	11.6	ºC	0.1	ppt	8.65	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 12/8/2007

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	144.5	uS	12	ºC	0.1	ppt	8.87	mg/L
5 ft	143.9	uS	11.7	ºC	0.1	ppt	9.09	mg/L
10 ft	143.2	uS	11.4	ºC	0.1	ppt	9.04	mg/L
15 ft	142.4	uS	11.3	ºC	0.1	ppt	8.91	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 12/8/2007

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	151.1	uS	12.4	ºC	0.1	ppt	9.65	mg/L
5 ft	148.6	uS	11.4	ºC	0.1	ppt	9.48	mg/L
10 ft	148.3	uS	11.3	ºC	0.1	ppt	9.3	mg/L
15 ft	148.6	uS	11.2	ºC	0.1	ppt	9.36	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 12/8/2007

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	156.1	uS	12.6	ºC	0.1	ppt	9.96	mg/L
5 ft	153	uS	11.4	ºC	0.1	ppt	9.62	mg/L
10 ft	152.4	uS	11.1	ºC	0.1	ppt	9.5	mg/L
15 ft	152.4	uS	11	ºC	0.1	ppt	9.44	mg/L
20 ft	152.4	uS	11	ºC	0.1	ppt	9.44	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 12/8/2007

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	154.1	uS	12.2	ºC	0.1	ppt	9.49	mg/L
5 ft	154.1	uS	11.5	ºC	0.1	ppt	9.56	mg/L
10 ft	154.1	uS	11.3	ºC	0.1	ppt	9.69	mg/L
15 ft	154	uS	11.3	ºC	0.1	ppt	9.52	mg/L
20 ft	153.9	uS	11.1	ºC	0.1	ppt	9.43	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 1/8/2008

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	240.1	uS	9.4	ºC	0.2	ppt	7.75	mg/L
5 ft	277.9	uS	9.2	ºC	0.2	ppt	7.8	mg/L
10 ft	272.4	uS	9.1	ºC	0.2	ppt	7.92	mg/L
15 ft	322.4	uS	9.1	ºC	0.2	ppt	7.87	mg/L
20 ft	310.5	uS	9.1	ºC	0.2	ppt	7.87	mg/L
25 ft	349.6	uS	9.1	ºC	0.2	ppt	7.54	mg/L
30 ft	330.4	uS	9	ºC	0.2	ppt	7.5	mg/L
35 ft	302.6	uS	9.1	ºC	0.2	ppt	7.19	mg/L
40 ft	326.2	uS	9.1	ºC	0.2	ppt	7.45	mg/L
45 ft	343.5	uS	9	ºC	0.2	ppt	7.51	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 1/8/2008

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	166.9	uS	9.4	ºC	0.1	ppt	8.65	mg/L
5 ft	166.6	uS	9.2	ºC	0.1	ppt	8.02	mg/L
10 ft	166.4	uS	9.1	ºC	0.1	ppt	7.93	mg/L
15 ft	166.4	uS	9	ºC	0.1	ppt	7.97	mg/L
20 ft	166.3	uS	8.9	ºC	0.1	ppt	7.97	mg/L
25 ft	166.1	uS	8.9	ºC	0.1	ppt	7.94	mg/L
30 ft	166.1	uS	8.8	ºC	0.1	ppt	7.94	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 1/8/2008

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	148.5	uS	9.3	ºC	0.1	ppt	7.91	mg/L
5 ft	148.5	uS	9	ºC	0.1	ppt	7.96	mg/L
10 ft	148.6	uS	8.9	ºC	0.1	ppt	7.94	mg/L
15 ft	148.8	uS	8.7	ºC	0.1	ppt	7.94	mg/L
20 ft	148.9	uS	8.9	ºC	0.1	ppt	8	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 1/8/2008

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	151.8	uS	9	ºC	0.1	ppt	8.13	mg/L
5 ft	151.6	uS	8.9	ºC	0.1	ppt	7.75	mg/L
10 ft	152.5	uS	8.8	ºC	0.1	ppt	7.86	mg/L
15 ft	151.8	uS	8.9	ºC	0.1	ppt	7.94	mg/L
20 ft	151.8	uS	8.9	ºC	0.1	ppt	7.85	mg/L
25 ft	151.8	uS	8.8	ºC	0.1	ppt	7.87	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 1/8/2008

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	200	uS	10.3	ºC	0.1	ppt	7.57	mg/L
5 ft	199.7	uS	10.1	ºC	0.1	ppt	7.67	mg/L
10 ft	199.7	uS	10	ºC	0.1	ppt	7.81	mg/L
15 ft	199.6	uS	9.9	ºC	0.1	ppt	7.81	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 1/8/2008

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	135.4	uS	9.9	ºC	0.1	ppt	7.6	mg/L
5 ft	135.2	uS	9.8	ºC	0.1	ppt	7.84	mg/L
10 ft	135.5	uS	9.6	ºC	0.1	ppt	6.47	mg/L
15 ft	136.3	uS	9.6	ºC	0.1	ppt	7.72	mg/L
20 ft	136.4	uS	9.5	ºC	0.1	ppt	7.5	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 1/8/2008

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	200	uS	10.5	ºC	0.1	ppt	8.29	mg/L
5 ft	201	uS	10.3	ºC	0.1	ppt	7.61	mg/L
10 ft	203.1	uS	10	ºC	0.1	ppt	7.74	mg/L
15 ft	203	uS	9.9	ºC	0.1	ppt	7.76	mg/L
20 ft	203.1	uS	9.9	ºC	0.1	ppt	7.58	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 1/8/2008

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	123.8	uS	11.2	ºC	0.1	ppt	7.76	mg/L
5 ft	120.7	uS	9.9	ºC	0.1	ppt	7.71	mg/L
10 ft	120	uS	9.6	ºC	0.1	ppt	7.37	mg/L
15 ft	119.2	uS	9.6	ºC	0.1	ppt	7.79	mg/L
20 ft	120.4	uS	9.5	ºC	0.1	ppt	7.77	mg/L
25 ft	120.8	uS	9.4	ºC	0.1	ppt	7.87	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 1/8/2008

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	105	uS	10.6	ºC	0.1	ppt	7.94	mg/L
5 ft	102.2	uS	9.6	ºC	0.1	ppt	8	mg/L
10 ft	101.9	uS	9.4	ºC	0.1	ppt	7.85	mg/L
15 ft	101.7	uS	9.3	ºC	0.1	ppt	7.73	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 1/8/2008

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	101.8	uS	10.5	ºC	0.1	ppt	8.11	mg/L
5 ft	99.3	uS	9.6	ºC	0.1	ppt	8.17	mg/L
10 ft	99.2	uS	9.4	ºC	0.1	ppt	7.7	mg/L
15 ft	99.2	uS	9.3	ºC	0.1	ppt	8.08	mg/L
20 ft	99.2	uS	9.3	ºC	0.1	ppt	8.01	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 1/8/2008

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	96.6	uS	9.8	ºC	0.1	ppt	8.62	mg/L
5 ft	96.4	uS	9.6	ºC	0.1	ppt	8.65	mg/L
10 ft	96.3	uS	9.5	ºC	0.1	ppt	8.5	mg/L
15 ft	96.2	uS	9.5	ºC	0.1	ppt	8.49	mg/L
20 ft	96.2	uS	9.4	ºC	0.1	ppt	7.85	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 1/8/2008

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	93.5	uS	9.9	ºC	0.1	ppt	8.2	mg/L
5 ft	93.3	uS	9.6	ºC	0.1	ppt	8.33	mg/L
10 ft	93.3	uS	9.5	ºC	0.1	ppt	8.38	mg/L
15 ft	93.4	uS	9.5	ºC	0.1	ppt	8.32	mg/L
20 ft	93.3	uS	9.4	ºC	0.1	ppt	8.24	mg/L
25 ft	93.3	uS	9.4	ºC	0.1	ppt	8.29	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 2/19/2008

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	149.3	uS	12.8	ºC	0.1	ppt	7.57	mg/L
5 ft	15603	uS	12.9	ºC	0.1	ppt	7.32	mg/L
10 ft	159.1	uS	12.9	ºC	0.1	ppt	7.60	mg/L
15 ft	159.7	uS	12.9	ºC	0.1	ppt	7.60	mg/L
20 ft	160.2	uS	12.9	ºC	0.1	ppt	7.52	mg/L
25 ft	160.2	uS	12.9	ºC	0.1	ppt	7.59	mg/L
30 ft	160.7	uS	12.9	ºC	0.1	ppt	7.58	mg/L
35 ft	160.7	uS	12.9	ºC	0.1	ppt	7.56	mg/L
40 ft	157.2	uS	12.9	ºC	0.1	ppt	7.60	mg/L
45 ft	156.8	uS	12.9	ºC	0.1	ppt	7.61	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 2/19/2008

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	140.3	uS	12.7	ºC	0.1	ppt	8.00	mg/L
5 ft	140.4	uS	12.8	ºC	0.1	ppt	7.67	mg/L
10 ft	140.6	uS	12.8	ºC	0.1	ppt	7.63	mg/L
15 ft	141.1	uS	12.8	ºC	0.1	ppt	7.58	mg/L
20 ft	141.2	uS	12.9	ºC	0.1	ppt	7.51	mg/L
25 ft	140.3	uS	12.9	ºC	0.1	ppt	7.61	mg/L
30 ft	140.1	uS	12.9	ºC	0.1	ppt	7.52	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 2/19/2008

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	139.8	uS	12.9	ºC	0.1	ppt	7.50	mg/L
5 ft	139.8	uS	12.9	ºC	0.1	ppt	7.57	mg/L
10 ft	139.9	uS	13.0	ºC	0.1	ppt	7.55	mg/L
15 ft	139.9	uS	13.0	ºC	0.1	ppt	7.56	mg/L
20 ft	139.9	uS	13.0	ºC	0.1	ppt	7.45	mg/L
25 ft	nd	uS	13.0	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 2/19/2008

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	122.2	uS	11.9	ºC	0.1	ppt	8.2	mg/L
5 ft	122.1	uS	12.6	ºC	0.1	ppt	8.08	mg/L
10 ft	122.2	uS	12.6	ºC	0.1	ppt	8.1	mg/L
15 ft	122.7	uS	12.6	ºC	0.1	ppt	8.06	mg/L
20 ft	121.6	uS	12.6	ºC	0.1	ppt	7.96	mg/L
25 ft	121.7	uS	12.6	ºC	0.1	ppt	7.98	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 2/19/2008

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	175.8	uS	12.5	ºC	0.1	ppt	8.49	mg/L
5 ft	170.0	uS	12.6	ºC	0.1	ppt	8.18	mg/L
10 ft	175.9	uS	12.6	ºC	0.1	ppt	7.68	mg/L
15 ft	175.8	uS	12.6	ºC	0.1	ppt	7.96	mg/L
20 ft	175.7	uS	12.6	ºC	0.1	ppt	7.92	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 2/19/2008

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	111.6	uS	12.1	ºC	0.1	ppt	9.80	mg/L
5 ft	111.6	uS	12.4	ºC	0.1	ppt	8.15	mg/L
10 ft	112.2	uS	12.3	ºC	0.1	ppt	8.27	mg/L
15 ft	112.4	uS	12.3	ºC	0.1	ppt	8.21	mg/L
20 ft	112.7	uS	12.3	ºC	0.1	ppt	8.22	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: 7 **Way point:** 019 **Date:** 2/19/2008

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	101.0	uS	12.1	ºC	0.1	ppt	8.09	mg/L
5 ft	100.9	uS	12.2	ºC	0.1	ppt	8.2	mg/L
10 ft	101.1	uS	12.1	ºC	0.1	ppt	8.46	mg/L
15 ft	100.9	uS	12.2	ºC	0.1	ppt	8.25	mg/L
20 ft	100.5	uS	12.2	ºC	0.1	ppt	8.28	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 2/19/2008

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	95.6	uS	11.8	ºC	0.1	ppt	9.07	mg/L
5 ft	95.5	uS	12.1	ºC	0.1	ppt	8.42	mg/L
10 ft	95.5	uS	12.1	ºC	0.1	ppt	8.34	mg/L
15 ft	95.5	uS	12.1	ºC	0.1	ppt	8.35	mg/L
20 ft	95.5	uS	12.1	ºC	0.1	ppt	8.38	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 2/19/2008

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	96.1	uS	11.9	ºC	0.1	ppt	9.15	mg/L
5 ft	96.1	uS	12.1	ºC	0.1	ppt	8.62	mg/L
10 ft	96.1	uS	12.1	ºC	0.1	ppt	8.52	mg/L
15 ft	96.1	uS	12.1	ºC	0.1	ppt	8.53	mg/L
20 ft	96.1	uS	12.1	ºC	0.1	ppt	8.43	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 2/19/2008

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	96.6	uS	12.0	ºC	0.1	ppt	9.55	mg/L
5 ft	96.5	uS	12.2	ºC	0.1	ppt	8.68	mg/L
10 ft	96.6	uS	12.1	ºC	0.1	ppt	8.61	mg/L
15 ft	96.6	uS	12.2	ºC	0.1	ppt	8.85	mg/L
20 ft	96.6	uS	12.2	ºC	0.1	ppt	8.49	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 2/19/2008

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	96.9	uS	12.1	ºC	0.1	ppt	9.62	mg/L
5 ft	96.9	uS	12.3	ºC	0.1	ppt	8.79	mg/L
10 ft	96.9	uS	12.2	ºC	0.1	ppt	8.66	mg/L
15 ft	96.9	uS	12.2	ºC	0.1	ppt	8.65	mg/L
20 ft	96.9	uS	12.2	ºC	0.1	ppt	8.64	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 2/19/2008

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	97.7	uS	12.2	ºC	0.1	ppt	8.65	mg/L
5 ft	97.6	uS	12.2	ºC	0.1	ppt	8.67	mg/L
10 ft	97.7	uS	12.2	ºC	0.1	ppt	8.63	mg/L
15 ft	97.5	uS	12.2	ºC	0.1	ppt	8.64	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 3/20/2008

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	123.6	uS	15.1	ºC	0.1	ppt	7.39	mg/L
5 ft	124.3	uS	14.9	ºC	0.1	ppt	7.41	mg/L
10 ft	124.6	uS	14.9	ºC	0.1	ppt	7.30	mg/L
15 ft	124.9	uS	14.9	ºC	0.1	ppt	7.40	mg/L
20 ft	125.0	uS	14.8	ºC	0.1	ppt	7.40	mg/L
25 ft	125.3	uS	14.8	ºC	0.1	ppt	7.46	mg/L
30 ft	125.5	uS	14.8	ºC	0.1	ppt	7.50	mg/L
35 ft	125.2	uS	14.8	ºC	0.1	ppt	7.42	mg/L
40 ft	125.1	uS	14.8	ºC	0.1	ppt	7.46	mg/L
45 ft	125.3	uS	14.8	ºC	0.1	ppt	7.41	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 3/20/2008

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	109.1	uS	15.1	ºC	0.1	ppt	7.44	mg/L
5 ft	111.5	uS	15.1	ºC	0.1	ppt	7.00	mg/L
10 ft	110.2	uS	15.1	ºC	0.1	ppt	6.95	mg/L
15 ft	109.5	uS	15.1	ºC	0.1	ppt	7.01	mg/L
20 ft	110.0	uS	15.1	ºC	0.1	ppt	6.88	mg/L
25 ft	110.1	uS	15.1	ºC	0.1	ppt	6.87	mg/L
30 ft	110.1	uS	15.1	ºC	0.1	ppt	6.72	mg/L
35 ft	nd	uS	nd	ºC	0.1	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	0.1	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	0.1	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 3/20/2008

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	124.3	uS	14.5	ºC	0.1	ppt	7.90	mg/L
5 ft	124.1	uS	14.5	ºC	0.1	ppt	7.63	mg/L
10 ft	124.6	uS	14.5	ºC	0.1	ppt	7.66	mg/L
15 ft	124.5	uS	14.5	ºC	0.1	ppt	7.64	mg/L
20 ft	124.6	uS	14.5	ºC	0.1	ppt	7.66	mg/L
25 ft	124.5	uS	14.5	ºC	0.1	ppt	7.63	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 3/20/2008

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	125.3	uS	14.4	ºC	0.1	ppt	8.03	mg/L
5 ft	125.3	uS	14.4	ºC	0.1	ppt	7.73	mg/L
10 ft	125.3	uS	14.4	ºC	0.1	ppt	7.70	mg/L
15 ft	125.3	uS	14.4	ºC	0.1	ppt	7.69	mg/L
20 ft	125.3	uS	14.4	ºC	0.1	ppt	7.59	mg/L
25 ft	125.3	uS	14.4	ºC	0.1	ppt	7.62	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 3/20/2008

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	124.8	uS	14.4	ºC	0.1	ppt	7.95	mg/L
5 ft	124.8	uS	14.4	ºC	0.1	ppt	7.67	mg/L
10 ft	124.8	uS	14.5	ºC	0.1	ppt	7.56	mg/L
15 ft	124.8	uS	14.6	ºC	0.1	ppt	7.55	mg/L
20 ft	124.9	uS	14.5	ºC	0.1	ppt	7.58	mg/L
25 ft	124.8	uS	14.5	ºC	0.1	ppt	7.50	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 3/20/2008

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	122.6	uS	14.2	ºC	0.1	ppt	8.46	mg/L
5 ft	122.4	uS	14.4	ºC	0.1	ppt	7.60	mg/L
10 ft	122.4	uS	14.4	ºC	0.1	ppt	7.54	mg/L
15 ft	122.4	uS	14.4	ºC	0.1	ppt	7.53	mg/L
20 ft	122.4	uS	14.4	ºC	0.1	ppt	7.51	mg/L
25 ft	122.3	uS	14.5	ºC	0.1	ppt	7.48	mg/L
30 ft	122.4	uS	14.5	ºC	0.1	ppt	7.39	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 3/20/2008

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	123.1	uS	14.3	ºC	0.1	ppt	7.82	mg/L
5 ft	122.2	uS	14.4	ºC	0.1	ppt	7.58	mg/L
10 ft	123.0	uS	14.4	ºC	0.1	ppt	7.58	mg/L
15 ft	122.9	uS	14.4	ºC	0.1	ppt	7.57	mg/L
20 ft	121.3	uS	14.4	ºC	0.1	ppt	7.54	mg/L
25 ft	121.6	uS	14.4	ºC	0.1	ppt	7.52	mg/L
30 ft	121.4	uS	14.4	ºC	0.1	ppt	7.45	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 3/20/2008

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	105.9	uS	14.2	ºC	0.1	ppt	8.10	mg/L
5 ft	105.9	uS	14.3	ºC	0.1	ppt	7.67	mg/L
10 ft	105.9	uS	14.3	ºC	0.1	ppt	7.76	mg/L
15 ft	105.9	uS	14.3	ºC	0.1	ppt	7.68	mg/L
20 ft	106.0	uS	14.3	ºC	0.1	ppt	7.63	mg/L
25 ft	106.0	uS	14.3	ºC	0.1	ppt	7.68	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 3/20/2008

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	105.2	uS	14.1	ºC	0.1	ppt	8.92	mg/L
5 ft	105.3	uS	14.2	ºC	0.1	ppt	7.86	mg/L
10 ft	105.3	uS	14.2	ºC	0.1	ppt	7.78	mg/L
15 ft	105.2	uS	14.2	ºC	0.1	ppt	7.78	mg/L
20 ft	105.2	uS	14.2	ºC	0.1	ppt	7.74	mg/L
25 ft	105.2	uS	14.2	ºC	0.1	ppt	7.66	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 3/20/2008

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	104.3	uS	13.9	ºC	0.1	ppt	8.69	mg/L
5 ft	104.3	uS	14.1	ºC	0.1	ppt	7.92	mg/L
10 ft	104.2	uS	14.1	ºC	0.1	ppt	7.83	mg/L
15 ft	104.5	uS	14.1	ºC	0.1	ppt	7.83	mg/L
20 ft	104.3	uS	14.1	ºC	0.1	ppt	7.80	mg/L
25 ft	104.3	uS	14.1	ºC	0.1	ppt	7.79	mg/L
30 ft	104.3	uS	14.1	ºC	0.1	ppt	7.78	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 3/20/2008

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	103.3	uS	14.0	ºC	0.1	ppt	8.04	mg/L
5 ft	103.3	uS	14.0	ºC	0.1	ppt	7.94	mg/L
10 ft	103.3	uS	14.0	ºC	0.1	ppt	7.72	mg/L
15 ft	103.3	uS	14.1	ºC	0.1	ppt	7.81	mg/L
20 ft	103.3	uS	14.1	ºC	0.1	ppt	7.81	mg/L
25 ft	103.3	uS	14.1	ºC	0.1	ppt	7.84	mg/L
30 ft	103.3	uS	14.1	ºC	0.1	ppt	7.76	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 3/20/2008

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	102.2	uS	13.9	ºC	0.1	ppt	8.30	mg/L
5 ft	102.3	uS	14.0	ºC	0.1	ppt	8.01	mg/L
10 ft	102.2	uS	14.0	ºC	0.1	ppt	8.01	mg/L
15 ft	102.2	uS	14.0	ºC	0.1	ppt	8.02	mg/L
20 ft	102.2	uS	14.0	ºC	0.1	ppt	7.95	mg/L
25 ft	102.2	uS	14.0	ºC	0.1	ppt	7.91	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 4/30/2008

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	152.6	uS	20.5	ºC	0.1	ppt	7.60	mg/L
5 ft	152.8	uS	20.5	ºC	0.1	ppt	7.90	mg/L
10 ft	151.9	uS	20.5	ºC	0.1	ppt	7.80	mg/L
15 ft	152.2	uS	20.5	ºC	0.1	ppt	7.69	mg/L
20 ft	152.0	uS	20.5	ºC	0.1	ppt	7.50	mg/L
25 ft	150.3	uS	20.5	ºC	0.1	ppt	7.60	mg/L
30 ft	149.9	uS	20.5	ºC	0.1	ppt	7.62	mg/L
35 ft	150.2	uS	20.5	ºC	0.1	ppt	7.60	mg/L
40 ft	150.2	uS	20.5	ºC	0.1	ppt	7.60	mg/L
45 ft	151.4	uS	20.5	ºC	0.1	ppt	7.54	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 4/30/2008

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	131.8	uS	20.8	ºC	0.1	ppt	8.63	mg/L
5 ft	131.8	uS	20.7	ºC	0.1	ppt	8.57	mg/L
10 ft	131.6	uS	20.6	ºC	0.1	ppt	8.65	mg/L
15 ft	131.6	uS	20.6	ºC	0.1	ppt	8.57	mg/L
20 ft	131.6	uS	20.5	ºC	0.1	ppt	8.55	mg/L
25 ft	131.5	uS	20.5	ºC	0.1	ppt	8.55	mg/L
30 ft	131.7	uS	20.5	ºC	0.1	ppt	8.57	mg/L
35 ft	131.7	uS	20.5	ºC	0.1	ppt	8.55	mg/L
40 ft	131.5	uS	20.4	ºC	0.1	ppt	8.52	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 4/30/2008

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	141.8	uS	21.2	ºC	0.1	ppt	8.76	mg/L
5 ft	141.6	uS	21.0	ºC	0.1	ppt	8.72	mg/L
10 ft	141.8	uS	20.9	ºC	0.1	ppt	8.74	mg/L
15 ft	141.7	uS	20.8	ºC	0.1	ppt	8.80	mg/L
20 ft	141.7	uS	20.8	ºC	0.1	ppt	8.75	mg/L
25 ft	141.6	uS	20.7	ºC	0.1	ppt	8.76	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 4/30/2008

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	137.7	uS	20.9	ºC	0.1	ppt	8.91	mg/L
5 ft	137.4	uS	20.7	ºC	0.1	ppt	8.88	mg/L
10 ft	137.4	uS	20.7	ºC	0.1	ppt	8.87	mg/L
15 ft	137.6	uS	20.7	ºC	0.1	ppt	8.89	mg/L
20 ft	137.2	uS	20.6	ºC	0.1	ppt	8.85	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 4/30/2008

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	130.6	uS	20.9	ºC	0.1	ppt	9.01	mg/L
5 ft	130.5	uS	20.8	ºC	0.1	ppt	8.9	mg/L
10 ft	130.4	uS	20.7	ºC	0.1	ppt	8.87	mg/L
15 ft	130.3	uS	20.6	ºC	0.1	ppt	8.87	mg/L
20 ft	130.3	uS	20.6	ºC	0.1	ppt	8.92	mg/L
25 ft	130.3	uS	20.6	ºC	0.1	ppt	8.84	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 4/30/2008

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	129.0	uS	21.0	ºC	0.1	ppt	9.17	mg/L
5 ft	128.9	uS	20.9	ºC	0.1	ppt	9.03	mg/L
10 ft	129.0	uS	20.8	ºC	0.1	ppt	8.98	mg/L
15 ft	128.9	uS	20.8	ºC	0.1	ppt	9.01	mg/L
20 ft	129.0	uS	20.7	ºC	0.1	ppt	9.00	mg/L
25 ft	129.0	uS	20.7	ºC	0.1	ppt	8.98	mg/L
30 ft	129.0	uS	20.7	ºC	0.1	ppt	8.77	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 4/30/2008

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	135.1	uS	21.1	ºC	0.1	ppt	8.93	mg/L
5 ft	132.2	uS	21	ºC	0.1	ppt	8.99	mg/L
10 ft	133.4	uS	20.9	ºC	0.1	ppt	8.99	mg/L
15 ft	133.6	uS	20.9	ºC	0.1	ppt	8.98	mg/L
20 ft	132.3	uS	20.9	ºC	0.1	ppt	8.98	mg/L
25 ft	131.9	uS	20.8	ºC	0.1	ppt	8.99	mg/L
30 ft	130.5	uS	20.8	ºC	0.1	ppt	8.95	mg/L
35 ft	131.2	uS	20.8	ºC	0.1	ppt	8.97	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 4/30/2008

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	115.3	uS	21.1	ºC	0.1	ppt	9.03	mg/L
5 ft	115.3	uS	20.9	ºC	0.1	ppt	8.98	mg/L
10 ft	115.3	uS	20.9	ºC	0.1	ppt	8.85	mg/L
15 ft	115.4	uS	20.8	ºC	0.1	ppt	8.90	mg/L
20 ft	115.3	uS	20.8	ºC	0.1	ppt	8.92	mg/L
25 ft	115.3	uS	20.8	ºC	0.1	ppt	8.96	mg/L
30 ft	115.3	uS	20.8	ºC	0.1	ppt	8.88	mg/L
35 ft	115.2	uS	20.8	ºC	0.1	ppt	8.92	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 4/30/2008

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	112.6	uS	21.1	ºC	0.1	ppt	9.22	mg/L
5 ft	112.5	uS	21.0	ºC	0.1	ppt	9.05	mg/L
10 ft	112.5	uS	21.0	ºC	0.1	ppt	9.03	mg/L
15 ft	112.4	uS	20.9	ºC	0.1	ppt	8.99	mg/L
20 ft	112.4	uS	20.9	ºC	0.1	ppt	9.00	mg/L
25 ft	112.4	uS	20.8	ºC	0.1	ppt	9.03	mg/L
30 ft	112.4	uS	20.8	ºC	0.1	ppt	9.02	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 4/30/2008

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	107.7	uS	21.1	ºC	0.1	ppt	9.14	mg/L
5 ft	107.8	uS	21.0	ºC	0.1	ppt	9.03	mg/L
10 ft	107.8	uS	20.9	ºC	0.1	ppt	9.03	mg/L
15 ft	107.6	uS	20.9	ºC	0.1	ppt	8.99	mg/L
20 ft	107.4	uS	20.8	ºC	0.1	ppt	8.98	mg/L
25 ft	107.5	uS	20.8	ºC	0.1	ppt	8.97	mg/L
30 ft	107.5	uS	20.8	ºC	0.1	ppt	9.02	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 4/30/2008

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	102.5	uS	21.3	ºC	0.1	ppt	8.93	mg/L
5 ft	102.4	uS	21.0	ºC	0.1	ppt	8.94	mg/L
10 ft	102.3	uS	20.9	ºC	0.1	ppt	8.92	mg/L
15 ft	102.3	uS	20.9	ºC	0.1	ppt	8.95	mg/L
20 ft	102.3	uS	20.8	ºC	0.1	ppt	8.97	mg/L
25 ft	102.3	uS	20.8	ºC	0.1	ppt	8.89	mg/L
30 ft	102.3	uS	20.8	ºC	0.1	ppt	8.93	mg/L
35 ft	102.2	uS	20.8	ºC	0.1	ppt	8.90	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 4/30/2008

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	100.6	uS	21.2	ºC	0.1	ppt	8.86	mg/L
5 ft	100.6	uS	21.1	ºC	0.1	ppt	8.75	mg/L
10 ft	100.7	uS	21.0	ºC	0.1	ppt	8.65	mg/L
15 ft	101.0	uS	20.9	ºC	0.1	ppt	8.36	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **1** **Date:** 5/20/2008

Latitude: 34º 16.837 N **Longitude: 78º 00.263 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	153.7	uS	22.5	ºC	0.1	ppt	6.55	mg/L
5 ft	155.2	uS	22.4	ºC	0.1	ppt	6.72	mg/L
10 ft	155.9	uS	22.2	ºC	0.1	ppt	6.83	mg/L
15 ft	155.3	uS	22.2	ºC	0.1	ppt	6.94	mg/L
20 ft	156.1	uS	22.2	ºC	0.1	ppt	6.81	mg/L
25 ft	156.8	uS	22.2	ºC	0.1	ppt	6.93	mg/L
30 ft	156.2	uS	22.1	ºC	0.1	ppt	6.89	mg/L
35 ft	156.3	uS	22.1	ºC	0.1	ppt	6.90	mg/L
40 ft	156.6	uS	22.1	ºC	0.1	ppt	6.81	mg/L
45 ft	156.2	uS	22.1	ºC	0.1	ppt	6.32	mg/L

Physical Measurements Collected At Depth

Site: **2** **Date:** 5/20/2008

Latitude: 34º 19.396 N **Longitude: 78º 00.549 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	158.0	uS	22.6	ºC	0.1	ppt	7.01	mg/L
5 ft	157.8	uS	22.4	ºC	0.1	ppt	6.66	mg/L
10 ft	156.9	uS	22.3	ºC	0.1	ppt	6.58	mg/L
15 ft	157.3	uS	22.3	ºC	0.1	ppt	6.77	mg/L
20 ft	157.5	uS	22.2	ºC	0.1	ppt	6.93	mg/L
25 ft	158.0	uS	22.2	ºC	0.1	ppt	6.8	mg/L
30 ft	157.6	uS	22.1	ºC	0.1	ppt	6.95	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **3** **Date:** 5/20/2008

Latitude: 34º 20.187 N **Longitude: 78º 02.900 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	164.3	uS	22.5	ºC	0.1	ppt	7.82	mg/L
5 ft	165.2	uS	22.2	ºC	0.1	ppt	7.52	mg/L
10 ft	174.4	uS	22.1	ºC	0.1	ppt	7.67	mg/L
15 ft	177.8	uS	22.1	ºC	0.1	ppt	7.35	mg/L
20 ft	168.7	uS	21.9	ºC	0.1	ppt	7.03	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **4** **Way point:** **016** **Date:** 5/20/2008

Latitude: 34º 20.276 N **Longitude: 78º 04.509 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	150.3	uS	23.0	ºC	0.1	ppt	7.79	mg/L
5 ft	149.4	uS	22.7	ºC	0.1	ppt	7.84	mg/L
10 ft	146.9	uS	22.1	ºC	0.1	ppt	7.62	mg/L
15 ft	147.3	uS	22.0	ºC	0.1	ppt	7.63	mg/L
20 ft	147.2	uS	21.9	ºC	0.1	ppt	7.44	mg/L
25 ft	147.3	uS	21.9	ºC	0.1	ppt	7.60	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **5** **Way point:** **017** **Date:** 5/20/2008

Latitude: 34º 21.312 N **Longitude: 78º 06.122 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	196.3	uS	22.8	ºC	0.1	ppt	7.76	mg/L
5 ft	193.8	uS	22.3	ºC	0.1	ppt	7.87	mg/L
10 ft	195.0	uS	22.1	ºC	0.1	ppt	7.81	mg/L
15 ft	194.8	uS	22.0	ºC	0.1	ppt	7.53	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **6** **Way point:** **018** **Date:** 5/20/2008

Latitude: 34º 21.963 N **Longitude: 78º 08.109 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	182.4	uS	22.5	ºC	0.1	ppt	7.94	mg/L
5 ft	183.2	uS	22.3	ºC	0.1	ppt	7.78	mg/L
10 ft	182.5	uS	22.1	ºC	0.1	ppt	7.79	mg/L
15 ft	182.4	uS	22.0	ºC	0.1	ppt	7.88	mg/L
20 ft	182.9	uS	22.0	ºC	0.1	ppt	7.74	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **7** **Way point:** **019** **Date:** 5/20/2008

Latitude: 34º 21.440 N **Longitude: 78º 09.949 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	143.9	uS	22.6	ºC	0.1	ppt	8.15	mg/L
5 ft	140.9	uS	22.3	ºC	0.1	ppt	7.91	mg/L
10 ft	140.1	uS	22.2	ºC	0.1	ppt	7.94	mg/L
15 ft	139.5	uS	22.2	ºC	0.1	ppt	8.05	mg/L
20 ft	138.9	uS	22.1	ºC	0.1	ppt	8.03	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **8** **Way point:** **020** **Date:** 5/20/2008

Latitude: 34º 21.413 N **Longitude: 78º 12.560 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	138.2	uS	22.9	ºC	0.1	ppt	8.08	mg/L
5 ft	139.0	uS	22.6	ºC	0.1	ppt	8.18	mg/L
10 ft	139.2	uS	22.5	ºC	0.1	ppt	8.00	mg/L
15 ft	139.2	uS	22.3	ºC	0.1	ppt	8.27	mg/L
20 ft	139.2	uS	22.3	ºC	0.1	ppt	8.31	mg/L
25 ft	139.3	uS	22.3	ºC	0.1	ppt	8.26	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **9** **Way point:** **021** **Date:** 5/20/2008

Latitude: 34º 22.470 N **Longitude: 78º 13.560 W**

Depth	**Conductivity**		**Temp**		**Salinity**		**D.O.**	
Surface	141.1	uS	23.0	ºC	0.1	ppt	8.35	mg/L
5 ft	140.8	uS	22.6	ºC	0.1	ppt	8.24	mg/L
10 ft	140.9	uS	22.5	ºC	0.1	ppt	8.33	mg/L
15 ft	140.9	uS	22.4	ºC	0.1	ppt	8.22	mg/L
20 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **10** **Way point:** **022** **Date:** 5/20/2008

Latitude: 34º 23.075 N **Longitude: 78º 14.705 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	142.2	uS	22.8	ºC	0.1	ppt	8.63	mg/L
5 ft	143.2	uS	22.6	ºC	0.1	ppt	8.42	mg/L
10 ft	143.2	uS	22.5	ºC	0.1	ppt	8.39	mg/L
15 ft	143.1	uS	22.5	ºC	0.1	ppt	8.50	mg/L
20 ft	143.1	uS	22.4	ºC	0.1	ppt	8.47	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **11** **Way point:** **023** **Date:** 5/20/2008

Latitude: 34º 23.824 N **Longitude: 78º 16.050 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	145.5	uS	22.7	ºC	0.1	ppt	8.45	mg/L
5 ft	145.3	uS	22.6	ºC	0.1	ppt	8.44	mg/L
10 ft	145.3	uS	22.5	ºC	0.1	ppt	8.44	mg/L
15 ft	145.3	uS	22.4	ºC	0.1	ppt	8.53	mg/L
20 ft	145.3	uS	22.4	ºC	0.1	ppt	8.44	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

Physical Measurements Collected At Depth

Site: **12** **Way point:** **024** **Date:** 5/20/2008

Latitude: 34º 24.218 N **Longitude: 78º 17.528 W**

Depth	Conductivity		Temp		Salinity		D.O.	
Surface	146.6	uS	22.6	ºC	0.1	ppt	8.35	mg/L
5 ft	146.7	uS	22.4	ºC	0.1	ppt	8.41	mg/L
				3				
10 ft	146.6	uS	22.3	ºC	0.1	ppt	8.65	mg/L
15 ft	146.5	uS	22.3	ºC	0.1	ppt	8.24	mg/L
20 ft	146.6	uS	22.2	ºC	0.1	ppt	8.56	mg/L
25 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
30 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
35 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
40 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L
45 ft	nd	uS	nd	ºC	nd	ppt	nd	mg/L

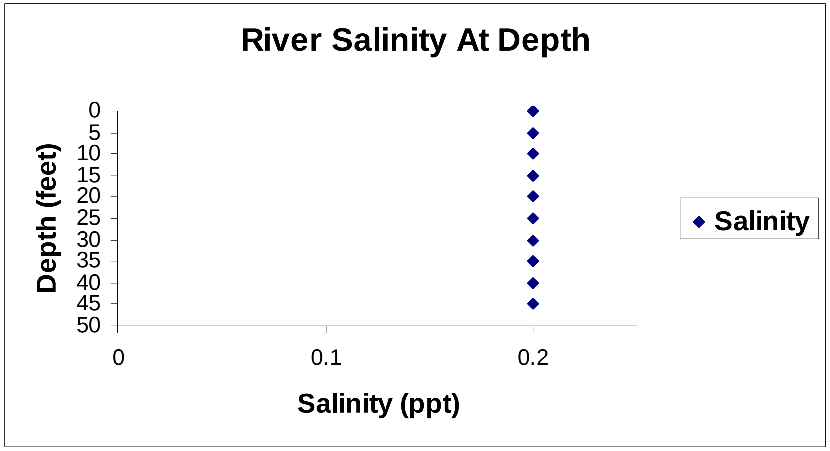
APPENDIX C

SALINITY PROFILES FOR ALL SITES FOR ALL COLLECTION DATES

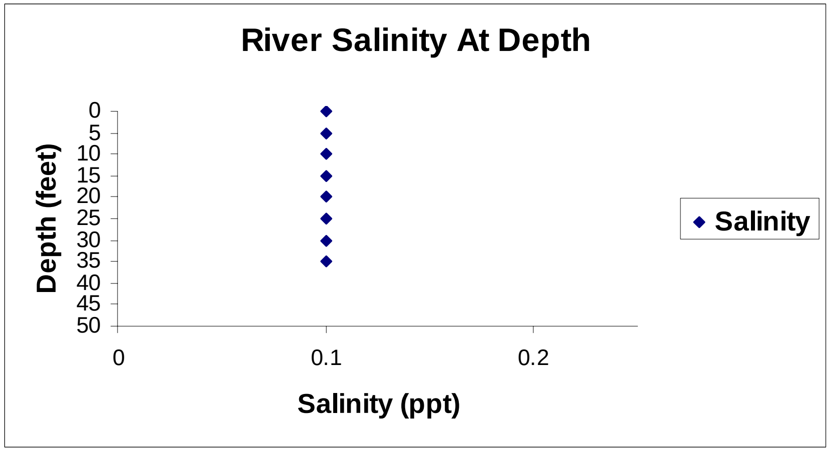
Appendix C. (continued)

Sampling Date: 6/21/07

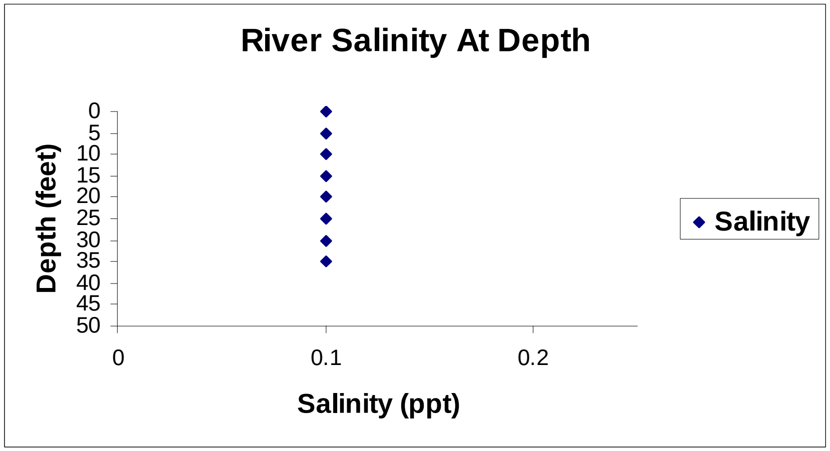
Site 1



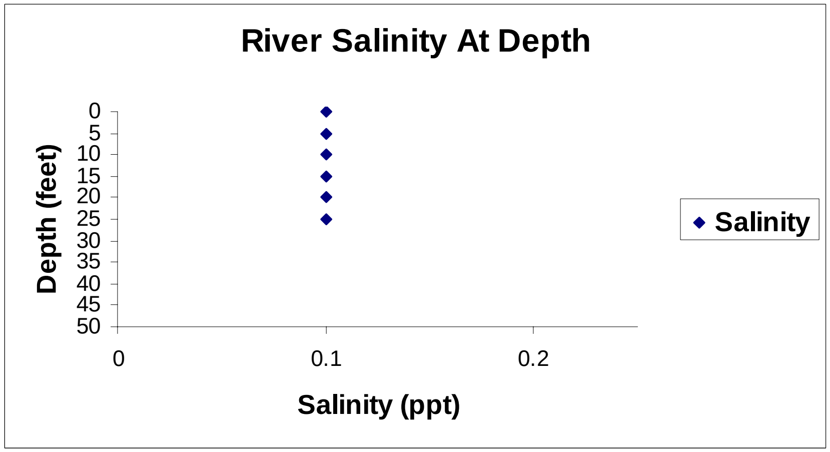
Site 2



Site 3

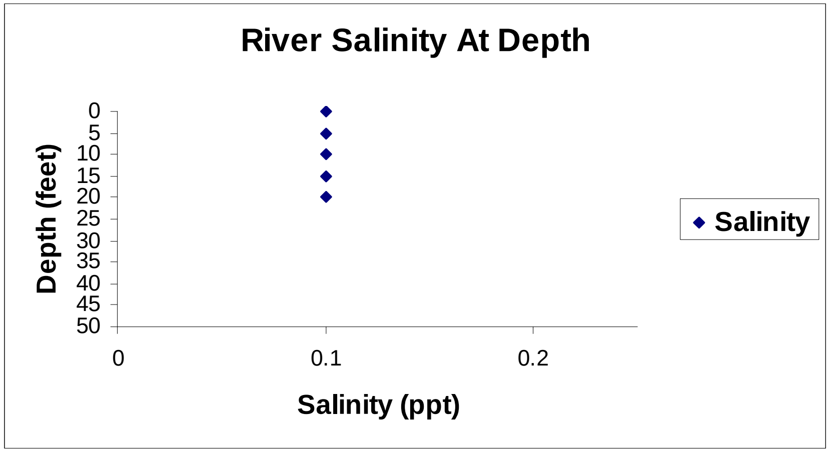


Site 4

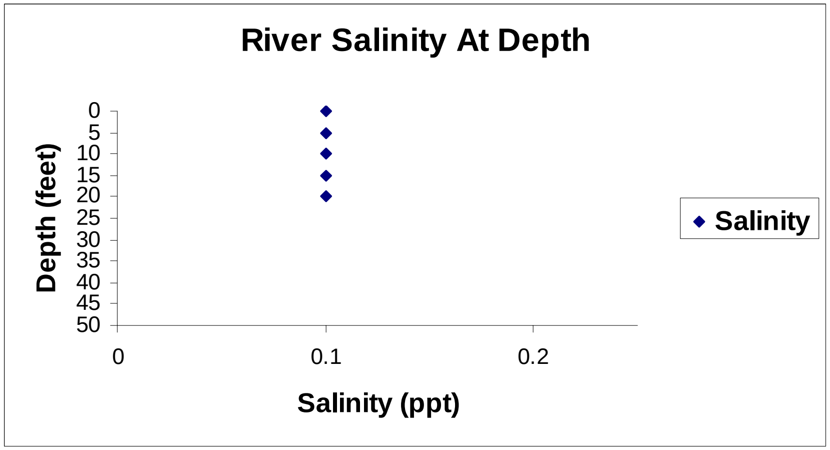


Sampling Date: 6/21/07

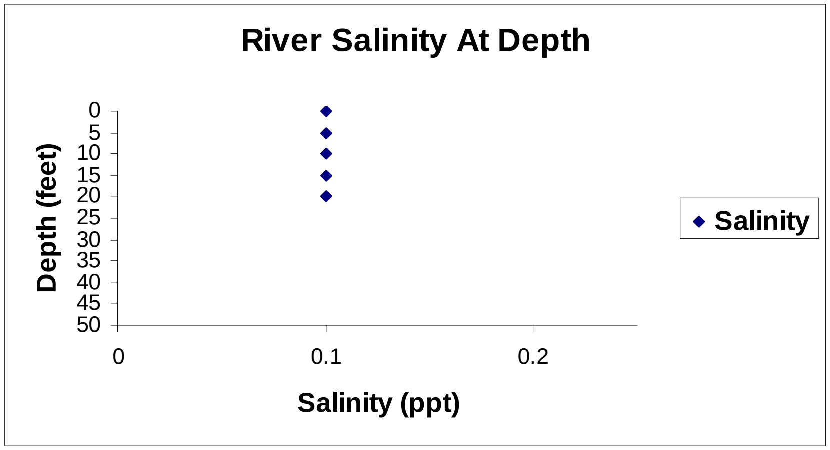
Site 5



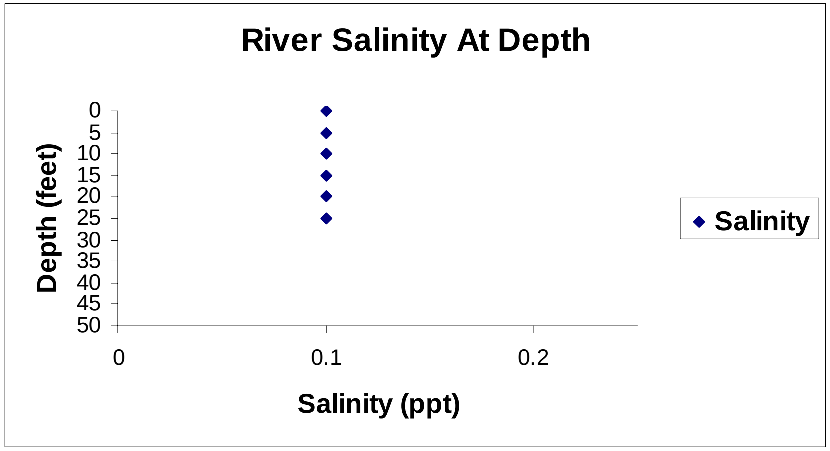
Site 6



Site 7

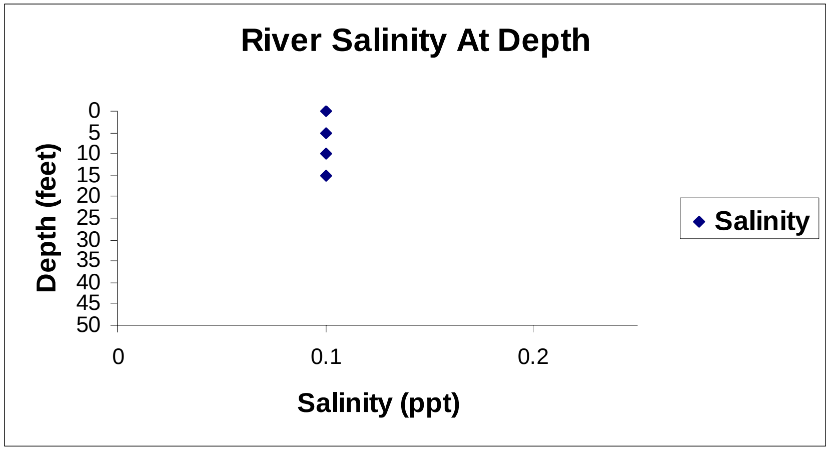


Site 8

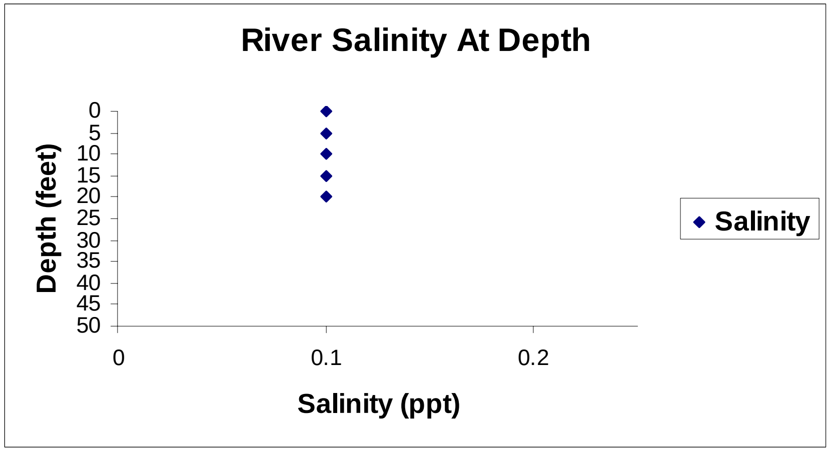


Sampling Date: 6/21/07

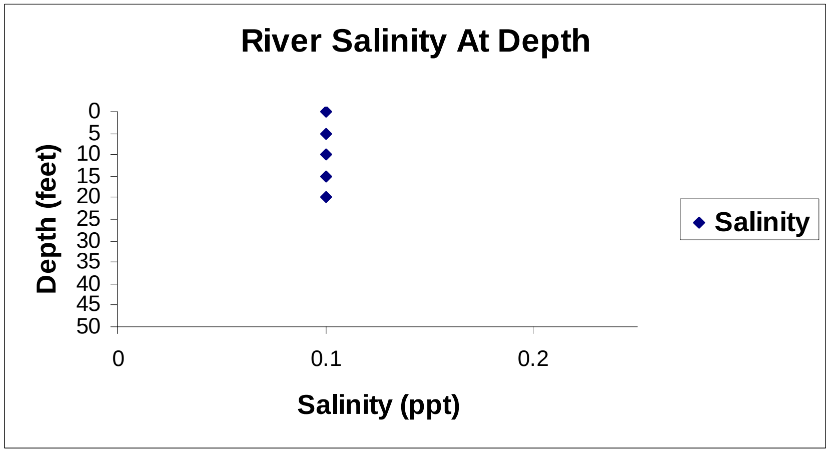
Site 9



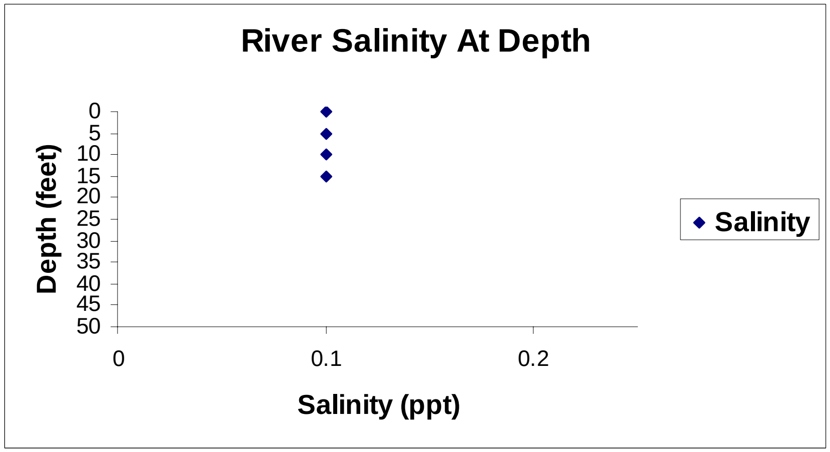
Site 10



Site 11

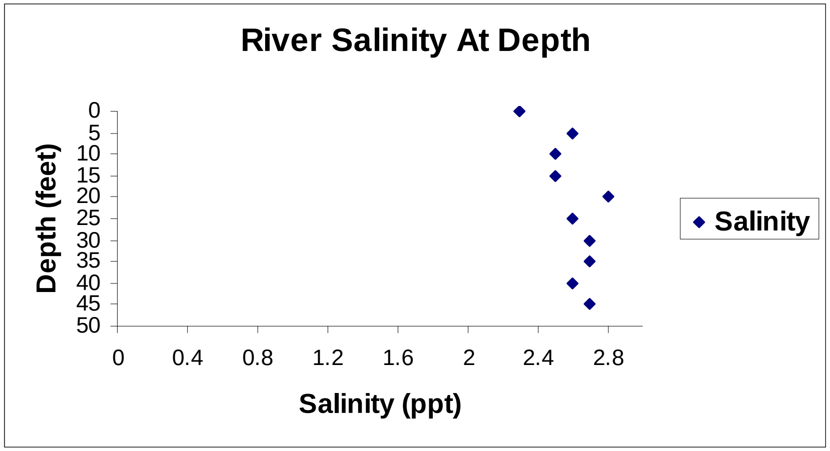


Site 12

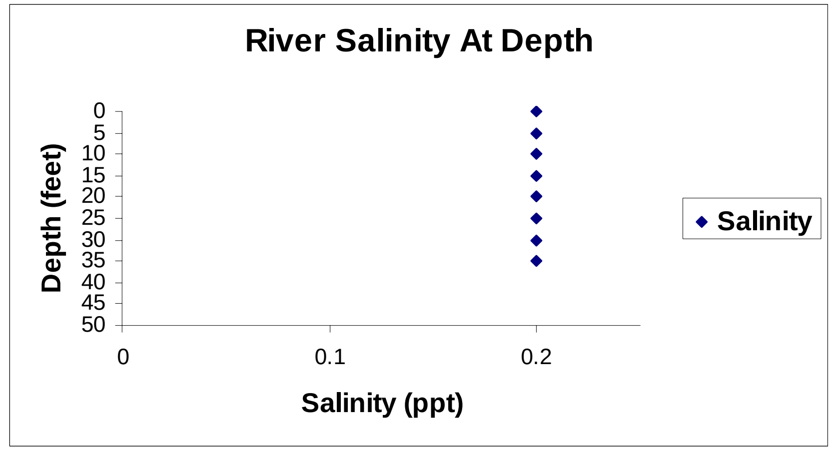


Sampling Date: 7/31/07

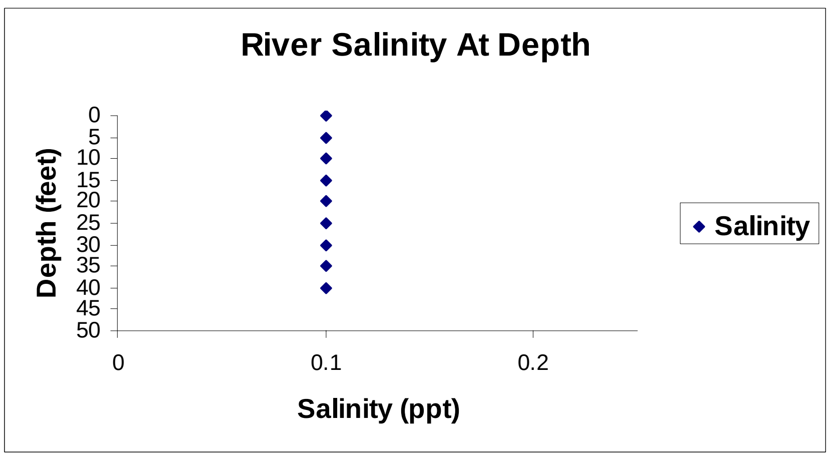
Site 1



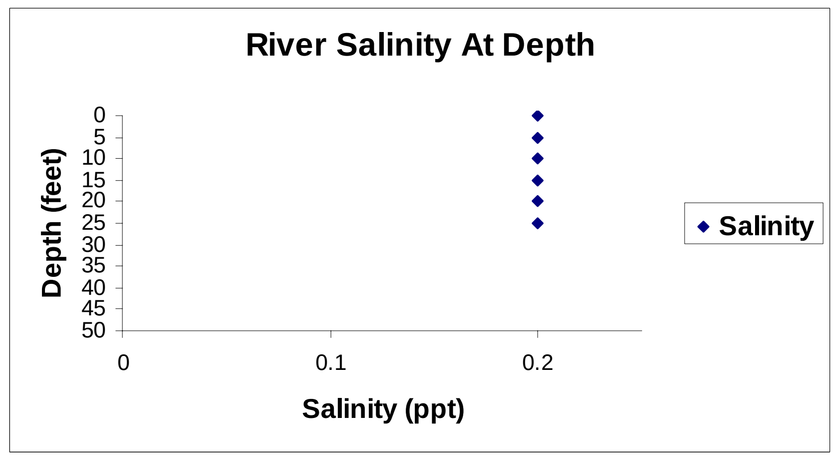
Site 2



Site 3

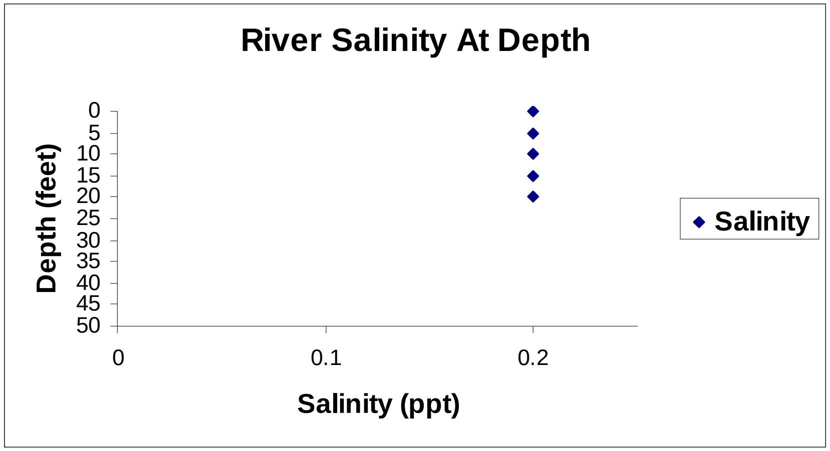


Site 4

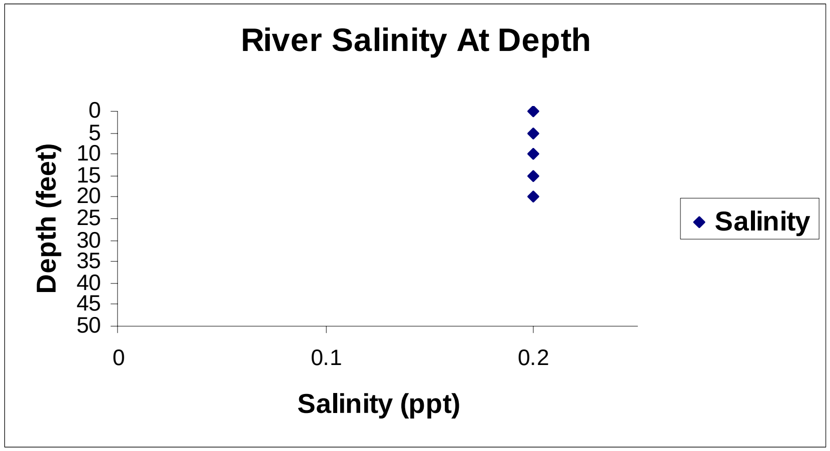


Sampling Date: 7/31/07

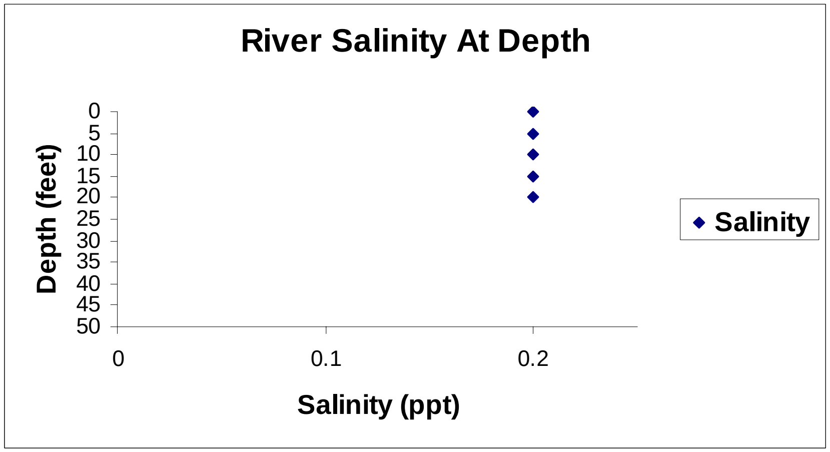
Site 5



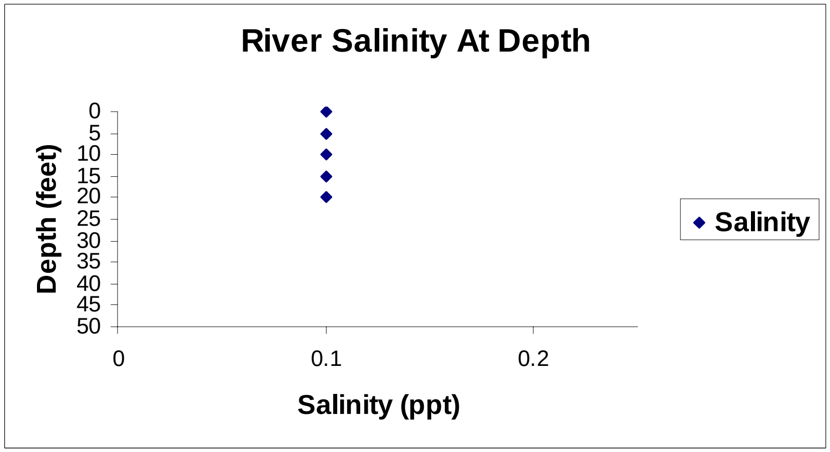
Site 6



Site 7



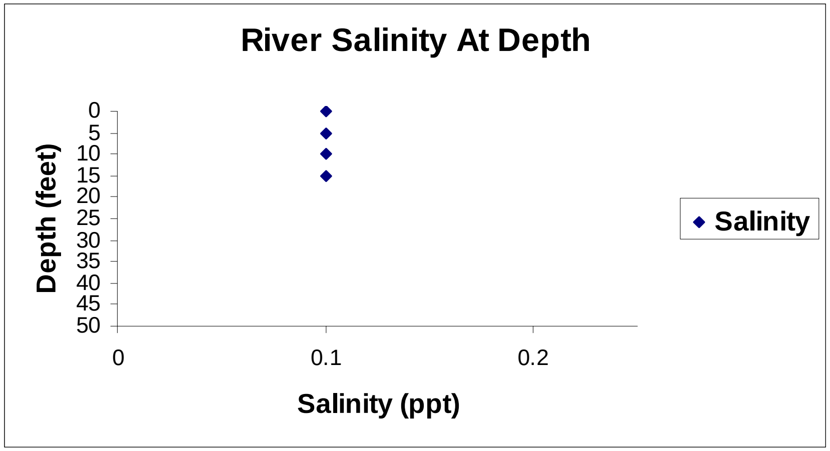
Site 8



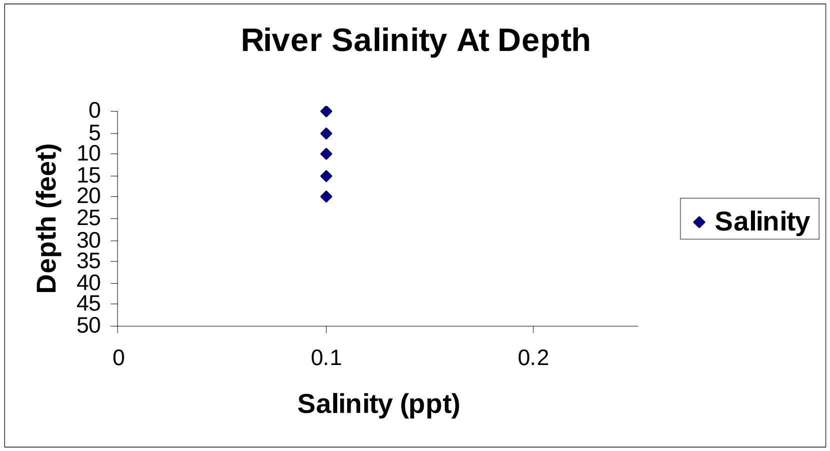
Appendix C. (continued)

Sampling Date: 7/31/07

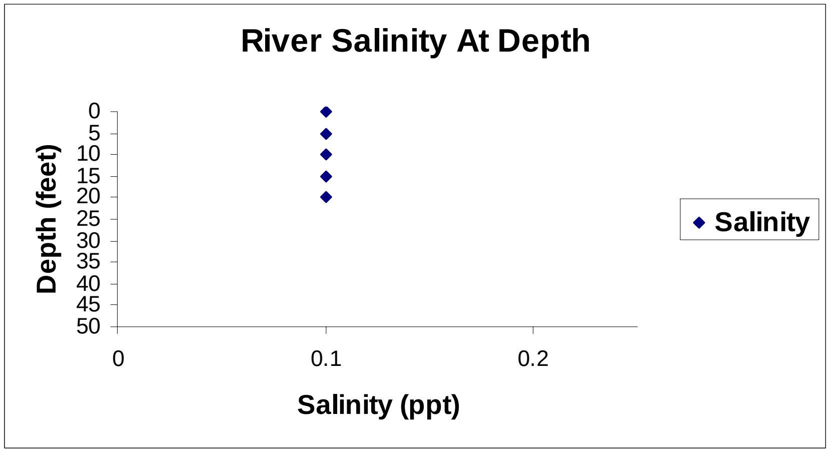
Site 9



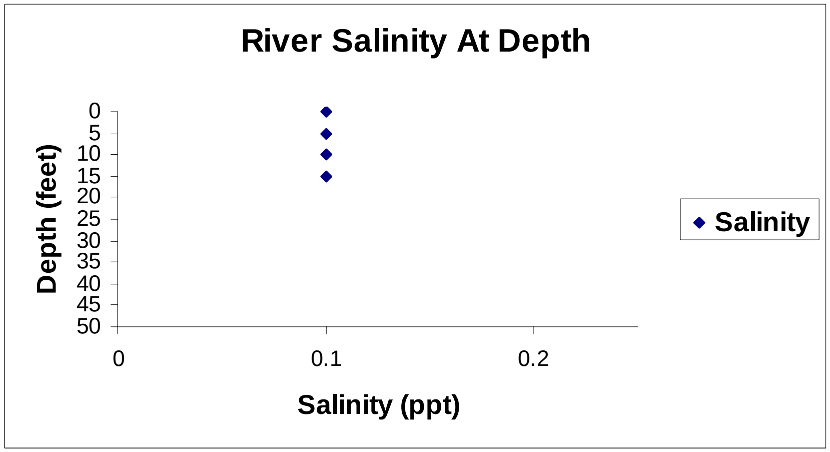
Site 10



Site 11



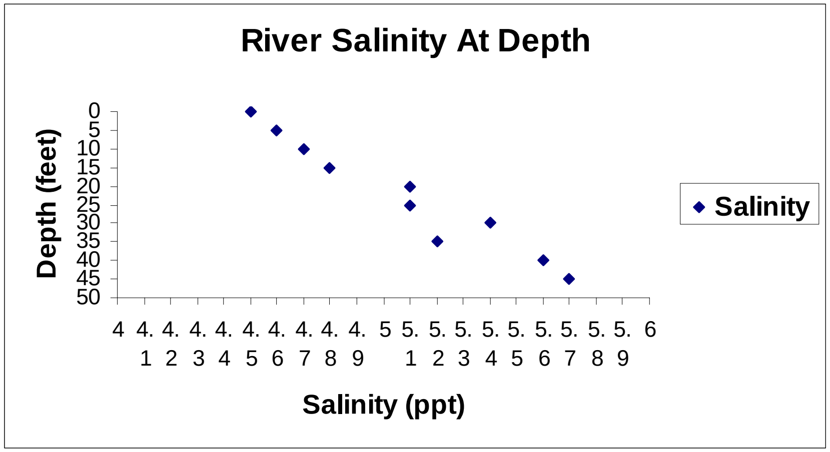
Site 12



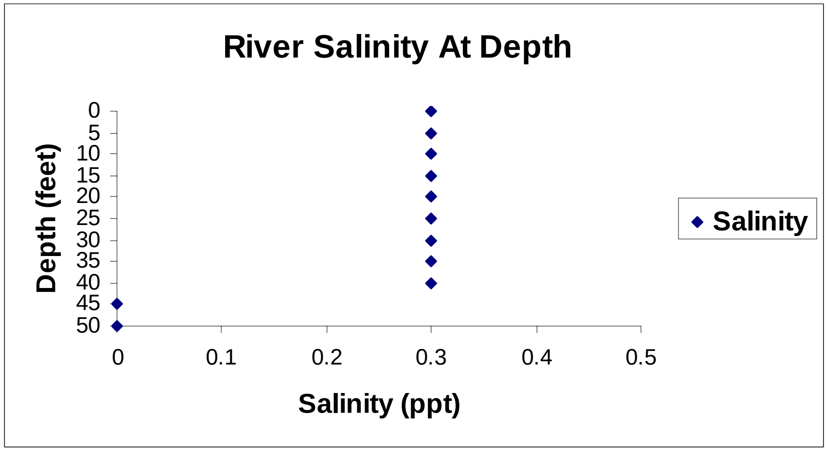
Appendix C. (continued)

Sampling Date: 8//30/07

Site 1



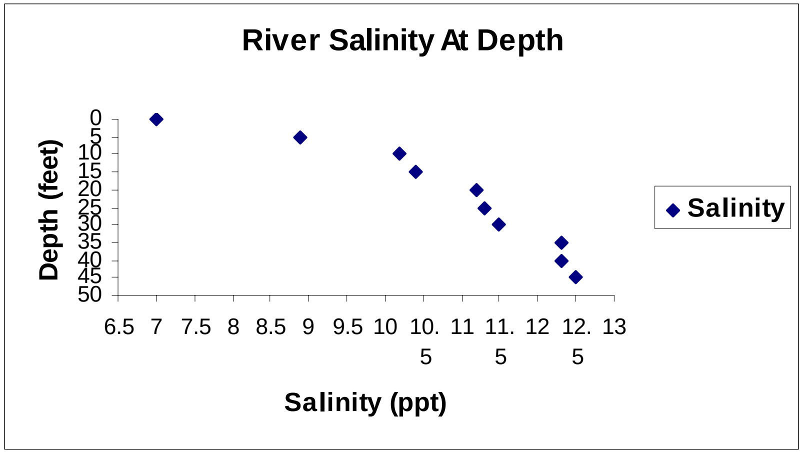
Site 2



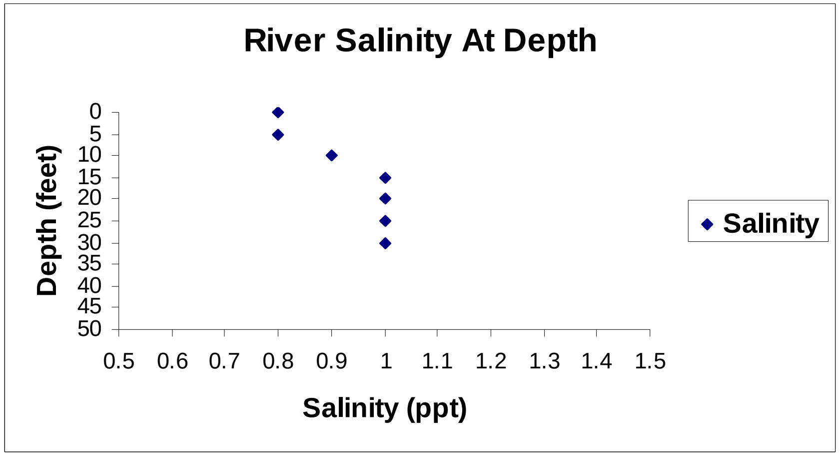
Appendix C. (continued)

Sampling Date: 9/06/07

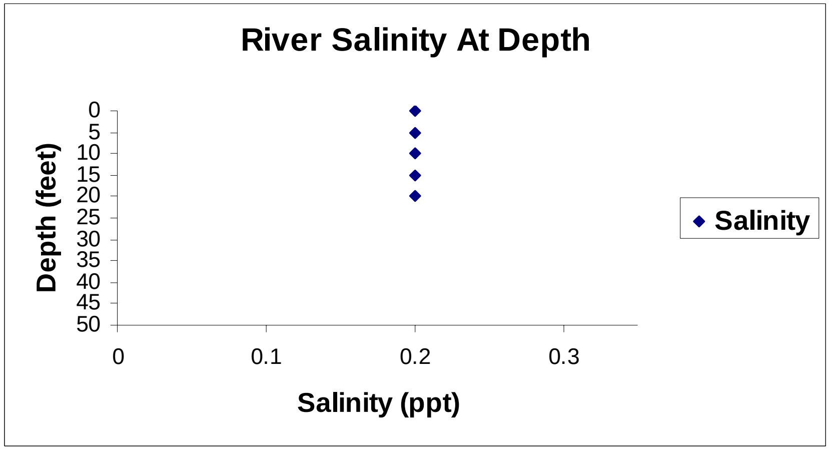
Site 1



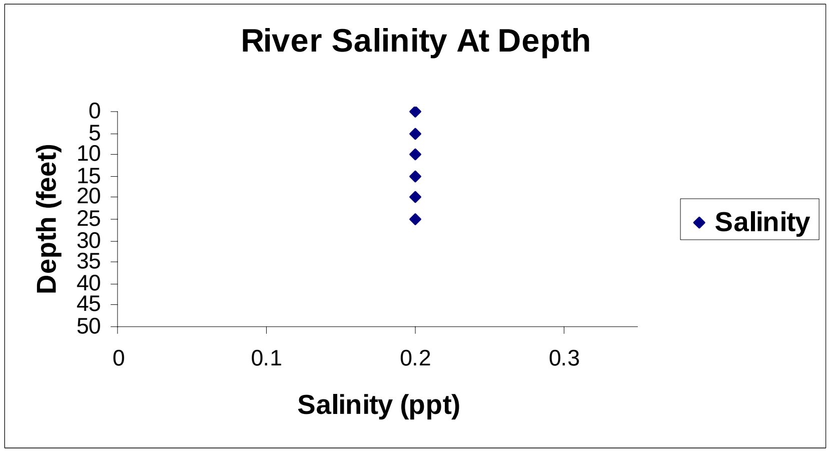
Site 2



Site 3

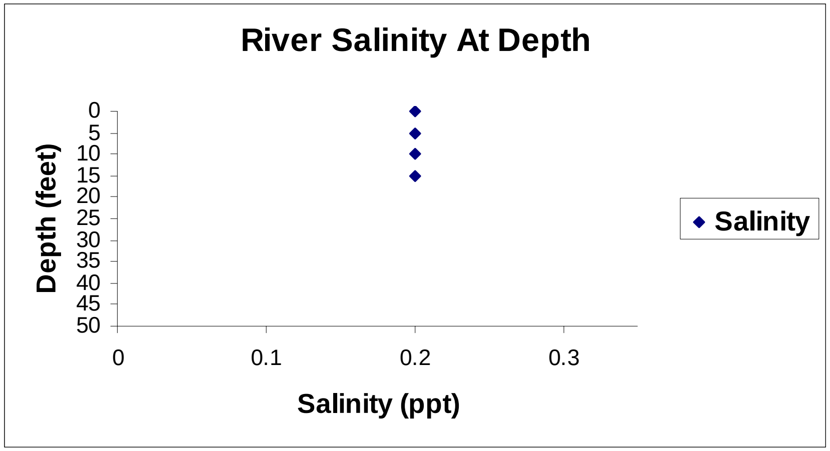


Site 4

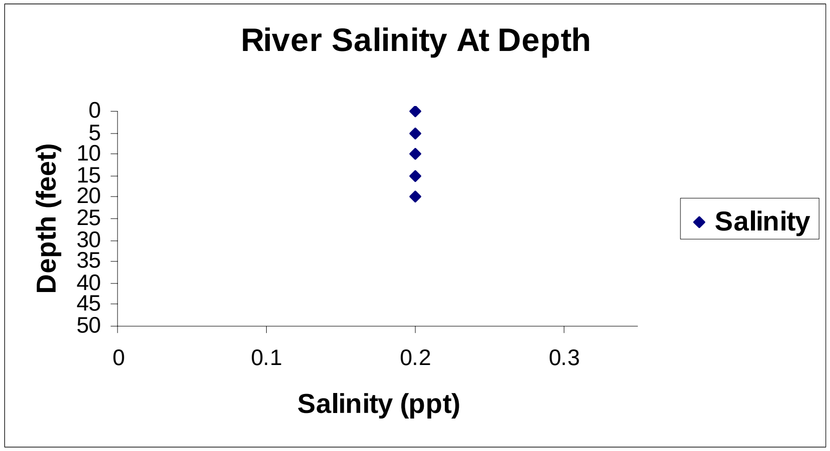


Sampling Date: 9/06/07

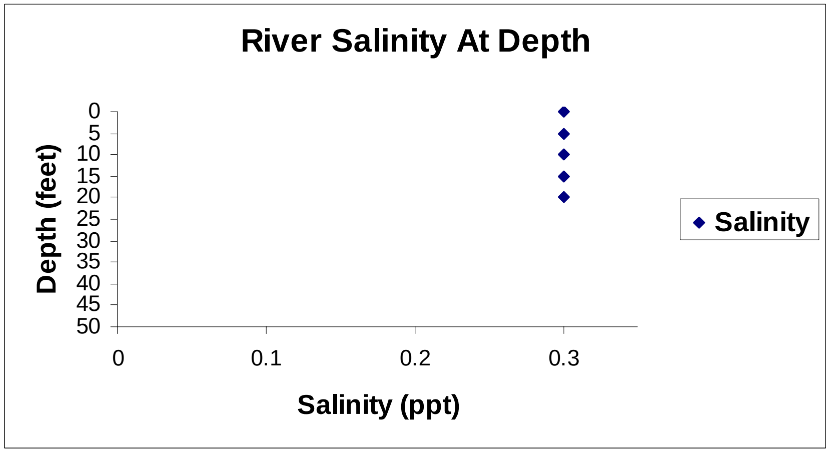
Site 5



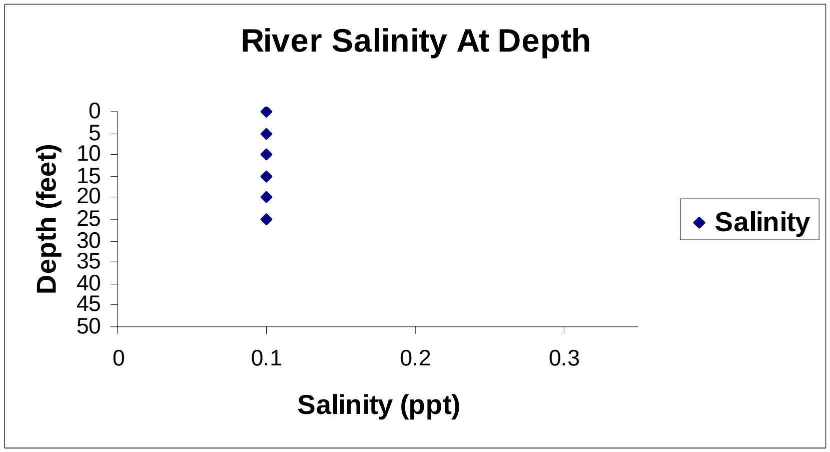
Site 6



Site 7

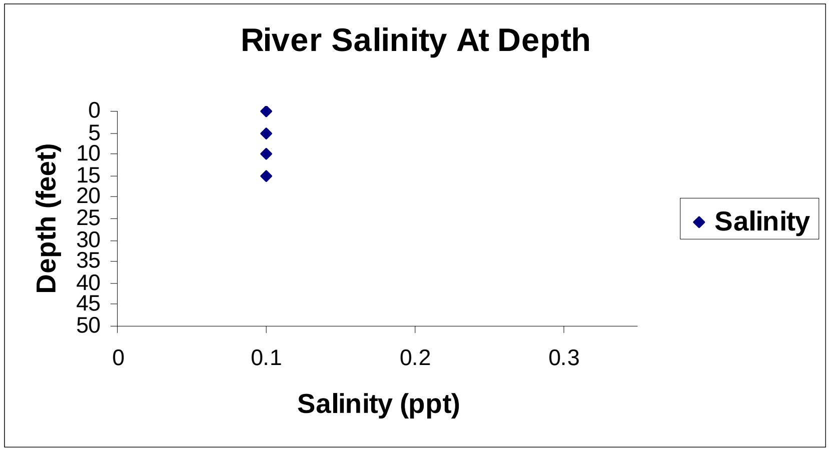


Site 8

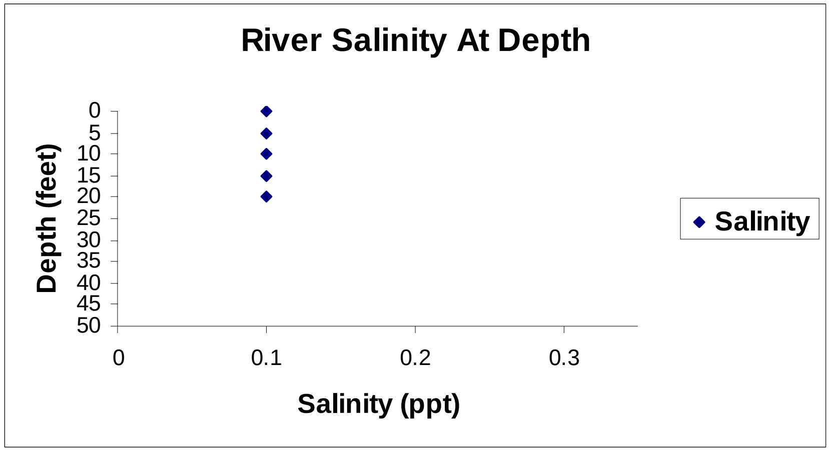


Sampling Date: 9/06/07

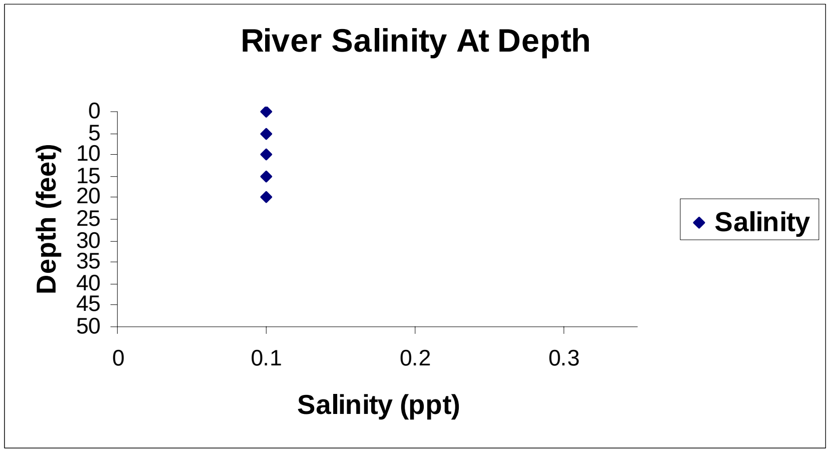
Site 9



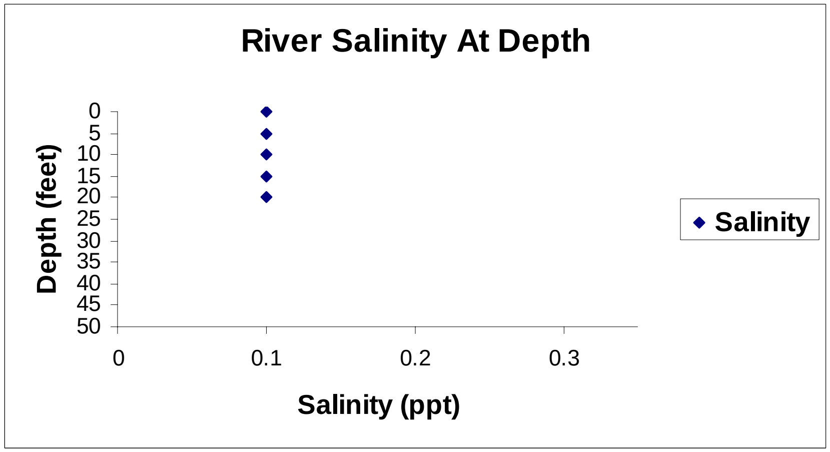
Site 10



Site 11

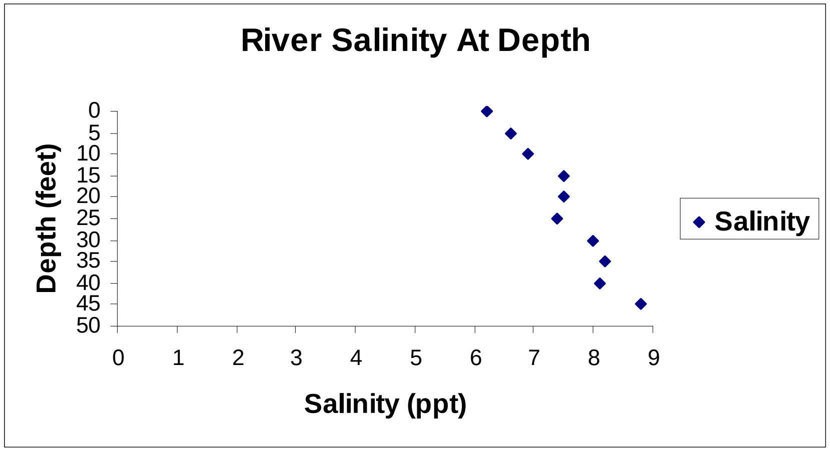


Site 12

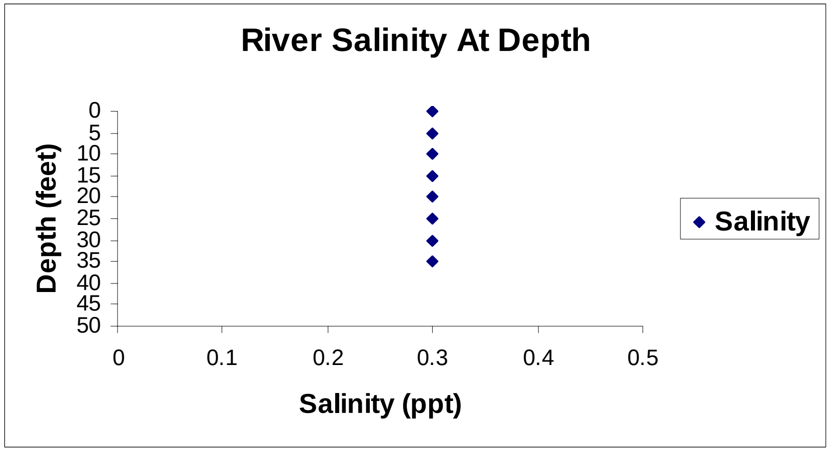


Sampling Date: 9/13/07

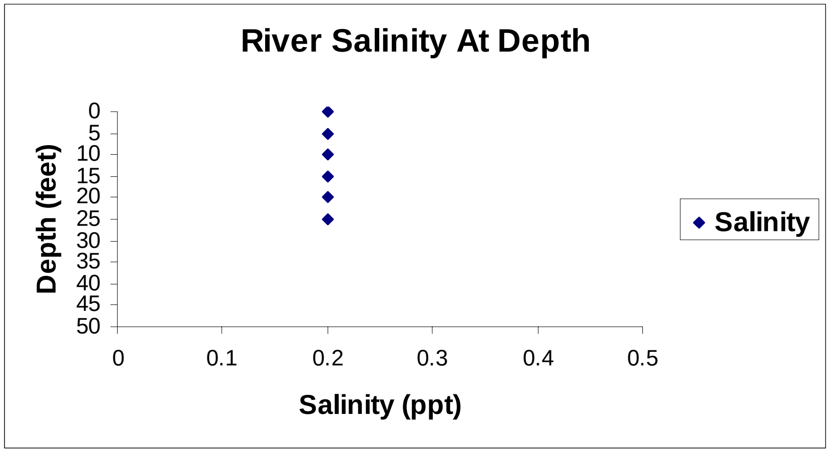
Site 1



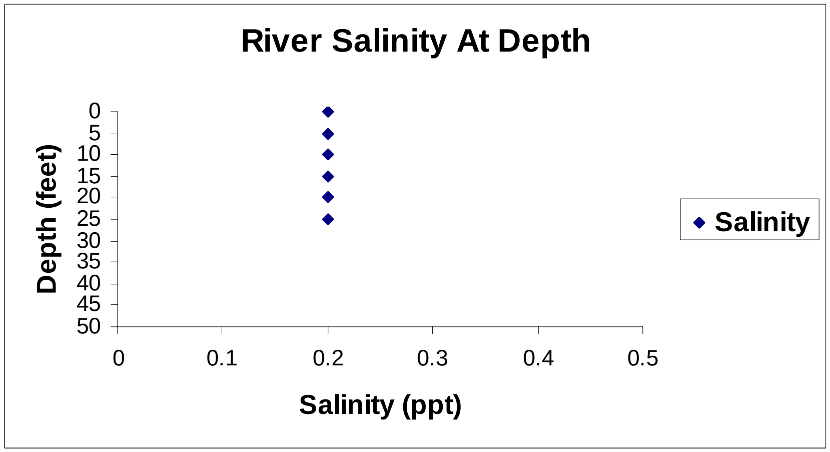
Site 2



Site 3

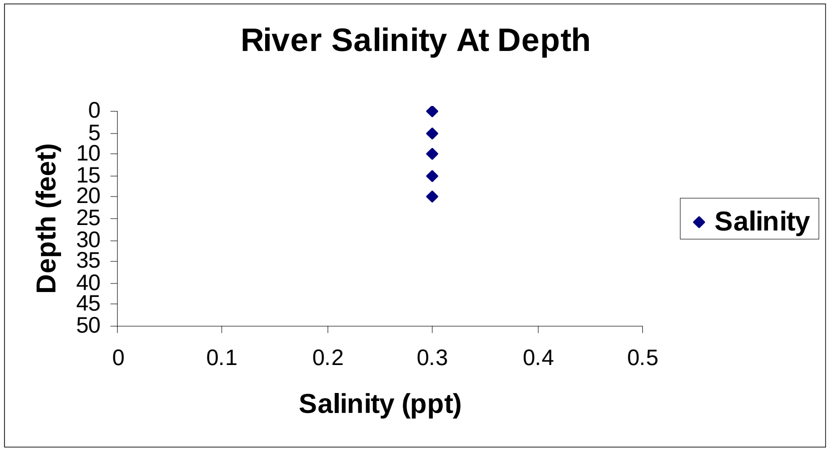


Site 4

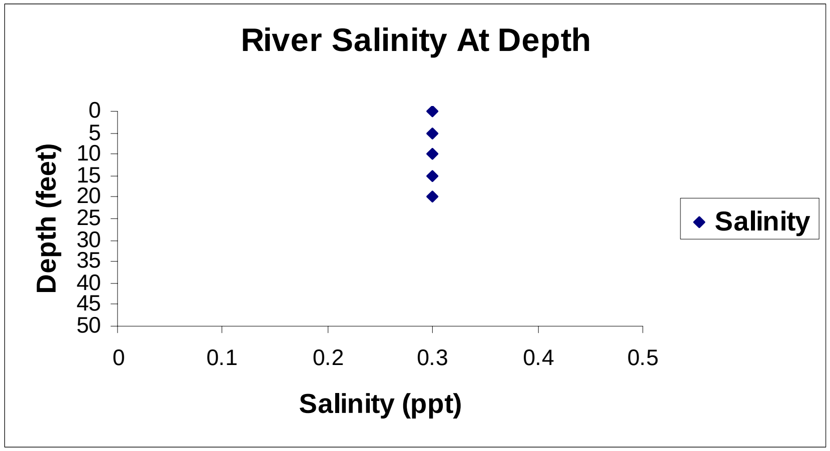


Sampling Date: 9/13/07

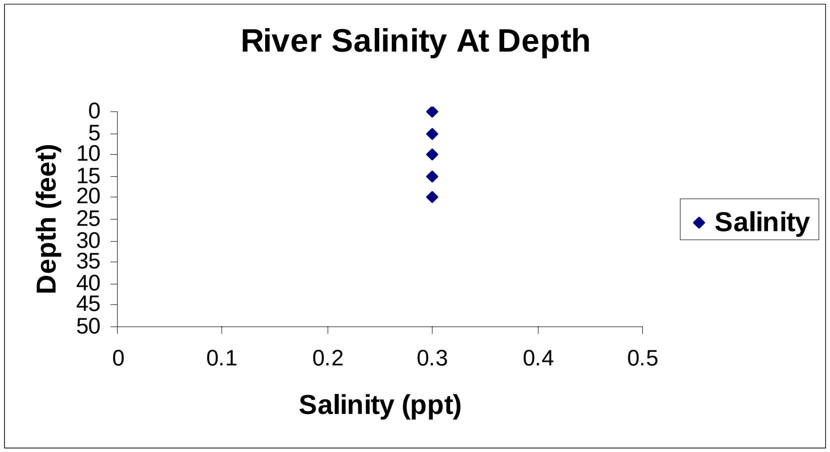
Site 5



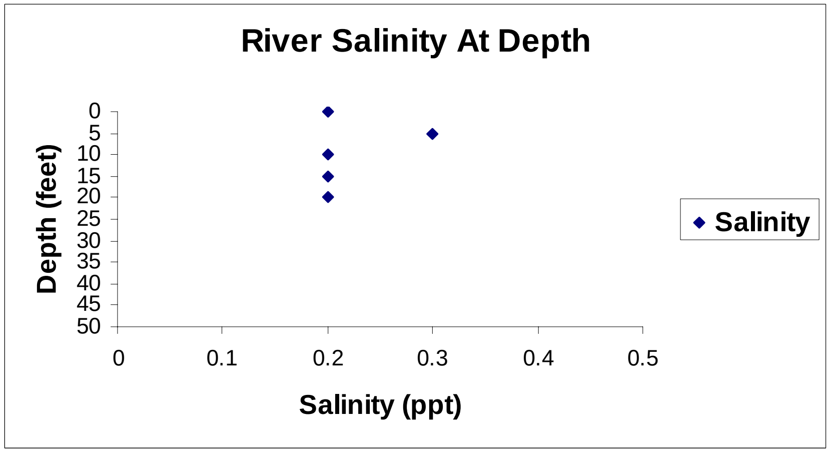
Site 6



Site 7

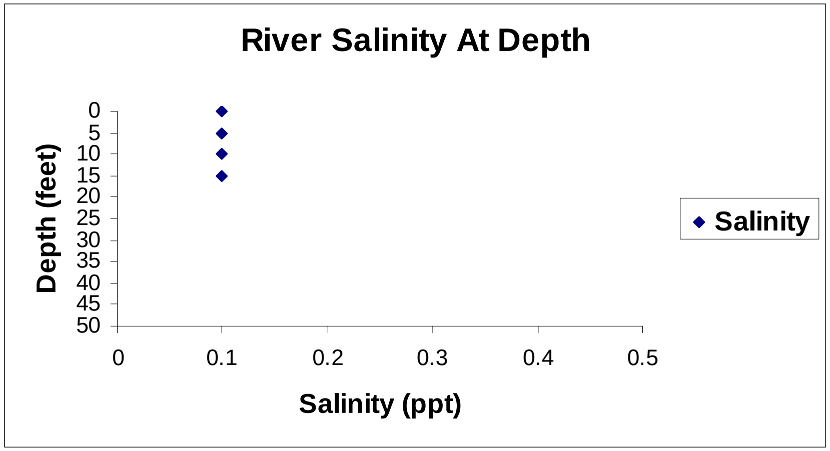


Site 8

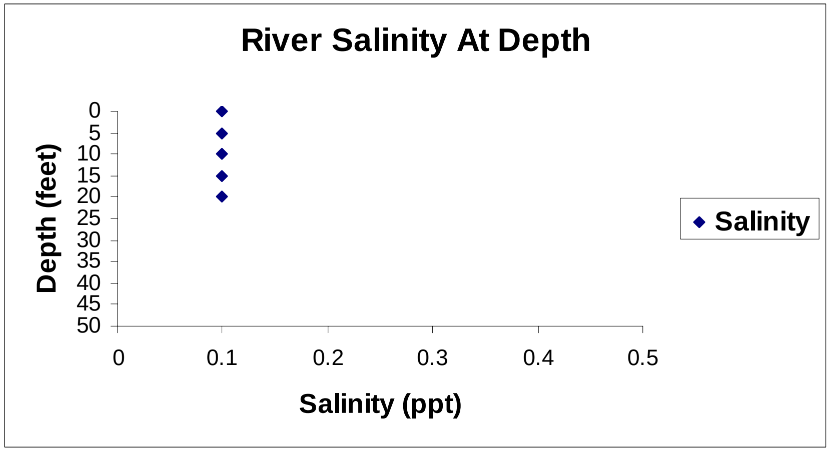


Sampling Date: 9/13/07

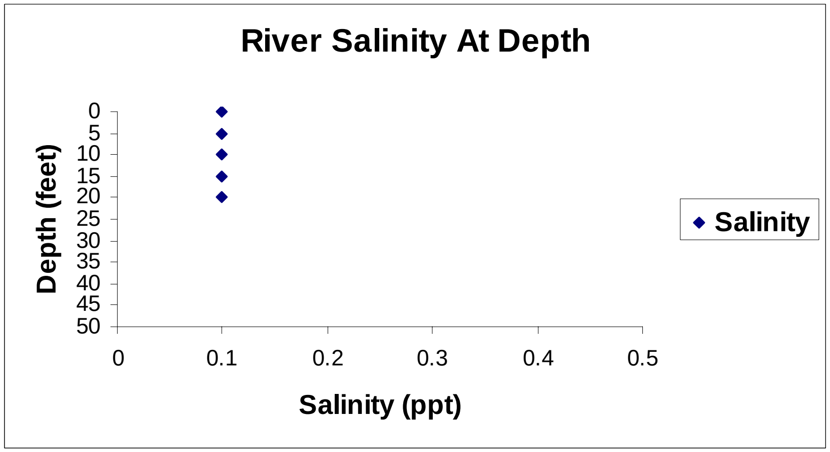
Site 9



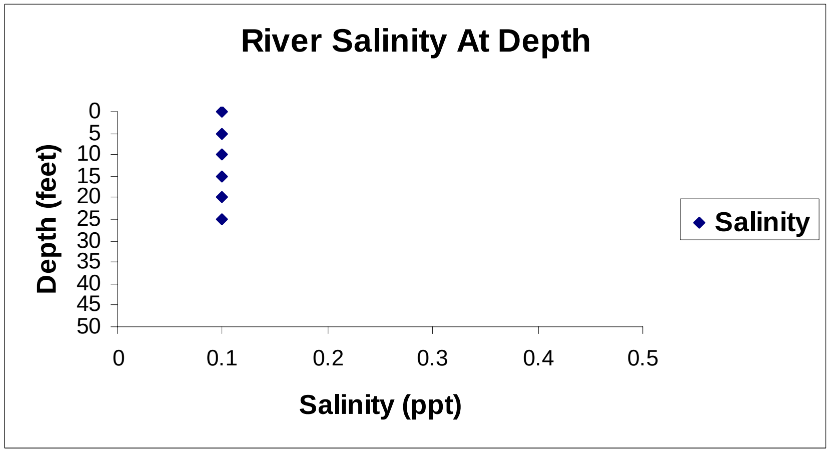
Site 10



Site 11

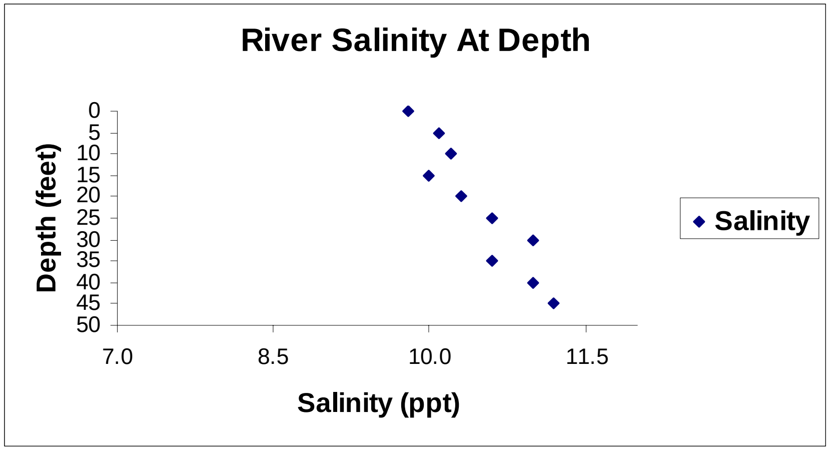


Site 12

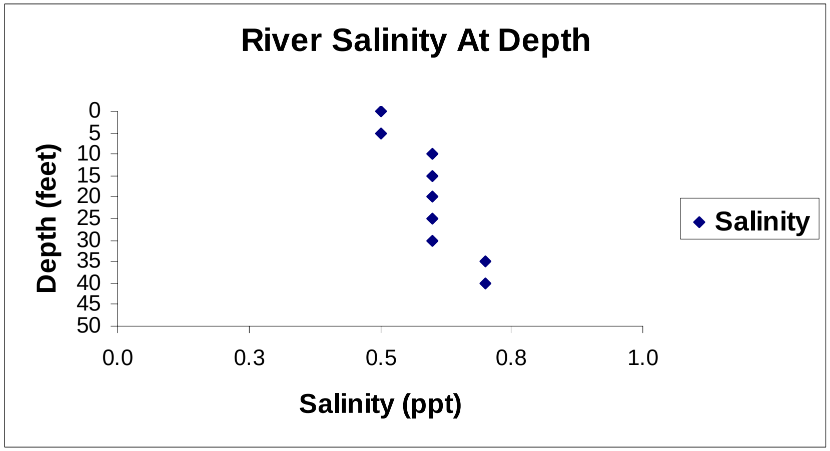


Sampling Date: 10/13/07

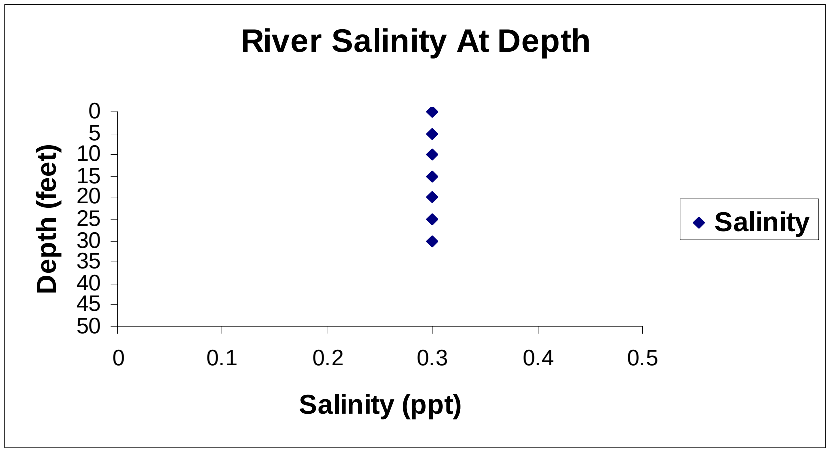
Site 1



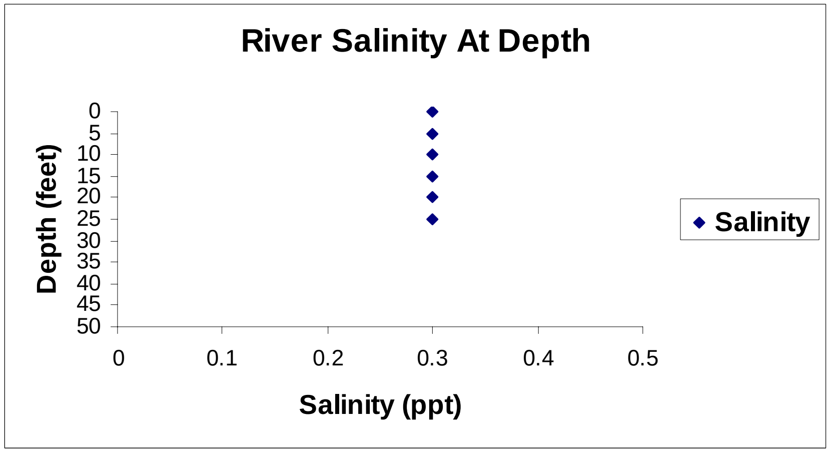
Site 2



Site 3

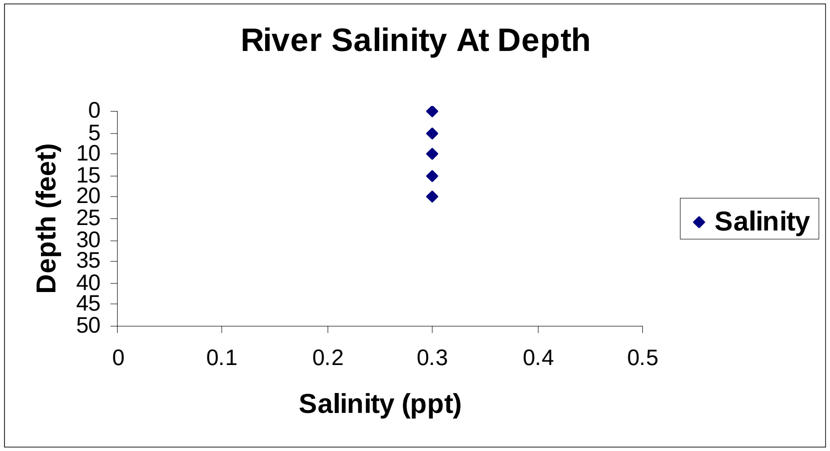


Site 4

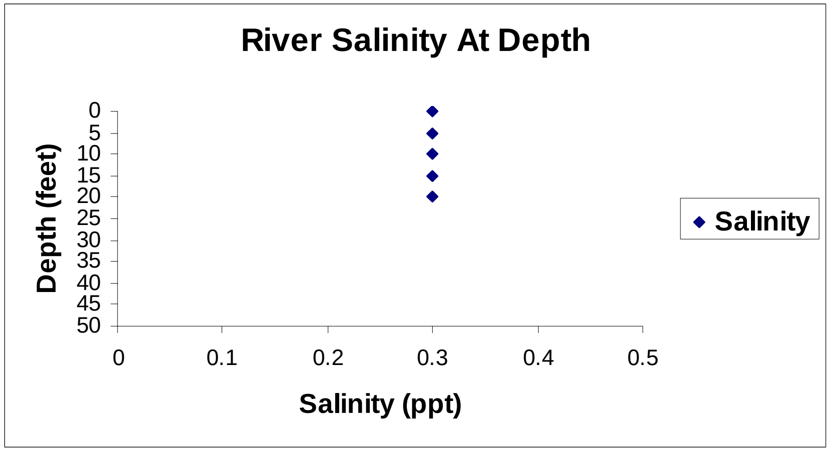


Sampling Date: 10/13/07

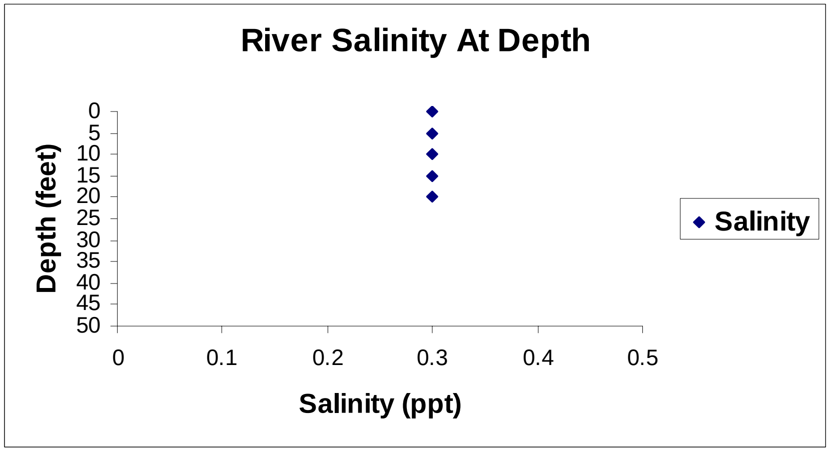
Site 5



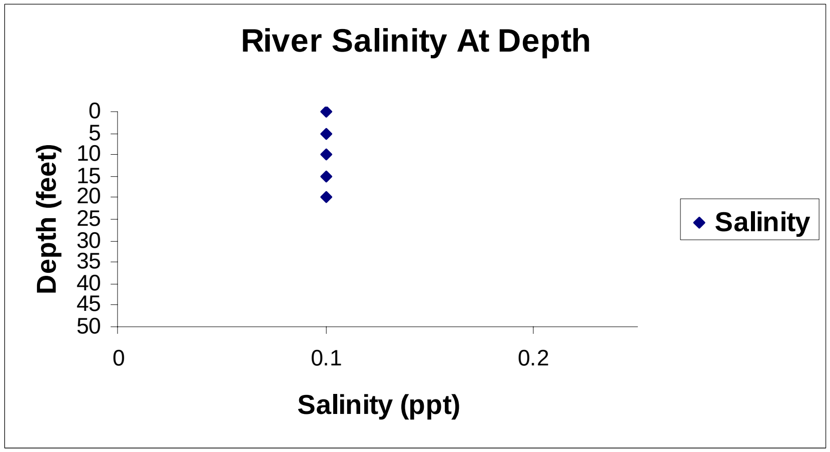
Site 6



Site 7

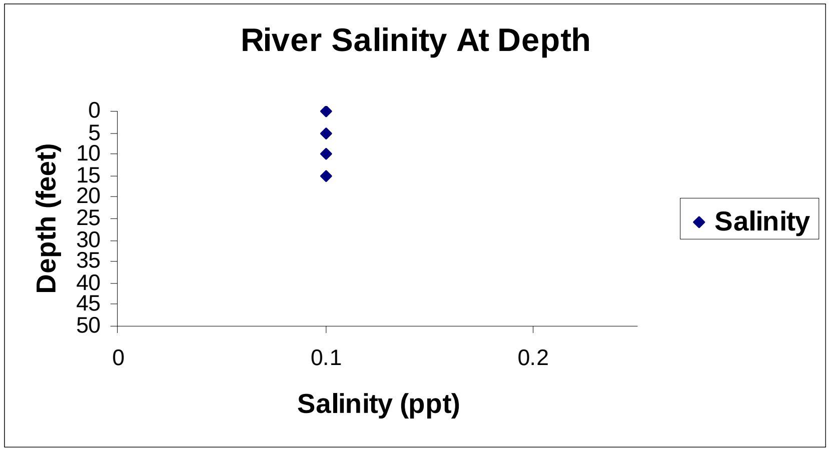


Site 8

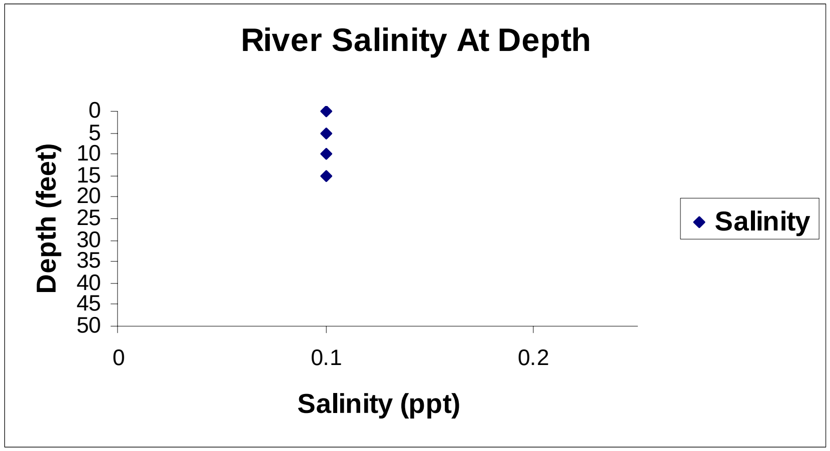


Sampling Date: 10/13/07

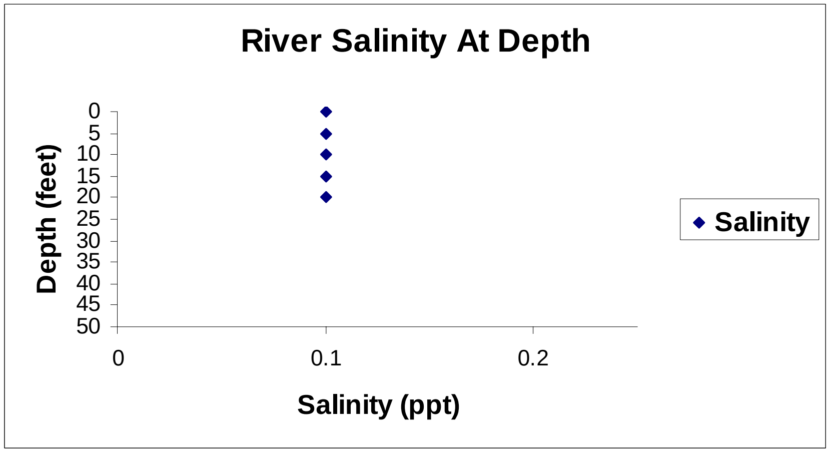
Site 9



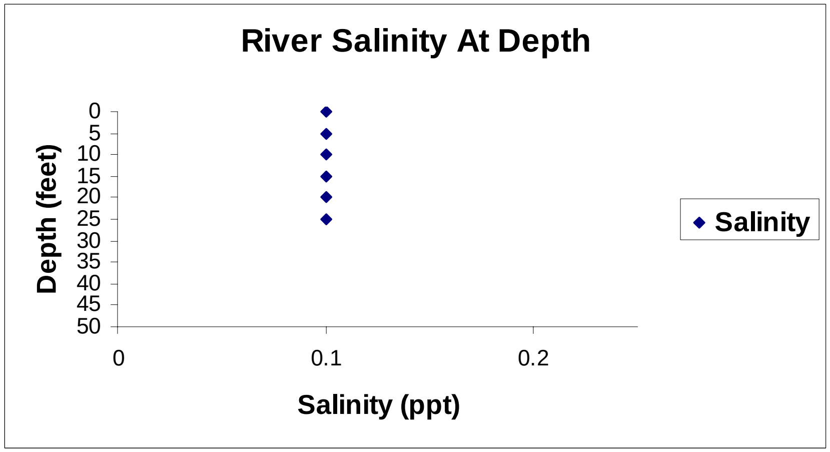
Site 10



Site 11

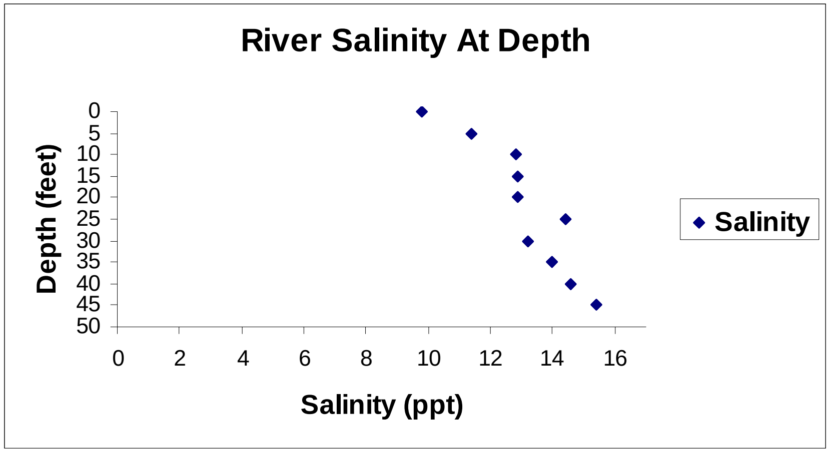


Site 12

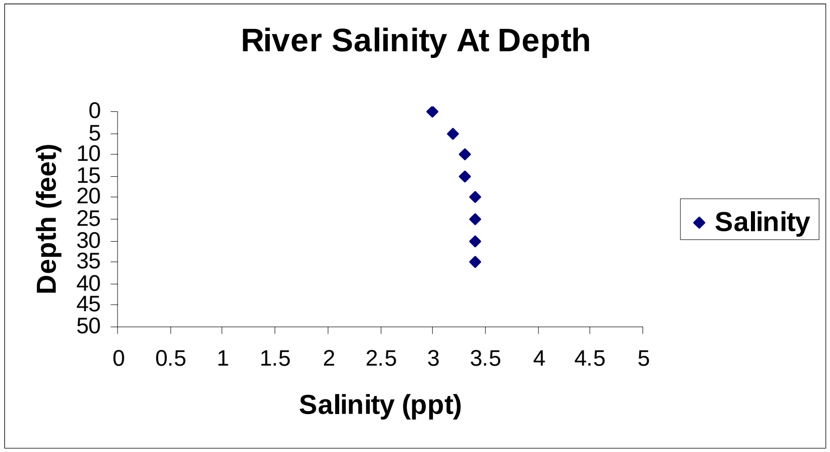


Sampling Date: 12/08/07

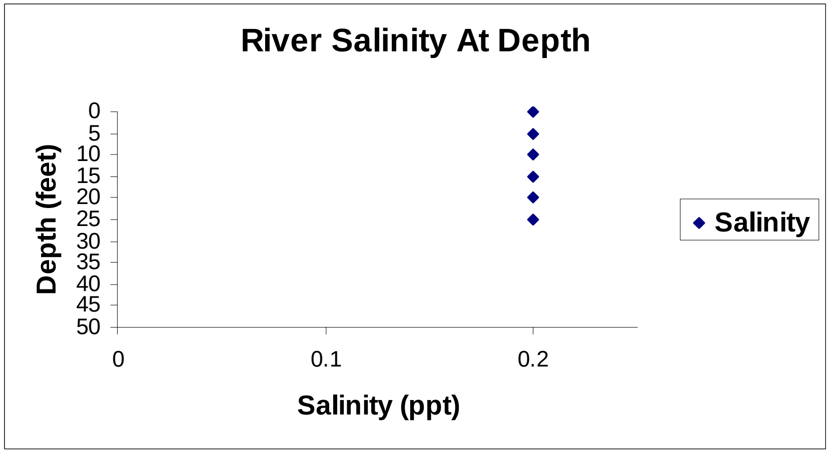
Site 1



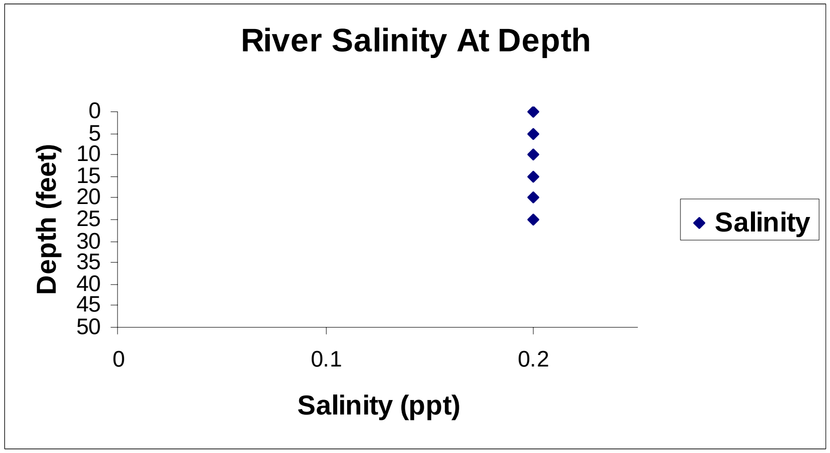
Site 2



Site 3



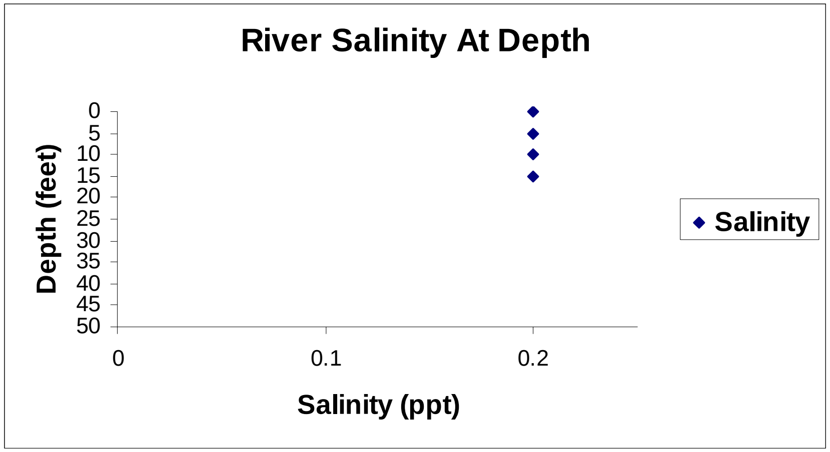
Site 4



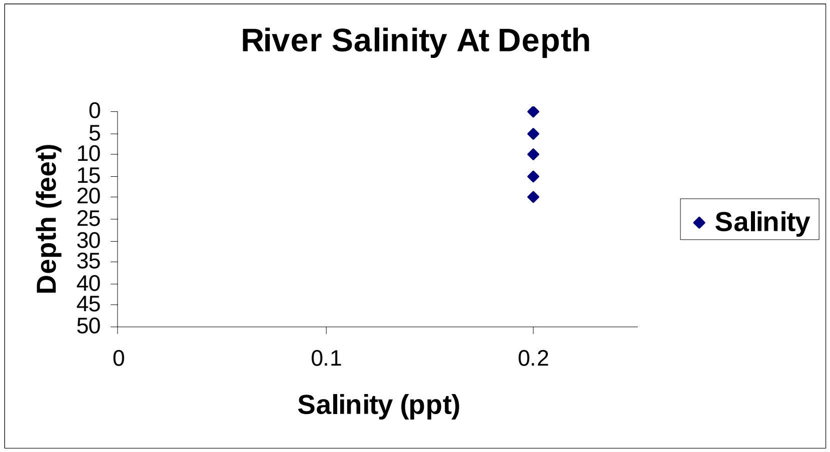
Appendix C. (continued)

Sampling Date: 12/08/07

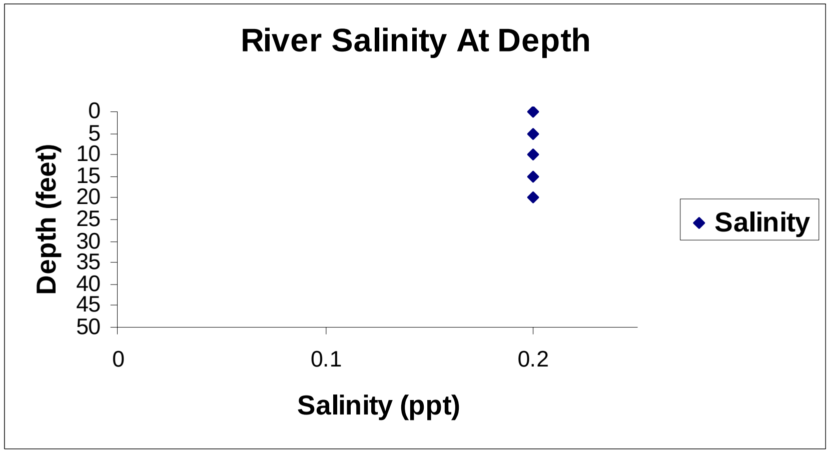
Site 5



Site 6



Site 7



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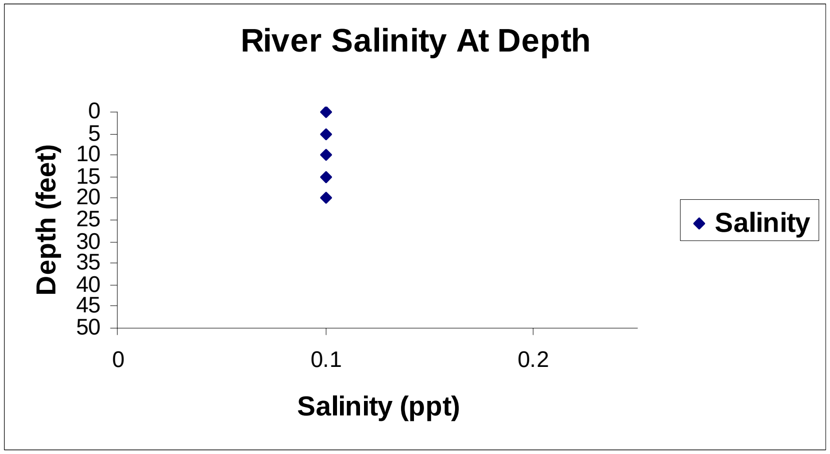

Appendix C. (continued)

Sampling Date: 12/08/07

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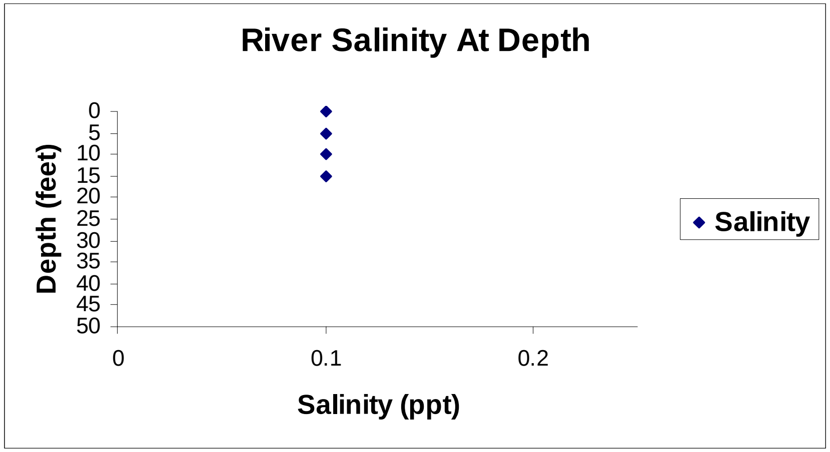

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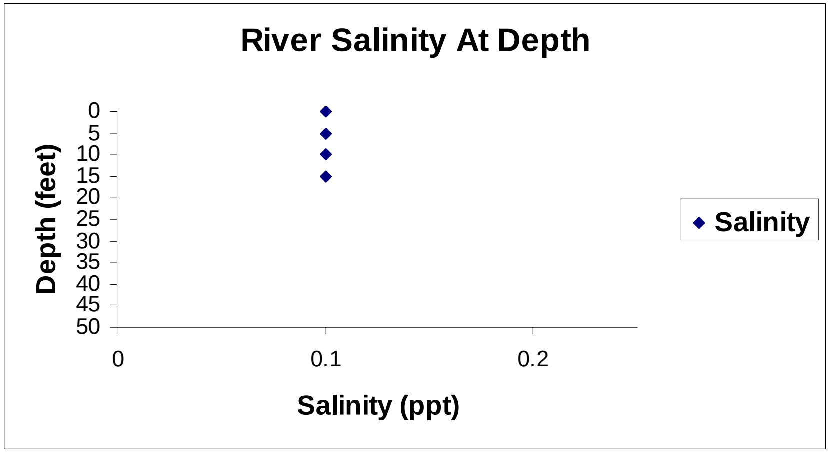

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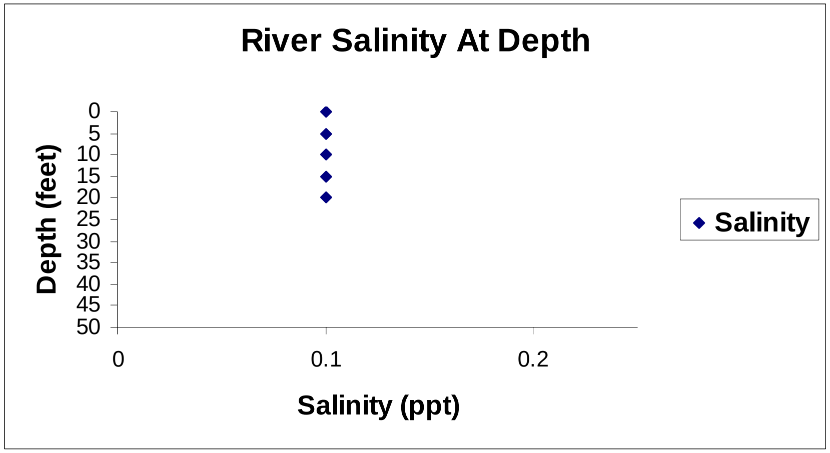

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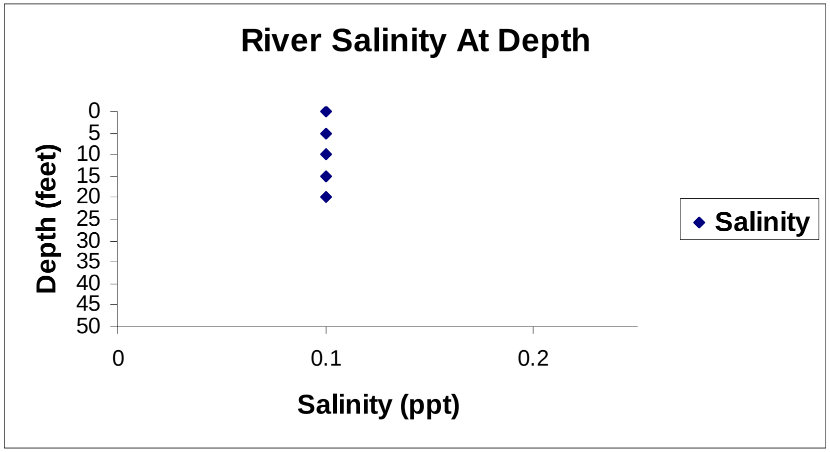

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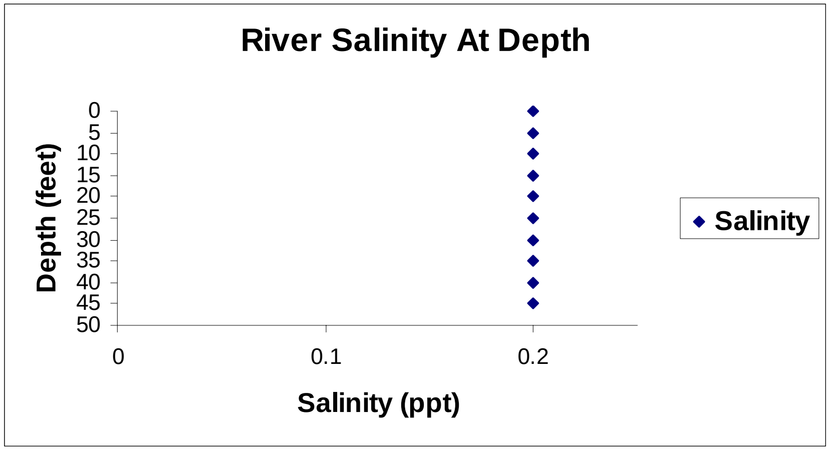

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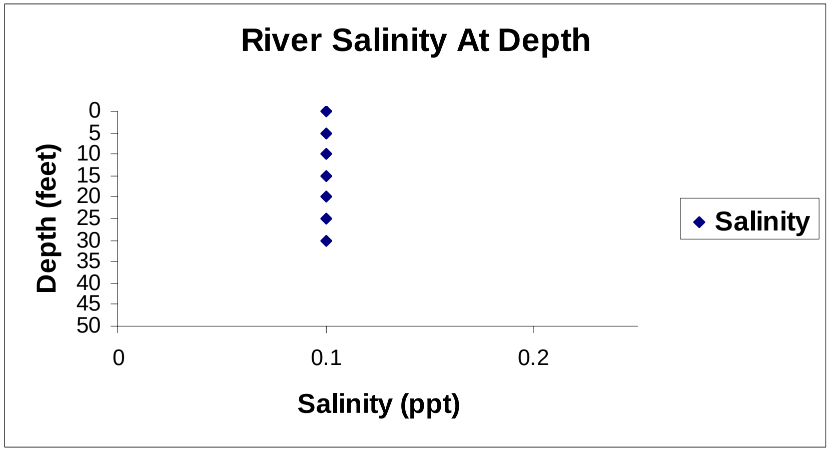

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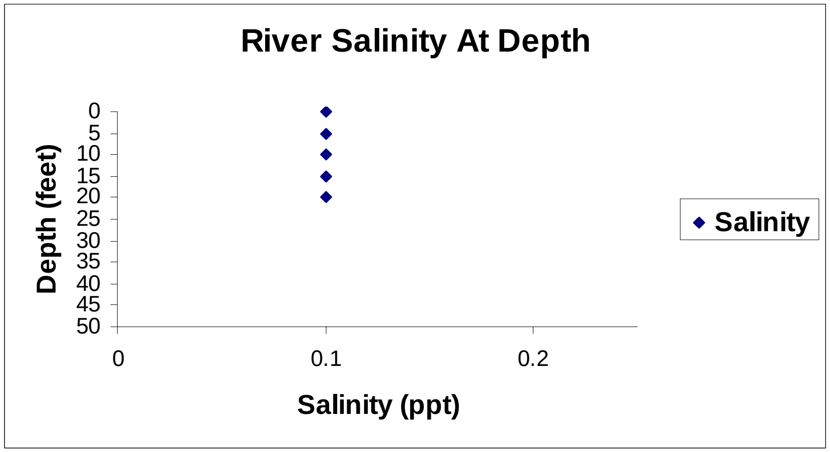

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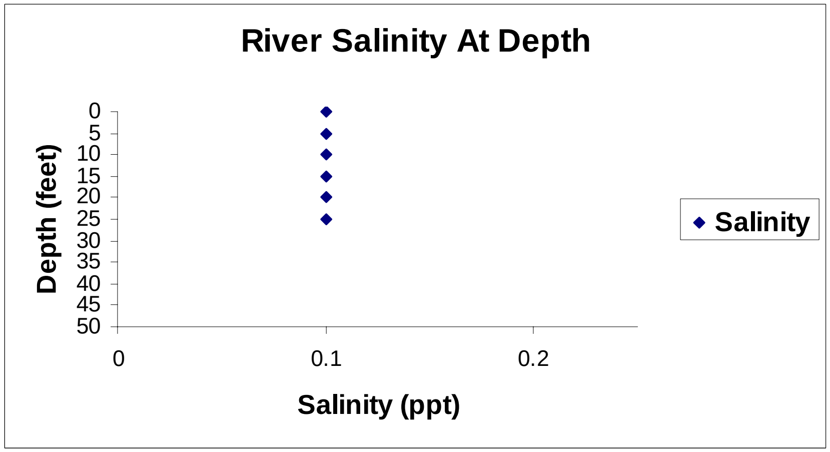

Sampling Date: 1/08/08

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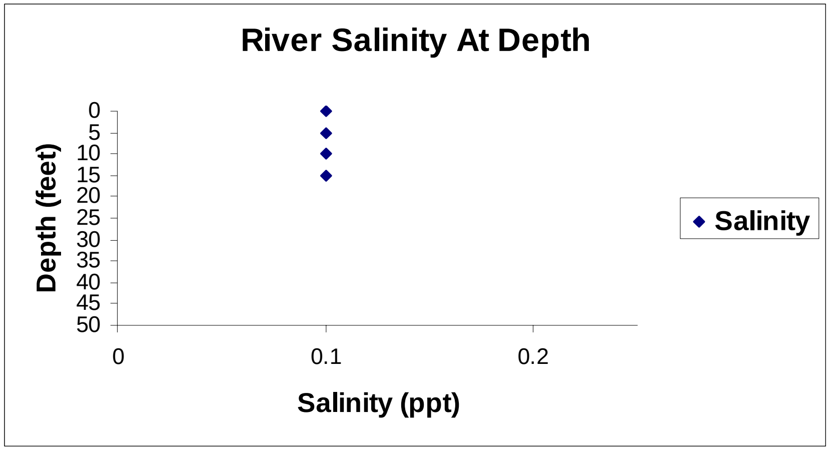

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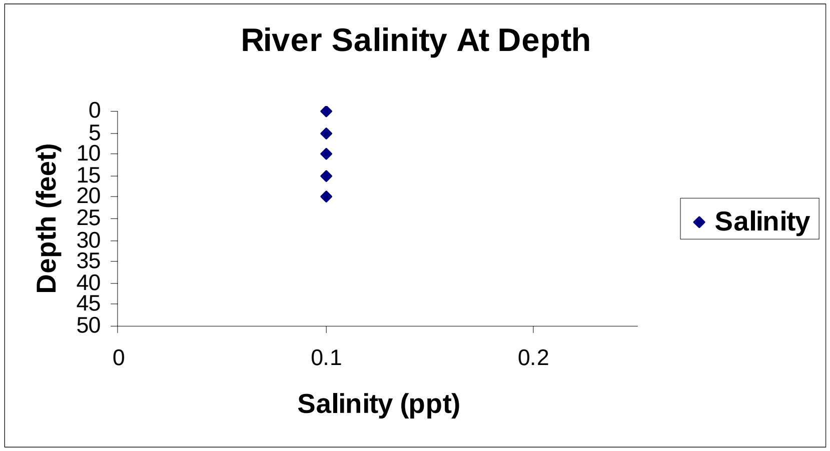

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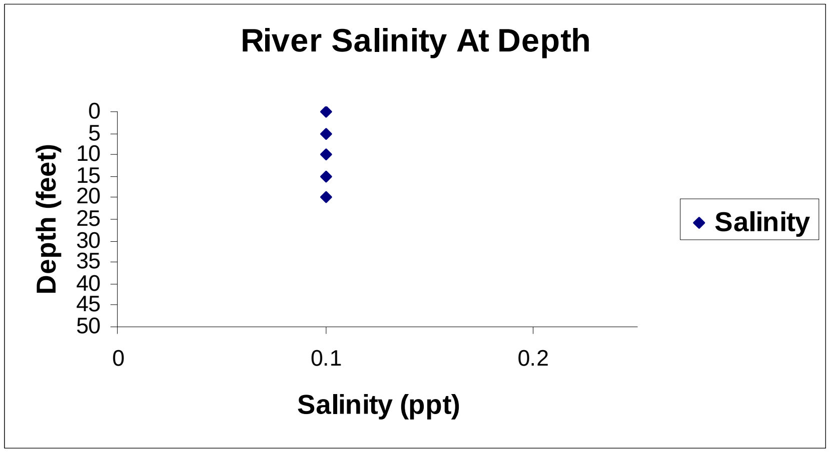

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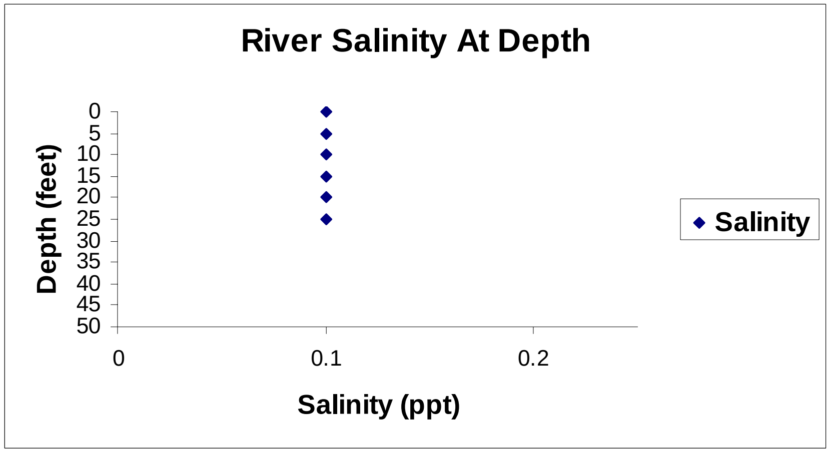

Appendix C. (continued)

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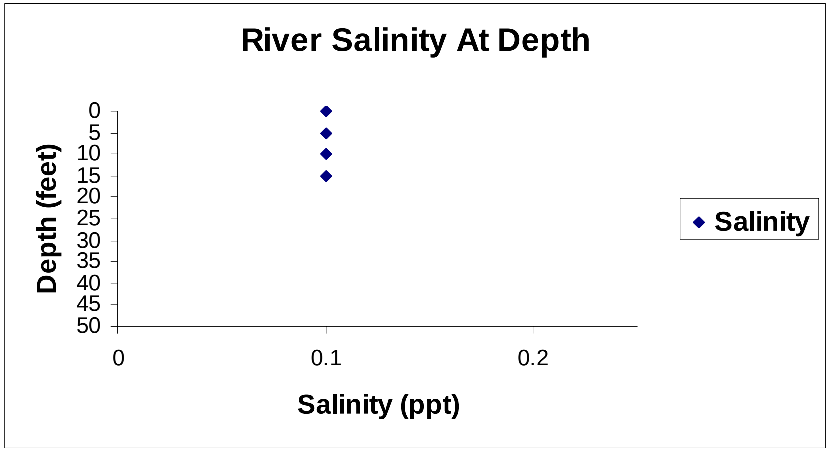

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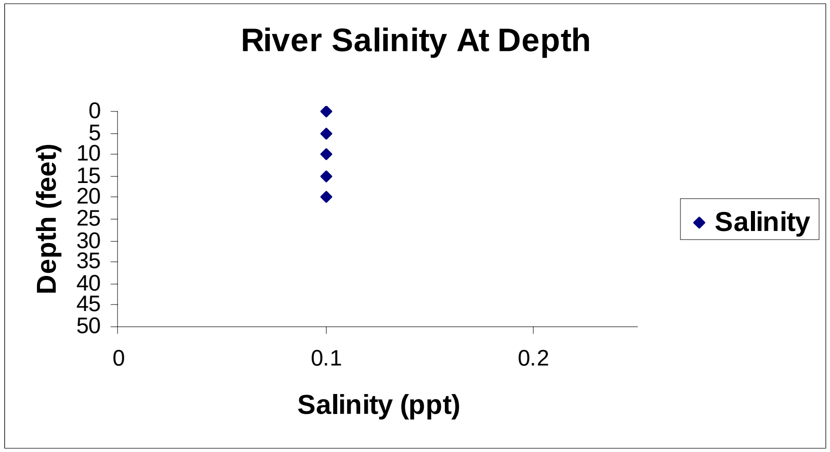

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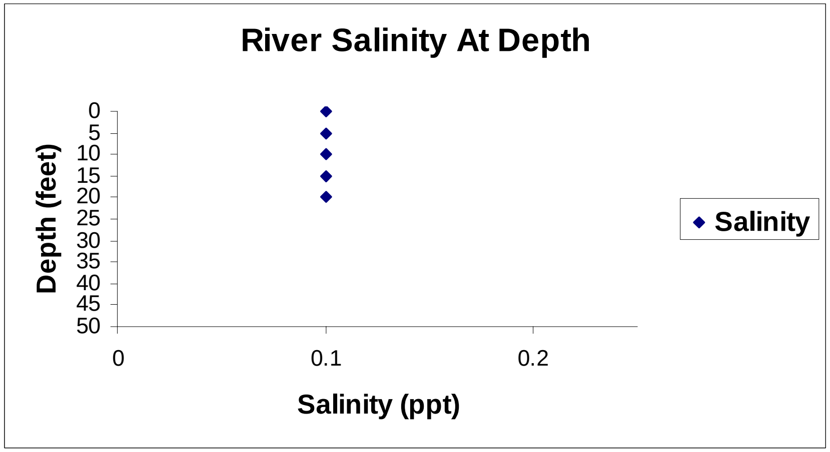

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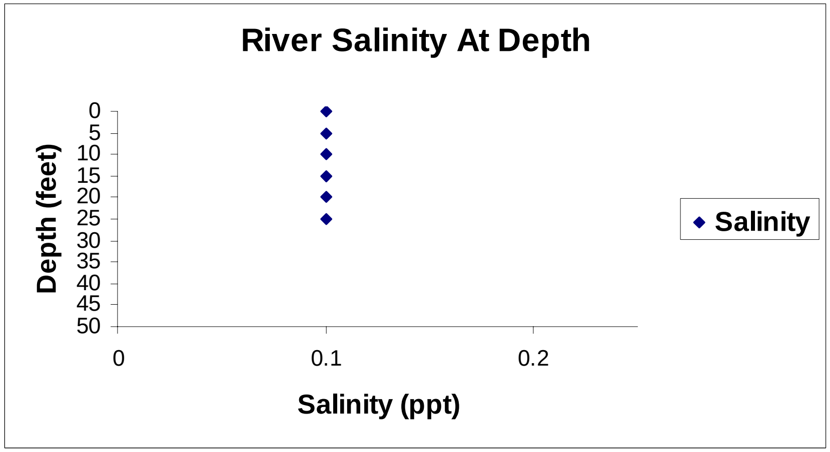

Sampling Date: 2/19/08

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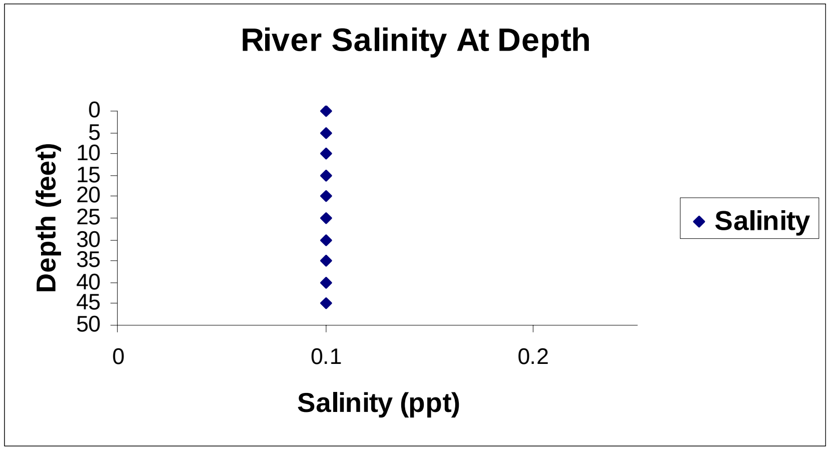

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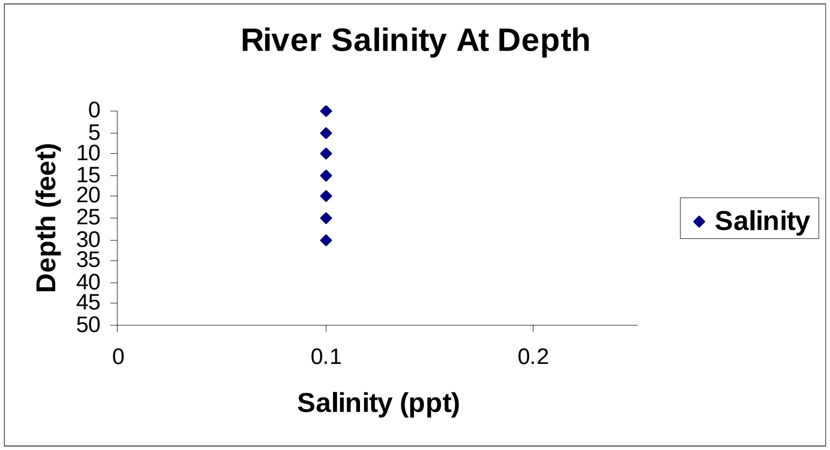

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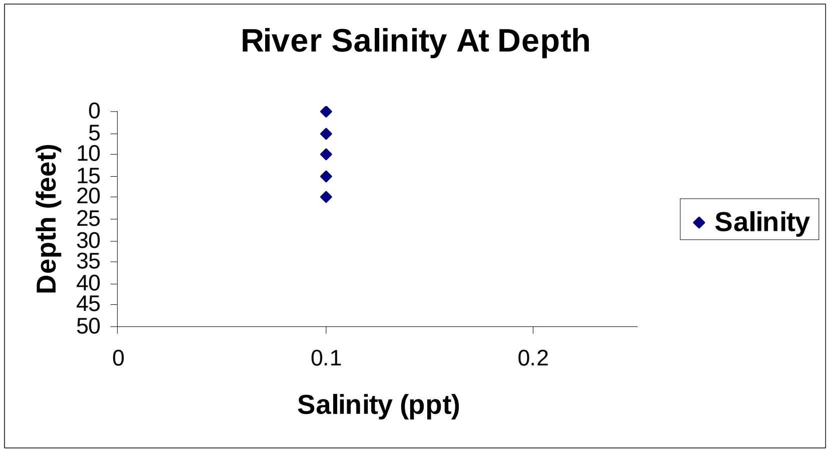

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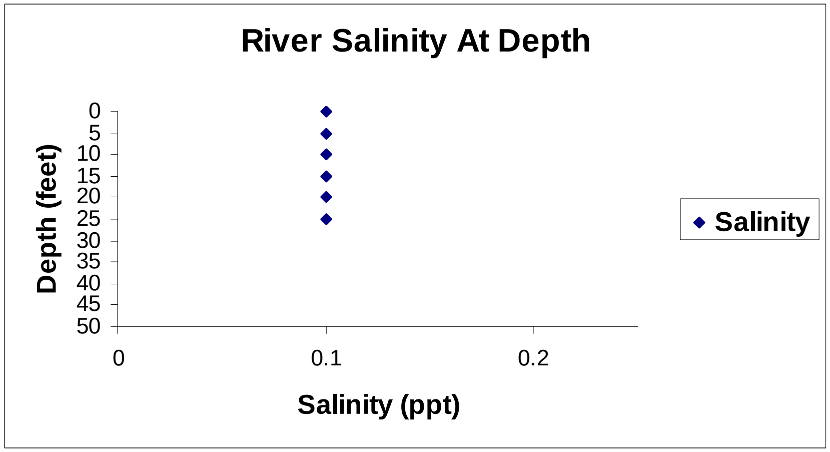

Sampling Date: 2/19/08

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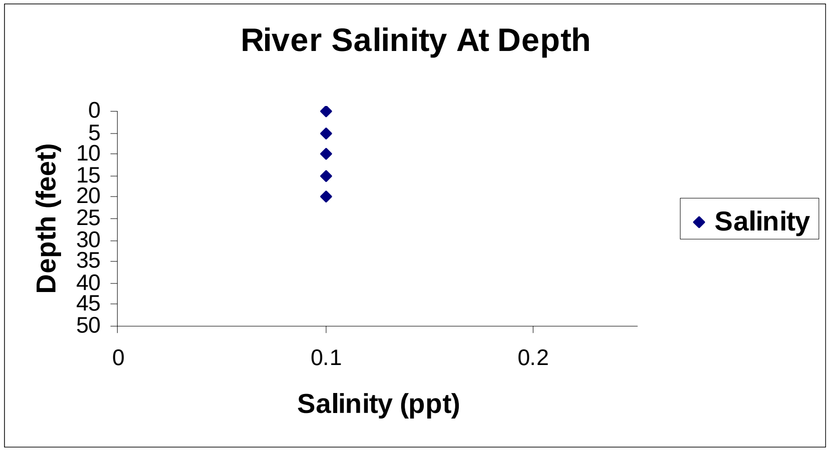

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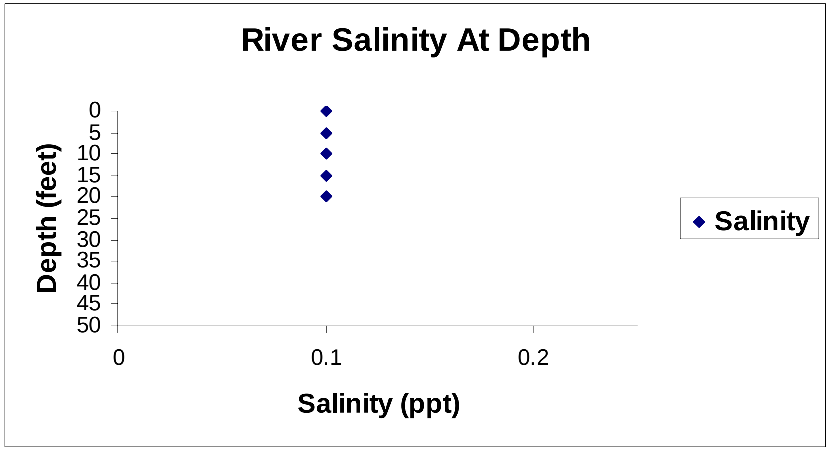

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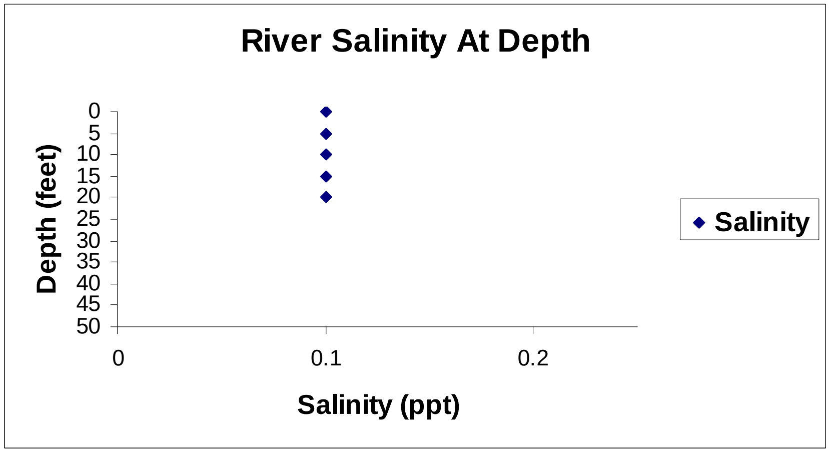

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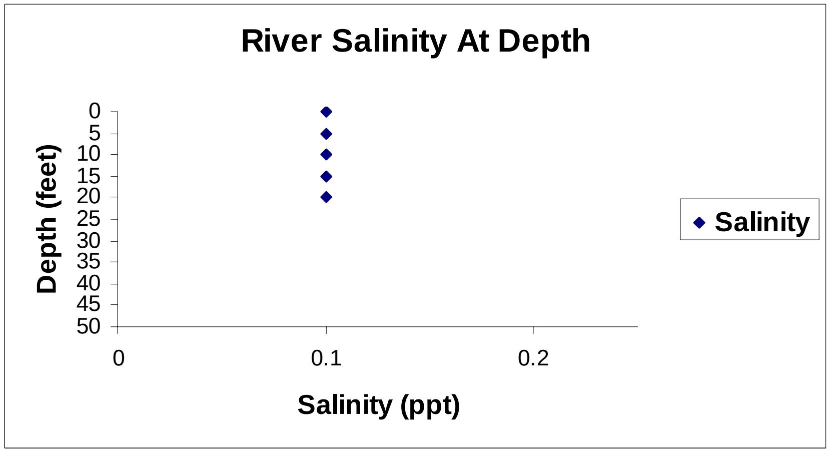

Appendix C. (continued)

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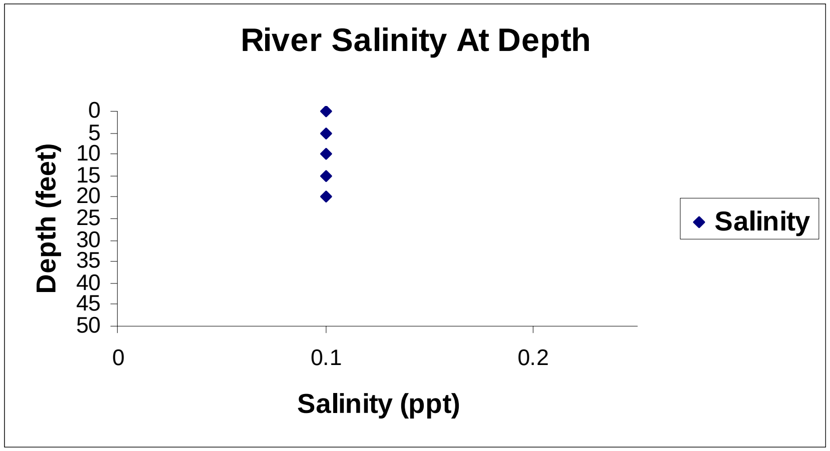

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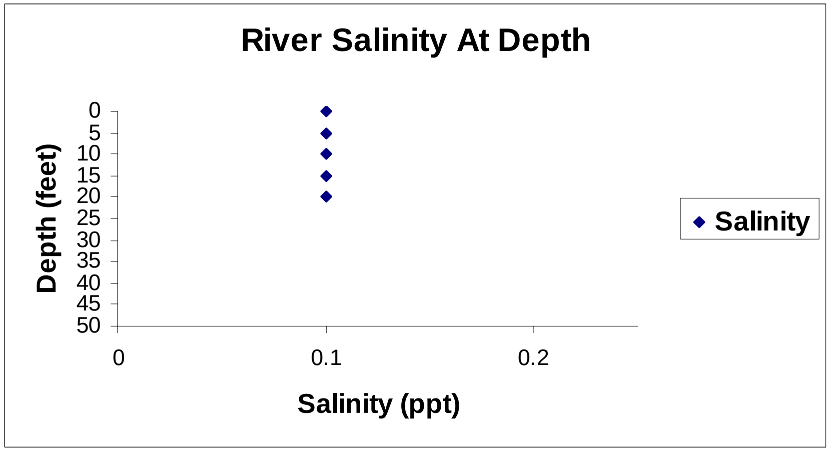

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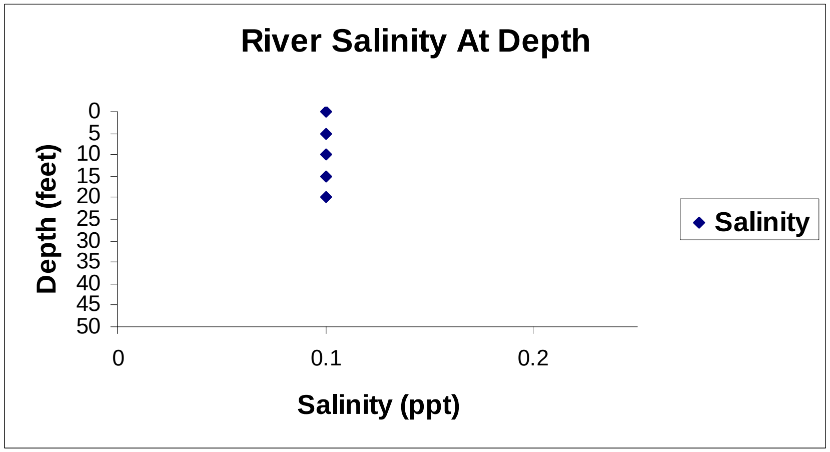

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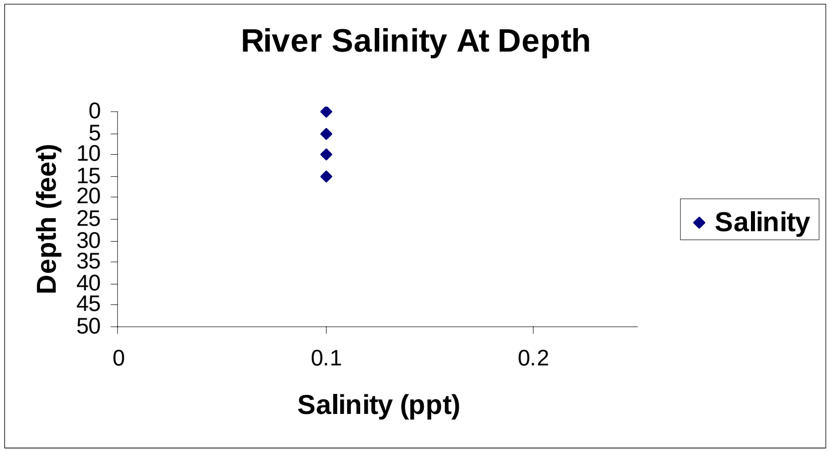

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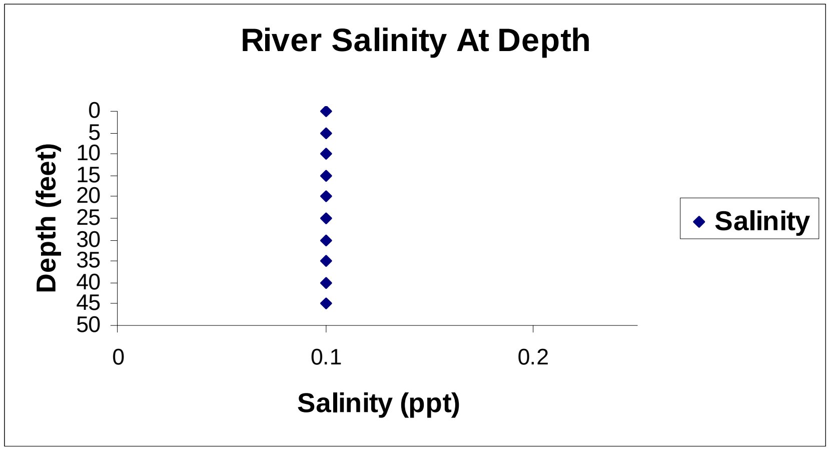

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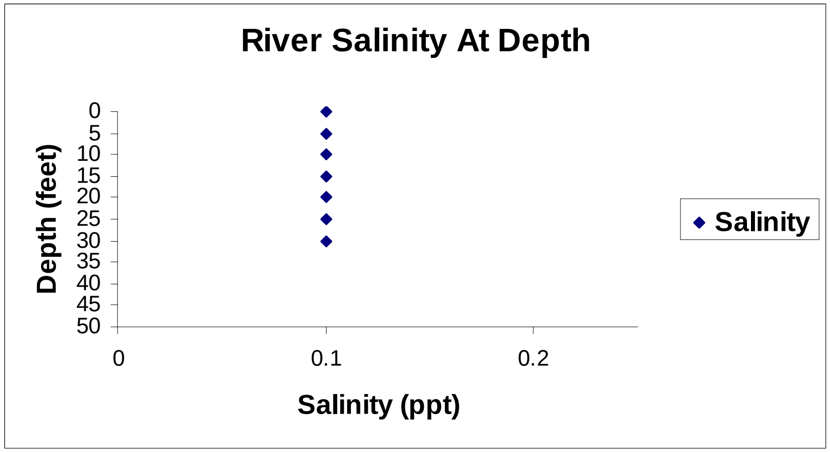

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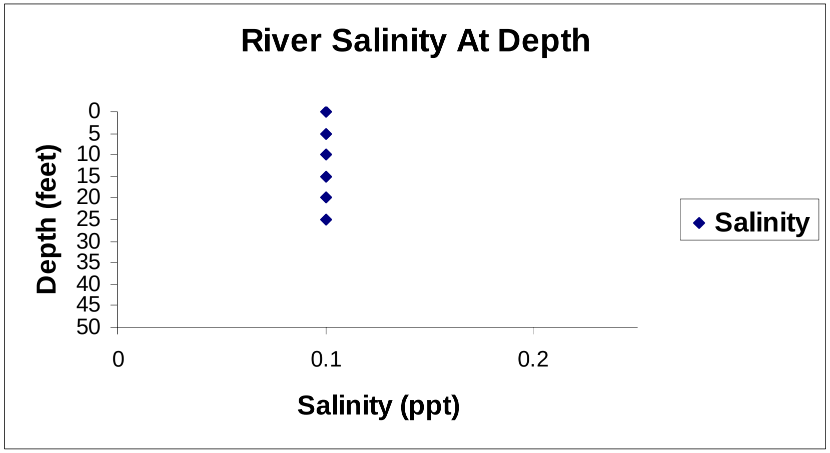

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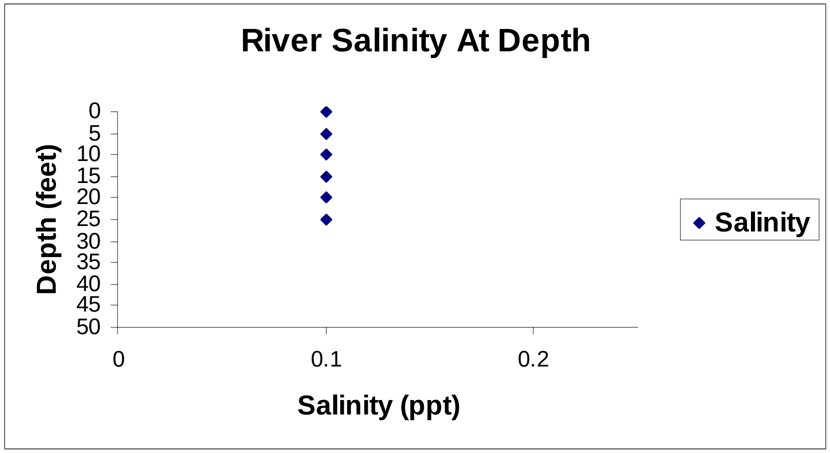

Sampling Date: 3/20/08

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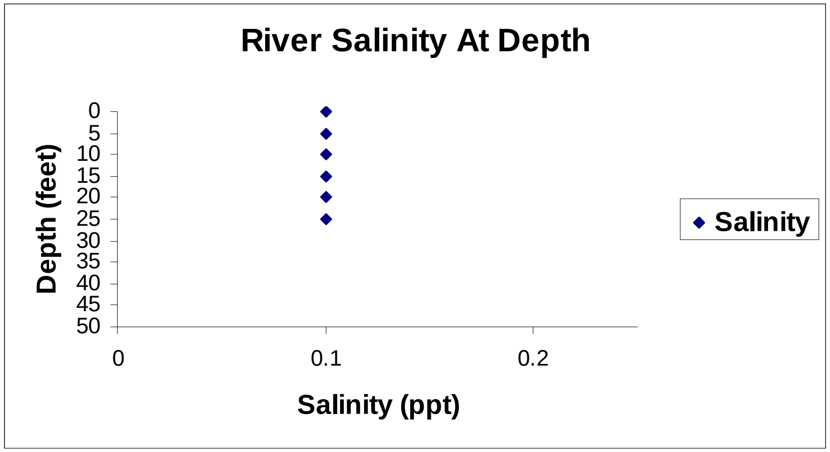

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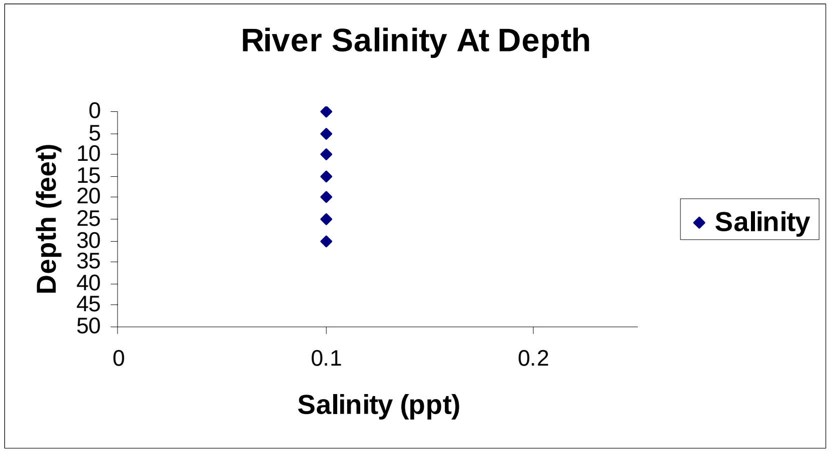

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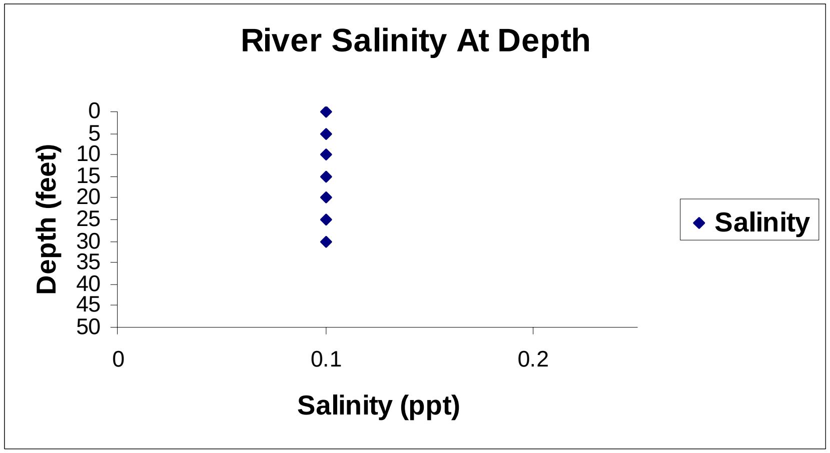

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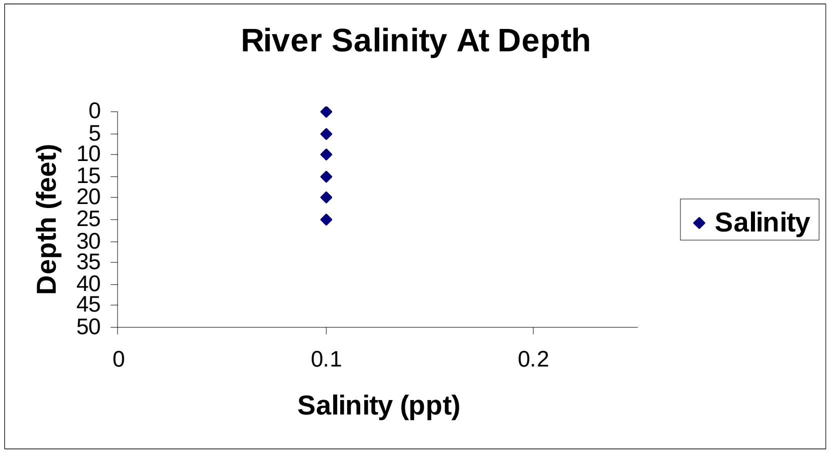

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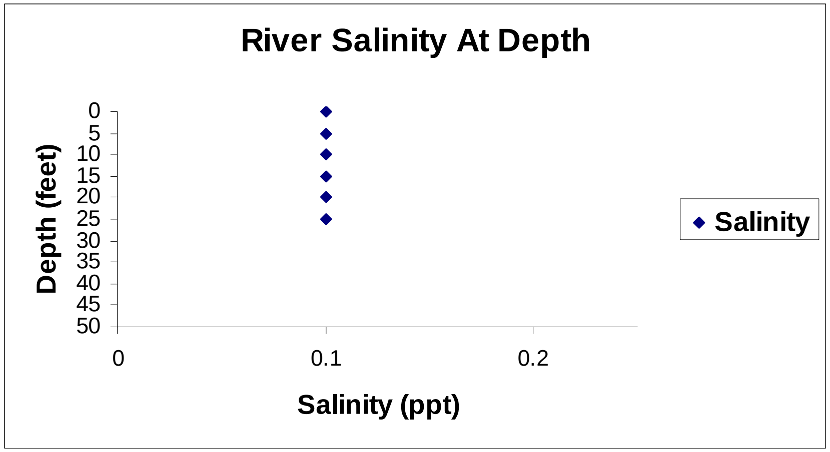

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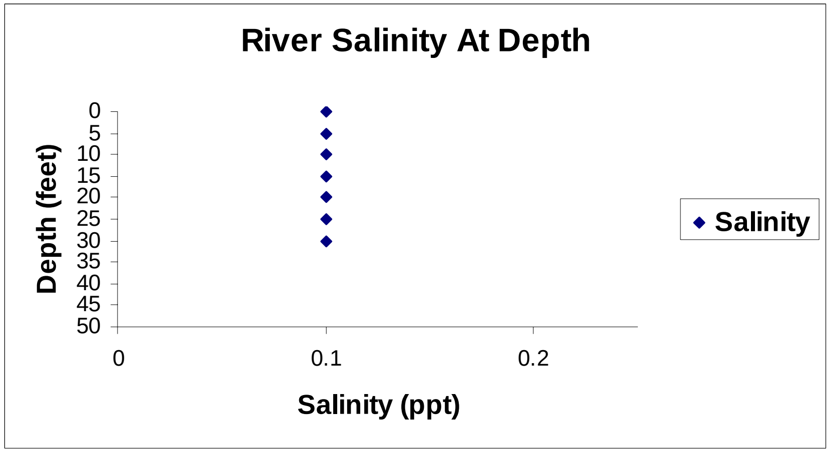

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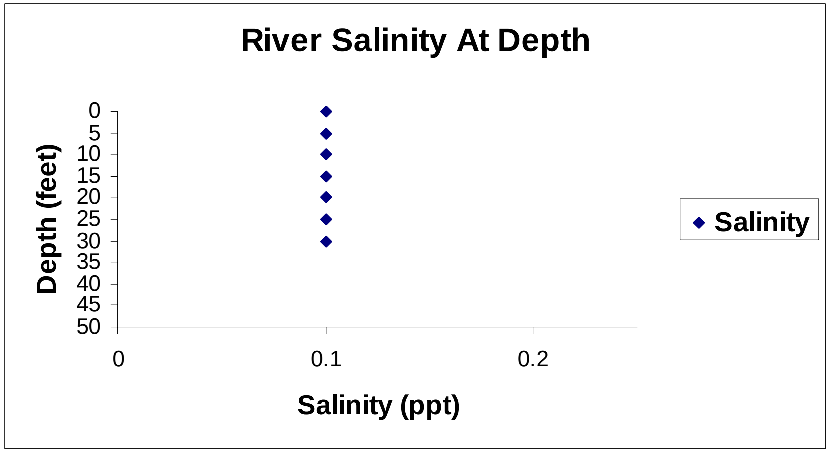

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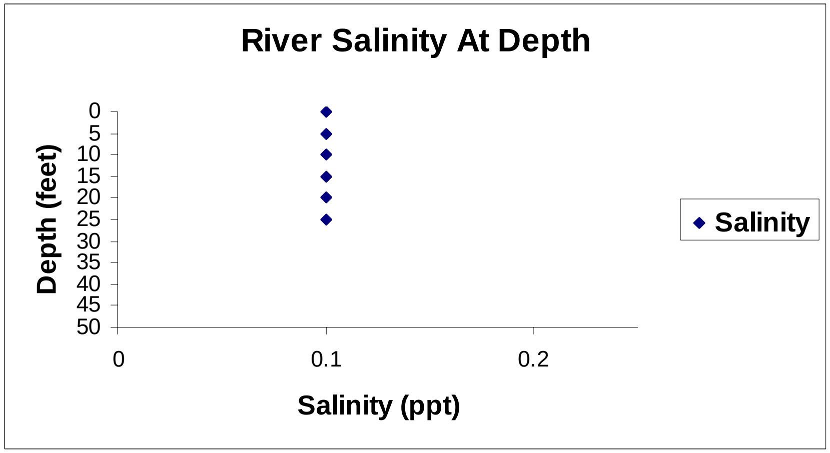

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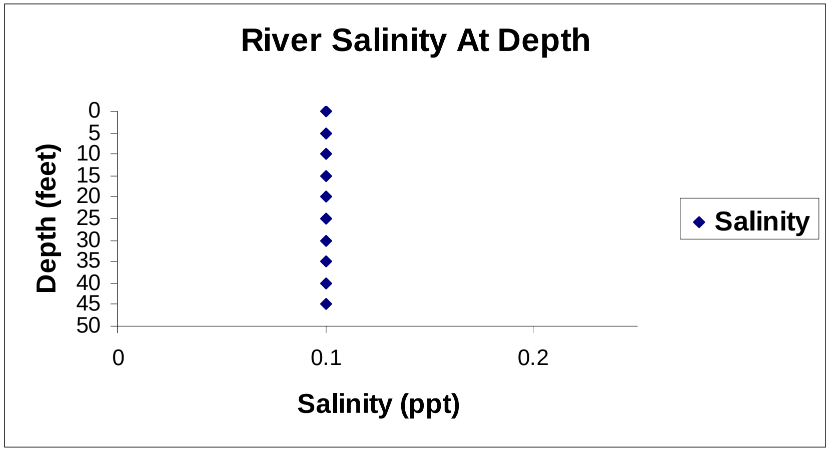

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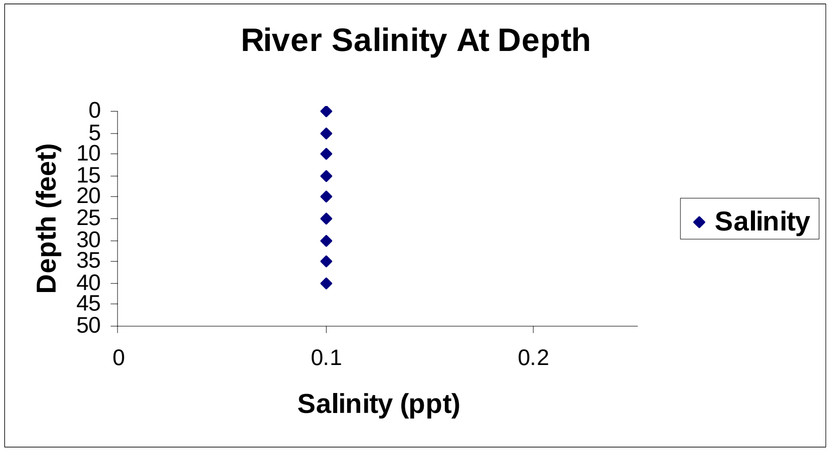

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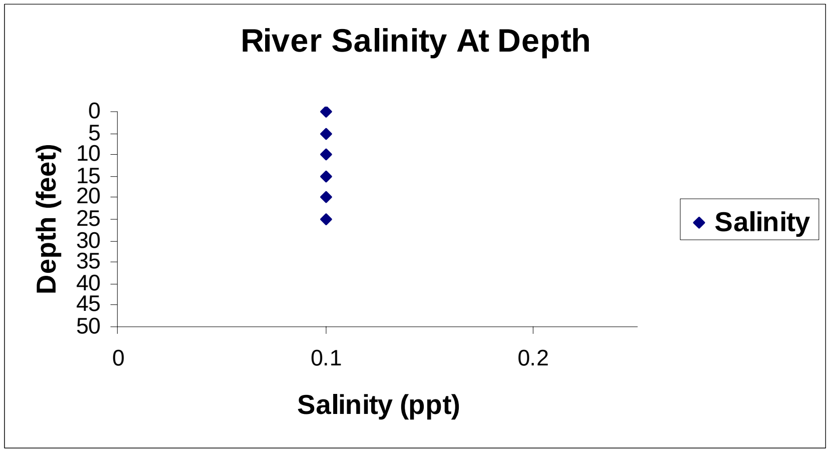

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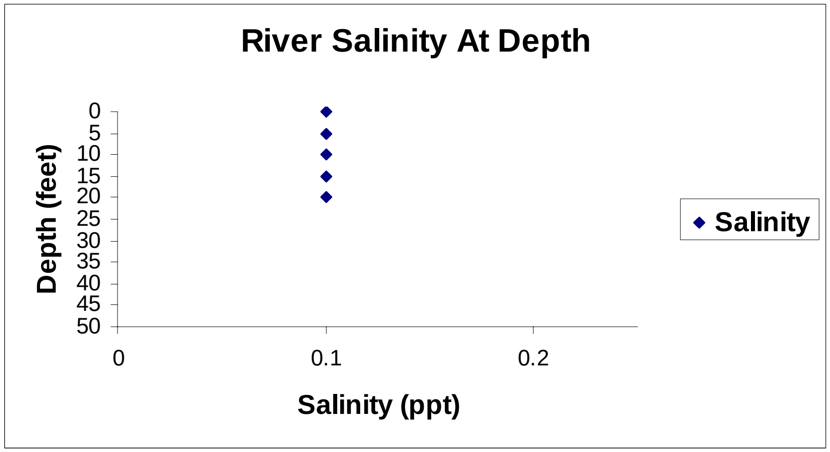

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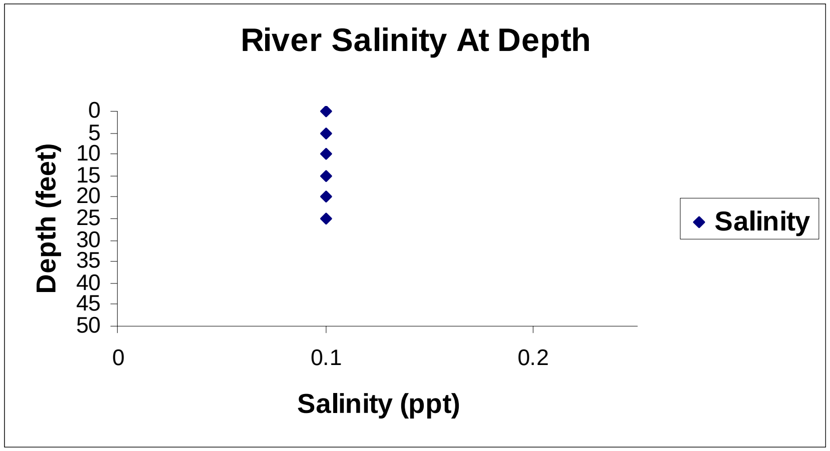

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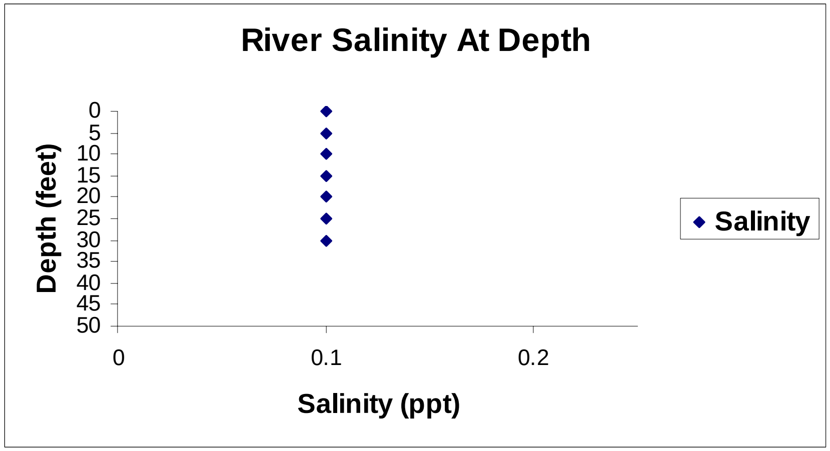

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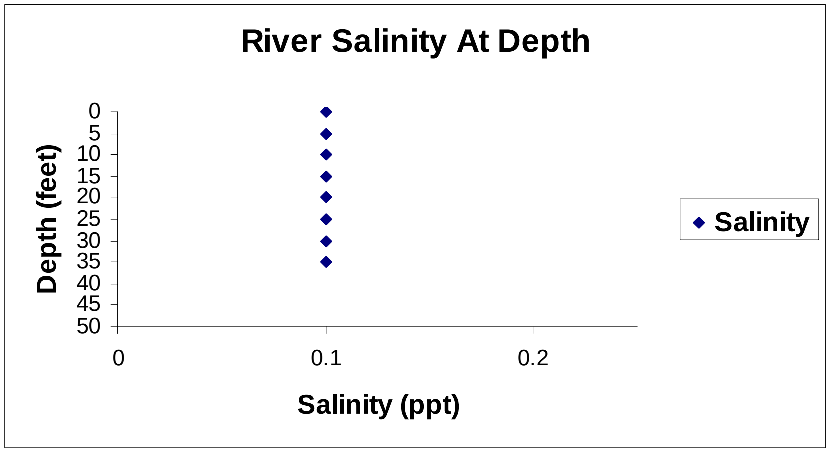

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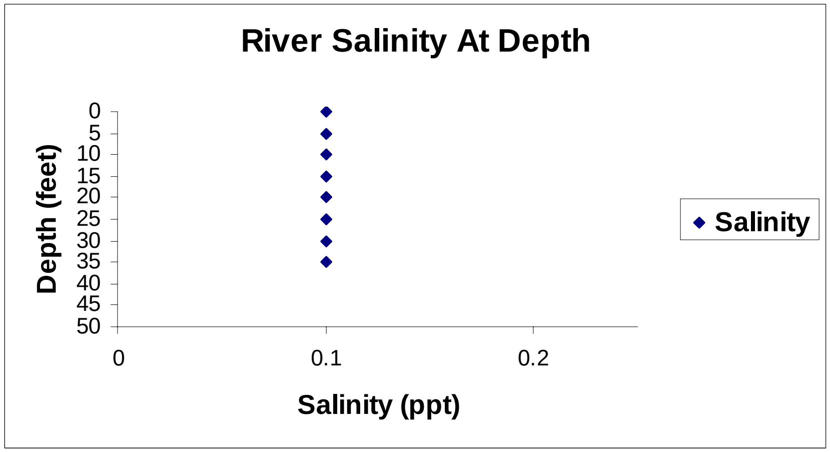

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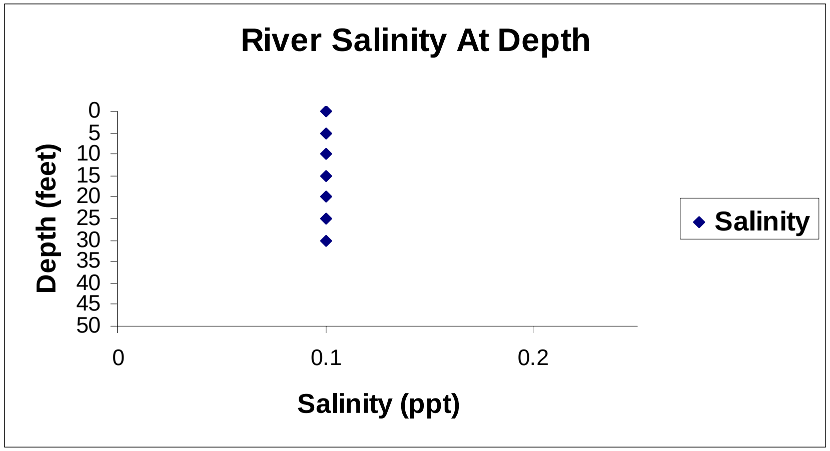

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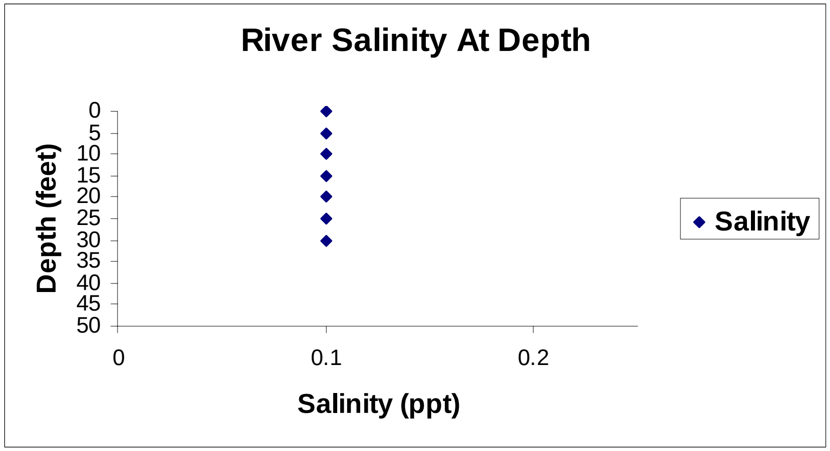

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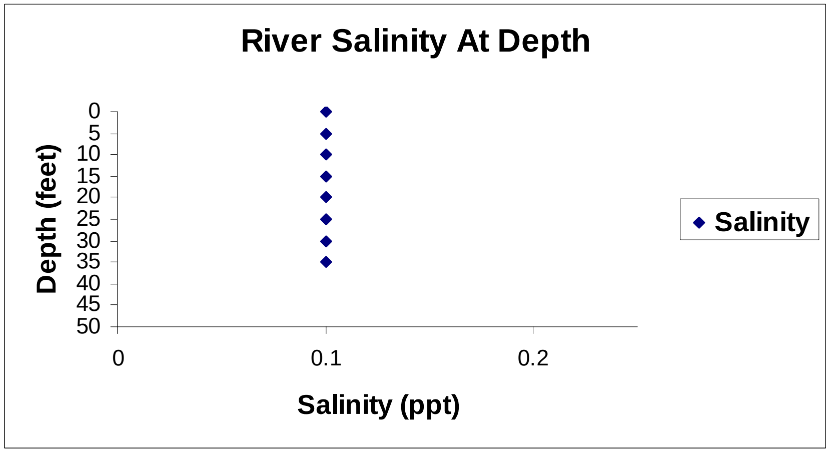

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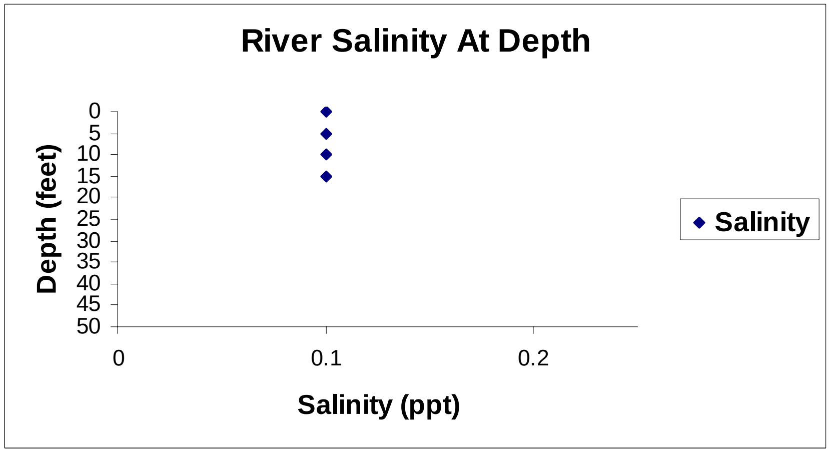

Sampling Date: 5/20/08

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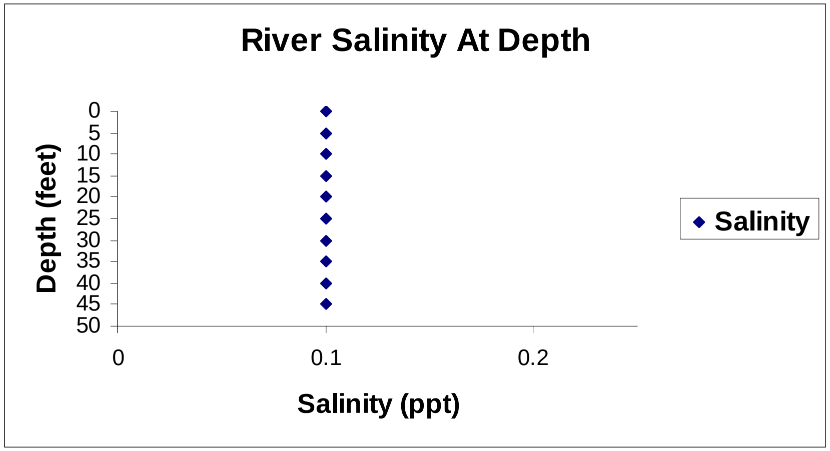

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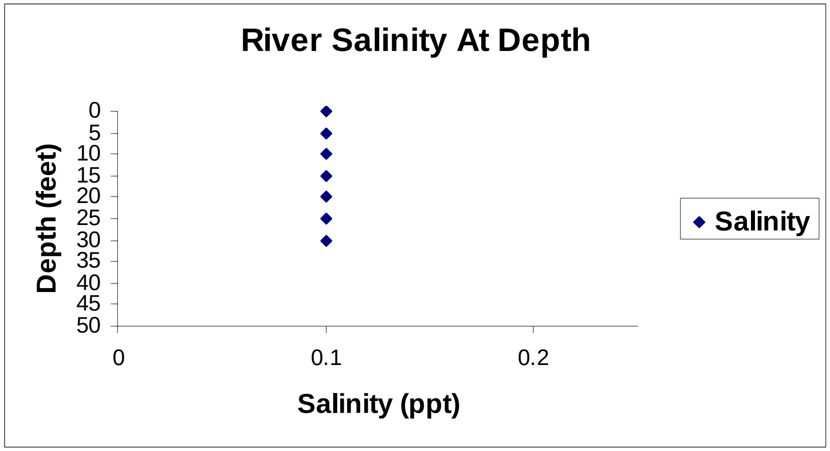

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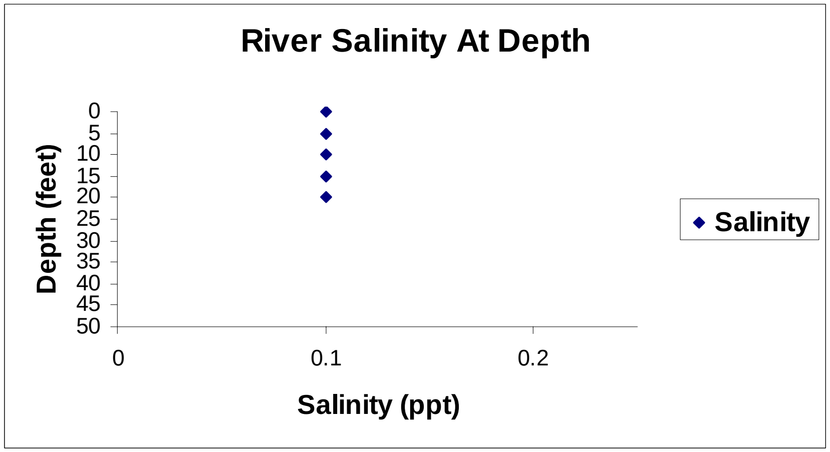

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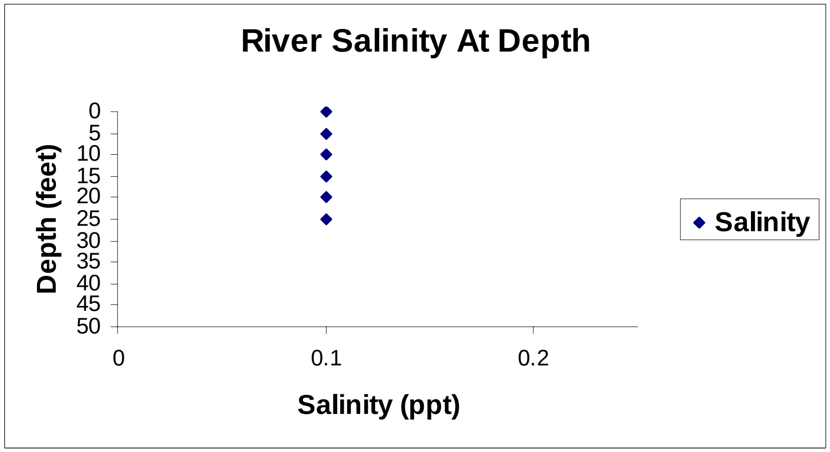

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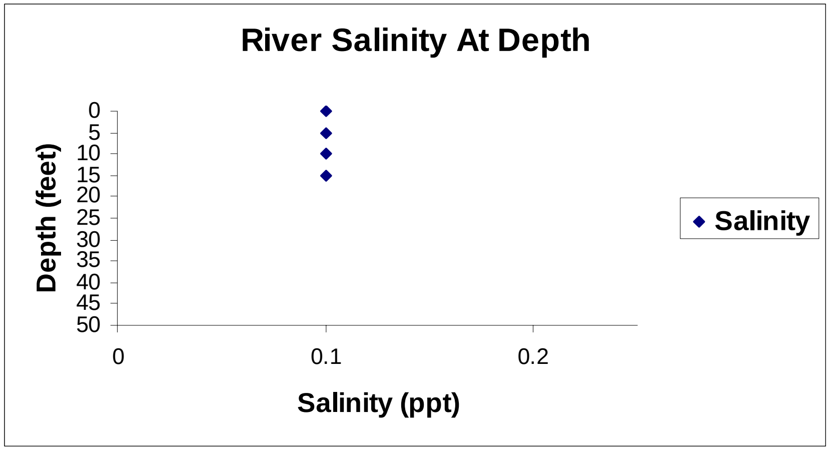

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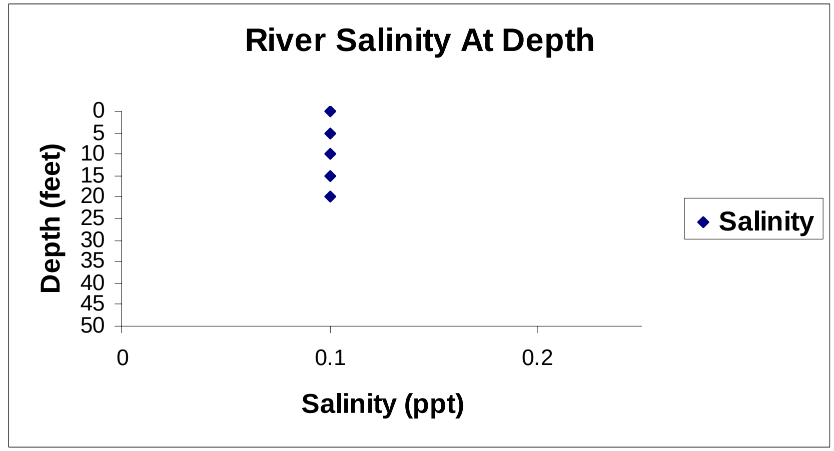

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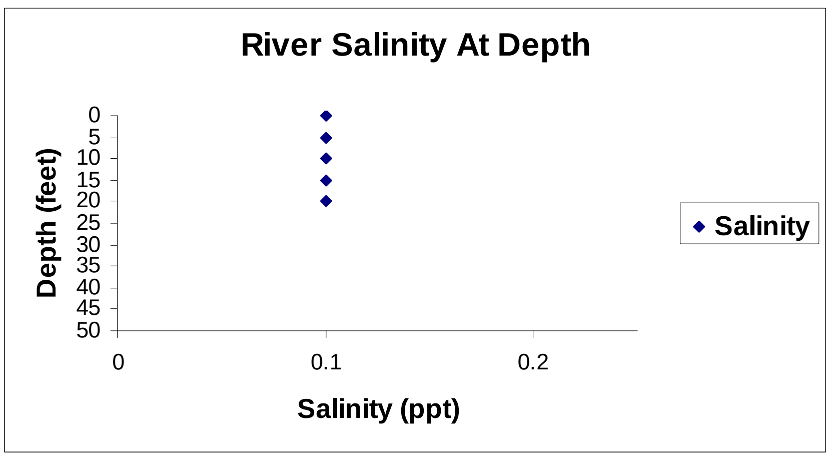

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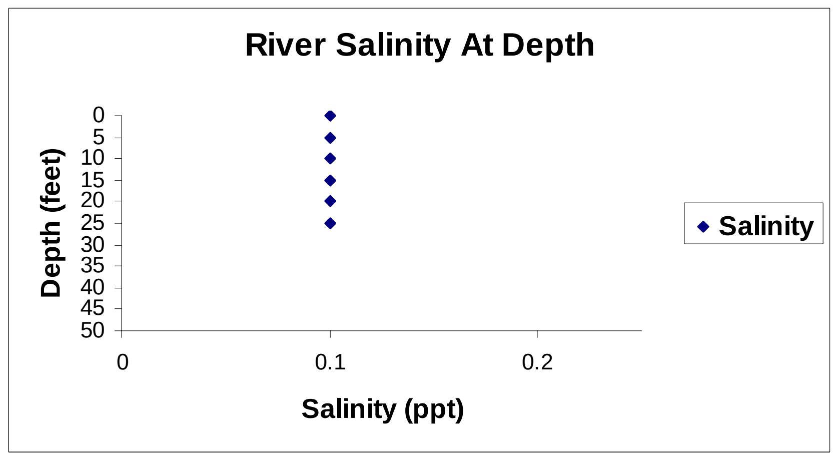

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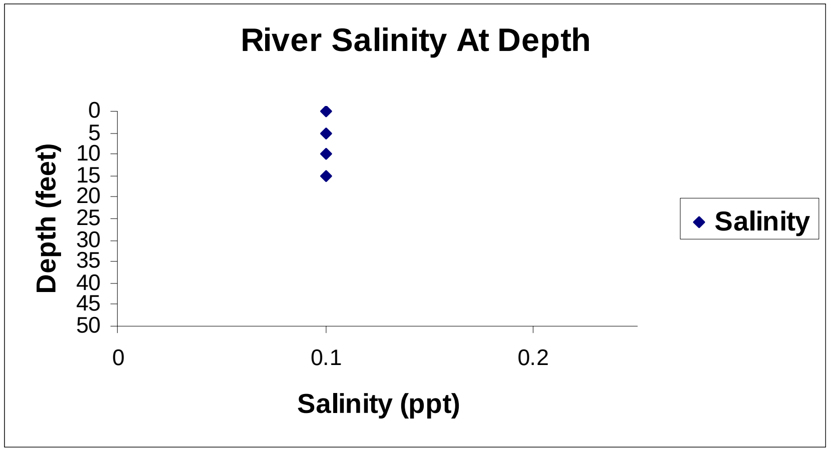

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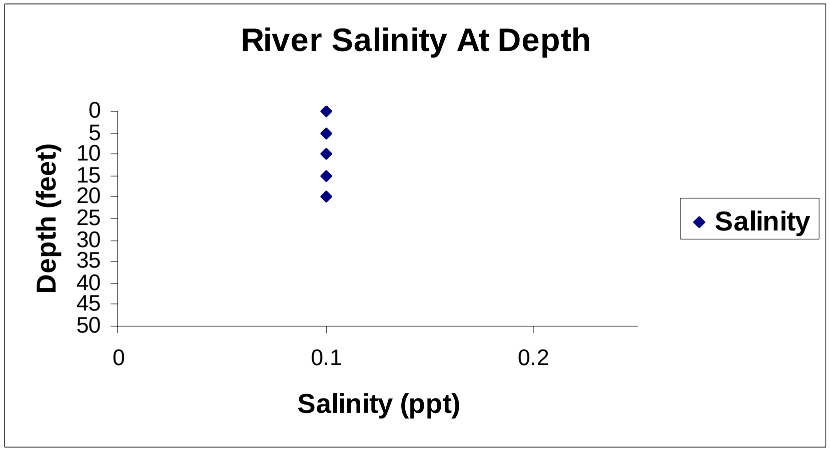

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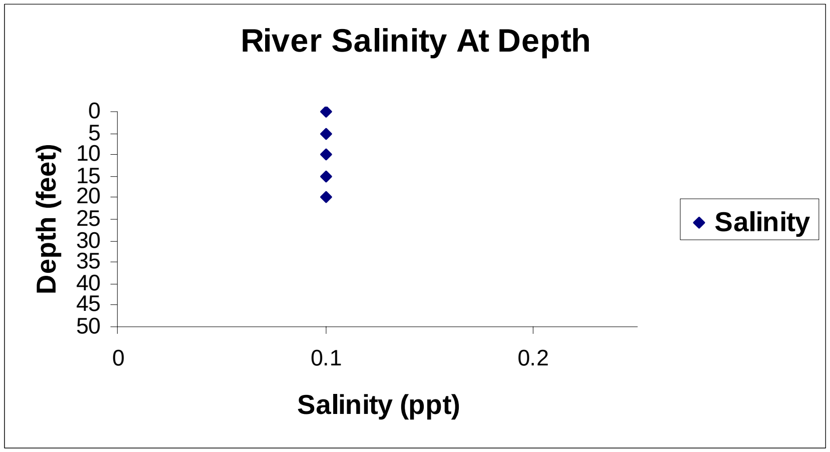

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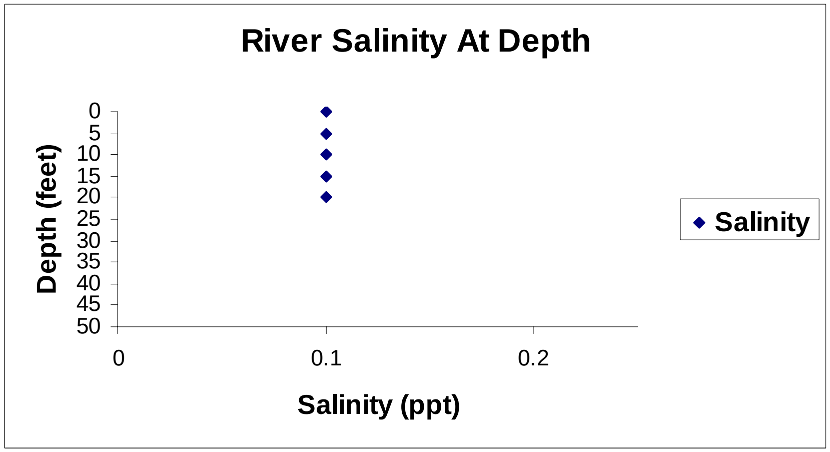

APPENDIX D

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

Appendix D. List of Plant Species

A list of plant species used in text and tables with accompanying authorities and common names follows. Both common and scientific names for vascular plants follow Kartesz and Meachum 2005. Species considered sensitive herbaceous species are marked with an asterisk (*). The list is cumulative for the project.

Acer rubrum L. Red Maple
**Alternanthera philoxeroides* (Mart.) Griseb. Alligator-Weed
Amaranthus cannabinus (L.)Sauer Tidal-Marsh Amaranth
Apios americana Medik. Groundnut
**Aster* sp. Probably *Symphyotrichum elliottii*.
Bidens laevis (L.)B.S.P. Smooth Beggarticks
Bidens mitis (Michx.)Sherff. Small-furit Beggarticks
**Bidens laevis* (L.)Britton Smooth Beggarticks
Bidens sp. Beggarticks
**Boehmeria cylindrica* (L.) Sw. Small-Spike False Nettle
**Boltonia asteroides* (L.) L'Hér. White Doll's-Daisy
Campsis radicans (L.) Seem. Ex Bureau Trumpet-Creeper
**Carex* L. Sedge
Carex amphibole Steud. Eastern narrow-leaf Sedge
**Carex crinita* Lam. Fringed Sedge
**Carex crinita* var. *brevicrinis* Fern. Fringed Sedge
**Carex crus-corvi* Shuttlw. Ex Kunze Raven-Foot Sedge
**Carex hyalinolepis* Steud. Shoreline Sedge
Carex leptalea Wahlenb. Bristly-stalk Sedge
**Carex lupulina* Muhl. Ex Willd. Hop Sedge
**Chasmanthium latifolium* (Michx.) Yates Indian Wood-Oats
**Cicuta maculata* L. Spotted Water-Hemlock
**Cinna arundinacea* L. Sweet Wood-Reed
**Commelina virginica* L. Virginia Dayflower
**Cyperus* L. Umbrella Sedge
**Decodon verticillatus* (L.) Ell. Swamp-Loosestrife
**Dulichium arundinaceum* (L.) Britt. Three-Way Sedge
**Elymus virginicus* L. Virginia Wild Rye
**Eryngium aquaticum* L. Rattlesnake-Master
Fraxinus caroliniana P. Mill. Carolina Ash
Fraxinus pennsylvanica Marsh. Green Ash
Fraxinus profunda (Bush) Bush Pumpkin Ash
**Galium* L. Bedstraw
Hydrocotyle L. Marsh-Pennywort
**Hydrocotyle verticillata* Thunb. Whorled Marsh-Pennywort
**Hymenocallis floridana* (Raf.) Morton Florida Spider-Lily
Hypericum mutilum L. Dwarf St. John's-Wort
Impatiens capensis Meerb. Spotted Touch-Me-Not
Ipomoea L. Morning-Glory
Lilaeopsis chinensis (L.) Kuntze Eastern Grasswort
**Lobelia cardinalis* L. Cardinal-Flower
**Ludwigia grandiflora* (M. Micheli) Greuter & Burdet Large-Flower Primrose-Willow
**Ludwigia palustris* (L.) Ell. Marsh Primrose-Willow
**Lycopus virginicus* L. Virginia Water-Horehound
**Mikania scandens* (L.) Willd. Climbing Hempvine
Murdannia keisak (Hassk.) Hand.-Maz. Wart-Removing-Herb
Nyssa aquatica L. Water Tupelo
Nyssa biflora Walt. Swamp Tupelo
Oenothera fruticosa ssp. *glauca* (Michx.) Straley Narrow-leaf Evening Primrose

**Orontium aquaticum* L. Goldenclub
Osmunda regalis L. Gray Royal Fern
Packera glabella (Poir.) C. Jeffrey Cress-Leaf Groundsel
**Peltandra virginica* (L.) Schott Green Arrow-Arum
**Phanopyrum gymnocarpon* (Ell.) Nash Savannah-Panic Grass
Physostegia leptophylla Small Slender-Leaf False Dragonhead
Pilea pumila (L.) Gray Canadian Clearweed
Platanthera flava (L.) Lindley
Pluchea odorata (L.) Cass. Sweetscent
Polygonum arifolium L. Halberd-Leaf Tearthumb
**Polygonum hydropiper* L. Mild Water-Pepper
**Polygonum hydropiperoides* Michx. Swamp Smartweed
**Polygonum punctatum* Ell. Dotted Smartweed
**Polygonum virginianum* L. Jumpseed
**Pontederia cordata* L. Pickerelweed
Porella pinnata L Leafy Liverwort
Proserpinaca palustris L. Marsh Mermaidweed
**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
Schoenoplectus robustus (Pursh) M.T. Strong Seaside Club-Rush
Schoenoplectus tabernaemontani (K.C. Gmel.) Palla Soft-Stem Club-Rush
**Sium suave* Walt. Hemlock Water-Parsnip
Smilax rotundifolia L. Horsebrier
Solidago sempervirens var. *mexicana* (L.) Fern. Seaside Goldenrod
Spartina cynosuroides (L.) Roth Big Cord Grass
**Symphyotrichum elliottii* (Torr. & Gray) Nesom Marsh American-Aster
Symphyotrichum subulatum (Michx.) Nesom Seaside American-Aster
Symphyotrichum tenuifolium (L.) Nesom Perennial Saltmarsh American-Aster
Taxodium ascendens Brongn. Pond-Cypress
Toxicodendron radicans (L.) Kuntze Eastern Poison-Ivy
**Triadenum walteri* (J.G. Gmel.) Gleason Greater Marsh-St. John's-Wort
**Typha latifolia* L. Broad-Leaf Cat-Tail
Typha angustifolia L. Narrow-Leaf Cat-Tail
Typha ×glauca Godr. (pro sp.)
**Zizania aquatica* L. Indian Wild Rice
**Zizaniopsis miliacea* (Michx.) Doell & Aschers. Marsh-Millet

Literature Cited

Kartesz, J.T., and C.A. Meacham. 2005. Synthesis of the North American Flora, Prepublication Version 2.0. Missouri Botanical Garden Press, St. Louis.

APPENDIX E

METADATA COVERING GIS/GPS FILES USED IN TEXT FIGURES IN SENSITIVE HERBACEOUS VEGETATION POLYGONS: 2007 ASSESSMENTS 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 STATION P3, INNER TOWN CREEK

FIGURE 8.41-1

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 STATION P3, INNER TOWN CREEK

FIGURE 8.41-1

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 STATION P3, INNER TOWN CREEK

FIGURE 8.41-1

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 STATION P3, TOWN CREEK

FIGURE 8.41-1

**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:	itcpol05 .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	10 Jan 2005
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 STATION P3, TOWN CREEK

FIGURE 8.41-1

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

FILE NAMES:	itcpt05 .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Point depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	10 Jan 2006
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

FILE NAMES:	P3Poly06 .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2006
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9 and Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 Jan 2007
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 STATION P7, INDIAN CREEK

FIGURE 8.42-1

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 STATION P7, INDIAN CREEK

FIGURE 8.42-1

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

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 STATION P7, INDIAN CREEK

FIGURE 8.42-1

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 STATION P7, INDIAN CREEK

FIGURE 8.42-1

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 STATION P8, DOLLISONS LAndING

FIGURE 8.43-1

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 STATION P8, DOLLISONS LAndING

FIGURE 8.43-1

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

FILE NAMES:	Area-gen.shp, .dbf .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2002
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:	6 January 2003
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

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 STATION P8, DOLLISONS LAndING

FIGURE 8.43-1

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 STATION P8, DOLLISONS LAndING

FIGURE 8.43-1

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 STATION P9, BLACK RIVER

FIGURE 8.44-1

**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 STATION P9, BLACK RIVER

FIGURE 8.44-1

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 STATION P9, BLACK RIVER

FIGURE 8.44-1

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 STATION P9, BLACK RIVER

FIGURE 8.44-1

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

FILE NAMES:	17tra.shp, .dbf, .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:	briv.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon
SOFTWARE:	Pathfinder Office 2.9, ArcView 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	21 January, 2006
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 STATION P12, RAT ISLAnd

FIGURE 8.45-1

**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:	Ratpil2.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Point depicting new location of piling, 2002
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:	5 August 2002
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 STATION P12, RAT ISLAnd

FIGURE 8.45-1

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 STATION P12, RAT ISLAnd

FIGURE 8.45-1

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 STATION P12, RAT ISLAnd

FIGURE 8.45-1

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

METADATA

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

FIGURE 8.46-1

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 STATION P13, FISHING CREEK

FIGURE 8.46-1

**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 STATION P13, FISHING CREEK

FIGURE 8.46-1

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 STATION P13, FISHING CREEK

FIGURE 8.46-1

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:	fcreek05, .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	12 January, 2006
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 STATION P13, FISHING CREEK

FIGURE 8.46-1

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

FILE NAMES:	Fishcr06, .shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2006
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	23 January, 2007
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 STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

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 STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

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 STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

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 STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

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:	pgc05.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2005
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	12 January, 2006
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 STATION P14, PRINCE GEORGE CREEK

FIGURE 8.47-1

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

FILE NAMES:	Prgeo06.shp, .dbf, .shx
DESCRIPTION OF LAYER:	Polygon depicting sensitive herbaceous plants, 2006
SOURCE:	Trimble PRO XRS GPS Unit
DATA TYPE:	Polygon from points
SOFTWARE:	Pathfinder Office 2.9, Arcview 3.3
DATUM:	North American Datum (NAD) 1983
COORDINATE SYSTEM:	U.S. State Plane 1983
REGION:	North Carolina 3200
UNITS OF MEASURE:	Feet
DATA COLLECTION:	24 January, 2007
SOURCE:	David M. DuMond
SOURCE CONTACT:	David M. DuMond
SOURCE ADDRESS:	225 Cheyenne Trail Wilmington, NC 28409
SOURCE PHONE:	910/799-0363

APPENDIX F

AREAS AND LOCATIONS OF NEW YEAR 2007 SENSITIVE HERBACEOUS SPECIES POLYGONS AT SAMPLING STATIONS IN THE CAPE FEAR RIVER ESTUARY, WILMINGTON HARBOR MONITORING PROJECT, NORTH CAROLINA

Appendix F. Areas and locations of year 2007 sensitive herbaceous species polygons at sampling stations in the Cape Fear River Estuary, Wilmington Harbor Monitoring Project, North Carolina.

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

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft)	Easting* (ft)
Town Creek/ P3	6,084.53 (Larger-outer)	1	140321.525	2304213.490
		2	140317.146	2304196.454
		3	140288.938	2304186.740
		4	140261.076	2304167.636
		5	140252.607	2304179.883
		6	140244.929	2304180.148
		7	140233.154	2304178.647
		8	140223.507	2304170.777
		9	140202.159	2304188.911
		10	140184.878	2304229.544
		11	140191.199	2304228.044
		12	140194.678	2304217.586
		13	140203.754	2304213.263
		14	140217.817	2304219.008
		15	140237.667	2304217.875
		16	140256.128	2304222.170
		17	140263.265	2304236.491
		18	140281.737	2304242.985
		19	140294.556	2304255.712
		20	140310.799	2304238.115
		21	140326.113	2304225.572
	489.15 (Smaller-inner exclusion)	1	140309.910	2304223.889
		2	140288.351	2304206.672
		3	140269.109	2304195.101
		4	140264.040	2304210.054
	SHV 5,595.38	5	140300.055	2304223.981
Fishing Creek P13	2,305.25	1	215488.258	2303579.337
		2	215477.957	2303573.547
		3	215460.894	2303577.797
		4	215462.618	2303580.661
		5	215459.321	2303588.410
		6	215454.031	2303589.906
		7	215440.722	2303601.881
		8	215441.058	2303588.009
		9	215444.086	2303570.767
		10	215449.537	2303569.833
		11	215462.874	2303562.776
		12	215471.319	2303561.060
		13	215484.991	2303554.457
		14	215490.240	2303559.210
		15	215512.084	2303552.944
		16	215515.847	2303544.156
		17	215534.395	2303532.742
		18	215541.905	2303521.272
		19	215557.480	2303535.837
		20	215539.168	2303556.427
		21	214528.129	2303555.210

Station Name/Number	Polygon Area (ft^2)	Point Number	Northing* (ft)	Easting* (ft)
		22	215515.587	2303563.859
		23	215499.374	2303578.647
		24	215496.352	2303584.049
		25	215492.110	2303579.827
		26	215492.295	2303576.125
Prince George	4,654.27	1	227249.382	2320207.407
Creek./P14		3	227239.422	2320220.613
		4	227228.147	2320219.541
		5	227223.333	2320227.802
		6	227222.761	2320226.481
		7	227216.395	2320237.856
		8	227205.979	2320246.828
		9	227219.109	2320255.928
		10	227212.191	2320264.090
		11	227200.192	2320267.484
		12	227212.408	2320280.374
		13	227204.615	2320281.100
		14	227197.910	2320294.990
		15	227212.928	2320308.345
		16	227224.513	2320295.858
		17	227224.402	2320287.504
		18	227230.925	2320275.025
		19	227245.152	2320284.439
		20	227254.087	2320277.377
		21	227266.556	2320276.958
		22	227283.959	2320282.841
		24	227293.668	2320299.085
		25	227300.016	2320282.207