Peconic Estuary Surface Water Quality Monitoring Report, 2010-2012

Suffolk County Department of Health Services

Steven Bellone, Suffolk County Executive
Dr. James L. Tomarken, Commissioner

March, 2016

Peconic Estuary Surface Water Quality Monitoring Report, 2010-2012

Suffolk County Department of Health Services

Dr. James L. Tomarken, MD, MSW, MPH, MBA, FRCPC, FACP
Commissioner

Division of Environmental Quality

Walter Dawydiak, P.E., J.D., Director

Office of Ecology

Chris Lubicich, Chief

Bureau of Marine Resources

Michael Jensen, Supervisor
Robert M. Waters (retired)
Nancy Pierson
Gary Chmurzynski
Lorian Peterson
Phil DeBlasi
Andrew Seal
Katherine Governale
Mark Long
Shawn Droskoski

Public & Environmental Health Laboratory

Joette Pavelka, Laboratory Director

Peconic Estuary Program

Alison Branco, Director

Cover photo: Looking east past the Port-o-Egypt Marina in Southold Bay

Table of Contents

Introduction 1
Materials and Methods 3
  Study Area 3
  Sampling Stations 4
  Sampling Parameters 5
  Data Processing 5
Results 10
  Marine Sampling 10
    Secchi Depth 10
    Temperature 11
    Salinity 13
    pH 16
    Dissolved Oxygen 16
      Summer Dissolved Oxygen 19
      Diurnal Dissolved Oxygen 22
    Coliform Bacteria 22
    Nitrogen 27
      Summer Total Nitrogen 33
    Phosphorus 38
    Chlorphyll-a 38
      Summer Chlorophyll-a 39
  Stream Sampling 42
    Coliform Bacteria 42
    Nitrogen 44
    Phosphorus 48
    Organics 49
      Pesticides 54
      VOCs 60
      PPCPs 61
    Metals 62

Table of Contents *continued*

Point Source Sampling 68
Riverhead STP 68
Nitrogen 68
Phosphorus 69
Coliform Bacteria 69
Atlantis Aquarium 72
Nitrogen 72
Coliform Bacteria 72
SPDES Compliance 73
Riverhead STP 73
Atlantis Aquarium 74
Comparisons with Historical Data 75
Marine Stations 75
Dissolved Oxygen 75
Nitrogen 78
Chlorophyll-a 79
Stream and Point Source Stations 85
Nitrogen 85
Toxics 95
Organics 95
Pesticides 100
VOCs 103
PPCPs 104
Metals 105
Discussion 109
Summary and Conclusion 129
References 136

List of Tables

Table 1. Sampling and Field Measurement Parameters 8
Table 2. Laboratory Parameters, Methods and QC Procedures 9
Table 3. Mean Values for Water Depth, Secchi Depth, Temperature, Salinity, pH and Dissolved Oxygen at Peconic Estuary Marine Sampling Locations 12
Table 4. Mean Summer (July-Sept) Dissolved Oxygen (DO) Concentrations at Peconic Estuary Marine Sampling Sites with the Percentage of Excursions Below NYS Standards 20
Table 5. Diurnal Dissolved Oxygen Concentrations in the Western Estuary with the Number of Excursions Below Standard Criteria (July-September) 23
Table 6. Coliform Geometric Mean and Median Values at Marine Sampling Locations with Percentages of Occurrences above Standard Thresholds 25
Table 7. Mean Nitrogen, Phosphorus and Chlorophyll-a Concentrations at Marine Sampling Locations 28
Table 8. Mean Summer (July-Sept) Total Nitrogen (TN) and Chl-a Concentrations at Marine Sampling Sites with the Percentage of Results Exceeding Recommended Guidelines 36
Table 9. Total and Fecal Coliform Statistics for Peconic Estuary Stream Stations 43
Table 10. Mean Concentrations of Nitrogen and Phosphorus Constituents at Peconic Estuary Stream Stations 46
Table 11. Organic Compounds Detected In Peconic Estuary Streams 51
Table 12. Summary of Organic Compound Detects in Peconic Estuary Streams 52
Table 13. Water Quality Standards for Pesticides Detected in Peconic Estuary Streams with the Number Criteria Exceedances 55
Table 14. Water Quality Standards for VOCs and PPCPs Detected in Peconic Estuary Streams with the Number of Criteria Exceedances 56
Table 15. Summary of Metal Detects in Peconic Estuary Streams 63
Table 16. Water Quality Standards for Metal Analytes Monitored in Peconic Estuary Streams with the Number of Criteria Exceedances 65
Table 17. Average Values for Total & Fecal Coliforms, Nitrogen, Phosphorus and Total Suspended Solids at the Riverhead STP and Atlantis Aquarium Point Source Sampling Sites 69

List of Tables *continued*

Table 18. Coliform, Nitrogen and Suspended Solids Permit Standards for the Riverhead STP and Atlantis Aquarium Discharges, with the Number of Criteria Violations 74

Table 19. Mean Summer Dissolved Oxygen (DO) Concentrations at Select Main-Bay and Western Estuary Stations During the 1990-1999, 2000-2009 and 2010-2012 Sampling Periods with the Percentage of Results Below the 4.8 mg/L Chronic and 3.0 mg/L Acute NYS Standards 77

Table 20. Mean Summer Total Nitrogen (TN) Concentrations at Select Main-Bay and Western Estuary Stations During the 1990-1999, 2000-2009 and 2010-2012 Sampling Periods with the Percentage of Results Exceeding the 0.45 mg/L TN guideline 82

Table 21. Mean Summer Chlorophyll-a Concentrations at Select Main-Bay and Western Estuary Stations During the 1990-1999, 2000-2009 and 2010-2012 Sampling Periods with the Percentage of Results Exceeding the 5.5 ug/L Guideline 85

Table 22. Summary of Historical Organic Compound Detections in Peconic Estuary Streams by Sampling Station 86

Table 23. Historical Comparison of Organic Compound Detections in Peconic Estuary Streams 97

Table 24. Historical Comparison of Metals of Concern Detected in Peconic Estuary Streams By Sampling Station 98

Table 25. Summary of Historical Detections of Metals of Concern in Peconic Estuary Streams 106

Table 26. Summary of Historical Detections of Metals of Concern in Peconic Estuary Streams 107

List of Figures

Figure 1. Peconic Estuary Marine Sampling Locations 6
Figure 2. Peconic Estuary Stream and Point Source Sampling Locations........ 7
Figure 3. Mean, maximum and minimum secchi depths at select Peconic Estuary sampling locations 14
Figure 4. Seasonal variations in temperature and salinity in Great Peconic Bay 14
Figure 5. Spatial Trends in Mean Salinity and Temperature at Northern, Main Bay and Southern Peconic Estuary Stations 15
Figure 6. Spatial Trends in Mean Dissolved Oxygen Levels at Northern, Main Bay and Southern Peconic Estuary Stations 17
Figure 7. Seasonal variations in Dissolved Oxygen and Temperature in Flanders Bay 18
Figure 8. Diurnal (AM/PM) Dissolved Oxygen Fluctuations in the Western Estuary 24
Figure 9. Spatial Trends in Mean Nitrogen and Chlorophyll-a Concentrations at Northern, Main Bay and Southern Stations 30
Figure 10. Spatial Trends in Average Ammonia (NH_3-N) and Nitrate+Nitrite (NO_x-N) Concentrations at Northern, Main Bay and Southern Peconic Estuary Stations 32
Figure 11. Temporal Variations in Nitrogen Concentrations in Flanders Bay 34
Figure 12. Temporal Variations in Nitrogen Concentrations in East Creek, South Jamesport 34
Figure 13. Temporal Variations in Nitrogen and Chlorophyll-a Concentrations in West Neck Bay 35
Figure 14. Temporal Variations in Phosphorus Concentrations in Flanders Bay 39
Figure 15. Spatial Trends in Mean Phosphorus Concentrations at Northern, Main Bay and Southern Peconic Estuary Stations 40
Figure 16. Temporal Variations in Chl-a concentrations in Northwest Harbor 41
Figure 17. Spatial Variations in Mean Concentrations of Total and Fecal Coliform Bacteria at Peconic Estuary Stream Stations 45
Figure 18. Spatial Variations in Concentrations of Total Nitrogen (TN), Dissolved Inorganic Nitrogen (DIN), Nitrite+Nitrate Nitrogen (NO_x-N) and Ammonia Nitrogen (NH_3-N) at Peconic Estuary Stream Stations 47

List of Figures *continued*

Figure 19. Spatial Variations in Concentrations of Total Phosphorus (TP) and Ortho-Phosphate (o-PO_4-P) at Peconic Estuary Stream Stations 49
Figure 20. Total Number of Organic Detects in Peconic Estuary Streams 53
Figure 21. Temporal Variations in Concentrations of Total Nitrogen (TN), Dissolved Inorganic Nitrogen (DIN), Nitrate+Nitrite (NO_x-N) and Ammonia (NH_3-N) in the Riverhead STP Discharge 70
Figure 22. Temporal Variations in Concentrations of Total Phosphorus (TP) and Ortho-phosphate (o-PO_4-P) in the Riverhead STP Discharge 71
Figure 23. Temporal Variations in Total and Fecal Coliform Levels in the Riverhead STP Discharge 71
Figure 24. Temporal Variations in Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in the Atlantis Aquarium Discharge 73
Figure 25. Annual and Summer Means (top) and Data Scatterplot (bottom) for Dissolved Oxygen Levels at Flanders Bay 76
Figure 26. Annual Means for TN, DON and DIN in Flanders Bay and Western Gardiners Bay 80
Figure 27. Annual and Summer Total Nitrogen (TN) Scatterplot for Flanders Bay and Western Gardiners Bay 81
Figure 28. Average Annual and Summer (Jul-Sept) Concentrations of Chlorophyll-a in Flanders Bay 83
Figure 29. Average Annual and Summer (Jul-Sept) Concentrations of Chlorophyll-a in West Neck Bay 84
Figure 30. Annual Means and Data Scatterplot for Total Nitrogen (TN), Dissolved Inorganic Nitrogen (DIN) and Dissolved Organic Nitrogen (DON) at Peconic River Station 200010 88
Figure 31. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at Meetinghouse Creek Station 200041 89
Figure 32. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at Meetinghouse Creek Station 200004 90
Figure 33. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at East Creek in South Jamesport 92

List of Figures *continued*

Figure 34. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at Downs Creek 94

Figure 35. Annual Means and Data Scatterplot for Total Nitrogen (TN), Ammonia (NH_3-N) and Nitrate+Nitrite (NO_x-N) in the Riverhead STP Discharge 96

Executive Summary

Results of monitoring conducted during 2010-2012 showed very good water quality to exist throughout much of the Peconic Estuary. However, in a number of areas where impairments had previously been documented, including in portions of the western estuary, multiple locations in the freshwater reaches of the Peconic River, and in various tributaries on the north fork, signs of adverse impacts continue to be apparent.

Dissolved oxygen levels at the majority of sites monitored, particularly those located in the expansive main embayments, remained at healthy levels year-round in both surface and bottom waters. Excursions below DO standards were common in only a limited number of sites in the western estuary where elevated nutrients from local point and non-point sources have long been an issue. Excursions were also occasionally noted in waters of a number of peripheral embayments, but in most cases these consisted of a single occurrence over the three year period, and as such were the exception rather than the rule.

Levels of total and fecal coliforms at marine locations were low throughout the sampling period, with all sites consistently in compliance with the appropriate criteria. In contrast, coliform levels in streams were highly variable, and in some cases extreme, with mean values significantly greater than those found at marine stations. Stream coliform levels were generally associated with prior precipitation, although elevated levels were also noted during dry periods suggesting that other factors such as waterfowl, boats, or poorly operating septic systems may be at fault.

Concentrations of nitrogen, the main nutrient of concern in the estuary, were fairly stable throughout the marine portion of the system, continuing a trend seen over the past decade. In main-bay and peripheral embayment areas, dissolved organic nitrogen (DON) was the main component of total nitrogen (TN), with dissolved inorganic nitrogen (DIN), mostly NO_x-N, more important in tidal creek areas. Spatially, mean TN levels exhibited a general west to east decline in concentration, a trend that highlights the enriched nature and comparatively limited degree of tidal flushing characteristic of the western estuary. As seen in past surveys, a number of sites in the western estuary continued to have the greatest percentage of samples exceeding the 0.45 mg/L TN guideline, and not coincidentally, the greatest percentage of summer excursions below NYS dissolved oxygen criteria.

In streams monitored, TN levels (mainly comprised of NO_x-N) were highest in areas of the western estuary and north fork where densely developed residential and/or agriculture are major land uses. The lowest TN levels were noted in areas with a greater proportion of open space, including some areas along the Peconic River and in tributaries to southern Flanders Bay. Long-term fluctuations in TN levels did not follow a consistent pattern among the streams studied, likely reflecting the complexity of land use mixes involved and varying changes in land use patterns and intensity over the decades.

Chlorophyll levels were comparatively elevated at a number of marine locations in the western estuary where ample sources of enrichment are available. Similar to TN levels, average chlorophyll-a levels generally declined eastward in the estuary with increasing distance from the sources of enrichment and an increased level of tidal flushing. Nutrient availability was apparently sufficient in a number of areas beyond the western estuary to support a moderate level of algal growth, particularly during summer months, but was not at a level that would result in water clarity and dissolved oxygen impairments.

Monitoring of potentially toxic constituents, including pesticides, volatile organic compounds (VOCs), pharmaceutical and personal care products (PPCPs) and trace metals, was routinely conducted at stream stations. Perhaps the most significant finding was the continued presence of multiple pesticide residues in a number of the streams located in areas of the north fork where agriculture operations are a principal land use. In comparison, detections of VOCs and PPCPs were uncommon. None of the pesticide residues exceeded any NYS surface water quality standards however, and only two exceedances of the EPA aquatic life criteria were found. Nevertheless, the occurrence of pesticide mixtures in a number of the streams monitored remains a concern, as the potential for additive or synergistic effects from pesticide mixtures may pose a greater risk to aquatic organisms than individual compounds. The situation in Brushes Creek in Laurel, a tributary to Great Peconic Bay, was particularly severe, as nine different pesticide compounds and as many as seven in a single sample were detected.

Concentrations of trace metals were generally low and exceedances of water quality criteria infrequent. Sites where metal residues were most common and highest in concentration, included one site where contaminants might be anticipated (the Peconic River site downstream from the BNL wastewater discharge), and three sites where open space is a principal upstream land use and metal contaminants would ordinarily not be expected (Pipes Creek and Pipes

Neck Creek in Greenport and Narrow River North in Orient). At the Peconic River site, metal contaminants may be associated with the BNL wastewater discharge as well as leaching and runoff from soils in the vicinity of the STP. An abandoned landfill located near Silver Lake in Greenport may be the source of contaminants found at Pipes Neck Creek. Sources of metals to the other two east end sites have yet to be identified; the possibility that other former dump sites exist remains to be investigated.

Introduction

This report describes trends in water quality at 64 marine, stream and point source locations in the Peconic Estuary that were monitored from 2010 through 2012 by staff from the Suffolk County Department of Health Services, Office of Ecology (Bureau of Marine Resources). Basic descriptive statistics and graphics depicting spatial and temporal variations provided the basis for the analysis. Sampling results for the prior two decades (1990-1999 and 2000-2009) were also examined to provide some context for the 2010-2012 data.

Suffolk County initiated water quality monitoring in the Peconic Estuary in 1976 under the federal "208 Study" (Section 208 of the Water Pollution Control Act), a comprehensive water quality management program calling for the development of a plan to meet established water quality goals. A major component of the plan was the water quality characterization of the major estuaries in Suffolk County, including the Peconic Estuary. At the conclusion of the 208 Program, monitoring in the estuary was continued on a limited basis in an effort to maintain a somewhat consistent database.

In 1986, in response to the "brown tide" bloom in the Peconic Estuary and the county's south shore bays, the Office of Ecology expanded its water quality monitoring program both in terms of sampling frequency and geographical coverage. In the Peconic Estuary, where the bloom wreaked havoc on a once prosperous bay scallop fishery, monitoring was increased to weekly with the easternmost sampling stations extending through Gardiners Bay. This expanded effort continued under the Brown Tide Comprehensive Assessment and Management Program (BTCAMP), initiated in 1988, and later under the Peconic Estuary Program (PEP) in 1993.

Currently, the SCDHS conducts a comprehensive year-round surface water quality monitoring program that focuses on indicator parameters for which measurable goals have been identified in the PEP's Comprehensive Conservation and Management Plan (CCMP, 2001). These include brown tide, nutrients, dissolved oxygen, water clarity, pathogens, and toxics. The objectives of the program are to provide a general assessment of the status and trends in estuary water quality, to assess water quality in terms of established criteria and standards (dissolved oxygen, coliforms, & total nitrogen), to provide data on water quality conditions in support of investigations being conducted by other agencies and researchers (brown tide studies, shellfish seeding efforts, SAV restoration programs and TMDL development efforts), and to provide data for use in evaluating whether desired environmental results have been achieved and whether objectives of the CCMP are being met.

Materials and Methods

Study Area

The Peconic Estuary System, located between the north and south forks of eastern Long Island (Figure 1), consists of a series of shallow interconnected bays, harbors and tributaries. Its watershed extends from the headwaters of the Peconic River on the west to Block Island Sound on the east and includes more than 158,000 acres of surface water.

Major embayments in the estuary include Flanders Bay, Great Peconic Bay, Little Peconic Bay, Shelter Island Sound and Gardiners Bay. Of the more than 50 tributaries discharging freshwater to the estuary, the Peconic River is by far the largest. The non-tidal portion of the river is approximately 15 miles long, and extends from its headwaters at the William Floyd Parkway east to Grangebel Park in Riverhead.

The estuary is generally well mixed, with circulation primarily driven by tidal flow and wind. The average tidal range is 2.7 feet, with water depths ranging from a mean of 5 feet in Flanders Bay to over 30 feet in Gardiners Bay. The deepest areas are located at the races around Shelter Island, where depths range from 18 to 95 feet (BTCAMP, 1992). Ocean exchange primarily occurs through Gardiners Bay and Block Island Sound. Although the Shinnecock Canal (located in the southern end of Great Peconic Bay) connects the estuary to Shinnecock Bay, tidal exchange with the Atlantic Ocean through Shinnecock Inlet is limited by a tidal gate on the canal that only allows flow from Great Peconic Bay to Shinnecock Bay. According to Hardy (1976), the residence time of water in the system decreases eastward from 55 days in Flanders Bay to 22 days in Shelter Island Sound .

The Peconic Estuary is one of 28 estuaries of "national significance" included in the National Estuary Program (NEP). The NEP is administered by the United States Environmental Protection Agency under the auspices of Sec. 320 of the Clean Water Act, to protect and preserve nationally significant estuaries which are threatened by pollution, development, or overuse. The Peconic Estuary was nominated for inclusion in the NEP in 1991 and the Program officially commenced in 1993.

Historically, impacts from population growth and development have not been as severe in the Peconic Estuary as in certain other regions on Long Island. However, a number of problems have emerged in recent years which suggest that the health of the estuary is at a crossroads. These problems include the occurrence of nuisance algal blooms (brown tides and more recently, rust tides caused by the organism *Cochlodinium polykrikoides*), the closure of shellfish beds, and occasionally bathing beaches, due to the presence of pathogenic organisms, declines in finfish abundance, the loss and fragmentation of habitats, nutrient over-enrichment resulting in low dissolved oxygen levels, the potential for impacts from low levels of toxics including several pesticides, and the loss of open space and farmland to residential development.

Sampling Stations

Sampling in the estuary is conducted on a year-round monthly basis in order to provide a data-set sufficient to document seasonal variability and trends in the constituents being measured. Sampling locations include 38 marine sites (main bays and peripheral embayments) located from the Peconic River in the west to Lake Montauk in the east (Figure 1), and an additional 26 stream and point source sites that are sampled to assess their relative impact on the estuary's water quality (Figure 2). In various tables and data listings, marine station numbers include an “060” prefix; stream and point source station designations have a “200” prefix. Descriptions of current station locations are listed in Appendix A1 for marine sites and in Appendix A2 for streams and point sources.

Because of the geographic extent of the estuary, each monthly main bay sampling event requires two boats and crews working simultaneously to accomplish. Select peripheral embayment sites (those not accessible to the large boats used for the main bay events) are sampled on subsequent dates each month using small outboard powered boats. Stream and point source sites are sampled from shoreline locations. The logistics of all sampling runs are arranged with respect to the tidal state, so that peripheral embayment and stream sites are sampled during the last 3-hours of an outgoing tide. The purpose of this effort is to minimize tidal influences that may mask subtle effects from upland sources.

In effort to assess observed fluctuations of dissolved oxygen (DO) levels below acceptable criteria in the western portion of the estuary, diurnal (AM/PM) sampling is conducted from April through September at three locations (Peconic River mouth, Meetinghouse Creek and Flanders Bay). The sites involved are initially sampled in the early morning (pre-photosynthesis) to measure the effects of nighttime respiration on DO levels, and then re-sampled during the afternoon.

Sampling Parameters

Samples are collected for a wide range of parameters (Table 1), including nitrogen & phosphorus nutrients, total and fecal coliform bacteria, total suspended solids, chlorophyll-a, and the phytoplankter *Aureococcus anophagefferens* (brown tide). Additional phytoplankton samples are collected when blooms are evident. At stream sampling locations, samples are also collected for metals and a full suite of organic constituents. Special radiological samples (for tritium, alpha, and beta particle analyses) are also collected from a site on the Peconic River downstream from the Brookhaven National Laboratory's wastewater treatment plant discharge. Routine field measurements at marine sites include temperature, dissolved oxygen, secchi depth, irradiance (PAR), salinity and pH. Field parameters for stream sites include conductivity, pH and temperature. All sample analyses (except for phytoplankton) are conducted by the SCDHS Public & Environmental Health Laboratory (PEHL). Phytoplankton samples are analyzed by Ecology staff. Descriptions of analysis methods are provided in Table 2.

Data Processing

All SCDHS water quality monitoring results are stored in program-specific *Access* databases. For a particular analysis, appropriate queries are designed to isolate and export the desired data-set to an *Excel* spreadsheet. Once in *Excel*, and prior to analysis of the data, a number of transformations are applied, including replacing left-censored data with ½ the value of the MRL (minimum reportable level), and calculating values for DIN (= NO_x-N + NH_3-N) and DON (= TDN – DIN). In cases where more than one sample was collected at a particular site on the same date (such as during diurnal or AM/PM monitoring in the western estuary), daily means are calculated prior to calculating annual means. For coliform bacteria statistics, geometric means are calculated. Once all data transformations are complete, subsets of the data are extracted and formatted as required for analysis by statistical (*Systat*, 2002) and graphing (*Grapher*, 2005) software.

Figure 1. Peconic Estuary Marine Sampling Locations

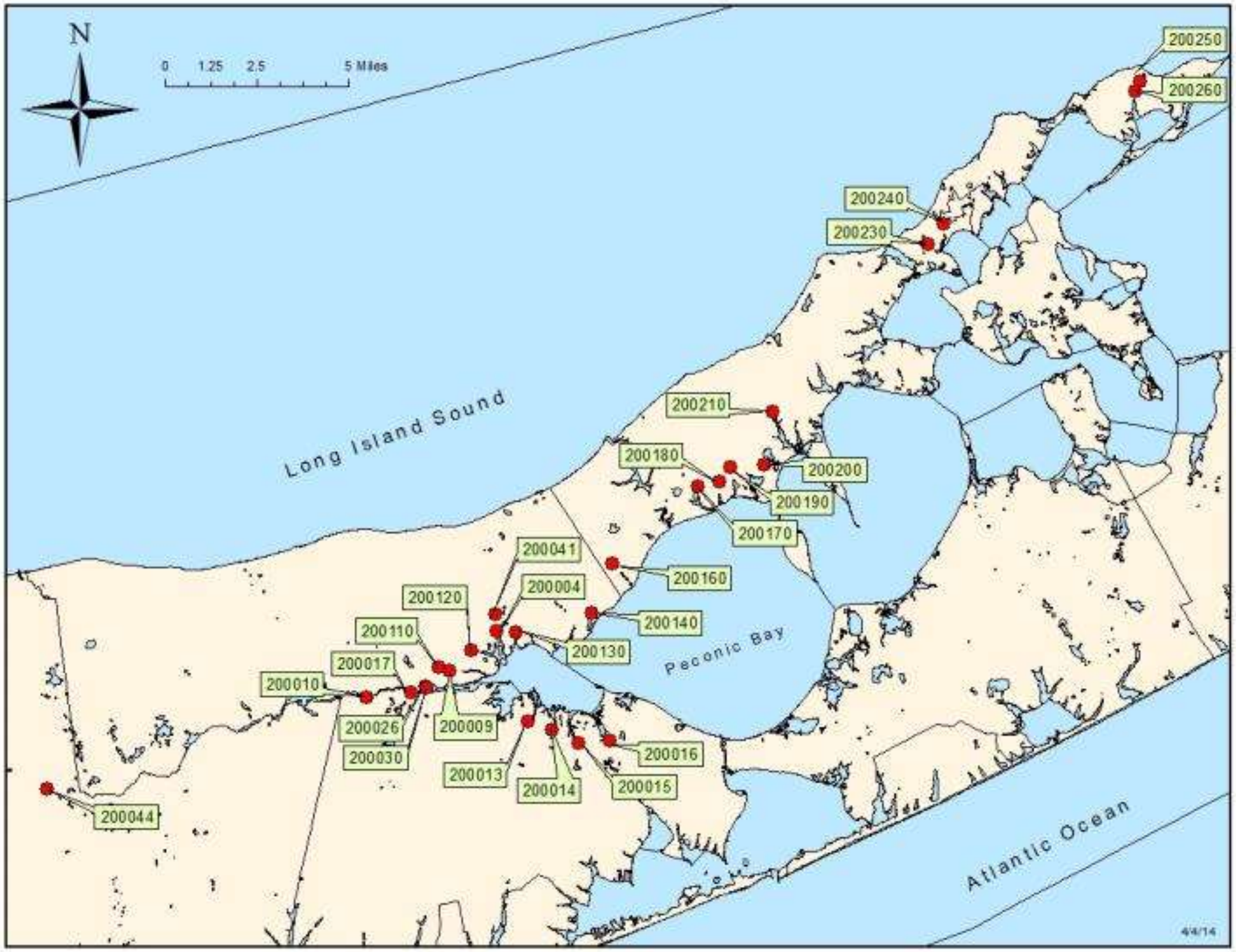


Figure 2. Peconic Estuary Stream and Point Source Sampling Locations

Table 1. Sampling and Field Measurement Parameters By Sample Type

Parameter	Marine	Streams	*In-situ* Sondes	STP Effluents
Water Samples:				
Ammonia (NH_3-N)	x	x		x
Nitrite (NO_2-N)		x		x
Nitrate (NO_3-N)		x		x
NO_x (NO_2+NO_3-N)	x			
Total Nitrogen (TN)	x	x		x
Total Dissolved Nitrogen (DN)	x	x		
Total Phosphorus (TP)	x	x		x
Total Dissolved Phosphorus (DP)	x	x		
Ortho-Phosphate (o-PO_4-P)	x	x		
Total Suspended Solids (TSS) [1]	x	x		x
Total & Fecal Coliform Bacteria	x	x		x
Total Chlorophyll-a	x			
General Phytoplankton [2]	x			
Aureococcus (Brown tide)	x			
Volatile Organic Compounds [3]		x		
Semi-volatile Organic Compounds [3]		x		
Carbamate Pesticides [3]		x		
Chlorinated Pesticides & Microextractables [3]		x		
Herbicide Metabolites [3]		x		
Dacthal Metabolites [3]		x		
Metals (Dissolved) [3]		x		
Radiologicals (tritium, alpha, beta) [4]		x		
Chloride, sulfate		x		
Field Measurements:				
Water Depth	x		x	
Secchi Depth	x			
Temperature	x	x	x	
Dissolved Oxygen	x	x	x	
Salinity	x		x	
Conductivity		x	x	
pH	x	x		
Light Attenuation (PAR)	x			
Flow				x

[1] Collected at sentinel sites only
[2] Collected when discolored waters or an obvious algal bloom are observed
[3] For a complete list of analytes, see Appendix D
[4] Only collected at the Peconic River site downstream from the BNL discharge

Table 2. Laboratory Parameters, Methods and QC Procedures			
Parameter	**Method**	**MRL**	**General QC Procedures**
Ammonia	Westco SmartChem 200-100C	0.02 mg/L	Calibration curves are established for all nutrient methods; MDLs calculated; LRBs, QCSs at low, mid and high analyte concentrations, matrix spikes, and duplicate samples analyzed.
Total Nitrogen	Lachat QuikChem 31-107-04-3-A	0.05 mg/L	
Nitrate+Nitrite	Lachat 31-107-04-1-C	0.005 mg/L	
Ortho-phosphate	Westco SmartChem 410-200B	0.01 mg/L	
Total Phosphorus	Lachat QuikChem 31-115-01-3-D	0.05 mg/L	
Total Coliforms	Standard Methods 9221B	20 MPN/100 ml	Sterility checks on media, buffers, and sample bottle lots; method blanks; negative and positive controls analyzed.
Fecal Coliforms	Standard Methods 9221E	20 MPN/100 ml	
Chlorophyll-a	EPA method 445.0	0.05 ug/L	LRBs, solvent blanks, QCS, & field duplicates
Aureococcus	Polyclonal procedure of Anderson, Kulis & Cosper	20 cells/ml – varies depending on volume of sample	LRBs, positive controls, field duplicates
Total Suspended Solids	Standard Methods 2540D	10 mg/L	MDL determined; QCS, LRB, and sample duplicates analyzed
Methyl Carbamate Pesticides	EPA Method 531.1	0.5 ug/L	For organic analyses, calibration curves are established; MDLs determined; and a combination of LRBs, LFBs, FRBs, QCSs, LPCs, and LFMs are analyzed either daily or per a specific number of samples.
Organo-halide Pesticides	EPA Method 505	0.01 – 0.2 ug/L	
Microextractables	EPA Method 504.1	0.01 - 0.02 ug/L	
Dacthal Metabolites	Suffolk County Method No.1 – HPLC/UV/PDA	5 ug/L	
Herbicide Metabolites	Suffolk County Method No.2 – LC/MS/MS	0.2 – 0.8 ug/L	
Semi-volatile Organic Compounds	EPA Method 525.2	0.02 – 3 ug/L	
Volatile Organic Compounds	EPA Method 524.2	0.5 – 20 ug/L	
Metals and Trace Elements	EPA Methods 200.7 & 200.8	200.7: 0.1 – 1 mg/l 200.8: 0.2 – 5 ug/L	Calibration curve established; MDLs determined; LRBs, LFBs, LFMs, and sample duplicates analyzed.
Tritium	EPA Method 906.0	200 pCi/L	Determination of MDA; analysis of LFBs, negative and positive controls, LPCs, and background check standards.
Gross alpha & beta radioactivity	EPA Method 900.0	1 pCi/L	

MDL=Minimum Detectable Level; MRL=Minimum Reporting Level; LRB=Laboratory Reagent Blank; QCS=Quality Control Sample; LFB=Laboratory Fortified Blank; FRB=Field Reagent Blank; LPC=Laboratory Performance Check; LFM=Laboratory Fortified Matrix; MDA=Minimum Detectable Activity

Results

Marine Sampling

During the 2010 and 2012 sampling period, water quality monitoring was conducted on 108 occasions at 38 marine sampling stations. Efforts were concentrated at main-bay sites, with peripheral embayment stations monitored as tide and time permitted. A total of 1,269 samples were collected during the three years. Basic descriptive statistics (mean, maximum and minimum values, standard deviation and N of cases) for select parameters are included in Appendix B1. Graphics depicting spatial variations are included for a number of parameters in the text below. For these, pertinent results were divided into estuary regions to facilitate comparisons among the large number of sites involved, including main-bay stations, northern peripheral embayment and Shelter Island stations, and southern peripheral embayment stations. A limited number of time-series plots are included as well, with the complete set of graphs included in Appendix C1.

Secchi Depth

Because of limited water depths at a number of sampling sites, it was often not possible to measure the true secchi depth (i.e., the secchi disk was still visible when it reached the bottom). This occurred predominantly in peripheral embayments where water depths were less than 10', but in some instances was also noted at stations with relatively deep water. In each case, the secchi depth was reported as greater than (>) the water depth. Because these results underestimate the true secchi depth, an assessment of mean values at stations where this occurs can lead to incorrect assumptions. Although this issue has been addressed in other studies using statistical regression techniques (Carstensen, 2010), these are beyond the scope of this report.

In an attempt to identify locations where the majority of the data represents true secchi depths, and make an assessment regarding trends, the percentage of instances where the secchi depth was reported as greater than the water depth were examined. Only those sites with <15% censored data (13 stations in all) were selected for further analysis. These are designated by the orange shading in Table 3. Water depths at these locations generally averaged greater than 10', with eight of the sites having depths in the 20' - 70' range.

Mean secchi depths at the 13 sites exhibited a general west to east increasing pattern, with values ranging from 4.8 ft. at station 220 in Meetinghouse Creek to 12.8 ft. at station 141 in Gardiners Bay (Table 3, Figure 3). Minimum values ranged from 2.0 ft. to 3.5 ft. at western sites (up to and including Little Peconic Bay), and from 4.5 ft. to 5.5 ft. east of that point. Minima generally occurred during warmer months (June through September), although at a number of deeper water sites they occurred in January. These included Shelter Island Sound, Noyac Bay, Northwest Harbor, Orient Harbor and Gardiners Bay. Maximum secchi depths generally occurred during the spring and fall, with highest values at each of the 13 sites recorded during the spring of 2010. These occurred either on 3/10/10 or 4/7/10, with values ranging from 20 ft. to 31 ft. at deeper stations from Great Peconic Bay through Gardiners Bay, and from 8.0 ft. to 14.0 ft. at shallower sites to the west (North Sea Harbor, Cutchogue Harbor and the Flanders Bay area).

Temperature

Not unexpectedly, water temperatures throughout the estuary exhibited a strong seasonal pattern with maxima occurring in July or August and minima in January. A typical example of this is shown in Figure 4 for station 130 in Great Peconic Bay (similar graphs for the other marine sites are included in Appendix C1).

Spatially, both mean and maximum temperature levels generally declined from west to east in the estuary. At main-bay sampling sites, the mean temperature ranged from a high of 16.3 ºC at station 240 in the mouth of the Peconic River to 14.2 ºC at station 141 in Gardiners Bay (Figure 5). A similar pattern was noted for sites in peripheral embayments and in the mouth of creeks, where mean temperature levels at northern sites ranged from 17.0 ºC in Meetinghouse Creek to 13.6 ºC in Hallocks Bay, and at southern estuary sites, from 16.6 ºC in Reeves Bay to 14.4 ºC in Lake Montauk. Temperature maxima similarly declined from 28.0 ºC in the Peconic River mouth to 23.2 ºC in Gardiners Bay; from 28.0 ºC in Reeves Bay to 25.2 ºC in Lake Montauk; and from 27.6 ºC in Meetinghouse Creek to 26.4 ºC in Hallocks Bay. Minimum temperatures ranged from -1.2 ºC in Flanders Bay to 3.3 ºC in Meetinghouse Creek and Gardiners Bay, with roughly half of the stations having levels below zero.

Table 3. Mean Values for Water Depth, Secchi Depth, Temperature, Salinity, pH and Dissolved Oxygen at Peconic Estuary Marine Sampling Locations (2010-2012)

Station No.	Location	Water Depth (ft)	Secchi Depth (ft)	Temp (deg C)	Salinity (psu)	pH	Dissolved Oxygen (mg/L)	
							Surface	Bottom
Western Estuary:								
060220	Meetinghouse Creek	9.3	4.8	16.8	21.5	7.6	7.9	6.2
060240	Peconic River Mouth	7.5	5.4	16.3	23.1	7.9	8.5	7.8
060210	Reeves Bay	6.6	5.2	16.6	25.3	8.0	8.7	8.3
060170	Flanders Bay	9.4	6.3	15.5	26.5	8.0	8.6	8.4
060101	East Creek (South Jamesport)	6.4	5.0	16.5	25.8	7.7	8.0	7.7
Great Peconic Bay:								
060130	Great Peconic Bay	22.1	7.0	15.5	27.7	8.0	8.6	8.3
060148	Bullhead Bay	5.0	4.6	16.0	26.8	8.0	8.3	8.2
060290	Cold Spring Pond	5.3	5.1	15.8	26.8	8.1	8.5	8.3
Little Peconic Bay:								
060102	Cutchogue Harbor	12.0	5.7	16.2	27.5	8.0	8.2	8.0
060103	East Creek (Cutchogue)	7.3	5.1	16.5	26.8	7.9	8.2	8.1
060104	North Sea Harbor	10.2	5.8	16.2	26.7	8.0	8.2	8.2
060113	Little Peconic Bay (Nassau Point)	35.1	6.9	15.4	27.9	8.0	8.5	8.4
060300	Wooley Pond	7.9	6.2	15.3	26.0	8.0	9.0	8.3
Noyac Bay:								
060121	Noyac Bay	25.2	9.4	15.1	28.3	8.0	8.5	8.5
060310	Noyac Creek	8.1	6.7	15.0	27.6	8.0	8.5	8.2
060320	Mill Creek (Noyac)	8.4	7.1	15.1	27.4	8.1	8.7	8.3
Shelter Island Sound / Southold Bay:								
060106	Goose Creek	7.4	6.4	15.7	27.8	8.0	8.1	8.0
060107	Town Creek	9.0	7.2	15.9	27.8	8.0	8.4	8.1
060109	Mill Creek (Southold)	7.7	6.1	15.8	27.9	7.9	8.5	8.4
060114	Shelter Island Sound (Paradise Point)	70.0	9.7	15.0	28.2	8.0	8.6	8.5
060340	Hashamomuck Pond (South)	6.1	5.5	14.0	27.9	8.0	9.0	8.9
060350	Hashamomuck Pond (North)	6.4	5.7	14.2	27.8	8.0	9.0	8.7

Table 3 *continued*. Mean Values for Water Depth, Secchi Depth, Temperature, Salinity, pH and Dissolved Oxygen at Peconic Estuary Marine Sampling Locations (2010-2012)								
Station No.	Location	Water Depth (ft)	Secchi Depth (ft)	Temp (deg C)	Salinity (psu)	pH	Dissolved Oxygen (mg/L) Surface	Dissolved Oxygen (mg/L) Bottom
Shelter Island Embayments:								
060119	West Neck Bay	12.2	8.0	16.4	27.2	7.9	8.4	8.0
060124	West Neck Harbor	11.0	7.6	16.0	28.0	8.0	8.4	8.2
060122	Coecles Harbor	8.3	6.8	15.0	28.2	8.0	8.4	8.3
Sag Harbor/Northwest Harbor:								
060126	Sag Harbor	11.3	8.4	15.7	27.9	7.9	8.5	8.4
060127	Sag Harbor Cove	7.4	6.2	16.3	27.1	8.0	8.3	8.1
060118	Northwest Harbor	25.7	11.4	14.6	28.5	8.0	8.7	8.6
060131	Northwest Creek	7.6	7.2	15.5	27.5	7.9	8.5	8.5
Orient Harbor/Hallocks Bay:								
060115	Orient Harbor	22.8	9.3	14.6	28.4	7.8	8.8	8.6
060330	Hallocks Bay	6.3	5.9	13.6	27.9	7.9	9.2	9.2
Gardiners Bay:								
060116	Gardiners Bay West	14.1	10.6	14.2	28.6	8.0	8.8	8.8
060117	Gardiners Bay South (Crow Shoal)	33.3	12.0	14.4	28.6	8.0	8.6	8.5
060141	Gardiners Bay East	69.7	12.8	14.2	28.6	8.0	8.5	8.4
Eastern Embayments:								
060132	Three-Mile Harbor	11.5	9.5	14.9	28.3	8.4	9.1	9.1
060133	Acabonac Harbor	6.5	6.3	15.7	28.5	8.3	8.7	8.4
060134	Napeague Harbor	6.3	6.5	15.0	29.3	8.0	8.6	8.4
060135	Lake Montauk	8.0	7.8	15.1	29.2	8.0	8.6	8.3

Salinity

Salinity levels exhibited an overall increasing trend through the sampling period, with lowest values at the majority of stations recorded in the spring of 2010 and highest in the fall of 2012. Using station 130 in Great Peconic Bay again as an example (Figure 4), the lowest salinity recorded during 3-year sampling period (24.6 psu) occurred in April of 2010, and was followed by a general increase in magnitude to a level of 28.8 psu in January 2011. Results thereafter exhibited a general declining trend through much of 2011 followed by an increasing trend through 2012, with the maximum salinity level (29.9 psu) occurring in November of that year.

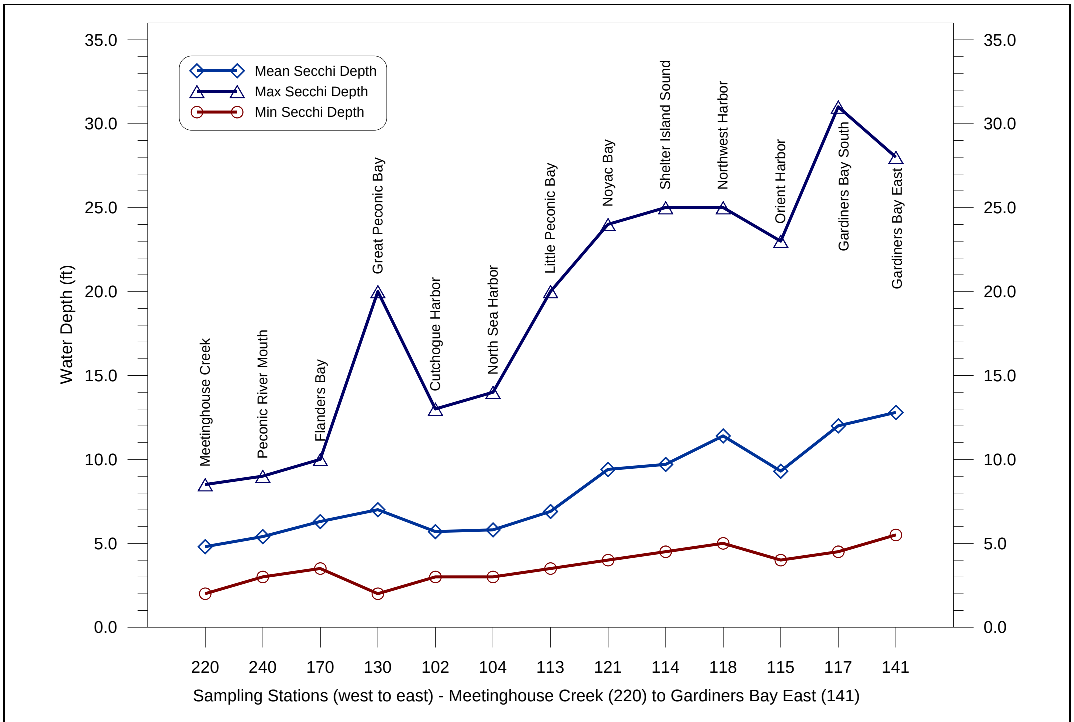


Figure 3. Mean, maximum and minimum secchi depths at select Peconic Estuary sampling locations (2010-2012)

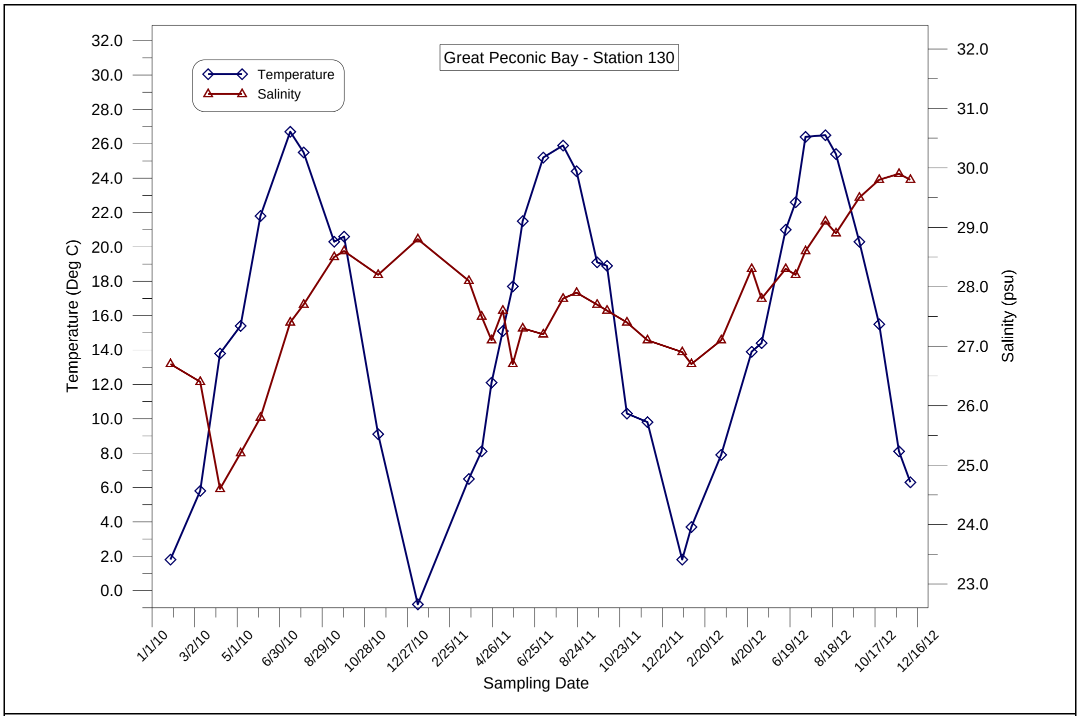


Figure 4. Seasonal variations in temperature and salinity in Great Peconic Bay (2010-2012)

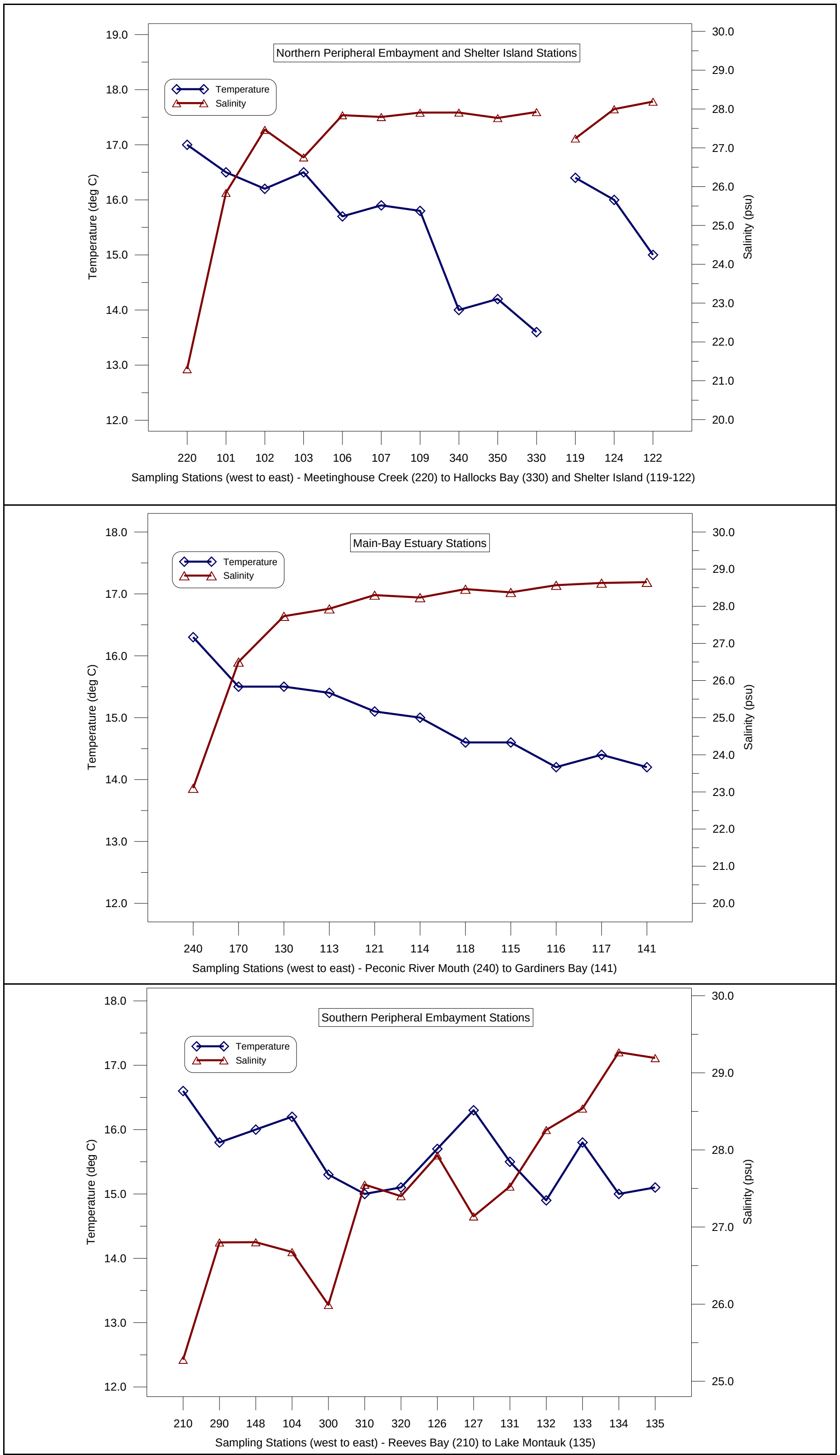


Figure 5. Spatial trends in mean salinity and temperature at northern, main-bay and southern Peconic Estuary Stations (2010-2012)

Spatially, average salinity levels increased from west to east in the estuary (Figure 5). In the northern peripheral embayment and creek mouth sites, average salinity ranged from 21.3 psu in Meetinghouse Creek to 27.9 in Hallocks Bay. At main-stem/main-bay sites, values ranged from 23.1 psu in the mouth of the Peconic River to 28.6 psu in Gardiners Bay, while in the southern peripheral embayments, average salinity ranged from 21.7 in Reeves Bay to 29.2 in Lake Montauk. Maximum values ranged from 27.8 psu in the mouth of the Peconic River to 31.2 psu in Napeague Bay, with minimum levels varying from 3.8 psu in Meetinghouse Creek to 25.9 psu in Gardiners Bay. The greatest range of salinity occurred in Meetinghouse Creek (24.5 psu), with smallest range in Napeague Bay (3.9 psu).

pH

Sampling results showed very little variability in pH levels throughout the estuary. Mean values ranged from 7.6 to 8.1, maxima from 8.2 to 8.9, and minima from 7.0 to 7.9 (Appendix B1). Twenty-four of the 38 stations sampled had a mean pH of 8.0. The lowest pH was recorded in Hallocks Bay (7.0), the lowest mean pH in Meetinghouse Creek (7.6), the highest pH result in Noyac Bay (8.9), and the highest mean pH (8.1) at four southern estuary peripheral embayment sites: Three-Mile Harbor, Acabonac Harbor, Cold Spring Pond and Mill Creek (Noyac).

Dissolved Oxygen

Average dissolved oxygen (DO) concentrations were generally lowest in the western estuary and highest in waters east of Shelter Island, but did not vary widely in magnitude (Table 3, Figure 6). Twenty-eight of the thirty-eight stations had mean surface concentrations in the 8.2 - 8.7 mg/L range and mean bottom concentrations from 8.0 – 8.5 mg/L. Only three sites had mean surface levels below 8.2 mg/L (Goose Creek, Meetinghouse Creek and East Creek in South Jamesport), and mean bottom levels below 8.0 mg/L (the Peconic River mouth, Meetinghouse Creek and East Creek).

In terms of temporal fluctuations, concentrations appear to directly mirror water temperatures, with maximum DO levels coinciding with temperature minima and low DO with temperature maxima (Figure 7). Surface and bottom levels were typically very similar, even at sites with depths greater than 30’ (Little Peconic Bay, Shelter Island Sound and Gardiners Bay) suggesting the system is well flushed.

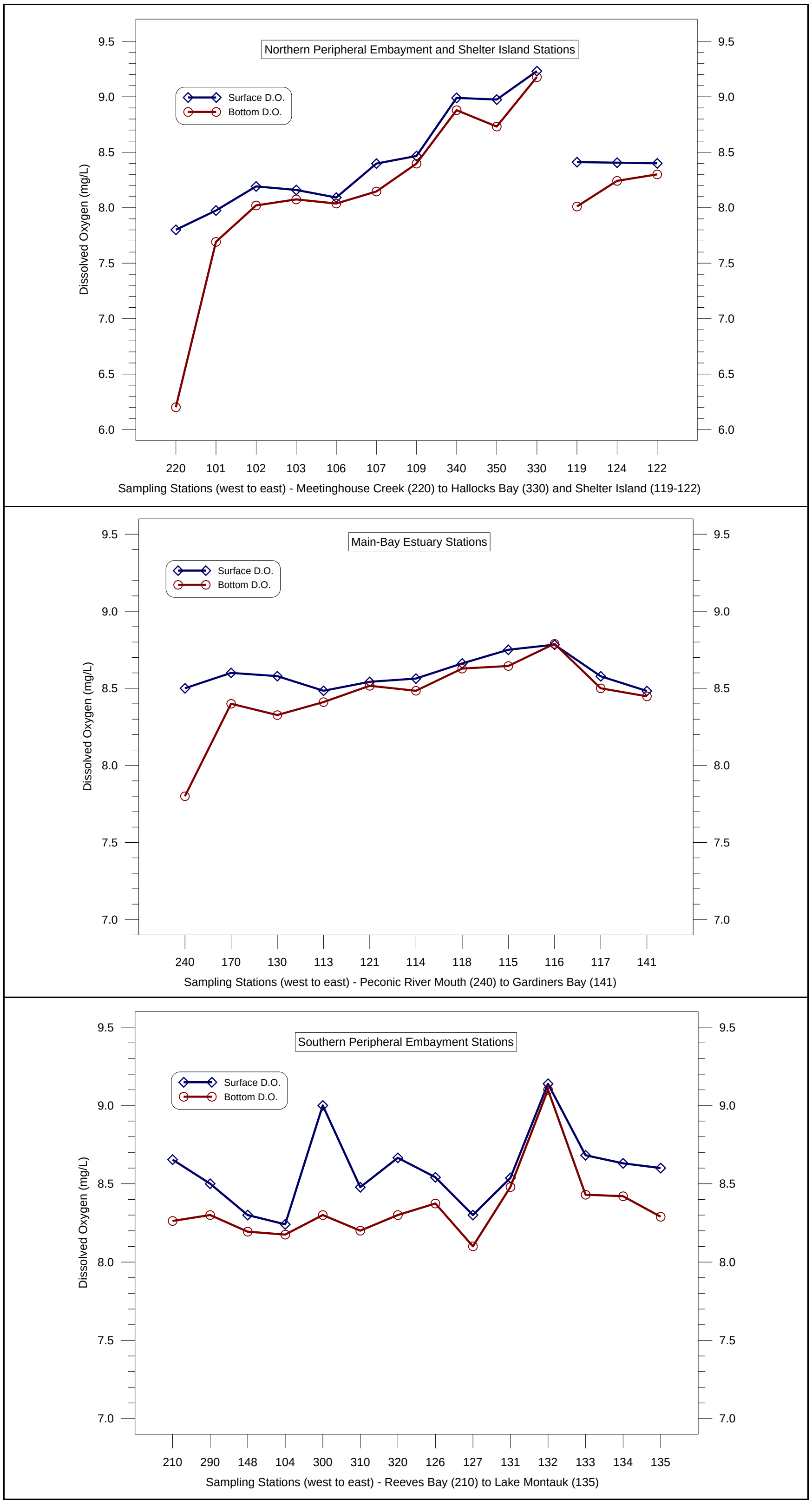


Figure 6. Spatial Trends in Mean Dissolved Oxygen Levels at Northern, Main Bay and Southern Peconic Estuary Stations (2010-2012)

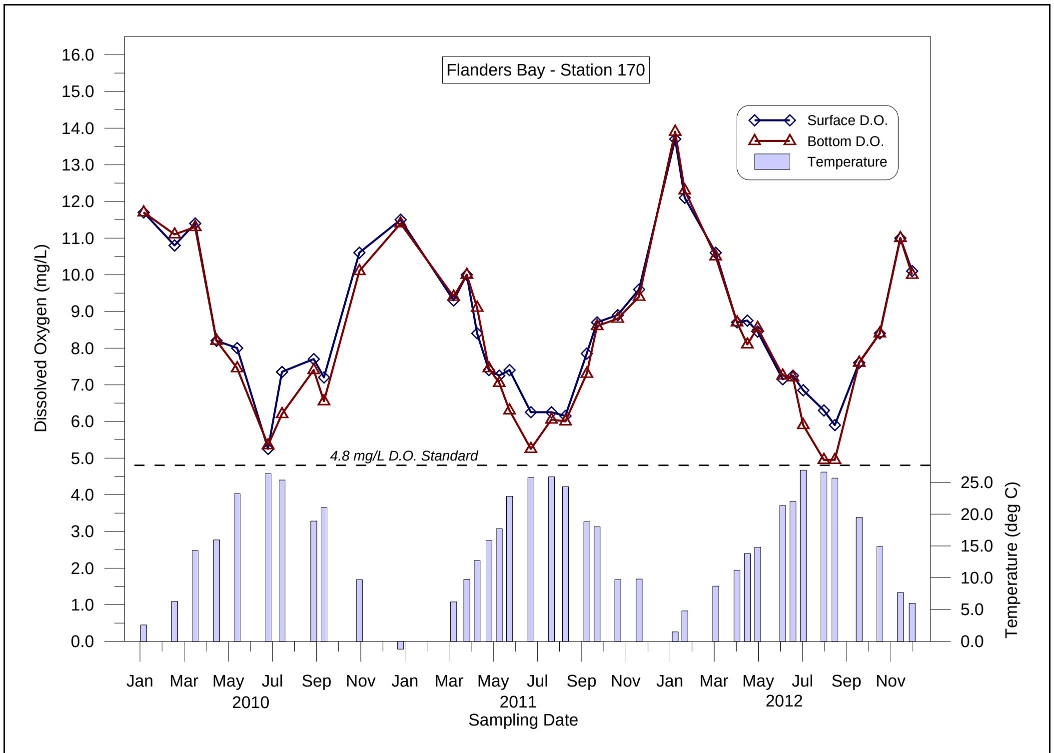


Figure 7. Seasonal variations in Dissolved Oxygen and Temperature in Flanders Bay (2010-2012)

Maximum DO concentrations generally occurred in January and minimum DO levels in July and August. The highest concentrations recorded occurred on 19-Jan 2012, when water temperatures were in the 0.4 to 6.6º C range and DO readings approached, and in some cases exceeded, saturation levels. Twenty of the 25 stations sampled that day had surface DO levels >13.0 mg/L, with five of these >14.0 mg/L. According to Hardy (1976), DO levels at or near saturation are typical during winter months in New York coastal waters.

The lowest DO levels found during the three year period were recorded on 15-Jul 2010 in Meetinghouse Creek when the water temperature was 26.7ºC. The surface DO on that date was 1.3 mg/L and the bottom DO was 0.2 mg/L, both results grossly violating the NYS chronic (4.8 mg/L) and acute (3.0 mg/L) standards (6 NYCRR Part 703). Results for four other sites also showed excursions below standard levels on that date, including the Peconic River mouth, East Creek in South Jamesport, Goose Creek and West Neck Bay.

Summer Dissolved Oxygen

To evaluate the 2010-2012 dissolved oxygen data in terms of worst case conditions, results for sampling conducted during summer months (July-September) were examined separately. Mean surface and bottom DO concentrations, as well as the percentage of summer results violating the 4.8 mg/L chronic and 3.0 mg/L acute DO standards (6 NYCRR Part 703.3), are included in Table 4.

Average summer oxygen levels at all stations monitored were significantly lower than year-round values, with surface measures declining by 15-25% and bottom values by 15-35%. As with year-round means, spatial differences in summer surface values were minimal at main-stem sites where mean concentrations were in the 6.6 - 6.7 mg/L range. A west to east gradient in bottom levels was apparent however, with concentrations increasing from 5.2 mg/L in the Peconic River mouth to 6.2 mg/L in Great Peconic Bay and 6.7 mg/L in western Gardiners Bay. Predictably, mean summer DO levels were lowest at sites in the western estuary, including Meetinghouse Creek (5.2 mg/L surface, 2.8 mg/L bottom), East Creek in South Jamesport (6.0 mg/L surface, 5.0 mg/L bottom) and the Peconic River mouth (6.6 mg/L surface, 5.2 mg/L bottom). The highest summer DO levels (with surface and bottom means greater than 7.0 mg/L) were noted at a number of eastern locations, including Hallocks Bay, eastern Gardiners Bay, Three-Mile Harbor, Acabonac Harbor and Napeague Harbor.

Regarding the NYS dissolved oxygen criteria, frequent excursions below the 4.8 mg/L chronic standard were apparent in both the surface and bottom waters of two western estuary sites, Meetinghouse Creek and East Creek in South Jamesport. In Meetinghouse Creek, 50% of surface samples and 83% of bottom samples contravened the criteria, while in East Creek, the rate of violations were 36% (surface) and 45% (bottom). Frequent bottom water excursions also occurred in the mouth of the Peconic River (33%), although the level of surface violations at that site was comparatively low (8% of samples). In Reeves Bay, no surface violations were noted with only an occasional excursion below the criteria occurring in bottom waters (8% of samples). No DO values in Flanders Bay, surface or bottom, were below the 4.8 mg/l standard.

Beyond the western estuary, only two locations exhibited surface water violations of the chronic standard: West Neck Bay (18% of samples) and Goose Creek (10%). Seven sites located in peripheral embayments or associated with tidal creeks showed occasional bottom water violations, including West Neck Bay (18%), Wooley Pond (17%), Mill Creek in Noyac (17%),

Table 4. Mean Summer (July-Sept) Dissolved Oxygen (DO) Concentrations at Peconic Estuary Marine Sampling Sites with the Percentage of Excursions Below NYS Standards (2010-2012)

Station [1] No.	Location	Surface DO (mg/L)	% Surface Results Below Criteria		Bottom DO (mg/L)	% Bottom Results Below Criteria	
			4.8 mg/L	3.0 mg/L		4.8 mg/L	3.0 mg/L
Western Estuary:							
060220 (12)	Meetinghouse Creek	5.2	50	8	2.8	83	75
060240 (12)	Peconic River Mouth	6.6	8	0	5.2	33	8
060210 (12)	Reeves Bay	7.0	0	0	5.8	8	8
060170 (12)	Flanders Bay	6.7	0	0	6.1	0	0
060101 (11)	East Creek (South Jamesport)	6.0	36	0	5.0	45	0
Great Peconic Bay:							
060130 (12)	Great Peconic Bay	6.7	0	0	6.2	0	0
060148 (10)	Bullhead Bay	6.3	0	0	6.0	10	0
060290 (6)	Cold Spring Pond	6.9	0	0	6.8	0	0
Little Peconic Bay:							
060102 (11)	Cutchogue Harbor	6.3	0	0	6.0	9	0
060103 (11)	East Creek (Cutchogue)	6.4	0	0	6.2	0	0
060104 (10)	North Sea Harbor	6.4	0	0	6.2	0	0
060113 (12)	Little Peconic Bay (Nassau Point)	6.6	0	0	6.4	0	0
060300 (6)	Wooley Pond	7.2	0	0	5.9	17	0
Noyac Bay:							
060121 (11)	Noyac Bay	6.7	0	0	6.5	0	0
060310 (6)	Noyac Creek	6.7	0	0	6.3	0	0
060320 (6)	Mill Creek (Noyac)	7.0	0	0	6.0	17	0
Shelter Island Sound / Southold Bay:							
060106 (10)	Goose Creek	5.8	10	0	5.7	10	0
060107 (10)	Town Creek	6.5	0	0	5.9	10	0
060109 (10)	Mill Creek (Southold)	6.4	0	0	6.3	0	0
060114 (11)	Paradise Point	6.6	0	0	6.5	0	0
060340 (5)	Hashamomuck Pond South	7.2	0	0	7.0	0	0
060350 (5)	Hashamomuck Pond North	7.0	0	0	6.7	0	0

[1] Numbers in parentheses below the station number are sample counts

Table 4 *continued*. Mean Summer (July-Sept) Dissolved Oxygen (DO) Concentrations at Peconic Estuary Marine Sampling Sites with the Percentage of Excursions Below Standards (2010-2012)

Station [1] No.	Location	Surface DO (mg/L)	% Surface Results Below Criteria		Bottom DO (mg/L)	% Bottom Results Below Criteria	
			4.8 mg/L	3.0 mg/L		4.8 mg/L	3.0 mg/L
Shelter Island Embayments:							
060119 (11)	West Neck Bay	6.3	18	0	5.9	18	0
060124 (10)	West Neck Harbor	6.7	0	0	6.3	0	0
060122 (10)	Coecles Harbor	6.9	0	0	6.8	0	0
Sag Harbor/Northwest Harbor:							
060126 (10)	Sag Harbor	6.6	0	0	6.2	0	0
060127 (10)	Sag Harbor Cove	6.7	0	0	6.4	0	0
060118 (10)	Northwest Harbor	6.6	0	0	6.5	0	0
060131 (6)	Northwest Creek	6.9	0	0	6.7	0	0
Orient Harbor/Hallocks Bay:							
060115 (11)	Orient Harbor	6.7	0	0	6.7	0	0
060330 (5)	Hallocks Bay	7.2	0	0	7.1	0	0
Gardiners Bay:							
060116 (10)	Gardiners Bay West	6.7	0	0	6.7	0	0
060117 (8)	Gardiners Bay South	7.1	0	0	6.9	0	0
060141 (8)	Gardiners Bay East	7.1	0	0	7.1	0	0
Eastern Embayments:							
060132 (7)	Three-Mile Harbor	7.7	0	0	7.7	0	0
060133 (8)	Acabonac Harbor	7.4	0	0	7.3	0	0
060134 (8)	Napeague Harbor	7.1	0	0	7.3	0	0
060135 (8)	Lake Montauk	7.3	0	0	6.8	0	0

[1] Numbers in parentheses below the station number are sample counts

Goose Creek (10%), Town Creek (10%), Bullhead Bay (10%) and Cutchogue Harbor (9%).

As for the 3.0 mg/L acute standard, the Meetinghouse Creek station exhibited occasional surface violations (8% of samples), the only location in the estuary where this occurred, as well as frequent violations in bottom waters (75%). Of the other western estuary sites, only the

Peconic River mouth and Reeves Bay showed any bottom water violations (8% at each). No sites beyond the western estuary exhibited any violations of the 3.0 mg/L standard.

Diurnal Dissolved Oxygen Monitoring

In an effort to document the occurrence of early morning DO depressions, diurnal (AM/PM) monitoring of DO levels at three western estuary stations (Flanders Bay, Meetinghouse Creek and the Peconic River mouth) was conducted from May through September. To be consistent with other report sections however, only summer (July-Sept) results are included here. As demonstrated by past monitoring efforts in the western portion of the estuary (SCDHS, 1998a), nighttime respiration by phytoplankton and macroalgae can result in early morning oxygen deficits, particularly during summer months when oxygen levels are already stressed by elevated water temperatures and decomposition processes.

For the ten diurnal sampling events conducted during 2010-2012, early AM oxygen depressions were generally limited in Flanders Bay and in the mouth of the Peconic River, while those in Meetinghouse Creek were typically severe (Table 5, Figure 8). Morning oxygen levels averaged 6.1 mg/L in both Flanders Bay and the Peconic River, with each having an AM/PM difference of approximately 1 mg/L. In Meetinghouse Creek, morning DO averaged 3.4 mg/L with the difference between the AM and PM concentrations also 3.4 mg/L.

Coliform Bacteria

With few exceptions, levels of total and fecal coliform bacteria were low throughout much of the estuary (Table 6). Only six of the thirty-eight sites sampled had mean total coliform (TC) levels above the minimum reportable level (MRL) of 20 mpn/100 ml (Table 2), including the Peconic River mouth, Meetinghouse Creek, East Creek in South Jamesport, Sag Harbor, East Creek in Cutchogue and Northwest Creek, with only four of these having fecal coliform (FC) means above that level. All six sites are located in areas that are likely subject to periodic effects from stormwater runoff and possibly area waterfowl. The Peconic River, Meetinghouse Creek and Sag Harbor stations are also potentially impacted by local point source discharges.

Although a thorough analysis of rainfall effects was not done for this report, the association between coliform levels and prior precipitation was noted for some of the more elevated results.

Table 5. Diurnal Dissolved Oxygen Concentrations in the Western Estuary with the Number of Excursions Below Standard Criteria (July-September, 2010-2012)								
Station	AM Concentration (mg/L)		PM Concentration (mg/L)		AM/PM Difference		No. Excursions Below Criteria (<4.8 / <3.0)	
	Range	Mean	Range	Mean	Range	Mean	AM	PM
Flanders Bay (Sta. 060170)	5.0 – 7.3	6.1	5.5 – 8.4	7.0	0 – 2.4	1.0	0/0	0/0
Meetinghouse Creek (Sta. 060220)	0.6 – 8.6	3.4	2.6 – 17.2	6.8	0 – 8.6	3.4	7/5	5/1
Peconic River Mouth (Sta. 060240)	3.9 – 9.2	6.1	5.0 – 9.5	6.8	0 – 4.3	0.8	1/0	0/0

Over the three year period, 12 of the 19 TC results >1,000 mpn/100 ml occurred within 48-hours of prior rainfall that exceeded 0.5”. Samples that yielded the two highest TC results (16,000 mpn/100 ml in Sag Harbor and Meetinghouse Creek), as well as the highest FC result (5,000 mpn/100 ml in Meetinghouse Creek), were collected during June of 2012 within 24-hours of rainfall that exceeded 1.0”.

To evaluate coliform levels in terms of existing criteria, thresholds established by the NYSDEC for assessing the water quality of various surface water classes (6 NYCRR Part 703), as well as those for certifying shellfish lands (6 NYCRR Part 47) were utilized. The NYS bathing beach criteria was not applied, as it utilizes Enterococcus rather than coliform as an indicator organism. Table 6 lists the water body classification for each of the marine sites monitored (SA or SC), the geometric mean and median values for TC and FC, and the percentage of sample results that exceeded the various criteria. It should be noted, that because annual statistics (rather than monthly) are utilized here, and because Peconic Estuary monitoring does not met the required level of frequency, the NYS criteria for Class SC waters (5 samples per month) are not directly applicable. Similarly, because the fecal coliform standard for shellfishing lands is set at a level below the limit of detectability utilized by the Suffolk County PEHL (14 per 100 ml vs. 20per 100/ml), the criteria for these waters are also not strictly applicable. To provide some means for general comparison however, both thresholds are included here.

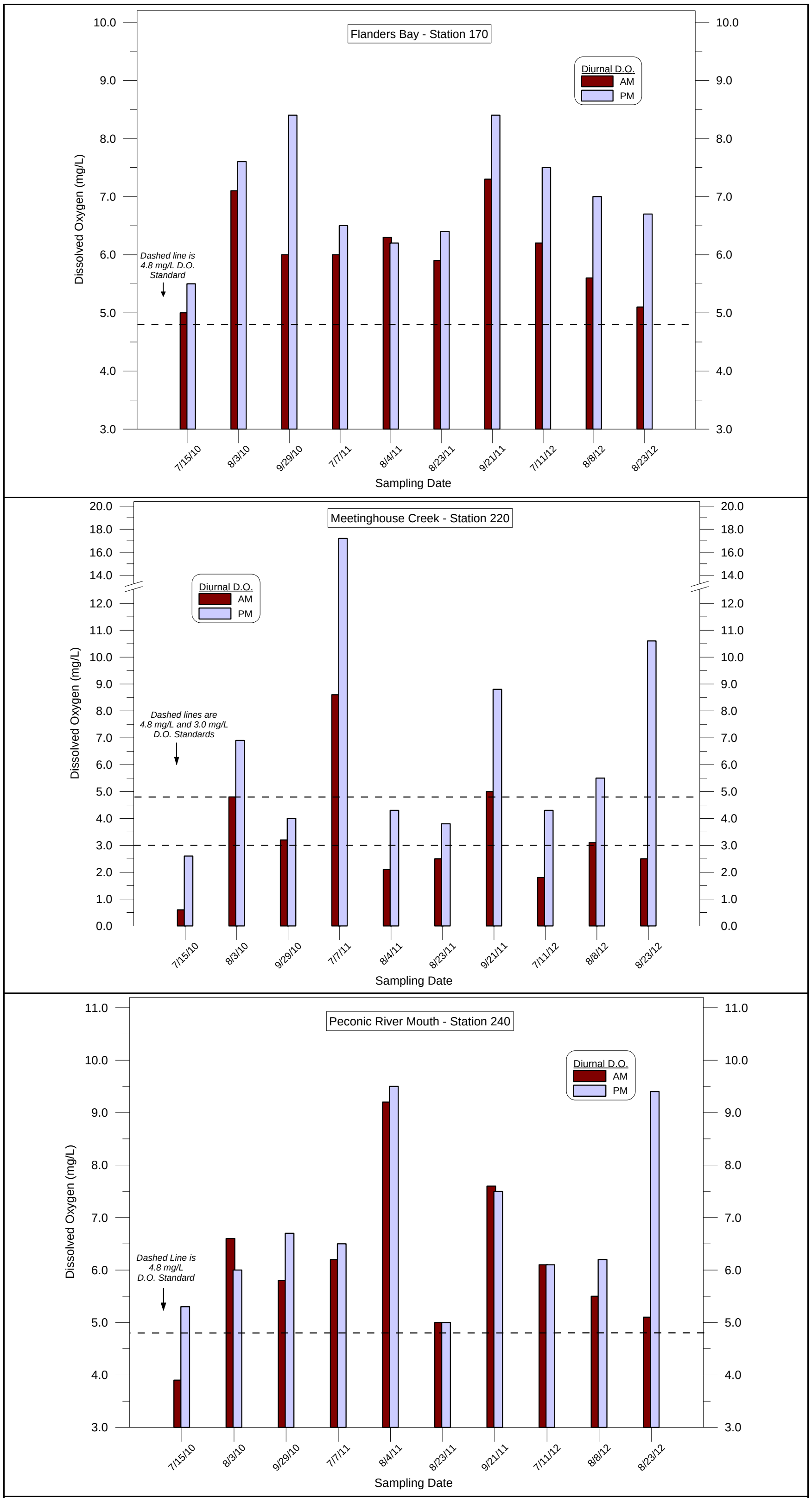


Figure 8. Diurnal (AM/PM) Dissolved Oxygen Fluctuations in the Western Estuary, 2010-2012

Table 6. Coliform Geometric Mean and Median Values at Peconic Estuary Marine Sampling Locations with Percentages of Occurrences Above Standard Thresholds (2010-2012)

Station No.	Location	Water Body Class	Total Coliform (mpn/100 ml)				Fecal Coliform (mpn/100 ml)		
			GM	Median	% > 5,000	% > 230	GM	Median	% > 43
Western Estuary:									
060220	Meetinghouse Creek	SC	104	104	3	22	36	28	38
060240	Peconic River Mouth	SC	72	80	0	13	32	28	32
060210	Reeves Bay	SA	< 20	< 20	0	3	< 20	< 20	3
060170	Flanders Bay	SA	< 20	< 20	0	3	< 20	< 20	3
060101	East Creek (South Jamesport)	SC	43	40	0	9	29	20	26
Great Peconic Bay:									
060130	Great Peconic Bay	SA	< 20	< 20	0	0	< 20	< 20	0
060148	Bullhead Bay	SA	< 20	< 20	0	3	< 20	< 20	9
060290	Cold Spring Pond	SA	< 20	< 20	0	0	< 20	< 20	0
Little Peconic Bay:									
060102	Cutchogue Harbor	SA	< 20	< 20	0	0	< 20	< 20	0
060103	East Creek (Cutchogue)	SA	28	20	0	9	< 20	< 20	14
060104	North Sea Harbor	SA	< 20	< 20	0	3	< 20	< 20	6
060113	Little Peconic Bay (Nassau Point)	SA	< 20	< 20	0	0	< 20	< 20	0
060300	Wooley Pond	SA	< 20	< 20	0	0	< 20	< 20	10
Noyac Bay:									
060121	Noyac Bay	SA	< 20	< 20	0	0	< 20	< 20	0
060310	Noyac Creek	SA	< 20	20	0	0	< 20	< 20	10
060320	Mill Creek (Noyac)	SC	20	20	0	0	< 20	< 20	0
Shelter Island Sound/Southold Bay:									
060106	Goose Creek	SA	< 20	< 20	0	3	< 20	< 20	3
060107	Town Creek	SA	< 20	< 20	0	3	< 20	< 20	3
060109	Mill Creek (Southold)	SA	< 20	< 20	0	3	< 20	< 20	3
060114	Shelter Island Sound (Paradise Point)	SA	< 20	< 20	0	0	< 20	< 20	0
060340	Hashamomuck Pond (South)	SA	< 20	< 20	0	0	< 20	< 20	0
060350	Hashamomuck Pond (North)	SA	< 20	< 20	0	4	< 20	< 20	0

Table 6 *continued*. Coliform Geometric Mean and Median Values at Peconic Estuary Marine Sampling Locations with Percentages of Occurrences Above Standard Thresholds

Station No.	Location	Water Body Class	Total Coliform (mpn/100 ml)				Fecal Coliform (mpn/100 ml)		
			GM	Median	% > 5,000	% > 230	GM	Median	% > 43
Shelter Island Embayments:									
060119	West Neck Bay	SA	< 20	< 20	0	3	< 20	< 20	3
060124	West Neck Harbor	SA	< 20	< 20	0	0	< 20	< 20	0
060122	Coecles Harbor	SA	< 20	< 20	0	0	< 20	< 20	0
Sag Harbor/Northwest Harbor:									
060126	Sag Harbor	SA	60	40	3	18	23	< 20	23
060127	Sag Harbor Cove	SA	< 20	< 20	0	3	< 20	< 20	3
060118	Northwest Harbor	SA	< 20	< 20	0	0	< 20	< 20	0
060131	Northwest Creek	SA	23	20	0	0	< 20	< 20	15
Orient Harbor / Hallocks Bay:									
060115	Orient Harbor	SA	< 20	< 20	0	0	< 20	< 20	0
060330	Hallocks Bay	SA	< 20	< 20	0	0	< 20	< 20	0
Orient Harbor / Hallocks Bay:									
060116	Gardiners Bay West	SA	< 20	< 20	0	0	< 20	< 20	0
060117	Gardiners Bay South (Crow Shoal)	SA	< 20	< 20	0	0	< 20	< 20	0
060141	Gardiners Bay East	SA	< 20	< 20	0	0	< 20	< 20	0
Eastern Embayments:									
060132	Three-Mile Harbor	SA	< 20	< 20	0	4	< 20	< 20	4
060133	Acabonac Harbor	SA	< 20	< 20	0	4	< 20	< 20	4
060134	Napeague Harbor	SA	< 20	< 20	0	0	< 20	< 20	0
060135	Lake Montauk	SA	< 20	< 20	0	0	< 20	< 20	0

NYSDEC Criteria for Class "SA" waters: The median Total Coliform level in any series of representative samples shall not exceed 70 mpn/100 ml.

NYSDEC Criteria for Class "SC" waters: For at least 5 samples, the Total Coliform monthly median shall not exceed 2,400 mpn/100 ml, and not more than 20% of Total Coliform samples can exceed 5,000 mpn/100 ml. The Fecal Coliform monthly geometric mean from a minimum of 5 samples shall not exceed 200 mpn/100 ml.

NYSDEC Criteria for Shellfish Waters: The Total Coliform median or geometric mean shall not exceed 70 mpn/100 ml and not more than 10% of Total Coliform samples can exceed 230 mpn/100 ml. The Fecal Coliform median or geometric mean shall not exceed 14 mpn/100 ml and not more than 10% of Fecal Coliform samples can exceed 43 mpn/100 ml.

All of the 34 sites designated as Class SA (the best usages of which being for shellfishing for market purposes, fishing and contact recreation), had median TC values that ranged from < 20 mpn/100 ml to 40 mpn/100 ml, all well below the standard threshold of median TC levels $\leq$ 70 mpn/100 ml. In terms of the shellfishing lands criteria, only the Sag Harbor site (which is located in an uncertified area) exceeded the TC threshold with 18% of results >230 mpn/100 ml. In addition to Sag Harbor, the FC shellfish criteria was exceed at only two other SA sites: East Creek in Cutchogue (14%) and Northwest Creek (15%). Both of these are listed as seasonally certified by the NYSDEC, meaning they are generally closed from mid-spring through the fall (the dates vary for each shellfishing area), due to previously identified water quality issues that occur during those periods.

Of the four sites considered Class SC (the best usage of which is for fishing), all had TC medians less than the 2,400 mpn/100 ml threshold as well as having less than 10% of samples greater than 5,000 mpn/100 ml. TC medians at the SC sites ranged from 20 mpn/100 ml at Mill Creek to 104 mpn/100 ml in Meetinghouse Creek. Two of the sites exceeded the 230 mpn/100 ml TC threshold for shellfish waters (Meetinghouse Creek at 22% and the Peconic River mouth at 13%), with three exceeding the 43 mpn/100 ml FC criteria (Meetinghouse Creek at 38%, Peconic River mouth at 32% and East Creek in South Jamesport at 26%). All three however, are located in areas that are not certified for shellfishing.

Nutrients

Nutrient parameters addressed include ammonia nitrogen (NH_3-N), nitrite + nitrate nitrogen (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP) and dissolved inorganic phosphate (o-PO_4-P). Mean values for the various N and P constituents are included in Table 7.

Nitrogen

Over the three year period, average concentrations of total nitrogen (TN) exhibited a general west to east trend of declining magnitude (Figure 9). Highest means were noted at a number of tributary and peripheral embayment sites in the western estuary, including Meetinghouse Creek (1.4 mg/L), East Creek in South Jamesport (0.50 mg/L), the Peconic River Mouth (0.35 mg/L) and Reeves Bay (0.30 mg/L). From Flanders Bay eastward through Northwest Harbor, mean TN concentrations ranged from 0.20 to 0.31 mg/L, while at stations further east in Orient Harbor, Gardiners Bay, and in the south fork harbors from Three-Mile Harbor to Lake Montauk, levels

Table 7. Mean Nitrogen, Phosphorus and Chlorophyll-a Concentrations at Peconic Estuary Marine Sampling Locations (2010-2012)

Station No.	Location	NH_3-N (mg/L)	NO_x-N (mg/L)	DIN (mg/L)	DON (mg/L)	TN (mg/L)	TP (mg/L)	o-PO_4-P (mg/L)	Chl-a (ug/L)
Western Estuary:									
060220	Meetinghouse Creek	0.278	0.899	1.18	0.23	1.4	0.45	0.425	26.1
060240	Peconic River Mouth	0.038	0.033	0.070	0.23	0.35	0.06	0.024	11.4
060210	Reeves Bay	< 0.02	0.006	0.025	0.20	0.30	< 0.05	0.022	8.6
060170	Flanders Bay	0.021	0.006	0.027	0.17	0.24	< 0.05	0.018	5.9
060101	East Creek (South Jamesport)	0.033	0.208	0.241	0.17	0.50	< 0.05	0.017	13.7
Great Peconic Bay:									
060130	Great Peconic Bay	0.024	< 0.005	0.027	0.16	0.21	< 0.05	0.018	3.3
060148	Bullhead Bay	< 0.02	0.006	0.025	0.16	0.23	< 0.05	0.014	3.7
060290	Cold Spring Pond	0.023	< 0.005	0.026	0.17	0.21	< 0.05	0.016	2.9
Little Peconic Bay:									
060102	Cutchogue Harbor	0.025	0.009	0.034	0.17	0.24	< 0.05	0.016	5.5
060103	East Creek (Cutchogue)	0.023	0.073	0.096	0.18	0.31	< 0.05	0.013	4.7
060104	North Sea Harbor	< 0.02	0.006	0.022	0.17	0.24	< 0.05	0.013	3.7
060113	Nassau Point	0.026	< 0.005	0.029	0.15	0.21	< 0.05	0.020	3.8
060300	Wooley Pond	< 0.02	0.027	0.045	0.17	0.25	< 0.05	0.011	5.5
Noyac Bay:									
060121	Noyac Bay	0.039	0.005	0.043	0.13	0.20	< 0.05	0.019	3.4
060310	Noyac Creek	0.025	< 0.005	0.029	0.16	0.21	< 0.05	0.013	4.0
060320	Mill Creek (Noyac)	0.025	0.006	0.031	0.16	0.23	< 0.05	0.014	4.2
Shelter Island Sound / Southold Bay:									
060106	Goose Creek	0.030	0.016	0.046	0.17	0.25	< 0.05	0.016	3.9
060107	Town Creek	0.027	0.028	0.056	0.17	0.25	< 0.05	0.014	4.6
060109	Mill Creek (Southold)	0.030	0.006	0.035	0.17	0.20	< 0.05	0.017	2.9
060114	Shelter Island Sound (Paradise Point)	0.027	0.005	0.031	0.15	0.20	< 0.05	0.021	3.3
060340	Hashamomuck Pond (South)	0.022	0.005	0.027	0.16	0.21	< 0.05	0.015	3.5
060350	Hashamomuck Pond (North)	0.022	0.005	0.027	0.16	0.23	< 0.05	0.015	4.0

Table 7 ***continued***. **Mean Nitrogen, Phosphorus and Chlorophyll-a Concentrations at Peconic Estuary Marine Sampling Locations (2010-2012), continued**									
Station No.	Location	NH_3-N (mg/L)	NO_x-N (mg/L)	DIN (mg/L)	DON (mg/L)	TN (mg/L)	TP (mg/L)	o-PO_4-P (mg/L)	Chl-a (ug/L)
Shelter Island Embayments:									
060119	West Neck Bay	0.025	< 0.005	0.029	0.19	0.26	< 0.05	0.015	7.4
060124	West Neck Harbor	0.022	< 0.005	0.026	0.16	0.21	< 0.05	0.017	2.9
060122	Coecles Harbor	0.025	< 0.005	0.028	0.16	0.21	< 0.05	0.013	3.5
Sag Harbor / Northwest Harbor:									
060126	Sag Harbor	0.029	0.005	0.034	0.15	0.20	< 0.05	0.016	3.2
060127	Sag Harbor Cove	0.026	0.006	0.031	0.16	0.22	< 0.05	0.015	4.3
060118	Northwest Harbor	0.031	0.006	0.037	0.14	0.19	< 0.05	0.019	3.3
060131	Northwest Creek	0.028	< 0.005	0.031	0.16	0.21	< 0.05	0.015	2.7
Orient Harbor / Hallocks Bay:									
060115	Orient Harbor	0.037	0.009	0.046	0.13	0.19	< 0.05	0.020	4.3
060330	Hallocks Bay	0.026	0.005	0.031	0.16	0.20	< 0.05	0.017	2.3
Gardiners Bay:									
060116	Gardiners Bay West	0.043	0.007	0.050	0.12	0.19	< 0.05	0.020	3.2
060117	Gardiners Bay South (Crow Shoal)	0.030	0.024	0.054	0.13	0.18	< 0.05	0.021	2.9
060141	Gardiners Bay East	0.049	0.031	0.080	0.10	0.19	< 0.05	0.021	2.3
Eastern Embayments:									
060132	Three-Mile Harbor	0.026	0.008	0.034	0.14	0.21	< 0.05	0.015	3.1
060133	Acabonac Harbor	0.033	< 0.005	0.037	0.15	0.20	< 0.05	0.015	3.0
060134	Napeague Harbor	0.029	0.005	0.034	0.12	0.18	< 0.05	0.013	2.5
060135	Lake Montauk	0.042	0.017	0.059	0.12	0.19	< 0.05	0.017	2.3

were in the 0.18 to 0.21 mg/L range. Individual TN maxima ranged from a high of 3.97 mg/L in Meetinghouse Creek to 0.28 mg/L in eastern Gardiners Bay. Minimum concentrations were predominantly less than 0.15 mg/L, with notable exceptions in Meetinghouse Creek (0.44 mg/L) and the Peconic River mouth (0.20 mg/L).

The TN pool at most locations was comprised primarily of dissolved organic nitrogen (DON), although at a number of tributary sites, dissolved inorganic nitrogen (DIN) concentrations were also periodically significant. Mean DON concentrations were spatially less variable than TN but

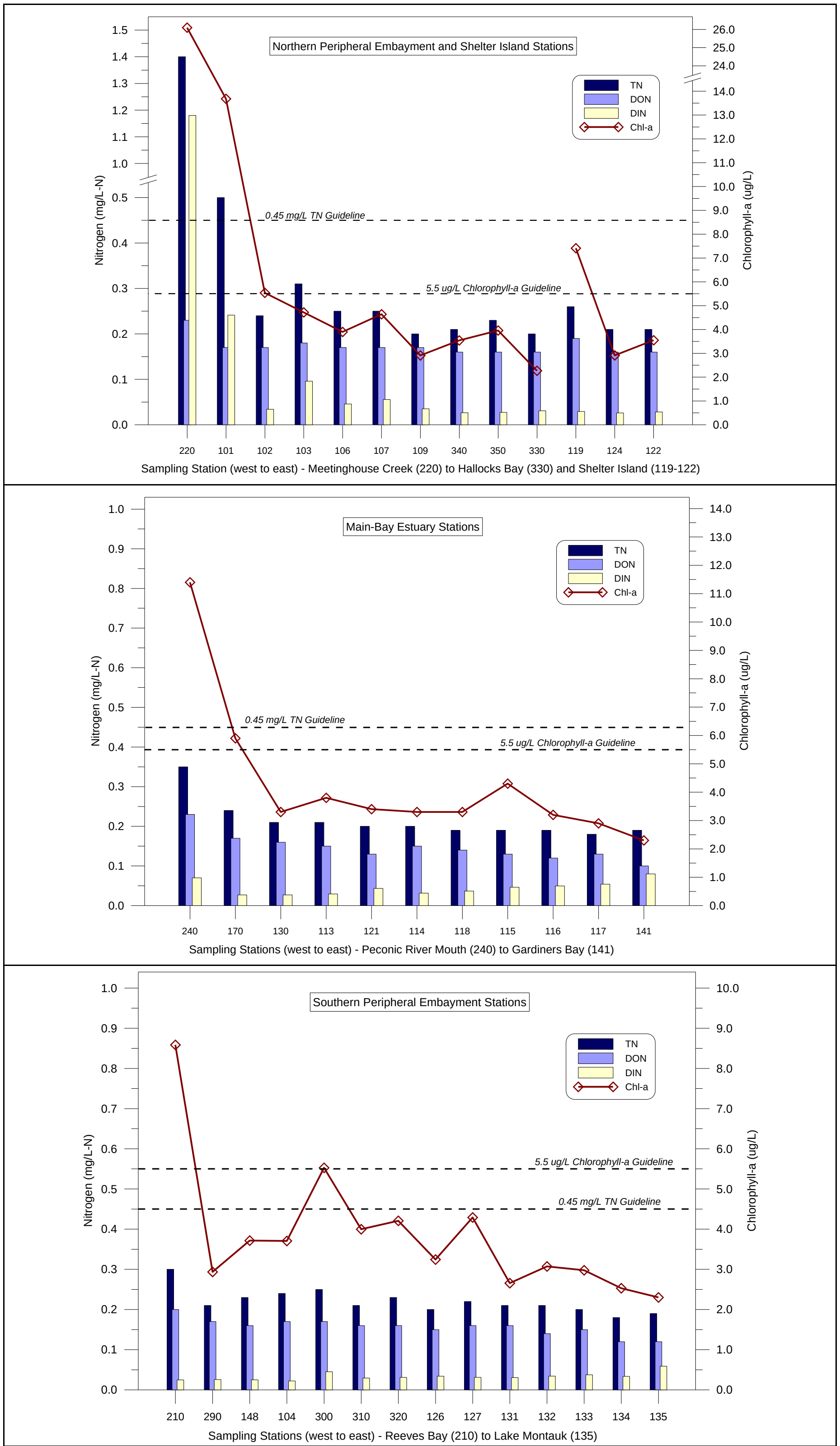


Figure 9. Spatial Trends in Mean Nitrogen and Chlorophyll-a Concentrations at Northern, Main Bay and Southern Stations

also exhibited a general west to east decline in magnitude, from a high of 0.23 mg/L at the Peconic River mouth and Meetinghouse Creek stations to 0.10 mg/L in eastern Gardiners Bay. Similarly, DON maxima ranged from 0.84 mg/L in Meetinghouse Creek to 0.22 mg/L in a number of eastern embayments.

Concentrations of DIN were highest at two western estuary sites: Meetinghouse Creek (1.18 mg/L) and East Creek in South Jamesport (0.241 mg/L). Levels were also comparatively elevated at a number of other tidal creek sites, including East Creek in Cutchogue (0.096 mg/L), the Peconic River mouth (0.070 mg/L) and Town Creek (0.056 mg/L). The lowest mean DIN levels (0.022 to 0.026 mg/L) were noted in four southern peripheral embayments in the western and central portion of the estuary, including Reeves Bay, Cold Spring Pond, Bullhead Bay and North Sea Harbor. Also interesting to note, is an apparent increasing trend in DIN levels in open waters east of Shelter Island, where concentrations ranged from 0.046 in Orient Harbor to 0.080 mg/L at the far eastern Gardiners Bay site (station 141), a level greater than that found in the Peconic River mouth. In terms of composition, the DIN at most main-bay and peripheral embayment sites primarily consisted of ammonia nitrogen (NH3-N), with nitrate+nitrite (NOx-N) generally having a greater significance at tidal creek sites (Figure 10). The only non-creek site where this pattern didn't fit was Wooley Pond, where the mean NH3-N concentration was below the limit of detection for the procedure (<0.02 mg/L) and the average NOx-N level (0.027 mg/L) the highest among all peripheral embayments sampled.

The spatial distribution of NH_3-N was similar to DIN, with by far the highest mean concentration found in Meetinghouse Creek (0.278 mg/L) and the lowest (< 0.02 mg/L) in a series of western estuary peripheral embayment sites (Reeves Bay, Bullhead Bay, North Sea Harbor and Wooley Pond). Of the ten highest NH_3-N means, seven were at eastern estuary locations (Noyac Bay, Northwest Harbor, Orient Harbor, Gardiners Bay, Acabonac Harbor and Lake Montauk) and three at western estuary tidal creeks (Meetinghouse Creek, Peconic River mouth and East Creek).

Concentrations of NO_x-N were low throughout much of the estuary, with values at 30 of the 38 marine sites averaging less than 0.020 mg/L. Of the remaining eight stations, five are tidal creeks, two are located in Gardiners Bay, and one is in a peripheral embayment (Wooley Pond). As with NH_3-N, the highest NO_x-N levels occurred in Meetinghouse Creek (0.899 mg/L) and

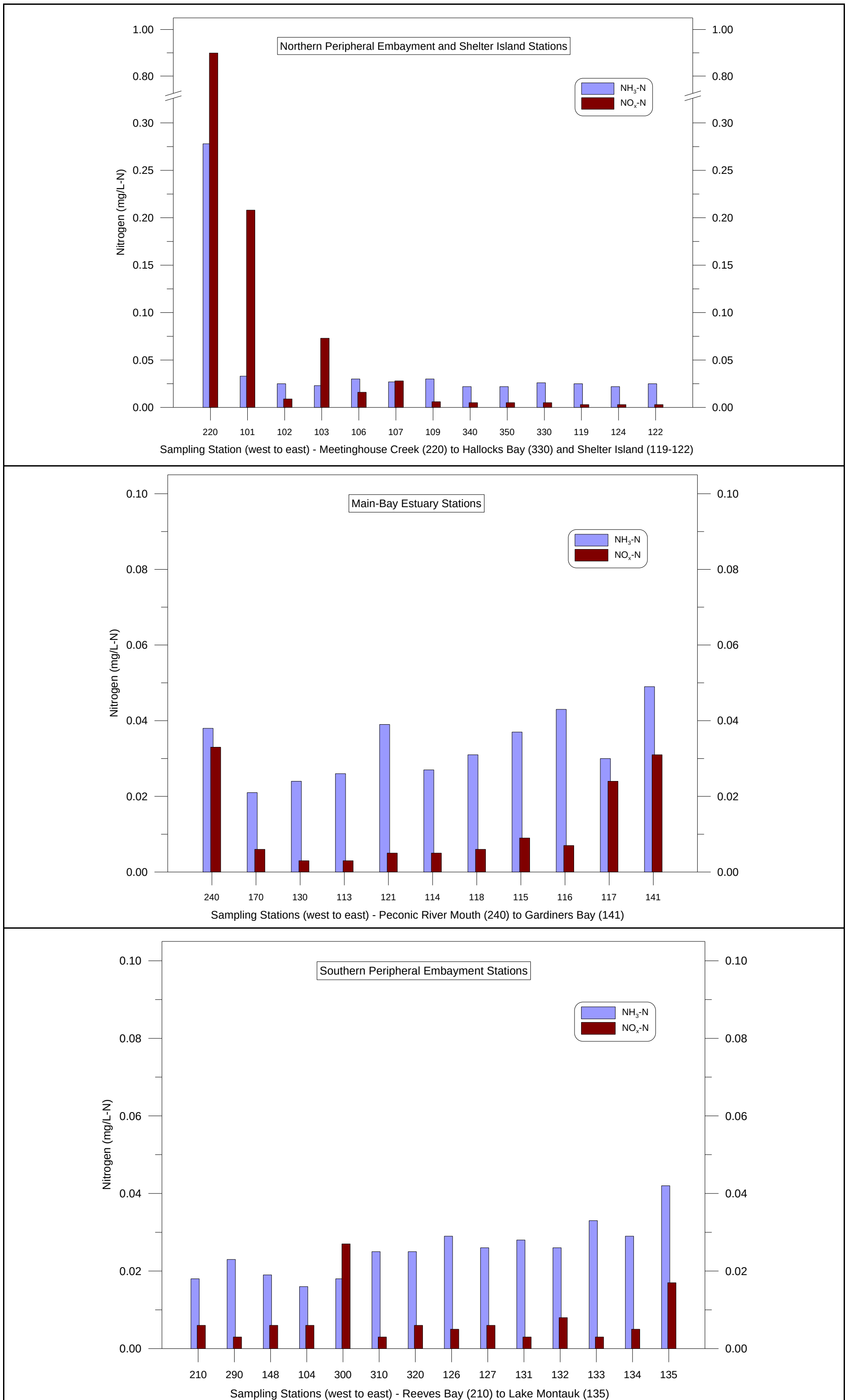


Figure 10. Spatial Trends in Average Ammonia (NH_3-N) and Nitrate+Nitrite (NO_x-N) Concentrations at Northern, Main Bay and Southern Peconic Estuary Stations

East Creek in South Jamesport (0.208 mg/L). Other sites with comparatively elevated means included East Creek in Cutchogue (0.073 mg/L), the Peconic River mouth (0.033 mg/L), eastern Gardiners Bay (0.031 mg/L), Town Creek in Southold (0.028 mg/L) and Wooley Pond (0.027 mg/L).

On a seasonal basis, TN levels at peripheral embayment and open bay (non-tributary) sites fluctuated widely but were typically lowest in the winter and early spring, increased in magnitude through the summer and declined through the fall (see temporal plots in Appendix C1). Fluctuations in DON at these sites generally followed those of TN, with little pattern apparent in DIN variability. As an example of typical seasonal variability at a non-tributary station, Figure 11 shows temporal nitrogen concentrations in Flanders Bay. At a number of tidal creek sites, particularly Meetinghouse Creek, East Creek in South Jamesport (Figure 12) and East Creek in Cutchogue, periodic spikes in DIN levels (comprised primarily of NOx-N) added to the level of TN variability. Observed peaks in TN concentrations may also be a reflection of particulate nitrogen (PN) contained in an ongoing (or recent) algal bloom. Such was the case in August of 2012 at station 119 in West Neck Bay, when a marked increase in the TN level (from 0.34 to 0.74 mg/L) coincided with a chlorophyll-a peak of 53.0 ug/L (Figure 13).

Summer Total Nitrogen

The Peconic Estuary Program has established a number of measureable goals and recommended criteria pertaining to nutrient pollution that can be evaluated using monitoring program results. These include:

- Decreasing total nitrogen concentrations in the western estuary to a summer mean of no more than 0.45 mg/L (as a means to prevent the worsening of DO stresses)
- Ensuring that existing TN levels in waters east of Flanders Bay are maintained or improved
- Ensuring that TN levels in shallow waters (those less than 3 meters in depth) remain at or below 0.40 mg/L (intended to preserve water quality in eelgrass habitat areas)
- Maintaining chlorophyll-a levels below 5.5 ug/L – a recommended guideline to optimize eelgrass habitat

To evaluate the 2010-2012 data in terms of these objectives, the percentage of samples collected during summer months (July-September) that exceeded the recommended criteria were calculated and included in Table 8 with mean summer values for TN and chlorophyll-a.

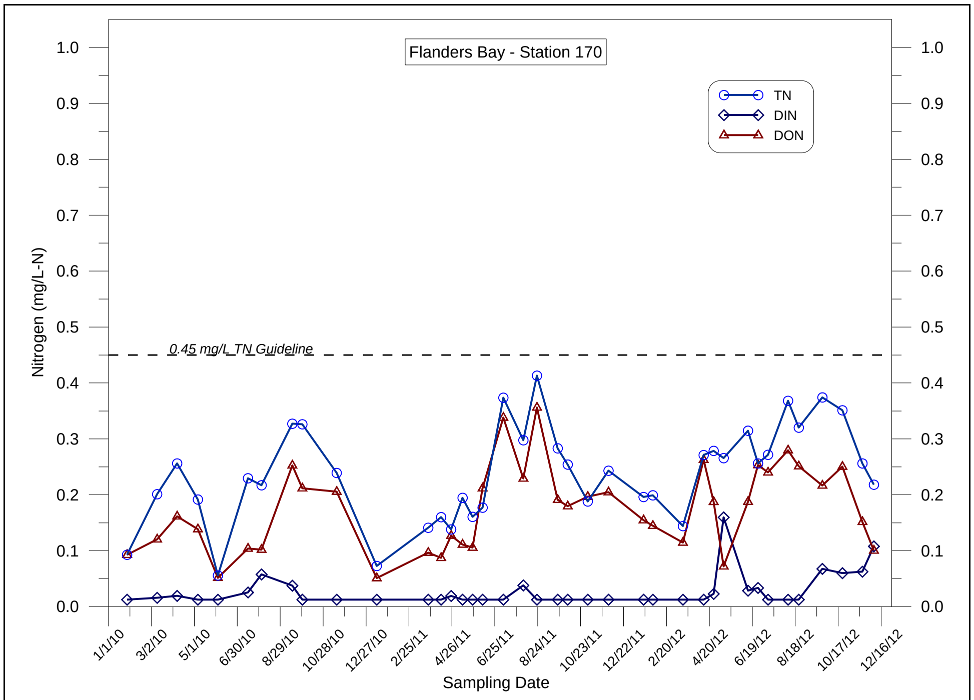


Figure 11. Temporal Variations in Nitrogen Concentrations in Flanders Bay (Station 060170)

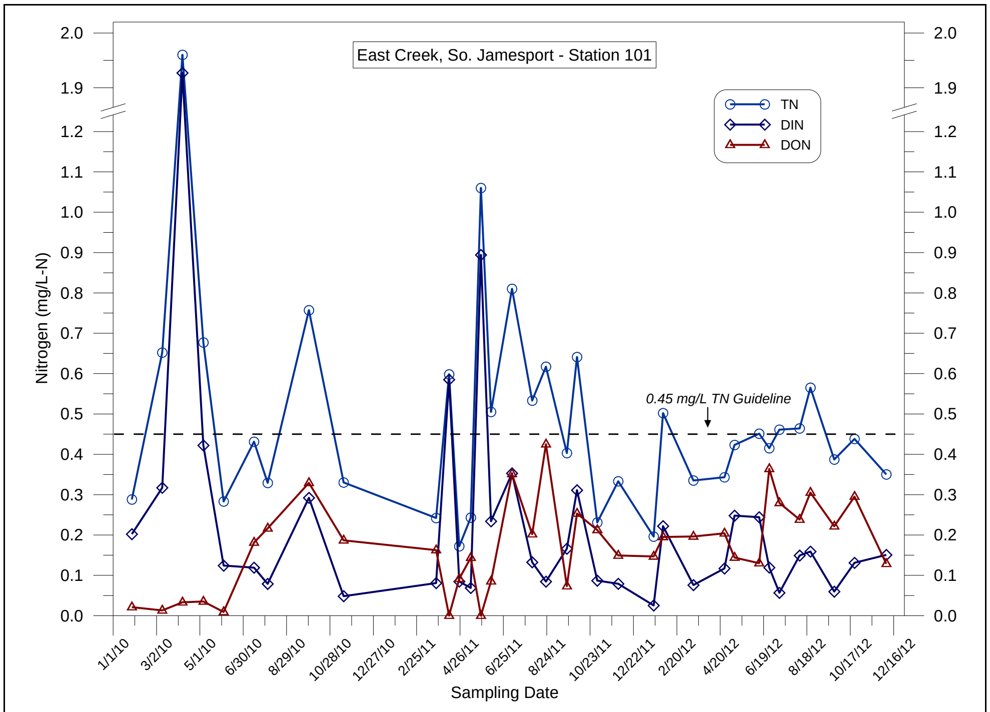


Figure 12. Temporal Variations in Nitrogen Concentrations in East Creek, South Jamesport (Station 060101)

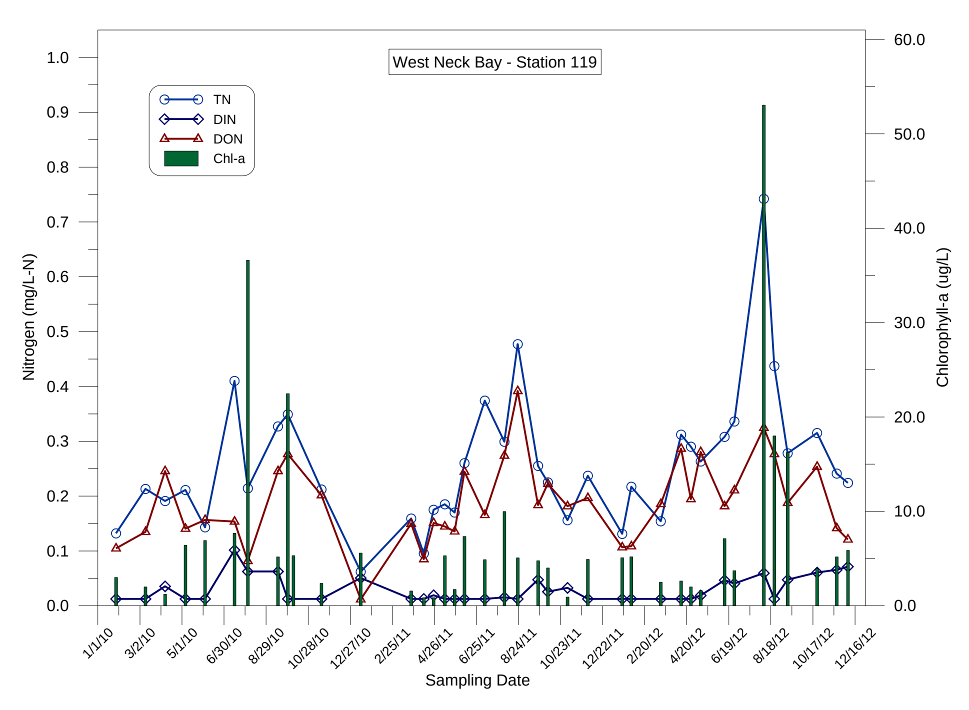


Figure 13. Temporal Variations in Nitrogen and Chlorophyll-a Concentrations in West Neck Bay (Station 060119)

Mean summer TN concentrations were higher in magnitude than year-round values at all stations except Meetinghouse Creek (where the means were equal). Approximately half of the stations had significantly (>25%) higher TN means. In the western estuary, mean summer TN values ranged from 0.32 mg/L in Flanders Bay to 1.4 mg/L in Meetinghouse Creek. Average levels in the central portion of the estuary varied from 0.24 mg/L in Mill Creek (Noyac) to 0.38 mg/L in West Neck Bay, with those in eastern waters from 0.19 mg/L in southern Gardiners Bay to 0.30 mg/L in Sag Harbor Cove.

Not surprisingly, the stations with the highest percentage of summer results exceeding the 0.45 mg/L TN guideline were the same western estuary sites that showed frequent surface and/or bottom DO standard violations: Meetinghouse Creek (100% of samples), East Creek in South Jamesport (64%), and the Peconic River mouth (42%). Reeves Bay, which showed occasional violations of both the chronic and acute DO standards in bottom waters only, had a relatively moderate TN guideline exceedance rate of 17%. In Flanders Bay, where no DO violations occurred, there were also no exceedances of the 0.45 mg/L TN guideline.

Table 8. Mean Summer (July-Sept) Total Nitrogen (TN) and Chlorophyll-a (Chl-a) Concentrations at Marine Sampling Sites with the Percentage of Results Exceeding Recommended Guidelines (2010-2012)

Station [1] No.	Location	TN (mg/L)	% TN > 0.45 mg/L	% TN > 0.40 mg/L	Chl-a (ug/L)	% Chl-a > 5.5 ug/L
Western Estuary:						
060220 (12)	Meetinghouse Creek	1.4	100	100	31.2	100
060240 (12)	Peconic River Mouth	0.43	42	58	19.3	100
060210 (12)	Reeves Bay	0.38	17	42	11.9	100
060170 (12)	Flanders Bay	0.32	0	8	9.3	50
060101 (11)	East Creek (South Jamesport)	0.52	64	82	28.7	91
Great Peconic Bay:						
060130 (12)	Great Peconic Bay	0.28	8	8	5.1	33
060148 (10)	Bullhead Bay	0.31	20	30	5.8	25
060290 (6)	Cold Spring Pond	0.26	0	0	3.5	17
Little Peconic Bay:						
060102 (11)	Cutchogue Harbor	0.32	9	18	10.0	54
060103 (11)	East Creek (Cutchogue)	0.35	18	18	6.5	54
060104 (10)	North Sea Harbor	0.33	20	20	5.1	30
060113 (12)	Little Peconic Bay (Nassau Point)	0.28	0	0	5.8	42
060300 (6)	Wooley Pond	0.32	0	0	7.2	67
Noyac Bay:						
060121 (11)	Noyac Bay	0.25	0	0	5.5	36
060310 (6)	Noyac Creek	0.25	0	0	6.2	33
060320 (6)	Mill Creek (Noyac)	0.29	0	0	6.9	50
Shelter Island Sound / Southold Bay:						
060106 (10)	Goose Creek	0.29	0	11	5.4	50
060107 (10)	Town Creek	0.32	0	10	8.0	60
060109 (10)	Mill Creek (Southold)	0.24	0	0	3.6	10
060114 (11)	Paradise Point	0.25	0	0	4.2	18
060340 (5)	Hashamomuck Pond South	0.27	0	0	4.6	20
060350 (5)	Hashamomuck Pond North	0.30	0	0	7.5	80

[1] *Numbers in parentheses below the station number are summer sample counts*
Stations shaded in blue are shallow water sites with potential eelgrass habitat

Table 8 *continued*. Mean Summer (July-Sept) Total Nitrogen (TN) and Chlorophyll-a (Chl-a) Concentrations at Marine Sampling Sites with the Percentage of Results Exceeding Recommended Guidelines (2010-2012)

Station [1] No.	Location	TN (mg/L)	% TN > 0.45 mg/L	% TN > 0.40 mg/L	Chl-a (ug/L)	% Chl-a > 5.5 ug/L
Shelter Island Embayments:						
060119 (11)	West Neck Bay	0.38	18	36	16.7	64
060124 (10)	West Neck Harbor	0.27	0	10	5.0	40
060122 (10)	Coecles Harbor	0.29	0	10	6.4	40
Sag Harbor / Northwest Harbor:						
060126 (10)	Sag Harbor	0.24	0	0	5.7	50
060127 (10)	Sag Harbor Cove	0.30	0	10	7.8	50
060118 (10)	Northwest Harbor	0.23	0	0	4.7	20
060131 (6)	Northwest Creek	0.27	0	0	3.6	0
Orient Harbor / Hallocks Bay:						
060115 (11)	Orient Harbor	0.26	0	0	6.6	18
060330 (5)	Hallocks Bay	0.27	0	0	2.8	0
Gardiners Bay:						
060116 (10)	Gardiners Bay West	0.24	0	0	3.1	10
060117 (8)	Gardiners Bay South	0.19	0	0	3.4	12
060141 (8)	Gardiners Bay East	0.20	0	0	2.8	12
Eastern Embayments:						
060132 (7)	Three-Mile Harbor	0.25	0	0	3.4	0
060133 (8)	Acabonac Harbor	0.24	0	0	3.0	0
060134 (8)	Napeague Harbor	0.22	0	0	2.9	0
060135 (8)	Lake Montauk	0.21	0	0	3.1	0

[1] *Numbers in parentheses below the station number are summer sample counts*
Stations shaded in blue are shallow water sites with potential eelgrass habitat

Beyond the western estuary, only six stations showed exceedances of the 0.45 mg/L TN guideline. Five of these are located in peripheral embayments, including Bullhead Bay (20% of samples), North Sea Harbor (20%), East Creek in Cutchogue (18%), West Neck Bay (18%) and Cutchogue Harbor (9%); the sixth was Great Peconic Bay (8%).

An evaluation of exceedances of the 0.40 mg/L TN guideline for shallow water eelgrass habitat revealed a total of 11 sites (of 26) that had one or more results above the criteria. The highest of these included Reeves Bay (42% of results), West Neck Bay (36%), Bullhead Bay (30%), North Sea Harbor (20%) and East Creek in Cutchogue (18%). Six other locations had exceedance percentages of about 10% (which equated to a single sample result above the criteria), including Flanders Bay, Goose Creek, Town Creek, West Neck Harbor, Coecles Harbor and Sag Harbor Cove.

Phosphorus

The majority of results for Total Phosphorus (TP) were below the minimum reportable level (MRL) of 0.05 mg/L for the method utilized (Table 2). Only two of the 38 sampling stations had mean TP levels above the MRL (Table 7): Meetinghouse Creek (0.45 mg/L) and the Peconic River mouth (0.06 mg/L). The highest individual TP concentration was, not unexpectedly, also recorded at the Meetinghouse Creek site (1.23 mg/L).

In contrast, concentrations of ortho-phosphate (o-PO4-P) were generally above the method MRL (0.010 mg/L). With the exception of levels at the nutrient-rich Meetinghouse Creek site however, concentrations of o-PO4-P varied little throughout the estuary. Mean values ranged from 0.011 mg/L in Wooley Pond to 0.024 mg/L in the mouth of the Peconic River, with the mean in Meetinghouse Creek more than an order of magnitude higher (0.425 mg/L). Maxima followed a similar pattern, ranging from 0.028 mg/L in Wooley Pond to 0.109 in the Peconic River mouth and 1.15 mg/L in Meetinghouse Creek. As with TP, o-PO_4-P levels were low and often undetectable during the colder months (< 0.01 mg/L) and increased to maximum levels during the summer. As an example of typical seasonal levels, phosphorus results for Flanders Bay are shown in Figure 14. Similar graphics for other sampling stations are included in Appendix C1. Spatial trends in phosphorus levels across the estuary are shown in Figure 15.

Chlorophyll-a

As with total nitrogen, average concentrations of chlorophyll-a in the estuary exhibited a general west to east declining trend. The highest mean concentrations occurred at two western estuary tidal creek sites, Meetinghouse Creek (26.1 ug/L) and East Creek in South Jamesport (13.7 ug/L), with levels in the mouth of the Peconic River (11.4 ug/L), Reeves Bay (8.6 ug/L) and West Neck Bay (7.4 ug/L) also comparatively elevated (Table 7, Figure 9). These contrasted with levels noted at three sites in the far eastern portion of the estuary (Lake Montauk, Gardiners Bay and Hallocks Bay) where the mean chlorophyll-a level for the sampling period was 2.3 ug/L. Individual chlorophyll maxima ranged from 6 ug/L at a number of eastern estuary

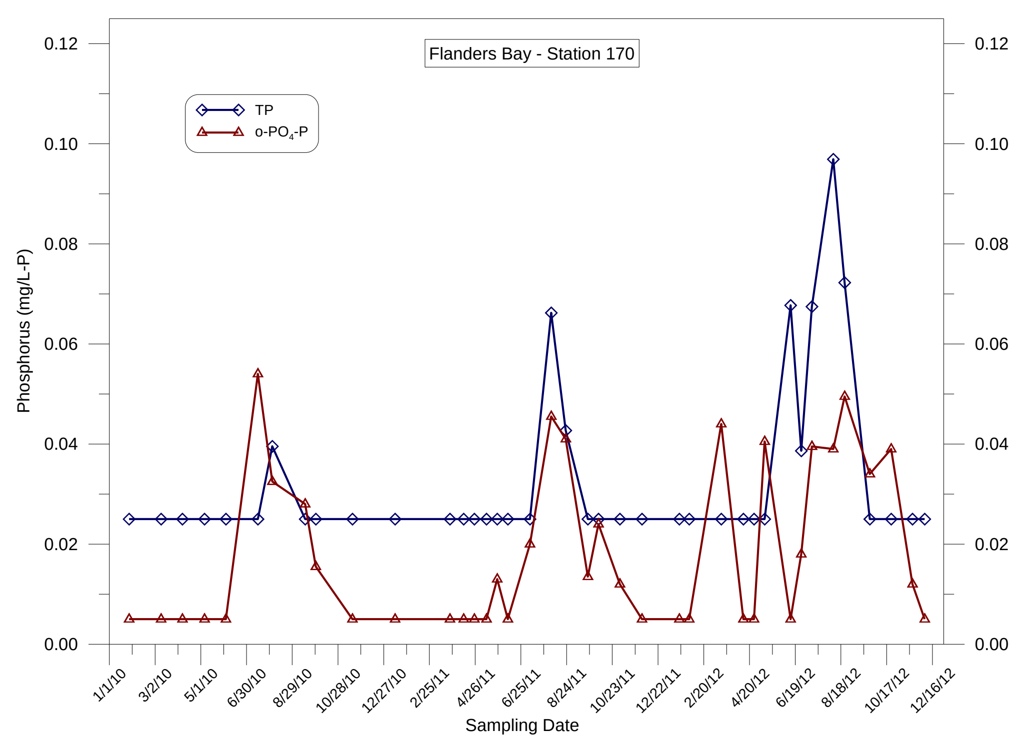


Figure 14. Temporal Variations in Phosphorus Concentrations in Flanders Bay (Station 060170)

sites to 247 ug/L in Meetinghouse Creek. Significantly elevated levels were also documented in East Creek in South Jamesport (140 ug/L), the Peconic River mouth (65 ug/L) and West Neck Bay (53 ug/L). In terms of trophic state, as defined by Molvaer *et al* (1997), the four western estuary sites and West Neck Bay would be classified as eutrophic since their average chlorophyll was >7 ug/L, with the 33 other sites monitored in the estuary considered mesotrophic (2-6 ug/L chlorophyll).

On a seasonal basis, chlorophyll-a levels were generally lowest in the winter and early spring and increased through the summer, with maximum concentrations often recorded in August and/or September (Figure 12, Appendix C1). At a number of eastern main-bay sites however, including Shelter Island Sound, Northwest Harbor (Figure 16), Orient Harbor and Gardiners Bay, secondary peaks also occurred in December and/or January that were, in some years, higher in magnitude than the summer maxima.

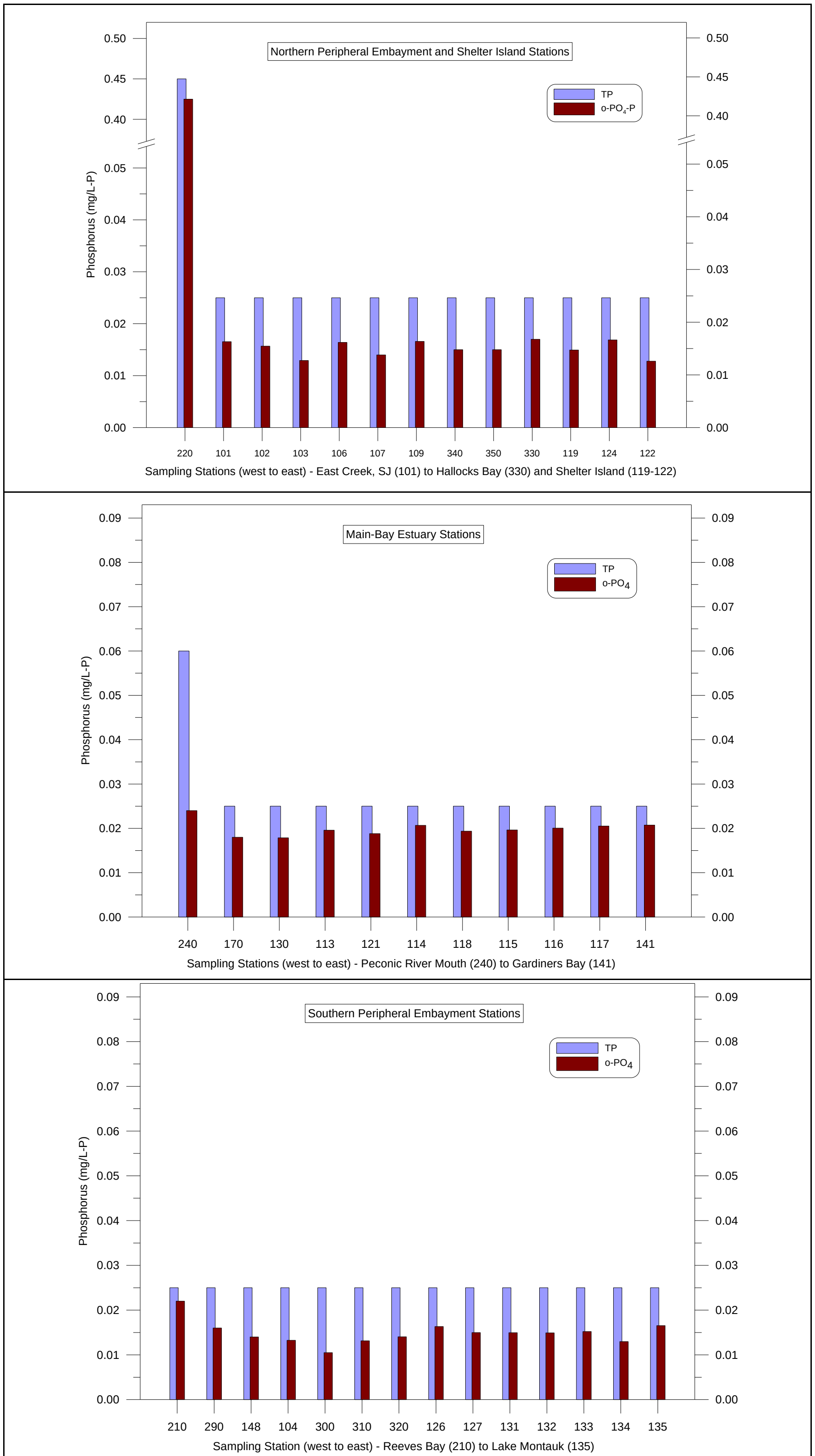


Figure 15. Spatial Trends in Mean Phosphorus Concentrations at Northern, Main Bay and Southern Peconic Estuary Stations

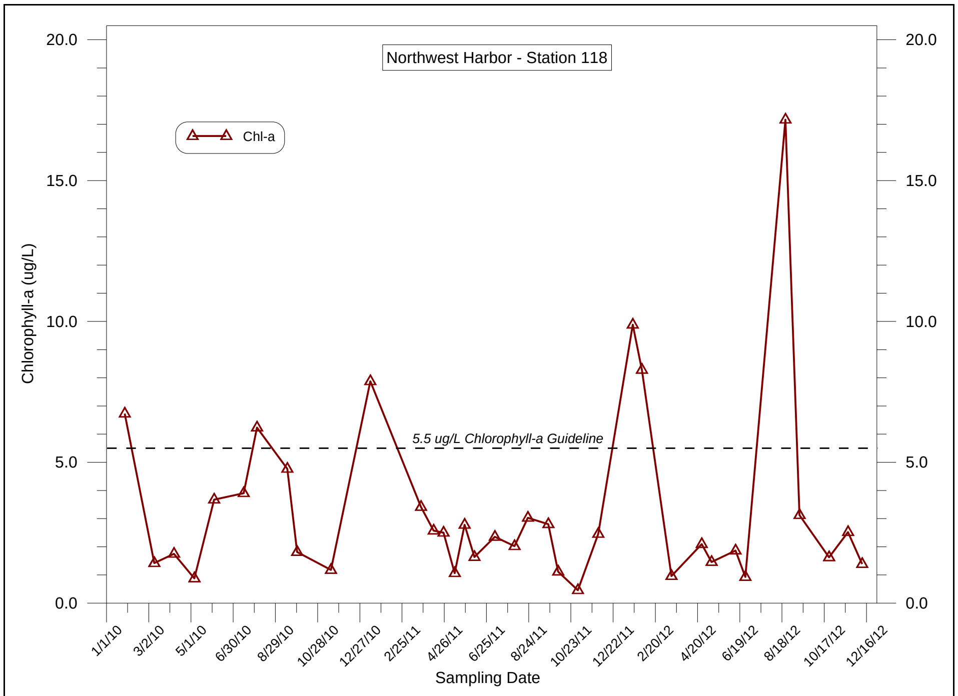


Figure 16. Temporal Variations in Chlorophyll-a concentrations in Northwest Harbor (Station 060118)

Summer Chlorophyll-a

Mean summer chlorophyll-a concentrations were higher than year-round values at all but one station in western Gardiners Bay (sta. 060116). The majority of sites showed summer increases of at least 25%, with over half of the stations increasing by more than 50%. As with year-round averages (Table 7), the highest summer means occurred in the western estuary at Meetinghouse Creek (31.2 ug/L), East Creek (28.7 ug/L) and the Peconic River mouth (19.3 ug/L), and generally declined in an easterly direction (Table 8). Between Great Peconic Bay and Orient Harbor, most sites had mean concentrations in the 4 to 7 ug/L range (although the level in West Neck Bay was 16.7 ug/L), with those in Gardiners Bay and the east end embayments averaging around 3 ug/L. When only summer results are considered, the number of sites considered eutrophic (Molvaer *et al,* 1997) would increase from five to eleven, and also include Flanders Bay, Cutchogue Harbor, Wooley Pond, Town Creek, Hashamomuck Pond North and Sag Harbor Cove.

Regarding the 5.5 ug/L chlorophyll-a guideline, adopted as a means to optimize water quality in eelgrass habitat areas, 20 of the 26 shallow waters sites had one or more summer results above the criteria (Table 8) with 15 sites having an exceedance rate of 25% or more. A comparatively high exceedance rate of (>50%) was noted for six tidal creek/peripheral embayment locations, including Reeves Bay, East Creek in Cutchogue, Wooley Pond, Town Creek, Hashamomuck Pond North and West Neck Bay. The lowest rate occurred at six eastern stations, where all summer chlorophyll-a results were less than the 5.5 ug/L criteria, including Three-Mile Harbor, Acabonac Harbor, Napeague Harbor, Lake Montauk, Northwest Creek and Hallocks Bay.

Stream Sampling Results

During the 2010-2012 sampling period, monitoring was conducted on 62 occasions at 24 stream stations with a total of 329 sample-sets collected. A statistical summary of results for key physical and nutrient parameters is included in Appendix B2. Since the objective of stream monitoring conducted under the PEP is to identify potential impacts that streams have on the estuary, and is not intended to provide a comprehensive year-round assessment of stream water quality, this section will only focus on the CCMP management priorities that are pertinent to streams: pathogens, nutrient pollution and toxics.

Coliform Bacteria

Table 9 includes basic statistics for total and fecal coliform results, including geometric mean and median values, and the percentage of samples exceeding NYSDEC standards for fresh waters (6 NYCRR Part 703). The NYSDEC water quality criteria for Class B,C fresh waters requires that for at least five monthly samples, the TC median cannot exceed 2,400 mpn/100 ml and not more than 20% of TC results can exceed 5,000 mpn/100 ml. For fecal coliforms, the criterion is a monthly geometric mean (for at least five samples) of not more than 200 mpn/100 ml. As with the marine data, because annual rather than monthly statistics are presented here and the required frequency of sample collection at Peconic Estuary streams did not achieve the required minimum of five monthly samples, the NYS coliform standards cannot be correctly applied. They are included in Table 9 in any event however, to provide a benchmark for comparison.

Coliform results exhibited a high degree of variability over the three year sampling period, with highest concentrations typically occurring during summer months and lower levels during the winter (see temporal plots in Appendix C2). As an indication of a high potential for contamination, 10 of the 24 stream sites (42%) had one or more Total Coliform (TC) result $\geq$16,000 mpn/100 ml, 20 (83%) had at least one TC result that was at or above 2,400 mpn/100 ml, and 18 of the streams (75%) had one or more Fecal Coliform (FC) result greater than 1,000 mpn/100 ml.

Table 9. Total and Fecal Coliform Statistics for Peconic Estuary Stream Stations, 2010-2012

Station No.	Location	Total Coliform			Fecal Coliform	
		GM	Median	% >5,000	GM	Median
Peconic River Stations:						
200044	Peconic River (at BNL)	37	30	0	24	< 20
200010	Peconic River (at USGS Gauge)	87	90	0	33	40
200017	Peconic River (at Grangebel Park)	308	300	7	167	130
200030B	Peconic River (at Riverhead Aquarium)	225	265	0	87	120
Western Estuary Stream Stations:						
200041	Meetinghouse Creek (at Rt. 25, Main Rd.)	530	500	0	187	170
200004	Meetinghouse Creek (at Crescent Duck Farm)	551	926	7	233	300
200110	Sawmill Creek	768	950	0	275	400
200120	Terrys Creek	747	950	21	353	500
200130	Reeves Creek	342	255	0	54	30
200140	East Creek, S. Jamesport	453	570	0	152	180
Southern Flanders Bay Stream Stations:						
200013	Goose Creek	277	285	0	20	< 20
200014	Birch Creek	46	65	0	< 20	< 20
200015	Mill Creek	54	55	0	20	< 20
200016	Hubbard Creek	50	40	0	20	< 20
North Fork Stream Stations:						
200160	Brushes Creek	202	113	0	33	20
200170	Deep Hole Creek	1,196	2,100	17	379	850
200180	Halls Creek	820	800	15	272	170
200190	Downs Creek	595	300	15	179	220
200200	West Creek	405	500	22	52	< 20
200210	East Creek (Cutchogue)	463	800	0	71	40
200230	Pipes Creek	697	800	22	170	80
200240	Pipes Neck Creek	1,349	1,700	27	708	500
200250	Narrow River North	463	285	10	55	< 20
200260	Narrow River South	2,445	1,650	40	358	315

NYSDEC Criteria for Class A, B, C, D fresh waters: For at least five samples, the Total Coliform monthly median shall not exceed 2,400 MPN/100 ml, and not more than 20% of Total Coliform values shall be greater than 5,000 MPN/100 ml; the monthly Fecal Coliform geometric mean shall not exceed 200 MPN/100 ml.

Although stormwater runoff is likely a major contributing factor to the coliform levels, other sources may also be involved. This was suggested by an examination of prior rainfall data that showed an association with elevated coliforms, but also revealed a number of occasions where significantly elevated TC and FC results (>5,000 mpn/100 ml) were not preceded by any measureable rainfall in the previous 96-hours.

Mean TC levels were lowest at two Peconic River stations (the USGS gage and BNL sites) and at three creeks in southern Flanders Bay (Birch, Mill and Hubbard), with values ranged from 37-87 mpn/100 ml (Figure 17). Streams with the highest TC levels were Narrow River South (2,445 mpn/100 ml), Pipes Neck Creek (1,349 mpn/100 ml) and Deep Hole Creek (1,196 mpn/100 ml). Mean FC concentrations were similarly low in the Peconic River and southern Flanders Bay, and highest in Pipes Neck Creek (708 mpn/100 ml), Deep Hole Creek (379 mpn/100 ml and the Narrow River (358 mpn/100 ml).

Regarding the NYS total coliform criteria, none of the streams sampled had TC medians >2,400 mpn/100 ml, although five sites (Terrys Creek, West Creek, Pipes Creek, Pipes Neck Creek and Narrow River south) had more than 20% of TC values >5,000 mpn/100 ml. For the fecal coliform criteria, seven streams had geometric means >200 mpn/100 ml, including Meetinghouse Creek (duck farm site), Sawmill Creek, Terrys Creek, Deep Hole Creek, Halls Creek, Pipes Neck Creek and Narrow River south.

Nutrients

Table 10 shows mean concentrations for the various nitrogen and phosphorus constituents that were monitored in Peconic Estuary streams, including ammonia (NH_3-N), nitrite + nitrate (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP) and ortho-phosphate (o-PO_4-P). For purposes of comparison, results are grouped by area (the Peconic River, Western Estuary, Southern Flanders Bay and the North Fork).

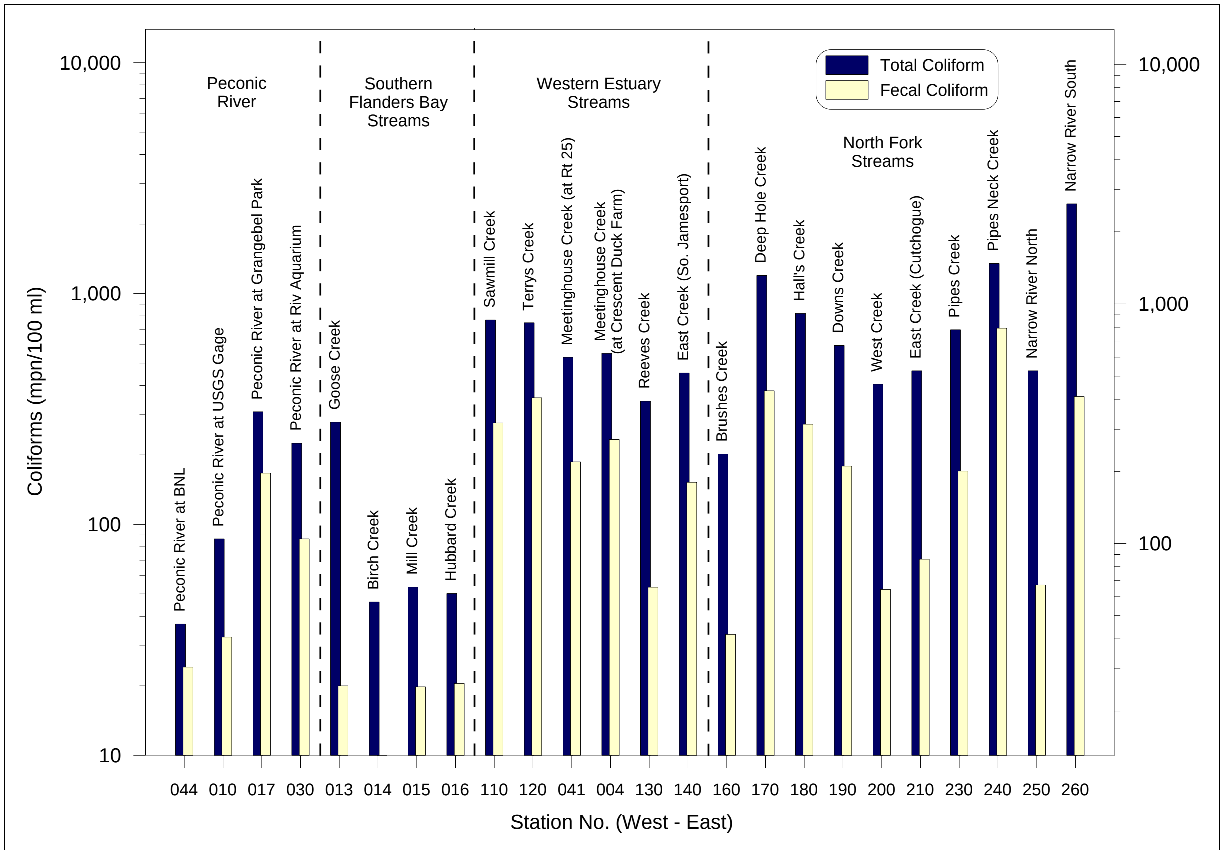


Figure 17. Spatial Variations in Mean Concentrations of Total and Fecal Coliform Bacteria at Peconic Estuary Stream Stations (2010-2012)

Nitrogen

As with the marine sampling results, the highest mean total nitrogen (TN) concentrations among stream stations were found at sites in the western estuary (Figure 18). These included the Meetinghouse Creek station at the Crescent Duck Farm (sta. 200004, 9.3 mg/L), Reeves Creek (200130, 4.8 mg/L), the Meetinghouse Creek station at Rt. 25 (200041, 4.3 mg/L) and East Creek in South Jamesport (200140, 4.1 mg/L). Also showing elevated TN levels were two tributaries to Great Peconic Bay: Brushes Creek (200160, 4.7 mg/L) and Deep Hole Creek (200170, 4.0 mg/L), and the sampling site on the Peconic River just downstream from Brookhaven National Laboratory's (BNL) wastewater treatment plant (200044, 4.3 mg/L). Locations with the lowest mean TN concentrations included two sites on the Peconic River: station 200010 at the USGS gage and station 200017 at Grangebel Park (0.4 – 0.5 mg/L), and four streams located in the southern portion of Flanders Bay: Goose Creek station 200013, Birch Creek station 200014, Mill Creek station 200015 and Hubbard Creek station 200016 (0.1 - 0.3 mg/L).

Table 10. Mean Concentrations of Nitrogen and Phosphorus Constituents at Peconic Estuary Stream Stations (2010-2012)

Station No.	Location	NH_3-N (mg/L)	NO_x-N (mg/L)	DIN (mg/L)	DON (mg/L)	TN (mg/L)	TP (mg/L)	o-PO_4-P (mg/L)
Peconic River Stations:								
200044	Peconic River (at BNL)	0.082	4.19	4.27	0.15	4.3	0.72	0.66
200010	Peconic River (at USGS Gauge)	0.046	0.160	0.206	0.15	0.38	< 0.05	< 0.01
200017	Peconic River (at Grangebel Park)	0.064	0.238	0.302	0.15	0.47	< 0.05	< 0.01
200030B	Peconic River (at Riverhead Aquarium)	0.066	0.082	0.148	0.24	0.50	0.08	0.03
Western Estuary Stream Stations:								
200041	Meetinghouse Creek (at Rt. 25, Main Rd.)	0.165	3.89	4.06	0.26	4.3	0.04	0.01
200004	Meetinghouse Creek (at Crescent Duck Farm)	1.77	7.39	9.16	0.45	9.3	2.65	2.6
200110	Sawmill Creek	0.239	0.332	0.571	0.38	1.0	0.09	0.05
200120	Terrys Creek	0.074	2.81	2.88	0.14	3.0	0.08	0.08
200130	Reeves Creek	0.058	4.51	4.56	0.55	4.8	0.07	0.05
200140	East Creek (South Jamesport)	0.141	3.77	3.91	0.22	4.1	< 0.05	< 0.01
Southern Flanders Bay Stream Stations:								
200013	Goose Creek	0.018	0.301	0.319	< 0.05	0.31	< 0.05	< 0.01
200014	Birch Creek	0.013	0.009	0.022	0.10	0.13	< 0.05	< 0.01
200015	Mill Creek	0.015	0.020	0.035	0.21	0.14	< 0.05	< 0.01
200016	Hubbard Creek	0.025	0.022	0.047	< 0.05	0.07	< 0.05	< 0.01
North Fork Stream Stations:								
200160	Brushes Creek	0.098	4.64	4.73	0.27	4.7	< 0.05	< 0.01
200170	Deep Hole Creek	0.069	3.93	3.99	0.26	4.0	< 0.05	0.02
200180	Halls Creek	0.074	0.993	1.07	0.15	1.2	< 0.05	0.03
200190	Downs Creek	0.092	2.24	2.33	0.05	2.3	< 0.05	0.01
200200	West Creek	0.220	1.80	2.03	0.61	2.6	0.16	0.09
200210	East Creek (Cutchogue)	0.054	1.37	1.42	0.32	1.6	< 0.05	< 0.01
200230	Pipes Creek	0.096	0.112	0.188	0.55	0.84	0.08	0.03
200240	Pipes Neck Creek	0.124	0.208	0.343	0.37	0.71	< 0.05	0.01
200250	Narrow River North	0.211	0.435	0.639	0.79	1.4	0.11	0.07
200260	Narrow River South	0.112	1.04	1.16	0.50	1.6	0.40	0.31

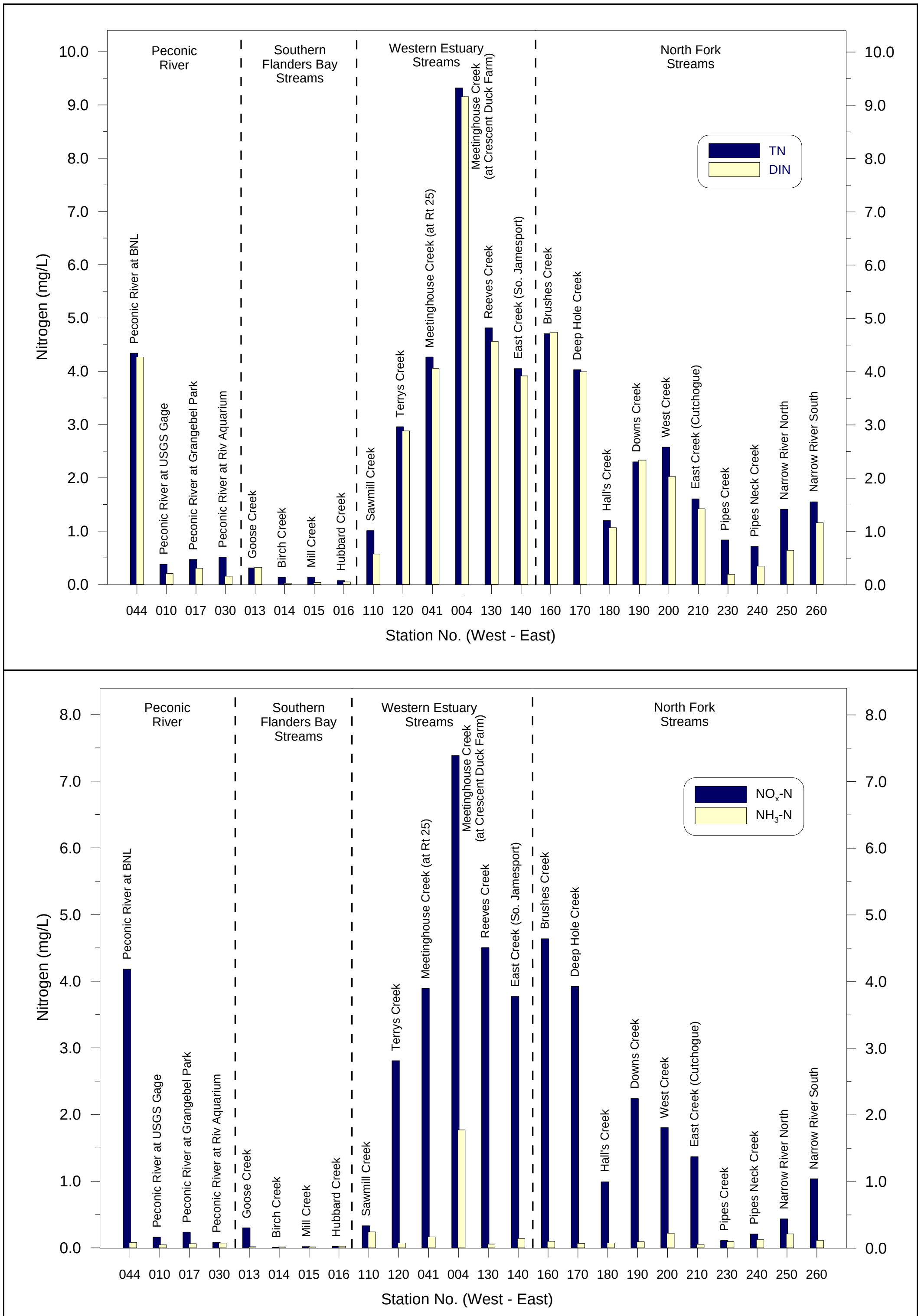


Figure 18. Spatial Variations in Concentrations of Total Nitrogen (TN), Dissolved Inorganic Nitrogen (DIN), Nitrite+Nitrate Nitrogen (NO_x-N) and Ammonia Nitrogen (NH_3-N) at Peconic Estuary Stream Stations (2010-2012)

At the majority of sites, TN was comprised primarily of NO_x-N. This was particularly apparent at sites in the western estuary, western north fork, and the Peconic River (BNL location) that exhibited relatively elevated TN levels. Only at two sites in southern Flanders Bay (Birch Creek and Mill Creek) and at three eastern locations (Pipes Creek station 200230, Pipes Neck Creek station 200240 and Narrow River North station 200250), did dissolved organic nitrogen (DON) levels comprise a greater percentage of the TN.

Average NO_x-N levels ranged from 7.39 mg/L in Meetinghouse Creek (the duck farm site) to 0.009 mg/L in Birch Creek. As with TN levels, relatively elevated levels of NO_x-N (and DIN) were also noted in Brushes Creek, Reeves Creek, Meetinghouse Creek (Rt. 25), East Creek (SJ), Deep Hole Creek and the Peconic River site at BNL. Mean concentrations of NH_3-N were generally insignificant, with the exception of those at the duck farm site on Meetinghouse Creek where the average level was 1.77 mg/L. Average NH_3-N concentrations at all other stream sites ranged from 0.24 to < 0.02 mg/L. Mean DON concentrations ranged from 0.8 mg/L in Narrow River (sta. 200250) to <0.05 in Goose Creek and Hubbard Creek.

In terms of temporal variations, stream nutrient levels (and stream chemistry in general) may be affected by a number of factors, including area land use, precipitation amounts, groundwater levels, the proximity to point sources, biological activity, stormwater runoff and in some cases, tidal exchange. At any given time, the interaction of a combination of these factors likely influences the concentration found. Consistent with this, no clear seasonal pattern in the fluctuation of nitrogen levels was apparent among the streams sites sampled between 2010 and 2012 (see temporal plots in Appendix C2). Some sites had lower nitrogen levels in the summer and higher values in the winter, while at others (particularly Reeves Creek), tidal influences (shown by spikes in conductivity) periodically reduced nitrogen levels. In some of the southern Flanders Bay creeks (Birch, Mill and Hubbard) where the sampling point is well removed from potential anthropogenic inputs and tidal influences, nitrogen concentrations exhibited very little variability.

Phosphorus

Phosphorus concentrations were generally low in the majority of the 24 Peconic Estuary streams monitored (Figure 19). Mean values for Total Phosphorus (TP) were less than the MRL (< 0.05 mg/L) at 14 sites, and between 0.07 and 0.16 mg/L at 7 others. At the three remaining stream stations, mean TP levels were 0.40 mg/L at Narrow River South, 0.72 mg/L at the BNL

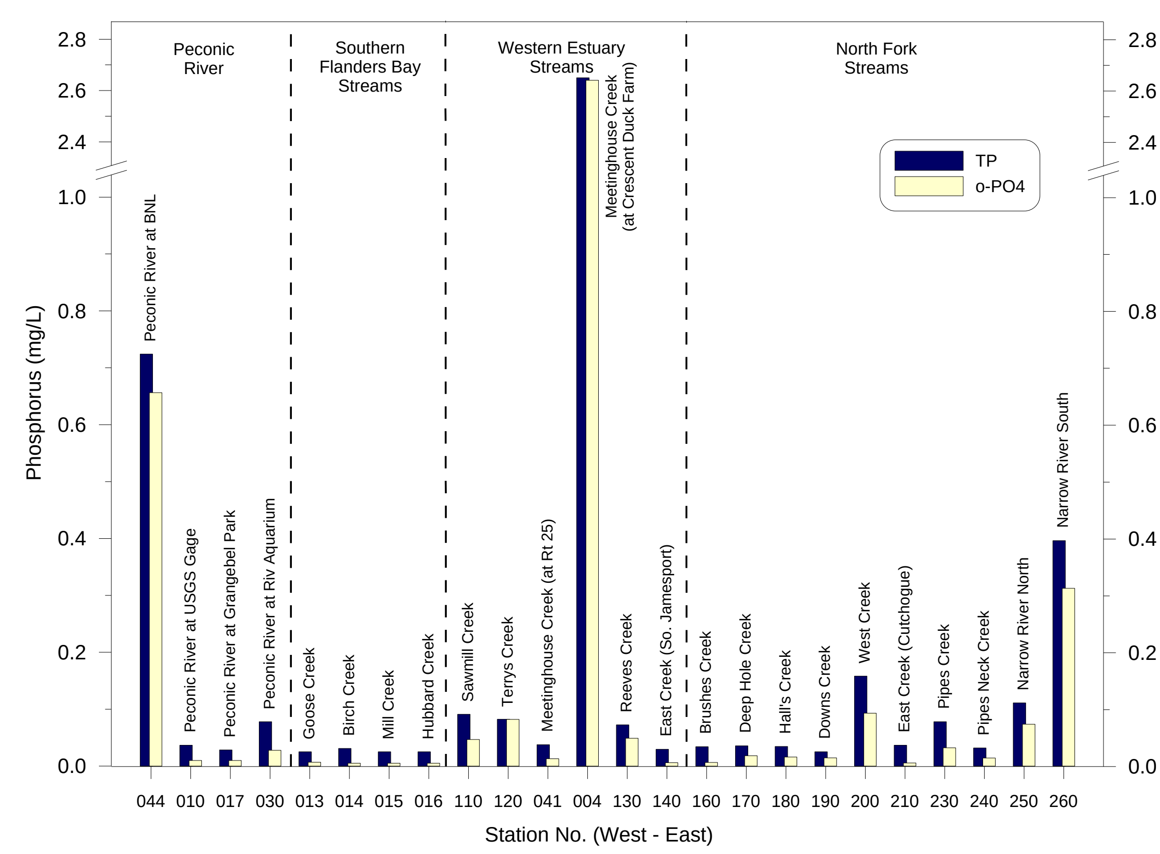


Figure 19. Spatial Variations in Concentrations of Total Phosphorus (TP) and Ortho-Phosphate (o-PO_4-P) at Peconic Estuary Stream Stations (2010-2012)

Peconic River station, and 2.7 mg/L at the Meetinghouse Creek duck farm site. Contrasting the elevated value at the duck farm location, the mean TP concentration at the upstream Meetinghouse Creek site (station 200041) was 0.04 mg/L. Mean o-PO_4-P concentrations were similar to TP levels, with highest values also noted in Meetinghouse Creek at the duck farm (2.6 mg/L), the Peconic River at BNL (0.66 mg/L) and Narrow River south (0.31 mg/L). The remaining 21 sites average between < 0.01 to 0.09 mg/L.

Toxics

To evaluate the extent to which toxic contaminants from upland watersheds are impacting the estuary, levels of numerous organic and metal constituents (listed in Appendix D1 and D2) are routinely monitored at 23 of the 24 Peconic Estuary stream stations (samples are not collected at station 200030 in the Peconic River).

Organics

During 2010-2012, a total of 294 samples were collected for the analysis of organic compounds. Groups of analytes (with the number of constituents in each shown in parentheses), included methyl carbamate pesticides (13), chlorinated acids (16), Dacthal degradation products (2), herbicide metabolites (20), micro-extractable pesticides (2), organohalide pesticides (19), semi-volatile organic compounds (SVOCs, 99), and volatile organic compounds (VOCs, 95).

Over the three year period, positive detects (results that were greater than the method MRL) were found for one or more of the analytes at 22 of the 23 sites tested. The detects (437 in total) were distributed among 29 compounds, including pesticides and their metabolites (16), volatile organic compounds (VOCs, 9) and pharmaceutical and personal care products (PPCPs, 4). Table 11 summarizes the compounds found by analyte group, and includes the number of sites where each was detected, the total number of detects and the frequency of detection. Table 12 summarizes organic results by station, including the number of samples, the number of analytes detected and the total number of detects. A listing of the compounds identified at each station, with the frequency of detections and sample concentrations (mean and maximum values), is included in Appendix E1.

The overwhelming majority of organic detects involved herbicides or herbicide metabolites (76%), with the remainder comprised of other pesticides (10%), VOCs (8%) and PPCPs (6%). By far the most common analytes found were the ESA and OA metabolites of Metolachlor (44% and 32% of all detects, respectively), and the ESA metabolite of Alachlor (18%). Other herbicides frequently identified included the Metolachlor parent compound (6.8%), the Dichlobenil metabolite 2,6-Dichlorobenzamide (5.1%), and the Atrazine metabolite Deisopropylatrazine (3.4%). Among other pesticides, the most common compounds detected included the fungicide Metalaxyl (7.1%) and two metabolites of the insecticide Aldicarb: A. sulfone (3.4%) and A. sulfoxide (2%). Frequently detected VOCs included Freon 113 (5.4%) and MTBE (2.7%), while DEET (4.7%) and Caffeine (3.4%) were the most frequently found PPCPs. Not surprisingly, the majority of pesticide detects occurred at north fork sites where agriculture is a principal land use in adjacent watersheds. VOC detects were predominantly in the Peconic River and western estuary regions, while PPCPs were occasionally noted in all areas monitored.

Table 11. Summary of Organic Compounds Detected In Peconic Estuary Streams (2010-2012)

Analyte Name	Description	No. Sites Detected At	Total No. Detects	Detection Frequency (%)
Herbicides and Metabolites:				
2,6-Dichlorobenzamide	Dichlobenil Metabolite	2	15	5.1
Alachlor ESA	Alachlor Metabolite	7	53	18.0
Deisopropylatrazine	Atrazine Metabolite	4	10	3.4
Dichlobenil	Herbicide	1	3	1.0
Dinoseb	Herbicide	1	3	1.0
Metolachlor	Herbicide	3	20	6.8
Metolachlor ESA	Metolachlor Metabolite	11	129	43.7
Metolachlor OA	Metolachlor Metabolite	10	95	32.2
Ronstar	Herbicide	1	2	0.7
Simazine	Herbicide	1	1	.03
Tebuthiuron	Herbicide	1	1	0.3
Other Pesticides and Metabolites:				
Aldicarb sulfone	Metabolite of Aldicarb Insecticide	4	10	3.4
Aldicarb sulfoxide	Metabolite of Aldicarb Insecticide	5	6	2.0
Dichlorvos	Insecticide	1	1	0.3
Imidacloprid	Insecticide	1	5	1.7
Metalaxyl	Fungicide	4	21	7.1
Pharmaceuticals and Personal Care Products (PPCPs):				
Caffeine	Food additive	10	10	3.4
Diethyltoluamide (DEET)	Insect repellant	12	14	4.7
Phenytoin (Dilantin)	Anti-epileptic Drug	1	1	0.3
Bisphenol A	Plasticizer	1	1	0.3
Volatile Organic Compounds (VOCs):				
1,1-Dichloroethene	Industrial Chemical	1	3	1.0
Bromoform	Solvent	1	1	0.3
Chlorodifluoromethane	Refrigerant	1	1	0.3
Chloroform	Solvent	1	1	0.3
Diethyl ether	Solvent	1	1	0.3
Freon 113	Refrigerant	2	16	5.4
Methyl-tertiary-butyl-ether	Gasoline Additive	2	8	2.7
Propanal	Industrial Chemical	1	1	0.3
Toluene	Solvent	2	4	1.3

Table 12. Summary of Organic Compound Detected by Station in Peconic Estuary Streams (2010-2012)

Station No.	Station Name	No. Samples	VOCs		Pesticides		PPCPs	
			Analytes Detected	Total Detects	Analytes Detected	Total Detects	Analytes Detected	Total Detects
Peconic River:								
200044	Peconic River (at BNL)	13	3	3	0	0	3	3
200010	Peconic River (at USGS Gage)	14	2	14	0	0	0	0
200017	Peconic River (at Grangebel Park)	14	1	5	0	0	0	0
Western Estuary Streams:								
200004	Meetinghouse Creek (Duck Farm Site)	14	1	5	3	35	1	1
200041	Meetinghouse Creek (at Rt. 25)	15	0	0	1	5	1	2
200110	Sawmill Creek	16	1	3	4	18	0	0
200120	Terrys Creek	14	0	0	3	29	0	0
200130	Reeves Creek	13	2	2	4	31	1	1
200140	East Creek, SJ	13	0	0	7	45	2	3
North Fork Streams:								
200160	Brushes Creek	13	0	0	9	72	1	1
200170	Deep Hole Creek	13	0	0	6	40	1	1
200180	Halls Creek	14	0	0	5	44	1	1
200190	Downs Creek	14	0	0	4	28	1	1
200200	West Creek	9	0	0	3	5	2	2
200210	East Creek, Cutch.	14	0	0	4	4	1	1
200230	Pipes Creek	10	1	1	1	1	2	2
200240	Pipes Neck Creek	10	0	0	0	0	0	0
200250	Narrow River North	11	1	3	0	0	1	1
200260	Narrow River South	11	0	0	3	18	0	0
Southern Flanders Bay Streams:								
200013	Goose Creek	15	0	0	0	0	1	1
200014	Birch Creek	15	0	0	0	0	2	2
200015	Mill Creek	15	0	0	0	0	2	2
200016	Hubbard Creek	15	0	0	0	0	1	1

Spatially, pesticide levels were generally elevated from Sawmill Creek in Riverhead to Downs Creek in Cutchogue (Figure 20), with the Meetinghouse Creek station on Rt. 25 being the only exception. By far the highest number of detects (73) occurred at the Brushes Creek site in Laurel. Brushes Creek was the only location where the herbicides Ronstar and Dichlobenil and the insecticide Imidacloprid were found, and moreover, showed measureable levels of the herbicide metabolites Metolachlor ESA, Alachlor ESA and 2,6-Dichlorobenzamide in every sample collected. At eastern north fork sites from West Creek in New Suffolk to Narrow River North in Orient, the number of pesticide detects was comparatively low (4-7), although those in Narrow River South were also elevated (18). The Pipes Neck Creek station in Southold was the only site sampled that did not exhibit any organic residues (pesticide, VOC or PPCP).

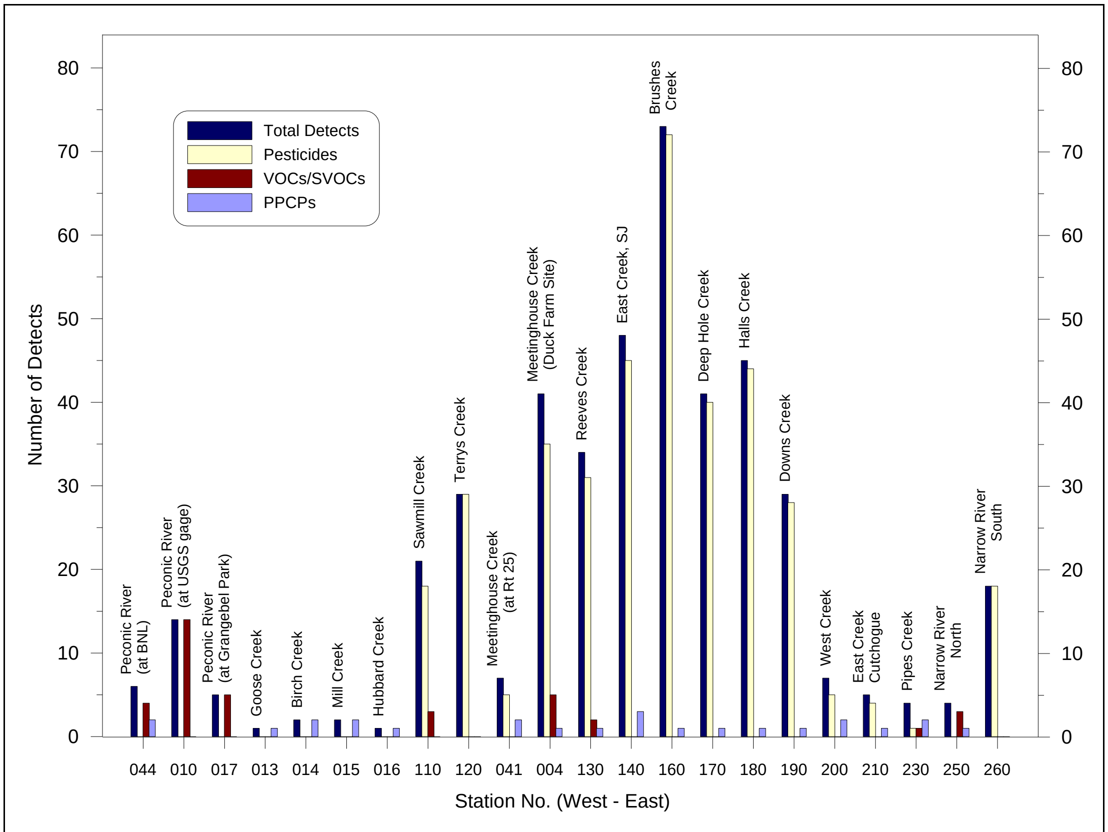


Figure 20. Total Number of Organic Detects in Peconic Estuary Streams (2010-2012)

Detects of VOCs were infrequent compared to pesticides, with each of the 10 analytes identified occurring at only one or two sites (Table 11). The most VOC detects (16) were of the refrigerant Freon 113, which was identified at only two locations on the Peconic River - the USGS Gaging station and Grangebel Park. Also noted at the gage site was the chemical 1,1-Dichloroethene.

At the Peconic River site downstream from BNL (station 200044), three VOC compounds were detected, each on one occasion, including the solvents Chloroform and Diethyl ether, and the refrigerant Chlorodifluoromethane (Freon 22). At two eastern locations, Pipes Creek and Narrow River north, the solvent Toluene was also detected.

Pharmaceutical and personal care products (PPCPs) were noted at 17 of the 22 sites tested, but also on an infrequent basis. Caffeine was identified at 10 sites (1 detect each) and the insect repellant Diethyltoluamide (DEET) at 12 sites (14 detects total). The anti-epileptic drug Phenytoin (Dilantin) and the plasticizer Bisphenol A (BPA) were each detected on one occasion at the BNL Peconic River site.

A summary of the individual pesticide, VOC and PPCP compounds detected, including the range of concentrations found and their relation to available water quality standards, follows below. Standards applicable to the compounds detected, including the number of standard exceedances, are shown in Table 13 for pesticides and Table 14 for VOCs and PPCPs. References utilized include the NYS Part 703 surface water and groundwater standards (6-NYCRR Part 703), the USEPA Office of Pesticide Programs aquatic life benchmarks for pesticides (USEPA, 2014) and the USEPA aquatic toxicity information retrieval database (AQUIRE) for VOCs (USEPA, 1996). The groundwater criteria are included in both tables for comparison purposes only, as applicable standards for fresh surface waters (Class B,C) have yet to be developed for any of the compounds detected.

Pesticides

2,6-Dichlorobenzamide (*BAM*) – a metabolite of the herbicide Dichlobenil, detected in 15 samples from 2 streams. The majority of detects (13) and highest concentration (7.0 ug/L) were at Brushes Creek in Laurel, where the chemical was detected in every sample collected. BAM has been reported to be practically non-toxic to fish and aquatic invertebrates on an acute basis (USEPA, 1998a). Both surface water and ecological criteria for BAM have yet to be developed.

Dichlobenil – an herbicide that was detected on 3 occasions in Brushes Creek at a maximum concentration of 1.5 ug/L. Dichlobenil has been found to be moderately toxic to aquatic invertebrates and fish (USEPA, 1998a). No surface water or groundwater standard for dichlobenil has been established. The available aquatic life criteria were not exceeded.

Table 13. Water Quality Standards for Pesticides Detected in Peconic Estuary Streams with the Number Criteria Exceedances (2010-2012)

Compound Name	NYS Surface Water Standard (ug/L)[1]	NYS Groundwater Standard (ug/L)[1]	EPA Aquatic Life Benchmarks (ug/L)[2] Fish Acute	Fish Chronic	Invertebrates Acute	Invertebrates Chronic	No. of Standard Exceedances
Alachlor ESA (metabolite)	---	---	> 52,000	---	> 52,000	---	0
Aldicarb sulfone (metabolite)	---	2[3]	21,000	---	140	---	0
Aldicarb sulfoxide (metabolite)	---	4[3]	3,570	---	21.5	---	0
Deisopropylatrazine (Atrazine metabolite)	---	---	---	---	---	---	0
Dichlobenil	---	---	2,465	< 330	1,850	560	0
2,6-Dichlorobenzamide (Dichlobenil metabolite)	---	---	---	---	---	---	0
Dichlorvos	---	---	91.5	5.2	0.035	0.0058	1 - (Aquatic Life-Invert.)
Dinoseb	---	---	---	---	---	---	0
Imidacloprid	---	---	> 41,500	1,200	34.5	1.05	0
Metalaxyl	---	---	65,000	9,100	14,000	100	0
Metolachlor	10[4]	10	1,600	30	550	1	0
Metolachlor ESA (metabolite)	50[3,4]	50[3]	24,000	---	> 54,000	---	0
Metolachlor OA (metabolite)	50[3,4]	50[3]	> 46,550	---	7,700	---	0
Ronstar	---	---	440	0.88	1,090	30	1 - (Aquatic Life-Fish)
Simazine	0.5[4]	0.5	3,200	960	500	2,000	0
Tebuthiuron	---	50	53,000	9,300	148,500	21,800	0

[1] NYS Surface Water and Groundwater Quality Standards – NYCRR Title 6, Chapter X, Part 703
[2] USEPA Office of Pesticide Programs Aquatic Life Benchmarks
[3] Guidance value (standard yet to be adopted)
[4] Applicable only to surface waters used as a source of drinking water (Class A, A-S, AA, AA-S)

Table 14. Water Quality Standards for VOCs and PPCPs Detected in Peconic Estuary Streams with the Number of Criteria Exceedances (2010-2012)

Compound Name	Compound Type	NYS Surface Water Standard (ug/L)[1]	NYS Groundwater Standard (ug/L)[1]	Lowest Concentrations That Affect a Species (ug/L)[2]			Number of Criteria Exceedances
				LC_{50}[3]	EC_{50}[4]	LOEC[5]	
1,1-Dichloroethene	VOC	---	---	---	410,000 (green algae)	---	0
Bromoform	VOC	---	---	---	38,600 (green algae)	---	0
Chlorodifluoromethane	VOC	---	---	---	---	---	0
Chloroform	VOC	7[6]	7	---	270 (amphibian)	---	0
Diethyl ether	VOC	---	---	> 1,000,000 (fish)	---	---	0
Freon 113	VOC	5[6]	5	---	---	---	0
Methyl-tertiary-butyl-ether	VOC	10[6,7]	10	672,000 (fish)	---	---	0
Propanal	VOC	---	---	---	---	---	0
Toluene	VOC	5[6] 6,000 (B,C)	5	---	---	6,000 (fish)	0
Bisphenol A	PPCP	---	---	---	---	---	0
Caffeine	PPCP	---	---	---	---	---	0
Diethyltoluamide (DEET)	PPCP	---	---	100-160 (invert)[8] 71-235 (fish)[8]	---	---	0
Phenytoin (Dilantin)	PPCP	---	---	---	---	---	0

[1] NYS Surface Water and Groundwater Quality Standards – NYCRR Title 6, Chapter X, Part 703
[2] USEPA Environmental Research Laboratory aquatic toxicity information retrieval database (AQUIRE) for VOCs, except as noted
[3] Median concentration lethal to 50% of test organisms
[4] Effective mean concentration affecting 50% of test organisms
[5] Lowest observed effective concentration
[6] Applicable only to surface waters used as a source of drinking water (Class A, A-S, AA, AA-S)
[7] Guidance value (standard yet to be adopted)
[8] Costanzo, et al, 2007

Alachlor ESA – a metabolite of the herbicide Alachlor, detected in 53 samples from 7 streams (Meetinghouse Creek in Aquebogue to Narrow River in Orient). The highest concentration was found in Brushes Creek (1.7 ug/L), with concentrations at the remaining sites ranging from 0.2 – 0.6 ug/L. Available studies indicate that Alachlor ESA has a low toxicity to freshwater fish and invertebrates (USEPA,1998b). The only standard available is an aquatic life benchmark of 52,000 ug/L, which is well above the concentrations detected

Deisopropylatrazine – a metabolite of the herbicide Atrazine, detected in 10 samples from 4 streams (East Creek, Brushes Creek, Deep Hole Creek and West Creek). The highest concentration (0.9 ug/L) and number of detects (5) were in Brushes Creek. The parent compound (not detected in this study) has been found to be slightly to highly toxic to freshwater and marine fish and invertebrates, and highly toxic to plants (USEPA, 2003b). The toxicity of its degradates has not been well studied, although it has been found to be significantly less toxic to algae than the parent compound (Kotrikla et al., 1999). No standard criteria were available for comparison.

Aldicarb sulfone – a metabolite of the carbamate insecticide/nematicide Aldicarb (*Temik*). Residues were detected in 10 samples from 4 sites (the Rt. 25 Meetinghouse Creek station, Deep Hole Creek, West Creek and East Creek in Cutchogue) at mean concentrations that ranged from 0.5 ug/L to 1.5 ug/L. The majority of detects were from Meetinghouse Creek (5) with the highest concentration found in East Creek. Aldicarb sulfone is listed as being slightly toxic to fish and highly toxic to zooplankton (PAN, 2015a). New York State has established a groundwater guidance level of 2 ug/L. USEPA acute aquatic life standards are 21,000 ug/L for fish and 140 ug/L for invertebrates. No samples exceeded any of the criteria.

Aldicarb sulfoxide – another metabolite of the carbamate insecticide Aldicarb. Detected in 6 samples from 5 creeks (Terrys Creek, Deep Hole Creek, Downs Creek, West Creek and East Creek in Cutchogue), with maximum concentrations ranging from 0.5 to 1.8 ug/L. As with the A. sulfone metabolite, the highest level was found in East Creek. Aldicarb sulfoxide is also toxic to fish and zooplankton (PAN, 2015b). Standard criteria include a NYS groundwater guidance level of 4 ug/L and USEPA aquatic criteria (acute) of 3,570 ug/L for fish and 21.5 ug/L for invertebrates. No samples exceeded any of the criteria.

Dichlorvos – an organophosphate insecticide that was only found in one sample from Sawmill Creek in Riverhead (0.7 ug/L). Dichlorvos has been found to be highly toxic to fish and crustaceans (Das, 2013; PAN, 2015c). No surface water or groundwater standards have been developed. The USEPA aquatic life benchmarks include an acute/chronic criteria for fish of 91.5 ug/L and 5.2 ug/L, respectively, and an acute/chronic criteria for invertebrates of 0.035 ug/L and 0.0058 ug/L. The concentration found in Sawmill Creek exceeded both the acute and chronic invertebrate criteria.

Dinoseb – a nitrophenolic herbicide found in three samples from Halls Creek in concentrations ranging from 0.3 to 1.0 ug/L. Dinoseb is highly toxic to fish and mollusks, and moderately toxic to invertebrates (PAN, 2015d; Extoxnet, 1996a). No surface water or aquatic life criteria have been developed for Dinoseb.

Imidacloprid – a systemic neonicotinoid insecticide found only in Brushes Creek (5 detects) in concentrations ranging from 0.2 to 0.5 ug/L. Imidacloprid has been found to be very toxic to aquatic invertebrates and to have a moderately low toxicity to fish (Extoxnet, 1996b; Stoughton, 2008). Standards for Imidacloprid are limited to aquatic life acute/chronic benchmarks of 41,500 ug/L and 1,200 ug/L for fish and 34.5 ug/L and 1.05 ug/L for invertebrates. No samples exceeded any of the criteria.

Metalaxyl – a systemic fungicide found in 21 samples from 4 locations (Reeves Creek, East Creek in South Jamesport, Brushes Creek and East creek in Cutchogue). The highest number of detects (12) and concentration (1.4 ug/L) occurred in Brushes Creek. An ecological effects assessment (USEPA, 1994a) noted that Metalaxyl poses minimal risks to fish, aquatic plants and estuarine species. Standards include aquatic benchmarks (acute/chronic) of 65,000 ug/L and 9,100 ug/L for fish and 14,000 ug/L and 100 ug/L for invertebrates. No samples exceeded any of the available criteria.

Metolachlor – a broad-spectrum pre-emergent herbicide detected in 20 samples from 3 locations (East Creek in South Jamesport, Deep Hole Creek and Halls Creek) in concentrations ranging from 0.2 to 0.7 ug/L. The highest concentration and most detects (12) occurred in Deep Hole Creek. Metolachlor is moderately toxic to freshwater and marine fish and crustaceans (USEPA, 2006a). A NYS water quality standard of 10 ug/L has been established for groundwater and for surface waters used as a source of drinking water (Class A, A-S, AA, AA-

S). USEPA aquatic benchmarks (acute/chronic) are 1,600 ug/L and 30 ug/L for fish, and 550 ug/L and 1.0 ug/L for invertebrates. No exceedances were noted.

Metolachlor ESA – a degradate of the herbicide Metolachlor. Metolachlor ESA was the most frequently detected pesticide, occurring in 129 samples from 11 streams. The chemical was found in every sample collected from 7 sites extending from Riverhead to Cutchogue, including Sawmill Creek, Reeves Creek, East Creek (SJ), Brushes Creek, Deep Hole Creek, Halls Creek and Downs Creek. It was also detected in Meetinghouse Creek, Terrys Creek, East Creek in Cutchogue and Narrow River. Concentrations found ranged from 0.3 to 5.5 ug/L, with the highest value and mean of detects (2.0 ug/L) noted in East Creek (SJ). Metolachlor ESA has been found to be slightly toxic to fish and slightly to practically non-toxic to invertebrates (USEPA, 2006a). Standard criteria include a NYS surface water (Class A, A-S, AA, AA-S) and groundwater guidance value of 50 ug/L and USEPA aquatic benchmarks of 24,000 ug/L for fish and 54,000 ug/L for invertebrates. No samples exceeded any of these levels.

Metolachlor OA – another metabolite of Metolachlor and the second most frequently detected organic compound, occurring in 95 samples from 10 sampling sites. It was detected in the same streams as Metolachlor ESA, with the exception of East Creek in Cutchogue. The highest individual sample concentration was found in Reeves Creek (3.5 ug/L) and the highest mean of detects (1.5 ug/L) in East Creek in South Jamesport. Metolachlor OA has been found to be practically non-toxic to fish and slightly to non-toxic to invertebrates (USEPA, 2006a). Standards include surface water/groundwater guidance levels of 50 ug/L and USEPA aquatic life (acute) benchmarks set at 46,550 ug/L for fish and 7,700 ug/L for invertebrates. No exceedances of these criteria were noted.

Ronstar – a pre-emergent herbicide (chemical name Oxadiazon). Found only in Brushes Creek (2 of 13 samples) at concentrations of 0.6 and 2.0 ug/L. Oxadiazon has been found to be moderately to highly toxic to fish and moderately toxic to aquatic invertebrates (USEPA, 2003c). Available criteria are limited to EPA aquatic benchmarks (acute/chronic) of 440 ug/L and 0.88 ug/L for fish and 1,090 ug/L and 30 ug/L for invertebrates. One sample from Brushes Creek exceeded the 0.88 ug/L chronic criteria for fish.

Simazine – a systemic herbicide detected in a single sample from Sawmill Creek (0.5 ug/L). Simazine is listed as being slightly toxic to fish and aquatic invertebrates but highly toxic to phytoplankton (PAN, 2015e; Extoxnet, 1996c). NYS standards include limits of 0.5 ug/L in groundwater and Class A, A-S, AA & AA-S surface waters (Sawmill Creek is a Class C waterbody). USEPA acute/chronic aquatic criteria are 3,200 ug/L and 960 ug/L for fish and 500 ug/L and 2,000 ug/L for invertebrates. The single detect from Sawmill Creek was equal to the surface water/groundwater standard limit but well below the other criteria.

Tebuthiuron – an herbicide detected in only one sample from Pipes Creek in Southold (0.3 ug/L). Tebuthiuron has been found to practically non-toxic on an acute basis to fish and aquatic invertebrates (USEPA, 1994b). The NYS groundwater criteria (50 ug/L) and USEPA acute/chronic aquatic criteria (53,000 and 9,300 ug/L for fish, 148,500 and 21,800 ug/L for invertebrates) are well above the levels of Tebuthiuron detected.

<u>Volatile Organic Compounds (VOCs)</u>:

1,1-Dichloroethene – an industrial chemical that is used in the manufacture of a variety of substances, including plastics and flame-retardant fibers. Only detected in three samples from the USGS gage station on the Peconic River (maximum level of 0.7 ug/L). As with most of the VOC and PPCP compounds detected, a specific NYS surface water or groundwater standard has yet to be developed for this chemical. The lowest concentration in the USEPA aquatic toxicity database found to affect a species, in this case green algae, were many orders of magnitude above those in the river.

Bromoform – a trihalomethane, also known as tribromomethane, that has been used as a solvent and in the manufacture of other chemicals and is a potential byproduct of disinfection by chlorine. The only bromoform detect was in Reeves Creek (0.6 ug/L) and was orders of magnitude below available aquatic toxicity criteria (for green algae).

Chlorodifluoromethane – a trihalomethane, also known as Freon-22 or R-22, that is used as a refrigerant. The chemical was detected in only one sample (0.6 ug/L) from the Peconic River site downstream from BNL. No surface water quality criteria were available for comparison.

Chloroform – another chemical belonging to trihalomethane group, chloroform is a common solvent used in laboratories and various industries. It was detected on only one occasion (0.9 ug/L), also from the Peconic River site downstream from BNL. The NYS Part 703 standards include a criteria of 7.0 ug/L for surface waters used as a source of drinking water (Class A, AA, A-S, AA-S) and for groundwater, and an aquatic toxicity EC_{50} of 270 ug/L for amphibians. All available criteria were well above the levels of chloroform detected.

Diethyl ether - Diethyl ether is a common laboratory solvent and is also often used as a starting fluid. As with some of the other VOC detects, it was only found in one sample from the Peconic River site downstream from BNL. The concentration found (8.4 ug/L) was significant in comparison to other VOC levels noted, but was well below the USEPA aquatic toxicity LC_{50} of $1X10^6$ ug/L for fish.

Freon 113 – a refrigerant also known as 1,1,2-Trichloro-1,2,2-Trifluoroethane. The chemical was commonly detected in the Peconic River at the USGS gage station (11 detects) and at Grangebel Park (5 detects) at concentrations ranging from 0.5 to 2.2 ug/L. The likely source of the Freon is a groundwater contaminant plume emanating from the former Hazeltine facility in Riverhead (SCDHS, 1992). Water quality standards for Freon-113 have been established for surface waters (Class A, AA, A-S, AA-S) and groundwater, all at a level of 5 ug/L which no sample exceeded. No aquatic toxicity criteria were found.

Methyl-tertiary-butyl-ether (MTBE) – an additive used to oxygenate gasoline. MTBE was only detected at two sites, Meetinghouse Creek (duck farm station) and Sawmill Creek, in concentrations ranging from 0.5 to 2.6 ug/L. Standards for MTBE include a NYS guidance value of 10 ug/L for surface waters used as a source of drinking water and for groundwater, and an aquatic toxicity LC_{50} of 672,000 ug/L for fish. None of the criteria were exceeded.

Propanal – also known as propionaldehyde, propanal is an industrial process chemical used in the production of other compounds such as alkyd resins. It was detected in one sample from Reeves Creek at a concentration of 16.0 ug/L. No surface water, groundwater or aquatic toxicity standards were available for propanal.

Toluene - a common solvent that is also used as an octane booster and as a reactant in the production of other materials. Toluene was found in 4 samples from two eastern north fork streams, Pipes Creek (one detect, 0.5 ug/L) and Narrow River north (3 detects, a mean of 1.8 ug/L). Water quality standards for toluene have been established for surface waters (Class A, A-S, AA, AA-S) and groundwater at a level of 5 ug/L, which no sample exceeded. The NYS standard for Class B,C surface waters and the EPA aquatic toxicity LOEC (lowest concentration causing an effect) for fish are both set at 6,000 ug/L, well above levels seen in Pipes Creek and the Narrow River.

Pharmaceuticals and Personal Care Products (PPCP):

Bisphenol A (BPA) – a synthetic organic compound used in the manufacture of plastics and epoxy resins. The only detect for BPA was in a single sample collected from the Peconic River station located downstream from the BNL wastewater discharge. No surface water or aquatic toxicity criteria could be located.

Caffeine – a stimulant drug that was detected on one occasion in each of 10 streams, including those in southern Flanders Bay (Birch Creek and Mill Creek), the western estuary (Meetinghouse Creek) and the north fork (from East Creek in South Jamesport to Narrow River in Orient). Concentrations detected ranged from 0.2 to 0.9 ug/L. No detects were noted in the Peconic River, including at the site located downstream from the BNL wastewater discharge. As caffeine residues are often associated with sewage discharges, this was unexpected. No surface water, groundwater or ecological standards have been established for caffeine.

Diethyltoluamide (DEET) – an insect repellant widely used to repel biting insects. DEET was the most widely distributed compound of the organics monitored, with one or two detections at each of 12 streams. Concentrations varied widely, from 0.2 ug/L to 44.0 ug/L. The highest levels were noted in Reeves Creek (4.7 ug/L), East Creek in South Jamesport (8.1 ug/L), Deep Hole Creek (17 ug/L) and Brushes Creek (44 ug/L). Ecological criteria established for fish and invertebrates (Costanzo *et al*, 2007) were not exceeded.

Phenytoin – an anticonvulsant drug (Dilantin) used to control seizures. Only one detect at the Peconic River site near the BNL wastewater discharge (0.2 ug/L) was noted. No standards were available for comparison.

Metals

Filtered samples for the analysis of 30 metals (listed in Appendix D2) are routinely collected from Peconic Estuary streams. During the 2010-2012 sampling period this effort yielded a total of 8,531 results. For purposes of this analysis, ten metals of concern for which water quality standards and/or recommended criteria are available, including Arsenic, Cadmium, Chromium, Copper, Lead, Nickel, Mercury, Silver, Selenium and Zinc, received the primary focus. A summary of metal detections by station, including the number and percent frequency of the analytes detected, is included in Table 15. Mean and maximum concentrations noted for each metal are included by station in Appendix E2.

Water quality criteria appropriate for comparisons with metal results include the NYS surface water standards for Class B,C waters (6 NYCRR Part 703) and the EPA aquatic life criteria for metals (USEPA, 2009). For the Class B,C criteria however, values for six of the metals evaluated (Cd, Cr, Cu, Pb, Ni, and Zn) must be derived using measured levels of hardness. Since hardness is a parameter not typically monitored under the PEP, calculation of the standard criteria for these metals was not possible. To provide some context for these results, comparisons were made with the NYS Part 703 criteria for Class A, AA fresh waters and groundwater. For a number of the EPA aquatic life criteria, which also require an input for water hardness to calculate, a value of 100 mg/L has already been incorporated. The numeric values for each water quality standard or criteria utilized, and a summary of the number of exceedances for each metal, is included in Table 16.

Arsenic - Reportable levels of arsenic were noted at all sites sampled except Goose Creek, Birch Creek and Mill Creek in southern Flanders Bay. Interestingly, in nearby Hubbard Creek, low levels of arsenic were measured in 11 of the 14 samples collected. The highest prevalence and concentrations of arsenic were generally found in creeks in north fork agricultural areas, where four sites had mean levels >5.0 ug/L (Reeves Creek, Deep Hole Creek, Halls Creek and Narrow River south). In Brushes Creek however, where pesticide residues were common, only 4 of 12 samples contained measureable levels of arsenic (mean of 1.7 ug/L).

No samples from the 23 streams monitored exceeded the acute/chronic criteria for NYS Class B,C fresh surface waters or the recommended EPA aquatic life criteria, both set at 340/150 ug/L. Only one sample, collected from the Narrow River south station (24.2 ug/L), approached the NYS standard for groundwater (25 ug/L).

Cadmium - All sample results for cadmium were below the method detection limit of 1 ug/L.

Chromium - Relatively few chromium results were greater than the method MRL (12% of all samples), and those that were reportable, were generally low in concentration (<3.0 ug/L). Ten of the streams sampled showed zero chromium detects, with eight others having either one or

Table 15. Summary of Metal Detections in Peconic Estuary Streams (2010-2012)

Station No.	Station Name	No. Samples	Metals Detected		Frequency of Detects (%) Number of Criteria Exceedances (if any)						
			No. Analytes	Total Detects	As	Cr	Cu	Pb	Ni	Se	Zn
Peconic River:											
200044	Peconic River (at BNL)	13	6	57	69.2	23.1	100	69.2 2[1]	100	0	76.9 1[2]
200010	Peconic River (at USGS Gage)	15	3	11	13.3	0	0	0	40	0	20 1[2]
200017	Peconic River (at Grangebel Park)	15	4	22	46.7	0	20	0	53.3	0	26.7 4[2]
Western Estuary Streams:											
200004	Meetinghouse Creek (Duck Farm Site)	14	5	49	100	35.7	100	0	100	0	14.3
200041	Meetinghouse Creek (at Rt. 25)	15	4	27	20	0	46.7	0	100	0	13.3 1[2]
200110	Sawmill Creek	16	5	40	68.8	12.5	31.3	0	100	0	37.5
200120	Terrys Creek	13	5	29	69.2	7.7	38.5	0	100	0	7.7
200130	Reeves Creek	5	3	15	100	0	100	0	100	0	0
200140	East Creek, SJ	12	5	32	100	0	41.7	0	100	8.3	16.7
North Fork Streams:											
200160	Brushes Creek	12	5	20	33.3	8.3	8.3	0	100	0	16.7 2[2]
200170	Deep Hole Creek	12	5	28	75	16.7	33.3	0	100	8.3	0
200180	Halls Creek	12	6	36	100	8.3	58.3	0	91.7	8.3	33.3 1[2]
200190	Downs Creek	14	5	30	57.1	0	35.7	0	100	7.1 1[3,4,5]	14.3 1[2]
200200	West Creek	8	6	17	62.5	12.5	50	12.5	50	0	25
200210	East Creek, Cutch.	12	3	15	16.7	0	16.7	0	91.7	0	0
200230	Pipes Creek	10	7	40	90	50	100	30 1[1]	100	10 1[3,4]	20
200240	Pipes Neck Creek	9	5	33	88.9	66.7	100	0	100	0	11.1 1[2]
200250	Narrow River North	10	6	46	100	50	100	70	80	0	60
200260	Narrow River South	8	7	28	87.5	25	87.5	25	87.5	12.5 1[3,4]	25
Southern Flanders Bay Streams:											
200013	Goose Creek	15	3	3	0	0	6.7	0	6.7	0	6.7
200014	Birch Creek	15	4	7	0	0	6.7	6.7	20	0	13.3 1[2]
200015	Mill Creek	15	4	6	0	6.7	13.3	0	13.3	0	6.7
200016	Hubbard Creek	15	3	17	73.3	0	0	0	33.3	0	6.7

[1] Exceedance of national recommended aquatic life criteria (chronic) for lead (2.5 ug/L)
[2] Exceedance of national recommended aquatic life criteria (chronic and acute) for zinc (120 ug/L)
[3] Exceedance of national recommended aquatic life criteria (chronic) for selenium (5 ug/L)
[4] Exceedance of the NYS surface water standard for selenium in Class B,C waters (4.6 ug/L)
[5] Exceedance of the NYS standard for selenium in Class A, AA and GA waters (10 ug/L)

Table 16. Water Quality Standards for Metal Analytes Monitored in Peconic Estuary Streams with the Number of Criteria Exceedances (2010-2012)

Compound Name	NYS Surface Water Standard (ug/L)[1]	NYS Groundwater Standard (ug/L)[1]	National Recommended Aquatic Life Criteria (ug/L)[3]		Number of Criteria Exceedances			
			Acute	Chronic	Surface Water	Groundwater	Drinking Water	Aquatic Life
Arsenic	50 (A+) 340 (a), 150 (c)	25	340	150	0	0	9	0
Cadmium	5 (A+) * (B,C)	5	2.0	0.25	nd	0	0	0
Chromium	50 (A+) * (B,C)	50	570	74	0	0	0	0
Copper	200 (A+) * (B,C)	200	**	**	0	0	0	---
Lead	50 (A+) * (B,C)	25	65	2.5	0	0	0	3
Mercury	0.7 (A+) 1.4 (a), 0.77 (c)	0.7	1.4	0.77	nd	0	0	0
Nickel	100 (A+) * (B,C)	100	470	52	0	0	0	0
Selenium	10 (A+) 4.6 (c)	10	---	5	1 (A+) 3 (B,C)	1	0	3
Silver	50 (A+) 0.1 (c)	50	3.2	---	nd	0	0	0
Zinc	2,000 (A+) * (B,C)	---	120	120	0	---	0	13

[1] NYS Surface Water and Groundwater Quality Standards – NYCRR Title 6, Chapter X, Part 703
[2] NYS Drinking Water Standards – NYCRR Title 10, Part 5, Subpart 5-1 - Public Water Systems
[3] USEPA Office of Water National Recommended Water Quality Criteria for Priority Pollutants (USEPA, 2009)
[4] Action level for treatment to control corrosion of water supply pipes
* Hardness level required to calculate the standard was not measured
** Levels of dissolved organic carbon and alkalinity required to calculate the copper standard were not measured
A+ refers to NYS Class A, AA, A-S and AA-S surface waters (those used as a source of drinking water)
B, C refers to NYS Class B and C fresh surface waters
c – chronic criteria for Class B,C waters used for fish consumption
a - acute criteria for Class B,C waters used for fish consumption
nd – not detected

two detects. Sites with the highest level of frequency (5 or 6 detects) were the Meetinghouse Creek duck farm site (a mean of 1.3 ug/L), Pipes Creek (1.6 ug/L), Pipes Neck Creek (1.6 ug/L), and Narrow River North (1.4 ug/L). No chromium results exceeded the NYS criteria for A, AA or GA waters (50 ug/L) or the EPA aquatic life criteria (570 ug/l acute; 74 ug/L chronic).

Copper - Copper was relatively prevalent (found in ~40% of samples) but generally in low concentrations in most of the streams sampled. Only two sites, the USGS gage site on the Peconic River and Hubbard Creek, did not show any results over the method MRL of 1.0 ug/L. Means of detects greater than the MRL generally ranged from 1-4 ug/L, with the exception of those at the Peconic River site downstream from BNL (22.0 ug/L) and the Narrow River south station (8.8 ug/L). The Peconic River site at BNL showed consistently elevated levels, with 11 of 13 results >10 ug/L and a maximum concentration of 58.4 ug/L.

Because the copper standard for Class C freshwaters require hardness values to calculate the criteria value, and the EPA aquatic criteria involves a calculation that includes ten input parameters including one not measured (dissolved organic carbon), the only water quality criteria for copper that was available for comparison is the NYS Part 703 standard for Class A, AA and GA waters (200 ug/L), which no samples exceeded.

Lead - The majority of lead results were below the method MRL of 1.0 ug/L, with only two sites (the Peconic River station downstream from BNL and Narrow River north), showing reportable lead levels in the majority of samples collected (~70%). Other sites where lead detections were fairly common included Pipes Creek (30%) and Narrow River south (25%). At the BNL Peconic River site, 9 of 13 samples had measureable lead levels, with a maximum value of 4.1 ug/L and a mean of 2.0 ug/L. At the Narrow River station, 7 of 10 samples were positive, with a maximum value of 2.4 ug/L and a mean of 1.6 ug/L. The highest lead concentration occurred at the Pipes Creek station (4.2 ug/L), where only 3 of 10 samples showed levels above the MRL. No samples had lead levels above standards for Class A, AA freshwaters (50 ug/L) or Class GA groundwater (25 ug/L), although two samples at the BNL Peconic River site and one sample at Pipes Creek exceeded the EPA's chronic criteria for aquatic life (2.5 ug/L).

Mercury - All sample results for mercury were below the method detection limit of 0.4 ug/L.

Nickel – Nickel was the most common metal detected, appearing in 74% of samples. The lowest frequency of detects occurred at the four southern Flanders Bay creeks (Birch, Goose, Mill and Hubbard) and at the USGS gage and Grangebel Park stations on the Peconic River. Mean concentrations were highest at the Meetinghouse Creek duck farm site (2.6 ug/L) and at the Peconic River site downstream from BNL (3.2 ug/L). Average levels at the remaining locations varied from 0.5 – 1.6 ug/L. No results exceeded the NYS nickel standard for Class A, AA and GA waters (100 ug/L) or the EPA aquatic life criteria (470 ug/L, acute; 52 ug/L, acute).

Selenium – Selenium was among the least common metals detected, with only 6 of the 23 streams sampled having a single detect above the method MRL of 4.0 ug/L. The highest concentrations were noted at Downs Creek (14.2 ug/L), Pipes Creek (5.9 ug/L) and Narrow River south (8.3 ug/L), each exceeding the NYS chronic criteria for Class B,C fresh waters (4.6 ug/L), as well as the EPA chronic criteria for aquatic life (5 ug/L).

Zinc - Concentrations of zinc above the MRL (50 ug/L) were generally infrequent (in 18% of samples), with three or less detects noted at 17 of the 23 streams sampled. The most detects (10) occurred at the BNL site on the Peconic River. Mean values ranged from 51 ug/L at Pipes Creek to 231 ug/L at the Grangebel Park station on the Peconic River, with the maximum level found in Brushes Creek (438 ug/L).

Nine streams had one or more results that exceeded the EPA aquatic life criteria for zinc (120 ug/L), including the Peconic River (USGS gage, Grangebel Park and BNL sites), Birch Creek, Meetinghouse Creek (Rt. 25 site), Brushes Creek, Halls Creek, Downs Creek and Pipes Creek (Appendix E2). The NYS zinc criteria was not applied, as hardness levels are required to calculate the Class B,C standard.

Point Source Sampling Results

The principal objective of point source monitoring in the Peconic Estuary is to track short and long-term variations in nutrient loading (CCMP, 2001). Point sources are generally considered minor sources of nitrogen to the estuary as a whole, but may be important locally. Under the Peconic Estuary Program (PEP), point source monitoring has been conducted at six discharge locations, including the wastewater treatment plants at Brookhaven National Laboratory (BNL), Grumman Aerospace, Riverhead Town, Sag Harbor Village and Shelter Island Heights, and at the Atlantis Marine World Aquarium facility in Riverhead. Past monitoring has also been conducted at a number of point source influenced sites, including a site in Meetinghouse Creek in the vicinity of the Corwin Duck Farm, in the Peconic River just downstream from the BNL discharge point, and at two locations in Fish Cove that were in the path of a plume from the Southampton Landfill.

Since 2010, only the Riverhead STP (station 200009) and Atlantis Aquarium (station 200026) point source discharges have been monitored. Point source influenced sites still sampled include station 200004 in Meetinghouse Creek (located just south of the former duck farm discharge point) and station 200044 in the Peconic River at BNL. Data for the latter two sites is addressed in the Stream Monitoring section of the report. For the Riverhead STP and the Atlantis Aquarium discharges, Table 17 includes mean values for TN (mg/L and lbs/day), NO_x-N, NH_3-N, TP, ortho-PO_4-P, total and fecal coliform bacteria and total suspended solids (TSS).

Riverhead STP

Samples from the Riverhead STP are currently collected from the disinfection tank at the plant. This was the original sampling site when routine monitoring of the discharge was initiated (circa 1976), but was moved in 1991 to a location on River Avenue adjacent to the Peconic River outfall (which became station 200092) in an effort to gain additional chlorine contact time before samples for bacterial analysis were collected. This tactic insured that coliform levels in the actual discharge (rather than at the plant) were being measured. When disinfection equipment was upgraded to UV in 2002, the sampling point was moved back to the current location at the plant and the original station designation (200009) reinstated.

<u>Nitrogen</u>

Concentrations of total nitrogen (TN) in the Riverhead STP discharge were generally less than10 mg/L, with the exception of two anomalous samples collected in July of 2010 and

Table 17. Average Values for Total & Fecal Coliforms, Nitrogen, Phosphorus and Total Suspended Solids at the Riverhead STP and Atlantis Aquarium Point Source Sampling Sites (2010-2012)

Parameter	Units	Riverhead STP	Atlantis Aquarium	Peconic River (30B)
Total Coliform	mpn/100 ml (geomeans)	445	781	225
Fecal Coliform		120	388	87
Ammonia-N	mg/L	2.76	0.38	0.07
Nitrate+Nitrite		2.98	0.91	0.08
Total Nitrogen		7.0	1.7	0.5
Total Nitrogen	lbs/day	58.1	0.053	---
Total Phosphorus	mg/L	0.87	0.21	0.08
o-Phosphate		0.73	0.19	0.03
Total Suspended Solids		21.2	---	---

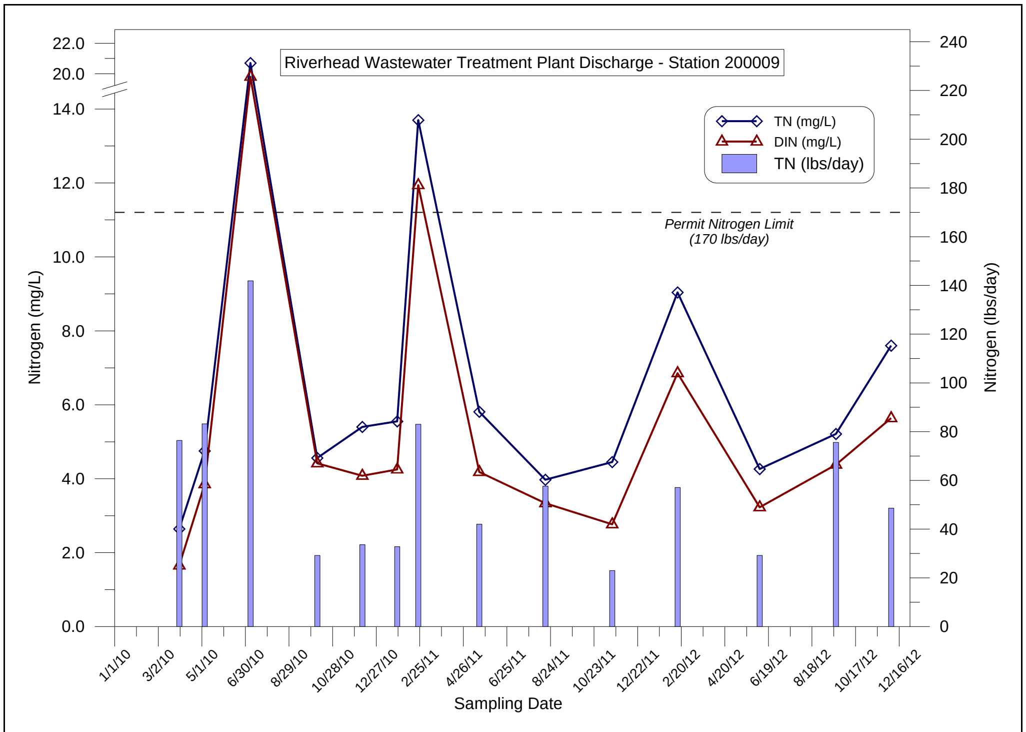
February of 2011, that had results of 20.7 and 13.7 mg/L, respectively (Figure 21). Although NO_x-N was typically the dominant form of nitrogen in the discharge, unusual spikes of NH_3-N on these two dates (19.6 and 9.1 mg/L) accounted for most of the TN.

Phosphorus

Concentrations of total phosphorus (TP), consisting primarily of dissolved ortho-phosphate (o-PO_4-P), varied from 0.10 to 2.2 mg/L (Figure 22), with a mean value of 0.87 mg/l. During 2010 and 2011, phosphorus concentrations in the effluent were generally at or below 1.0 mg/L, but during 2012, exhibited a steady increase to values greater than 2.0 mg/L. In terms of comparisons with stream sites sampled, the mean values for both TP and o-PO_4-P were similar to levels noted at the Peconic River station downstream from the BNL discharge, and as with TN, second only to the Meetinghouse Creek duck farm site in magnitude.

Coliform Bacteria

Concentrations of both total and fecal coliforms varied widely in the STP effluent, ranging from <20 to >16,000 mpn/100 ml (Figure 23). The highest levels were noted on the same two dates as the elevated NH_3-N and TN peaks previously mentioned (7/7/10 and 2/23/11). Geometric means for both parameters (445 and 120 mpn/100 ml) were low in comparison to levels found in



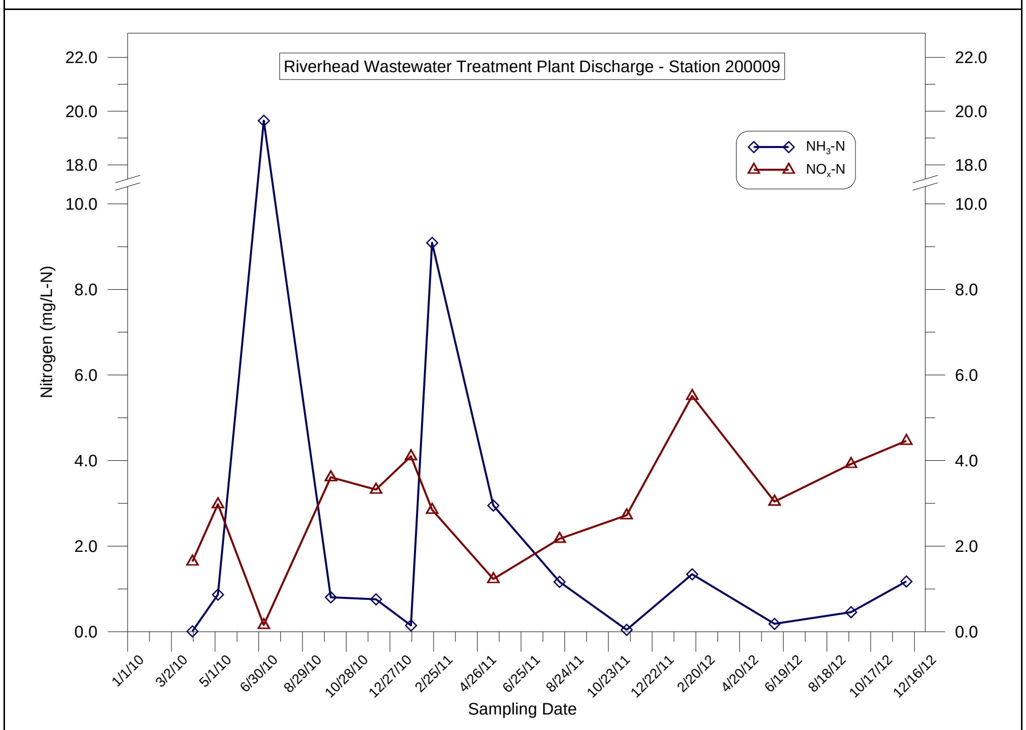


Figure 21. Temporal Variations in Concentrations of Total Nitrogen (TN), Dissolved Inorganic Nitrogen (DIN), Nitrate+Nitrite (NO_x-N) and Ammonia (NH_3-N) in the Riverhead STP Discharge (2010-2012)

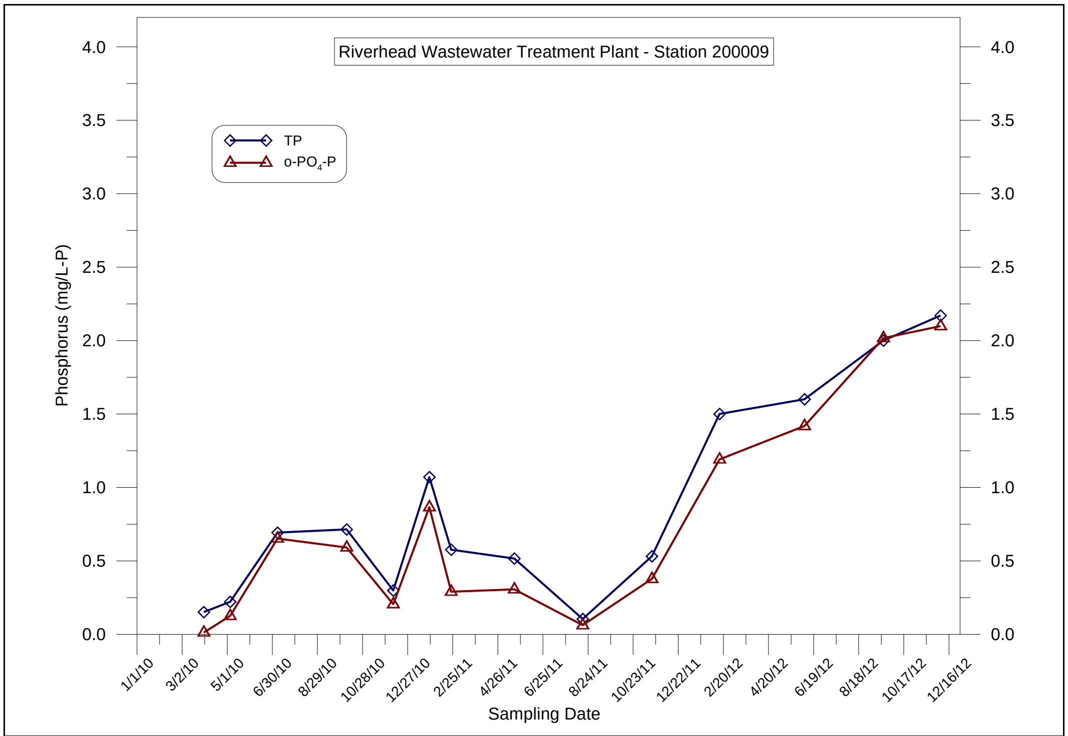


Figure 22. Temporal Variations in Concentrations of Total Phosphorus (TP) and Ortho-phosphate (o-PO_4-P) in the Riverhead STP Discharge (2010-2012)

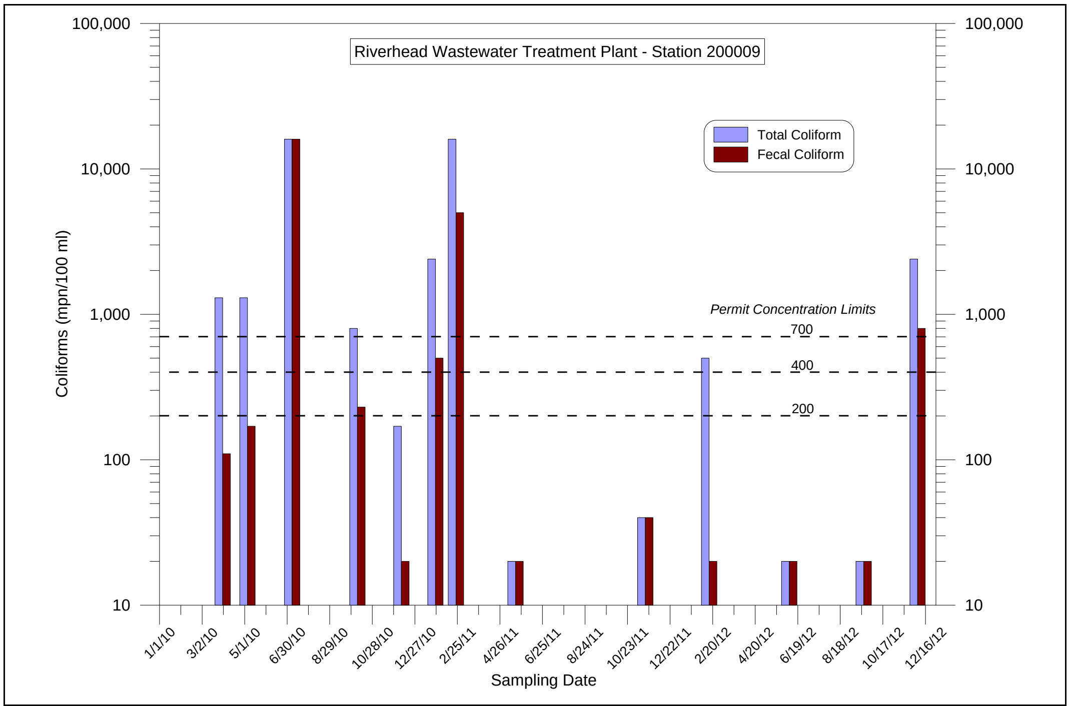


Figure 23. Temporal Variations in Total and Fecal Coliform Levels in the Riverhead STP Discharge (2010-2012)

most of the streams monitored, particularly those located in the western estuary and on the north fork.

Atlantis Aquarium

Monitoring of the Atlantis Aquarium discharge (sta. 200026) was initiated in 2001. For purposes of comparison with the discharge data, samples of the Peconic River source water utilized by the aquarium is collected from a bottom location just off the facility's dock (station 200030B). During the 2010-2012 sampling period, the aquarium was sampled on 13 occasions.

Nitrogen

Concentrations of TN in the Aquarium discharge were widely variable, ranging from 0.45 to 5.0 mg/L, with a mean value of 1.7 mg/L (Figure 24, Table 17). The nitrogen was predominantly comprised of DIN, which mostly consisted of NO_x-N. Using an average flow of 3,800 gal/day (ECHO, 2014), the nitrogen load from the facility averaged a minimal 0.053 lbs/day over the three year study period.

Coliform Bacteria

Total and fecal coliform concentrations in the aquarium discharge also exhibited a wide range of concentrations, varying from <20 mpn/100 ml to >16,000 mpn/100 ml. Geometric means for the two parameters were 781 and 388 mpn/100 ml, respectively (Table 17). Compared to values for estuary streams monitored and the Riverhead STP discharge, these values are relatively high. Only four of the stream sites monitored had higher mean total coliform levels, with only one showing a higher fecal level. In past years it was suggested by some that elevated coliform levels in the discharge may be associated with contaminated Peconic River source water rather from aquarium activities. This assertion was the primary reason for adding station 200030B, located in the river just off the aquarium dock, as a routine monitoring site. A comparison of the average aquarium discharge values for nitrogen and coliform bacteria with those of station 200030B (Table 17), leaves little doubt that elevated levels in the discharge do not have the river as their source.

SPDES Compliance

The NYSDEC regulates discharges to groundwater and surface waters under the State Pollutant Discharge Elimination System (SPDES) program, through the issuance of wastewater

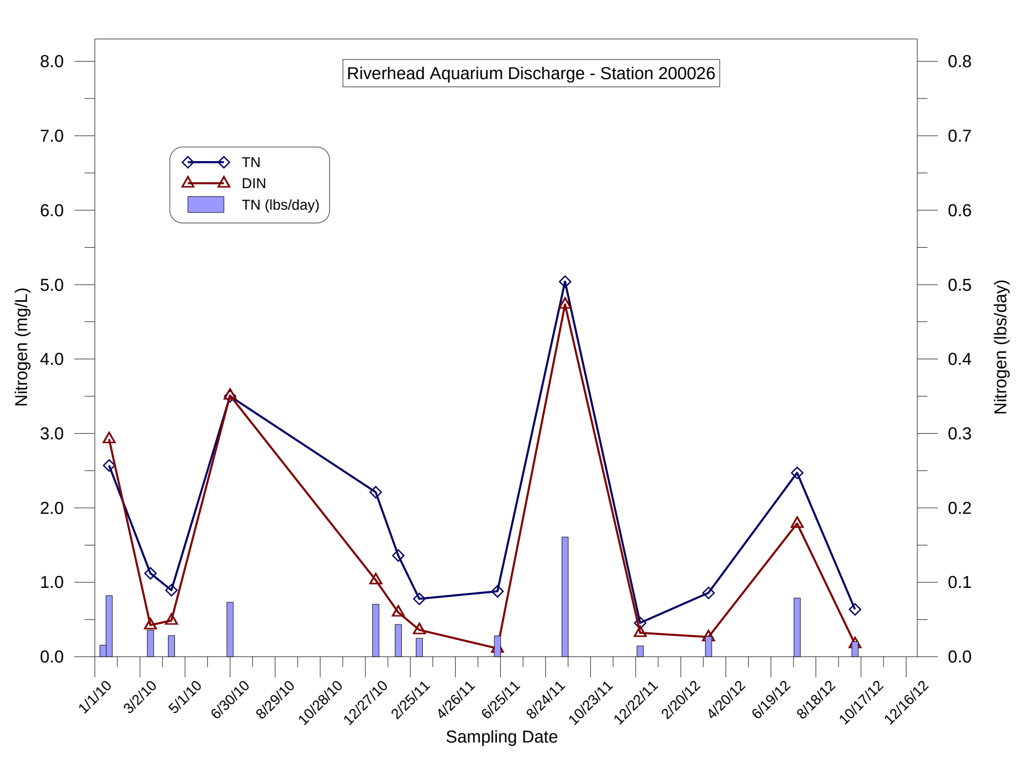


Figure 24. Temporal Variations in Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in the Atlantis Aquarium Discharge (2010-2012)

discharge permits. The permits specify the monitoring to be conducted and require the periodic submittal of Discharge Monitoring Reports (DMR) showing results of any testing done.

Riverhead STP

The SPDES permit for the Riverhead STP requires quarterly monitoring of total and fecal coliform bacteria, total nitrogen (TN) and total suspended solids (TSS). Total coliform limits include a monthly median of no more than 700/100 ml; fecal limits include a 30-day geometric mean of no more than 200/100 ml, as well as a 7-day geometric mean of no more than 400/100 ml (Table 18). For TN, the permit limit is a monthly average, in lbs/day, of no more than 170. The TSS limits are a monthly average of 325 mg/L and a 7-day arithmetic mean of no more than 488 mg/L.

According to facility reports obtained through the ECHO website (referencing testing done by the facility or its agents), five results for total coliform, twelve results for fecal coliform and four results for TSS exceeded permit limits during 2010-2012. The 2010-2012 Suffolk County data

Table 18. Coliform, Nitrogen and Suspended Solids Permit Standards for the Riverhead STP and Atlantis Aquarium Discharges, with the Number of Criteria Violations (2010-2012)

			Permit Concentration Limit		Number of Violations			
					ECHO		SC Data	
Parameter	Units	Statistic	STP	Aquarium	STP	Aquarium	STP	Aquarium
Total Coliform	No./100 ml	Monthly Median	700	700	5	1	7	6
Fecal Coliform	No./100 ml	30-Day GM	200	200	3	2	5	8
		7-Day GM	400	400	9	1	4	6
Total Nitrogen	lbs/day	Monthly Average	170	4	0	No data	0	0
Total Suspended Solids	mg/L	Monthly Average	325	Not Required	1	---	0	---
		7-Day AM	488		3		0	

also shows several permit limit violations for total and fecal coliforms (Figure 23), but none for TSS or TN (Figure 21). Seven samples exceeded the total coliform limit of 700/100 ml, five were above the 200/100 ml criteria for fecal coliform and four exceeded the 400/100 ml fecal threshold (Figure 23, Table 18).

Atlantis Aquarium

The SPDES permit for the Aquarium discharge requires quarterly monitoring of total and fecal coliforms (same limits as the STP permit), as well as chlorine residual. It is not clear if nitrogen monitoring is required under the aquarium's permit. Some charts on the ECHO website include it as a parameter (with a limit of 4 lbs/day), but no data was available.

In terms of permit violations, the ECHO report for monthly samples collected by the facility between 2010 and 2012 indicate one result exceeded the total coliform limit and three results exceeded the fecal coliform limit. The Suffolk County monitoring data also shows a number of coliform criteria violations, including 6 of 12 samples over the 700/100 ml total coliform limit, 8 samples greater than the 200/100 ml limit and 6 exceeding the 400/100 ml limit (Table 16). No sample results were greater than the 4 lbs/day nitrogen level.

Comparisons with Historical Data

In an effort to gauge water quality conditions in the estuary in an historical context, key parameter results from the prior two decades (1990-1999 and 2000-2009) at select marine, stream and point source sites were summarized for comparison with the 2010-2012 data. It should be noted, that due to the limited frequency of sampling during some years, particularly at a number of stream stations, some of the inter-annual comparisons may suggest over-all trends that are not necessarily statistically significant. To highlight years where means were based on limited data sets, the number of cases for each year is shown on the various long-term plots included in Appendix F.

Marine Stations

The marine sites examined included eight main-stem/main-bay locations that generally received the bulk of the sampling effort (the Peconic River mouth, Flanders Bay, Great Peconic Bay, Little Peconic Bay, Shelter Island Sound, Orient Harbor, western Gardiners Bay and Northwest Harbor) and two sites that are unique because of past water quality issues (Meetinghouse Creek and West Neck Bay). Parameters were limited to key monitoring constituents, including dissolved oxygen, total nitrogen and chlorophyll-a. Graphics depicting mean annual results, as well as the distribution of results over the 23-year period, are included in Appendix F1 and below as necessary.

<u>Dissolved Oxygen</u>

Over the two-plus decades examined, very little in the way of trends was apparent in year to year fluctuations of dissolved oxygen. Average annual concentrations generally varied over a narrow range (8-9 mg/L), with a few exceptions occurring in the mid-2000's when values at some sites approached 10 mg/L (Figure 25). Mean summer values also showed little temporal pattern (Table 19), although it's difficult to attach any significance to these inter-annual comparisons due to the limited number of summer samples collected post-1998. Scatterplots constructed for each of the ten stations (Appendix F1) similarly indicate a lack of any significant long-term tendency in concentrations. A number of the linear trend lines on the plots have slopes that are somewhat positive (indicating an increasing trend), while others are either horizontal or slightly negative, but none indicate a strong relationship.

As with the 2010-2012 year-round data, long-term summer DO concentrations were lowest at the westernmost sites with levels at main-bay sites east of Flanders Bay showing little variation.

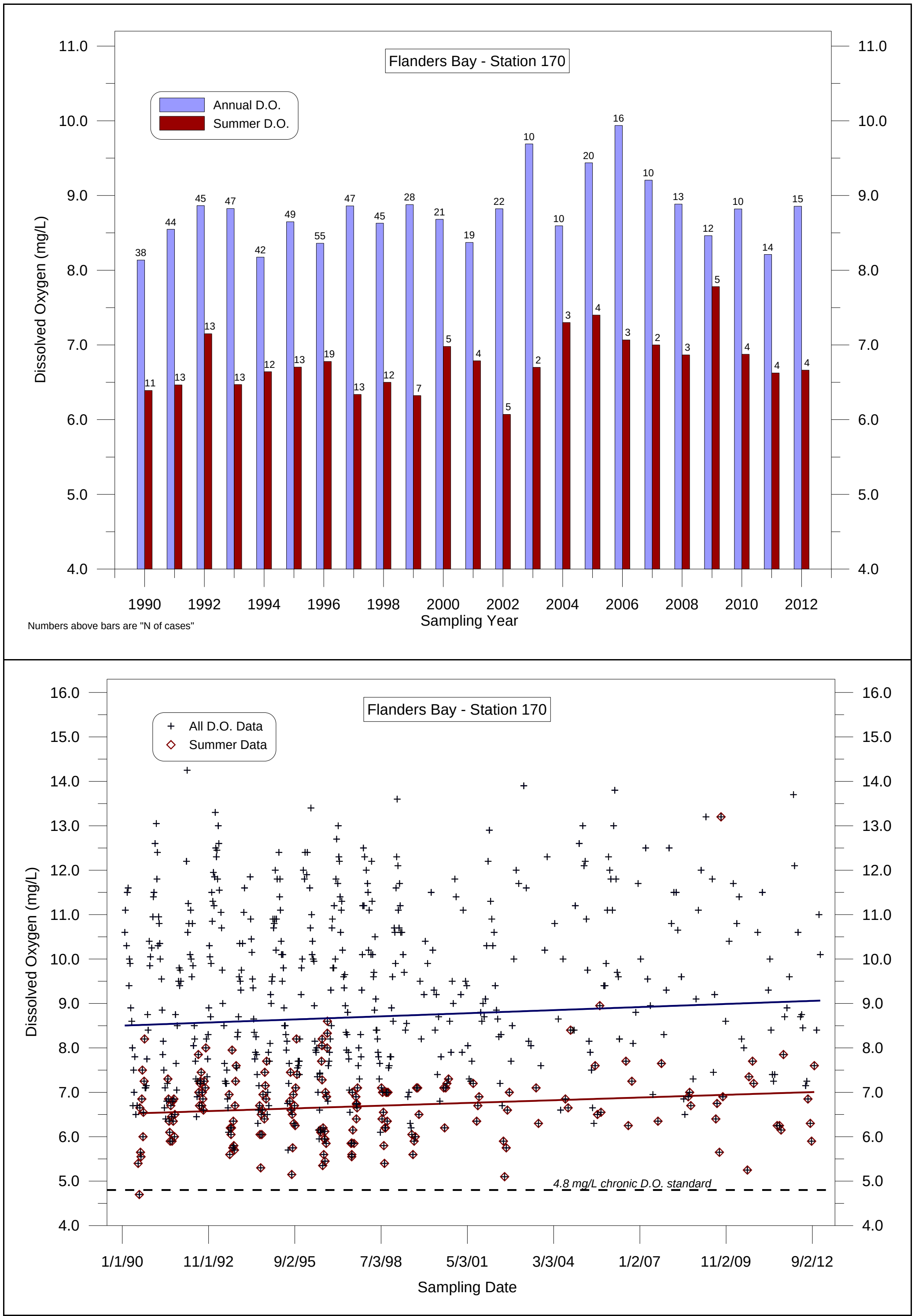


Figure 25. Annual and Summer Means (top) and Data Scatterplot (bottom) for Dissolved Oxygen Levels at Flanders Bay Station 060170 (1990-2012)

Table 19. Mean Summer Dissolved Oxygen (DO) Concentrations at Select Main-Bay and Western Estuary Stations During the 1990-1999, 2000-2009 and 2010-2012 Sampling Periods with the Percentage of Results Below the 4.8 mg/L Chronic and 3.0 mg/L Acute NYS Standards

Station No.	Location	Mean Surface DO (mg/L)			% Surface Results < 4.8 / <3.0 mg/L			Mean Bottom DO (mg/L)			% Bottom Results < 4.8 / <3.0 mg/L		
		90-99	00-09	10-12	90-99	00-09	10-12	90-99	00-09	10-12	90-99	00-09	10-12
060220[1]	Meetinghouse Creek	5.4	5.4	5.2	**54** / **14**	**53** / **11**	**50** / **8**	2.8	2.9	2.8	**84** / **55**	**89** / **53**	**83** / **75**
060240[1]	Peconic River Mouth	6.2	6.4	6.6	**12** / 0	**6** / 0	**8** / 0	5.0	4.8	5.2	**43** / **4**	**40** / 0	**33** / **8**
060170[1]	Flanders Bay	6.6	6.9	6.7	**1** / 0	0 / 0	0 / 0	6.3	6.2	6.1	0 / 0	0 / 0	0 / 0
060130	Great Peconic Bay	6.5	6.9	6.7	0 / 0	0 / 0	0 / 0	5.8	6.3	6.2	**12** / **1**	**3** / 0	0 / 0
060101	East Creek, South Jamesport	5.8	6.2	6.0	**19** / **4**	**17** / 0	**36** / 0	4.4	5.8	5.0	**60 / 20**	**22** / 0	**45 /** 0
060113	Nassau Point	6.2	6.5	6.6	0 / 0	0 / 0	0 / 0	6.1	6.3	6.4	0 / 0	0 / 0	0 / 0
060114	Paradise Point	6.4	6.5	6.6	0 / 0	0 / 0	0 / 0	6.2	6.5	6.5	**3** / 0	0 / 0	0 / 0
060115	Orient Harbor	6.4	6.6	6.7	0 / 0	0 / 0	0 / 0	6.4	6.6	6.7	**1** / 0	0 / 0	0 / 0
060116	Gardiners Bay West	6.6	6.6	6.7	0 / 0	0 / 0	0 / 0	6.5	6.6	6.7	0 / 0	0 / 0	0 / 0
060118	Northwest Harbor	6.6	6.6	6.6	0 / 0	0 / 0	0 / 0	6.5	6.6	6.5	0 / 0	0 / 0	0 / 0
060119	West Neck Bay	6.5	6.8	6.3	**2** / 0	0 / 0	**18** / 0	5.5	5.3	5.9	**19** / **1**	**30** / **5**	**18** / 0

[1] Results for diurnal (AM/PM) sampling at these sites were averaged into daily means before computing the long-term means

In terms of the NYS dissolved oxygen standards (6 NYCRR, Part 703), Meetinghouse Creek shows a long history of an extreme level of violations of both the chronic (4.8 mg/L) and acute (3.0 mg/L) criteria in surface and bottom samples (Table 19). Similarly, the Peconic River mouth station has continued to show occasional surface and frequent bottom water violations of the chronic standard, as well as occasional bottom water violations of the acute criteria. In Great Peconic Bay where no surface violations occurred, bottom water violations were frequent in the 1990-1999 decade, occasional in 2000-2009 and absent in 2010-2012. In West Neck Bay, where minor surface violations occurred during the summers of 1993 and 1994, no additional excursions were recorded until recently, when violations of the 4.8 mg/L criteria were noted in July of 2010 and August of 2012. Bottom water violations at the West Neck Bay site however, have occurred frequently through the years and continued to occur in 2010-2012.

For the remainder of the ten sites examined, oxygen levels indicative of good water quality were the norm throughout the prior two decades and continued to be so through 2010-2012. During the 23-year interval, a single surface DO violation occurred at only three of the sampling locations (out of more than 100 samples at each site), including Flanders Bay (4.7 mg/L in July, 1990), Orient Harbor (4.6 mg/L in August 1998) and Northwest Harbor (4.7 mg/L in August 1998). No excursions have occurred at any of these sites since.

Nitrogen

An examination of annual TN means over the 23-year period, reveals an estuary-wide pattern where concentrations increased during the mid to late 1990's and then declined significantly into the next decade to levels that have remained relatively stable since. With the exception of Meetinghouse Creek, where dissolved inorganic nitrogen (DIN) was the major nitrogen constituent, fluctuations in the level of TN has predominantly been due to changing concentrations of dissolved organic nitrogen (DON).

To illustrate typical long-term nitrogen fluctuations, Figure 26 shows annual means for TN, DIN and DON at two sites at opposite ends of the system, station 170 in Flanders Bay and station 116 in western Gardiners Bay. As the graphic shows, average TN levels in Flanders Bay were in the 0.3-0.5 mg/L range during the 1990's and generally fluctuated in the 0.2-0.3 mg/L range thereafter. In Gardiners Bay the differences weren't as pronounced, with average levels in the 1990's in the 0.2-0.4 mg/L range and those thereafter in the 0.15-0.30 mg/L. The TN scatterplots for these locations (Figure 27), similarly show a trend of declining magnitude over

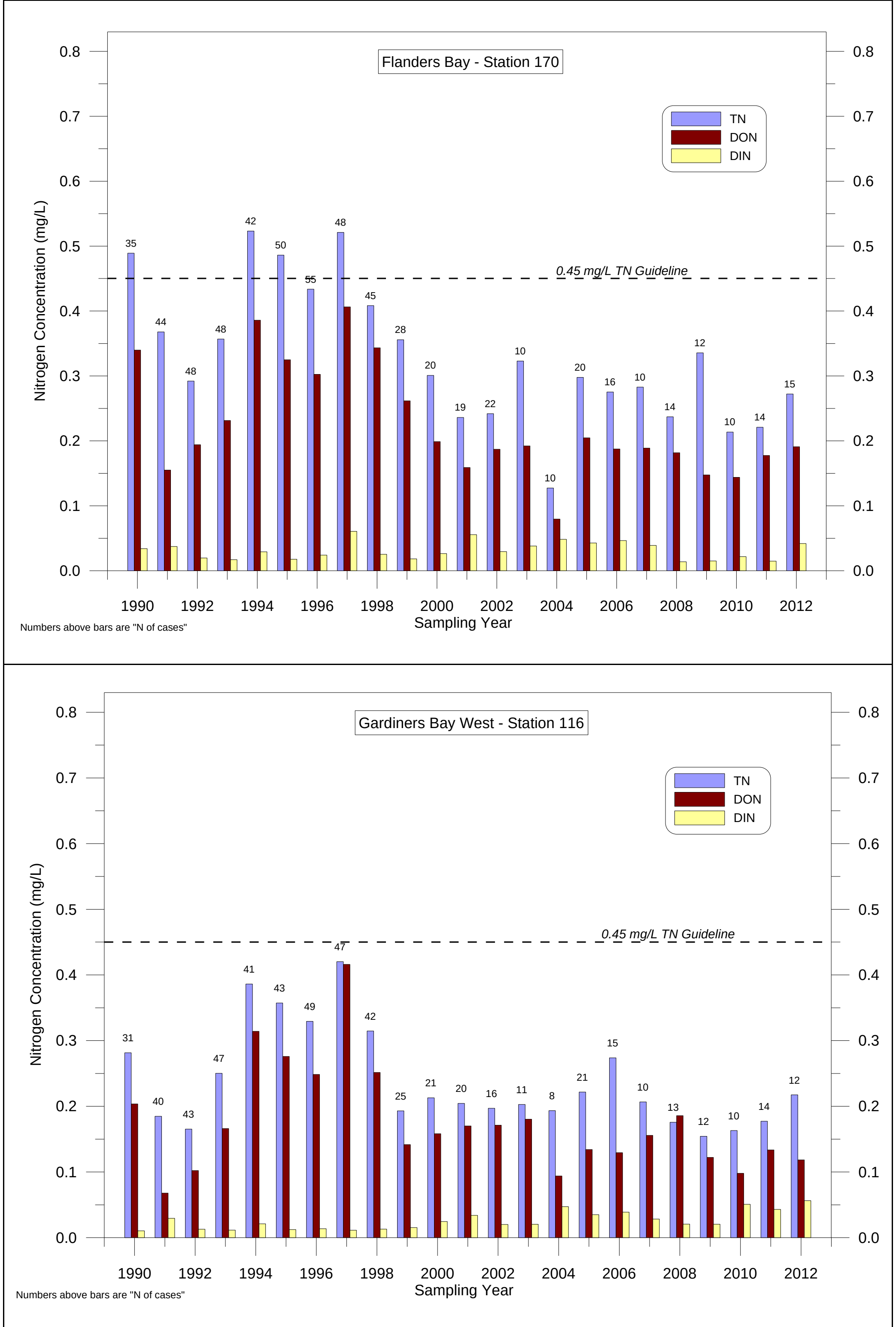
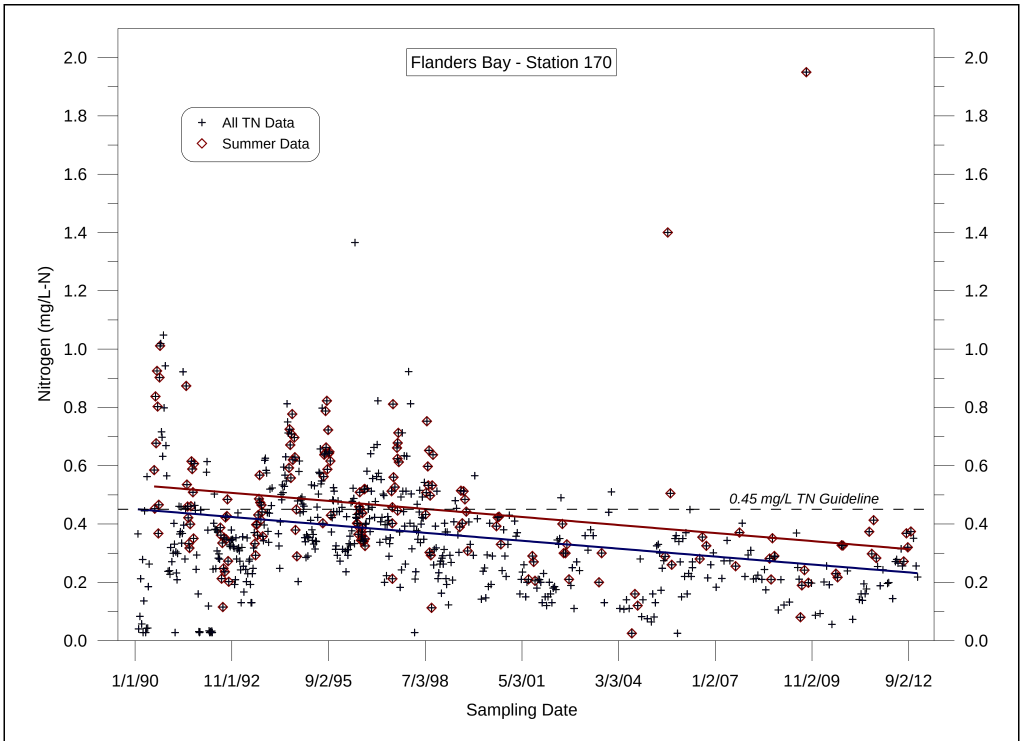


Figure 26. Annual Means for TN, DON and DIN in Flanders Bay and Western Gardiners Bay (1990-2012)



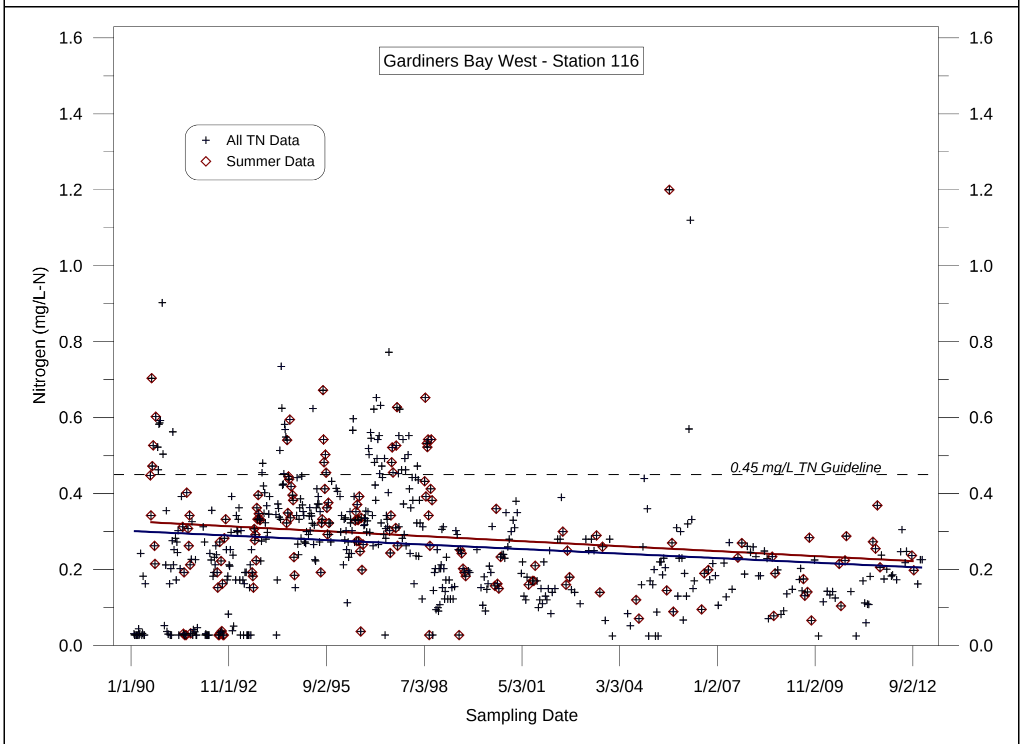


Figure 27. Annual and Summer Total Nitrogen (TN) Scatterplot for Flanders Bay and Western Gardiners Bay (1990-2012)

the two plus decades for both annual and summer values.

In terms of summer conditions (Table 20), the percent decline in TN from the decade of the 1990s to the 2010-2012 sampling period ranged from 25-40% along the main-stem (from the Peconic River mouth through Gardiners Bay). The highest rate of decline was noted in Meetinghouse Creek (55%), with the lowest interestingly occurring in East Creek in S. Jamesport (22%). A significant decline in the number of samples exceeding the 0.45 mg/L TN guideline similarly occurred throughout much of the estuary. The only exception was Meetinghouse Creek, where exceedances remained extreme at 100%. Other western estuary sites, although exhibiting a significant decline in percent exceedances, remained comparatively elevated, including the Peconic River mouth (42%) and East Creek (64%). In Flanders Bay however, percent exceedances declined from 54% of results in 1990-1999 to 0% in 2010-2012.

<u>Chlorophyll-a</u>

As shown in historical plots (Appendix F1), long-term trends in mean chlorophyll-a concentrations were generally not apparent, other than periodic spikes that occurred during the mid to late 1990's and again during the last decade. As to an explanation for the increases, there is little doubt that some are associated with the two major algal blooms that have impacted the system – the brown tides during the 1990's (caused by *Aureococcus anophagefferens*), and more recently, the rust tides caused by *Cochlodinium polykrikoides*. In Flanders Bay and West Neck Bay, the summer chlorophyll-a peaks that were recorded in 1991 and 1995 coincide well with the estuary-wide brown tide blooms that occurred during those years (Figure 28 and Figure 29). Similarly, the summer chlorophyll-a peak shown for West Neck Bay in 1992 (and not for Flanders Bay) coincides with a brown tide that was limited to that embayment. Unfortunately, because cell counts during rust tides were not regularly conducted by the SCDHS, it's not possible to directly associate observed chlorophyll peaks with bloom occurrences. *Cochlodinium* was first identified in West Neck Bay in 2002, and has bloomed at various sites throughout the estuary since 2004. Coincident peaks in chlorophyll-a levels during those years are likely due to the rust tide (reports of other blooms being absent), but can't be verified with available data.

On a spatial scale, summer chlorophyll levels have long been elevated at the western estuary sites examined (Meetinghouse Creek, Peconic River mouth and Flanders Bay) as well as in West Neck Bay, and continued to be so in 2010-2012 (Table 21). Along the main-stem of the

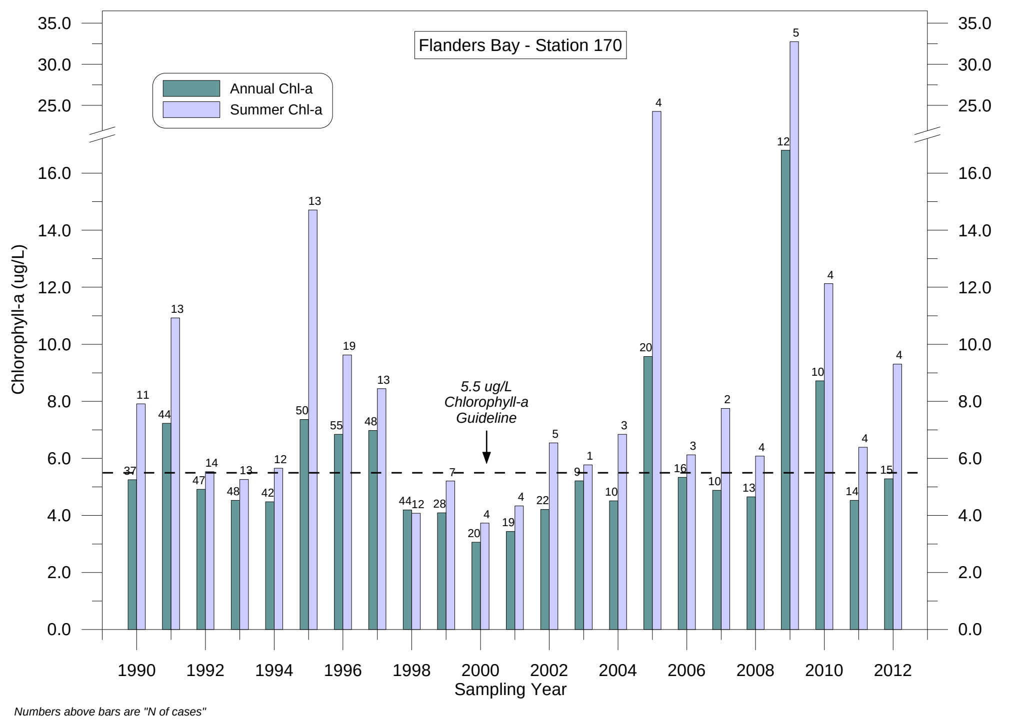
Table 20. Mean Summer Total Nitrogen (TN) Concentrations at Select Main-Bay and Western Estuary Stations During the 1990-1999, 2000-2009 and 2010-2012 Sampling Periods With the Percentage of Results Exceeding the 0.45 mg/L TN guideline

Station No.	Location	Mean Summer TN (mg/L)			% TN Results >0.45 mg/L		
		90-99	00-09	10-12	90-99	00-09	10-12
060220	Meetinghouse Creek	3.1	1.5	1.4	100	97.2	100
060240	Peconic River Mouth	0.70	0.40	0.43	94.7	22.2	41.7
060170	Flanders Bay	0.50	0.35	0.32	54.0	8.3	0
060101	East Creek, South Jamesport	0.67	0.44	0.52	89	26	64
060130	Great Peconic Bay	0.43	0.27	0.28	42.2	8.1	8.3
060113	Nassau Point	0.42	0.24	0.28	40.4	2.7	0
060114	Paradise Point	0.38	0.20	0.25	30.8	2.8	0
060115	Orient Harbor	0.35	0.21	0.26	20.1	2.9	0
060116	Gardiners Bay West	0.32	0.22	0.24	18.9	2.9	0
060118	Northwest Harbor	0.33	0.20	0.23	25.7	5.6	0
060119	West Neck Bay	0.54	0.29	0.38	69.1	2.7	18.2

estuary, concentrations have typically declined eastward as tidal flushing increases, with levels in Gardiners Bay ranging from 80-90% lower than those in the mouth of the Peconic River. When decadal periods are considered, recent (2010-2012) values at most sites were generally greater than those seen during the previous decade (although those in Flanders Bay declined somewhat) and similar to those seen during the 1990's. The rate of exceedances of the recommended guideline (5.5 ug/L) followed a similar pattern, increasing above percentages noted in 2000-2009 to levels comparable to those seen in the 1990's.

Stream and Point Source Stations

Twenty-three of the 24 stream stations were used in the historical comparison (station 200030 was excluded due to a lack of historical data), with the Riverhead STP discharge the lone point source included. Comparisons included long-term and annual nitrogen fluctuations (TN, DIN and where applicable, DON), and general observations on changes in organic and metal detections in streams.



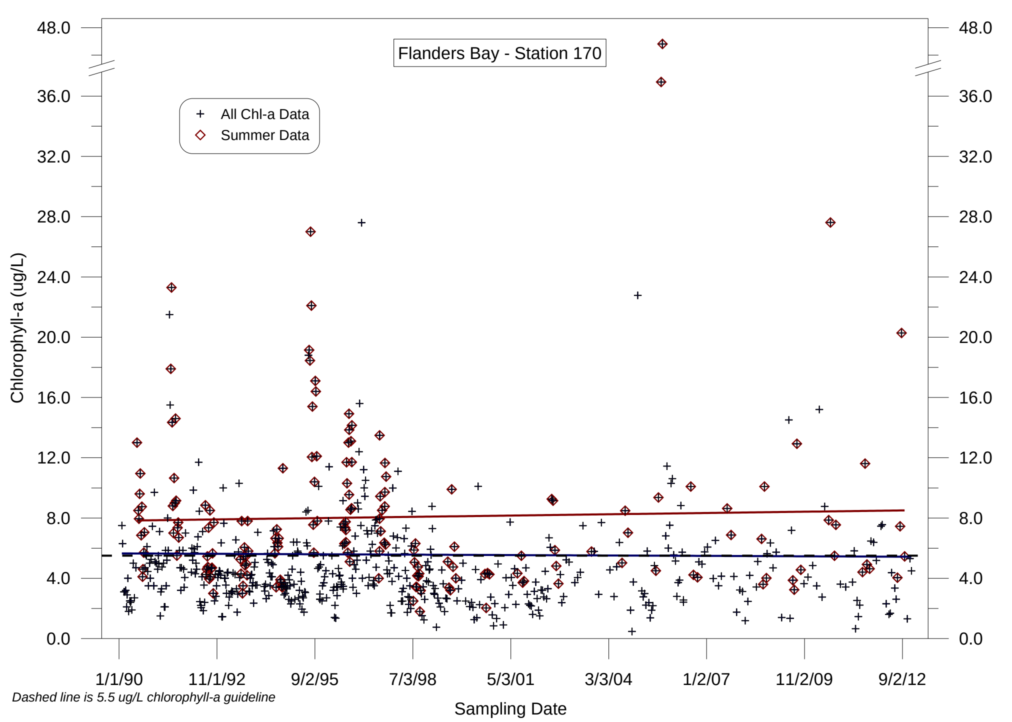


Figure 28. Average Annual and Summer (Jul-Sept) Concentrations of Chlorophyll-a in Flanders Bay (1990-2012)

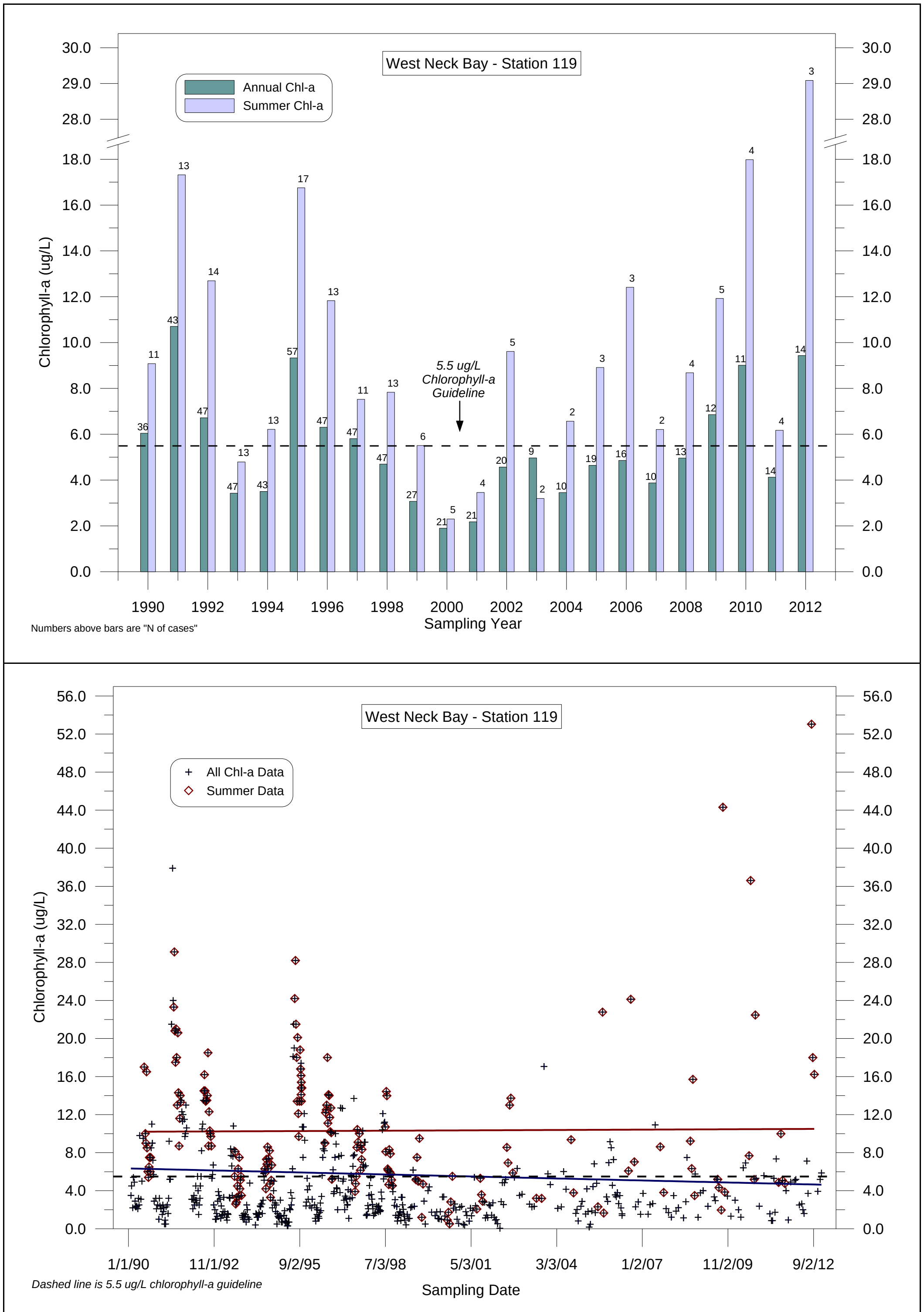


Figure 29. Average Annual and Summer (Jul-Sept) Concentrations of Chlorophyll-a in West Neck Bay (1990-2012)

Table 21. Mean Summer Chlorophyll-a Concentrations at Select Main-Bay and Western Estuary Stations During the 1990-1999, 2000-2009 and 2010-2012 Sampling Periods With the Percentage of Results Exceeding the 5.5 ug/L Guideline							
Station No.	Location	Mean Summer Chlorophyll-a (ug/L)			% Chlorophyll-a Results >5.5 ug/L		
		90-99	00-09	10-12	90-99	00-09	10-12
060220	Meetinghouse Creek	38.6	30.7	31.2	100	91	100
060240	Peconic River Mouth	16.6	15.0	19.3	98	89	100
060170	Flanders Bay	8.0	11.7	9.3	65	46	50
060130	Great Peconic Bay	5.8	3.9	5.1	33	15	33
060113	Nassau Point	6.4	4.2	5.8	41	19	42
060114	Paradise Point	4.9	2.9	4.2	23	6	18
060115	Orient Harbor	4.5	2.9	6.6	23	6	18
060116	Gardiners Bay West	3.1	1.8	3.1	12	0	10
060118	Northwest Harbor	4.0	3.0	4.7	18	3	20
060119	West Neck Bay	10.5	7.5	16.7	79	43	64

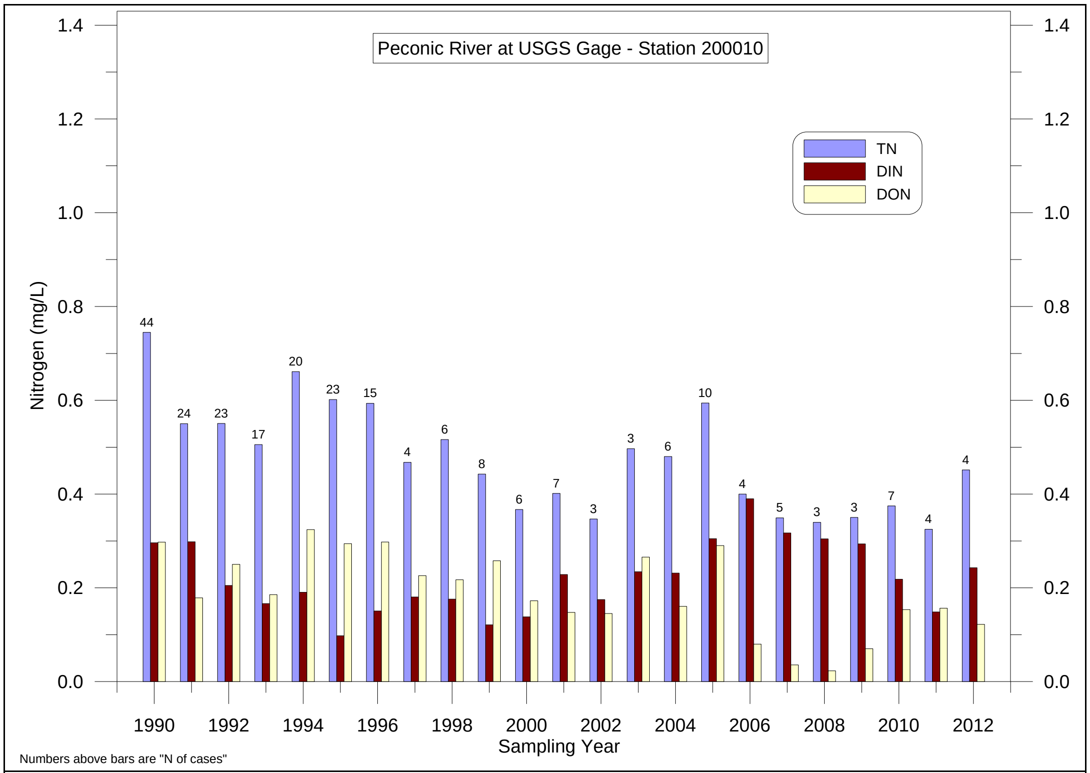
Nitrogen

Graphics depicting annual mean concentrations of TN, DIN and DON, as well as the distribution (scatterplot) of data points over the 1990-2012 sampling period, are included in Appendix F2. Not unexpectedly, with the mix of land uses involved (residential, agricultural, open space, etc), the magnitude and pattern of long-term fluctuations in nitrogen concentrations varied widely among the streams examined (Table 22).

Peconic River – At the USGS gage station (200010), average TN concentrations during the 2010-2012 sampling period were somewhat lower than those recorded for the site during the prior decade, but considerably lower than the average seen during the 1990's. This is also borne out in the scatterplots (Figure 30), which show a long-term declining trend in TN levels, although little change is apparent in concentrations of DIN and DON. At the Grangebel Park station (200017), TN levels were somewhat higher in 2010-2012, but similarly exhibited a long-term declining trend. At the site downstream from the BNL discharge (station 200044), little pattern was evident other than TN (mostly NO_x-N) being elevated compared to other Peconic River sites (likely due to its proximity to the BNL wastewater discharge), and that levels seen in 2012 (mean >6 mg/L) were the highest recorded since monitoring began in 2002.

Table 22. Historic Mean Nitrogen Concentrations in Peconic Estuary Streams

Station No.	Location	Total Nitrogen (mg/L)			DIN (mg/L)			DON (mg/L)			NOx-N (mg/L)		
		90_99	00_09	10_12	90_99	00_09	10_12	90_99	00_09	10_12	90_99	00_09	10_12
200004	Meetinghouse Creek (at Crescent Duck Farm)	16.0	10.5	9.3	14.9	10.67	9.16	1.3	0.27	0.45	5.99	6.18	7.39
200010	Peconic River at USGS Gage	0.61	0.43	0.38	0.211	0.260	0.206	0.26	0.16	0.15	0.171	0.221	0.160
200013	Goose Creek	---	0.41	0.31	---	0.284	0.319	---	0.15	0.01	---	0.267	0.301
200014	Birch Creek	---	0.13	0.13	---	0.138	0.022	---	0.04	0.10	---	0.123	0.009
200015	Mill Creek	---	0.16	0.14	---	0.137	0.035	---	0.05	0.21	---	0.122	0.020
200016	Hubbard Creek	---	0.23	0.07	---	0.210	0.047	---	0.06	0.04	---	0.189	0.022
200017	Peconic River at Grangebel park	0.61	0.49	0.47	0.244	0.307	0.302	0.27	0.17	0.15	0.178	0.255	0.238
200041	Meetinghouse Creek at Rt. 25	8.3	6.9	4.3	7.64	6.43	4.06	0.16	0.46	0.26	7.33	6.17	3.89
200044	Peconic River (at BNL)	---	4.0	4.3	---	3.35	4.27	---	0.59	0.15	---	3.26	4.19
200110	Sawmill Creek	1.0	0.83	1.0	0.392	0.452	0.571	0.46	0.27	0.38	0.296	0.319	0.332
200120	Terrys Creek	2.3	2.6	3.0	1.89	2.30	2.88	0.33	0.30	0.14	1.85	2.24	2.81
200130	Reeves Creek	4.6	5.5	4.8	4.16	5.16	4.56	0.29	0.37	0.55	4.13	5.11	4.51
200140	East Creek, SJ	4.4	4.3	4.1	3.85	4.07	3.91	0.44	0.23	0.22	3.73	3.92	3.77
200160	Brushes Creek	4.3	5.4	4.7	3.95	5.18	4.73	0.31	0.44	0.27	3.92	5.11	4.64
200170	Deep Hole Creek	2.09	2.71	4.03	1.51	2.32	3.99	0.41	0.47	0.26	1.44	2.21	3.93
200180	Halls Creek	2.4	2.0	1.2	1.73	1.48	1.07	0.57	0.43	0.15	1.64	1.43	0.993
200190	Downs Creek	5.1	3.4	2.3	4.61	3.31	2.33	0.38	0.25	0.05	4.59	3.27	2.24
200200	West Creek	2.3	1.9	2.6	1.11	0.822	2.03	0.90	0.92	0.61	1.05	0.642	1.80
200210	East Creek (Cutchogue)	3.9	3.1	1.6	3.53	2.84	1.42	0.31	0.28	0.32	3.47	2.83	1.37
200230	Pipes Creek	1.3	0.99	0.84	0.177	0.358	0.188	0.99	0.55	0.55	0.125	0.193	0.112
200240	Pipes Neck Creek	1.1	0.83	0.71	0.166	0.248	0.343	0.94	0.56	0.37	0.113	0.161	0.208
200250	Narrow River North	1.5	1.3	1.4	0.494	0.335	0.639	0.82	0.64	0.79	0.361	0.139	0.435
200260	Narrow River South	5.0	2.3	1.5	4.25	2.13	1.16	0.44	0.41	0.50	4.21	2.07	1.04



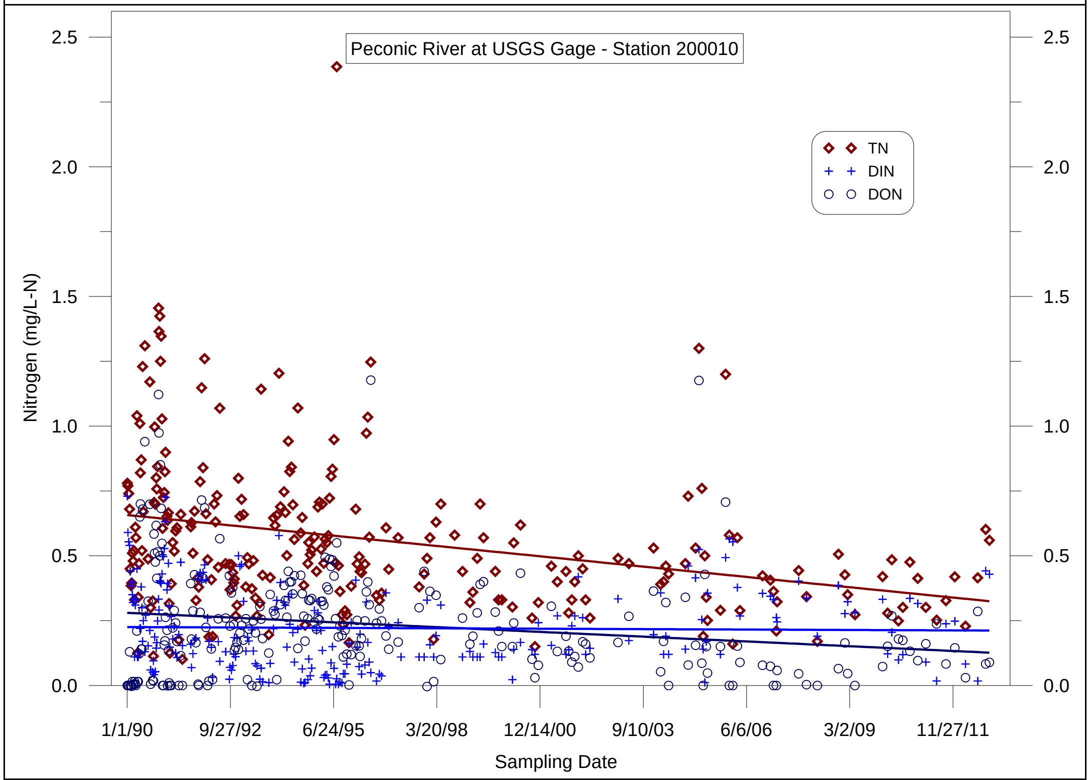


Figure 30. Annual Means and Data Scatterplot for Total Nitrogen (TN), Dissolved Inorganic Nitrogen (DIN) and Dissolved Organic Nitrogen (DON) at Peconic River Station 200010 (1990-2012)

Southern Flanders Bay Stations – The four creeks in southern Flanders Bay (Goose Creek, Birch Creek, Mill Creek and Hubbard Creek) have consistently been among the lowest in TN and DIN in the system, reflecting the lower concentrations characteristic of area groundwater (SCDHS, 1999a). Little pattern in concentration has been evident since monitoring of these creeks was initiated in 2002, other than in Hubbard Creek, where both parameters have steadily declined in concentration.

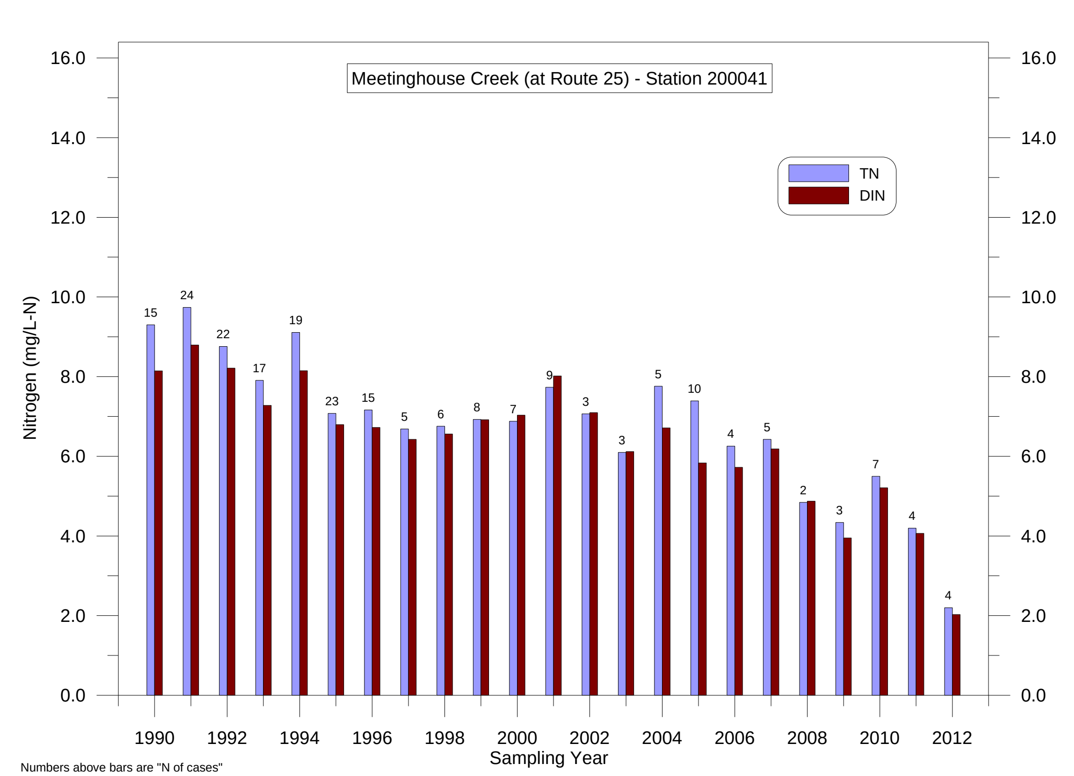
Meetinghouse Creek – At the Rt. 25 station (200041), nitrogen concentrations noted during the 2010-2012 sampling period were significantly lower than historic values (Figure 31). Levels of TN (primarily consisting of NO_x-N) have declined from ~10 mg/L in the early 1990's to ~8 mg/L in 2000 and ~4 mg/L in 2010-2012. At the station to the south (200004), the elimination of a direct discharge from the Crescent Duck Farm has significantly improved water quality in the creek (BTCAMP, 1992). TN and DIN concentrations during 2010-2012 were similar to those noted at the site since 1999 (averaging from 9-12 mg/L), but substantially lower than previous years (90-98) when averages were in the 14-21 mg/L range (Figure 32).

Sawmill Creek - The average TN concentration in Sawmill Creek during the 2010-2012 sampling period (1.0 mg/L) was similar to the 1990-2009 mean of 0.9 mg/L. The scatterplot for this station (Appendix F2) shows somewhat of a long-term increasing trend in TN and DIN however, with DON levels comparatively stable.

Terrys Creek – Graphics similarly show a gradual increasing trend in both TN and DIN (mostly NO_x-N) for Terrys Creek. The mean TN level during the 2010-2012 sampling period was 3.0 mg/L, increasing from means of 2.6 mg/L in 2000-2009 and 2.3 mg/L in 1990-1999.

Reeves Creek - Mean concentrations of TN (mostly NO_x-N) during the 2010-2012 sampling period (6.6 mg/L) was virtually unchanged from the long-term 1996-2009 average (6.7 mg/L). Although the scatterplot for this site shows a long-term increasing trend in both TN and DIN (Appendix F2), it's primarily due to the influence of two unusually elevated results during the winters of 2007 and 2008.

East Creek (South Jamesport) – On average, nitrogen levels have remained fairly similar at this site since monitoring was initiated in 1996 (Figure 33). The 2010-2012 mean for TN was 4.1 mg/L, only a minimal decline from the 1996-2009 mean of 4.4 mg/L. DIN concentrations (mainly



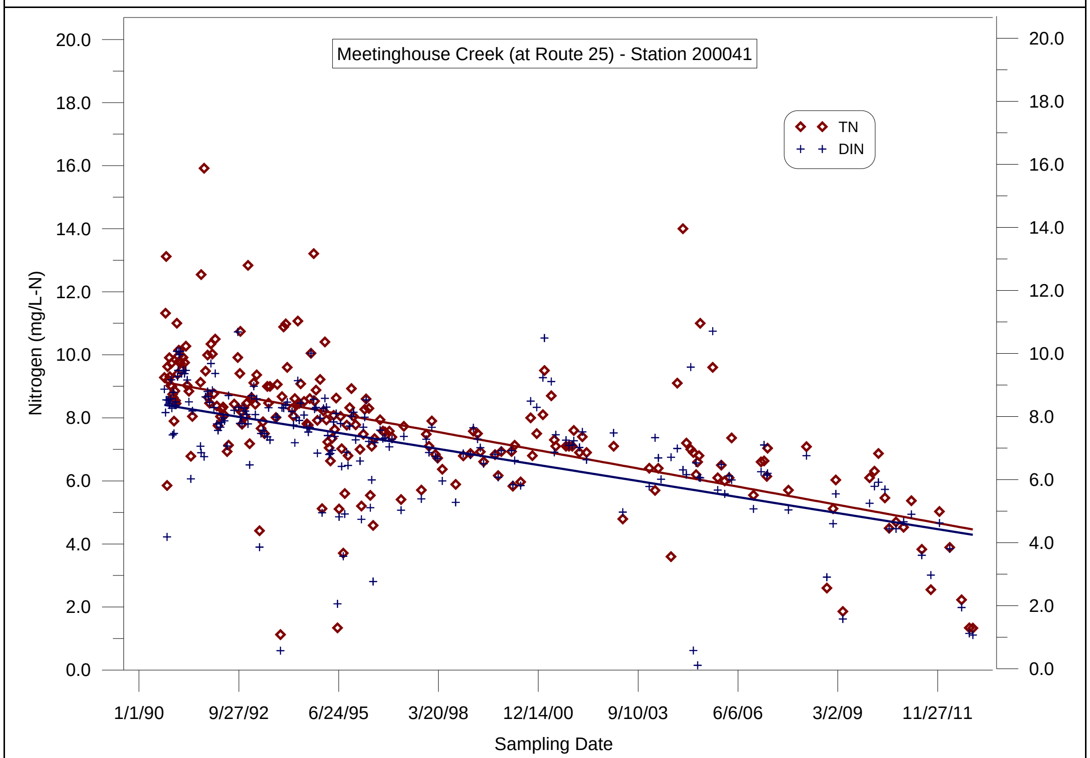


Figure 31. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at Meetinghouse Creek Station 200041 (1990-2012)

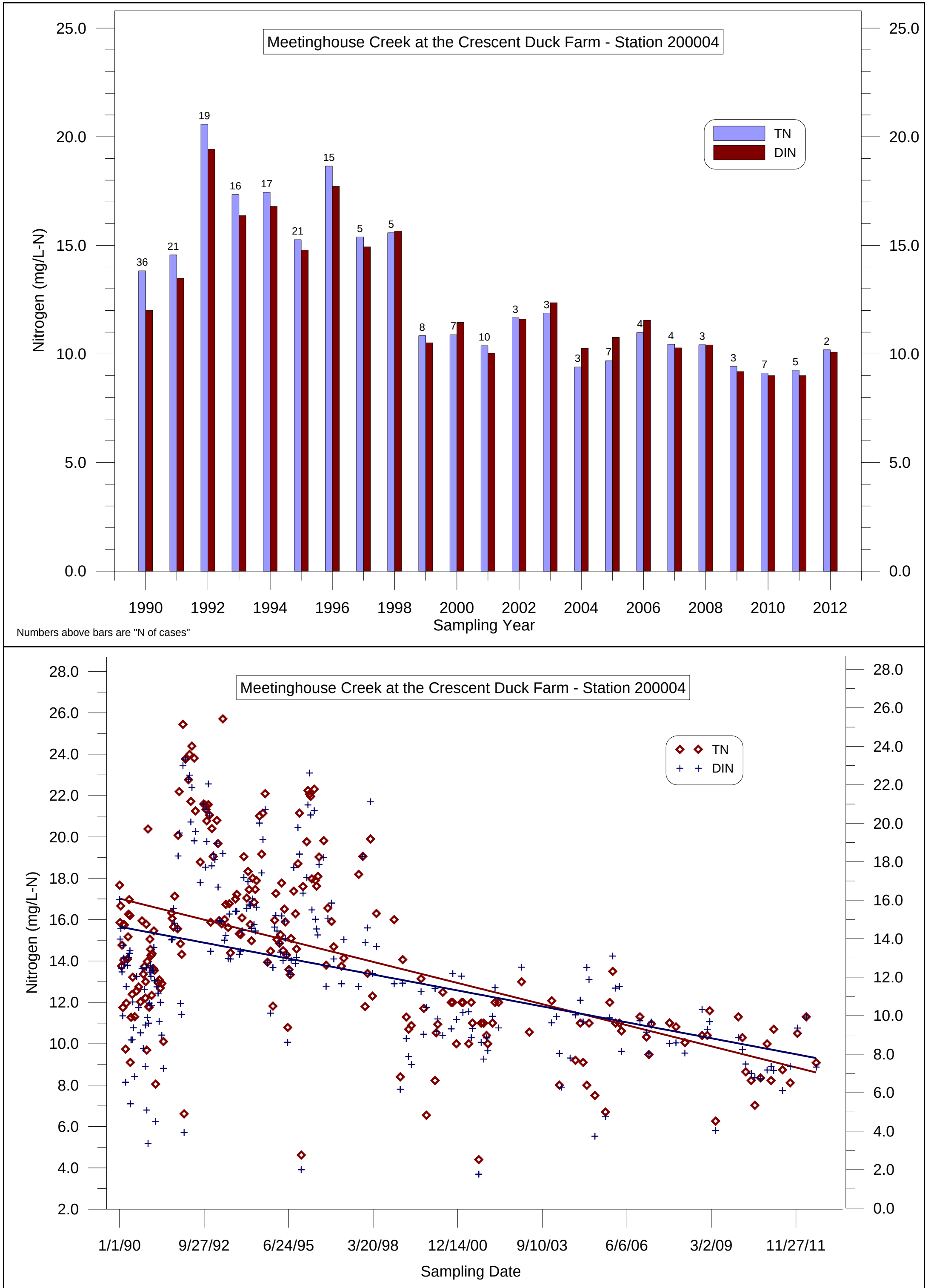


Figure 32. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at Meetinghouse Creek Station 200004 (1990-2012)

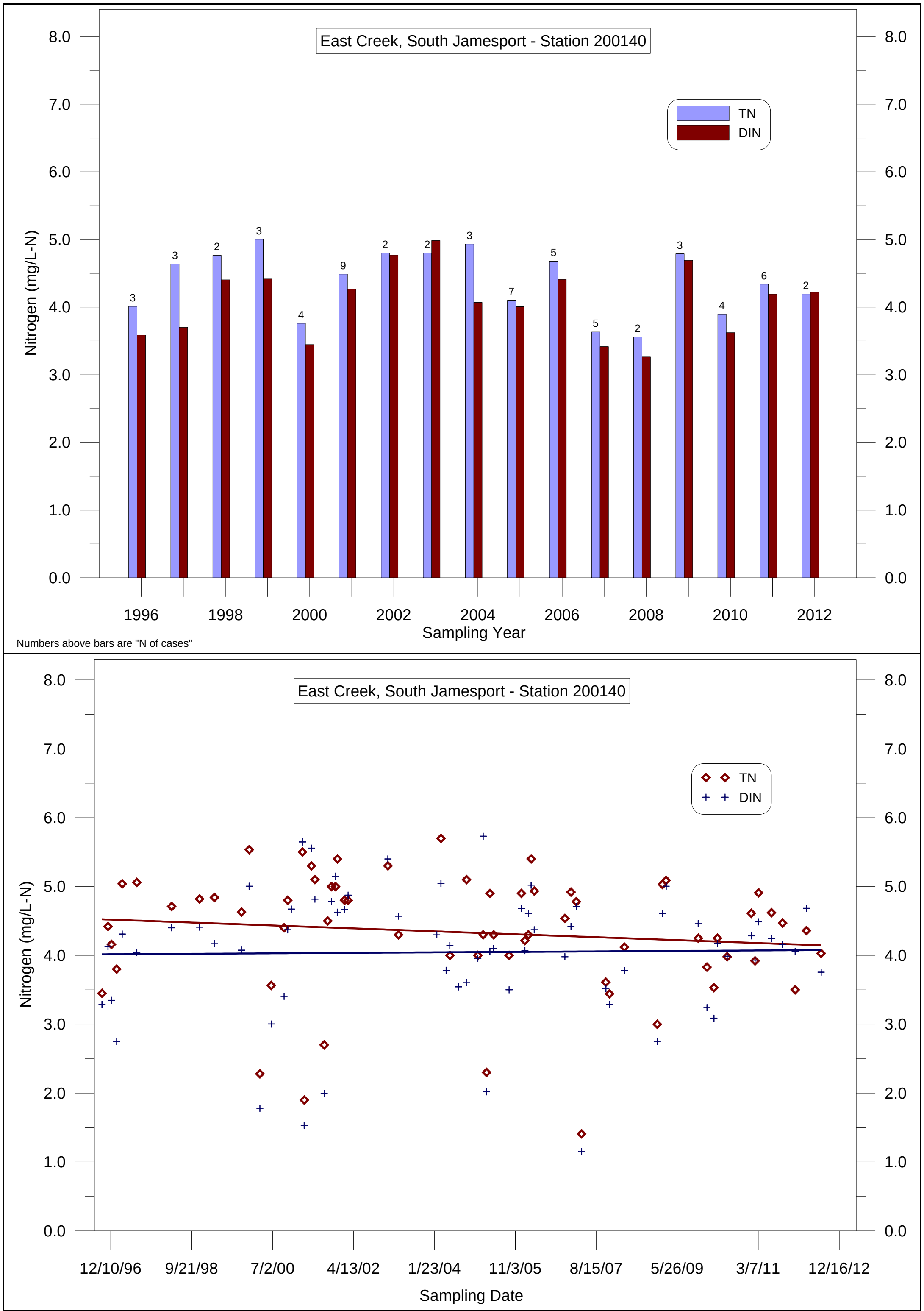


Figure 33. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at East Creek Station 200140 (1990-2012)

as NO_x-N) varied similarly, with means of 4.1 mg/L and 4.0 mg/L over the same time periods. Both are reflected in the scatterplots, which show a very slight declining trend in TN and virtually no change in DIN.

Brushes Creek – Annual average TN concentrations (again, mostly NO_x-N) in Brushes Creek have fluctuated between 3.5 and 7 mg/L since 1997. Although values during the last two years examined were the lowest recorded since 2000 (4.3 mg/L), the scatterplots for this station (Appendix F2) show an increasing trend over the 17-year period for both TN and DIN.

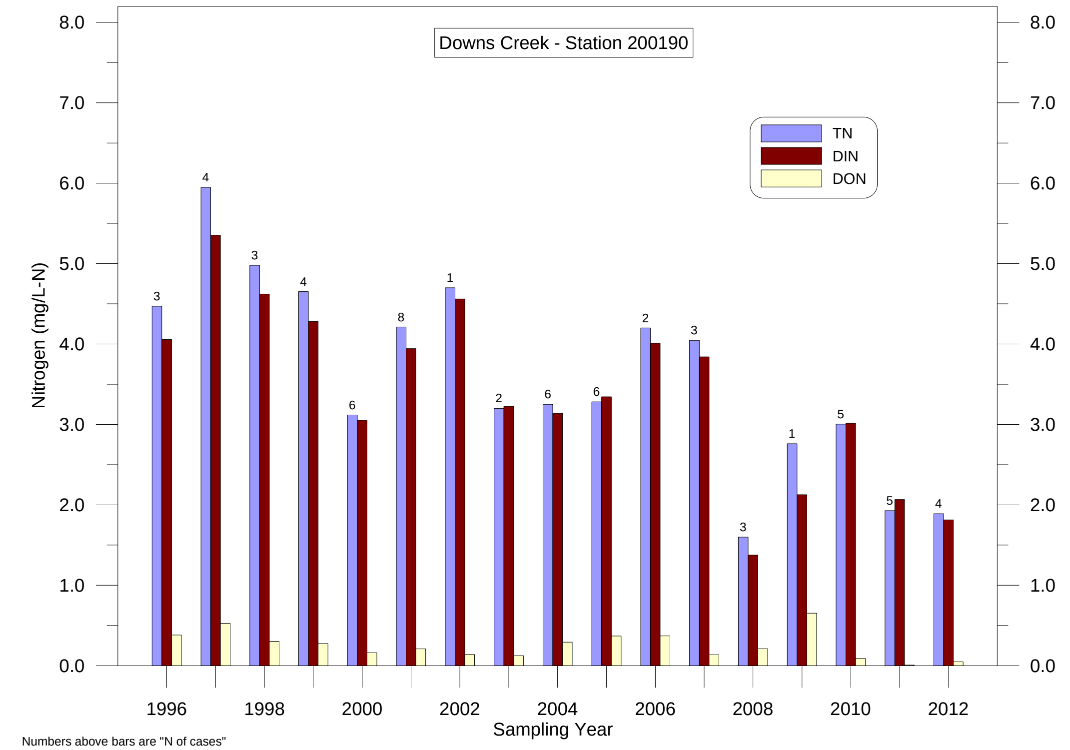
Deep Hole Creek – Concentrations of TN and DIN in Deep Hole Creek exhibit a long-term increasing trend that seems to have abruptly started in 2003. Both parameters averaged approximately 4 mg/L during the 2010-2012 sampling period, a significant increase from the 1.5 to 2 mg/L seen in 1996 and 1997. In the scatterplot in Appendix F2, a period of unusually low TN and DIN is shown between 1999 and 2002. While an explanation for these apparent outliers is elusive, even if the data is removed from the analysis, both parameters would continue to show increasing trends.

Halls Creek – In contrast to nearby Deep Hole Creek, Halls Creek in Mattituck exhibited a long-term declining trend in nitrogen levels. In 2012, the average TN concentration in the creek was 0.9 mg/L, well below the ~3 mg/L recorded during 1997 and 1998.

Downs Creek – A more pronounced long-term decline in TN and DIN (NO_x-N) occurred in Downs Creek. As shown in Figure 34, both parameters exhibited a steady decline in concentration from >5 mg/L in 1997 to <2 mg/L in 2012.

West Creek – In contrast to the majority of north fork creeks where TN levels are predominantly NO_x-N, DON was often the main component of TN in West Creek. A similar mix is also seen in Pipes Creek, Pipes Neck Creek and Narrow River North to the east (but not Narrow River South). Little trend was apparent in the annual fluctuations of the three parameters, although average levels of NO_x-N were unusually elevated during 2010 and 2012.

East Creek (Cutchogue) – Nitrogen concentrations exhibited wider year to year fluctuations in East Creek, but similarly showed a declining trend over the 17-year period (Appendix F2). Average levels of TN during the 2010-2012 sampling period (1.6 mg/L), represented a



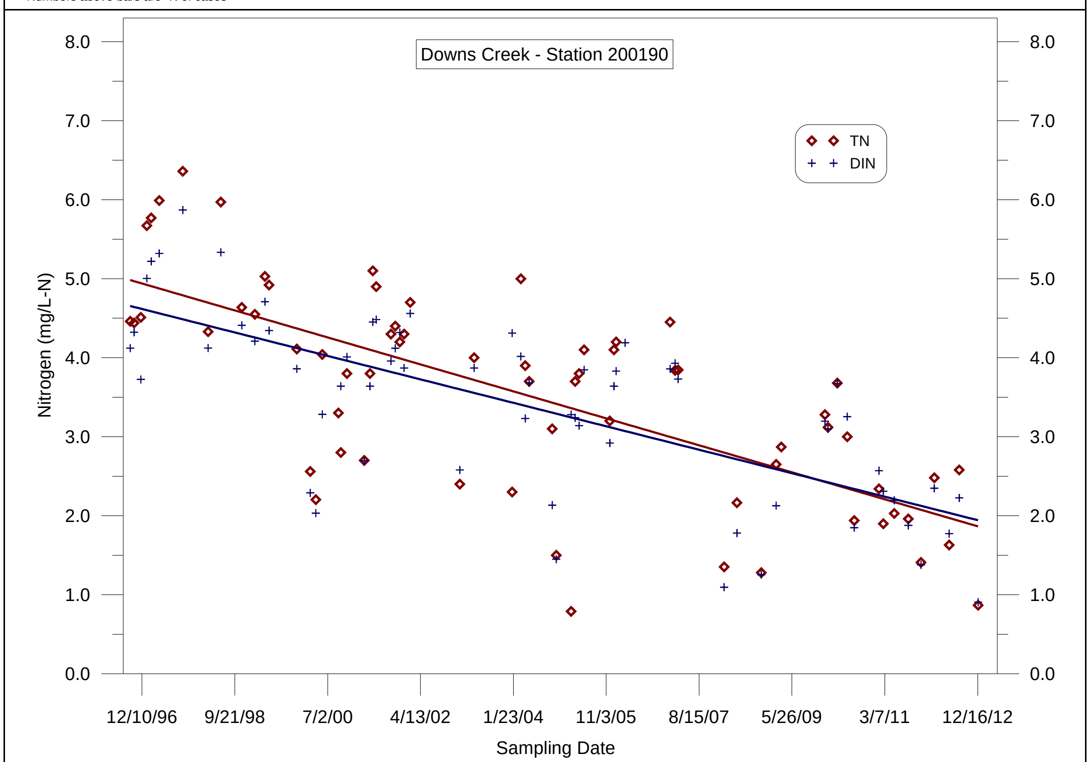


Figure 34. Annual Means and Data Scatterplot for Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) at Downs Creek Station 200190 (1990-2012)

significant decline from the concentrations seen in 1990-1999 (3.9 mg/L) and 2000-2009 (3.1 mg/L).

Pipes Creek and Pipes Neck Creek – Both of these creeks drain relatively undeveloped non-agricultural areas in Southold: the Arshamomaque Preserve and Moore's Drain. Nitrogen levels at each, mainly consisting of DON, have historically been the lowest among the nine north fork creeks monitored, and continued to be in 2010-2012. Scatterplots for both (Appendix F2) show a moderate long-term decline in TN and DON, with DIN declining somewhat at Pipes Creek and increasing somewhat at Pipes Neck Creek.

Narrow River (North and South) – The northern Narrow River station drains an area characterized by open space (wetlands) and low density residential development, while the southern station is located in an area that is surrounded by agricultural fields. Historical nitrogen levels for each site are a reflection of their upland watersheds, with the north station having comparatively low TN levels (~1.4 mg/L) that mainly consist of DON, and the south station generally higher TN levels that primarily consist of NO_x-N. Total nitrogen levels at the north site have changed very little since monitoring was initiated there in 1996, in sharp contrast to the agriculture associated south site where levels have declined steadily from a mean of 5.0 mg/L in 1990-1999 to 1.5 mg/L in 2010-0212 (Table 22, Appendix F2).

Riverhead STP – Nitrogen levels in the Riverhead STP discharge declined dramatically following the installation of tertiary treatment at the plant in 2000 (Figure 35). Concentrations of TN, which had averaged 25.6 mg/L over the 1990-2000 time period, declined to a mean of 7.5 mg/L in 2001-2012. Similarly, over the same two periods, the N-load decreased from an average of 164 lbs/day to 53 lbs/day. As shown in the graphic, the improvement was primarily due to reductions in ammonia (NH_3-N) levels, which decreased from an average of 19.7 mg/L to 3.6 mg/L.

Toxics

Under the Peconic Estuary Program (PEP), monitoring for the presence of potentially toxic compounds in streams began in the early 1990's, primarily targeting a limited number of organic constituents (pesticides and VOCs) at sites in the western estuary. As laboratory capabilities expanded through the years, the number of sampling locations and analytes tested also

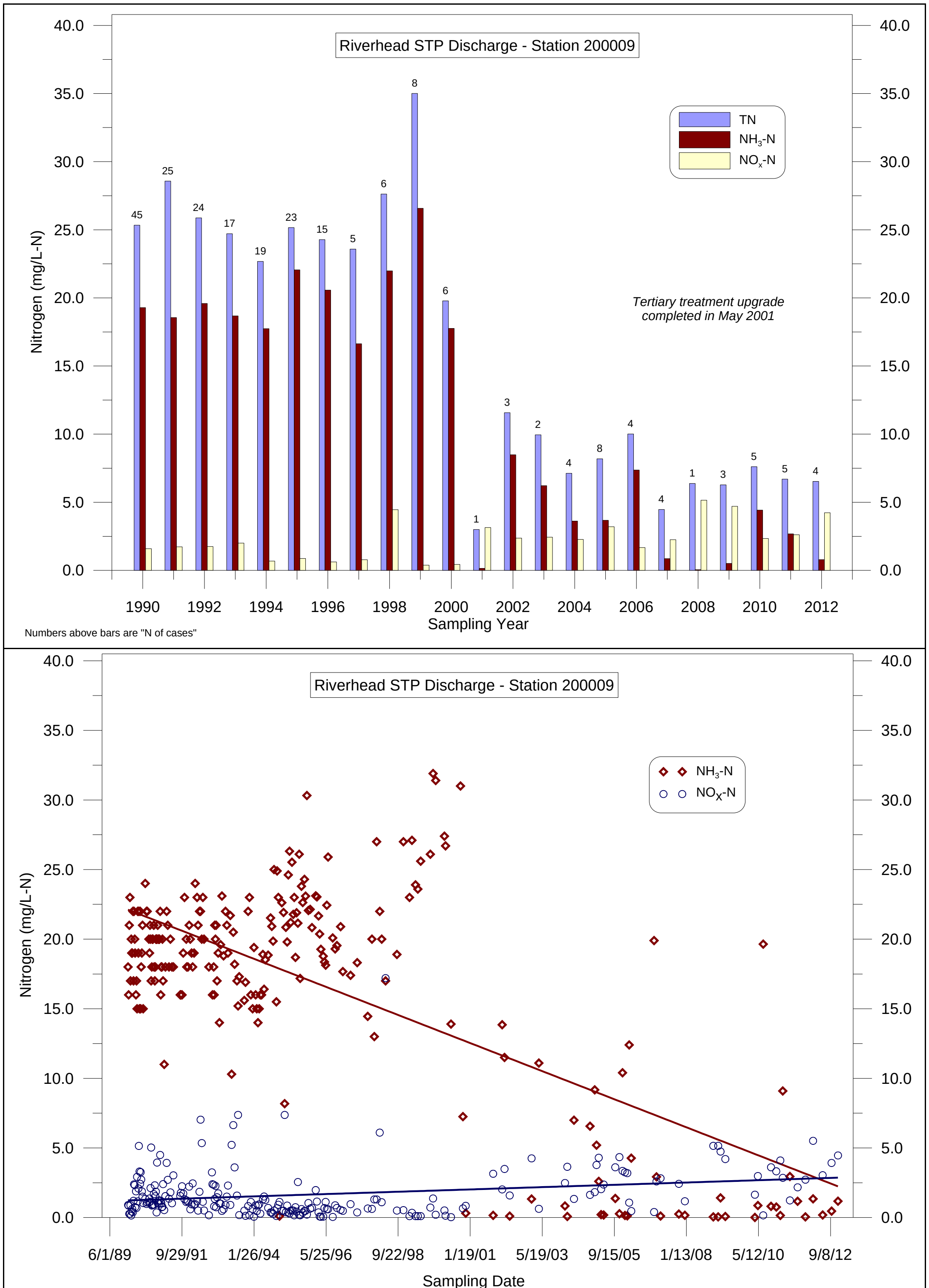


Figure 35. Annual Means and Data Scatterplot for Total Nitrogen (TN), Ammonia (NH_3-N) and Nitrate+Nitrite (NO_x-N) in the Riverhead STP Discharge (1990-2012)

increased. Monitoring of additional north fork streams was initiated in 1996 and metal compounds added to the suite of analytes in 2000.

Organics

For the 23 stream stations included in the comparison, Table 23 contrasts the relative number of organic compound detects recorded during the 1990-2009 and 2010-2012 sampling periods for each of the three groups of analytes examined: pesticides, volatile organic compounds (VOCs) and pharmaceutical and personal care products (PPCPs). Table 24 summarizes the number and frequency of detects by individual compounds.

During the 1990-2009 sampling period, a total of 52 compounds were detected, including 25 pesticides or pesticide degradates, 23 VOCs and 4 PPCPs. This number decreased to 29 compounds in 2010-2012, including 16 pesticides (a 36% decline), 9 VOCs (a 61% decline) and 4 PCPPs. The greatest number of detects during the earlier period occurred in Meetinghouse Creek (both sites) and in a number of north fork creeks, particularly Brushes Creek and Halls Creek, and consisted primarily of pesticides. During 2010-2012, the number of detections in Meetinghouse Creek decreased significantly but continued to be highest in Brushes Creek, and comparatively elevated at a number of other north fork sites, and again primarily consisted of pesticide compounds. The lowest number of detections during both periods was recorded at the four southern Flanders Bay streams (Birch Creek, Goose Creek, Mill Creek and Hubbard Creek).

<u>Pesticides</u>

2,6 – Dichlorobenzamide – Sampling for this compound, a degradate of the herbicide Diclobenil, was not initiated until 2003. Since that time it has consistently been found in Brushes Creek, appearing in 95% of samples collected and averaging 5.8 ug/L through 2012. The only other site showing residues (East Creek in S. Jamesport) had considerably less detects (15%) and a significantly lower mean concentration (0.6 ug/L).

4,4 DDT – An organo-halide insecticide that was banned by the USEPA in 1992 because of its adverse environmental and public health effects. During 1990-2009, only a single detection was noted at the duck farm station on Meetinghouse Creek (in 2001). None have been recorded since.

Table 23. Summary of Historical Organic Compound Detections in Peconic Estuary Streams by Sampling Station

Station No.	Station Name	Pesticides		VOCs		PPCPs		Total Analytes	
		90-09	10-12	90-09	10-12	90-09	10-12	90-09	10-12
200010	Peconic River (at USGS Gage)	0	0	8	2	0	0	8	2
200013	Goose Creek	0	0	1	0	0	1	1	1
200014	Birch Creek	0	0	0	0	0	2	0	2
200015	Mill Creek	0	0	0	0	0	2	0	2
200016	Hubbard Creek	0	0	1	0	0	1	1	1
200017	Peconic River (at Grangebel Park)	1	0	2	1	0	0	3	1
200004	Meetinghouse Creek (Duck Farm Site)	10	3	4	1	0	1	14	5
200041	Meetinghouse Creek (Rt. 25 Site)	10	1	5	1	2	0	17	2
200044	Peconic River at BNL	1	0	2	3	1	3	4	6
200110	Sawmill Creek	3	4	4	1	0	0	7	5
200120	Terrys Creek	6	3	2	0	0	0	8	3
200130	Reeves Creek	8	4	3	2	0	1	11	7
200140	East Creek South Jamesport	8	7	2	0	0	2	10	9
200160	Brushes Creek	13	9	4	0	0	1	17	10
200170	Deep Hole Creek	7	6	2	0	0	1	9	7
200180	Halls Creek	11	5	3	0	0	1	14	6
200190	Downs Creek	6	4	4	0	0	1	10	5
200200	West Creek	6	3	1	0	0	2	7	5
200210	East Creek Cutchogue	6	4	5	0	0	1	11	5
200230	Pipes Creek	2	1	7	1	0	2	9	4
200240	Pipes Neck Creek	0	0	3	0	1	0	4	0
200250	Narrow River North	3	0	4	1	0	1	7	2
200260	Narrow River South	6	3	2	0	1	0	9	3

Table 24. Historical Comparison of Organic Compound Detections in Peconic Estuary Streams					
Analyte	Description	Number of Sites Detected At		Overall Detection Frequency (%)	
		1990-2009	2010-2012	1990-2009	2010-2012
Pesticides:					
2,6-Dichlorobenzamide	Dichlobenil (Herbicide) Metabolite	2	2	4.6	4.9
4,4 DDT	Insecticide	1	0	0.1	0.0
Alachlor ESA	Alachlor (Herbicide) Metabolite	12	7	19.0	17.2
Alachlor OA	Alachlor (Herbicide) Metabolite	5	0	5.9	0.0
Aldicarb sulfone	Aldicarb (Nematicide) Metabolite	10	4	11.2	3.2
Aldicarb sulfoxide	Aldicarb (Nematicide) Metabolite	10	5	10.6	1.9
Azoxystrobin	Fungicide	2	0	0.3	0.0
Chlorothalonil	Fungicide	2	0	0.2	0.0
Deisopropylatrazine	Atrazine (Herbicide) Metabolite	1	4	0.2	3.2
Diazinon	Insecticide	1	0	0.1	0.0
Dichlobenil	Herbicide	1	1	2.3	1.0
Dichlorvos	Insecticide	0	1	0.0	0.3
Dinoseb	Herbicide	1	1	0.8	1.0
Diuron	Herbicide	1	0	1.2	0.0
Endosulfan sulfate	Endosulfan (Insecticide) Metabolite	2	0	0.2	0.0
EPTC	Herbicide	1	0	0.1	0.0
Imidacloprid	Insecticide	2	1	0.9	1.6
Metalaxyl	Fungicide	6	4	10.7	6.8
Metolachlor	Herbicide	6	3	6.2	6.5
Metolachlor ESA	Metolachlor Metabolite	15	11	44.5	41.7
Metolachlor OA	Metolachlor Metabolite	13	10	32.5	30.7
Metribuzin	Herbicide	1	0	0.4	0.0
Ronstar	Herbicide	1	1	5.1	0.6
Simazine	Herbicide	5	1	0.7	0.3
Tebuthiuron	Herbicide	0	1	0.0	0.3
Terbacil	Herbicide	2	0	0.7	0.0
Tetrachloroterephthalic Acid	Dacthal (Herbicide) Metabolite	4	0	2.3	0.0

Table 24 *continued*. Historical Comparison of Organic Compound Detections in Peconic Estuary Streams

Analyte	Description	Number of Sites Detected At		Overall Detection Frequency (%)	
		1990-2009	2010-2012	1990-2009	2010-2012
Volatile Organic Compounds (VOCs):					
1,1,1-Trichloroethane	Solvent	2	0	3.8	0.0
1,1,2,2-Tetrachloroethane	Solvent	1	0	0.1	0.0
1,1-Dichloroethene	Industrial Chemical	1	1	0.4	1.0
1,2-Dichloropropane	Industrial Chemical	1	0	0.1	0.0
2-Butanone (MEK)	Solvent	2	0	0.2	0.0
bis (2-ethylhexyl) phthalate	Plasticizer	5	0	0.6	0.0
Bromoform	Solvent	0	1	0.0	0.3
Carbon disulfide	Industrial Chemical	2	0	0.2	0.0
Chlorodifluoromethane	Refrigerant	0	1	0.0	0.3
Chloroform	Solvent	1	1	0.1	0.3
Chloromethane	Refrigerant	12	0	1.5	0.0
Dibutyl phthalate	Plasticizer	1	0	0.2	0.0
Diethyl ether	Solvent	1	1	0.5	0.3
Diethyl phthalate	Plasticizer, Solvent	3	0	0.5	0.0
Dimethyl disulfide	Soil fumigant	2	0	0.2	0.0
Ethenylbenzene	Industrial Chemical	3	0	0.2	0.0
Fluoranthene	Combustion By-product	1	0	0.2	0.0
Freon 113	Refrigerant	1	2	4.2	5.4
Isopropyltoluene	Industrial Chemical	1	0	0.2	0.0
Methylene chloride	Solvent	3	0	0.4	0.0
Methyl-tertiary-butyl-ether	Fuel Additive	15	2	8.5	2.7
Phenanthrene	Industrial Chemical	1	0	0.2	0.0
Propanal	Industrial Chemical	0	1	0.0	0.3
Tert-amyl-methyl-ether	Fuel Additive	1	0	0.2	0.0
Toluene	Solvent	7	2	1.5	1.3
Xylene (total)	Solvent	1	0	0.1	0.0
Pharmaceuticals and Personal Care Products (PPCPs):					
Bisphenol A	Plasticizer	0	1	0.0	0.3
Caffeine	Food Additive	0	10	0.0	3.4
Carisoprodol	Muscle Relaxant	1	0	0.2	0.0
Diethyltoluamide (DEET)	Insect repellant	3	12	0.5	4.7
Gemfibrozil	Lipid-reducing drug	1	0	0.2	0.0
Ibuprofen	Anti-inflammatory Drug	1	0	0.2	0.0
Phenytoin (Dilantin)	Anit-convulsant	0	1	0.0	0.3

Alachlor ESA and OA – Residues of the ESA metabolite of the herbicide have historically been widespread, with detects recorded at 12 of the 23 sites in 1990-2009. During the 2010-0212 sampling period, the compound was somewhat less common, appearing at only 6 sites. Frequencies have remained high throughout both periods in Brushes Creek (98%-100%) and Halls Creek (90%-71%), although average concentrations occurring at the two sites have declined - those in Brushes Creek from 2.2 to 0.7 ug/L and in Halls Creek from 1.6 to 0.3 ug/L. Detections of the Alachlor OA metabolite, occurring at 5 sites in 1996-2009, were not noted in 2010-2012.

Aldicarb sulfone/sulfoxide – Detects of both A. sulfone and A. sulfoxide, breakdown products of the carbamate insecticide/nematicide Aldicarb (*Temik*), have declined in prevalence and concentration in recent years. This continues a trend noted in previous assessments that was attributed to the banning of the product in 1980 and its eventual movement out of the groundwater system (SCDHS, 2002).

Between 1990 and 2009, both A. sulfone and A. sulfoxide were detected in 10 of the 23 sites, with three locations (Meetinghouse Creek, Downs Creek and East Creek in Cutchogue) having a detection frequency of 50-75%. The same locations also had the highest concentrations, with mean values ranging from 0.7-1.8 ug/L. During 2010-2012, only five sites showed reportable levels, with most consisting of a single detect. The mean concentration at the only site with multiple detects (Meetinghouse Creek at Rt 25) was a comparatively low 0.5 ug/L.

Azoxystrobin and Chlorothalonil – Both compounds are fungicides that were each detected on one occasion in 2001 at both Meetinghouse Creek stations (on Route 25 and at the duck farm). No detects of either fungicide have been recorded at any of the sites examined since.

Deisopropylatrazine – A degradate of the herbicide Atrazine, this compound was found in Brushes Creek in 1990-2009 (5% of samples), and at four locations during 2010-2012, including Brushes Creek (38% of samples), Deep Hole Creek (23%), West Creek in New Suffolk (11%) and East Creek in S. Jamesport (8%). Concentrations throughout have been minimal (<1.0 ug/L) with the highest values consistently noted in Brushes Creek.

Diazinon – An insecticide that was found in a single sample collected in 2000 from Deep Hole Creek. No residues have been detected in any of the 23 streams since.

Dichlobenil – An herbicide only found in Brushes Creek in 2000-2009 (44% of samples, mean of 1.3 ug/L), and similarly in 2010-2012 (23% of samples, mean of 0.9 ug/L).

Dichlorvos – An insecticide found on one occasion (0.7 ug/L) in Sawmill Creek during 2010-2012, but not noted in prior years.

Dinoseb – An herbicide found only in Halls Creek in Cutchogue, where it was detected on 7 occasions between 2003 and 2007 (maximum concentration of 6.4 ug/L), and again on three occasions in 2010 (maximum of 1.0 ug/L).

Imidacloprid – An insecticide found in one sample from Meetinghouse Creek in 2001 (0.2 ug/L) and in 7 samples from Brushes Creek between 2003 and 2007 (maximum of 0.3 ug/L). The compound was only detected in Brushes Creek in 2010-2012, appearing in 5 of 13 samples with a mean of 0.3 ug/L.

Metalaxyl – A fungicide that was noted in 6 north fork streams during 1990-2009, with most detections in Reeves Creek (50% of samples), East Creek in South Jamesport (68%) and Brushes Creek (61%). In 2010-2012, the frequency of detections decreased to 30% in Reeves Creek and East Creek, but increased significantly to 92% of samples in Brushes Creek (averaging 0.6 ug/L).

Metolachlor – The number of locations where Metolachlor has been detected has decreased from 6 of the 23 stream sites in 1990-2009, to 3 in 2010-2012. The highest mean concentrations and prevalence during the earlier period were in Halls Creek (88%, 0.5 ug/L), with detects also common in Reeves Creek and Deep Hole Creek. During 2010-2012, detects remained frequent in Halls Creek (50%) with those in Deep Hole Creek more prevalent (92%, mean of 0.5 ug/L).

Metolachlor ESA – The ESA metabolite of Metolachlor has been ubiquitous in north fork streams since monitoring of the compound was initiated in 2000. Between 2000 and 2009, the compound was noted at all 15 of the north fork stream sites, with 7 of these showing frequencies >90%. During 2010-2012, reportable levels of Metolachlor ESA were found in 11 of the 15 streams, with 7 of these having detection frequencies of 100%. Sites with the highest concentrations (means ranging from 1 to 3 ug/L) were consistent across both periods, and included Reeves Creek, East Creek (SJ), Halls Creek and Downs Creek.

Metolachlor OA – The OA metabolite of Metolachlor was similarly a frequent contaminant in a number of Peconic Estuary streams. Reportable levels were noted at 13 sites in 1990-2009 (with 5 having detection frequencies >80%) and at 10 sites in 2010-2012 (4 sites >80%). As with the ESA metabolite, the highest concentrations were recorded in Reeves Creek, East Creek (SJ), Halls Creek and Downs Creek.

Ronstar – An herbicide that was only found in Brushes Creek during both sampling periods. Between 2004 and 2009 it was present in 100% of the 22 samples collected at a mean concentration of 0.8 ug/L. The frequency of detection declined significantly in 2010-2012, appearing in just 2 of 13 samples with a mean of 1.3 ug/L.

Simazine – Detections of simazine was relatively infrequent, with one or two detects (0.2 -0.6 ug/L) recorded at five north fork creeks between 2000 and 2004 (East Creek in S. Jamesport, Brushes Creek, Halls Creek, West Creek and Pipes Creek). During 2010-2012, only one detect was noted in Sawmill Creek (0.5 ug/L).

Tebuthiuron – Sampling for this herbicide did not begin until 2010, so historical data is not available. During 2010-2012, only one detection in Pipes Creek was noted (0.3 ug/L).

Terbacil – This herbicide was an infrequent contaminant in Reeves Creek and Halls Creek between 2004 and 2006 (means of 0.6-0.8 ug/L) and has not been detected since.

Tetrachloroterephthalic Acid – A degradate of the herbicide Dacthal that although not widespread in Peconic Estuary streams, was frequently present at two sites on opposite ends of the north fork: the Meetinghouse Creek station on Rt. 25 in Aquebogue (11 samples from 1999-2008; 5-16 ug/L) and Narrow River south in Orient (13 samples from 1997-2006; 5-39 ug/L). No detects occurred at any locations in 2010-2012.

<u>Volatile Organic Compounds (VOCs)</u>
The number of VOCs detected declined from 23 compounds in 1990-2009 to 9 in 2010-2012, a 61% decrease (Table 23). Most of the analytes not found in 2010-2012 were generally

uncommon to begin with, so their absence may be a reflection of sampling frequency rather than a result of mitigation efforts. The following compounds were detected in a single sample at either one or two sites in 1990-2009, and not detected during 2010-2012: 1,1,2,2-tetrachloroethane, 1,2-dichloropropane, 2-butanone (MEK), carbon disulfide, chloroform, dibutyl phthalate, dimethyl disulfide, fluoranthene, isopropyltoluene, phenanthrene, tert-amyl-methyl ether, and xylene. VOCs that are notable due to an increase or decrease in their frequency and/or extent in 2010-2012, are listed below.

1,1,1 – Trichloroethane – The solvent was detected at each of the two Peconic River sites during 1990-2009, frequently at the USGS gage station (47% of samples, mean of 0.8 ug/L). In 14 samples during the 2010-2012 sampling period however, no detects were recorded.

1,1 – Dichloroethene – An industrial chemical detected at the Peconic River gage station during both periods, with a frequency of 5% of samples (mean 0.7 ug/L) in 1990-2009 and 21% (mean of 0.6 ug/L) in 2010-2012.

Bis (2-ethylhexyl) phthalate – a plasticizer noted in five streams in 1990-2009, but not detected in 2010-2012.

Chloromethane – A refrigerant detected at 12 sites in 1990-2009, but not found in 2010-2012.

Diethyl ether – A solvent only detected at the BNL site on the Peconic River (during both periods). The concentrations found were significant compared to other VOC residues, with a maximum level of 4.0 ug/L noted during 1990-2009 and 8.4 ug/L in 2010-2012.

Diethyl phthalate – A solvent/plasticizer that was found at three sites in 1990-2009 (Peconic River gage, Downs Creek and East Creek in Cutchogue), but not detected in 2010-2012.

Ethenylbenzene (*Styrene*) – An industrial chemical detected at three locations in 1990-2009 (Halls Creek, East Creek in Cutchogue and Pipes Creek), but not found in 2010-2012.

Freon 113 – This refrigerant compound continues to be a frequent contaminant in the Peconic River. Historically it had been found only at the gage station (47% of samples, mean concentration of 0.8 ug/L), but was detected at both river sites during 2010-2012: 79% of samples at USGS gage station (a mean of 1.2 ug/L) and 36% of samples at the Grangebel Park location (mean of 0.6 ug/L).

Methylene chloride – A solvent detected at three sites in 1990-2009 (the BNL station on the Peconic River, Reeves Creek and Downs Creek), but not found during 2010-2012.

MTBE (methyl-tertiary-butyl-ether) – Once considered ubiquitous, sites where MTBE was detected decreased from 15 in 1990-2009 to 2 sites during 2010-2012. Most notable were results for the duck farm station in Meetinghouse Creek, where a detection frequency of 60% of samples in 1990-2009 (averaging 5.9 ug/L) declined to 38% in 2010-2012 (averaging 1.2 ug/L).

Toluene – A common solvent that was detected at seven sites in 1990-2009 (Peconic River gage, Meetinghouse Creek and five north fork streams) and two sites in 2010-2012. The highest detection frequency and concentration continue to occur at the Narrow River north station, although mean concentrations at the site have declined from 4.0 ug/L in 1990-2009 to 1.8 ug/L in 2010-2012.

<u>Pharmaceutical and Personal Care Products (PPCPs)</u>

Comparatively few PPCP residues have been found in Peconic Estuary streams, with detections generally localized and infrequent. During 1990-2009, detects were limited to three pharmaceuticals, including the muscle relaxant Carisoprodol, the anti-inflammatory drug Ibuprofen and the lipid-reducing drug Gemfibrozil, as well as the insect repellant DEET. The drug results each consisted of a single detect, with residues of DEET found at three locations. Only DEET was also found during 2010-2012, when it increased in extent to 12 sites but remained relatively infrequent (14 detections). The concentrations of DEET found increased as well, from a maximum of 0.6 ug/L in historical samples to levels of 8.1 ug/L in East Creek (SJ), 17.0 ug/L in Deep Hole Creek and 44.0 ug/L in Brushes Creek. Other PPCPs noted during 2010-2012 included the anti-convulsant drug Dilantin, the stimulant Caffeine and the plasticizer Bisphenol-A. Detections of Caffeine were somewhat widespread, appearing in 10 streams, but only a single low-level (<1.0 ug/L) detect was noted at each.

<u>Metals</u>

For each of the ten metals of concern, Table 25 compares, by station, the percentage of samples with detects during the 2000-2009 sampling period with those recorded during 2010-

Table 25. Historical Frequency (%) of Metals of Concern Detected in Peconic Estuary Streams

Station	Station Name	Arsenic		Cadmium		Chromium		Copper		Lead		Mercury		Nickel		Selenium		Zinc	
		00-09	10-12	00-09	10-12	00-09	10-12	00-09	10-12	00-09	10-12	00-09	10-12	00-09	10-12	00-09	10-12	00-09	10-12
200004	Meetinghouse Creek	22.4	69.2	0	0	64	23.1	84	100	8	0	0	0	90	100	2	0	44	14.3
200010	Peconic River Gage	0	13.3	0	0	10.4	0	18.2	0	5.2	0	0	0	22.1	40	0	0	20.8	20
200013	Goose Creek	3.4	0	0	0	10.3	0	20.7	6.7	3.4	0	0	0	27.6	6.7	0	0	20.7	6.7
200014	Birch Creek	0	0	0	0	0	0	23.3	6.7	3.3	6.7	0	0	10	20	0	0	10	13.3
200015	Mill Creek	0	0	0	0	10	6.7	23.3	13.3	3.3	0	0	0	16.7	13.3	0	0	20	6.7
200016	Hubbard Creek	3.4	73.3	0	0	0	0	13.8	0	3.4	0	0	0	17.2	33.3	0	0	10.3	6.7
200017	Peconic River	0	46.7	0	0	12.5	0	18.8	20	3.1	0	0	0	34.4	53.3	0	0	25	26.7
200041	Meetinghouse Creek	0	20	0	0	47.9	0	58.3	46.7	6.3	0	0	0	93.8	100	0	0	29.2	13.3
200044	Peconic River at BNL	10.3	69.2	3.4	0	51.7	23.1	96.6	100	44.8	69.2	0	0	96.6	100	3.4	0	58.6	76.9
200110	Sawmill Creek	2	68.8	0	0	45.1	12.5	58.8	31.3	19.6	0	0	0	66.7	100	0	0	27.5	37.5
200120	Terrys Creek	9.3	69.2	0	0	41.1	7.7	33.9	38.5	1.8	0	0	0	60.7	100	3.6	0	16.1	7.7
200130	Reeves Creek	40.7	100	0	0	29.6	0	66.7	100	7.4	0	0	0	81.5	100	3.7	0	11.1	0
200140	East Creek (SJ)	17.6	100	0	0	56.9	0	39.2	41.7	19.6	0	2.1	0	82.4	100	0	8.3	15.7	16.7
200160	Brushes Creek	6.7	33.3	0	0	46.7	8.3	17.8	8.3	4.4	0	0	0	80	100	2.2	0	20	16.7
200170	Deep Hole Creek	20	75	0	0	44.4	16.7	26.7	33.3	2.2	0	0	0	60	100	8.9	8.3	13.3	0
200180	Halls Creek	26.9	100	0	0	57.7	8.3	73.1	58.3	23.1	0	0	0	73.1	91.7	0	8.3	26.9	33.3
200190	Downs Creek	2.6	57.1	0	0	52.6	0	34.2	35.7	5.3	0	0	0	71.1	100	0	7.1	18.4	14.3
200200	West Creek	48.4	62.5	3.2	0	51.6	12.5	100	50	67.7	12.5	0	0	67.7	50	3.2	0	45.2	25
200210	East Creek (Cutch)	5.7	16.7	0	0	40.0	0	37.1	16.7	11.4	0	0	0	68.6	91.7	0	0	25.7	0
200230	Pipes Creek	46.7	90	0	0	43.3	50	96.7	100	73.3	30	0	0	73.3	100	0	10	36.7	20
200240	Pipes Neck Creek	10.8	88.9	0	0	83.8	66.7	86.5	100	40.5	0	0	0	100	100	2.7	0	27	11.1
200250	Narrow River North	81.5	100	0	0	48.1	50	92.6	100	59.3	70	0	0	48.1	80	0	0	40.7	60
200260	Narrow River South	46.2	87.5	0	0	38.5	25	84.6	87.5	15.4	25	0	0	84.6	87.5	0	12.5	34.6	25

Note: Silver not listed as no detections above the MRL occurred during either period

2012. The number of detects and overall detection frequency are summarized by analyte in Table 26.

Table 26. Summary of Historical Detections of Metals of Concern in Peconic Estuary Streams

Metal	Number of Sites Detected At		Overall Detection Frequency (%)	
	2000-2009	2010-2012	2000-2009	2010-2012
Arsenic	18	20	15.0	55.1
Cadmium	2	0	0.2	0
Chromium	21	13	39.1	12.3
Copper	23	21	49.3	42.1
Lead	23	6	16.5	8.1
Mercury	1	0	0.1	0
Nickel	23	23	62.2	74.0
Selenium	8	6	1.4	2.1
Silver	0	0	0	0
Zinc	23	20	25.3	19.0

Arsenic – During 2010-2012, arsenic was detected in 20 of the 23 stream sites sampled (55% of total samples) with four sites showing residues in all samples collected. This represented a significant increase over the prevalence noted during 2000-2009, when only 15% of samples showed detects and five streams had no detects. During both periods, detection frequencies and concentrations were generally highest in agricultural areas.

Cadmium – Cadmium has rarely been noted in Peconic Estuary streams, with only two detects noted during 2000-2009: one at the BNL site on the Peconic River in 2008 (2.3 ug/L) and the other in West Creek in 2004 (1.4 ug/L). No detects were noted during 2010-2012.

Chromium – Only a limited number of results during 2010-2012 were greater than the chromium MRL (12% of all samples), with 10 sites having no detects. Concentrations were low as well, with means ranging from 1.0 – 1.6 ug/L. In contrast, every site but two showed detects during

2000-2009 (39% of all samples), with means ranging from 1.2 – 3.1 ug/L and a maximum result of 20.8 ug/L recorded at the Narrow River North site in Orient. The decline in prevalence was particularly apparent in north fork streams between Meetinghouse Creek and East Creek in Cutchogue, where chromium detection frequencies decreased from 47% to 5% of samples collected.

Copper – Copper was relatively prevalent during both periods (appearing in ~45% of all samples collected), with the highest frequencies consistently noted at the BNL site on the Peconic River, the duck farm site in Meetinghouse Creek, Reeves Creek, Pipes Creek, Pipes Neck Creek and at both Narrow River sites. The lowest copper frequencies were found in the lower Peconic River, the southern Flanders Bay creeks, and interestingly, in Brushes Creek. With the exception of those at the BNL site on the Peconic River, average concentrations ranged from 1.4 – 3.8 ug/L in 2000-2009 and from 1.1 – 8.8 ug/L in 2010-2012. At the BNL site on the Peconic River means for the two periods were 25.7 and 22 ug/L and the maximum values recorded 80 and 58 ug/L.

Lead – Lead was detected at all of the 23 sites during 2000-2009, but at only six locations during 2010-2012. The level of prevalence also declined at the majority of locations (Table 25), but remained frequent at the BNL Peconic River and Narrow River North stations.

Mercury – During 2000-2009, a single sample collected from East Creek in South Jamesport had a reportable level of mercury (2.1 ug/L). No detects were found during 2010-2012.

Nickel – Nickel was a common contaminant, particularly at the 17 stream sites between Meetinghouse Creek and the Narrow River in Orient, where the cumulative detection frequency was 95% in 2010-2012 and 76% in 2000-2009. The highest mean concentrations during both periods occurred at the BNL site on the Peconic River (3.2 - 6.7 ug/L), followed by the duck farm site on Meetinghouse Creek (2.6 - 3.7 ug/L)

Selenium – Selenium detects have been rare since monitoring was initiated, with only approximately 2% of samples collected showing reportable levels. During the 2000-2009 sampling period only 12 detects were recorded at 8 sites, with only a single detection noted at four sites in 2010-2012.

Zinc – Zinc detects were widespread during both periods but relatively infrequent at 25% of samples in 2000-2009 and 20% in 2010-2012. The highest percentage of reportable results were noted at the BNL site on the Peconic River, although concentrations found were moderate compared to a number of other locations (Appendix E2).

Discussion

The main objective of this report was to provide an assessment of water quality conditions in the Peconic Estuary as indicated by results of samples collected from 2010 through 2012 by the Suffolk County Department of Health Services (SCDHS) Office of Ecology. For purposes of historical context, data collected during the prior two decades (1990-1999 and 2000-2009) was also summarized for comparison purposes.

Suffolk County has been monitoring water quality in the Peconic Estuary for nearly 40 years, initially under the federal "208 Study" which began in 1976, followed by the Brown Tide Comprehensive Assessment and Management Program (BTCAMP) in 1988 and the Peconic Estuary Program (PEP) in 1993. Currently, the SCDHS conducts a comprehensive year-round water quality monitoring program that focuses on indicator parameters for which measurable goals have been identified in the PEP's Comprehensive Conservation and Management Plan (CCMP). These include brown tide, nutrients, dissolved oxygen, water clarity, pathogens, and toxics. The objectives of the program are to provide a general assessment of the status and trends in estuary water quality, to assess water quality in terms of established criteria and standards, to provide data on water quality conditions in support of investigations being conducted by other agencies and researchers, and to provide data for use in evaluating whether desired environmental results have been achieved and whether objectives of the Comprehensive Conservation and Management Plan (CCMP) are being met.

In general, this analysis showed very good water quality to exist throughout much of the estuary. Stresses that have been well documented by past surveys however, were found to still exist in portions of the western estuary as well as in a number of streams and peripheral embayment sites further east. Although these impacts have generally lessened over the years, some continued to cause significant local impairments. The recent fish kill in the lower Peconic River, attributed to algal blooms and depleted oxygen levels, is the latest of many that have occurred there over the years and is an indication that water quality stresses remain an issue today. Major findings for key water quality parameters are discussed below.

Water Clarity: Adequate water clarity is critical to the growth and survival of a number of benthic communities, including seagrasses such as eelgrass (*Zostera marina*), various macroalgae and numerous planktonic organisms (i.e., phytoplankton). Eelgrass beds have a particular importance in the Peconic Estuary, as they provide critical habitat for the commercially important bay scallop (*Argopecten irradians*) as well as other shellfish, finfish and invertebrates.

Under the PEP, water clarity is monitored using secchi depth and light extinction measurements. The light extinction data has yet to be complied however, but will be included in future updates of this report. Secchi depth measurements are the simplest procedure for estimating water clarity, but often aren't possible in shallow waters. This was the case in a number of peripheral embayment sites during 2010-2012, where limited water depths prevented measurement of the true secchi depth because the secchi disk was still visible when it reached the bottom. To assess water clarity using secchi measurements, only 13 sites where depth was not an issue were considered.

In general, water clarity throughout much of the estuary was very good, with 3-year means at sites east of Flanders Bay in the 7-13 ft. range. A west to east pattern of increasing clarity was noted as expected, with higher secchi depths occurring in waters subject to a greater degree of tidal flushing. Periods of secchi minima generally corresponded to periods of higher phytoplankton activity, with those in the shallower western sites occurring during warmer months and those in deeper eastern waters during the winter. It is interesting to note, that the highest secchi depths were recorded at each of the 13 sites in the spring of 2010, a period marked by unusually heavy precipitation when both chlorophyll-a and salinity levels were at their minimum.

Temperature: Water temperature is an important factor in various chemical and biological processes occurring in an estuarine ecosystem. It regulates metabolic and biochemical reactions affecting nutrient availability, plays a role in the timing of migration and spawning of various organisms, and is a critical factor in determining the concentration of dissolved oxygen available to organisms. Spatial and temporal variations in temperature occur on both a short and long-term basis, the degree to which depending on factors such as water depth, air temperature, solar radiation, weather events, currents, tidal exchange and the existence of freshwater and/or groundwater inputs.

For the 2010-2012 sampling period, average water temperatures generally declined from the shallower western estuary eastward, with a predictable seasonal pattern of maxima occurring in July or August and minima in January apparent throughout the system (Figure 4, Appendix C1).

Salinity: At any given location in the estuary, salinity is generally a function of the relative degree to which freshwater flows and tidal influences affect the site. Groundwater underflow is the largest source of freshwater to the Peconic system, with an annual average discharge of approximately 175 cfs (Tetra Tech, 2000). The Peconic River, located in the far western portion of the estuary, is the major source of surface freshwater (32 cfs) with the numerous other tributaries and discharges from wastewater treatment plants relatively minor sources. Tidal exchange with ocean occurs primarily through Gardiners Bay and Block Island Sound on the estuary's eastern boundary. The volume of tidal exchange far exceeds the volume of freshwater inflow (BTCAMP, 1992), a factor which facilitates the dispersal and flushing of pollutants entering the system.

Predictably, the 2010-2012 data show a general increase in average salinity from west to east in the estuary. The average salinity gradient from Flanders Bay to Gardiners Bay was 2.1 psu, which agrees very well with the 2.3 ppt gradient noted by Hardy (1976). In terms of temporal variations, salinity levels but did not exhibit a clear seasonal pattern of increase or decrease that is characteristic of some estuaries, but rather showed a general increasing trend through the three-year sampling period. Lowest salinities in all open water sites occurred during the spring of 2010, with maximum values recorded in the fall of 2012. Since the salinity of ocean waters is relatively stable, it's likely that this pattern was predominantly driven by variations in the frequency and intensity of rainfall events. An examination of historical rainfall data (Weather Underground, 2015) revealed that unusually heavy rainfall occurred in the days prior to each of the three spring 2010 sampling events, a likely explanation for the comparatively low levels of salinity noted. Similarly, the data show comparatively lower levels of total precipitation occurring during 2012 (30" as compared to 43" in each of 2010 and 2011), which likely contributed to the higher salinity levels noted.

Dissolved Oxygen: Adequate levels of dissolved oxygen (DO) are critical to the growth and survival of marine life. Factors that primarily affect the concentration of DO in the water column include temperature, surface mixing (through wind and wave) and biological activity (photosynthesis, respiration and bacterial decomposition).

Historically, DO levels throughout much of the Peconic Estuary have been very good (CCMP, 2001) with only a limited number of sites in the western estuary experiencing periodic excursions below standard criteria. Because DO stresses can be a consequence of excessive nutrient levels and associated algal growth, the PEP's CCMP has established a number of measureable goals within the context of nutrient pollution (discussed below). The association between excess nitrogen loadings and depressed DO levels in the western estuary has also prompted the NYSDEC, under the auspices of Section 303(d) of the Federal Clean Water Act, to require Suffolk County to develop a Total Maximum Daily Load (TMDL) for nitrogen (NYSDEC, 2007). The objective of the TMDL, once fully implemented, is to improve water quality in the western estuary and to achieve compliance with DO standards.

An assessment of worst-case summer conditions during 2010-2012, revealed that a number of western estuary sites continue to experience periodic excursions below DO standards, including Meetinghouse Creek, the Peconic River mouth and East Creek in South Jamesport. Conditions are particularly severe in Meetinghouse Creek, where excursions below the acute 3.0 mg/L standard (6 NYCRR, Part 703) occurred in both surface and bottom waters. Results of diurnal monitoring similarly showed extreme conditions to exist in Meetinghouse Creek, with 70% of early morning samples below criteria. In contrast, no early morning DO excursions were noted in any of the samples from nearby Flanders Bay.

In West Neck Bay, where a surface water violation hadn't occurred since July of 1994 (bottom water excursions have been commonplace), two comparatively severe depressions (3.5 mg/L and 3.9 mg/L) were recorded during the summers of 2010 and 2012. West Neck Bay is the only embayment east of Flanders Bay where multiple excursions below criteria were noted. The area is subject to enrichment from bordering homes (likely fertilizer and septic-based), experiences frequent algal blooms and receives a limited degree of tidal flushing, all factors that may contribute to the periodically depressed oxygen levels noted.

On an encouraging note, the only location beyond the western estuary and West Neck Bay that showed a surface water violation was Goose Creek, and although six sites experienced bottom water excursions (Bullhead Bay, Cutchogue Harbor, Wooley Pond, Mill Creek in Noyac, Goose Creek and Town Creek), all consisted of a single sample below the criteria during July or August when water temperatures were at their peak. Based on this, the CCMP objective of at least maintaining DO levels in waters east of Flanders Bay seems to have been accomplished for the majority of system embayments. The goal of improving DO levels in the western estuary however, has not been fully achieved.

Coliform Bacteria: Coliform bacteria, particularly fecal coliforms, are found in high numbers in the intestinal tracts of warm-blooded animals, and as such, are used as indicators of potential pathogen contamination. Pathogens are primarily a concern in the Peconic Estuary because of the human health risks associated with contact and/or ingestion of contaminated water and shellfish, but also because of the potential economic losses associated with closures of shellfish beds and bathing beaches.

The main contributors of pathogens to the estuary are generally nonpoint sources, particularly stormwater runoff that is contaminated with waste from wildlife, waterfowl, domestic pets and livestock, as well as direct inputs from waterfowl (Battelle, 2006). Other comparatively minor sources may include marine vessel discharges, poorly operating septic systems and point source discharges. The two point sources currently monitored under the PEP, the Riverhead STP and Atlantis Aquarium discharges, likely don't impact the estuary as a whole but may be important as local sources of contamination. Each has a history of occasionally exceeding permit limits for total and fecal coliforms, both in SCDHS samples and in regulatory samples collected by facility agents.

During 2010-2012, coliform levels were generally low throughout the marine portion of the system, with only a small number of sites having total and/or fecal coliform means greater than the minimum reportable level (MRL) for the procedure used. All of these sites are located in tidal creeks or enclosed areas that are subject to stormwater runoff and possibly impacts from waterfowl, including the Peconic River mouth, Meetinghouse Creek, East Creek in S. Jamesport, East Creek in Cutchogue, Northwest Creek and Sag Harbor. Predictably, a cursory look at rainfall data showed a positive association between peaks in coliform levels and prior precipitation.

In terms of NYS water quality standards for coliforms (6 NYCRR Part 703), all Class SA and SC marine sites met the basic criteria. Six sites didn't meet the minimum standards for shellfishing (6 NYCRR Part 47), and accordingly four of these are located in areas already uncertified for shellfish harvesting (Peconic River mouth, Meetinghouse Creek, East Creek in South Jamesport and Sag Harbor), and two are located in areas that are seasonally certified due to known water quality issues during warmer months of the year (East Creek in Cutchogue and Northwest Creek).

In contrast to marine locations, coliform levels in the streams sampled were highly variable, and in some cases extreme, with mean values significantly greater than those found at marine stations. This was not unexpected, due to the proximity of stream sites to potential sources of contamination and the reduced opportunity for dilution. Nine north fork streams from Terrys Creek in Riverhead to Narrow River in Orient exceeded the NYS criteria for total and/or fecal coliforms. Although elevated levels were generally associated with prior precipitation amounts, some were also noted during dry periods suggesting that other factors such as waterfowl, boats, and/or poorly operating septic systems may be locally important in some streams. Both the Riverhead STP and Atlantis Aquarium discharges to the Peconic River had frequent violations of their permit limits for total and fecal coliforms.

Nutrients: All aquatic waterbodies require a supply of nutrients to maintain healthy ecosystems. An excessive supply (eutrophication) however, can have far reaching consequences, including the proliferation of nuisance and sometimes harmful algal blooms, reduced water clarity and depressed levels of dissolved oxygen. Nitrogen is the nutrient that generally limits productivity in coastal ecosystems and is the nutrient of concern in the Peconic Estuary, particularly during summer months when environmental stresses are greater. Although most of the estuary has excellent water quality, a number of waterbodies in the western portion of the estuary, including the lower Peconic River, Flanders Bay and Meetinghouse Creek, have historically been nitrogen enriched and as a result have been characterized by a high level of algal production and periodically depressed oxygen levels.

In an effort to address nitrogen impacts, the Peconic Estuary Program (PEP) incorporated the reduction of loads to the western estuary and preservation of existing water quality in the eastern estuary as major CCMP objectives. Among the PEP measureable goals with regard to nutrients include the following:

- Decrease the total nitrogen (TN) concentrations in the western estuary to a summer mean of no more than 0.45 mg/l
- Improve the dissolved oxygen concentrations in the western estuary to ensure that the New York State dissolved oxygen standard is not violated
- Ensure that the TN levels in shallow waters remain at or below 0.4 mg/l to help optimize water clarity, maintaining and potentially improving conditions for eelgrass beds
- Ensure that the existing TN and dissolved oxygen levels are maintained or improved in waters east of Flanders Bay (i.e., do not increase TN nor decrease DO)

The majority of external nitrogen contributed to the estuary is from non-point sources, including wet and dry atmospheric deposition, groundwater enriched by agricultural and residential fertilizer use and on-site sewage disposal systems, and to a lesser extent, stormwater runoff (CCMP, 2001; NYSDEC, 2007). In the western estuary, point sources such as the Crescent Duck Farm and the Riverhead Wastewater Treatment Plant may be locally important, but are not thought to have a significant influence on the estuary as a whole. A recent study that modeled nitrogen loads from forty-three sub-watersheds in the estuary (Lloyd, 2014), noted that among land-based sources of nitrogen, wastewater (from on-site systems and treatment plants) was the single largest contributor of nitrogen to the estuary (49.6%), followed by fertilizer from agricultural, residential and golf course sources (26.4%) and atmospheric deposition (24%). The study also reported however, an estimate of the nitrogen load from direct atmospheric deposition to the water surface that far exceeded all other sources combined. The impact of this load on ecological dynamics in the estuary remains unexplored. Within the estuary, the remineralization of nitrogen from sediments (sediment flux) is a critical component of the system's nitrogen cycle, particularly in the western estuary where legacy loadings from the numerous duck farms that operated from the early 1900's through the 1970's may still exist. When considered with external sources, sediment flux has been estimated to comprise 51% of the total nitrogen loading to the estuary (CCMP, 2001).

Marine Nitrogen: Results of 2010-2012 marine sampling show that average concentrations of TN have remained similar to levels seen during the prior decade (2000-2009), but are considerably lower than those seen during the 1990's. At main-bay and peripheral embayment sites, TN was primarily comprised of dissolved organic nitrogen (DON), with levels of dissolved inorganic nitrogen (DIN) comparatively insignificant. DON is generally the largest pool of fixed nitrogen in most aquatic systems (Bronk, 2002), and although once thought to be largely refractive and unavailable to primary producers, is now considered to be an important source of nitrogen nutrition to phytoplankton (Wiegner et al., 2006; Bronk et al., 2007; Berg et al., 1997; Capone et al., 2008). At a number of tidal creek sites, particularly those in the western estuary and along the north fork, DIN (mostly NO_x-N) was predictably the main component of the TN. These sites are associated with watersheds where agricultural and/or residential developments are the predominant land use, and area groundwater has been nitrate-enriched with wastewater from onsite septic systems and fertilizer applications.

On spatial and temporal scales, TN concentrations varied in a similar manner to that noted in past accounts (SCDHS, 1998b; SCDHS, 1998c; BTCAMP, 1992). Along the estuary's main-stem, levels were generally highest during summer months, likely reflecting increased biological activity in sediments and the release of regenerated nitrogen. Garber *et al* (1990) and others have noted that sediment-water exchanges follow a strong seasonal pattern with maximum rates occurring during the mid to late summer and minimum rates in the winter. The data also show a general west to east decline in TN magnitude, with average levels decreasing by 44% from the Peconic River mouth to Gardiners Bay. An examination of worst-case summer conditions showed that a number of sites in the western estuary (Meetinghouse Creek, the tidal portion of East Creek in South Jamesport and the Peconic River mouth) continued to have the greatest percentage of samples exceeding the 0.45 mg/L TN guideline, and not coincidentally, the greatest percentage of summer excursions below NYS dissolved oxygen criteria. This was not unexpected, as the western estuary is particularly susceptible to nutrient inputs from a preponderance of point and non-point sources and a reduced level of tidal flushing. Water quality issues at these sites however, are localized phenomena that likely have little impact on the estuary as a whole. Beyond the western estuary, particularly along the main-stem from Flanders Bay through Gardiners Bay, water quality in terms of nitrogen and dissolved oxygen, continues to be very good. Even in peripheral embayments where flushing can be an issue, only four locations had greater than 10% of summer samples greater than the 0.45 mg/L TN guideline (Bullhead Bay, North Sea Harbor, East Creek in Cutchogue and West Neck Bay). Similarly, only 11 of the 26 shallow water sites exhibited exceedances of the 0.40 mg/L guideline, with most of these having less than a 20% exceedance rate.

Stream Nitrogen: Nitrogen levels in Peconic Estuary streams are a function of the quality of the groundwater base flow the stream receives, coupled with relative impacts from upstream pollution sources. Concentrations will vary with the type of land use, precipitation amounts, groundwater levels, the proximity to area point sources, stormwater runoff and in some cases, tidal exchange. Natural attenuation processes, including plant and bacterial uptake, mixing with low nitrate water and denitrification, may act to reduce nitrogen levels in the groundwater discharge, resulting in stream concentrations that are lower than that in area groundwater.

Past assessments have reported on the association between elevated nitrogen loads (predominantly as nitrate-N) in groundwater and surface waters of the estuary and densely developed residential and/or agricultural land uses (Eckhardt et al., 1989; BTCAMP, 1992; Trent and Robbins, 1996; SCDHS, 2002). Consistent with this, streams with the highest total nitrogen levels during 2010-2012 were located in areas of the western estuary and north fork where upland watersheds predominantly support these uses. Similarly, sites with relatively low nitrogen levels were located in areas with a greater proportion of open space, including some areas of the Peconic River and along tributaries to southern Flanders Bay. Predictably, the TN in the majority of streams was mainly comprised of NO_x-N, with significant levels of NH_3-N only noted at the Meetinghouse Creek site downstream from the Crescent Duck Farm.

An assessment of long-term fluctuations in stream nitrogen levels did not reveal a consistent pattern among the streams examined, with some locations showing increasing trends while others were decreasing. The range of results noted is likely associated with the mix of land uses involved (residential, agriculture, open space, etc) and changes in types and intensity of uses over the decades, as well as the relative intensity of sampling and the availability of comparison data. At the two lower Peconic River stations (the USGS gage and Grangebel Park), average TN concentrations showed a long-term declining trend that was associated with changing levels of DIN and /or DON, while in Meetinghouse Creek, a more pronounced pattern of declining TN was apparent that was almost entirely due to declining DIN (mainly NO_x-N). At the Route 25 site on the creek (station 200041), the reduction in measured nitrogen concentrations may be associated with the gradual shift from agriculture to low density residential land use that has occurred in the upland watershed over the past two decades, while in lower Meetinghouse Creek (station 200004), the elimination of a direct discharge from the Crescent Duck Farm has resulted in improved water quality in the creek (BTCAMP, 1992). Together these improvements are reflected in summer TN levels in the tidal portion of the creek (station 060220), which have declined by 55% since the 1990’s. It is important to note however, that although improved treatment practices at the duck farm (instituted in 1987) have resulted in a diminished nitrogen load to Meetinghouse Creek, levels remain significant and continue to adversely impact the water quality in the western estuary. To wit, the average levels of TN (and DIN) found at the sampling site on the south side of the facility (station 200004) are still more than double that found north of the farm at the Route 25 site (station 200041). Moreover, the level of NH_3-N on the south side is ten times that found to the north and the levels of TP and o-PO_4-P two orders of magnitude (100X) higher. This doesn’t speak well for the efficiency of the facility’s treatment process, and suggests that perhaps the current SPDES discharge limits need to be reexamined.

At other western estuary streams, increasing trends in TN and DIN were noted at Sawmill Creek, Terrys Creek and Reeves Creek, with little tendency shown for East Creek (SJ). The four creeks in southern Flanders Bay have historically been among the lowest in TN and DIN, reflecting lower levels characteristic of area groundwater, and continued to be so in 2010-2012. Of the north fork streams, Brushes Creek and Deep Hole Creek showed TN/DIN increasing trends, while six of the eight easternmost creeks monitored (Halls Creek, Downs Creek, East Creek in Cutchogue, Pipes Creek, Pipes Neck Creek, and Narrow River South) exhibited declining trends.

Point Source Nitrogen: Nitrogen additions from the two point sources monitored under the PEP, the Riverhead STP and Atlantis Aquarium discharges, are minimal compared to other sources and are not thought to have a significant impact on the estuary as a whole. This has particularly been the case since 2000, when treatment upgrades at the STP that significantly reduced the plant's nitrogen load were completed. Both point sources however, particularly the STP, may still impact water quality in portions of the western estuary where elevated nutrients and chlorophyll-a, and periodically depressed DO levels remain an issue. As testament to this, an investigation into the recent (spring 2015) menhaden fish kills in the lower Peconic River identified recurring algal blooms and diminished oxygen levels associated with hyper-eutrophication in the river as primary causes.

Chlorophyll-a: The concentration of chlorophyll-a in marine waters is used as an indicator of phytoplankton biomass and indirectly as a surrogate for the relative level of nutrient enrichment. In the Peconic Estuary, waterbodies in the westernmost portion of the system have historically been characterized by comparatively elevated nutrient (nitrogen) and chlorophyll-a concentrations, primarily due to their association with current and former enriched discharges (and the legacy of those discharges in area sediments), enriched groundwater and a limited degree of tidal flushing. Correspondingly, chlorophyll-a levels have generally declined in an eastward direction with increased distance from these sources of enrichment and an increased level of tidal flushing.

The 2010-2012 data shows that chlorophyll-a levels continued to be comparatively elevated at four western estuary sites (Meetinghouse Creek, Reeves Bay, the Peconic River mouth and East Creek in South Jamesport) as well as in West Neck Bay in Shelter Island. Although nitrogen levels have declined throughout much of the estuary over the past decade, they apparently remain sufficiently elevated at these locations to support a relatively high level of primary productivity. In terms of trophic state, according to the scale developed by Molvaer *et al* (1997), each of the five sites would be classified as eutrophic with average chlorophyll levels >7 ug/L. At the 33 other sites monitored in the estuary, mean chlorophyll-a levels are in the 2-6 ug/L range and as such would be considered mesotrophic. A water body with mesotrophic conditions may be nutrient-enriched but generally does not experience the adverse impacts typically associated with the overgrowth of algae (low DO and reduced water clarity) that are characteristic of eutrophic water bodies (EPA, 2003a).

When only summer data are considered, the number of sites on the eutrophic spectrum increases from 5 to 11, and similarly, the percentage of shallow water sites with mean values above the 5.5 ug/L guideline increases from 8% to 50%. Although this indicates that a number of locations beyond the western estuary are sufficiently enriched to support a moderate level of algal growth, they are either not at the level that would result in water clarity and dissolved oxygen issues, or factors such as tidal flushing are acting to mitigate the impact.

Toxics: To evaluate the extent to which toxic contaminants from adjoining watersheds are impacting the estuary, levels of numerous organic and trace metal compounds are routinely monitored at stream stations. In general, concentrations of toxics in streams are a function of baseflow water quality and the degree to which the waterbody is subject to effects from stormwater runoff and/or point source discharges. Potential sources are numerous, and may include agricultural operations, runoff from parking lots and roads, private septic systems, wastewater treatment plant discharges, spills/leaks, boats and marinas, golf courses, treated lumber in docks and pilings, and atmospheric deposition.

Organics: Past monitoring conducted under the PEP (1990-2009) has documented the presence of numerous organic constituents in estuary streams, including various pesticides and volatile organic compounds (VOCs), and occasionally, a number of pharmaceutical/personal care products (PPCPs). The most frequently detected pesticides included three herbicide degradates (the OA and ESA metabolites of Metolachlor and the OA degradate of Alachlor), degradates of the carbamate insecticide Aldicarb (A. sulfoxide and A. sulfone) and the fungicide Metalaxyl. Commonly detected VOCs included the gasoline additive MTBE and the solvents Chloromethane, Freon 113, Toluene and 1,1,1-Trichloroethane. Detections of PPCPs were limited to the insect repellant DEET and three medications, the muscle relaxant Carisoprodol, the lipid reducing drug Gemfibrozil and the anti-inflammatory drug Ibuprofen. Pesticide detects were primarily found in streams where agriculture was a principal land use in adjacent watersheds, while VOC detects were more common at sites associated with commercial/industrial and/or residential land uses. The association between pesticide contamination in groundwater (the source of baseflow for Peconic streams) and agricultural activities, particularly in the east end towns that border the Peconic Estuary, has been documented by a number of past studies (Zaki et al., 1982; Trent and Robbins, 1996; SCDHS, 1999b; SCDHS 2002; USGS,1984; USGS, 1999).

During 2010-2012, the number of organic compounds detected decreased significantly from that noted during the prior two decades, with the number of pesticides declining from 25 to 16 (36% less) and the number of VOCs from 23 to 9 compounds (61% less). While this may reflect, at least in part, reductions in the use and/or improvements in the handling of these chemicals, the decline may also be associated with the comparatively lower sampling size (3 years of data compared to 17 years at most sites). This may be particularly true for many of the VOCs detected, which were generally infrequent to begin with (found in <1 % of historical samples).

Despite the overall reduction in compound numbers, pesticide residues remained common in a number of north fork streams, particularly the four situated along the northern shoreline of Great Peconic Bay: East Creek, Brushes Creek, Deep Hole Creek and Halls Creek. None of the residues however, exceeded the few existing NYS surface water quality standards for pesticides and only two exceedances of the EPA aquatic life criteria were noted, one involving a single detect of Ronstar in Brushes Creek and the other a single detect of Dichlorvos in Sawmill Creek. The most frequently detected compounds continued to be the metabolites of Metolachlor and Alachlor, with Deisopropylatrazine, Metalaxyl and the sulfone and sulfoxide degradates of Aldicarb also somewhat common. Detections of the Aldicarb residues have actually declined significantly in in recent years, appearing in about half of the streams it was found in during 1990-2009. This pattern has been noted by other surveys and has been attributed to the banning of Aldicarb in 1980 and its eventual movement out of the groundwater system (SCDHS, 2002). Other pesticides that have also declined in incidence during 2010-2012 included the herbicide Simazine (from 5 to 1 site) and Tetrachloroterephthalic Acid, an herbicide metabolite of Dacthal (from 4 to no sites).

As in past years, Brushes Creek in Laurel was by far the worst Peconic Estuary stream in 2010-2012, both in terms of the frequency and the concentration of pesticide residues. The 13 samples collected at the creek yielded 72 detects involving 9 different pesticides, with a cocktail of at least 4 and as many as 7 residues present in each sample collected. The site had the highest number of detects and concentrations of the herbicide metabolites 2,6-Dichlorobenzamide and Deisopropylatrazine and the fungicide Metalaxyl, the highest concentration of the herbicide degradate Alachlor ESA and the insect repellant DEET, and was the only site where the herbicides Dichlobenil and Ronstar, and the insecticide Imidacloprid, were detected. Although the majority of these detects involved concentrations well below aquatic benchmarks (Ronstar being the only exception), the potential for cumulative ecological effects from long-term exposures to such a mixture of pesticides remains a question. Because toxicity criteria apply to individual compounds and are usually developed for a single test species, the potential for additive or synergistic effects of pesticide mixtures is not addressed by commonly used benchmarks (Nowell, 2014). According to a study conducted by the USGS under its National Water Quality Assessment (NAWQA) Program, mixtures of pesticides are common to streams associated with substantial agricultural, urban or mixed land uses, and in most instances a mixture of pesticides presents a greater risk to aquatic organisms than do any of the individual compounds (Gilliom *et al*, 2007).

In contrast to Brushes Creek and other north fork streams, a significant improvement in the number of pesticides found was noted in Meetinghouse Creek where detects at the Rt. 25 station declined from ten compounds to one and at the duck farm site from ten compounds to three. This reduction is likely associated with a general change in land use in the upland watershed (from predominantly agricultural to medium density residential) that has occurred over the past few decades. Not by coincidence, the long-term decline in nitrogen concentrations seen at the upstream Rt. 25 location is also likely associated with the changing land use pattern. Also highlighting the association between agricultural land uses and pesticide residues in Peconic streams, is the continued lack of any pesticide detects in the Peconic River and southern Flanders Bay creeks, both areas where agricultural activities are minimal.

Detections of VOCs in Peconic Estuary streams were uncommon compared to pesticides, with each of nine compounds found only at one or two sites. Frequencies were generally less than 2% of samples, with the exception of Freon 113 (5.4%) and MTBE (2.7%). VOCs are associated with a myriad of products used in commercial, industrial and household activities, including plastics, adhesives, refrigerants, paints, gasoline and dry-cleaning fluids (USGS, 2006). They can reach groundwater and surface waters through a variety of pathways, including wastewater discharges, septic systems, engine exhaust and other emissions, landfills, leaking storage tanks and storm water runoff. The majority of VOC detects during 2010-0212 were at western estuary sites associated more with commercial/industrial and/or residential land uses rather than agriculture, including the Peconic River (USGS gage, Grangebel Park and BNL sites), the Meetinghouse Creek duck farm site and Sawmill Creek.

In the Peconic River, the source of the refrigerant Freon 113 (detected only at the USGS gage and Grangebel Park sites) is apparently associated with a groundwater contaminant plume emanating from the former Hazeltine Europe facility on Old Country Road in Riverhead (SCDHS, 1992). The Freon spill reportedly occurred at the facility in 1987 and was subsequently remediated using groundwater extraction wells and an air stripping tower. Residues were first detected at the gage site in 1992 and have been noted there in at least one sample collected in every year since but two. During 2010-2012, the frequency and incidence of Freon detections exhibited an increasing trend in the river, although residues remained at low concentrations. At the gage site, 47% of historical (1992-2009) samples showed reportable levels (mean of 0.8 ug/L; max of 2.0 ug/L), while during 2010-2012 the frequency was 79% (mean of 1.2 ug/L; max of 2.2 ug/L). At the Grangebel Park station, Freon was undetectable in 37 samples collected between 1995 and 2009, but present in 5 of the 14 samples (36%) collected during 2010-2012 (mean of 0.6 ug/L; max of 0.9 ug/L). The only available water quality standards for Freon 113 are for Class A, AA surface waters (those used as a drinking water source) and for groundwater, both set at 5 ug/L which no sample (past or present) has exceeded No ecological criteria were located.

The gasoline additive MTBE, once considered ubiquitous in surface waters (and noted at 15 Peconic streams in 1990-2009), was only noted in 2010-2012 at the Meetinghouse Creek duck farm site and in Sawmill Creek in relatively low concentrations. The reduced prevalence is likely associated with the chemical being banned as a gasoline additive in Suffolk County in 2000 over concerns about it being a potential carcinogen. Other notable improvements in VOC detects concerns the chemical Chloromethane, found at 12 sites in 1990-2009 but undetected in 2010-2012, and the solvent Toluene, which declined from 7 to 2 sites over the same period. None of the VOC residues detected in 2010-2012 exceeded available water quality criteria.

Occurrences of pharmaceutical and personal care products (PPCP) in the streams were also infrequent and limited in the number of compounds detected. PPCPs are a diverse group of chemicals that include both prescription and over the counter medications, fragrances, insect repellants, preservatives and UV filters (used in sunscreens). They are primarily introduced to surface waters through wastewater discharges, although some personal care products are also likely washed directly off the skin of bathers. PPCPs are an emerging environmental concern due to their potential to cause endocrine system disruption in aquatic organisms, and because they tend to bioaccumulate and can possibly affect higher trophic levels (EPA, 2013; Brausch and Rand, 2011).

During 2010-2012, PPCP detects were limited to four chemicals: Caffeine, the insect repellant DEET, Bisphenol A (BPA, a plasticizer) and Dilantin (an anti-epileptic). The incidence of detects increased compared to the 1990-2009 sampling period from 4 to 17 streams, but remained infrequent with only one or two detects recorded per site. Residues of caffeine, often associated with sources of domestic wastewater (Seiler et al., 1999), were detected at 10 sites but at low (< 1.0 ug/L) concentrations. Both Dilantin and BPA were only found at the BNL site on the Peconic River, also at very low levels (0.3 ug/L), and likely had their source in the upstream wastewater effluent from the lab. DEET, routinely found in surface waters throughout the United States (Brausch and Rand, 2011) and the only PPCP found during both sampling periods, was detected in 12 Peconic Estuary streams. Although concentrations of DEET were generally low (in the 0.2-2.0 ug/L range), levels of 17 ug/L and 44 ug/L were noted at Deep Hole Creek and Brushes Creek, respectively. Surface water quality standards for PPCPs are generally lacking, although a reference was found concerning aquatic life criteria for DEET (Costanzo et al, 2007) that no result exceeded.

Metals: As with pesticides and other contaminants, trace-metals can be delivered to estuary streams through both non-point and point sources, including atmospheric deposition, surface runoff, groundwater (blending agricultural, residential and industrial sources) and wastewater treatment plant effluents. Once in the system, the solubility of a metal and its relative bioavailability can vary with changes in factors such as water temperature, salinity, pH and oxidation-reduction potential that affect the sorption of the metal to (adsorption) and from (desorption) the surface of suspended particles and/or sediments (Connell and Miller, 1984; Nimick *et al*, 2003). For some dissolved metals, variations in concentrations have been shown to occur on a diurnal basis, suggesting that consistency in the timing of sample collection may be an important consideration when designing a trace-metal monitoring plan.

Among concerns regarding trace metals outlined in the CCMP, were the tendency of some metals to accumulate in bottom sediments where they can potentially be ingested by bottom-dwelling organisms, and the possibility that some metals may travel through the food chain and bio-accumulate in tissues of finfish, shellfish and crustaceans. In a study of sediment quality conducted at 12 locations in the estuary (Little, 1996), no samples exceeded published ER-M (Effects Range-Medium) values developed by NOAA (Long & Morgan, 1990) which are the concentrations above which contaminant induced effects are likely. A number of sample results however, mostly from Meetinghouse Creek and East Creek in South Jamesport, did exceed ER-L (Effects Range-Low) values which correspond to concentrations below which effects are unlikely. Based on these results, the study concluded that the estuary is not in a situation where adverse effects from metals in sediments would be expected to occur frequently, but cautioned that occasional adverse biological effects can be expected.

Of the ten metals of concern focused on in this report, three of the most toxic in terms of aquatic criteria (USEPA, 2009), including cadmium, mercury and silver, were not detected during 2010-2012 in any of the stream sites monitored and were rarely found during previous sampling efforts. Of the other metals studied, one was only occasionally detected (selenium), two have declined in overall frequency since the 2000-2009 sampling period (chromium and lead), three have remained relatively common throughout the years (copper, nickel and zinc), and one increased significantly in prevalence during 2010-2012 (arsenic).

Sites where trace metal residues were most common and highest in concentration, generally included the BNL site on the Peconic River, Pipes Creek and Pipes Neck Creek in Greenport and Narrow River North in Orient. The lowest incidence and concentrations were found in the lower Peconic River and in the four creeks located along southern Flanders Bay (Birch, Goose, Mill and Hubbard). Exceedances of water quality standards were infrequent and involved a limited number of sites, including two locations where lead levels were above aquatic life criteria (the Peconic River BNL site and Pipes Creek) and three sites where selenium levels were above NYS criteria for streams, groundwater and aquatic life (Downs Creek, Pipes Creek and Narrow River South). It should be noted again, that results for five of the metals detected (Cr, Cu, Pb, Ni and Zn) could not be evaluated in relation to appropriate NYS criteria for Class B,C fresh waters, since the hardness data required to calculate the thresholds was not available.

Arsenic – Arsenic detections were widespread but occasional in past years, appearing at 18 of the 23 sites in 2000-2009 and in 15% of samples collected, but increased significantly in frequency during 2010-2012 (20 sites, 55% of samples). Relative concentrations have remained similar however, with the lowest levels consistently noted in tributaries to southern Flanders Bay and in the lower Peconic River (1-3 ug/L), and the highest concentrations (often exceeding 10 ug/L) found at a number of north fork creeks where agriculture is a predominant land use in adjacent watersheds.

Potential sources of arsenic in Suffolk County include lumber used in docks and pilings that has been treated with wood preservatives such as CCA (chromated copper arsenate) and ACA (ammoniacal copper arsenate), arsenic-bearing minerals in unconsolidated deposits within the groundwater aquifer, and agricultural pesticides containing sodium arsenite and lead arsenate (Cartwright, 2004). In a nationwide study of the occurrence of arsenic in groundwater, Welch *et al.* (2000) noted that arsenic released through a geochemical reaction of iron oxide with natural or anthropogenic organic carbon (such as VOCs) appeared to be the most common cause of arsenic concentrations exceeding 10 ug/L in groundwater. In a local study of lead and arsenic residues in potato field soils where sodium arsenite and lead arsenate pesticides had previously been applied, Sanok et al. (1995) found concentrations that were markedly higher than in untreated controls.

Copper - Copper has historically been a common contaminant in Peconic Estuary streams, appearing in ~45% of all samples collected. As with arsenic and other metals, the lowest prevalence has generally been in the lower Peconic River (at the gage and Grangebel Park sites) and in the creeks located along the southern border of Flanders Bay. The highest frequencies during both the 2000-2009 and 2010-2012 sampling periods (>80%) were in Meetinghouse Creek at the duck farm site, at the BNL site on the Peconic River, in Pipes and Pipes Neck Creeks in Southold, and at both Narrow River sites in Orient. Average concentrations have generally been low (from 1-4 mg/L) however, with the exception of those at the BNL site (25.7 and 22.0 mg/L) and at the Narrow River North location in 2010-2012 (8.8 mg/L).

Sources of copper to surface waters may include stormwater runoff from roads and parking lots, lumber treated with wood preservatives (CCA, CAA and copper naphthenate), agricultural pesticides and atmospheric deposition. Anti-fouling paints used on boat hulls is also a common source of copper, although not likely a significant factor at the stream sites studied here. In a study of heavy metal residues in storm water runoff, Woodward-Clyde (1994) identified vehicle brake pad wear as a significant source of copper (and to a lesser extent zinc) to the surface waters of San Francisco Bay.

Chromium - The decline in chromium detections was particularly evident at north fork creek stations between Meetinghouse Creek and East Creek in Cutchogue, where the frequency dropped from 47% to 5% of samples collected. Further east at three sites in Greenport and Orient (Pipes Creek, Pipes Neck Creek and Narrow River North) however, chromium detections remained common (>50%).

Potential sources of chromium to surface waters are numerous, making assessments regarding changes in stream concentration and prevalence difficult. In addition to naturally occurring chromium which leaches into surface waters from soils and rocks, sources may include wastewater from electroplating, CCA (chromated copper arsenate) treated docks and pilings, leather tanning and textile industries, municipal refuse, sewage sludge, solid wastes from chromate processing facilities that have been disposed of in landfills and the atmospheric deposition of emissions from coal, oil and natural gas combustion (ATSDR, 2008).

The three sites where chromium detections continued to be common are each located downstream from areas that primarily consist of freshwater wetlands and/or open space where residues of chromium typically wouldn't be expected. Further research did reveal that the Silver Lake/Moore's Drain area in Greenport, located upstream from the Pipes Neck Creek station, was formerly the site of a municipal dump and thus could be a source of the chromium and other metal contaminants noted at that site. Obvious sources were not apparent at the Pipes Creek station (located across Rt. 25 from the Arshamomaque Preserve) or at the Narrow River North site, however.

Lead - Although the overall prevalence of lead residues in estuary streams also declined significantly from that found during 2000-2009 (from 23 to 6 stations), it remained a common contaminant at the BNL site on the Peconic River and at the Narrow River North station.

Exceedances of the chronic aquatic life criteria (2.5 ug/L) were limited to two samples from the BNL site and one sample from Pipes Creek. Since leaded gasoline can no longer be sold in the United States, a general decline in the frequency of lead detections with time would be expected. Historically, lead contamination in the environment has primarily been the result of anthropogenic emissions to the atmosphere (ATSDR, 2007; Eisenreich et al., 1986), with leaded gasoline the principal source. Starting in the 1980s, the USEPA instituted a gradual phase-out of lead additives, and by 1996 banned the sale completely. Other potential sources of lead have also been curtailed or eliminated through regulation, including the use of lead arsenate pesticides, lead-based paints, lead shot and lead sinkers.

In a study of trace metal concentrations in a number of locations throughout the Peconic Estuary, Breuer *et al*. (1999) noted that unusually high levels of lead found at a site in the freshwater reaches of the Peconic River near Riverhead, may have been associated with remobilization from contaminated sediments and/or suspended particles. With this in mind, it's possible that the persistence of lead at the BNL site on the Peconic River may be associated with leaching and runoff from soils in the vicinity of the STP which have been found in past studies (CCMP, 2001) to have elevated levels of several trace metals including lead. The facility's wastewater discharge is also a potential source. At the Narrow River North location, potential sources of lead were not apparent.

Nickel – Nickel has been the most common metal detected in Peconic Estuary streams, particularly during the 2010-2012 sampling period when 15 of the 23 sites tested had a detection frequency of at least 85%. Highest concentrations were typically noted at the BNL site on the Peconic River and at the duck farm site on Meetinghouse Creek.

Sources of nickel to surface waters include metal plating and other industrial discharges, municipal sewage effluents, and several non-point sources conveyed by storm water runoff and/or atmospheric deposition such as brake lining dust, tires, fertilizers, Ni-Cd batteries and fossil fuel combustion by-products from cars/trucks, power plants and incinerators. In the Peconic Estuary, Breuer *et al*. (1999) found the highest concentrations of dissolved nickel at a location in the Peconic River near the Riverhead STP discharge.

Selenium – Detections of selenium were rare, with only one sample from 6 of the 23 stream sites monitored showing residues. Of these, three were at or just above the minimum reportable level of 4.0 ug/L. A similar level of infrequency was noted in past monitoring efforts. Selenium is a naturally occurring trace element commonly found in sedimentary rock layers that are rich in fossil fuel deposits, including coal, crude oil and oil shale. Sources to aquatic systems include runoff from mining operations, petroleum contamination (leaks and spills), fossil fuel combustion and waste disposal (Mauk and Brown, 1999; Swift, 2002). Although selenium is nutritionally required for life, it can bioaccumulate in aquatic food chains and is toxic at very low levels (Lemly, 2007, 2009). The element is normally present in surface waters at trace levels (<0.5 ug/L) and has been found to be toxic to fish at levels as low as 2 – 5 ug/L (Lemly, 2009). Single samples from three of the stream sites monitored (Downs Creek, Pipes Creek and Narrow River South) had selenium levels in the 5.9 – 14.2 ug/L range, all exceeding the NYS criteria for B,C waters (4.6 ug/L) and the EPA aquatic life criteria (5.0 ug/L).

Zinc – Reportable zinc detections were widespread although generally infrequent, appearing in about 20% of samples collected. The only exceptions were the BNL site on the Peconic River and the Narrow River North station, where 77% and 60%, respectively, of samples contained zinc residues. Exceedances of aquatic criteria were also widespread but infrequent, occurring in one or two samples from nine of the streams monitored.

Sources of zinc to surface waters are primarily associated with runoff, and include galvanized metal surfaces, motor oil, hydraulic fluid, tire dust, paints, wood preservatives, pesticides, fertilizers and dust from vehicle disc brakes (Golding, 2008; Woodward-Clyde, 1994). As with lead, the persistence of zinc at the BNL site may be associated with leaching and runoff from soils in the vicinity of the facility's wastewater treatment plant, where elevated levels of several trace metals have been found in past studies (CCMP, 2001).

Summary

Results of water quality monitoring conducted during 2010-2012 under the Peconic Estuary Program (PEP) showed very good water quality to exist throughout much of the estuary, but also revealed that impacts continue to exist in some portions of the system. In the western estuary, adverse impacts from various sources of contamination remain an issue, including enriched groundwater, discharges from the Riverhead wastewater treatment plant and the Corwin Duck Farm, storm water runoff and legacy fluxes from highly organic sediments associated with past duck farm operations. Stresses also continue to be apparent in a number of tributaries to the estuary, including in the Peconic River downstream from the BNL wastewater discharge (metals), in the lower Peconic River at the USGS gage and Grangebel Park sites (VOCs), and in various north fork streams where detections of multiple pesticide residues from adjacent agricultural activities continue to be commonplace.

Significant findings are summarized as follows:

Water Clarity:

- As measured by secchi depths, water clarity throughout much of the estuary was very good with 3-year means at sites east of Flanders Bay in the 7-13 ft. range.
- A west to east pattern of increasing clarity was noted as expected, with higher secchi depths occurring in waters subject to a greater degree of tidal flushing.
- Secchi minima were generally associated with periods of higher phytoplankton growth, occurring during the summer in the shallower western estuary and during winter months in the deeper eastern waters.

Salinity:

- Fluctuations in salinity levels in an estuary are a function of the changing balance between freshwater (groundwater, streams and precipitation) and tidal influences.
- During 2010-2012 in the main body of the estuary, a general increase in average salinity through the sampling period was found to be associated with coincident precipitation patterns. Relatively low salinity levels were recorded during the spring of 2010 when heavy rain occurred within days of three consecutive sampling events. Salinity levels were comparatively higher during 2012, a year that was considerably dryer than the prior two in terms of total rainfall.

Dissolved Oxygen:

- Dissolved oxygen (DO) levels remain very good throughout much of the estuary and the CCMP objective of maintaining DO levels in waters east of Flanders Bay seems to have been accomplished for the majority of system embayments.
- Although a number of peripheral embayments showed occasional bottom water DO excursions, West Neck Bay was the only embayment east of Flanders Bay where multiple surface water excursions below criteria were noted.
- In the western estuary however, a number of sites continue to experience periodic excursions below DO standards, including Meetinghouse Creek, the Peconic River mouth and East Creek in South Jamesport. Conditions remain particularly severe in Meetinghouse Creek, where excursions below the acute 3.0 mg/L standard occurred in both surface and bottom waters.

Coliform Bacteria:

- Very low levels of coliform contamination were noted at marine sampling locations, with the majority of results at or near the lower limit of detectability.
- All marine sites were consistently in compliance with the appropriate Class SA and SC coliform criteria.
- In contrast, coliform levels in streams were highly variable, and in some cases extreme, with mean values significantly greater than those found at marine stations.
- Elevated stream levels were generally associated with prior precipitation, although some were also noted during dry periods suggesting that other factors such as waterfowl, boats, or poorly operating septic systems may be at fault.
- Five of the streams sampled exceeded NYS criteria for total coliforms; nine exceeded the criteria for fecal coliforms.
- Both the Riverhead STP and the Atlantis Aquarium had several permit violations of discharge limits for total and fecal coliforms.

Nitrogen:

- Total Nitrogen (TN) levels have remained similar to those seen during the prior decade (2000-2009) but, in some locations, are considerably lower than noted during the 1990’s.

- The degree to which the decline is associated with a change in the TN analysis method that was instituted in the summer of 2000, is currently being investigated.
- As shown by the data, TN at marine sampling locations was primarily comprised of Dissolved Organic Nitrogen (DON) with levels of Dissolved Inorganic Nitrogen (DIN) comparatively insignificant.
- At tidal creek sites where agriculture and/or residential developments are the predominant land use in adjacent watersheds, DIN (mainly NO_x-N) was a more important component of TN.
- A general west to east decline in average TN concentrations was evident along the estuary's main-stem, with average levels decreasing by 44% from the Peconic River mouth to Gardiners Bay.
- TN levels were generally highest during summer months, likely reflecting increased biological activity in sediments and the release of regenerated nitrogen.
- A number of sites in the impacted western estuary continued to have the greatest percentage of samples exceeding the 0.45 mg/L TN guideline, and not coincidentally, the greatest percentage of summer excursions below NYS dissolved oxygen criteria.
- As with tidal creeks, the highest TN levels in streams monitored continued to occur in areas of the western estuary and north fork where densely developed residential and agriculture are major land uses. The lowest TN levels were noted in areas with a greater proportion of open space, including some areas along the Peconic River and in tributaries to southern Flanders Bay.
- TN is streams was mainly comprised of NO_x-N, with significant levels of NH_3-N only noted at the Meetinghouse Creek site that is associated with the Crescent Duck Farm.
- Long-term fluctuations in stream nitrogen levels did not follow a consistent pattern among the waterbodies studied, likely reflecting the complexity of land use mixes involved and varying changes in land use patterns and intensity over the decades.
- Nitrogen additions from the Riverhead STP, although considerably lower due to pant upgrades and not thought to represent a significant impact to the estuary as a whole, continue to have local impacts in the Peconic River.

- Nutrient (nitrogen and phosphorus) discharges from the Corwin Duck Farm, although significantly lower than historic levels, continue to adversely impact water quality in the western estuary.

Chlorophyll-a:

- Chlorophyll levels were comparatively elevated at a number of locations in the western estuary where nutrients from a variety of sources (current discharges, groundwater and sediment fluxes) provide ample enrichment.
- Average chlorophyll-a levels generally declined eastward in the estuary with increased distance from sources of enrichment and an increased level of tidal flushing.
- The level of nutrient enrichment in a number of areas beyond the western estuary however, is apparently sufficient to support occasional algal blooms, particularly during summer months, but is not at a level that would result in water clarity and dissolved oxygen issues.

Organics:

- The number of pesticides and volatile organic compounds (VOCs) detected has declined considerably compared to those noted during prior decades. It is not clear however, if this is due to actual improvements or is a function of sampling effort.
- Pesticide residues continue to be undetectable at stations sampled in the Peconic River and in tributaries to southern Flanders Bay where agricultural activities are minimal.
- A significant reduction in pesticide detections was noted in Meetinghouse Creek, likely reflecting the gradual replacement of farms with residential developments that has occurred there over the past few decades.
- Pesticide residues remain common in a number of streams located in areas of the north fork where agriculture operations are a principal land use. Those situated along the northern shoreline of Great Peconic Bay (East Creek, Brushes Creek, Deep Hole Creek and Halls Creek), have been particularly susceptible to contamination.
- As in past surveys, the most frequently detected pesticides were the metabolites of Metolachlor and Alachlor, with Deisopropylatrazine, Metalaxyl and the sulfone and sulfoxide degradates of Aldicarb also common.
- None of the pesticide residues exceeded any of the available NYS surface water quality standards and only two exceedances of the EPA aquatic life criteria were noted (one for

the insecticide Dichlorvos in Sawmill Creek and the other for the herbicide Ronstar in Brushes Creek).

- The herbicide Dinoseb, which is reportedly moderately to highly toxic to fish and invertebrates but for which no water quality standards or aquatic life criteria exist, was found on three occasions in Halls Creek.
- The occurrence of pesticide mixtures in a number of the streams monitored continues to be a concern, as the potential for additive or synergistic effects may pose a greater risk to aquatic organisms than individual compounds. The situation in Brushes Creek in Laurel, where 9 different pesticide compounds were detected and as many as 7 in a single sample, is particularly severe.
- Detections of VOCs in Peconic Estuary streams were uncommon compared to pesticides, with each of nine compounds found infrequently and at only one or two sites.
- The majority of VOC detects were at western estuary sites associated more with commercial/industrial and/or residential land uses rather than agriculture, including the USGS gage, Grangebel Park and BNL sites on the Peconic River, the Meetinghouse Creek duck farm site and Sawmill Creek.
- The source of the refrigerant Freon 113, detected repeatedly at the USGS Gage and Grangebel Park sites on the Peconic River, is apparently a groundwater contaminant plume emanating from the former Hazeltine Europe facility on Old Country Road in Riverhead. The Freon spill was reported to have occurred in 1987, and although concentrations detected in 2010-2012 remain well below available standards, the frequency of detections has increased considerably over that noted during prior decades.
- The gasoline additive MTBE, once considered ubiquitous in surface waters, was only noted at two locations. The reduced prevalence is likely associated with the chemical being banned as a gasoline additive in Suffolk County in 2000 over concerns that it was a potential carcinogen.
- Occurrences of pharmaceutical and personal care products (PPCP), an emerging environmental concern due to their potential to cause endocrine system disruption in aquatic organisms, were infrequent and limited to only four chemicals with Caffeine and the insect repellant DEET the most commonly detected.

Metals:

- Concentrations of metals were generally low and exceedances of water quality standards infrequent and involving a limited number of sites.
- Potential sources of metals are numerous and may include wood preservatives, pesticides, paints, fertilizers, sewage discharges, landfill leachate, petroleum by-products, brake dust in road runoff, fossil fuel combustion, and various industrial processes. Stormwater runoff and atmospheric deposition are principal means of transport to surface waters.
- Sites where trace metal residues were most common and highest in concentration, generally included the BNL site on the Peconic River, Pipes Creek and Pipes Neck Creek in Greenport, and the Narrow River North site in Orient.
- The lowest incidence and concentrations of metals were found in the lower Peconic River and in the four creeks located along southern Flanders Bay (Birch, Goose, Mill and Hubbard).
- Of the ten metals of concern examined, the three most toxic in terms of published aquatic criteria (Cadmium, Mercury and Silver) were not detected during 2010-2012.
- Of the remaining seven, four metals generally declined in frequency or were seldom detected (Lead, Chromium, Selenium and Zinc) and three either remained common (Copper and Nickel) or increased in frequency (Arsenic).
- Although chromium detections declined in frequency at most sites, they remained common at three sites in the Greenport/Orient area (Pipes Creek, Pipes Neck Creek and Narrow River North) that are each located directly downstream from natural wetland areas where chromium contamination wouldn't normally be expected. Further investigation found an abandoned landfill near Silver Lake in Greenport that may explain the residues found in Pipes Neck Creek. Sources to the other areas have yet to be identified, but the possibility of other waste sites existing is worthy of investigation.
- Similarly, although lead detections showed a general decline, they continued to be common at the BNL site on the Peconic River and at Narrow River North station. The decline in lead detections is likely associated with the phasing out and eventually banning of leaded gasoline in the 1990s. The continued detections and occasionally high levels of lead at the Peconic River BNL site is probably linked to residues in the

plant's wastewater discharge or to contaminated sediments that have previously been identified in the area. As with chromium, sources of lead to the Narrow River North station were not apparent.

- Selenium detections were rare but three of the six results exceeded aquatic life criteria. Direct sources of selenium were not apparent, but potentially include fuel combustion, petroleum leaks and waste disposal.
- Zinc detects were widespread but infrequent, except at the Peconic River BNL site and in Narrow River North. Stormwater runoff from roads and parking areas is the primary source of zinc residues in surface waters, although at the Peconic River BNL site, the STP discharge and contaminated sediments are again likely sources. Specific sources of zinc and other metals to the Narrow River site are unknown.
- The two most commonly detected metals, copper and nickel, have two sources in common (storm water runoff and atmospheric deposition) that likely explain much of their observed prevalence. At the three locations where comparatively high concentrations of copper and nickel were noted however, including the BNL site on the Peconic River, the duck farm site on Meetinghouse Creek and the Narrow River North station, other sources are likely. As previously mentioned, the wastewater discharge at the BNL plant and the contaminated sediments found in the area are a likely source to the nearby Peconic River station. Possible sources to the Narrow River North station and to the duck farm site on Meetinghouse Creek were not apparent.
- The only trace metal to exhibit an increasing trend was arsenic (from 15% of samples in 1990-1999 to 55% in 2010-2012). Concentrations remained similar over the period, with highest levels typically associated with streams that are located in areas of the north fork where agriculture is a principal land use. With multiple potential sources, including natural mineral deposits, leachate from preserved wood such as CCA (chromated copper arsenate) and remnants of formerly used arsenic-containing pesticides, it's difficult to say where the arsenic is coming from.

References

Armstrong, Louis J., 1994. Contribution of Heavy Metals to Storm Water From Automotive Disc Brake Pad Wear. Woodward-Clyde Consultants, Oakland, CA.

ATSDR, 2007. U.S. Dep't. of Health and Human Services, Agency for Toxic Substances and Disease Registry. *Toxicological Profile for Lead, Part 6.2 – Releases to the Environment*. August 2007. pp 303-316.

ATSDR, 2008. Agency for Toxic Substances and Disease Registry. *Case Studies for Environmental Medicine (CSEM), Chromium Toxicity.* 67 pp.

Battelle, 2006. *Final Report for Peconic Bay Pathogens TMDL*. September, 2006. 120 pp.

Berg, G.M., P.M. gilbert, M.W. Lomas and M.A. Burford, 1997. Organic nitrogen uptake and growth by the chrysophyte *Aureococcus anophagefferens* during a brown tide event. *Marine Biology* 129:377-387.

Brausch, J.M. and G.M. Rand, 2011. A review of personal care products in the aquatic environment: Environmental concentrations and toxicity. *Chemosphere* 82: 1518-1532.

Breuer, E., S.A. Sanudo-Wilhelmy, R.C. Aller, 1999. Trace metals and dissolved organic carbon in an estuary with restricted flow and a brown tide. *Estuaries* 22(3A): 603-615.

Bronk D. A., 2002. *Dynamics of DON, in: Biogeochemistry of Marine Dissolved Organic Matter*, edited by: Hansell, D. A. and Carlson, C. A., Academic Press, San Diego, pp 153–249.

Bronk, D.A., J.H. See, P. Bradley and L. Killberg, 2007. DON as a source of bioavailable nitrogen for phytoplankton. *Biogeosciences* 4:283-296.

BTCAMP, 1992. Brown Tide Comprehensive Assessment and Management Program. Suffolk County Department of Health Services, November 1992.

Capone, D.G., D.A. Bronk, M.R. Mulholland and E.J. Carpenter, 2008. *Nitrogen in the Marine Environment.* Elsevier, Inc. N.Y.

Carstensen, 2010. Censored data regression: Statistical methods for analyzing secchi transparency in shallow systems. *Limnol. Oceanogr.: Methods* 8(8): 376-452.

Cartwright, R. A., 2004. *Occurrence of arsenic in ground water of Suffolk County, NY, 1997-2002*. U.S. Geological Survey Water-Resources Investigations Report 03-4315, 11 pp.

CCMP, 2001. Peconic Estuary Program. *Peconic Estuary Comprehensive Conservation and Management Plan*, 866pp.

Connell, D.W., Miller, G.J. 1984. *Chemistry and Ecotoxicology of Pollution*. John Wiley & Sons, New York.

Costanzo, S.D., A.J. Watkinson, E.J. Murby, D.W. Kolpin and N.W. Sandstrom, 2007. Is there a risk associated with the insect repellant DEET (N,N-diethyl-m-toluamide) commonly found in aquatic environments? *Sci. Total Environ*. 384, 214-220.

Das, S., 2013. A review of Dichlorvos toxicity in fish. *Current World Environment* 8(1):143-149.

Eckhardt, D.A., W.J. Flipse Jr., and E.T. Oaksford, 1989. *Relation between land use and ground-water quality in the upper glacial aquifer in Nassau and Suffolk Counties, Long Island, New York.* Water-Resources Investigations Report 86-4142.

ECHO, 2014. USEPA Enforcement and Compliance History Online. http://echo.epa.gov.

Eisenreich S.J., N.A. Metzer, N.R. Urban, 1986. Response of atmospheric lead to decreased use of lead in gasoline. *Environ Sci Technol*. 20:171–174.

Erickson, W. and L. Turner, 2002. *Metolachlor: Analysis of Risks to Endangered and Threatened Salmon and Steelhead*. Environmental Field Branch, Office of Pesticide Programs. Washington, D.C.

Extoxnet, 1996a. Pesticide information profile for *Dinoseb*. Extension Toxicology Network. Oregon State University, OR. Web address: http://extoxnet.orst.edu/pips/dinoseb.htm.

Extoxnet, 1996b. Pesticide information profile for *Imidacloprid*. Extension Toxicology Network. Oregon State University, OR. Web address: http://extoxnet.orst.edu/pips/imidaclo.htm

Extoxnet, 1996c. Pesticide information profile for *Simazine*. Extension Toxicology Network. Oregon State University, OR. Web address: http://extoxnet.orst.edu/pips/simazine.htm.

Garber, J.H., J.M. Barnes and S. Stammerjohn, 1990. *Sediment-water flux measurements in the Peconic Bay estuarine ecosystem: July and October 1989*. Final report submitted to the County of Suffolk, Riverhead, N.Y.

Gilliom, R.J., J.E. Barbash, C.G. Crawford, P.A. Hamilton, J.D. Martin, N. Nagagaki, L.H. Nowell, J.C. Scott, P.E. Stackelberg, G.P Thelin and D.M. Wolock, 2007. *The Quality of Our Nation's Waters: Pesticides in the Nation's Streams and Ground Water*, 1992-2001. USGS Circular 1291.

Golding, S., 2008. *Suggested practices to reduce zinc concentrations in industrial stormwater discharges.* Washington State Dep't. of Ecology Environmental Assessment Program for Water Quality Program. Publication No. 08-10-025.

Grapher, 2005. Grapher v.6.1.21. Golden Software. Golden, CO.

Hardy, C., 1976. *A preliminary Description of the Peconic Bay Estuary*. Marine Science Research Center Special Report No. 3, Ref. 76-4. SUNY Stony Brook, NY.

Howes, B.L., D.R. Schlezinger, N.P. Millham, G. Hampson, D.D. Goehringer and S. Aubrey, 1998. *Final Report: Oxygen Uptake and Nutrient Regeneration in the Peconic Estuary*. Prepared for the Suffolk County Dep't. of Health Services, Riverhead, N.Y. 21 pp.

Kotrikla, A., G. Gatidou and T.D. Lekkas, 1999. Toxic effects of atrazine, deethyl-atrazine, deisopropyl-atrazine and metolachlor on *Chlorella fusca var-fusca*. *Global Nest: The International Journal* 1(1):39-45.

LaRoche, J., R. Nuzzi, R. Waters, K. Wyman, P.G. Falkowski and W.R. Wallace, 1997. Brown tide blooms in Long Island's coastal waters linked to interannual variability in groundwater flow. *Global Change Biology*, 3: 397–410.

Lemly, A.D., 1997. Environmental implications of excessive selenium: a review. *Biomedical and Environmental Sciences*. 10:415-435.

Lemly, A. D., 2009. *Aquatic Hazard of Selenium Pollution From Mountaintop Removal Coal Mining.* Prepared for the Appalachian Center for the Economy & the Environment and the Sierra Club. Wake Forest University, Winston-Salem, N.C. 17pp.

Little, A.D. Inc., 1996. *Chemical Contaminant Distributions in Peconic Estuary Sediments*. Final Report Submitted to the Suffolk County Dep't. of Health Services and the Peconic Estuary Program. Ref. 47389.

Lloyd, S., 2014. *Nitrogen load modeling to forty-three subwatersheds of the Peconic Estuary*. The Nature Conservancy in partnership with the Peconic Estuary Program. 20 pp.

Long E.R., L.G. Morgan, 1990. The Potential for Biological Effects of Sediment-Sorbed Contaminants Tested in the National Status and Trends Program. NOAA Technical Memorandum NOS OMA 52. National Oceanic and Atmospheric Administration. Seattle, Washington.

Mauk, R.J. and M. L. Brown, 1999. Acute toxicity of sodium selenite to juvenile walleye. *Bulletin of Environmental Contamination and Toxicology*. 63:188-194.

Molvaer, J., J. Knutzen, J. Magnusson, B. Rygg, J. Skei and J. Sorensen, 1997. Classification of environmental quality in fjords and coastal waters: a guide. Norwegian State Pollution Control Authority (SFT) publication 97:03. Oslo, Norway. 36 pp.

Moran, K.D., 2004. Copper Sources in Urban Runoff and Shoreline Activities. TDC Environmental, LLC, San Mateo CA.

Nimick, D.A., C.H. Gammons, T.E. Cleasby, J.P. Madison, D. Skaar, and C.M. Brick., 2003. *Diel variation in trace metal concentrations in streams*. USGS Fact Sheet FS-086-13.

Nowell, L.H., J.E. Norman, P.W. Moran, J.D. Martin and W.W. Stone, 2014. Pesticide toxicity index – A tool for assessing potential toxicity of pesticide mixtures to freshwater aquatic organisms. *Science of the Total Environment* 476-477 (2014): 144-157.

6 NYCRR, Part 703. Title 6 of New York Codes, Rules and Regulations. Part 703: Surface Water and Groundwater Quality Standards.

6 NYCRR, Part 47. Title 6 of New York Codes, Rules and Regulations. Part 47: Certification of Shellfish Lands.

10 NYCRR, Part 5. Title 10 of New York Codes, Rules and Regulations. Part 5: Drinking Water Standards, Subpart 5-1: Public Water Systems.

NYSDEC, 2007. New York State Dep't. of Environmental Conservation. *Total Maximum Daily Load for Nitrogen in the Peconic Estuary Program Study Area, Including Waterbodies Currently Impaired Due to Low Dissolved Oxygen: the Lower Peconic River and Tidal Tributaries; Western Flanders Bay and Lower Sawmill Creek; and Meetinghouse Creek, Terrys Creek and Tributaries.* September 2007.

NYSDOH, 2015: New York State Department of Health website: Sources of Lead. https://www.health.ny.gov/environmental/lead/sources.htm#soil.

PAN Pesticide Database, 2015(a). *Aldicarb sulfone (*Aldoxycarb) - Identification, toxicity, use, water pollution, ecological toxicity and regulatory information. Pesticide Action Network, Oakland, CA. Web address: http://www.pesticideinfo.org.

PAN Pesticide Database, 2015(b). *Aldicarb sulfoxide* - Identification, toxicity, use, water pollution, ecological toxicity and regulatory information. Pesticide Action Network, Oakland, CA. Web address: http://www.pesticideinfo.org.

PAN Pesticide Database, 2015(c). *Dichlorvos* - Identification, toxicity, use, water pollution, ecological toxicity and regulatory information. Pesticide Action Network, Oakland, CA. Web address: http://www.pesticideinfo.org.

PAN Pesticide Database, 2015(d). *Dinoseb* - Identification, toxicity, use, water pollution, ecological toxicity and regulatory information. Pesticide Action Network, Oakland, CA. Web address: http://www.pesticideinfo.org.

PAN Pesticide Database, 2015(e). *Simazine* - Identification, toxicity, use, water pollution, ecological toxicity and regulatory information. Pesticide Action Network, Oakland, CA. Web address: http://www.pesticideinfo.org.

Rodriguez del Rey, Z, E.F. Granek and S. Sylvester, 2012. Occurrence and concentration of caffeine in Oregon coastal waters. *Marine Pollution Bulletin* 64(7): 1417-1424.

Rowe, B.L., S.J. Landrigan and T.J. Lopes, 1997. *Summary of Published Aquatic Toxicity Information and Water Quality Criteria for Selected Volatile Organic Compounds*. U.S.

Sanok, W. J., J. G. Ebel, K. L. Manzell, W. H. Gutenman and D. J. Lisk, 1995. Residues of arsenic and lead in potato soils on Long Island. *Chemosphere* 30(4): 803-806.

SCDHS, 1992. Suffolk County Dep't. of Health Services, Unpublished report: *Groundwater investigation report, Hazeltine Corporation facility – Riverhead, New York. January, 1992*. 8 pp.

SCDHS, 1998a. *Peconic Estuary Program Surface Water Quality Monitoring Report, 1976-1996*. *Volume I, Narrative*. April, 1998.

SCDHS, 1998b. Suffolk County Department of Health Services, Office of Ecology. *Peconic Estuary Program – Point and Nonpoint Source Nitrogen Loading Overview.* January, 1998.

SCDHS, 1998c. Suffolk County Department of Health Services, Office of Ecology. *Peconic Estuary Program – Nitrogen Loading Budget and Trends, Major, External, Anthropogenic Nitrogen Sources: Groundwater and Duck Farms*. January, 1998.

SCDHS, 1999a. Suffolk County Department of Health Services, Peconic Estuary Program. *Nitrogen Loading Budget and Trends*, *Major External Anthropogenic Nitrogen Sources: Groundwater and Duck Farms*. January 1999.

SCDHS, 1999b. Suffolk County Department of Health Services. *Water quality monitoring program to detect pesticide contamination in groundwater of Nassau and Suffolk Counties, New York.* Hauppauge, N.Y.

SCDHS, 2002. Suffolk County Department of Health Services. *Impacts of agriculture on shallow groundwater in Suffolk County, N.Y.*

Seiler, R.L., S.D. Zaugg, J.M. Thomas and D.L. Howcroft, 1999. Caffeine and pharmaceuticals as indicators of waste water contamination in wells. *Ground Water* 37(3): 405-410.

Soren, J. and W.G. Stelz, 1984. Aldicarb-pesticide contamination of ground water in eastern Suffolk County, Long Island, New York. US Geological Survey, Water Resources Investigations Report 84-4251. Syosset, NY. 34 pp.

Stephenson, L. and W. Grothe, 2009. Peconic Estuary Program (PEP) Natural Resources Subcommittee, *Habitat Restoration Plan*. November 2009. 56 pp.
Geological Survey Open-file Report 97-563. Rapid City, SD, 12 pp.

Stoughton, S.J., K. Liber, J. Culp and A. Cessna, 2008. Acute and chronic toxicity of Imidacloprid to the aquatic invertebrates *Chironomus tentans* and *Hyalella azteca* under constant and pulse exposure conditions. *Archives of Environmental Contamination and Toxicology* 54(4): 662-673.

Swift, M.C., 2002. Stream ecosystem response to, and recovery from, experimental exposure to selenium. *Journal of Aquatic Ecosystem Stress and Recovery*. 9:159-184.

Systat, 2002. Systat v.10.2. Systat Software, Inc. Richmond, CA.

Tetra Tech, 2000. *Three-Dimensional Hydrodynamic and Water Quality Model of the Peconic Estuary.* Report for Peconic Estuary Program, Suffolk County, N.Y., Tetra Tech, Inc., VA.

Trent, M and S.F. Robbins, 1996. Suffolk County Department of Health Services. *Nitrate and pesticide impacts of agriculture on groundwater quality in Suffolk County, N.Y.*

USEPA, 1994(a). *Reregistration Eligibility Decision (RED) Factsheet for Metalaxyl*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. EPA-738-F-94-013.

USEPA, 1994(b). *Reregistration Eligibility Decision (RED) Factsheet for Tebuthiuron*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. EPA-738-F-94-006.

USEPA, 1996. US Environmental Protection Agency. AQUIRE: Aquatic toxicity information retrieval database. http://cfpub.epa.gov/ecotox/

USEPA, 1997. *Reregistration Eligibility Decision (RED) Factsheet for Aldicarb*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances.

USEPA, 1998(a). *Reregistration Eligibility Decision (RED) Factsheet for Dichlobenil*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. EPA-738-F-98-005.

USEPA, 1998(b). *Reregistration Eligibility Decision (RED) Factsheet for Alachlor.* U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. EPA-738-R-98-020.

USEPA, 1998(c). *Reregistration Eligibility Decision (RED) Factsheet for DEET*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. EPA-738-R-98-010.

USEPA, 2003(a). *Ambient Water Quality Criteria for Dissolved Oxygen, Water Clarity and Chlorophyll for the Chesapeake Bay and its Tidal Tributaries*. U.S. Environmental Protection Agency. EPA 903-R-03-002. April, 2003.

USEPA, 2003(b). *Interim Reregistration Eligibility Decision (IRED) Factsheet for Atrazine*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances.

USEPA, 2003(c). *Reregistration Eligibility Decision (RED) Factsheet for Oxadiazon*. U.S. Environmental Protection Agency, Office of Prevention, Pesticides and Toxic Substances. EPA-738-R-04-003.

USEPA, 2006(a). *Risks of Metolachlor Use to 26 Evolutionarily Significant Units of Endangered and Threatened Pacific Salmon and Steelhead*. U.S. Environmental Protection Agency, Environmental Fate and Effects Division, Office of Pesticide Programs.

USEPA, 2006(b). U.S. Environmental Protection Agency, Volunteer Estuary Monitoring Manual. Chapter 12: *Contaminants and Toxic Chemicals: Heavy Metals, Pesticides, PCBs and PAHs.* EPA-842-B-06-003. March 2006.

USEPA, 2009. *National Recommended Water Quality Criteria for Priority Pollutants.* U.S. Environmental Protection Agency, Office of Water, Office of Science and Technology. EPA-4304T.

USEPA, 2013. *Contaminants of Emerging Concern (CECs) in Fish: Pharmaceutical and Personal Care Products (PPCPs).* U.S. Environmental Protection Agency, Office of Water. EPA-820-F-13-004. September 2013.

USEPA, 2014. Aquatic life benchmarks for pesticide registration. U.S. Environmental Protection Agency, Office of Pesticide Programs. http://www2.epa.gov/pesticide-science-and-assessing-pesticide-risks/aquatic-life-benchmarks-pesticide-registration#benchmarks.

USGS, 1999. *Pesticides and their metabolites in wells of Suffolk County, New York, 1998*. U.S. Geological Survey. Water Resources Investigations Report 99-4095.

USGS, 2006. *Volatile Organic Compounds in the Nation's Ground Water and Drinking Water Supply Wells – A Summary*. U.S. Geological Survey. Factsheet 2006-3048.

Weather Underground, 2015. Historical weather at Westhampton Beach, NY. The Weather Channel, LLC. http://www.wunderground.com/

Welch, A.H., D. B. Westjohn, D. R. Helsel and R. B. Wanty, 2000. Arsenic in groundwater of the United States – occurrence and geochemistry. *Ground Water* 38(4): 589-604.

Wiegner, T.N., S.P. Seitzinger, P.M. Glibert and D.A. Bronk, 2006. Bioavailability of dissolved organic nitrogen and carbon from nine rivers in the eastern United States. *Aquatic Microbial Ecology* 43:277-287.

Woodward-Clyde, 1994. *Contribution of Heavy Metals to Storm Water From Automotive Disc Brake Pad Wear.* Prepared for the Santa Clara Valley Nonpoint Source Pollution Control Program, October 1994

Zaki, M.H., D. Moran, and D. Harris, 1982. Pesticides in Ground water – The Aldicarb story in Suffolk County, New York. *American Journal of Public Health* 72(12):1391-1395.

Zoe Rodriguez del Rey, E. F. Granek, and S. Sylvester. "Occurrence and Concentration of Caffeine in Oregon Coastal Waters" *Marine Pollution Bulletin* 64.7 (2012): 1417-1424.

Peconic Estuary Surface Water Quality Monitoring Report, 2010-2012

Volume II. Appendices

Suffolk County Department of Health Services

Steven Bellone, Suffolk County Executive
Dr. James L. Tomarken, Commissioner

March, 2016

Peconic Estuary Surface Water Quality Monitoring Report, 2010-2012

Suffolk County Department of Health Services
Dr. James L. Tomarken, MD, MSW, MPH, MBA, FRCPC, FACP
Commissioner

Division of Environmental Quality
Walter Dawydiak, P.E., J.D., Director

Office of Ecology
Chris Lubicich, Chief

Bureau of Marine Resources
Michael Jensen, Supervisor
Robert M. Waters (retired), Principal Author
Nancy Pierson
Gary Chmurzynski
Lorian Peterson
Phil DeBlasi
Andrew Seal
Kathy Governale
Mark Long
Shawn Doroski

Public & Environmental Health Laboratory
Joette Pavelka, Laboratory Director

Peconic Estuary Program
Alison Branco, Director

Table of Contents

Appendix A1: Marine Sampling Station Locations

Appendix A2: Stream and Point Source Station Locations

Appendix B1: Water Quality Statistics for Marine Sampling Locations

Appendix B2: Water Quality Statistics for Stream and Point Source Locations

Appendix C1: Time Series Plots for Marine Sampling Locations

Appendix C2: Time Series Plots for Stream Sampling Locations

Appendix D1: Organic Compounds Monitored in Peconic Estuary Streams

Appendix D2: Metal Analytes Monitored in Peconic Estuary Streams

Appendix E1: Organic Compounds Detected in Peconic Estuary Streams

Appendix E2: Metals of Concern Detected in Peconic Estuary Streams

Appendix F1: Plots of Historic Dissolved Oxygen, Nitrogen and Chlorophyll-a Concentrations at Select Marine Sampling Locations

Appendix F2: Plots of Historic Nitrogen Concentrations at Select Stream and Point Source Sampling Locations

Appendix A1

Marine Sampling Station Locations

Appendix A1. Peconic Estuary Marine Sampling Locations

Station Name	Station No.	Latitude	Longitude	Description
East Creek (South Jamesport)	060101	40.9436	-72.5708	In East Creek, S. Jamesport, off the state boat ramp
Cutchogue Harbor	060102	41.0020	-72.4603	In Cutchogue Harbor, midway between the entrance to Wickham Creek & Little Hog Neck, 0.5 mi south of the entrance to East/Mud Creeks
East Creek (Cutchogue)	060103	41.0089	-72.4603	In East Creek, Cutchogue, at the confluence of East Creek and Mud Creek
North Sea Harbor	060104	40.9428	-72.4147	In North Sea Harbor, where the entrance channel from Little Peconic Bay meets the main harbor
Goose Creek	060106	41.0527	-72.4140	In Goose Creek, just east of the Bayview Bridge
Town Creek	060107	41.0591	-72.4142	At the confluence of Town Creek and Jockey Creek
Mill Creek (Hashamomuck Pond)	060109	41.0764	-72.4006	At the entrance to Mill Creek (south of Hashamomuck Pond), on the south side of the Route 25 bridge
Little Peconic Bay	060113	40.9758	-72.4295	In Little Peconic Bay, south of Nassau Point, at buoy R "22"
Paradise Point	060114	41.0500	-72.3767	In Shelter Island Sound, east of Paradise Point, at buoy R"12"
Orient Harbor	060115	41.1144	-72.3175	At the entrance to Orient Harbor, at buoy R "6"
Gardiner's Bay West	060116	41.0814	-72.2731	On the east side of Shelter Island in western Gardiner's Bay, approximately 0.3 mi east of Ram's Head
Gardiner's Bay South	060117	41.0765	-72.1766	In Gardiner's Bay, approximately 1.3 mi. north of Hog Creek Pt., at the Crow Shoal buoy R"14"
Northwest Harbor	060118	41.0275	-72.2600	In Northwest Harbor, midway between Cedar Pt. and Barcelona Pt.
West Neck Bay	060119	41.0636	-72.3593	In the center of West Neck Bay, Shelter Island
Noyac Bay	060121	41.0133	-72.3445	In the center of Noyac Bay, approximately 0.8 mi N of Pine Neck
Coecles Harbor	060122	41.0780	-72.3116	In Coecles Harbor, midway between Little Ram Island and Shelter Island, approximately 1.0 mi south of Ram Island Dr.
West Neck Harbor	060124	41.0453	-72.3472	In the center of West Neck Harbor
Sag Harbor	060126	41.0036	-72.2929	At the entrance to Sag Harbor, inside the jetty, 0.2 mi north of the shoreline
Sag Harbor Cove	060127	41.0015	-72.3075	In the main channel, 0.6 mi west of the North Haven bridge

Appendix A1. Peconic Estuary Marine Sampling Locations, continued

Station Name	Station No.	Latitude	Longitude	Description
Great Peconic Bay	060130	40.9364	-72.5122	In Great Peconic Bay, approx. 2.5 mi. north of Shinnecock Canal and east of the mouth of East Creek
Northwest Creek	060131	41.0104	-72.2525	In Northwest Creek, just south of the opening to Northwest Harbor
Three Mile Harbor	060132	41.0206	-72.1820	In the main channel on the east side of the harbor.
Acabonac Harbor	060133	41.0250	-72.1392	In Acabonac Harbor, on the north side of Wood Tick Island.
Napeague Harbor	060134	41.0103	-72.0542	On the eastern side of Napeague Harbor, midway between the opening to Napeague Bay and the southern shoreline
Lake Montauk	060135	41.0642	-71.9278	In the center of Lake Montauk
Gardiner's Bay East	060141	41.1519	-72.1515	In Gardiners Bay north of "The Ruins" at Fl G 4S gong buoy "1GI"
Bullhead Bay	060148	40.9117	-72.4436	Approximately in the center of Bullhead Bay
Flanders Bay	060170	40.9228	-72.5872	In Flanders Bay, northeast of Goose Creek Pt., at buoy R "8"
Reeves Bay	060210	40.9139	-72.6150	In the center of Reeves Bay
Meetinghouse Creek	060220	40.9383	-72.6186	In Meetinghouse Creek, just downstream from Hubbard Ave.
Peconic River Mouth	060240	40.9217	-72.6195	At the mouth of the Peconic River, at the FL R"4" day-marker buoy, east of the entrance to Sawmill Creek
Cold Spring Pond	060290	40.9002	-72.4591	In the center of Cold Spring Pond
Wooley Pond	060300	40.9553	-72.3995	In the center of Wooley Pond
Noyac Creek	060310	40.9941	-72.3678	In the main channel due west of the Cedar Point boat ramp
Mill Creek	060320	40.9963	-72.3498	At the green channel marker, south of the inlet
Hallocks Bay	060330	41.1345	-72.2714	In the approximate center of Hallocks Bay
Hashamomuck Pond 1	060340	41.0822	-72.4025	In the southeast portion of Hashamomuck Pond, approximately 1000' north of the railroad bridge
Hashamomuck Pond 2	060350	41.0861	-72.4122	At the mouth of Long Creek

Appendix A2

Stream and Point Source Sampling Station Locations

Appendix A2. Peconic Estuary Stream and Point Source Sampling Locations				
Station Name	**Station No.**	**Latitude**	**Longitude**	**Description**
Crescent Duck Farm	200004	40.9395	-72.6189	From Meetinghouse Creek on the north side of Meetinghouse Creek Rd., Aquebogue
Riverhead STP	200009	40.9236	-72.6439	Effluent from the chlorine contact tank
Peconic River	200010	40.9139	-72.6875	At USGS gauge station, south of Rt. 25 and east of Mill Rd.
Goose Creek	200013	40.9034	-72.6038	On the north side of Rte. 24 in Flanders
Birch Creek	200014	40.8999	-72.5911	On the northeast side of Service Rd., east of Birch Creek Rd., Flanders
Mill Creek	200015	40.8943	-72.5774	On the south side of Riverhead - Hampton Bay Rd., Flanders
Hubbard Creek	200016	40.8952	-72.5613	On the east side of Red Creek Rd., Flanders
Peconic River	200017	40.9156	-72.6642	At the Grangebel Park waterfall, west of the confluence of Little River and the Peconic River
Riverhead Aquarium	200026	40.9178	-72.6570	From the spillway to the Peconic River
Riverhead Aquarium	200030	40.9172	-72.6558	Near-bottom from the Peconic River - at the pump that feeds the Riverhead Aquarium's artificial wetland pond
Meetinghouse Creek	200041	40.9461	-72.6197	North of Crescent Duck Farm on the south side of Main Rd., Aquebogue
Peconic River	200044	40.8796	-72.8548	Just downstream from the BNL treatment plant outfall
Sawmill Creek	200110	40.9253	-72.6497	On the south side of Main St., west of Hubbard Ave., Riverhead
Terry Creek	200120	40.9320	-72.6322	On the north side of Hubbard Ave on the east side of the east ramp to Rt. 105, Riverhead
Reeves Creek	200130	40.9386	-72.6089	At the Scheurer Farm access on the east side of the creek, on the north side of Peconic Bay Blvd., Riverhead
East Creek, South Jamesport	200140	40.9458	-72.5695	On the north side of Peconic Bay Blvd at Town Beach Dr., South Jamesport
Brushes Creek	200160	40.9654	-72.5581	From the bridge east of Condor Ct., Laurel
Deep Hole Creek	200170	40.9951	-72.5133	On the west side of Cardinal Dr., north of Blossom Dr., Mattituck

Appendix A2. Peconic Estuary Stream and Point Source Sampling Locations, continued				
Station Name	**Station No.**	**Latitude**	**Longitude**	**Description**
Hall's Creek	200180	40.9969	-72.5018	Approximately 150 yds south of Main Rd., Cutchogue
Downs Creek	200190	41.0026	-72.4955	In a vacant lot on the west side of Country Club Dr., Cutchogue
West Creek	200200	41.0034	-72.4781	From New Suffolk Rd., north of the intersection with Grathwohl Rd., New Suffolk
East Creek, Cutchogue	200210	41.0243	-72.4735	At the rear of the Hartman property at # 33780 Main Rd., Cutchogue
Pipes Creek	200230	41.0891	-72.3909	From the culvert between Kerwin Blvd and Pipes Neck Rd., Southold
Pipes Neck Creek (Moores Drain)	200240	41.0972	-72.3821	From the culvert on the north side of Main Rd. at the intersection with Old Mill Rd., Southold
Narrow River North	200250	41.1520	-72.2779	From the culvert on the south side of Main Rd., approximately 500' east of Narrow River Rd., Orient
Narrow River South	200260	41.1480	-72.2806	From the stream approximately 800' south of Main Rd on the south side of Narrow Rd., Orient

Appendix B1

Water Quality Statistics for Marine Sampling Locations

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012)

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L)		Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
					Surface	Bottom														
060101 East Creek S. Jamesport	Mean	6.4	5.0	16.5	8.0	7.7	25.8	7.7	43	29	0.033	0.208	0.241	0.17	0.50	< 0.05	0.017	----	13.7	104
	Max	8.0	7.5	27.3	13.6	14.2	29.3	8.3	5,000	700	0.107	1.860	1.927	0.42	1.96	0.08	0.043	----	140.4	891
	Min	5.0	3.0	2.2	3.3	3.0	20.2	7.2	< 20	< 20	< 0.02	<0.005	0.025	< 0.05	0.17	< 0.05	< 0.01	----	1.9	< 20
	N	35	35	35	35	35	35	32	35	35	35	35	35	35	35	35	35	----	35	16
	SD	0.7	1.1	7.7	2.6	2.7	2.0	0.3	858	127	0.031	0.330	0.339	0.112	0.32	0.02	0.014	----	24.9	223
060102 Cutchogue Harbor	Mean	12.0	5.7	16.2	8.2	8.0	27.5	8.0	< 20	< 20	0.025	0.009	0.034	0.17	0.24	< 0.05	0.016	----	5.5	136
	Max	15.0	13.0	26.9	13.7	13.6	29.8	8.3	80	20	0.087	0.113	0.123	0.44	0.62	0.11	0.045	----	33.7	879
	Min	10.5	3.0	1.9	5.3	4.7	24.2	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.05	< 0.05	< 0.01	----	1.4	< 20
	N	35	35	35	35	35	35	33	35	35	35	35	35	35	35	35	35	----	35	16
	SD	1.0	2.4	7.8	2.0	2.1	1.2	0.2	17	2	0.021	0.019	0.026	0.086	0.10	0.02	0.012	----	6.4	223
060103 East Creek Cutchogue	Mean	7.3	5.1	16.5	8.2	8.1	26.8	7.9	28	< 20	0.023	0.073	0.096	0.18	0.31	< 0.05	0.013	----	4.7	89
	Max	10.5	8.0	27.2	14.0	14.3	29.6	8.3	1,100	700	0.114	0.848	0.873	0.42	0.79	0.06	0.042	----	10.2	581
	Min	5.0	3.0	0.9	5.0	4.9	22.6	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.11	< 0.05	< 0.01	----	1.1	< 20
	N	35	35	35	35	35	35	33	35	35	35	35	35	35	35	35	35	----	35	16
	SD	1.3	1.3	7.8	2.0	2.1	1.5	0.2	190	123	0.023	0.155	0.155	0.086	0.13	0.01	0.010	----	2.7	143
060104 North Sea Harbor	Mean	10.2	5.8	16.2	8.2	8.2	26.7	8.0	< 20	< 20	0.016	0.006	0.022	0.17	0.24	< 0.05	0.013	----	3.7	123
	Max	15.0	14.0	26.9	13.7	13.7	29.0	8.3	800	300	0.058	0.044	0.078	0.43	0.82	0.07	0.035	----	8.4	726
	Min	6.0	3.0	0.7	5.3	5.1	22.8	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	0.05	0.08	< 0.05	< 0.01	----	1.0	< 20
	N	32	32	32	32	32	32	30	31	31	32	32	32	32	32	32	32	----	32	14
	SD	2.2	2.4	8.0	2.0	2.1	1.2	0.2	141	53	0.014	0.008	0.017	0.083	0.13	0.01	0.010	----	1.8	208
060106 Goose Creek	Mean	7.4	6.4	15.7	8.1	8.0	27.8	8.0	< 20	< 20	0.030	0.016	0.046	0.17	0.25	< 0.05	0.016	----	3.9	129
	Max	10.0	10.0	25.4	13.3	13.3	29.8	8.3	1,300	110	0.105	0.131	0.141	0.34	0.41	0.09	0.035	----	11.2	1079
	Min	5.0	4.0	1.7	4.4	4.3	24.6	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.11	< 0.05	< 0.01	----	1.0	< 20
	N	35	35	35	35	35	35	33	35	35	35	35	35	35	35	35	35	----	35	12
	SD	1.5	1.5	7.2	2.4	2.3	1.2	0.2	217	18	0.030	0.024	0.033	0.071	0.08	0.01	0.011	----	2.5	309

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L)		Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
					Surface	Bottom														
060107 Town Creek	Mean	9.0	7.2	15.9	8.4	8.1	27.8	8.0	< 20	< 20	0.027	0.028	0.056	0.17	0.25	< 0.05	0.014	----	4.6	40
	Max	11.0	11.0	25.8	12.9	12.9	30.0	8.3	1,100	700	0.083	0.160	0.180	0.31	0.42	< 0.05	0.049	----	16.7	242
	Min	5.0	4.0	2.0	5.0	4.6	24.1	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.09	< 0.05	< 0.01	----	1.2	< 20
	N	34	34	35	35	35	35	33	35	35	35	35	35	35	35	35	35	----	35	12
	SD	1.3	2.1	7.4	1.9	2.2	1.2	0.2	184	116	0.022	0.033	0.038	0.077	0.08	0.00	0.010	----	3.9	66
060109 Mill Creek	Mean	7.7	6.1	15.8	8.5	8.4	27.9	7.9	< 20	< 20	0.030	0.006	0.035	0.17	0.20	< 0.05	0.017	----	2.9	81
	Max	10.0	10.0	25.9	13.0	12.9	30.2	8.2	300	80	0.118	0.029	0.121	0.29	0.34	0.05	0.039	----	6.8	448
	Min	6.0	3.0	2.5	5.2	4.8	24.7	7.3	< 20	< 20	< 0.02	<0.005	< 0.02	0.06	0.08	< 0.05	< 0.01	----	0.6	< 20
	N	35	35	35	35	35	35	32	35	35	35	35	35	35	35	35	35	----	35	12
	SD	1.1	1.7	7.4	2.1	2.2	1.2	0.2	52	13	0.024	0.006	0.025	0.058	0.06	0.00	0.012	----	1.5	152
060113 Nassau Point Little Peconic Bay	Mean	35.1	6.9	15.4	8.5	8.4	27.9	8.0	< 20	< 20	0.026	<0.005	0.029	0.15	0.21	< 0.05	0.020	----	3.8	108
	Max	37.0	20.0	26.5	13.6	13.3	29.9	8.4	40	< 20	0.095	0.019	0.098	0.36	0.42	0.07	0.060	----	18.9	1099
	Min	34.0	3.5	-0.5	5.2	5.3	24.9	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.08	< 0.05	< 0.01	----	1.0	< 20
	N	38	38	38	38	38	38	36	37	37	38	38	38	38	38	38	38	----	38	18
	SD	0.7	3.5	8.2	2.0	2.1	1.1	0.2	5	0	0.022	0.003	0.022	0.072	0.08	0.01	0.016	----	3.1	251
060114 Paradise Pt. Shelter Island Sound	Mean	70.7	9.7	15.0	8.6	8.5	28.2	8.0	< 20	< 20	0.027	0.005	0.031	0.15	0.19	< 0.05	0.021	----	3.3	56
	Max	79.0	25.0	26.0	12.8	12.7	30.3	8.3	40	< 20	0.091	0.029	0.102	0.32	0.44	< 0.05	0.054	----	10.7	205
	Min	45.0	4.5	-0.1	5.5	5.4	25.3	7.3	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	< 0.05	< 0.05	< 0.01	----	1.0	< 20
	N	37	38	38	38	38	38	35	37	37	38	38	38	38	38	38	38	----	38	13
	SD	6.9	3.3	7.8	2.1	2.0	1.1	0.2	7	0	0.022	0.006	0.025	0.066	0.08	0.00	0.013	----	2.0	53
060115 Orient Harbor	Mean	22.8	9.3	14.6	8.8	8.6	28.4	7.8	< 20	< 20	0.037	0.009	0.046	0.13	0.19	< 0.05	0.020	----	4.3	49
	Max	41.0	23.0	25.5	14.0	13.7	31.0	8.2	20	20	0.148	0.060	0.161	0.28	0.37	0.06	0.048	----	36.0	186
	Min	15.0	4.0	0.5	6.1	6.1	23.9	7.2	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.05	< 0.05	< 0.01	----	0.9	< 20
	N	38	38	38	38	38	38	35	36	36	38	38	38	38	38	38	38	----	38	11
	SD	5.0	4.1	7.4	2.0	1.9	1.4	0.3	2	2	0.035	0.013	0.038	0.069	0.07	0.00	0.013	----	5.7	58

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L) Surface	Dissolved Oxygen (mg/L) Bottom	Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
060116 Gardiners Bay West	Mean	14.1	10.8	14.2	8.8	8.8	28.6	8.0	< 20	< 20	0.043	0.007	0.050	0.12	0.19	< 0.05	0.020	14	3.2	131
	Max	16.0	16.0	24.8	14.0	13.9	30.4	8.4	20	< 20	0.146	0.038	0.160	0.33	0.37	< 0.05	0.042	114	12.2	806
	Min	5.0	4.0	-0.1	5.6	5.6	25.8	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	< 0.05	< 0.05	< 0.01	< 5	0.7	< 20
	N	36	36	36	36	36	36	34	35	34	36	36	36	36	36	36	36	35	36	10
	SD	1.9	3.3	7.2	2.1	2.1	1.1	0.2	2	0	0.036	0.009	0.040	0.067	0.07	0.00	0.013	24	2.9	244
060117 Crow Shoal Gardiners Bay	Mean	33.3	12.0	14.4	8.6	8.5	28.6	8.0	< 20	< 20	0.030	0.024	0.054	0.13	0.18	< 0.05	0.021	14	2.9	131
	Max	37.0	31.0	23.8	13.2	13.2	30.8	8.2	20	20	0.079	0.132	0.142	0.27	0.37	< 0.05	0.044	102	7.4	439
	Min	26.0	4.5	2.1	5.4	5.7	25.9	7.6	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	< 0.05	< 0.05	< 0.01	< 5	0.5	< 20
	N	23	23	23	23	23	23	22	23	23	23	23	23	23	23	23	23	20	23	5
	SD	2.4	6.6	7.3	2.1	2.2	1.2	0.2	3	2	0.020	0.039	0.042	0.070	0.08	0.00	0.011	22	1.9	178
060118 Northwest Harbor	Mean	25.7	11.4	14.6	8.7	8.6	28.5	8.0	< 20	< 20	0.031	0.006	0.037	0.14	0.19	< 0.05	0.019	----	3.3	127
	Max	40.0	25.0	25.1	14.4	14.2	30.7	8.5	80	20	0.144	0.027	0.164	0.35	0.36	0.07	0.056	----	17.2	813
	Min	12.0	5.0	-0.3	5.2	5.2	26.1	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	< 0.05	< 0.05	< 0.01	----	0.5	< 20
	N	36	36	36	36	36	36	34	35	35	36	36	36	36	36	36	36	----	36	10
	SD	8.1	5.2	7.5	2.2	2.2	1.1	0.2	12	2	0.033	0.006	0.036	0.074	0.07	0.01	0.014	----	3.3	248
060119 West Neck Bay	Mean	12.2	8.0	16.4	8.4	8.0	27.2	7.9	< 20	< 20	0.025	<0.005	0.029	0.19	0.26	< 0.05	0.015	14	7.4	266
	Max	14.0	14.0	27.6	13.4	13.2	30.1	8.3	300	130	0.099	0.025	0.102	0.39	0.74	0.18	0.048	106	53.0	3125
	Min	9.0	2.0	-0.7	3.5	3.3	23.3	7.3	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.06	< 0.05	< 0.01	< 5	0.9	< 20
	N	39	39	39	39	39	39	37	37	37	38	38	38	38	38	38	38	37	39	33
	SD	1.1	3.2	8.3	2.3	2.5	1.4	0.2	59	20	0.024	0.004	0.023	0.076	0.12	0.03	0.013	21	10.1	667
060121 Noyack Bay	Mean	25.2	9.4	15.1	8.5	8.5	28.3	8.0	< 20	< 20	0.039	0.005	0.043	0.13	0.20	< 0.05	0.019	----	3.4	85
	Max	36.0	24.0	25.9	12.8	12.8	30.3	8.9	40	40	0.142	0.024	0.149	0.31	0.37	< 0.05	0.051	----	19.2	592
	Min	19.5	4.0	-0.3	5.6	5.3	25.5	7.3	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	< 0.05	< 0.05	< 0.01	----	0.7	< 20
	N	38	38	38	38	37	37	36	37	37	38	38	38	38	38	38	38	----	38	13
	SD	3.8	4.3	7.8	1.9	2.0	1.2	0.3	6	6	0.036	0.005	0.038	0.060	0.08	0.00	0.014	----	3.1	156

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L)		Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
					Surface	Bottom														
060122 Coecles Harbor	Mean	8.3	6.8	15.0	8.4	8.3	28.2	8.0	< 20	< 20	0.025	<0.005	0.028	0.16	0.21	< 0.05	0.013	----	3.5	80
	Max	10.0	10.0	26.8	12.3	12.3	30.3	8.3	130	40	0.088	0.007	0.091	0.39	0.44	0.07	0.030	----	14.2	350
	Min	6.0	4.0	-1.0	5.5	5.5	25.2	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.06	< 0.05	< 0.01	----	0.3	< 20
	N	36	36	37	35	35	37	35	36	36	37	37	37	37	37	37	37	----	37	11
	SD	1.1	1.6	8.0	1.8	1.8	1.1	0.2	20	5	0.022	0.001	0.022	0.077	0.08	0.01	0.009	----	3.0	110
060124 West Neck Harbor	Mean	11.0	7.6	16.0	8.4	8.2	28.0	8.0	< 20	< 20	0.022	<0.005	0.026	0.16	0.21	< 0.05	0.017	----	2.9	121
	Max	14.0	13.0	26.2	12.6	12.5	29.9	8.4	110	20	0.090	0.012	0.093	0.37	0.40	0.07	0.045	----	11.9	604
	Min	8.0	3.0	1.9	5.4	5.1	24.9	7.1	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.08	< 0.05	< 0.01	----	0.3	< 20
	N	36	36	36	36	36	36	33	35	35	35	35	35	35	35	35	35	----	35	18
	SD	1.2	2.8	7.7	2.0	2.1	1.1	0.2	19	2	0.021	0.003	0.021	0.066	0.08	0.01	0.012	----	2.3	182
060126 Sag Harbor	Mean	11.3	8.4	15.7	8.5	8.4	27.9	7.9	60	23	0.029	0.005	0.034	0.15	0.20	< 0.05	0.016	----	3.2	27
	Max	14.0	14.0	26.0	14.7	14.6	30.1	8.6	>16,000	1,100	0.118	0.025	0.121	0.32	0.31	0.13	0.040	----	13.1	99
	Min	5.0	4.5	2.5	5.4	5.3	25.7	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	0.05	0.09	< 0.05	< 0.01	----	0.6	< 20
	N	34	34	34	34	34	34	31	34	34	34	34	34	34	34	34	34	----	34	11
	SD	1.7	2.8	7.4	2.3	2.3	1.0	0.2	2,863	221	0.028	0.005	0.029	0.057	0.06	0.02	0.012	----	2.6	30
060127 Sag Harbor Cove	Mean	7.4	6.2	16.3	8.3	8.1	27.1	8.0	< 20	< 20	0.026	0.006	0.031	0.16	0.22	< 0.05	0.015	12	4.3	28
	Max	10.0	9.0	26.7	12.7	12.8	29.3	8.3	1,100	500	0.094	0.022	0.097	0.34	0.42	0.07	0.040	121	15.9	116
	Min	5.0	4.0	1.8	4.9	5.1	22.7	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.08	< 0.05	< 0.01	< 5	0.4	< 20
	N	34	34	34	33	33	34	31	34	34	34	34	34	34	34	34	34	34	34	11
	SD	1.1	1.4	7.4	2.0	2.1	1.3	0.2	187	84	0.024	0.005	0.025	0.070	0.08	0.01	0.011	21	3.7	34
060130 Great Peconic Bay	Mean	22.1	7.0	15.5	8.6	8.3	27.7	8.0	< 20	< 20	0.024	<0.005	0.027	0.16	0.21	< 0.05	0.018	19	3.3	188
	Max	23.5	20.0	26.7	13.8	13.8	29.9	8.4	20	20	0.093	0.015	0.096	0.35	0.47	0.08	0.053	88	10.7	1576
	Min	18.0	2.0	-0.8	5.7	5.4	24.6	7.7	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.06	< 0.05	< 0.01	< 5	0.9	< 20
	N	38	38	38	38	38	38	35	37	37	38	38	38	38	38	38	38	37	37	18
	SD	1.0	4.2	8.1	2.0	2.1	1.2	0.2	2	2	0.024	0.002	0.024	0.080	0.09	0.01	0.015	23	2.1	377

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L) Surface	Dissolved Oxygen (mg/L) Bottom	Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
060131 Northwest Creek	Mean	7.6	7.2	15.5	8.5	8.5	27.5	7.9	23	< 20	0.028	<0.005	0.031	0.16	0.21	< 0.05	0.015	----	2.7	17
	Max	11.0	11.0	26.1	12.7	12.7	30.0	8.2	130	130	0.103	0.007	0.106	0.23	0.32	0.09	0.032	----	7.1	50
	Min	5.0	5.0	3.1	6.2	5.8	24.9	7.3	< 20	< 20	< 0.02	<0.005	< 0.02	0.07	0.13	< 0.05	< 0.01	----	0.9	< 20
	N	20	20	20	20	20	20	18	20	20	20	20	20	20	20	20	20	----	20	6
	SD	2.1	1.9	7.4	1.9	2.0	1.5	0.2	35	38	0.028	0.001	0.028	0.053	0.06	0.02	0.009	----	1.5	16
060132 Three Mile Harbor	Mean	11.5	9.5	14.9	9.1	9.1	28.3	8.1	< 20	< 20	0.026	0.008	0.034	0.14	0.21	< 0.05	0.015	----	3.1	117
	Max	14.0	13.0	25.8	12.4	12.8	30.0	8.7	500	70	0.097	0.076	0.118	0.32	0.32	< 0.05	0.035	----	6.6	198
	Min	7.0	5.0	-0.8	6.4	6.4	24.0	7.8	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.08	< 0.05	< 0.01	----	0.8	< 20
	N	23	23	22	21	21	22	17	23	23	23	23	23	23	23	23	23	----	23	5
	SD	2.1	2.3	8.2	1.7	1.9	1.3	0.2	102	13	0.028	0.015	0.031	0.070	0.06	0.00	0.009	----	1.6	98
060133 Acabonac Harbor	Mean	6.5	6.3	15.7	8.7	8.4	28.5	8.1	< 20	< 20	0.033	<0.005	0.037	0.15	0.20	< 0.05	0.015	----	3.0	50
	Max	9.0	9.0	25.9	11.9	11.5	30.6	8.5	500	130	0.104	0.024	0.123	0.32	0.38	0.08	0.055	----	9.9	208
	Min	4.5	4.5	-0.4	6.2	6.1	26.3	7.6	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.08	< 0.05	< 0.01	----	0.6	< 20
	N	22	22	24	23	20	24	20	24	24	24	24	24	24	24	24	24	----	24	5
	SD	1.2	1.2	8.2	1.7	1.4	1.1	0.2	102	25	0.033	0.005	0.034	0.074	0.07	0.01	0.011	----	1.9	89
060134 Napeague Harbor	Mean	6.3	6.5	15.0	8.6	8.4	29.3	8.0	< 20	< 20	0.029	0.005	0.034	0.12	0.18	< 0.05	0.013	----	2.5	114
	Max	10.0	10.0	25.5	12.5	11.5	31.2	8.4	40	20	0.115	0.030	0.118	0.22	0.34	0.06	0.033	----	8.0	355
	Min	3.0	3.5	-0.6	6.1	6.4	27.3	7.6	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.06	< 0.05	< 0.01	----	0.6	< 20
	N	22	21	24	23	20	24	22	24	24	24	24	24	24	24	24	24	----	24	5
	SD	2.2	2.1	7.9	1.7	1.4	1.0	0.2	4	6	0.032	0.007	0.033	0.06	0.07	0.01	0.008	----	1.8	154
060135 Lake Montauk	Mean	8.0	7.8	15.1	8.6	8.3	29.2	8.0	< 20	< 20	0.042	0.017	0.059	0.12	0.19	< 0.05	0.017	----	2.3	37
	Max	9.0	9.0	25.2	11.4	11.5	31.0	8.3	40	20	0.131	0.091	0.186	0.22	0.31	< 0.05	0.032	----	5.7	91
	Min	6.5	6.0	-0.6	6.5	6.1	25.5	7.4	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.08	< 0.05	< 0.01	----	0.5	< 20
	N	22	22	24	23	22	24	23	24	23	24	24	24	24	24	24	24	----	24	5
	SD	0.6	0.8	7.7	1.4	1.5	1.2	0.5	9	4	0.042	0.025	0.048	0.06	0.07	0.00	0.009	----	1.5	38

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L)		Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
					Surface	Bottom														
060141 Gardiners Bay East	Mean	69.7	12.8	14.2	8.5	8.4	28.6	8.0	< 20	< 20	0.049	0.031	0.080	0.10	0.19	< 0.05	0.021	10	2.3	32
	Max	90.0	28.0	23.2	13.1	12.2	30.8	8.5	20	10	0.146	0.146	0.180	0.22	0.28	0.05	0.043	46	5.7	94
	Min	54.0	5.5	3.3	5.2	5.3	26.4	7.7	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.05	< 0.05	< 0.01	< 5	0.3	< 20
	N	23	23	23	23	23	23	22	23	23	23	23	23	23	23	23	23	22	22	6
	SD	9.4	5.1	6.6	2.0	2.0	1.2	0.2	4	0	0.044	0.044	0.054	0.080	0.06	0.01	0.012	11	1.3	36
060148 Bullhead Bay	Mean	5.0	4.6	16.0	8.3	8.2	26.8	8.0	< 20	< 20	0.019	0.006	0.025	0.16	0.23	< 0.05	0.014	----	3.7	157
	Max	6.5	6.0	27.2	13.8	14.1	28.7	8.3	300	230	0.054	0.058	0.097	0.38	0.65	0.16	0.047	----	14.4	512
	Min	3.5	2.5	0.4	5.2	4.2	24.1	7.5	< 20	< 20	< 0.02	<0.005	< 0.02	0.06	0.10	< 0.05	< 0.01	----	0.6	< 20
	N	33	33	33	33	33	33	30	32	32	33	33	33	33	33	33	33	----	33	15
	SD	0.7	0.9	8.2	2.2	2.3	1.2	0.2	56	43	0.013	0.010	0.018	0.079	0.11	0.02	0.012	----	3.0	172
060170 Flanders Bay	Mean	9.4	6.3	15.5	8.6	8.4	26.5	8.0	< 20	< 20	0.021	0.006	0.027	0.17	0.24	< 0.05	0.018	16	5.9	131
	Max	11.0	10.0	26.9	13.7	13.9	29.5	8.5	500	130	0.102	0.085	0.160	0.36	0.41	0.10	0.054	99	27.6	850
	Min	8.0	3.5	-1.2	5.3	5.0	21.3	7.7	< 20	< 20	< 0.02	<0.005	< 0.02	0.05	0.06	< 0.05	< 0.01	< 5	0.7	< 20
	N	39	39	39	39	39	39	38	38	38	39	39	39	39	39	39	39	39	39	35
	SD	0.7	1.7	8.0	2.0	2.2	1.5	0.2	58	13	0.022	0.013	0.030	0.08	0.09	0.02	0.016	21	5.2	191
060210 Reeves Bay	Mean	6.6	5.2	16.6	8.7	8.3	25.3	8.0	< 20	< 20	0.018	0.006	0.025	0.20	0.30	0.04	0.022	----	8.6	156
	Max	8.0	7.0	28.0	14.6	14.8	28.0	8.4	300	80	0.076	0.065	0.085	0.44	0.65	0.16	0.100	----	30.6	922
	Min	5.5	3.0	-0.6	5.3	2.9	21.7	7.6	< 20	< 20	< 0.02	<0.005	< 0.02	0.05	0.08	< 0.05	< 0.01	----	0.8	< 20
	N	36	36	37	37	37	37	35	36	36	36	36	36	36	36	36	36	----	36	16
	SD	0.5	1.4	8.3	2.1	2.6	1.4	0.2	49	13	0.016	0.011	0.020	0.088	0.11	0.04	0.025	----	5.8	262
060220 Meetinghouse Creek	Mean	9.3	4.8	17.0	7.8	6.2	21.3	7.6	104	36	0.278	0.899	1.18	0.23	1.5	0.45	0.425	13	26.1	99
	Max	11.0	8.5	27.6	14.1	13.9	27.7	8.4	16,000	5,000	0.817	3.03	3.76	0.84	3.97	1.23	1.15	90	247`	432
	Min	7.0	2.0	3.3	1.6	0.2	4.8	6.9	< 20	< 20	< 0.02	0.062	0.087	< 0.05	0.44	0.05	0.034	< 5	2.2	< 20
	N	38	38	38	38	38	38	57	37	37	38	38	38	38	38	38	38	37	38	19
	SD	0.8	1.6	7.1	3.2	3.4	5.7	0.4	1,447	547	0.227	0.811	1.01	0.19	0.92	0.32	0.332	19	39.9	136

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L)		Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
					Surface	Bottom														
060240 Peconic River Mouth	Mean	7.5	5.4	16.3	8.5	7.8	23.1	7.9	800	500	0.038	0.033	0.070	0.22	0.35	0.06	0.024	16	11.4	51
	Max	9.5	9.0	28.0	14.6	14.3	27.8	8.3	387	263	0.133	0.238	0.302	0.43	0.62	0.19	0.109	89	65.0	324
	Min	5.5	3.0	-0.1	4.6	2.5	11.0	7.2	< 20	< 20	< 0.02	<0.005	< 0.02	0.08	0.20	< 0.05	< 0.01	< 5	0.8	< 20
	N	39	39	39	39	39	39	58	38	38	39	39	39	39	39	39	39	39	39	20
	SD	0.9	1.4	8.0	2.2	2.7	3.6	0.2	119	69	0.033	0.045	0.068	0.09	0.10	0.05	0.026	22	12.3	79
060290 Cold Spring Pond	Mean	5.3	5.1	15.8	8.5	8.3	26.8	8.1	< 20	< 20	0.024	<0.005	0.026	0.17	0.21	< 0.05	0.016	----	2.9	29
	Max	7.0	7.0	27.7	12.5	12.2	28.9	8.5	20	20	0.075	0.010	0.078	0.26	0.37	0.09	0.044	----	5.7	106
	Min	4.0	4.0	1.8	5.2	5.1	18.0	7.7	< 20	< 20	< 0.02	<0.005	< 0.02	0.10	0.13	< 0.05	< 0.01	----	1.2	< 20
	N	18	18	18	18	19	18	16	18	18	19	19	19	19	19	19	18	----	19	5
	SD	0.9	0.9	8.5	1.9	1.8	2.4	0.2	4	3	0.020	0.002	0.020	0.05	0.06	0.02	0.013	----	1.2	43
060300 Wooley Pond	Mean	7.9	6.2	15.3	9.0	8.3	26.0	8.0	< 20	< 20	0.018	0.027	0.045	0.17	0.25	< 0.05	0.011	----	5.5	19
	Max	9.5	8.0	27.4	12.8	12.6	28.6	8.5	800	500	0.087	0.132	0.142	0.29	0.38	0.09	0.028	----	16.3	55
	Min	6.0	4.0	2.8	6.3	4.6	22.9	7.4	< 20	< 20	< 0.02	<0.005	< 0.02	0.05	0.15	< 0.05	< 0.01	----	1.3	< 20
	N	20	20	20	20	20	20	17	19	19	20	20	20	20	20	20	20	----	20	5
	SD	0.9	1.2	8.6	1.8	2.4	1.5	0.2	55	51	0.020	0.035	0.035	0.061	0.07	0.02	0.008	----	3.7	20
060310 Noyac Creek	Mean	8.1	6.7	15.0	8.5	8.2	27.6	8.0	< 20	< 20	0.025	<0.005	0.029	0.16	0.21	< 0.05	0.013	----	4.0	28
	Max	11.0	9.0	26.2	12.5	12.6	29.9	8.4	130	80	0.070	0.020	0.073	0.31	0.32	0.06	0.036	----	16.6	58
	Min	6.0	3.0	2.1	5.5	5.1	25.9	7.7	< 20	< 20	< 0.02	<0.005	< 0.02	0.06	0.13	< 0.05	< 0.01	----	1.0	< 20
	N	20	20	20	20	20	20	17	19	19	20	20	20	20	20	20	20	----	20	5
	SD	1.0	1.7	8.3	2.0	2.2	1.2	0.2	33	23	0.022	0.004	0.021	0.06	0.06	0.01	0.010	----	3.4	25
060320 Mill Creek	Mean	8.4	7.1	15.1	8.7	8.3	27.4	8.1	20	< 20	0.025	0.006	0.031	0.16	0.23	< 0.05	0.014	----	4.2	190
	Max	11.0	10.0	26.9	12.6	12.6	29.5	8.3	80	40	0.116	0.018	0.121	0.24	0.34	0.06	0.039	----	12.3	989
	Min	6.5	3.0	2.8	6.0	3.5	25.5	7.9	< 20	< 20	< 0.02	<0.005	< 0.02	0.05	0.10	< 0.05	< 0.01	----	1.2	< 20
	N	21	21	21	21	21	21	18	21	21	21	21	21	21	21	21	21	----	21	6
	SD	1.2	1.6	8.2	2.0	2.5	1.2	0.1	27	11	0.026	0.005	0.027	0.07	0.07	0.01	0.011	----	3.1	393

Appendix B1. Water Quality Statistics for Peconic Estuary Marine Sampling Locations (2010-2012), continued

Station	Stat	Water Depth (ft)	Secchi Depth (mg/l)	Temp (deg C)	Dissolved Oxygen (mg/L)		Salinity (psu)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH_3-N (mg/l)	NO_x-N (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4-P (mg/l)	TSS (mg/L)	Chl-a (ug/l)	Aureo (cells/ml)
					Surface	Bottom														
060330 Hallocks Bay	Mean	6.3	5.9	13.6	9.2	9.2	27.9	7.9	< 20	< 20	0.026	0.005	0.031	0.16	0.20	< 0.05	0.017	----	2.3	58
	Max	8.0	8.0	26.4	13.5	13.1	30.3	8.4	20	20	0.108	0.019	0.119	0.25	0.31	< 0.05	0.045	----	6.2	183
	Min	3.0	2.0	-0.2	6.3	6.3	23.8	7.0	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.05	< 0.05	< 0.01	----	0.6	< 20
	N	24	24	24	24	24	24	23	22	22	24	24	24	24	24	24	24	----	24	7
	SD	1.4	1.7	8.6	2.1	2.1	1.7	0.3	4	3	0.029	0.004	0.030	0.06	0.07	0.00	0.011	----	1.4	68
060340 Hashamomuck Pond, South	Mean	6.1	5.5	14.0	9.0	8.9	27.9	8.0	< 20	< 20	0.022	0.005	0.027	0.16	0.21	< 0.05	0.015	----	3.5	113
	Max	8.0	8.0	27.7	13.1	12.6	29.9	8.5	40	20	0.110	0.040	0.113	0.28	0.34	< 0.05	0.038	----	13.3	581
	Min	4.0	4.0	0.5	5.7	5.7	25.2	7.8	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.07	< 0.05	< 0.01	----	0.4	< 20
	N	24	24	24	24	24	24	24	22	22	24	24	24	24	24	24	24	----	24	7
	SD	1.0	1.1	8.9	2.1	2.1	1.4	0.2	9	4	0.024	0.008	0.026	0.07	0.07	0.00	0.011	----	2.7	210
060350 Hashamomuck Pond, North	Mean	6.4	5.7	14.2	9.0	8.7	27.8	8.0	< 20	< 20	0.022	0.005	0.027	0.16	0.23	< 0.05	0.015	----	4.0	153
	Max	7.5	7.0	27.9	13.1	12.6	29.9	8.3	500	20	0.070	0.018	0.073	0.25	0.33	0.07	0.039	----	10.1	932
	Min	5.5	3.0	-0.1	5.9	5.4	24.4	7.9	< 20	< 20	< 0.02	<0.005	< 0.02	< 0.05	0.07	< 0.05	< 0.01	----	0.7	< 20
	N	23	23	24	24	24	24	24	22	22	24	24	24	24	24	24	24	----	24	7
	SD	0.5	1.1	9.0	2.1	2.3	1.5	0.1	104	4	0.018	0.004	0.018	0.05	0.07	0.01	0.012	----	2.6	345

Notes:
Total and Fecal Coliform means are calculated as geometric means
Results for multiple samples collected on the same day at stations 170, 220, and 240 (during summer diurnal monitoring) were averaged into daily means before computing long-term means

Appendix B2

Water Quality Statistics for Stream and Point Source Sampling Locations

Appendix B2. Water Quality Statistics for Peconic Estuary Stream and Point Source Locations (2010-2012)

Station	Stat	Temp (deg C)	D.O. (mg/L)	Salinity (psu)	Cond (uS/cm)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH3 (mg/l)	NO_x (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4 (mg/l)	Chloride (mg/L)
200004 Meetinghouse Creek (Crescent Duck Farm)	Mean	12.3	7.8	----	626	6.8	551	233	1.77	7.39	9.16	0.45	9.2	2.7	2.64	169
	Max	22.0	14.1	----	2,012	7.3	16,000	1,700	2.99	10.1	11.3	1.69	11.0	3.6	3.65	832
	Min	4.4	3.2	----	277	6.3	20	< 20	1.09	6.27	7.74	< 0.05	7.0	1.9	2.14	41.0
	N	14	14	----	14	14	14	14	14	14	14	14	14	14	14	14
	SD	5.7	3.0	----	474	0.3	4,121	588	0.50	1.13	1.00	0.58	1.3	0.51	0.41	206
200009 Riverhead STP Discharge	Mean	----	----	----	----	----	445	120	2.76	2.98	5.74	----	7.0	0.87	0.73	----
	Max	----	----	----	----	----	>16,000	>16,000	19.6	5.51	19.8	----	20.0	2.2	2.1	----
	Min	----	----	----	----	----	< 20	< 20	< 0.02	0.157	1.65	----	2.6	0.10	0.012	----
	N	----	----	----	----	----	13	13	14	14	14	----	14	14	14	----
	SD	----	----	----	----	----	5,765	4,487	5.39	1.38	4.72	----	4.80	0.69	0.70	----
200010 Peconic River (at USGS Gauge)	Mean	13.4	9.3	----	93	7.0	87	33	0.05	0.160	0.206	0.15	0.38	< 0.05	0.010	19.6
	Max	25.8	12.8	----	137	7.7	330	140	0.14	0.359	0.442	0.29	0.60	0.10	0.025	23.8
	Min	1.5	6.3	----	7	6.4	< 20	< 20	< 0.02	0.007	0.017	< 0.05	0.23	< 0.05	< 0.01	13.2
	N	15	15	----	15	15	15	15	15	15	15	15	15	15	15	15
	SD	7.9	2.0	----	35	0.3	107	43	0.04	0.113	0.141	0.07	0.12	0.02	0.01	3.1
200013 Goose Creek	Mean	11.1	7.8	----	73	6.6	277	20	< 0.02	0.301	0.319	< 0.05	0.31	< 0.05	< 0.01	12.5
	Max	12.9	10.0	----	108	7.9	1,400	230	0.07	0.509	0.537	0.08	0.48	< 0.05	0.016	15.4
	Min	9.0	6.3	----	64	5.8	20	< 20	< 0.02	0.150	0.177	< 0.05	0.12	< 0.05	< 0.01	9.3
	N	15	15	----	15	15	14	14	15	15	15	15	15	15	15	15
	SD	1.1	1.0	----	11	0.5	478	64	0.02	0.100	0.099	0.02	0.09	0	0	1.5
200014 Birch Creek	Mean	12.2	8.5	----	44	6.0	46	13	< 0.02	0.009	< 0.025	0.10	0.13	< 0.05	< 0.01	10.3
	Max	27.0	12.5	----	83	7.3	340	40	0.03	0.021	0.043	0.23	0.23	0.06	< 0.01	24.0
	Min	1.3	4.7	----	26	4.7	< 20	< 20	< 0.02	< 0.005	< 0.025	< 0.05	< 0.05	< 0.05	< 0.01	< 9
	N	15	15	----	15	15	14	14	15	15	15	15	15	15	15	15
	SD	8.1	2.4	----	14	0.7	104	9	0.01	0.005	0.010	0.06	0.07	0.01	0	5.4

Appendix B2. Water Quality Statistics for Peconic Estuary Stream and Point Source Locations (2010-2012), continued

Station	Stat	Temp (deg C)	D.O. (mg/L)	Salinity (psu)	Cond (uS/cm)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH3 (mg/l)	NO_x (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	o-PO_4 (mg/l)	Chloride (mg/L)
200015 Mill Creek	Mean	10.7	7.1	----	43	6.2	54	20	< 0.02	0.020	0.035	0.21	0.14	< 0.05	< 0.01	8.1
	Max	23.4	10.8	----	68	7.2	3,000	500	0.04	0.122	0.132	1.71	0.21	< 0.05	< 0.01	10.2
	Min	1.4	3.4	----	28	5.2	< 20	< 20	< 0.02	0.005	< 0.025	0.05	0.08	< 0.05	< 0.01	< 12
	N	15	15	----	15	15	14	14	15	15	15	15	15	15	15	15
	SD	7.1	2.0	----	11	0.5	786	130	0.01	0.029	0.029	0.42	0.04	0	0	1.4
200016 Hubbard Creek	Mean	11.1	7.0	----	333	6.5	50	20	0.03	0.022	0.047	< 0.05	0.07	< 0.05	< 0.01	113
	Max	20.7	9.3	----	1,499	7.3	2,800	1,100	0.07	0.052	0.082	0.25	0.14	< 0.05	< 0.01	583
	Min	4.5	4.3	----	66	6.0	< 20	< 20	< 0.02	< 0.005	< 0.025	< 0.05	< 0.05	< 0.05	< 0.01	18.2
	N	15	15	----	15	15	14	14	15	15	15	15	15	15	15	15
	SD	4.1	1.3	----	398	0.4	735	289	0.02	0.013	0.020	0.07	0.04	0	0	153
200017 Peconic River (at Grangebel Park)	Mean	13.3	8.9	----	122	7.0	308	167	0.06	0.238	0.302	0.15	0.47	< 0.05	0.010	26.2
	Max	26.0	12.7	----	165	7.4	9,000	1,300	0.15	0.492	0.565	0.27	0.66	0.07	0.024	43.1
	Min	1.8	5.6	----	67	6.5	20	20	< 0.02	0.066	0.076	0.05	0.28	< 0.05	< 0.01	17.6
	N	15	15	----	15	15	15	15	15	15	15	15	15	15	15	15
	SD	7.8	2.3	----	33	0.3	2,293	379	0.04	0.131	0.163	0.06	0.14	0.01	0.01	5.8
200026 Riverhead Aquarium Discharge	Mean	13.5	7.6	18.9	----	7.5	781	388	0.38	0.906	1.29	0.53	1.7	0.21	0.195	----
	Max	26.1	12.3	22.2	----	8.1	>16,000	16,000	1.37	4.64	4.73	2.02	5.0	0.58	0.568	----
	Min	2.9	3.5	13.7	----	7.0	< 20	< 20	< 0.02	0.082	0.110	< 0.05	0.45	0.07	0.023	----
	N	13	13	12	----	12	12	12	13	13	13	13	13	13	13	----
	SD	8.3	3.1	2.3	----	0.3	5,948	4,485	0.41	1.34	1.50	0.62	1.3	0.17	0.18	----
200030B Peconic River (Bottom sample at Riverhead Aquarium)	Mean	12.9	6.9	21.2	----	7.5	225	87	0.07	0.082	0.154	0.24	0.51	0.08	0.028	----
	Max	26.8	13.0	25.8	----	8.0	3,000	300	0.33	0.160	0.492	0.66	1.2	0.20	0.122	----
	Min	1.3	0.6	5.2	----	7.1	20	< 20	< 0.02	0.018	0.028	< 0.05	0.25	< 0.05	< 0.01	----
	N	13	12	13	----	11	10	10	10	10	10	10	10	10	10	----
	SD	9.2	4.5	5.6	----	0.4	893	125	0.11	0.056	0.148	0.19	0.33	0.06	0.04	----

Appendix B2. Water Quality Statistics for Peconic Estuary Stream and Point Source Locations (2010-2012), continued

Station	Stat	Temp (deg C)	D.O. (mg/L)	Salinity (psu)	Cond (uS/cm)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH3 (mg/l)	NO_x (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	$o\text{-}PO_4$ (mg/l)	Chloride (mg/L)
200041 Meetinghouse Creek (at Rt 25, Main Rd)	Mean	11.2	6.8	----	184	6.5	530	187	0.17	3.89	4.06	0.26	4.3	< 0.05	0.013	30.5
	Max	18.0	12.4	----	265	7.0	5,000	3,500	0.35	5.91	5.96	0.77	6.97	0.12	0.040	53.4
	Min	3.2	2.4	----	140	5.9	40	< 20	< 0.02	0.809	1.11	< 0.05	1.3	< 0.05	< 0.01	22.2
	N	15	15	----	15	15	15	15	15	15	15	15	15	15	15	15
	SD	4.7	3.0	----	33	0.3	1,509	1,010	0.11	1.64	1.60	0.28	1.7	0.03	0.01	8.2
200044 Peconic River (downstream from BNL discharge)	Mean	14.8	8.4	----	274	7.0	37	24	0.08	4.19	4.27	0.15	4.3	0.72	0.656	73.8
	Max	26.0	12.1	----	428	8.6	1,100	1,100	0.46	9.99	10.1	0.65	9.6	1.4	1.30	210
	Min	3.4	4.5	----	113	5.4	< 20	< 20	< 0.02	0.177	0.187	< 0.05	0.44	0.06	0.048	28.4
	N	13	13	----	13	13	12	12	13	13	13	13	13	13	13	13
	SD	8.0	2.2	----	98	0.8	313	312	0.12	2.60	2.62	0.21	2.5	0.41	0.39	45.2
200110 Sawmill Creek	Mean	11.5	8.2	----	187	7.0	768	275	0.24	0.332	0.571	0.38	1.0	0.09	0.047	45.9
	Max	24.8	15.5	----	292	7.4	5,000	5,000	1.11	0.778	1.62	0.73	2.7	0.20	0.077	97.6
	Min	0.9	4.9	----	133	6.5	20	< 20	< 0.02	0.061	0.092	0.19	0.43	< 0.05	0.017	34.2
	N	16	16	----	16	16	16	16	16	16	16	16	16	16	16	16
	SD	8.4	2.8	-----	50	0.3	1,612	1,210	0.30	0.233	0.464	0.14	0.60	0.04	0.02	14.8
200120 Terrys Creek	Mean	13.3	9.1	----	1,120	6.9	747	353	0.07	2.81	2.88	0.14	3.0	0.08	0.082	266
	Max	23.7	13.4	----	5,160	7.3	>16,000	9,000	0.11	3.27	3.36	0.45	3.6	0.20	0.182	486
	Min	2.8	5.1	----	220	6.5	< 20	< 20	0.04	2.24	2.28	< 0.05	2.5	< 0.05	0.043	57.5
	N	15	15	----	15	15	14	14	14	14	14	14	14	14	14	13
	SD	5.8	2.1	----	1,185	0.2	6,503	2,718	0.02	0.329	0.338	0.15	0.31	0.05	0.03	152
200130 Reeves Creek	Mean	13.4	9.1	15.7	13,463	6.8	342	54	0.06	4.51	4.56	0.55	4.8	0.07	0.049	1,307
	Max	25.4	14.0	21.8	31,506	7.7	5,000	2,400	0.20	10.1	10.1	2.46	8.5	0.16	0.126	1,700
	Min	4.2	4.3	6.5	2,834	6.0	20	< 20	< 0.02	1.27	1.30	< 0.05	1.3	< 0.05	< 0.01	814
	N	13	13	4	13	13	12	12	13	13	13	13	13	13	13	5
	SD	7.6	2.9	7.2	11,786	0.4	1,564	682	0.06	2.73	2.75	0.78	2.5	0.04	0.03	349

Appendix B2. Water Quality Statistics for Peconic Estuary Stream and Point Source Locations (2010-2012), continued

Station	Stat	Temp (deg C)	D.O. (mg/L)	Salinity (psu)	Cond (uS/cm)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH3 (mg/l)	NO_x (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	$o\text{-}PO_4$ (mg/l)	Chloride (mg/L)
200140 East Creek, S. Jamesport	Mean	11.0	8.5	----	2,308	6.7	453	152	0.14	3.77	3.91	0.22	4.1	< 0.05	< 0.01	2,406
	Max	18.3	13.2	----	14,067	7.1	5,000	1,300	0.24	4.54	4.68	0.60	4.9	0.08	0.017	24,400
	Min	5.3	4.7	----	515	6.4	40	< 20	0.03	2.62	2.79	< 0.05	2.7	< 0.05	< 0.01	119
	N	13	13	----	13	13	12	12	13	13	13	13	13	13	13	12
	SD	4.7	2.0	----	3,617	0.3	1,393	464	0.05	0.58	0.56	0.25	0.59	0.02	0.00	6,930
200160 Brushes Creek	Mean	11.9	9.5	----	860	6.8	202	33	0.10	4.64	4.73	0.27	4.7	< 0.05	< 0.01	319
	Max	25.3	15.6	----	6,098	7.5	5,000	300	0.31	6.96	7.01	1.01	7.0	0.09	0.016	2,910
	Min	1.7	6.3	----	150	5.6	20	< 20	< 0.02	1.71	1.84	< 0.05	2.0	< 0.05	< 0.01	29.1
	N	13	13	----	13	13	12	12	13	13	13	13	13	13	13	13
	SD	7.7	2.5	----	1,593	0.5	1,576	93	0.08	1.54	1.53	0.33	1.4	0.02	0.00	789
200170 Deep Hole Creek	Mean	9.7	7.4	----	2,411	6.6	1,196	379	0.07	3.93	3.99	0.26	4.0	< 0.05	0.018	768
	Max	19.5	12.9	----	9,850	7.0	>16,000	3,000	0.15	5.14	5.15	1.20	5.0	0.10	0.037	2,205
	Min	1.9	4.1	----	377	6.3	80	20	< 0.02	1.83	1.87	< 0.05	1.9	< 0.05	< 0.01	59.4
	N	13	13	----	13	13	12	12	13	13	13	13	13	13	13	12
	SD	5.5	2.9	----	2,562	0.2	4,766	1,201	0.04	0.89	0.88	0.33	0.97	0.03	0.01	674
200180 Halls Creek	Mean	11.2	6.2	----	3,742	6.8	820	272	0.07	0.99	1.07	0.15	1.2	< 0.05	0.031	723
	Max	23.9	10.1	----	18,833	7.3	16,000	9,000	0.31	2.06	2.11	0.39	1.9	0.07	0.220	1,910
	Min	1.2	2.1	----	262	6.0	70	< 20	< 0.02	0.097	0.213	< 0.05	0.56	< 0.05	< 0.01	94.1
	N	14	14	----	14	14	13	13	14	14	14	14	14	14	14	12
	SD	7.6	2.5	----	5,245	0.4	4,722	2,670	0.08	0.66	0.632	0.15	0.48	0.02	0.06	662
200190 Downs Creek	Mean	12.9	7.7	----	593	6.7	595	179	0.09	2.24	2.33	0.05	2.3	< 0.05	0.014	202
	Max	22.5	11.4	----	3,494	7.6	>16,000	>16,000	0.42	3.64	3.67	0.22	3.7	< 0.05	0.038	1,600
	Min	6.2	4.7	----	171	6.0	40	< 20	< 0.02	0.703	0.91	< 0.05	0.87	< 0.05	< 0.01	28.4
	N	14	14	----	14	14	13	13	14	14	14	14	14	14	14	14
	SD	5.3	2.2	----	863	0.5	4,739	4,365	0.11	0.813	0.77	0.07	0.78	0.00	0.01	415

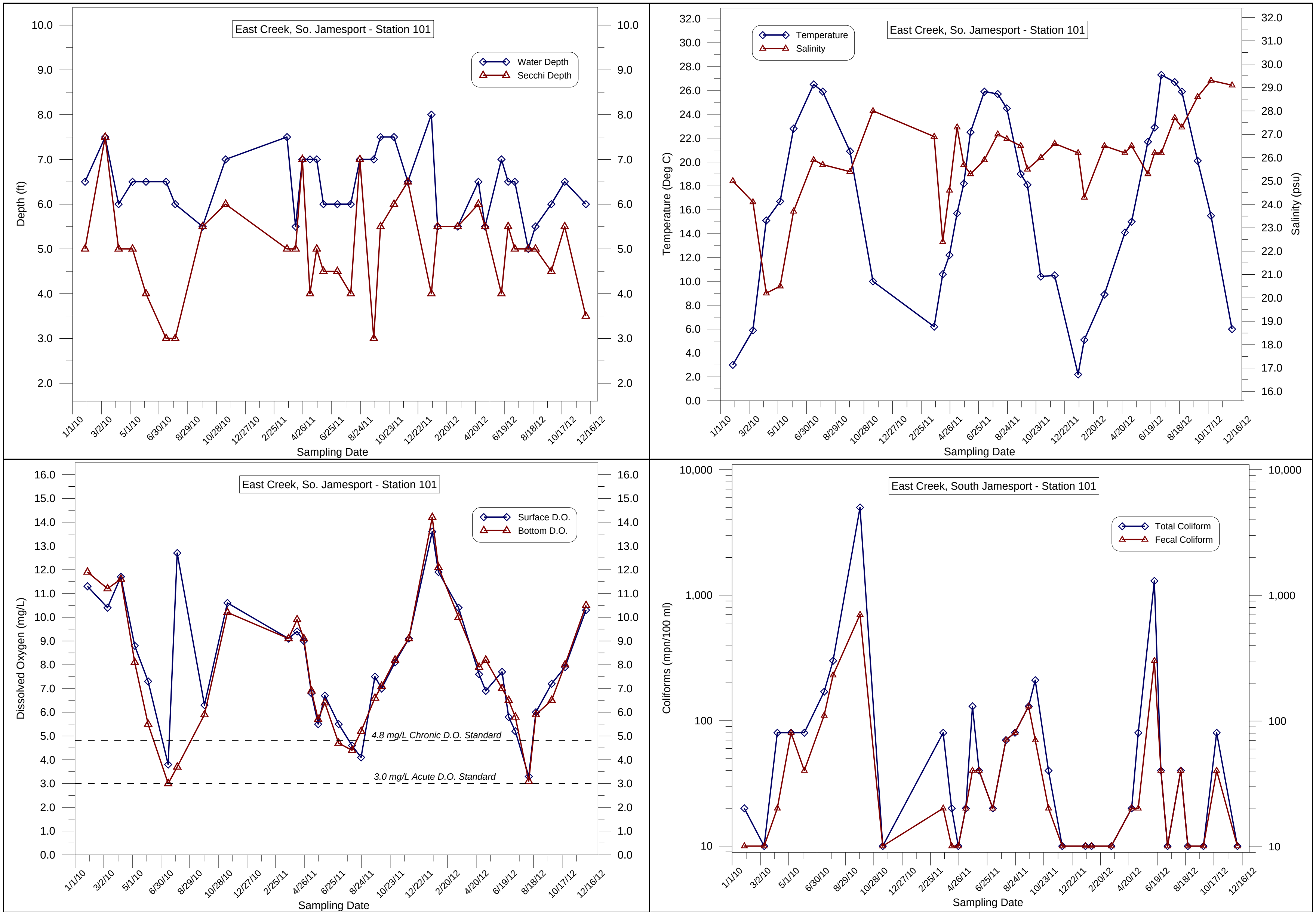
Appendix B2. Water Quality Statistics for Peconic Estuary Stream and Point Source Locations (2010-2012), continued

Station	Stat	Temp (deg C)	D.O. (mg/L)	Salinity (psu)	Cond (uS/cm)	pH	Total Coliform (mpn/100 ml)	Fecal Coliform (mpn/100 ml)	NH3 (mg/l)	NO_x (mg/l)	DIN (mg/l)	DON (mg/l)	TN (mg/l)	TP (mg/l)	$o\text{-}PO_4$ (mg/l)	Chloride (mg/L)
200200 West Creek	Mean	10.7	8.5	----	2,036	6.6	405	52	0.22	1.80	2.03	0.61	2.68	0.16	0.093	25.7
	Max	20.2	16.4	----	16,982	7.0	>16,000	16,000	1.43	5.44	5.47	1.35	5.5	0.56	0.479	67.7
	Min	1.0	0.7	----	80	5.7	< 20	< 20	< 0.02	< 0.005	< 0.025	< 0.05	0.74	< 0.05	< 0.01	10.4
	N	9	9	----	9	9	9	9	9	9	9	9	9	9	9	8
	SD	7.3	4.5	----	5,605	0.5	6,840	5,290	0.47	2.52	2.42	0.48	1.8	0.17	0.15	17.9
200210 East Creek, Cutchogue	Mean	12.7	6.4	4.3	2,403	6.5	463	71	0.05	1.37	1.42	0.32	1.6	< 0.05	< 0.01	199
	Max	19.3	8.7	6.2	14,140	7.1	5,000	3,000	0.13	3.07	3.08	2.74	4.4	0.19	0.011	1,310
	Min	6.0	3.3	2.4	118	5.8	< 20	< 20	< 0.02	0.113	0.195	< 0.05	0.18	< 0.05	< 0.01	11.6
	N	14	14	2	14	14	13	13	14	14	14	14	14	14	14	12
	SD	4.5	1.7	2.7	4,500	0.4	1,589	841	0.04	1.052	1.03	0.74	1.30	0.04	0	376
200230 Pipes Creek	Mean	11.1	5.3	----	1,213	6.7	697	170	0.10	0.112	0.188	0.55	0.84	0.08	0.032	417
	Max	21.5	11.4	----	5,085	7.2	>16,000	>16,000	0.25	0.355	0.544	1.00	1.2	0.18	0.060	1,650
	Min	1.3	0.3	----	240	6.0	60	< 20	< 0.02	0.006	0.037	< 0.05	0.40	< 0.05	0.010	40.6
	N	11	11	----	11	11	9	9	9	8	8	8	9	9	8	9
	SD	6.9	3.4	----	1,395	0.4	5,547	5,251	0.10	0.124	0.160	0.33	0.30	0.05	0.02	503
200240 Pipes Neck Creek	Mean	11.3	7.3	----	3,931	6.7	1,349	708	0.12	0.208	0.343	0.37	0.71	< 0.05	0.014	653
	Max	24.4	9.8	----	19,092	7.3	>16,000	>16,000	0.59	0.615	0.852	0.76	1.4	0.07	0.033	1,740
	Min	0.1	2.7	----	129	6.0	40	40	< 0.02	0.036	0.046	0.10	0.31	< 0.05	< 0.01	11.8
	N	13	13	----	13	13	11	11	12	11	11	11	12	12	11	9
	SD	8.2	2.2	----	5,190	0.4	6,194	5,055	0.17	0.164	0.281	0.23	0.31	0.02	0.01	513
200250 Narrow River North	Mean	9.8	4.7	----	856	6.2	463	55	0.21	0.435	0.639	0.79	1.4	0.11	0.074	32.5
	Max	23.8	17.4	----	8,208	8.0	>16,000	9,000	0.86	3.52	3.58	1.92	4.1	0.52	0.194	108
	Min	0.5	0.8	----	67	4.2	124	< 20	< 0.02	< 0.005	< 0.025	0.26	0.39	< 0.05	< 0.01	0.6
	N	11	11	----	11	11	10	10	11	10	10	10	11	11	10	10
	SD	7.5	4.9	----	2,439	0.9	4,940	2,819	0.26	1.1	1.07	0.49	1.03	0.14	0.06	30.5
200260 Narrow River South	Mean	10.6	5.2	10.6	3,535	6.4	2,445	358	0.11	1.04	1.16	0.50	1.6	0.40	0.312	1,317
	Max	17.9	9.5	11.0	12,482	7.0	>16,000	>16,000	0.54	2.21	2.27	1.26	2.9	1.9	1.68	7,300
	Min	1.1	3.2	10.2	93	5.9	300	< 20	< 0.02	0.028	0.038	< 0.05	0.38	< 0.05	< 0.01	5.0
	N	12	12	2	11	12	10	10	10	9	9	9	10	10	9	8
	SD	5.6	2.0	0.6	4,512	0.4	7,822	6,616	0.18	0.610	0.650	0.43	0.86	0.58	0.55	2,489

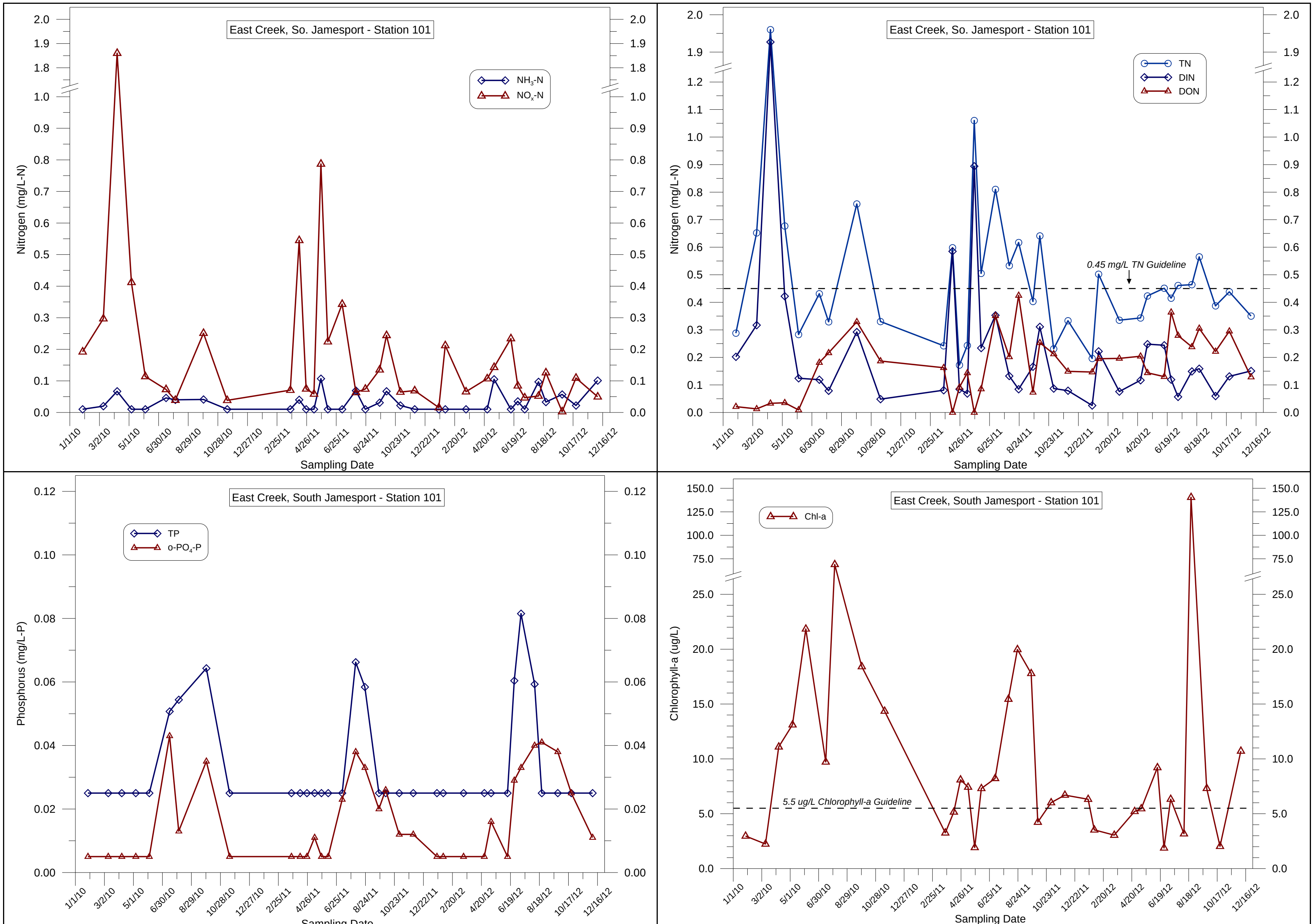
Appendix C1

Time Series Plots for Marine Sampling Locations

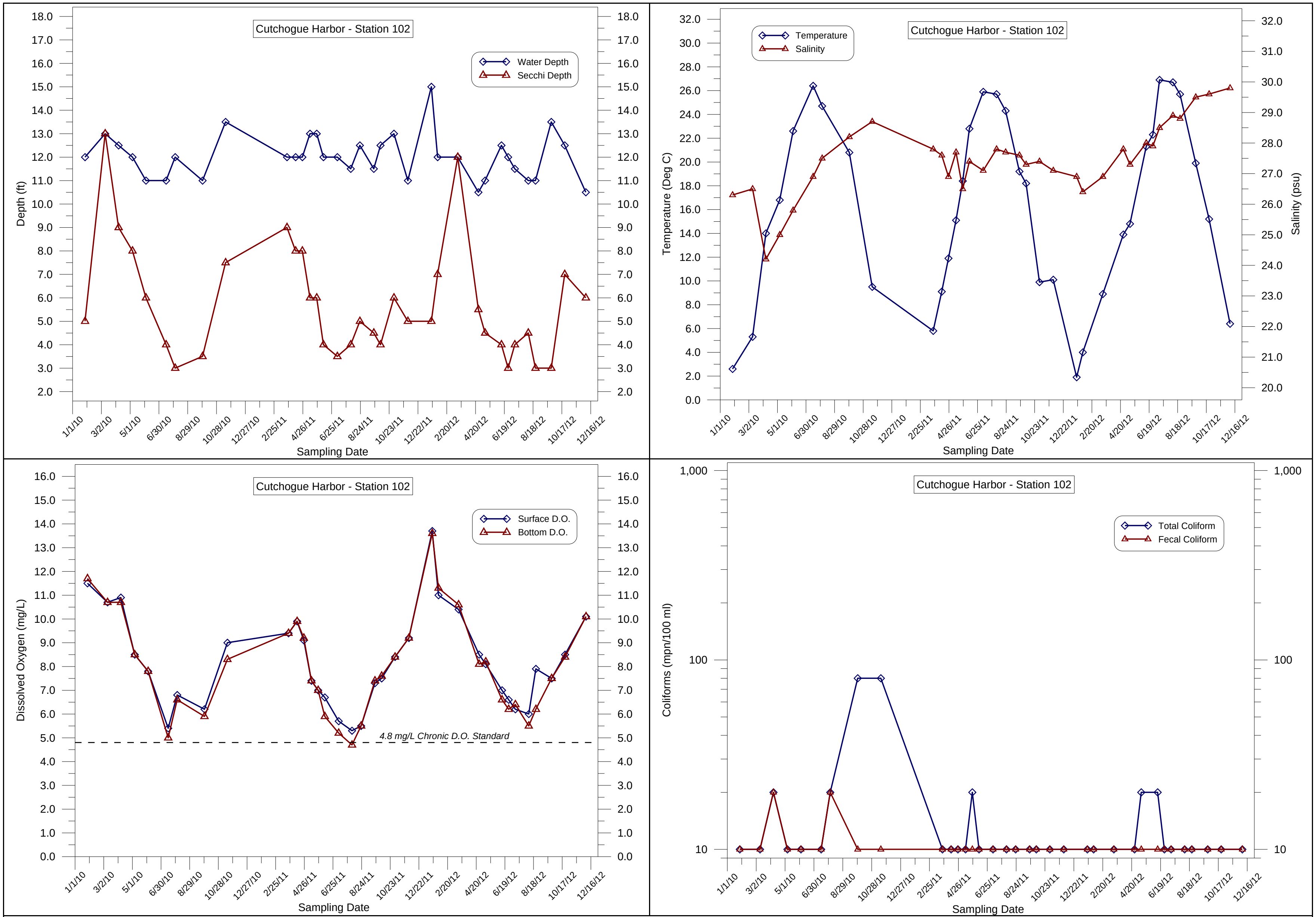
Parameters include:
Water Depth
Secchi Depth
Temperature
Salinity
Dissolved Oxygen
Coliform Bacteria
Ammonia (NH_3-N)
Nitrate+Nitrite (NO_x-N)
Dissolved Inorganic Nitrogen (DIN)
Dissolved Organic Nitrogen (DON)
Total Nitrogen (TN)
Total Phosphorus (TP)
ortho-Phosphate (o-PO_4-P)
Chlorophyll-a



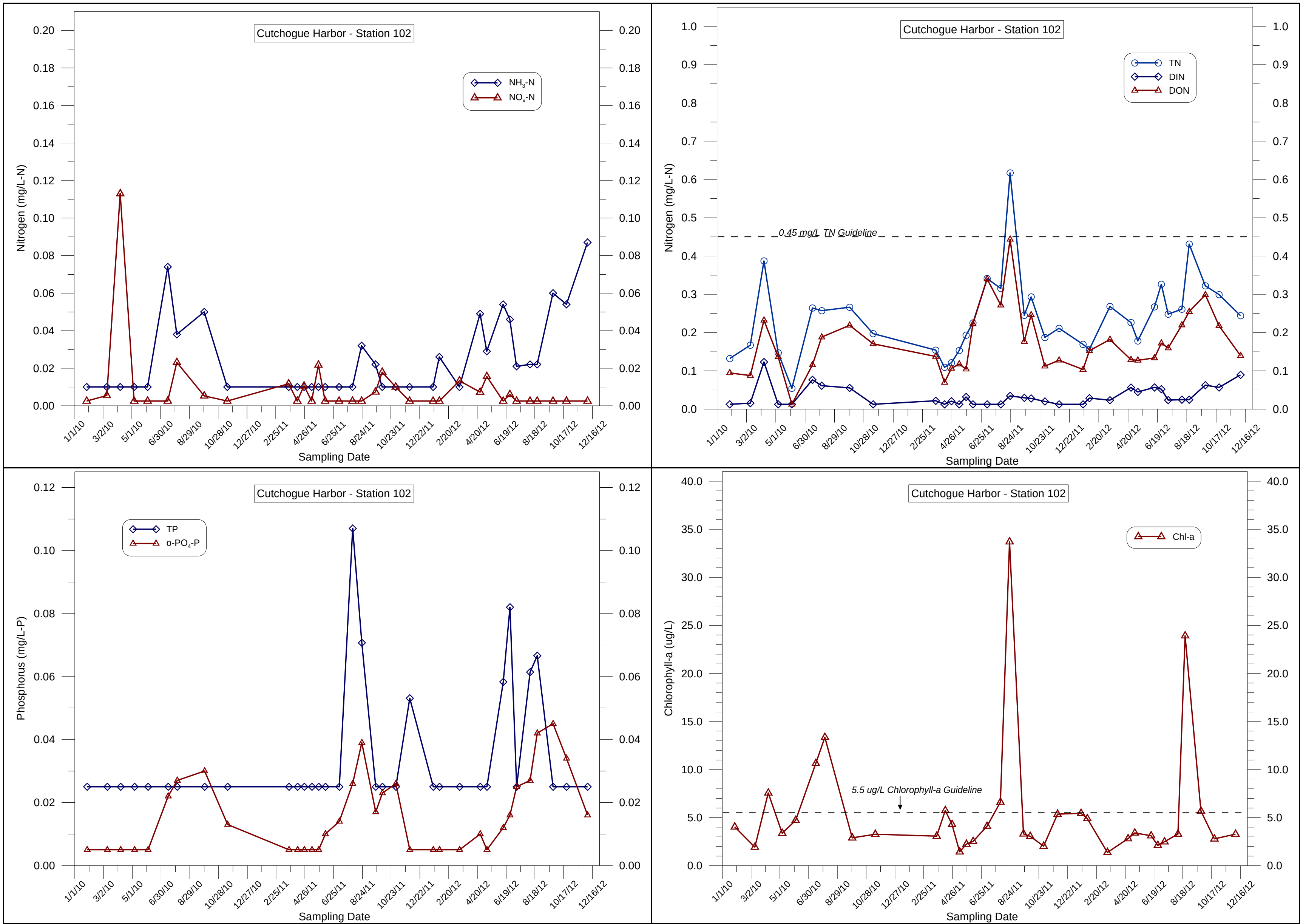
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in East Creek, S. Jamesport (Station 060101), 2010-2012



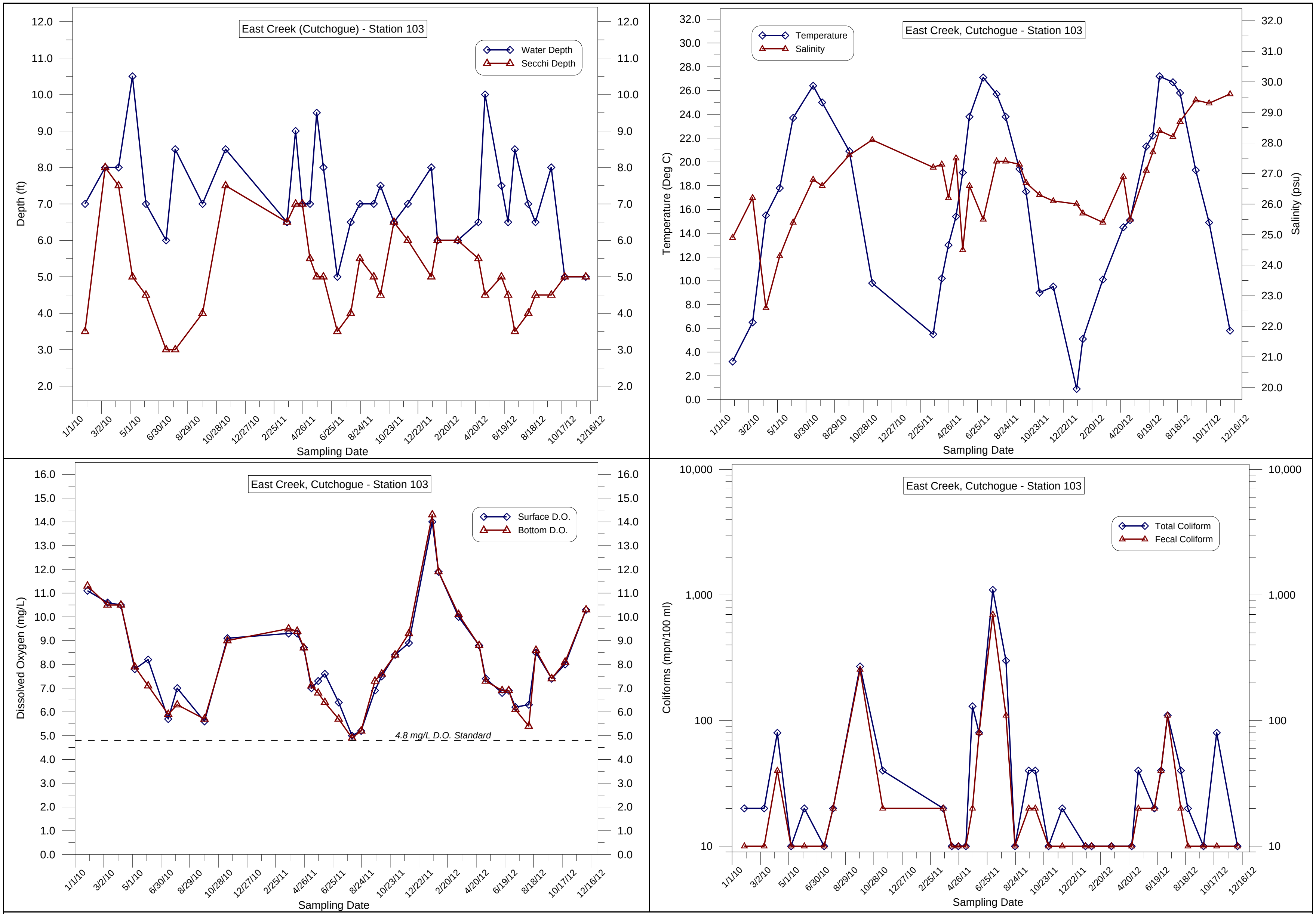
Seasonal variations in ammonia (NH$_3$-N), nitrate+nitrite (NO$_x$-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO$_4$-P) and chlorophyll-a in East Creek, S. Jamesport (Station 060101), 2010-2012



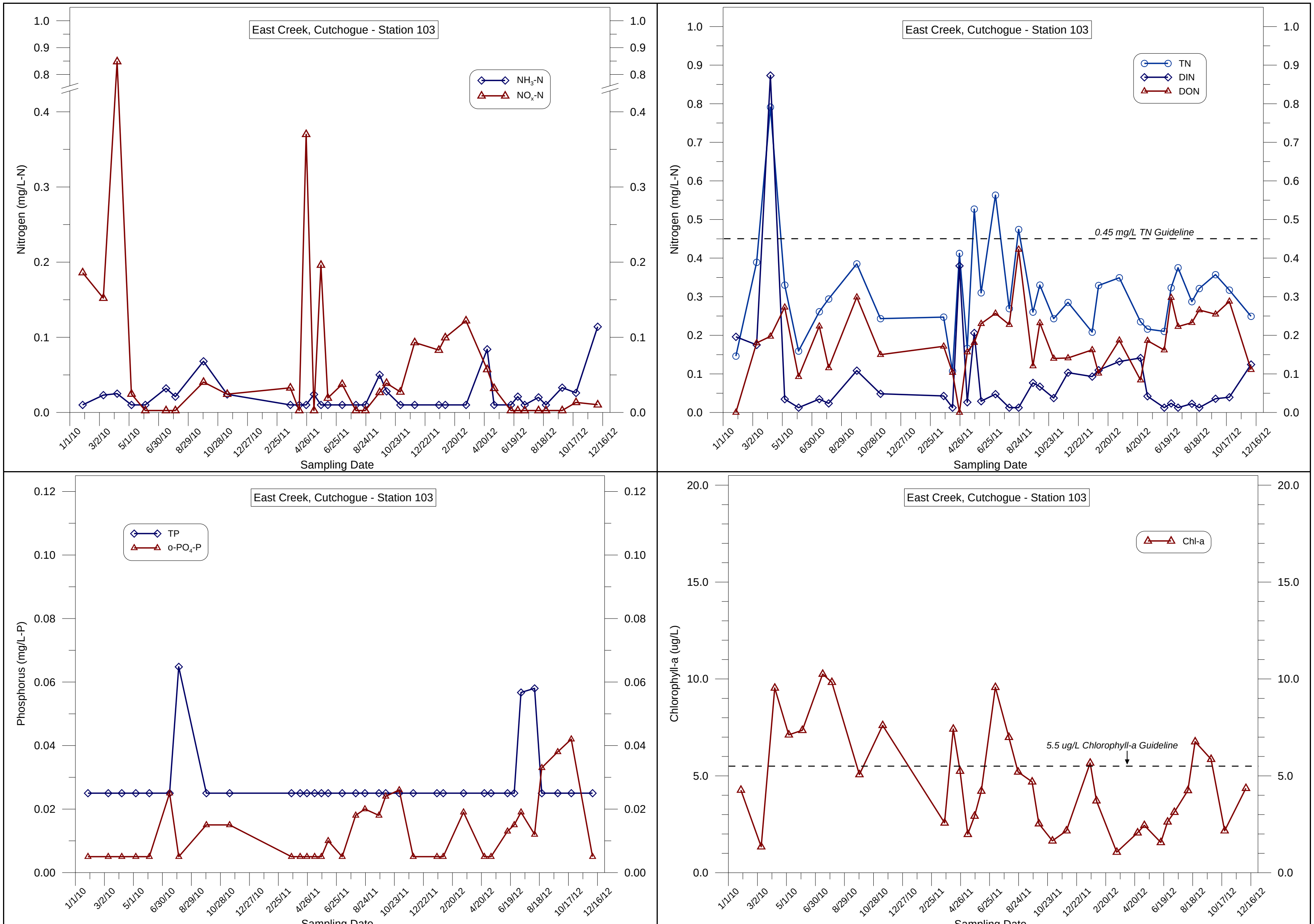
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Cutchogue Harbor (Station 060102), 2010-2012



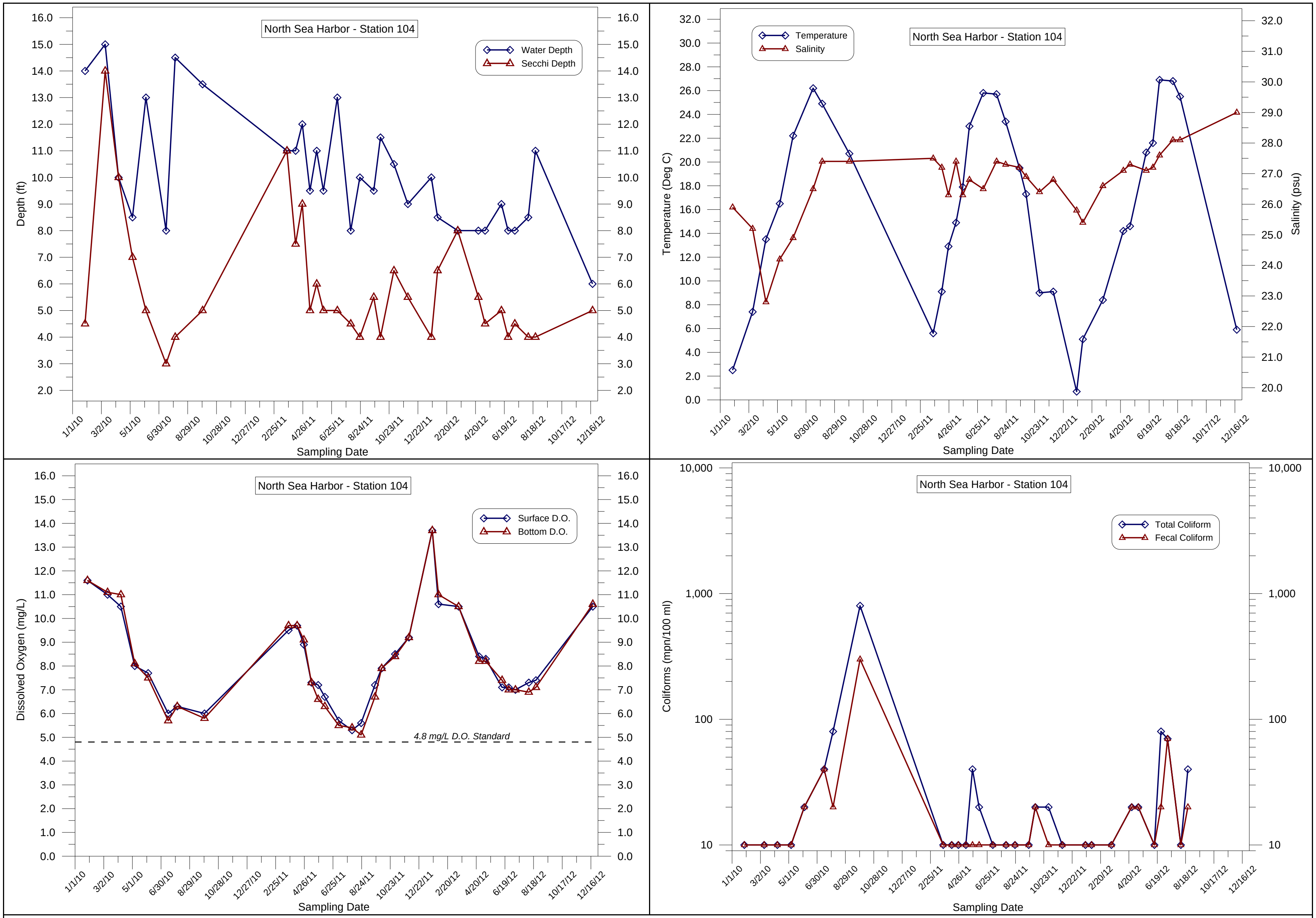
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Cutchogue Harbor (Station 060102), 2010-2012



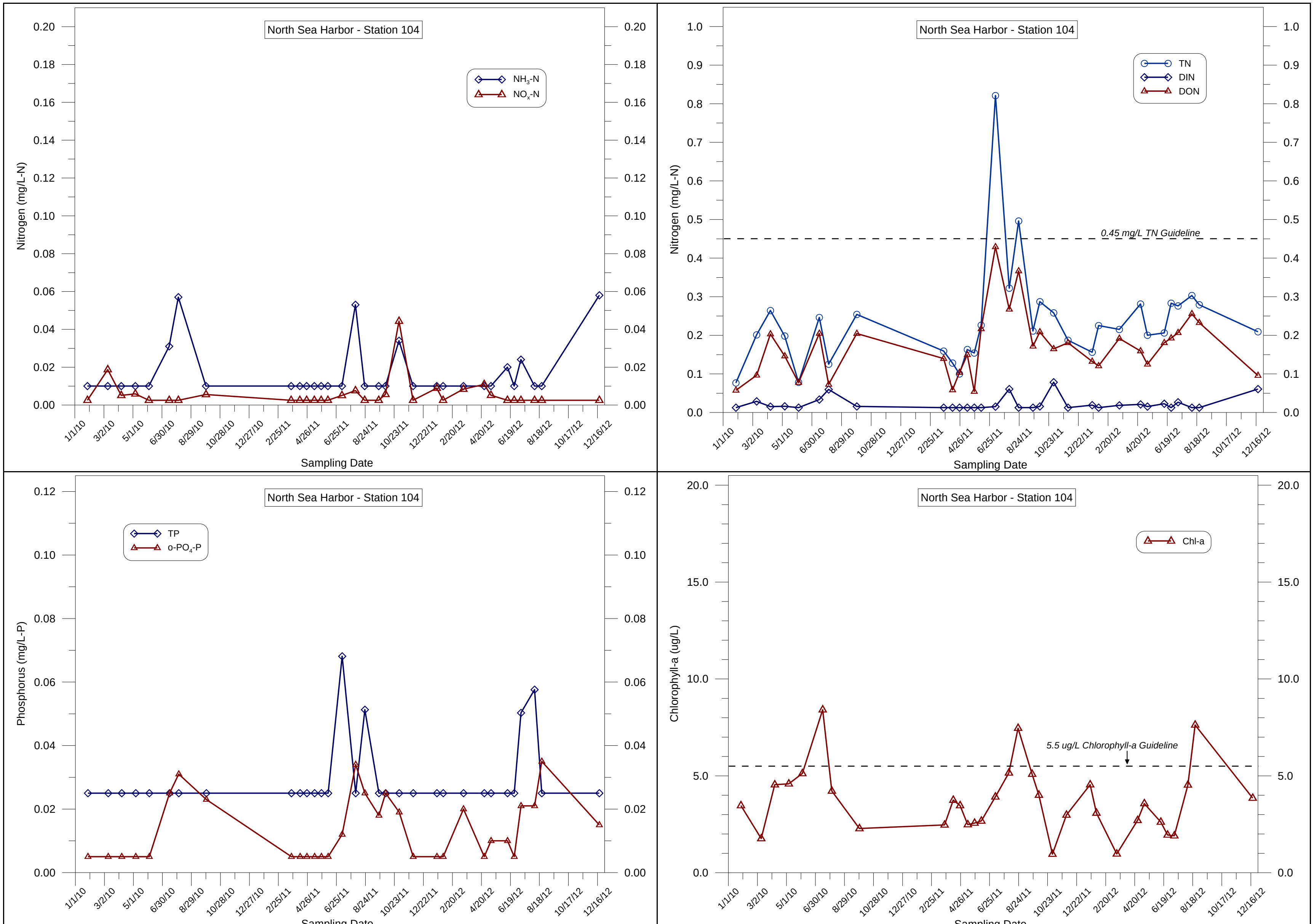
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in East Creek, Cutchogue (Station 060103), 2010-2012



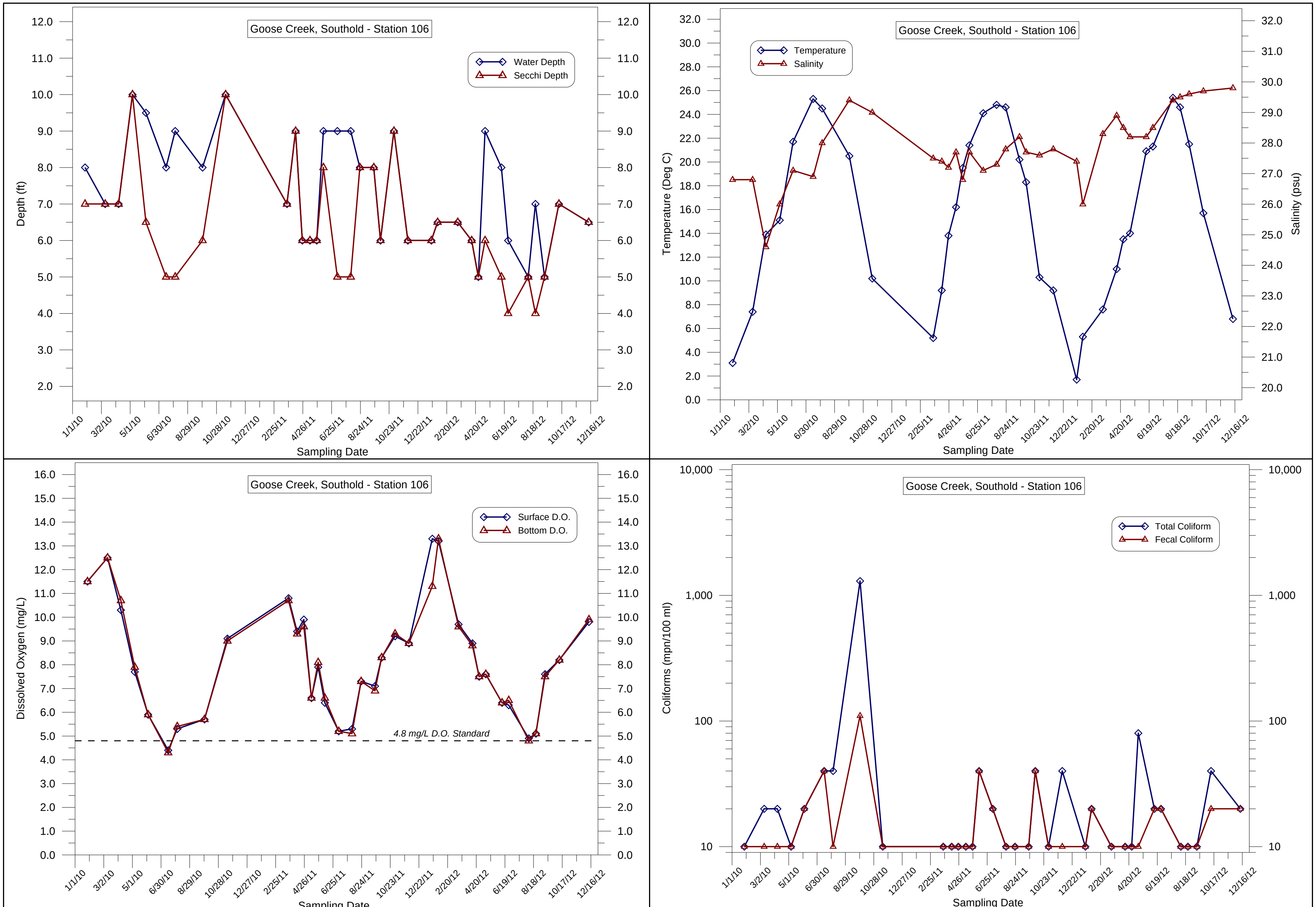
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in East Creek, Cutchogue (Station 060103), 2010-2012



Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in North Sea Harbor (Station 060104), 2010-2012

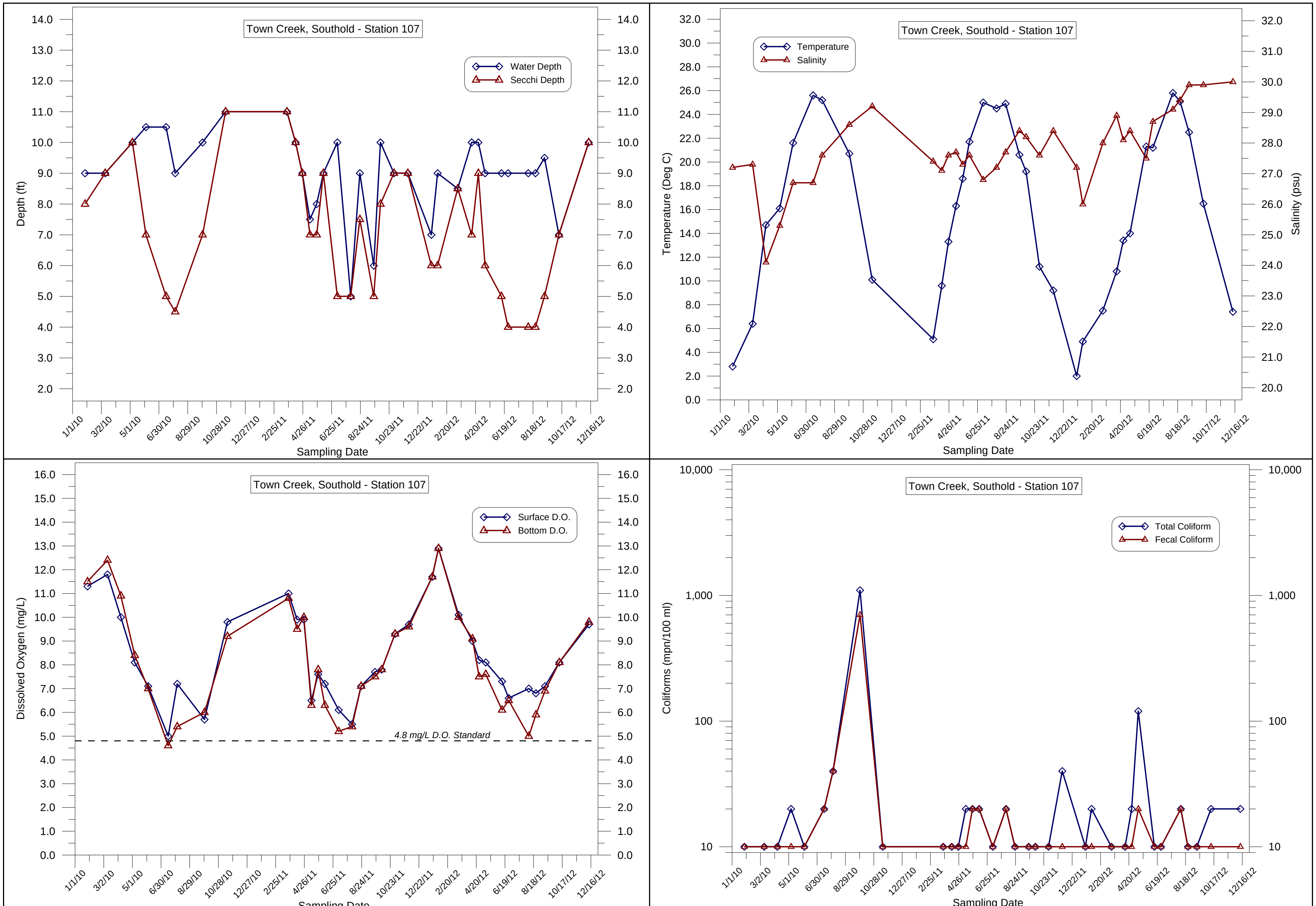


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in North Sea Harbor (Station 060104), 2010-2012



Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Goose Creek, Southold (Station 060106), 2010-2012

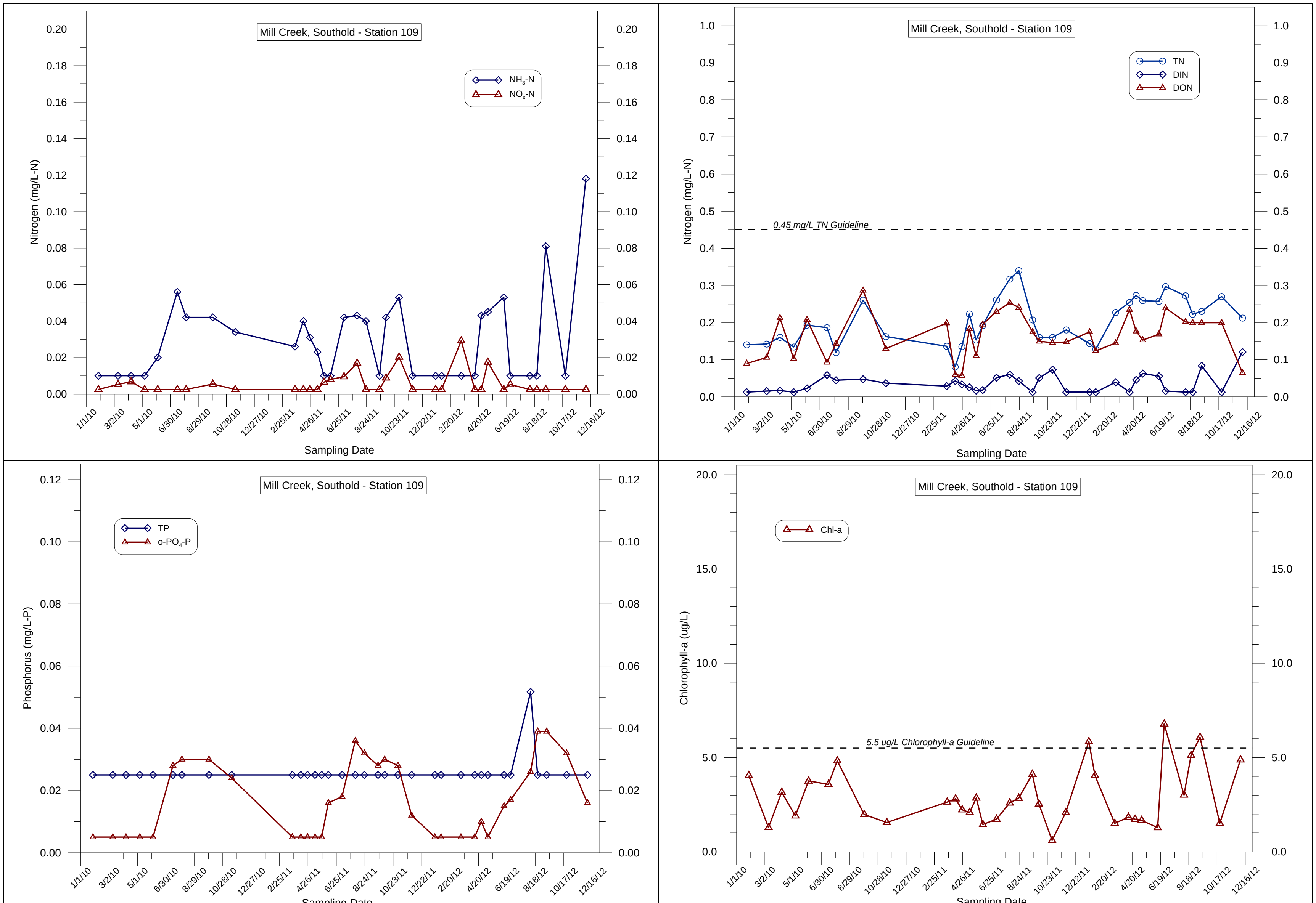
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Goose Creek, Southold (Station 060106), 2010-2012



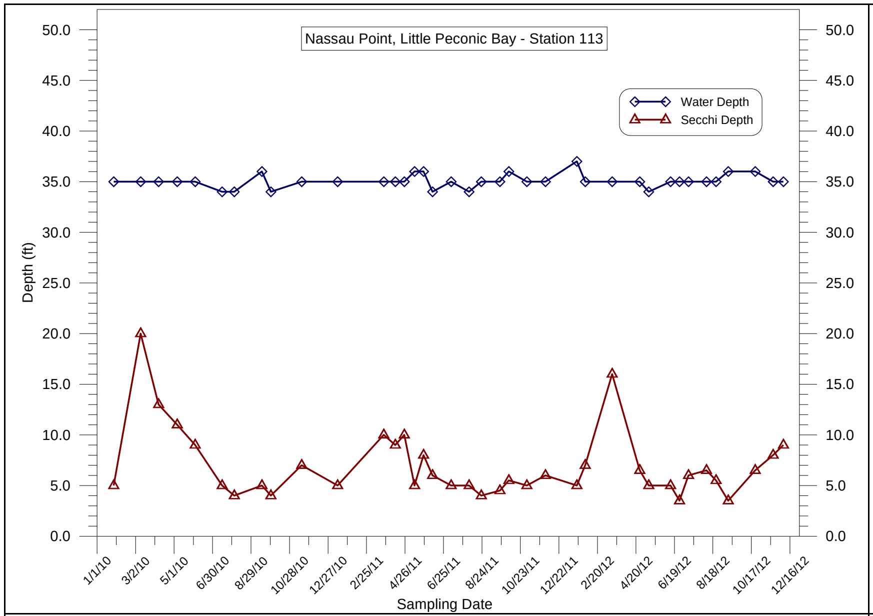
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Town Creek, Southold (Station 060107), 2010-2012

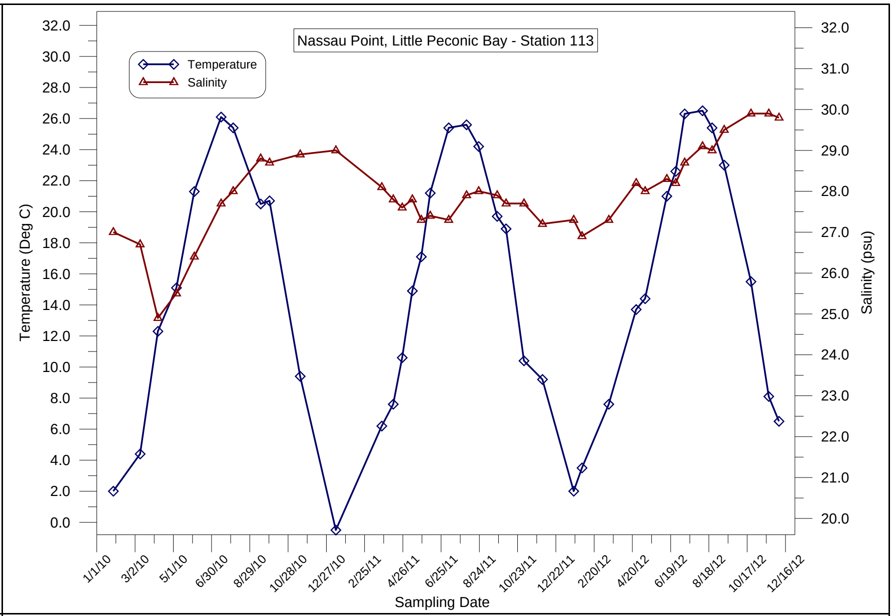
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Town Creek, Southold (Station 060107), 2010-2012

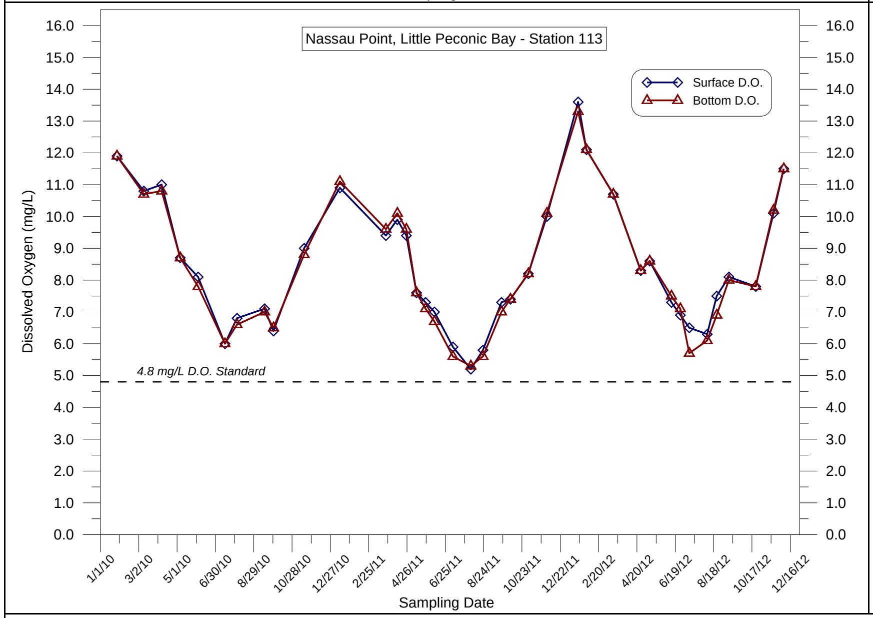
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Mill Creek, Southold (Station 060109), 2010-2012

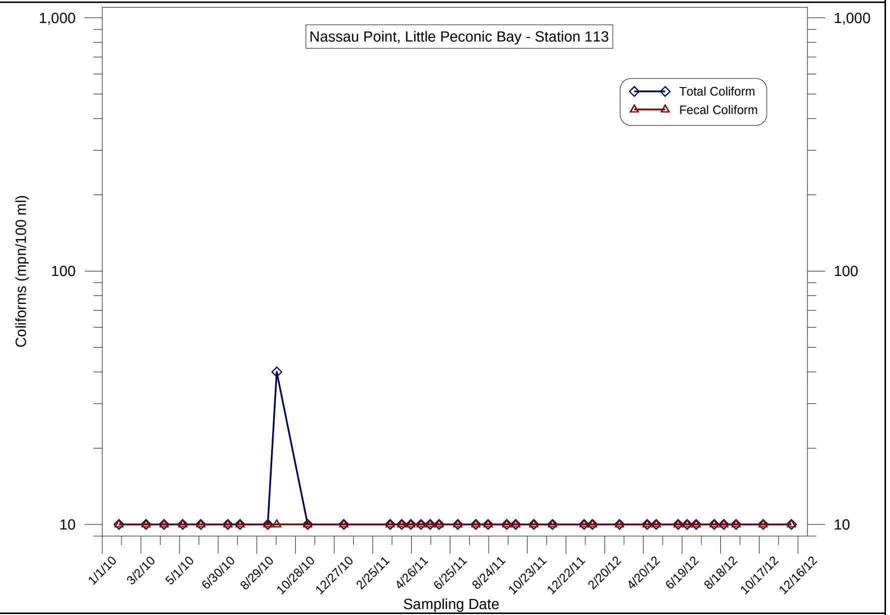


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Mill Creek, Southold (Station 060109), 2010-2012

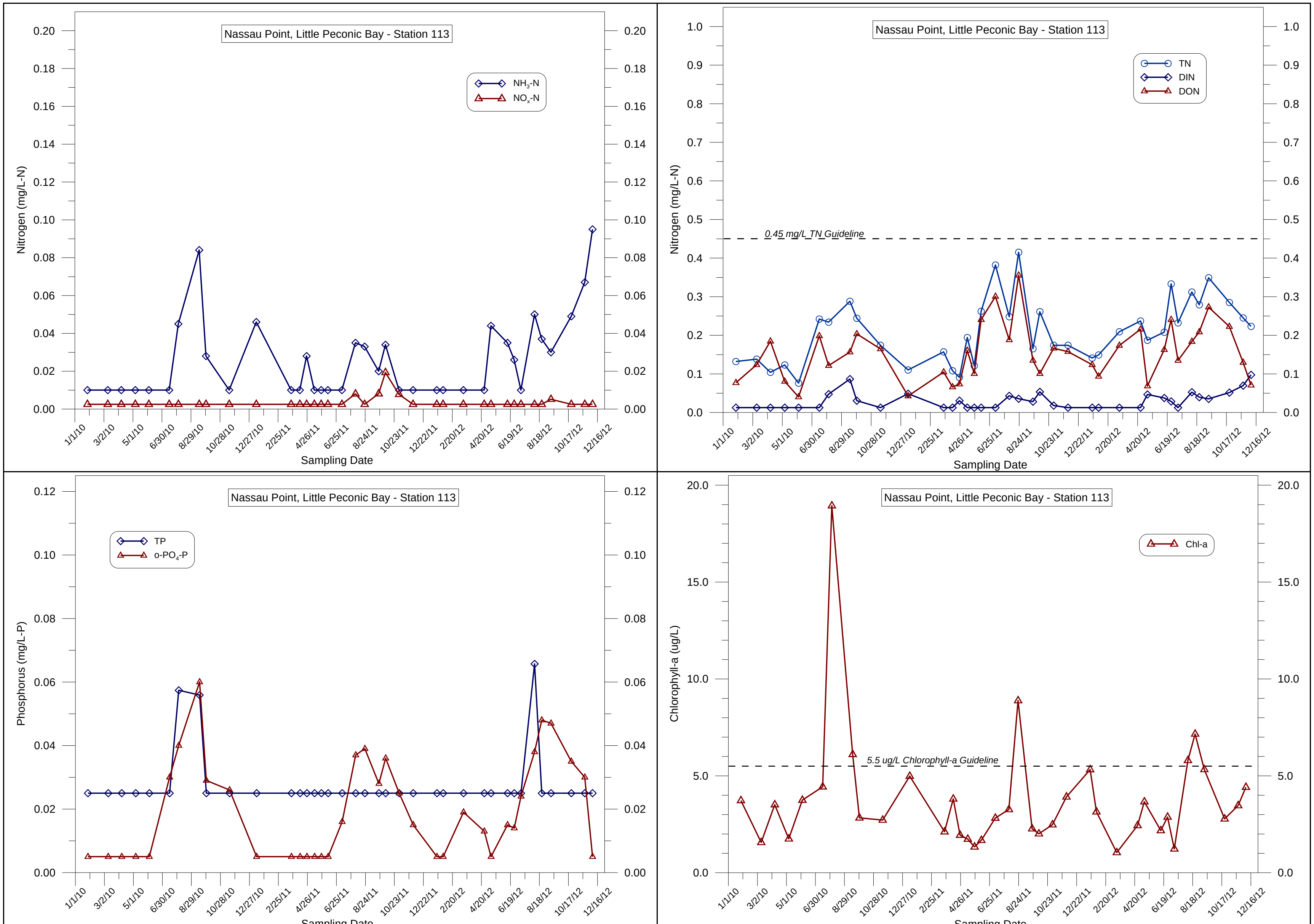




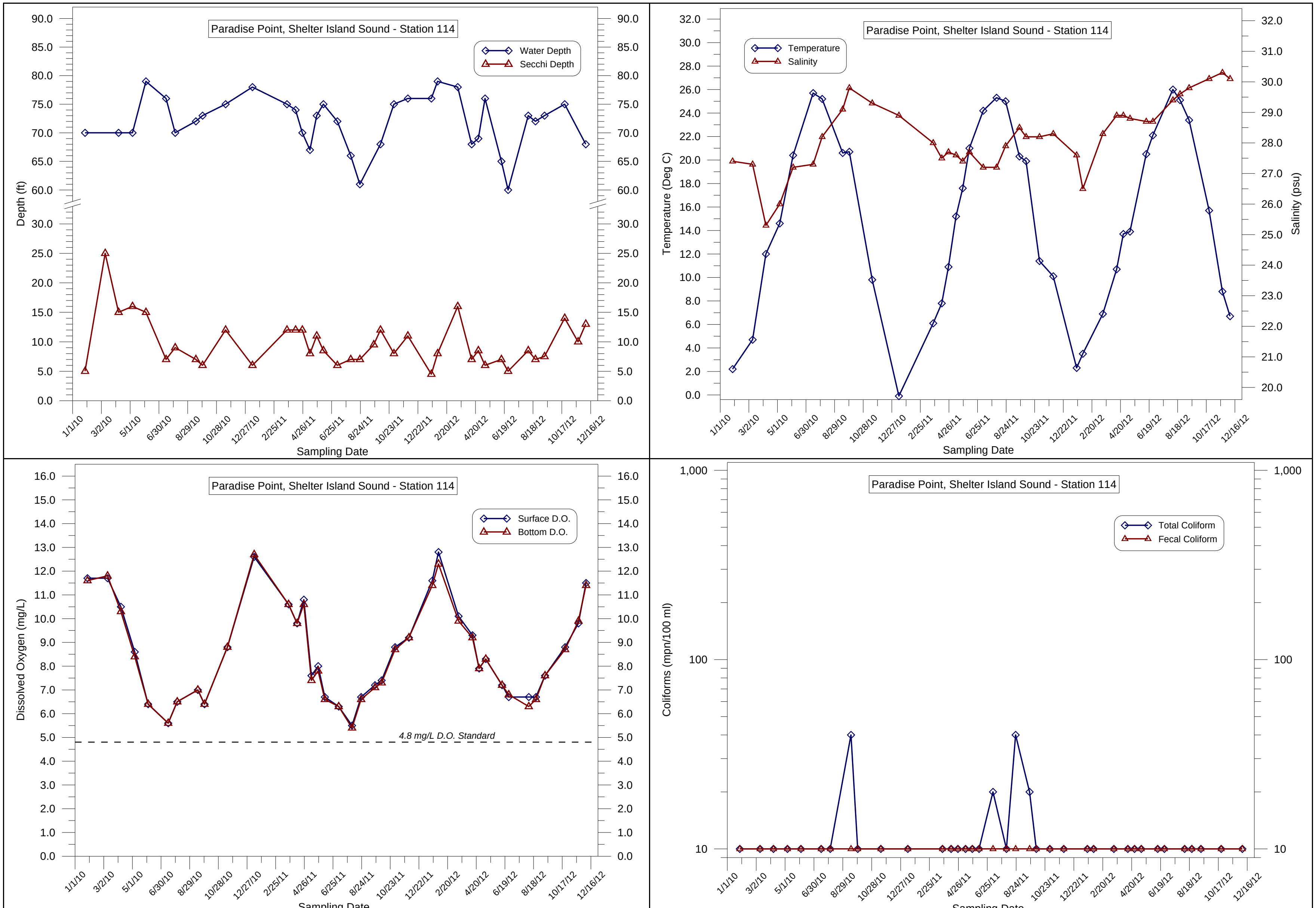




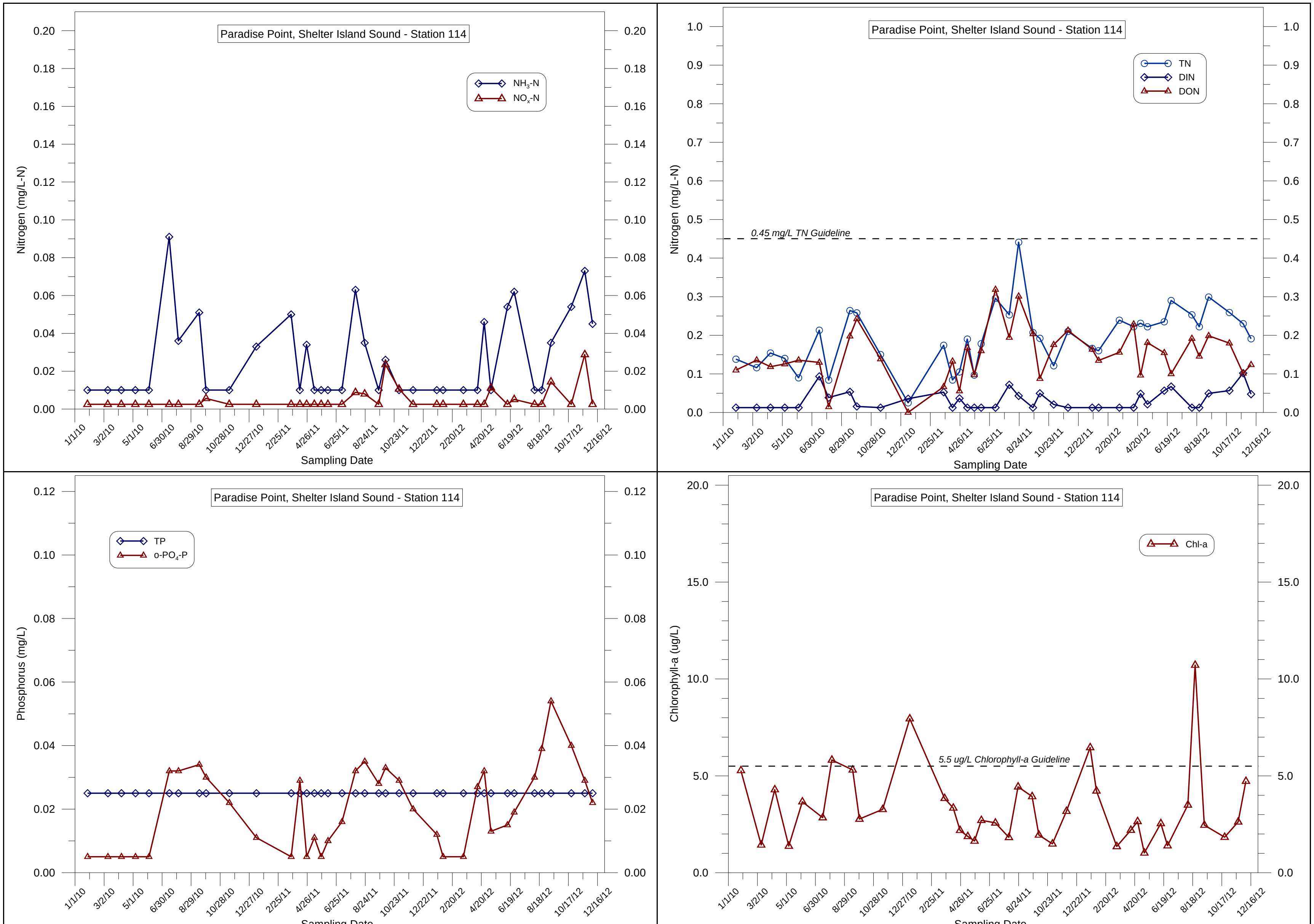
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Little Peconic Bay (Station 060113), 2010-2012



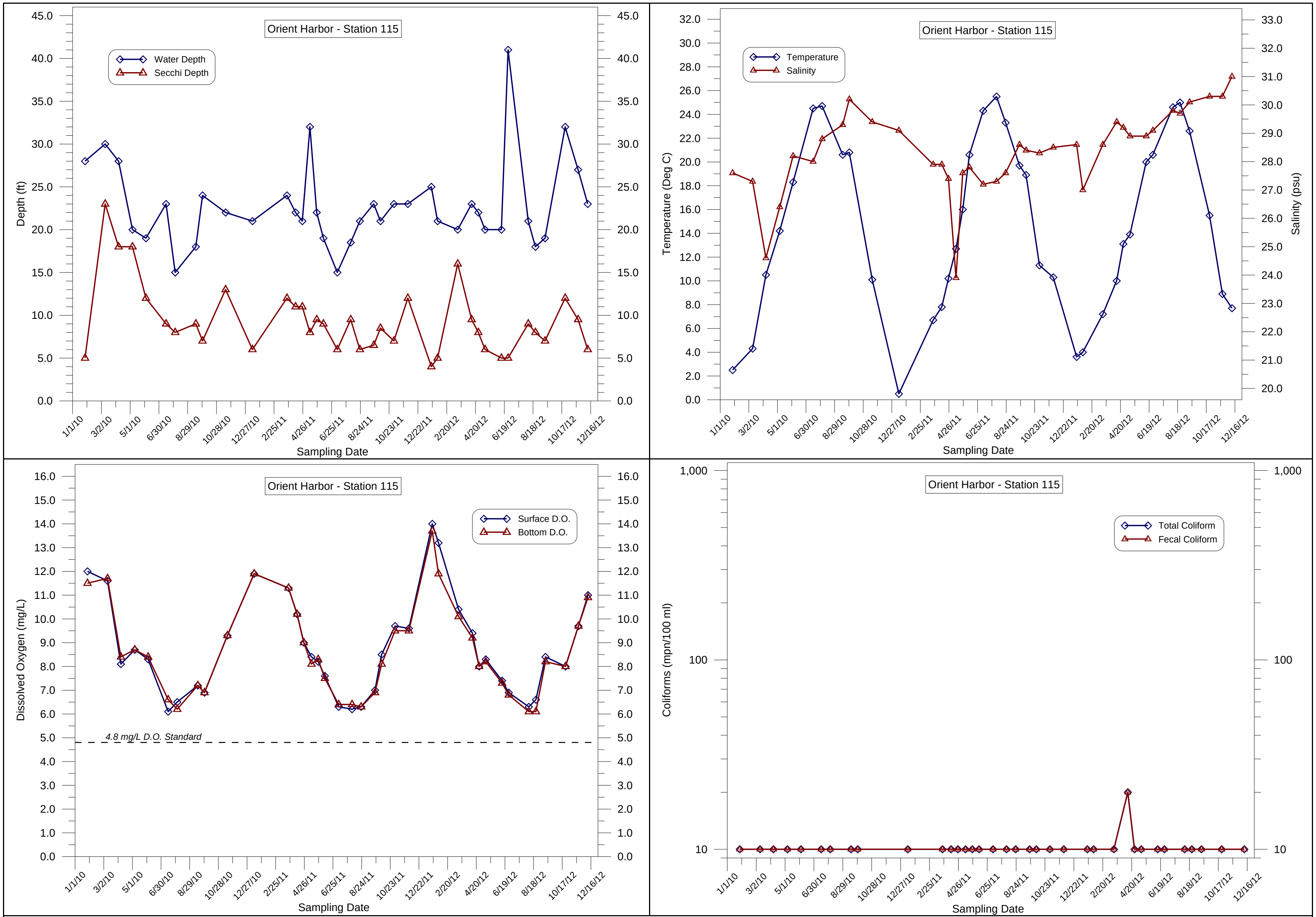
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Little Peconic Bay (Station 060113), 2010-2012



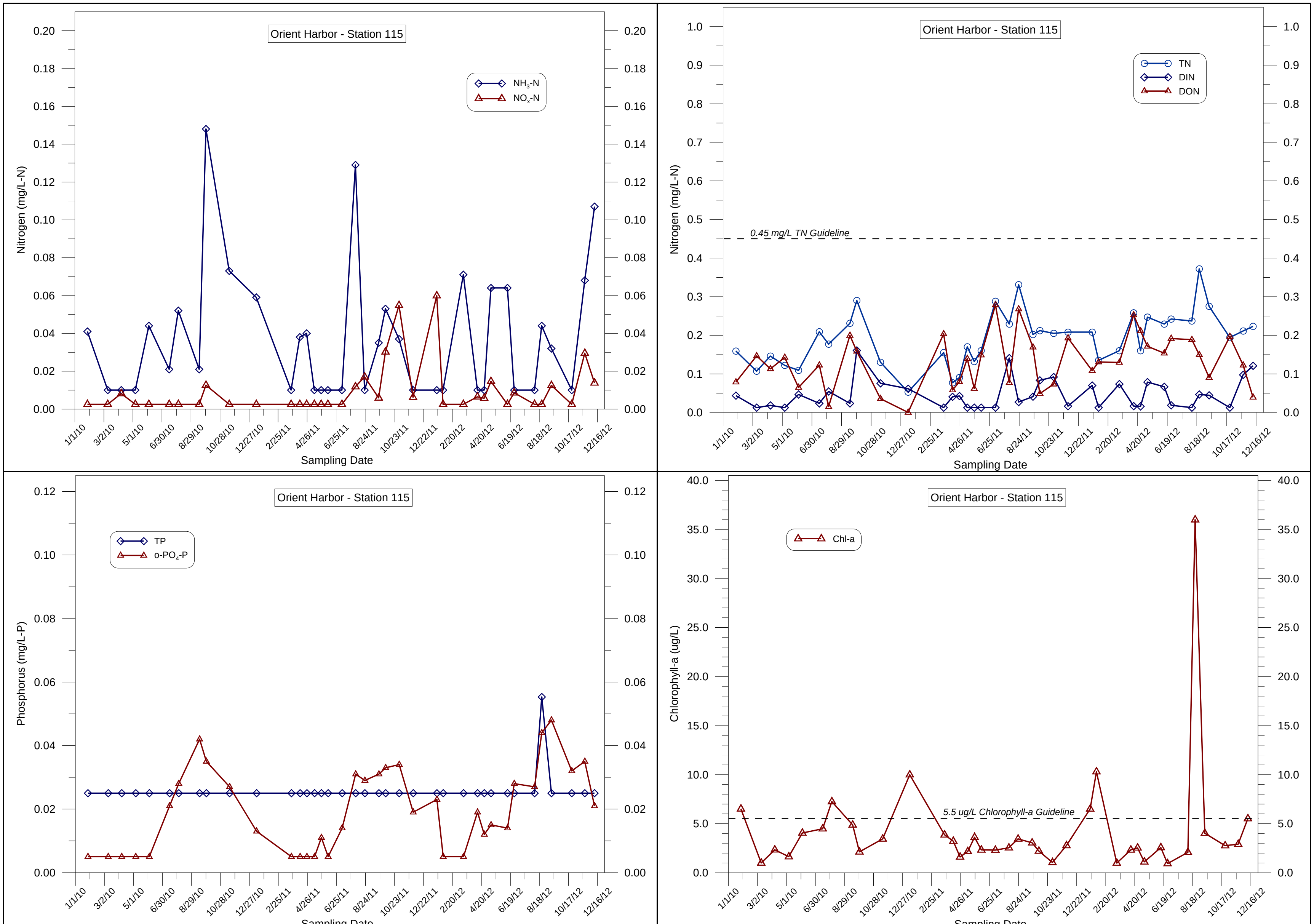
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Shelter Island Sound (Station 060114), 2010-2012



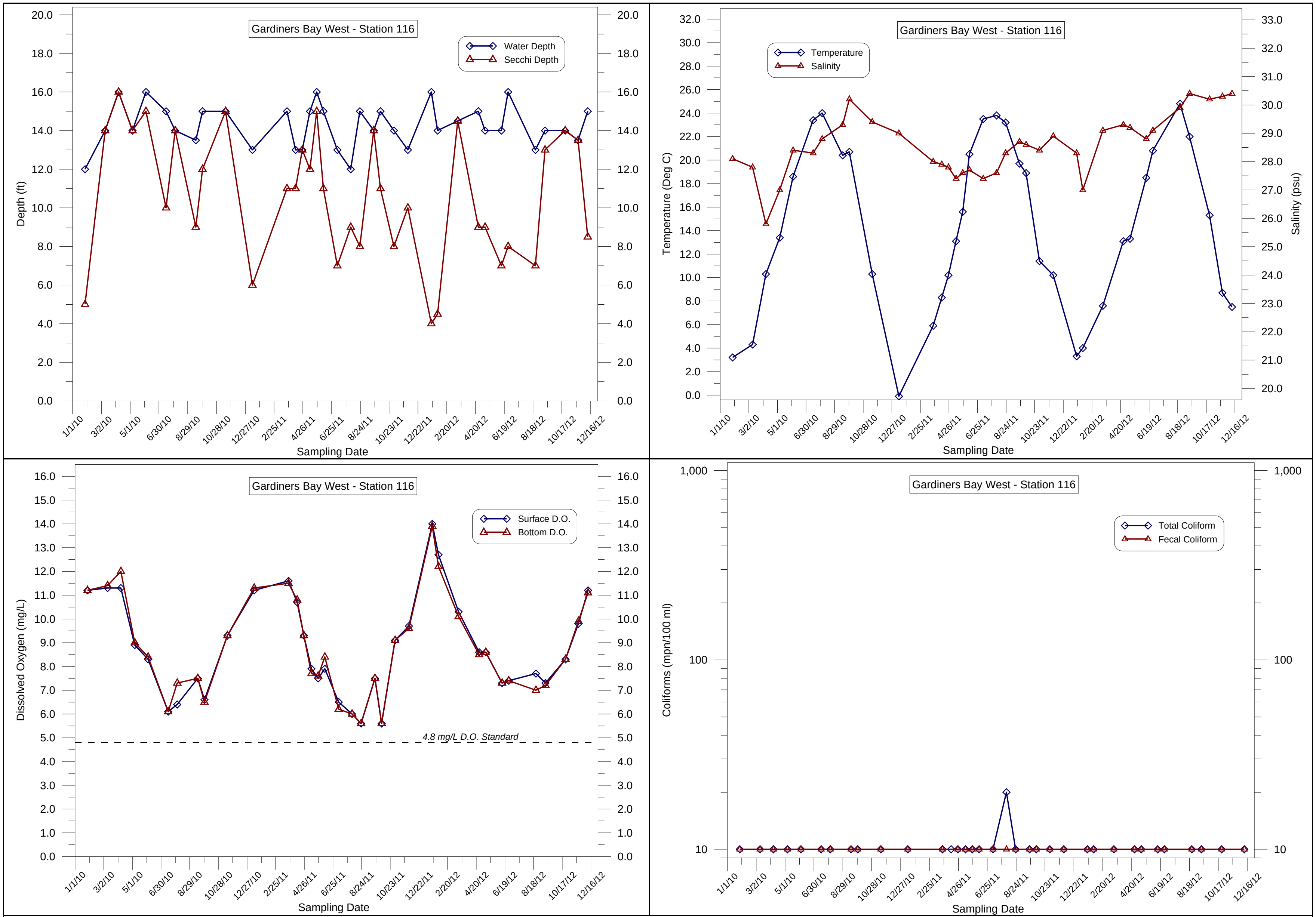
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Shelter Island Sound (Station 060114), 2010-2012



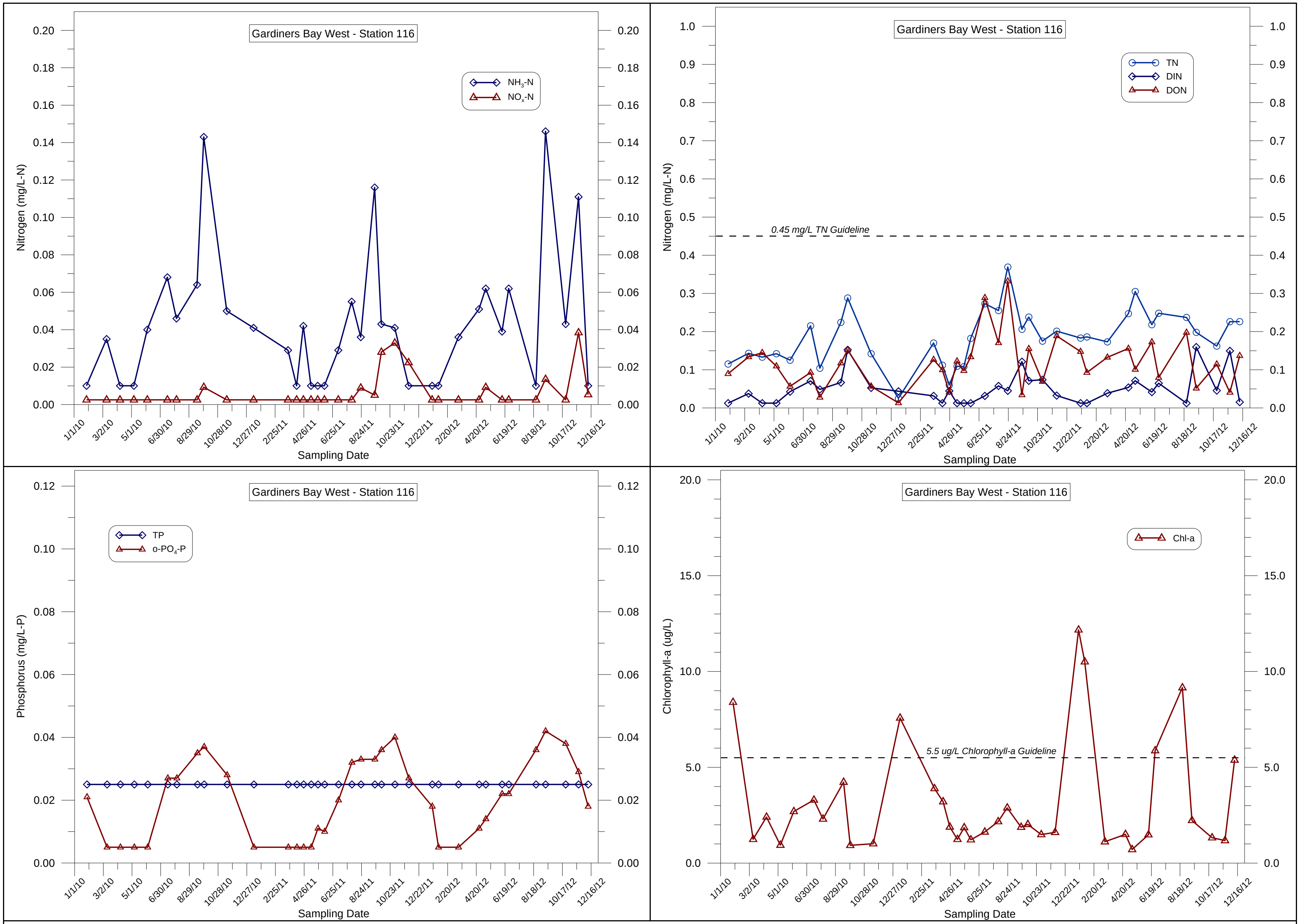
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Orient Harbor (Station 060115), 2010-2012



Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Orient Harbor (Station 060115), 2010-2012

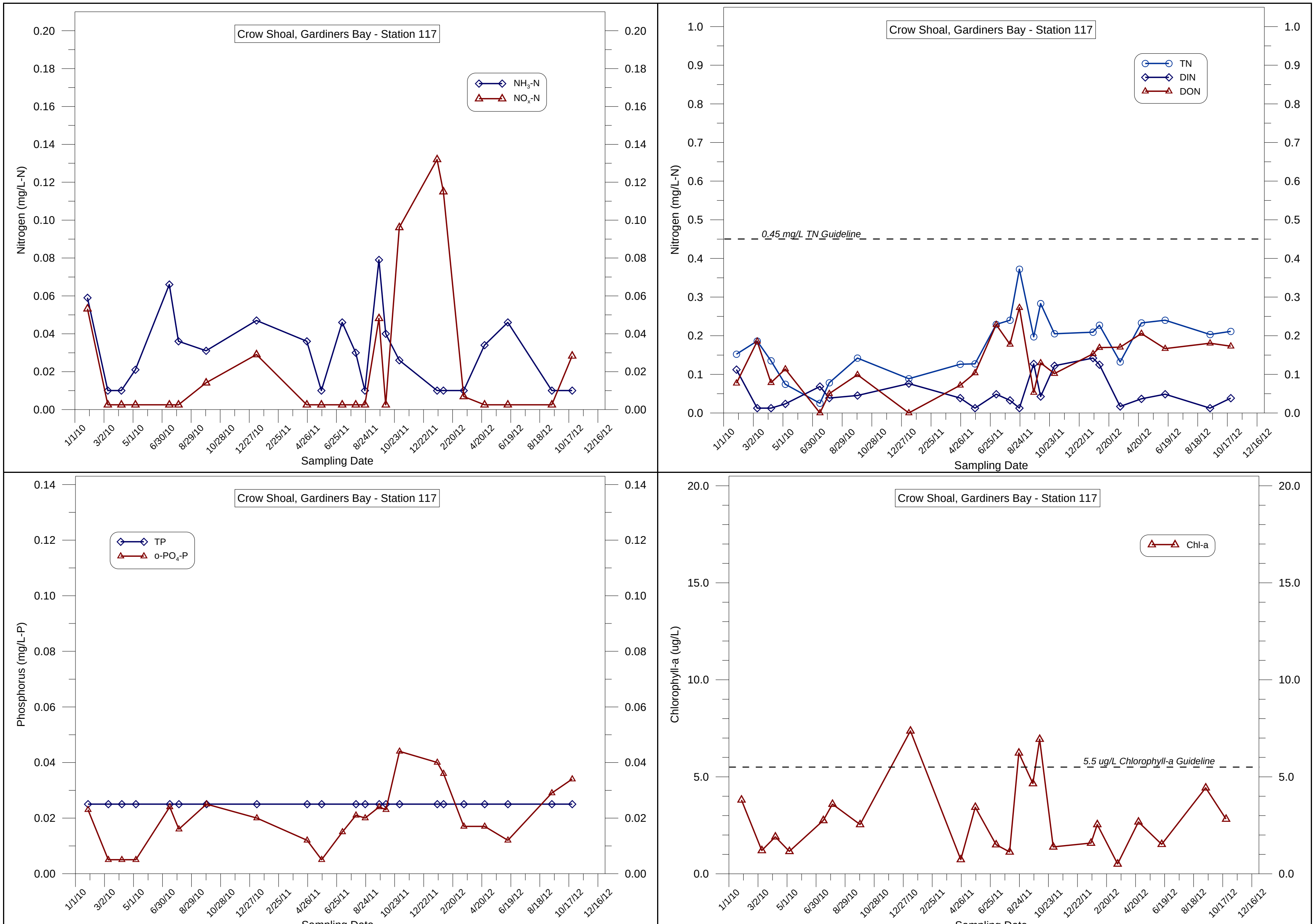


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in western Gardiners Bay (Station 060116), 2010-2012



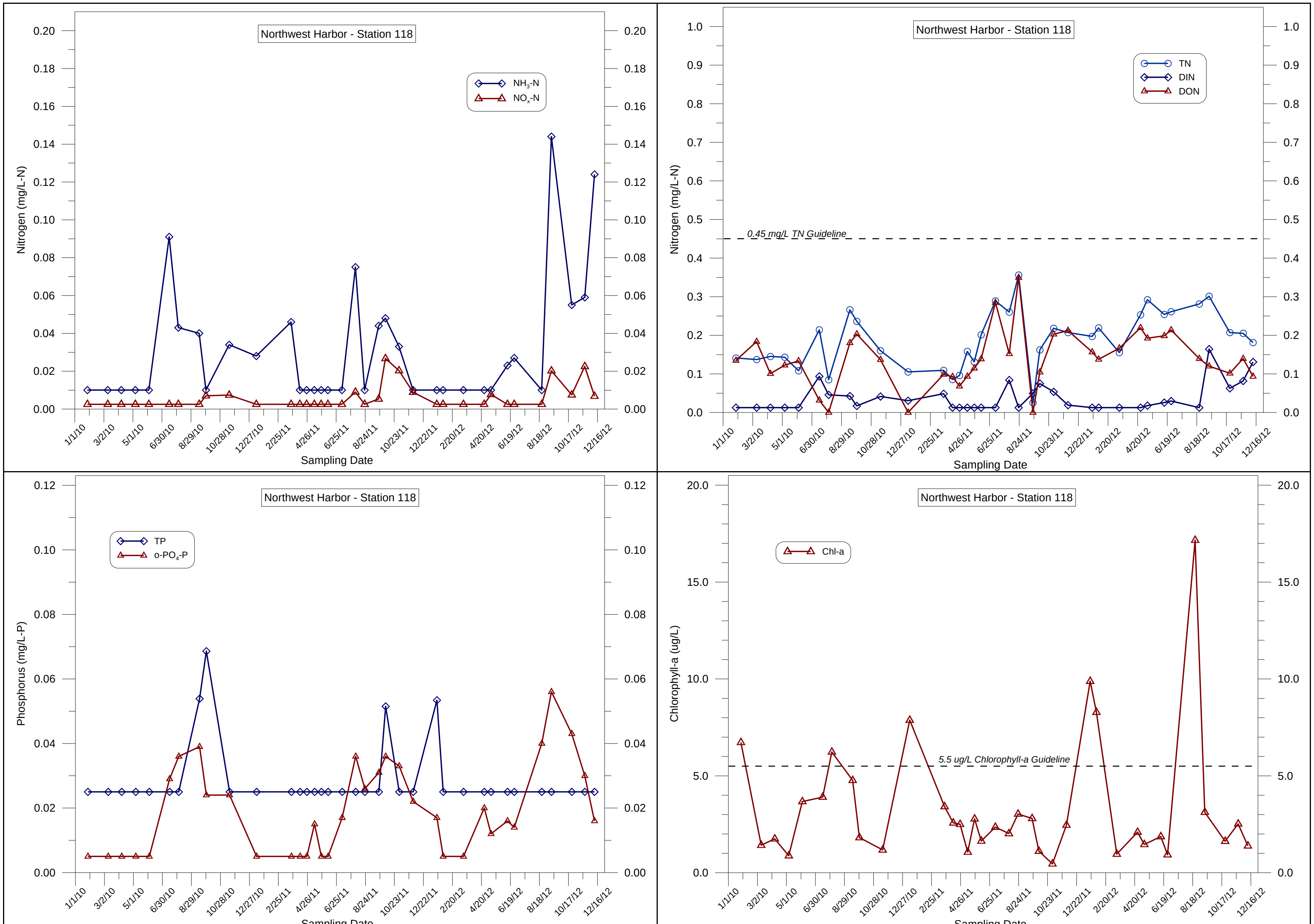
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in western Gardiners Bay (Station 060116), 2010-2012

Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Gardiners Bay (Station 060117), 2010-2012

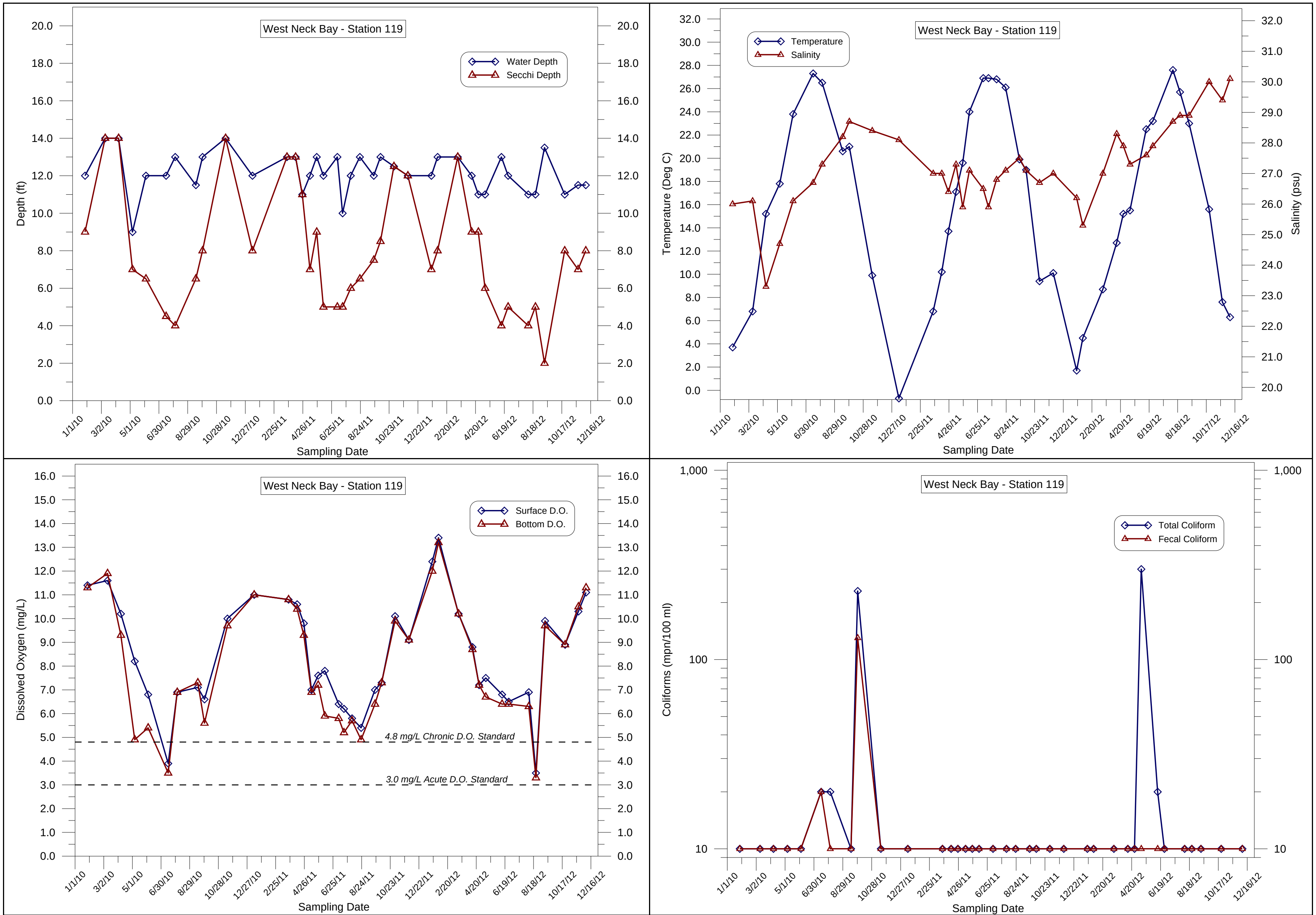


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Gardiners Bay (Station 060117), 2010-2012

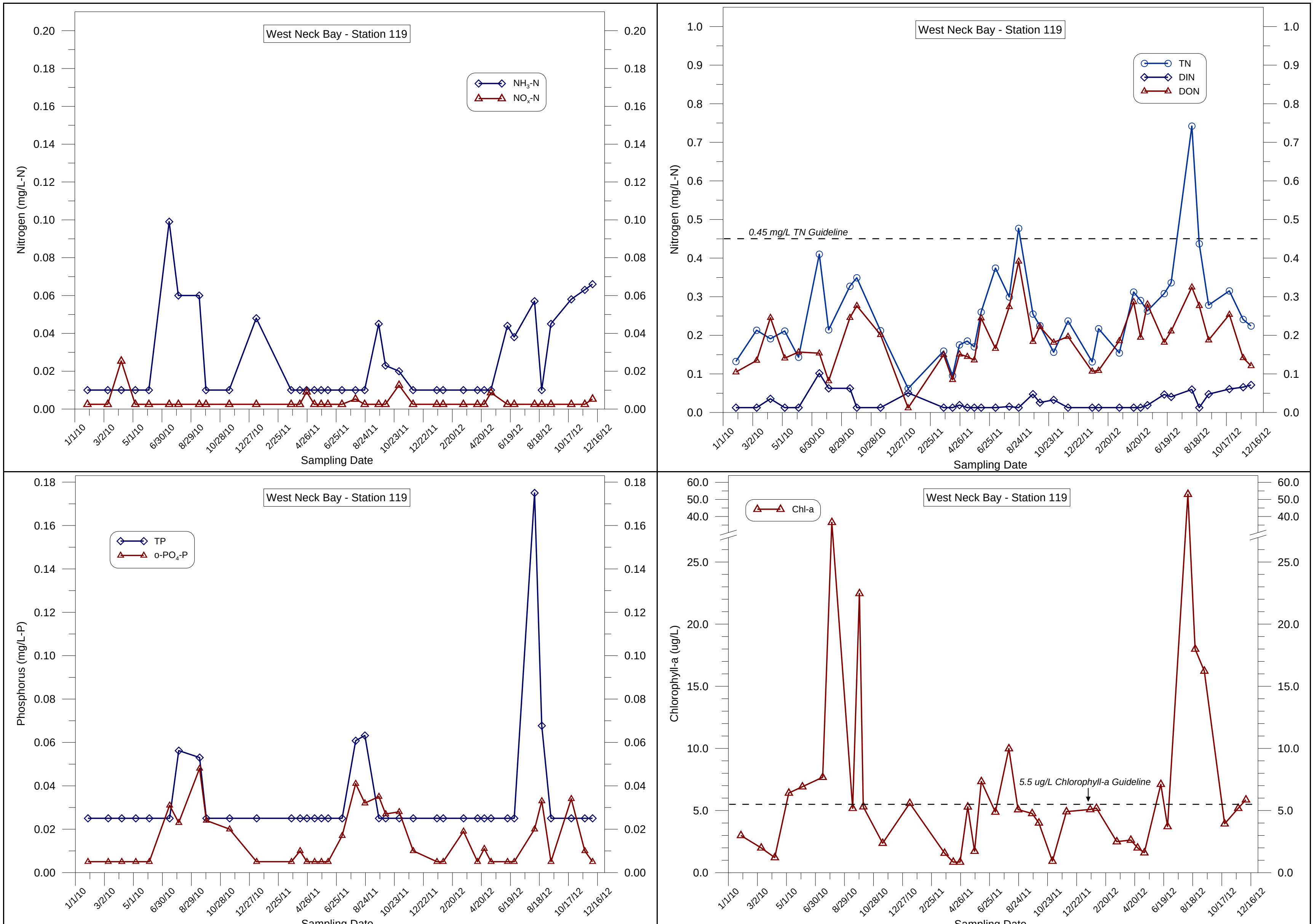
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Northwest Harbor (Station 060118), 2010-2012



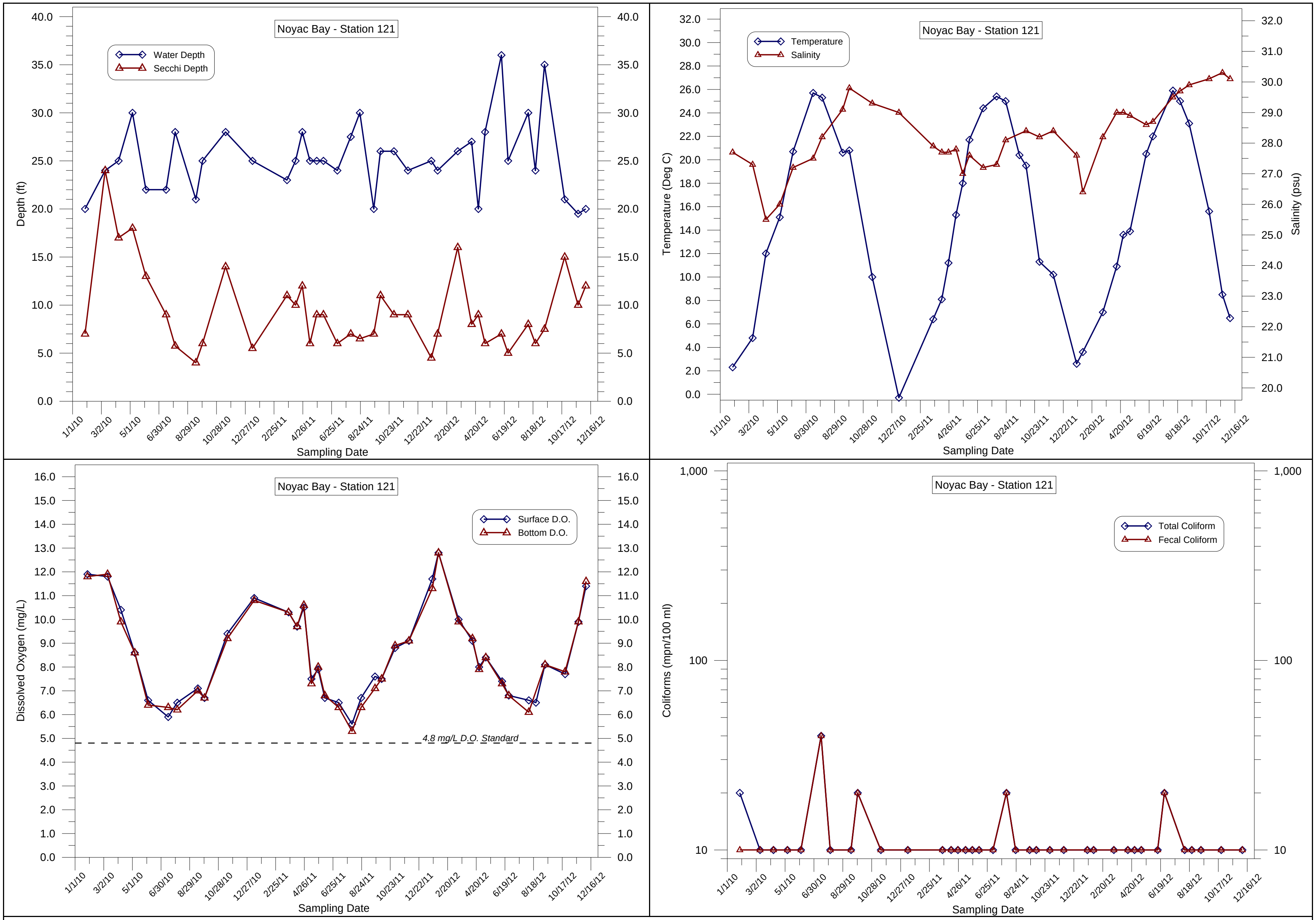
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Northwest Harbor (Station 060118), 2010-2012



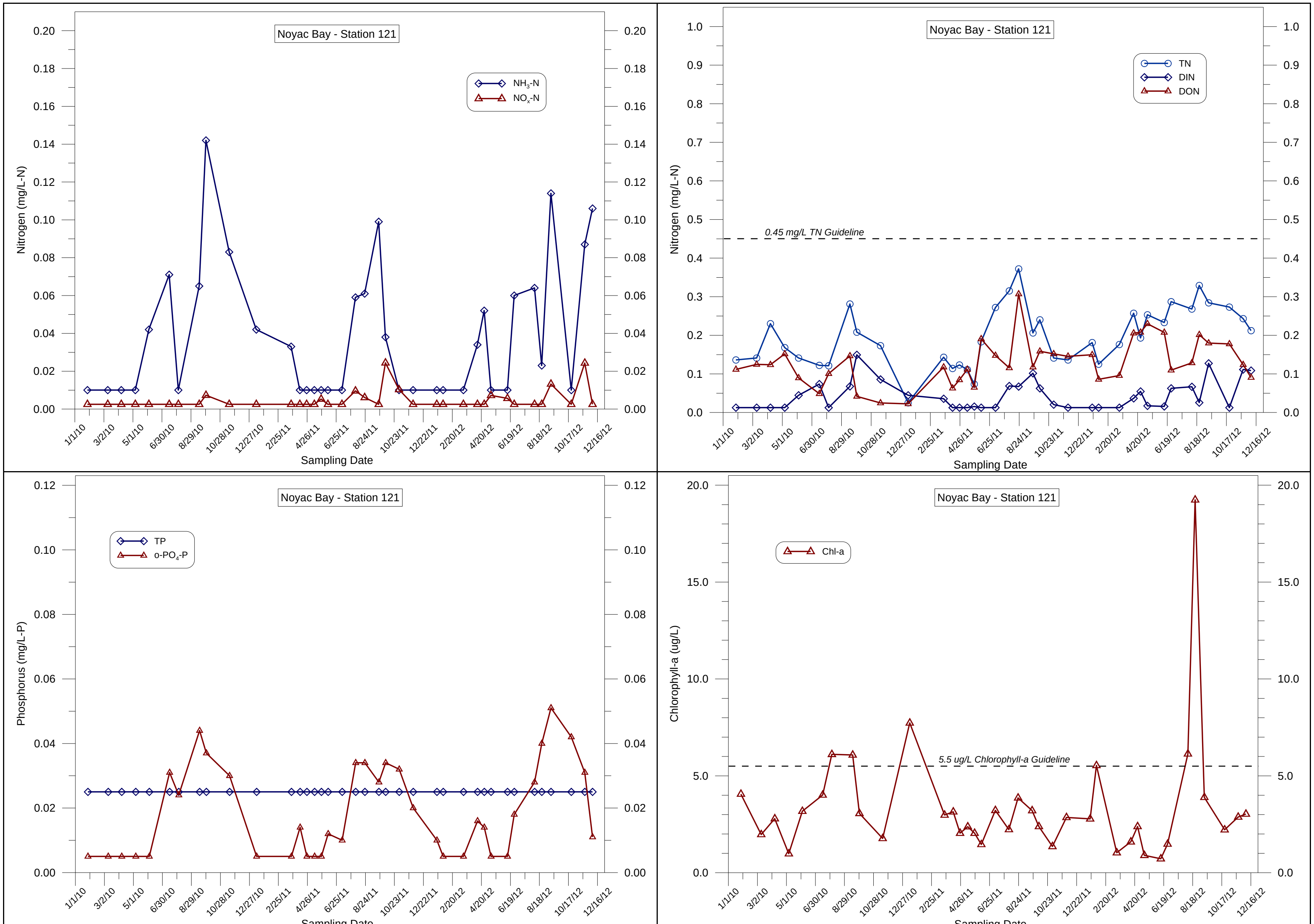
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in West Neck Bay (Station 060119), 2010-2012



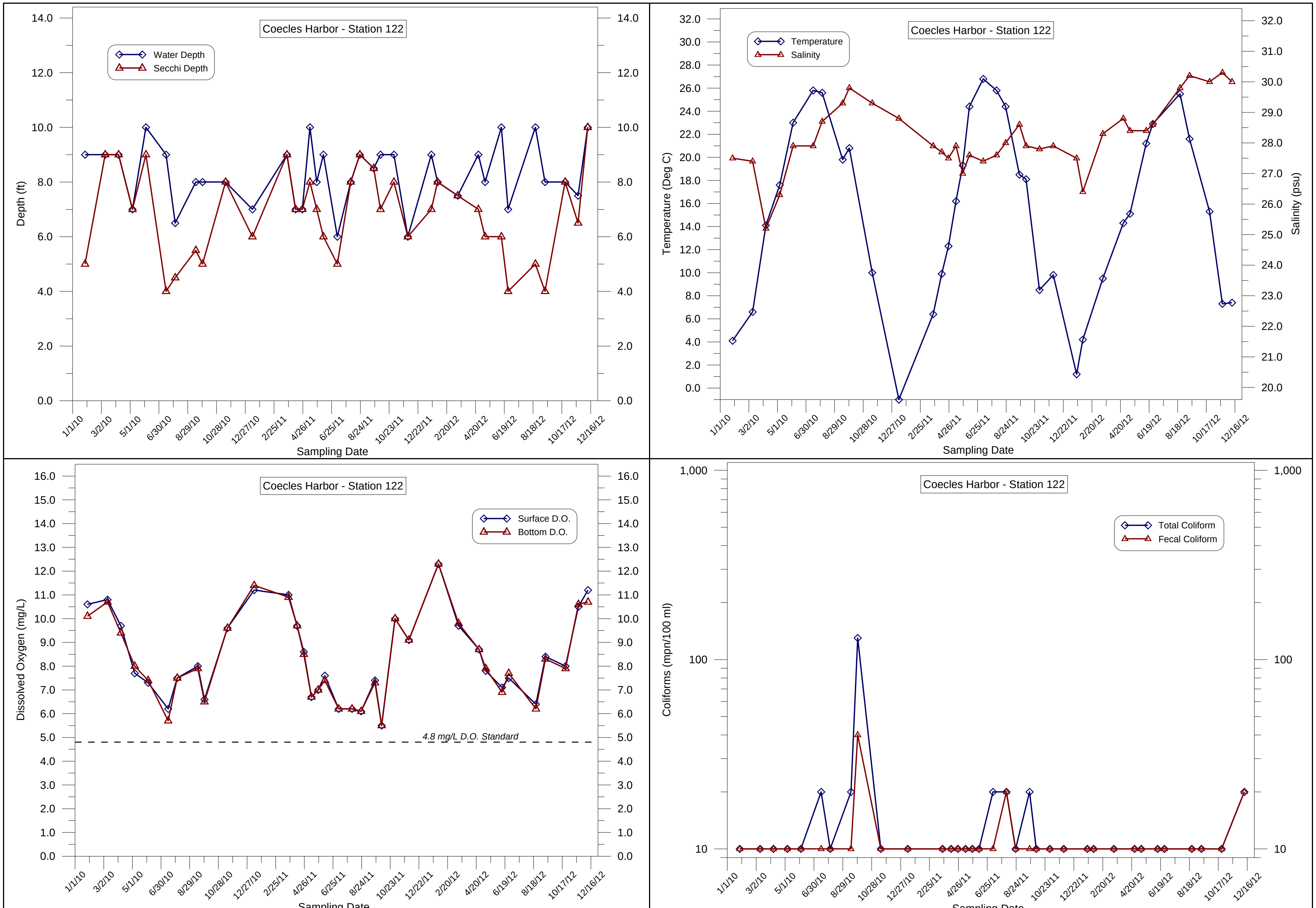
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in West Neck Bay (Station 060119), 2010-2012



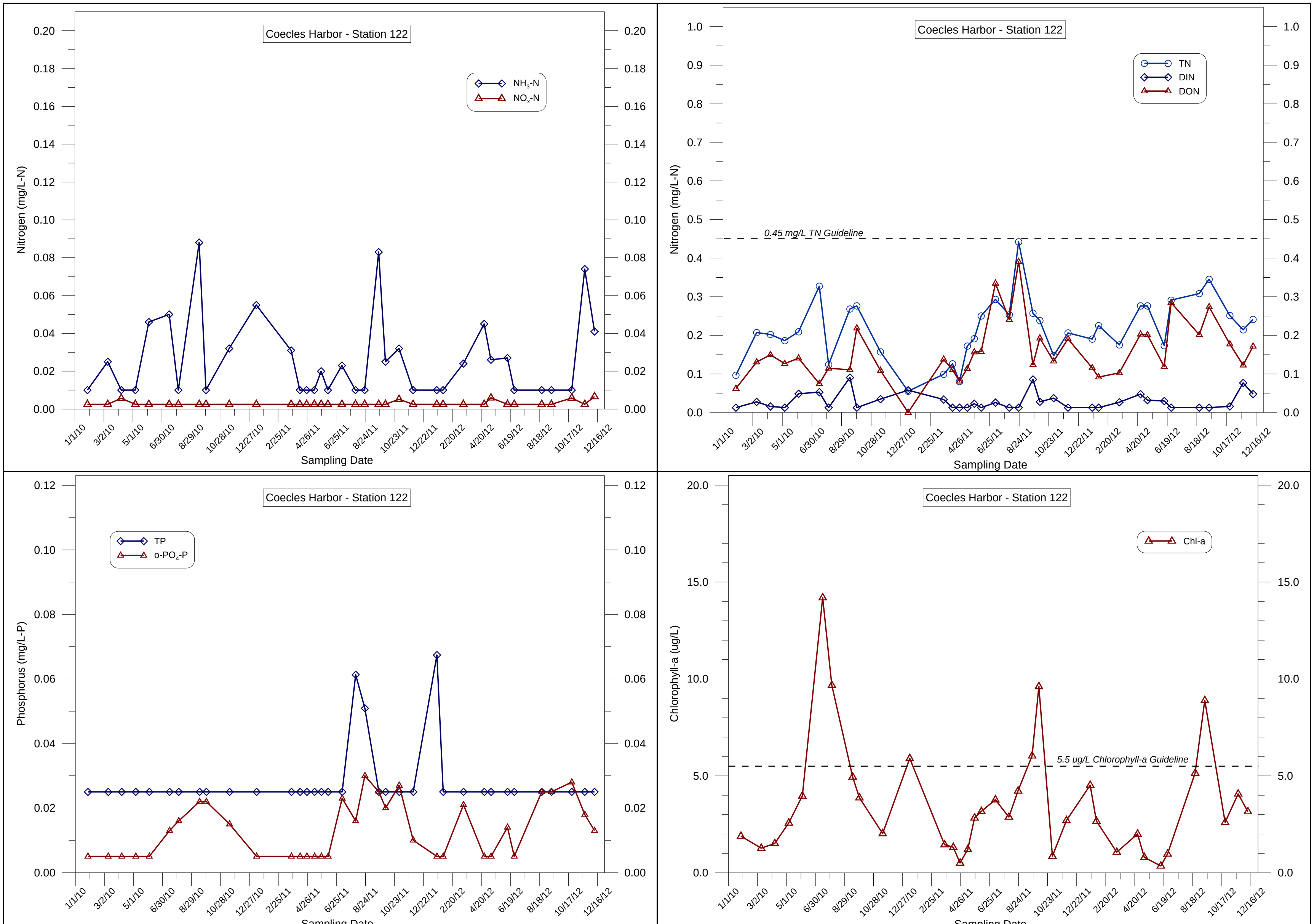
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Noyac Bay (Station 060121), 2010-2012



Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Noyac Bay (Station 060121), 2010-2012

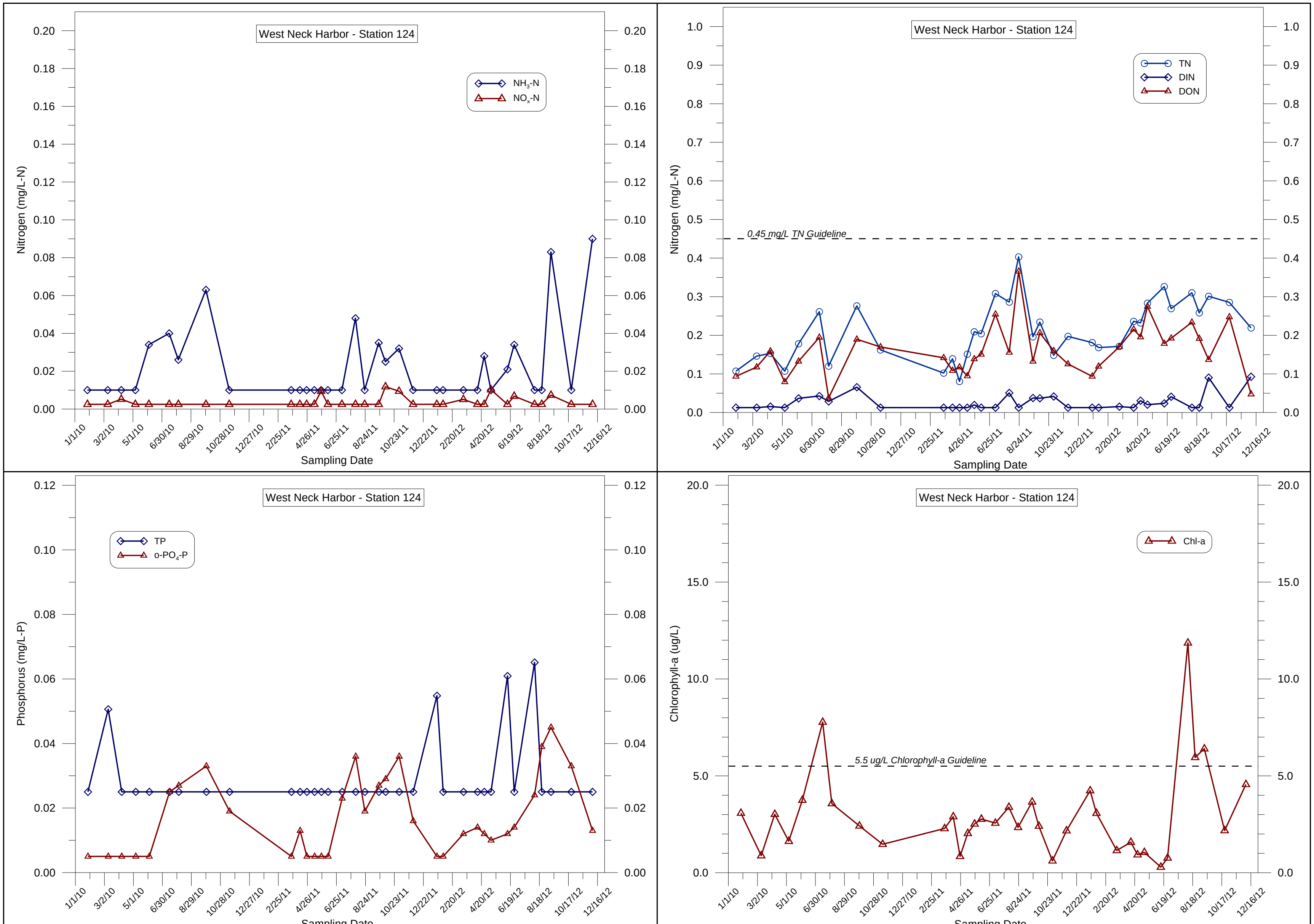


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Coecles Harbor (Station 060122), 2010-2012

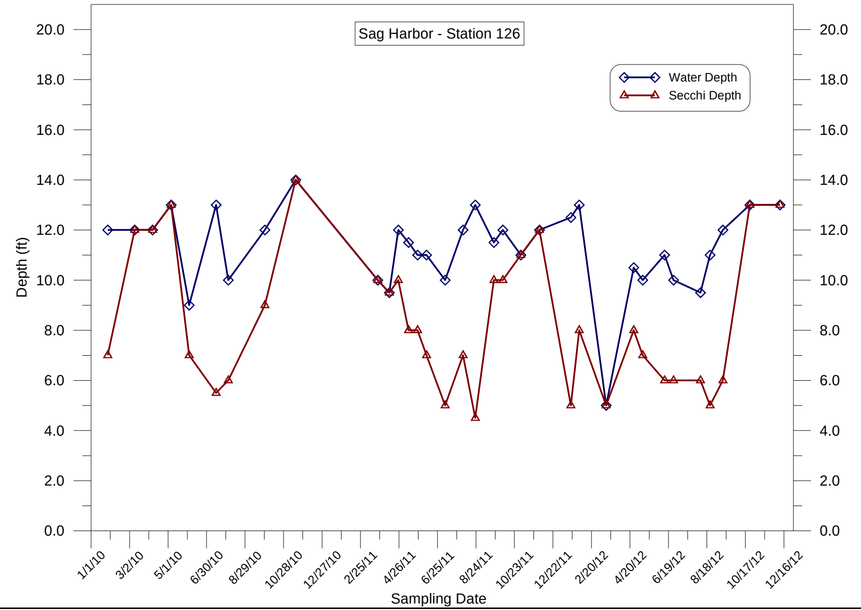


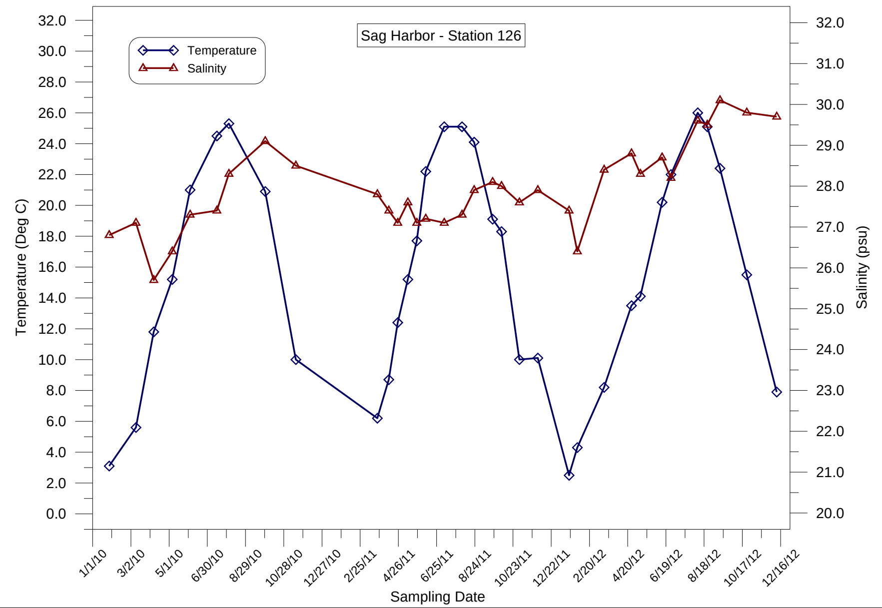
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Coecles Harbor (Station 060122), 2010-2012

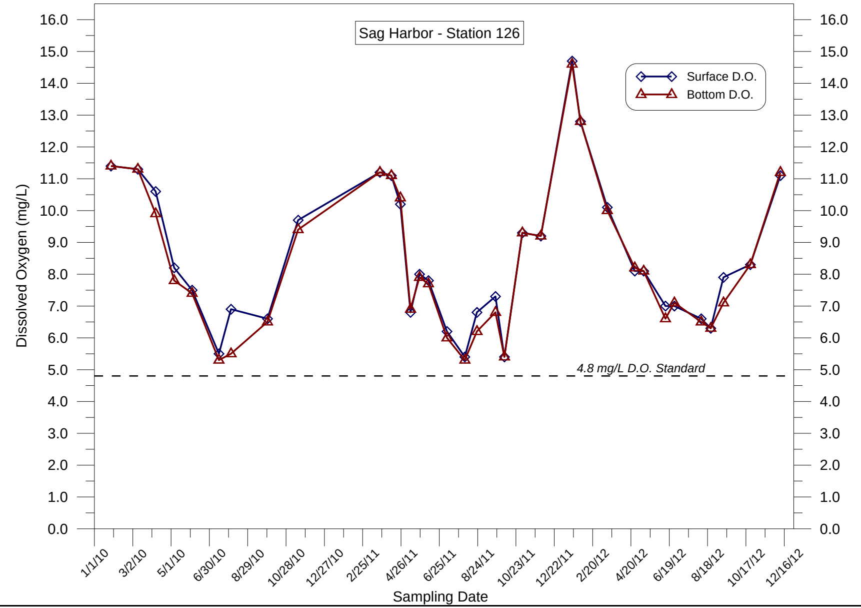
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in West Neck Harbor (Station 060124), 2010-2012

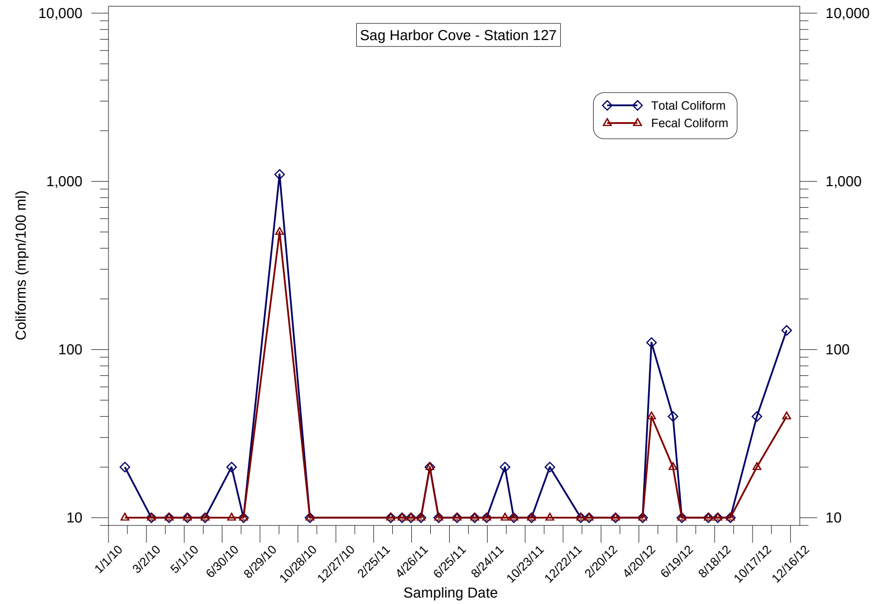


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in West Neck Harbor (Station 060124), 2010-2012

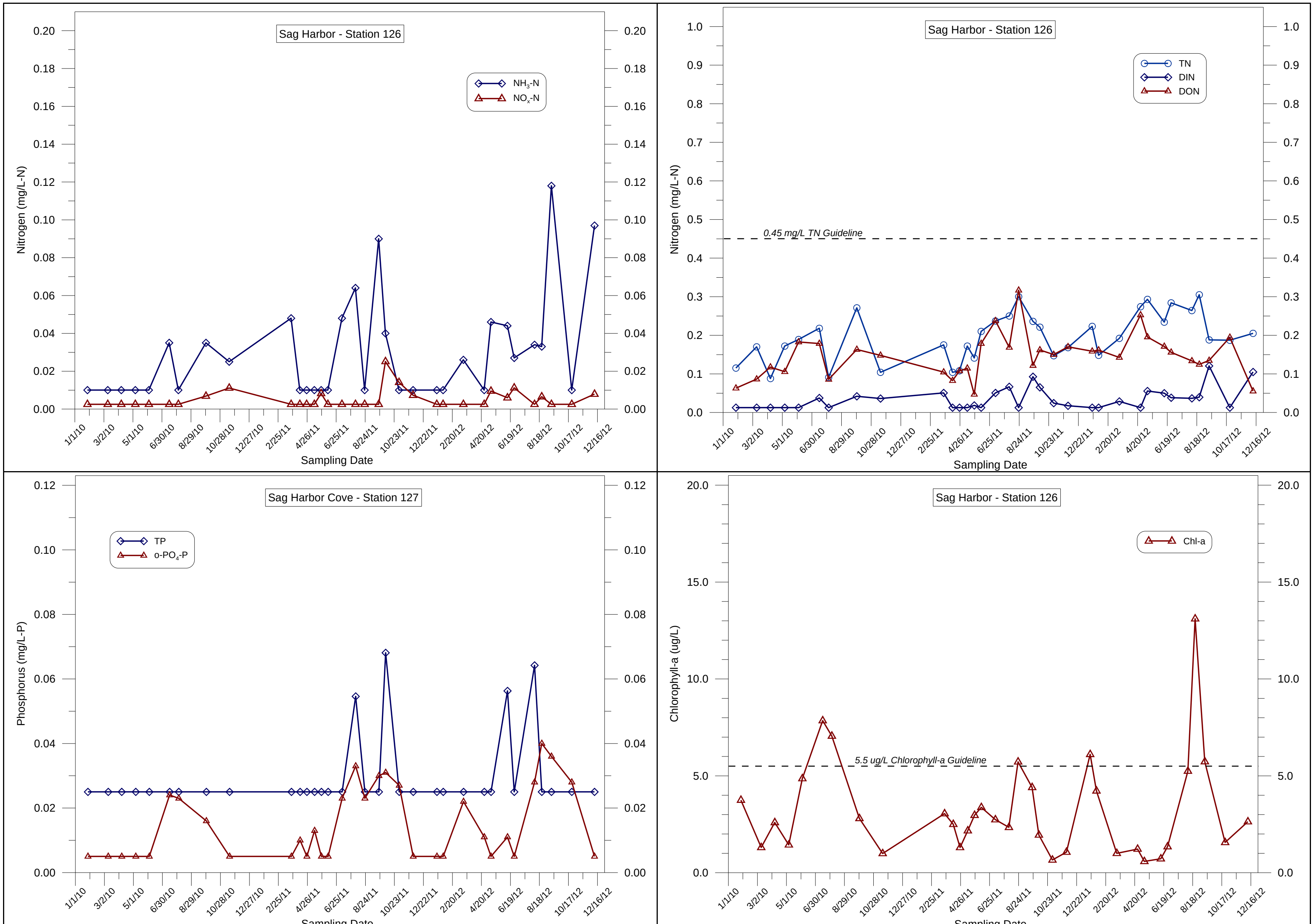




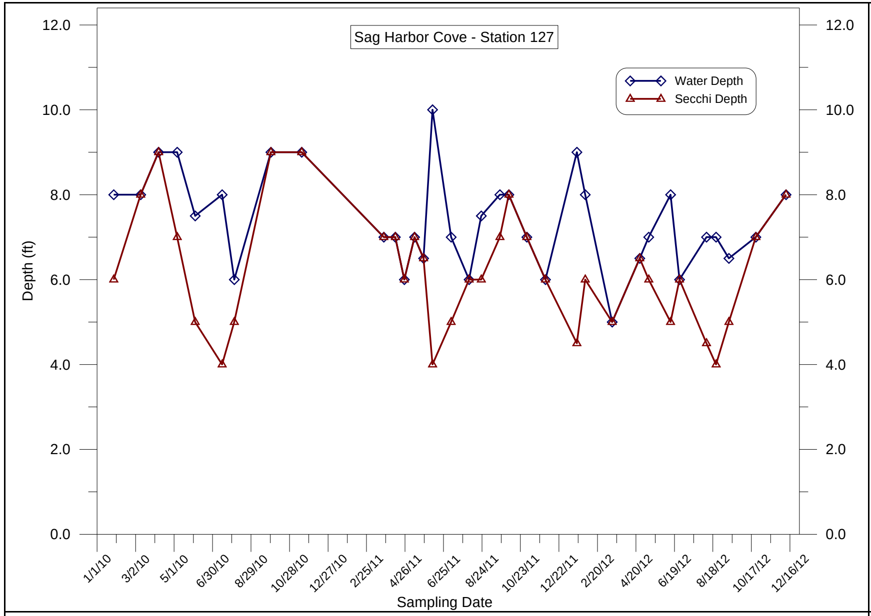


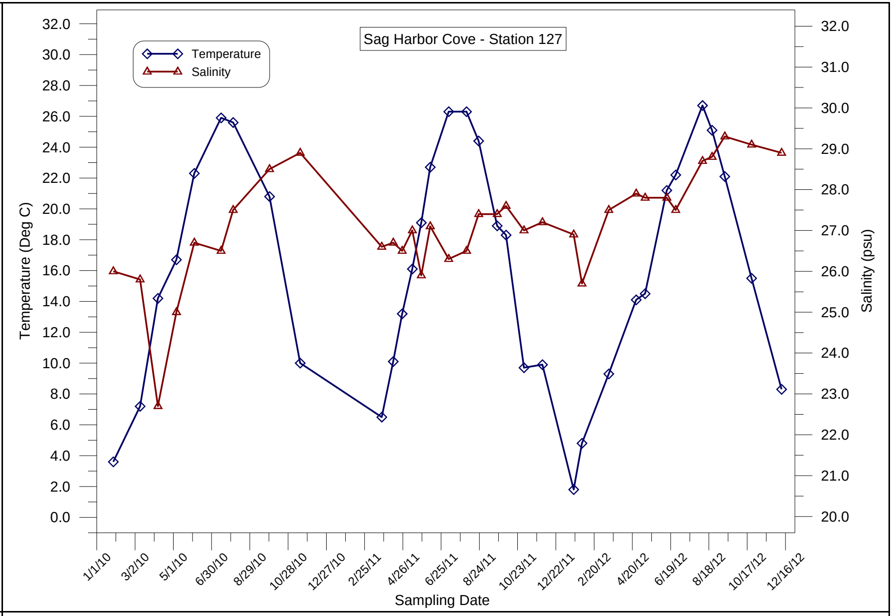


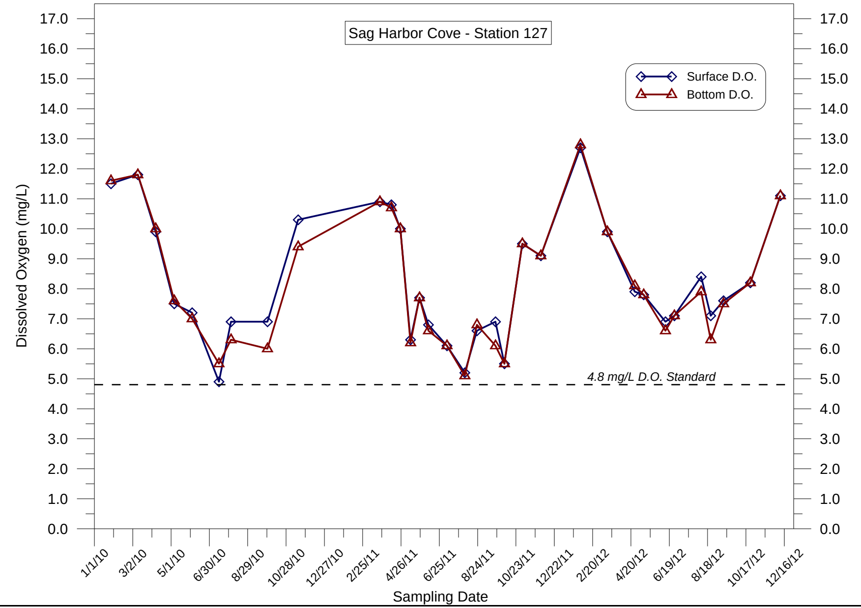
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Sag Harbor (Station 060126), 2010-2012

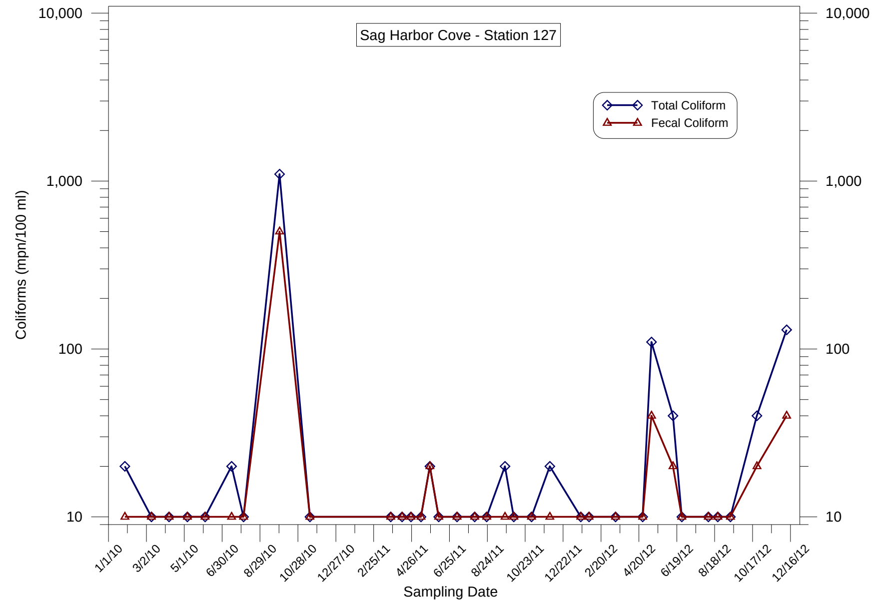


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Sag Harbor (Station 060126), 2010-2012

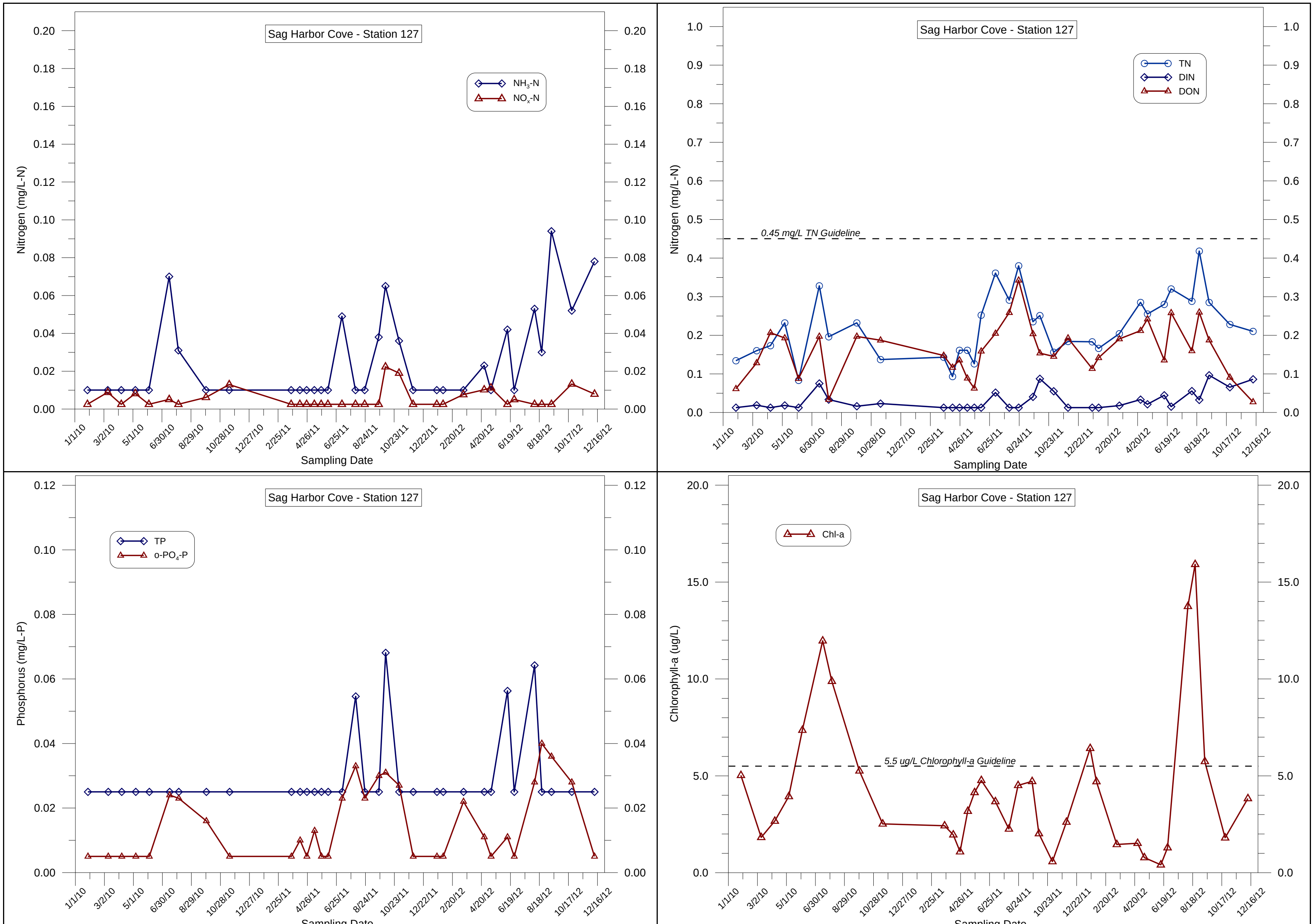




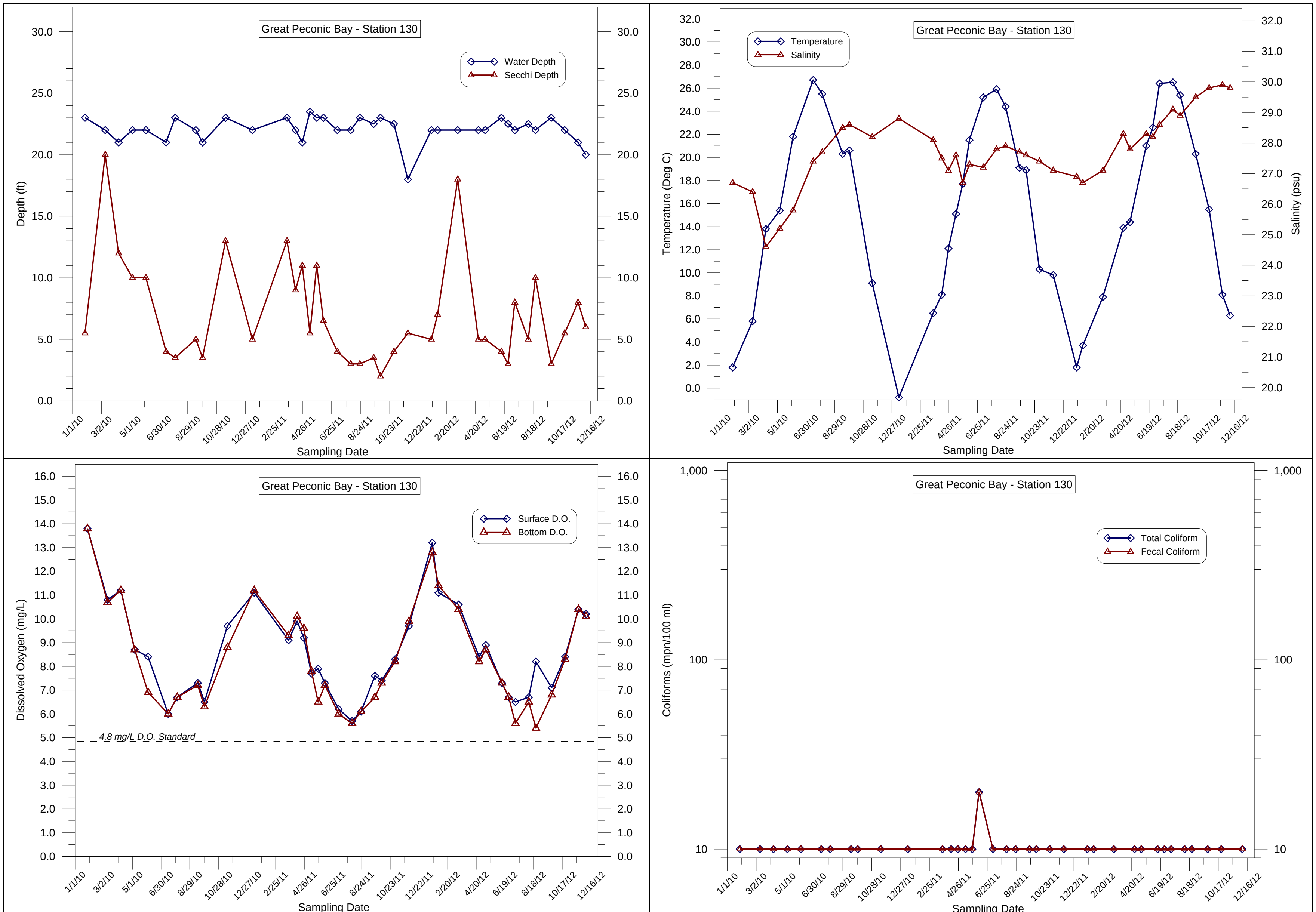




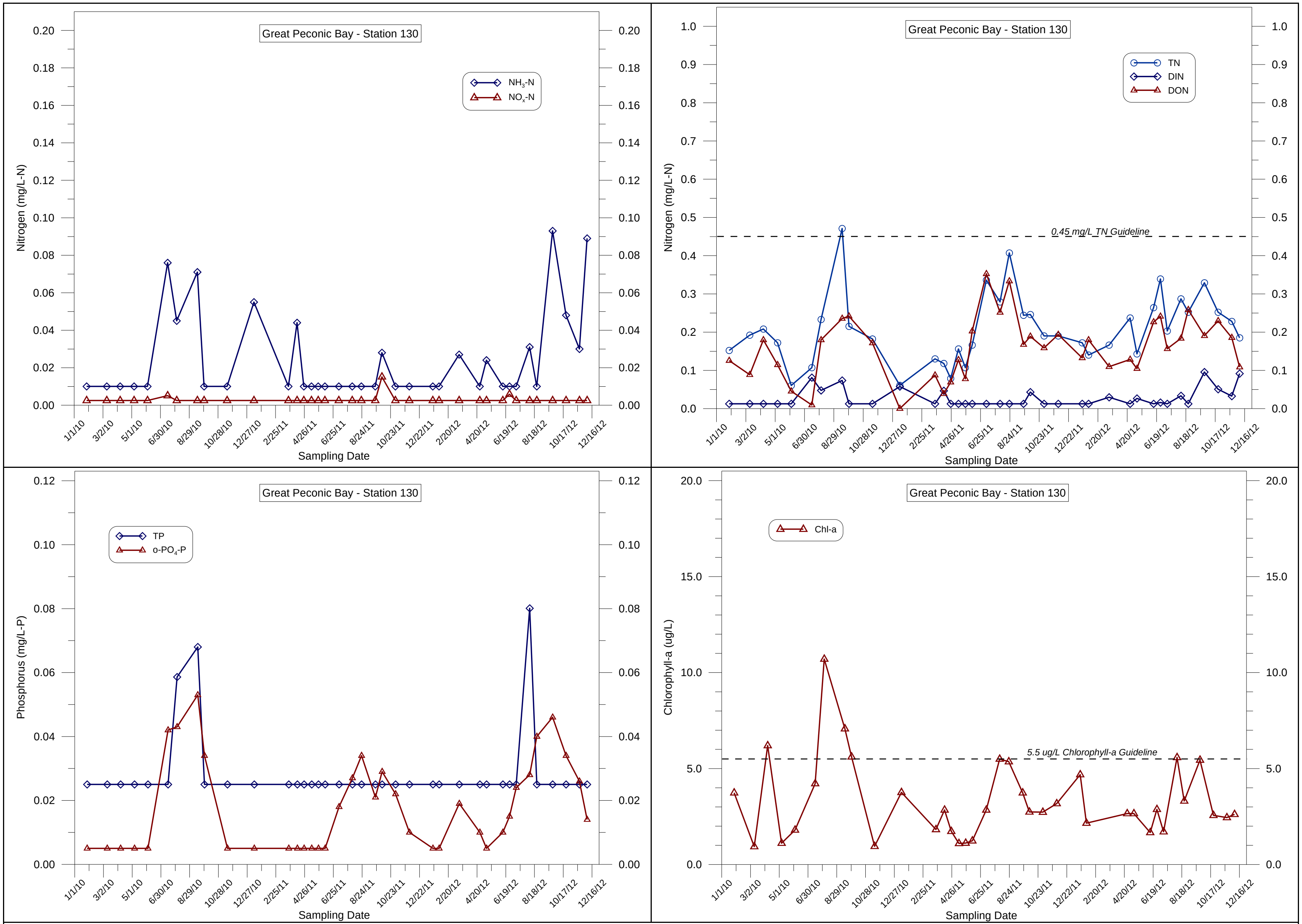
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Sag Harbor Cove (Station 060127), 2010-2012



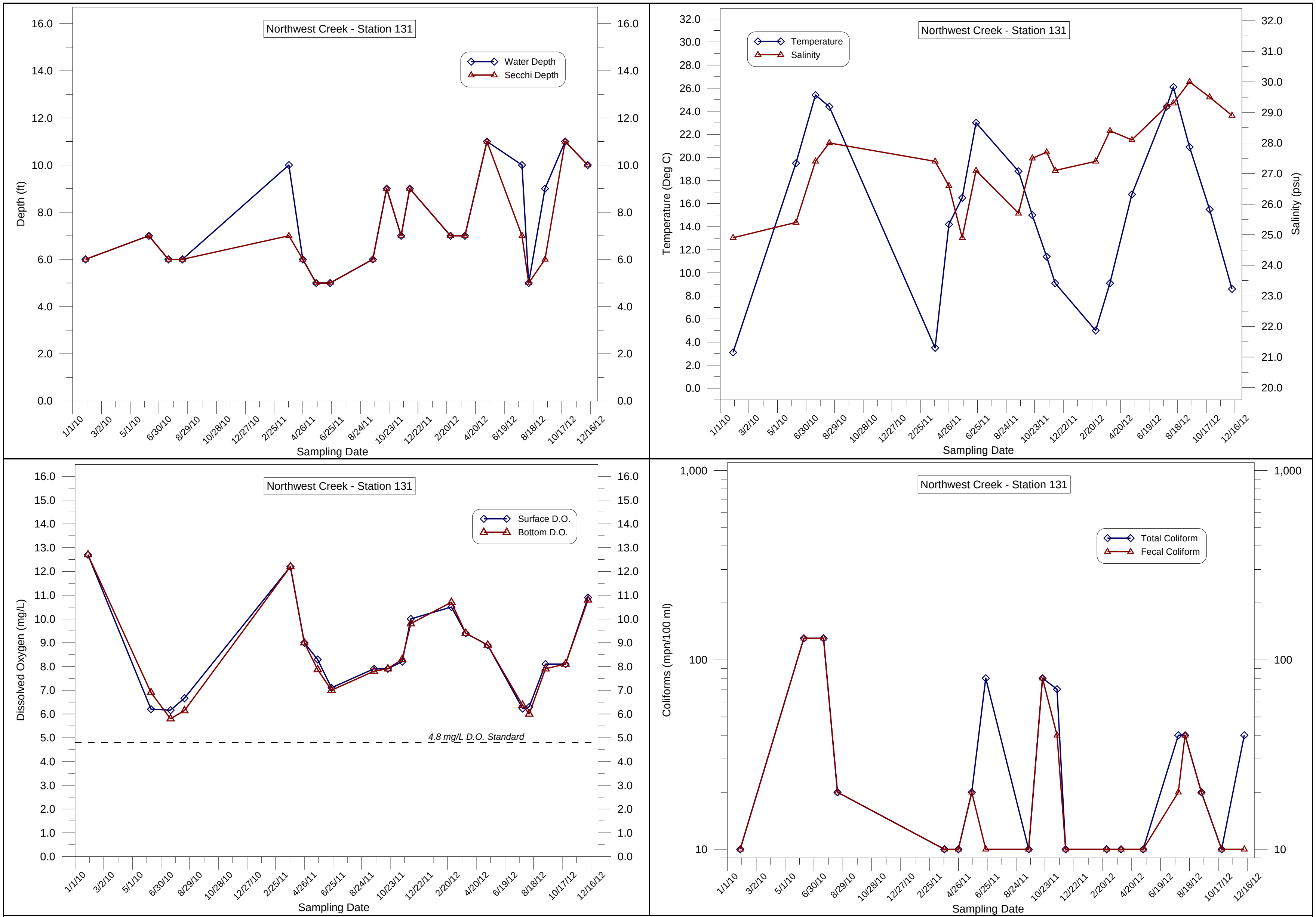
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Sag Harbor Cove (Station 060127), 2010-2012



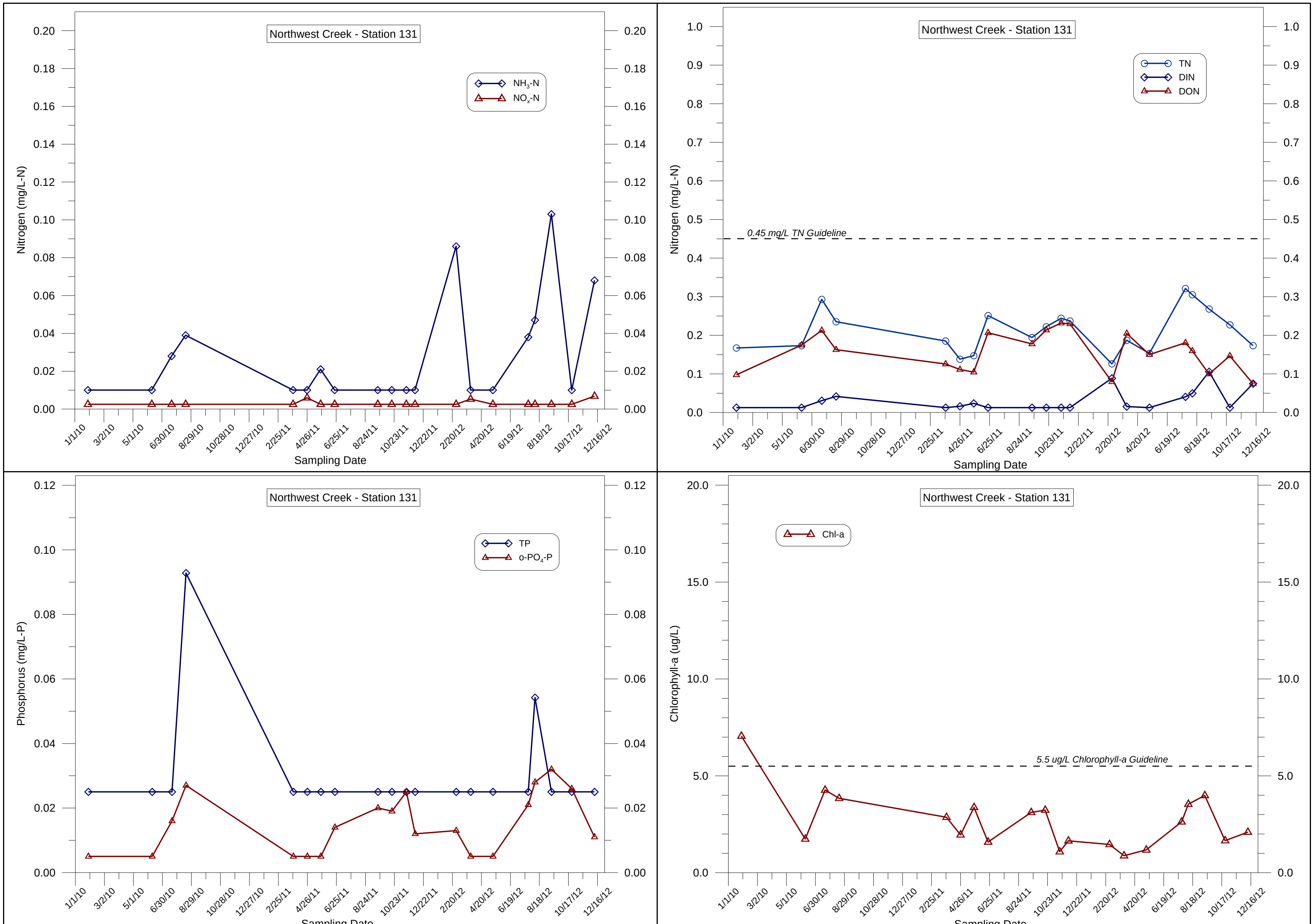
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Great Peconic Bay (Station 060130), 2010-2012



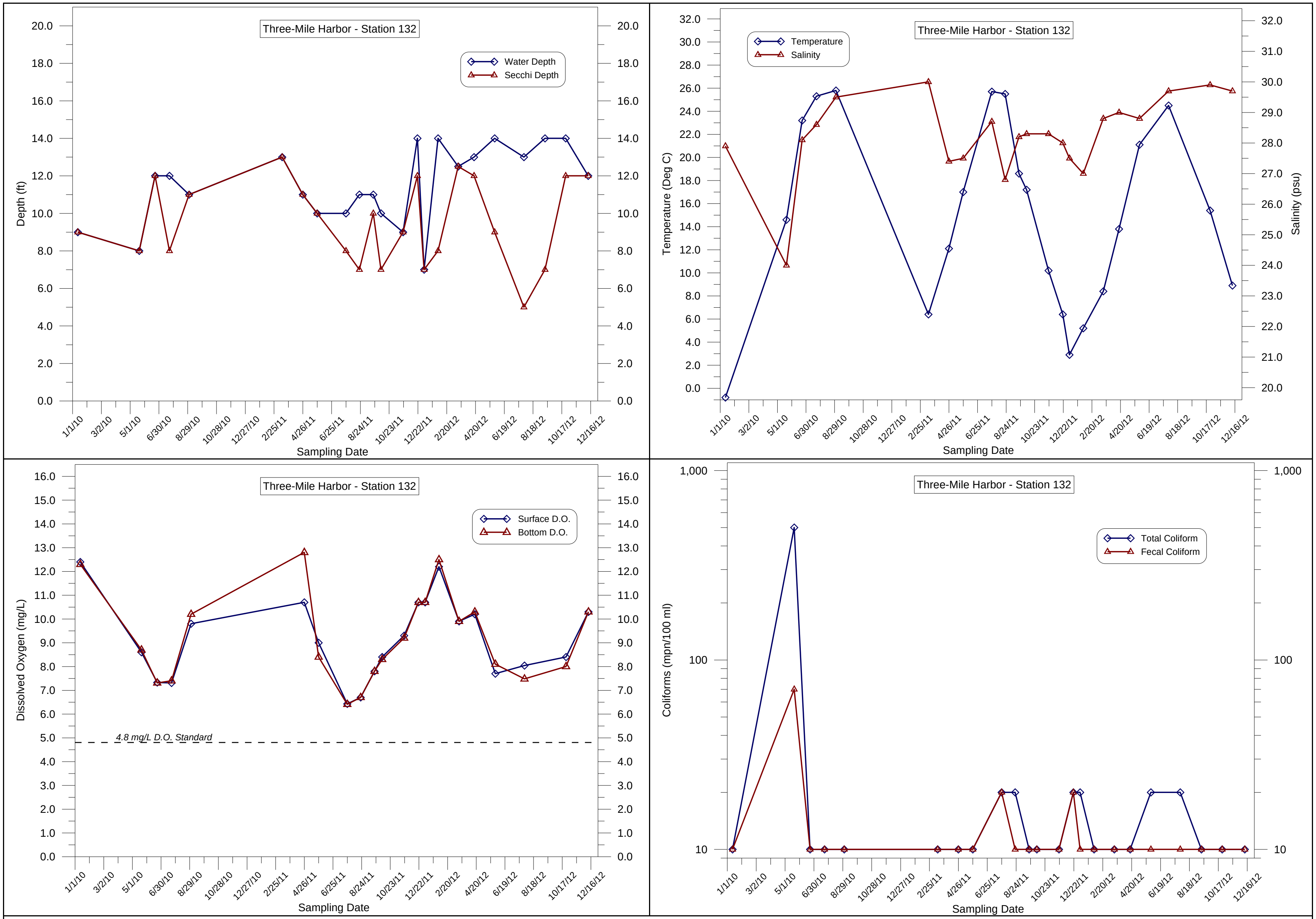
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Great Peconic Bay (Station 060130), 2010-2012



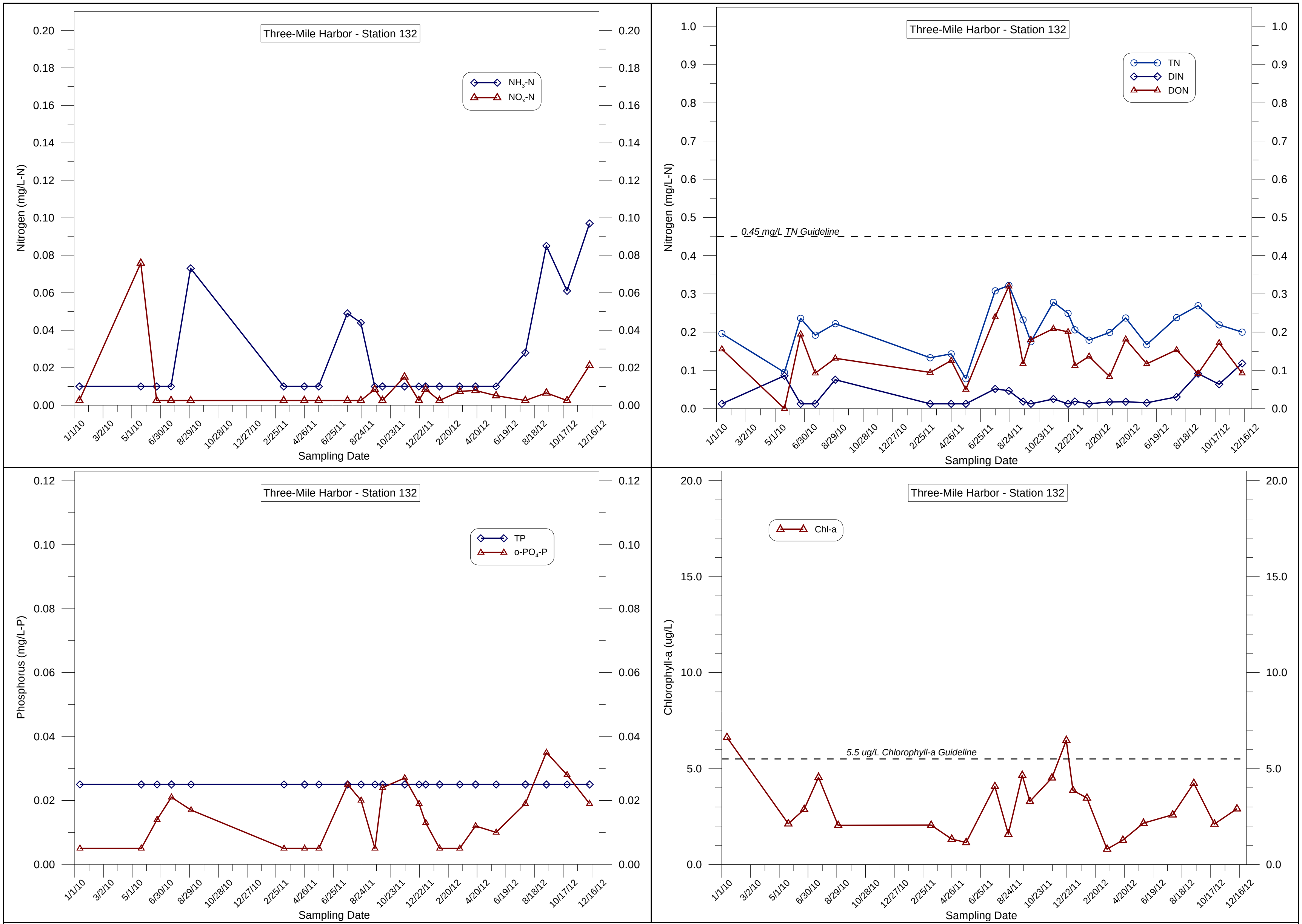
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Northwest Creek (Station 060131), 2010-2012



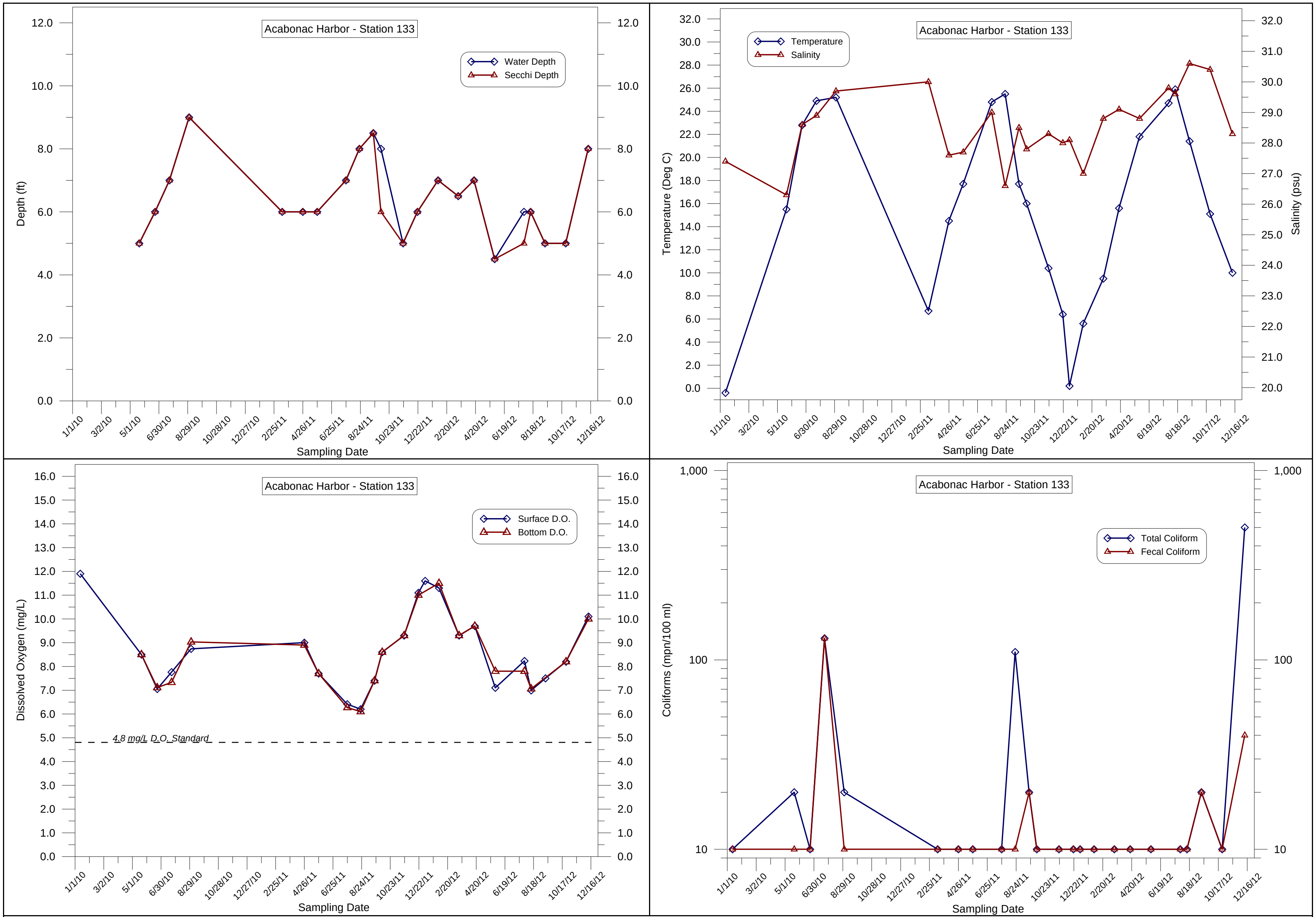
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Northwest Creek (Station 060131), 2010-2012



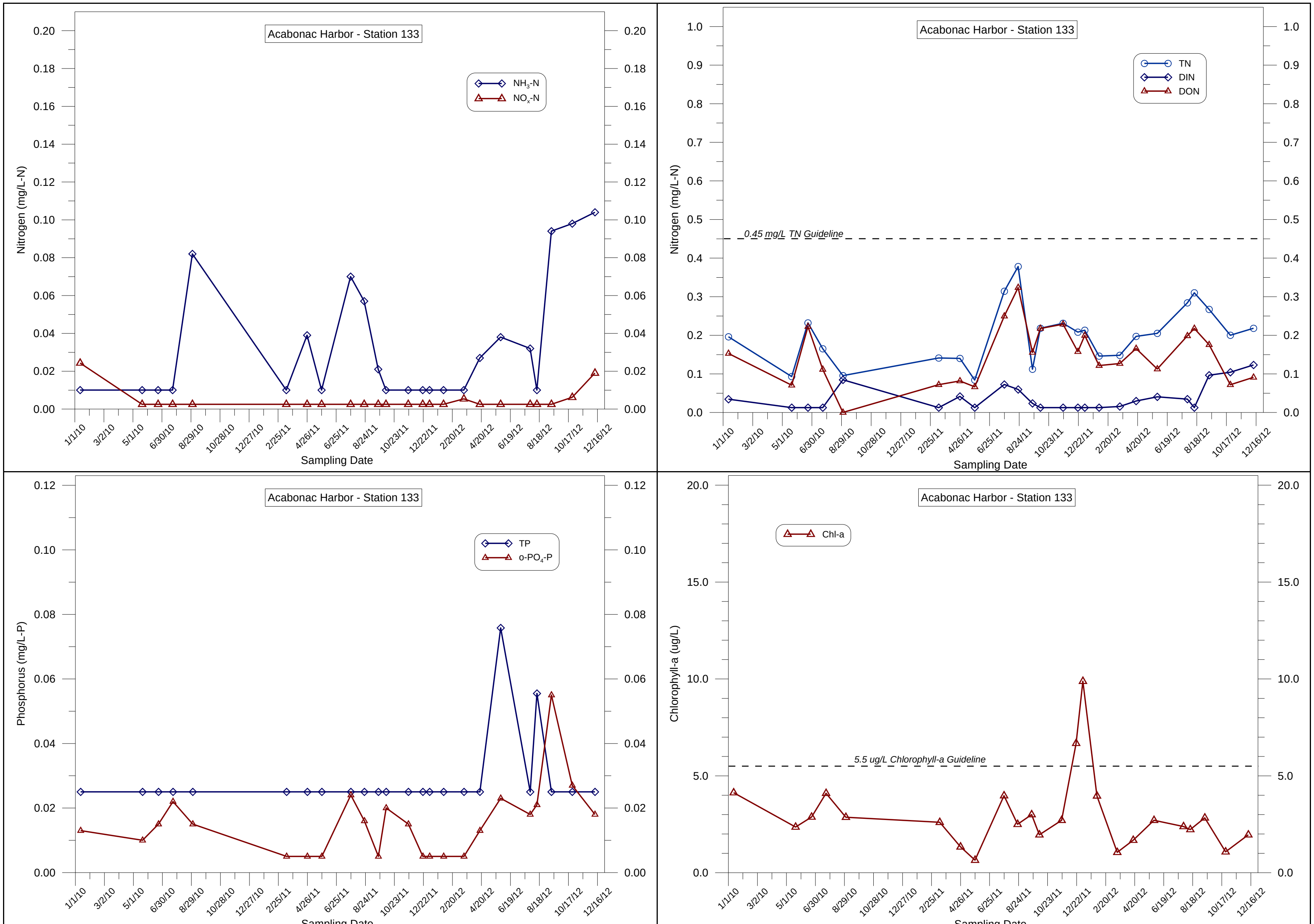
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Three-Mile Harbor (Station 060132), 2010-2012



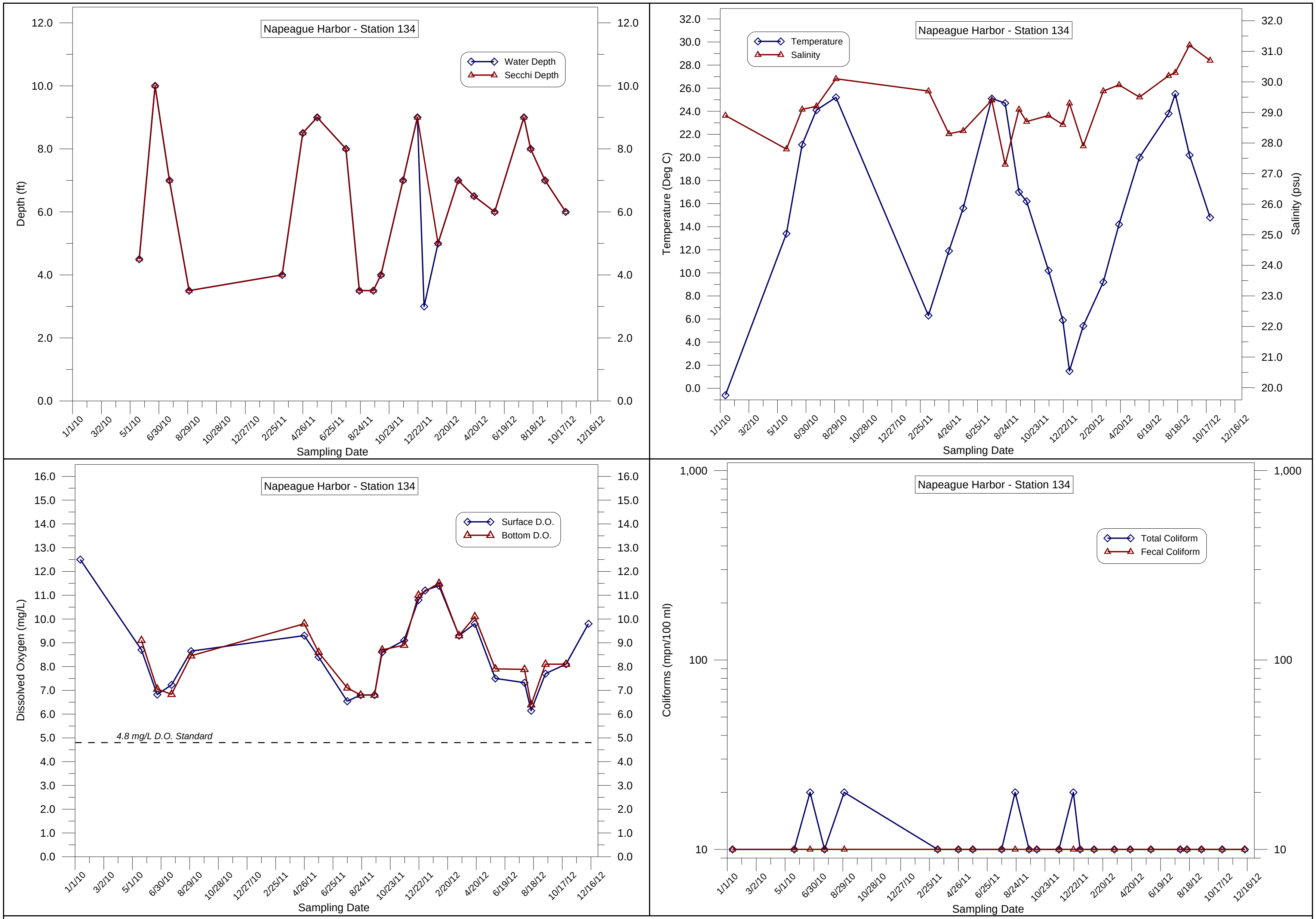
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Three-Mile Harbor (Station 060132), 2010-2012



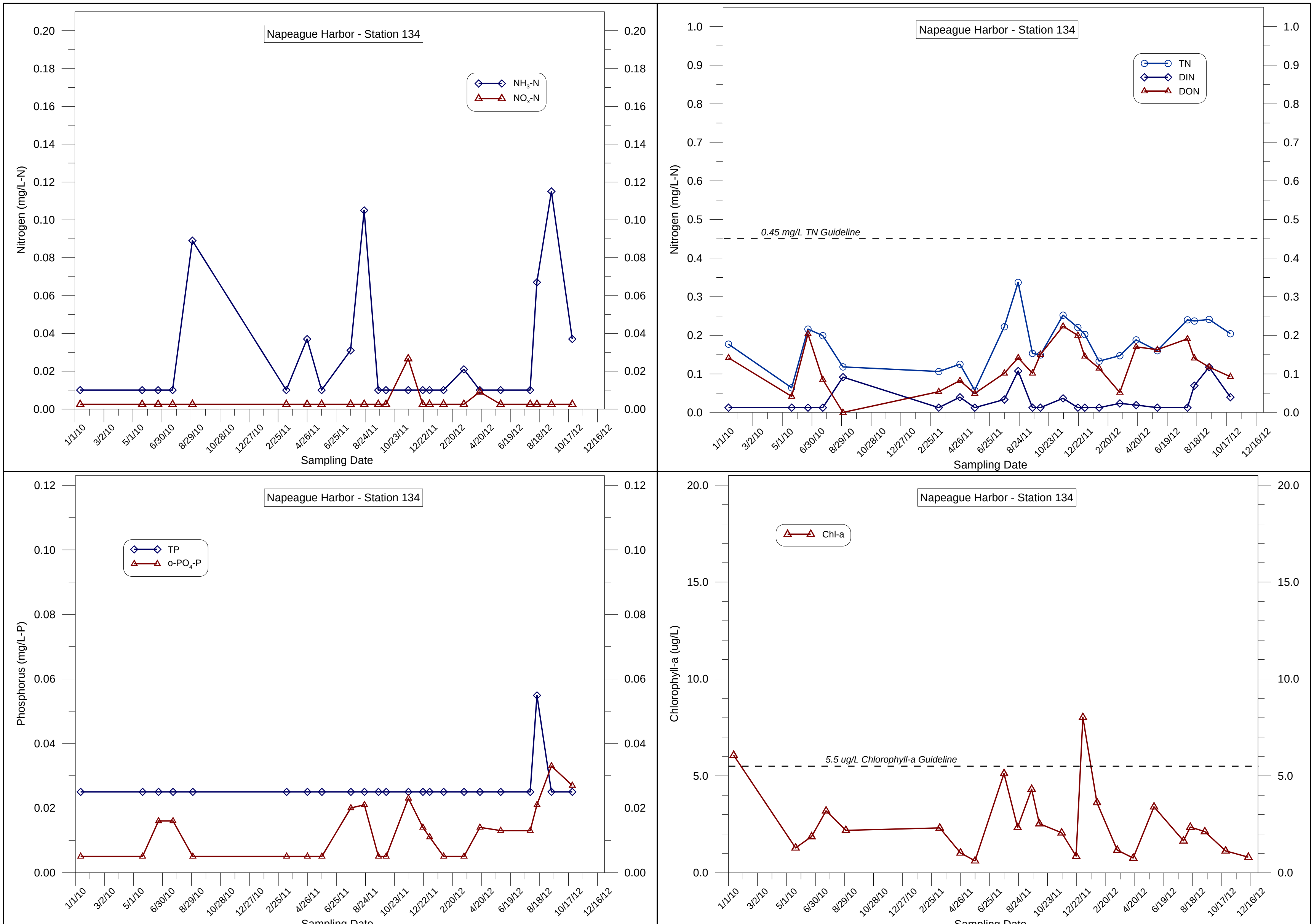
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Acabonac Harbor (Station 060133), 2010-2012



Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Acabonac Harbor (Station 060133), 2010-2012

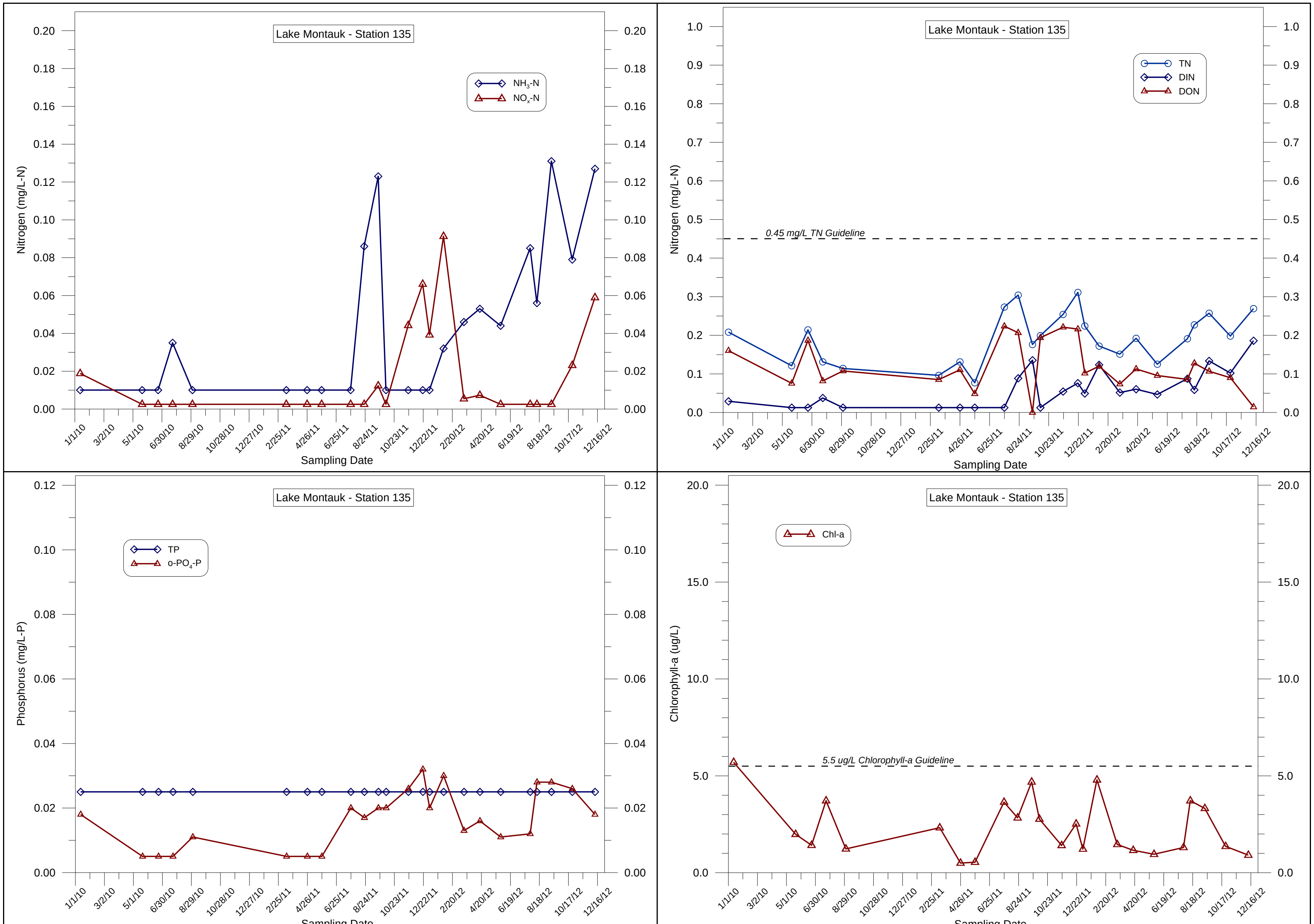


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Napeague Harbor (Station 060134), 2010-2012



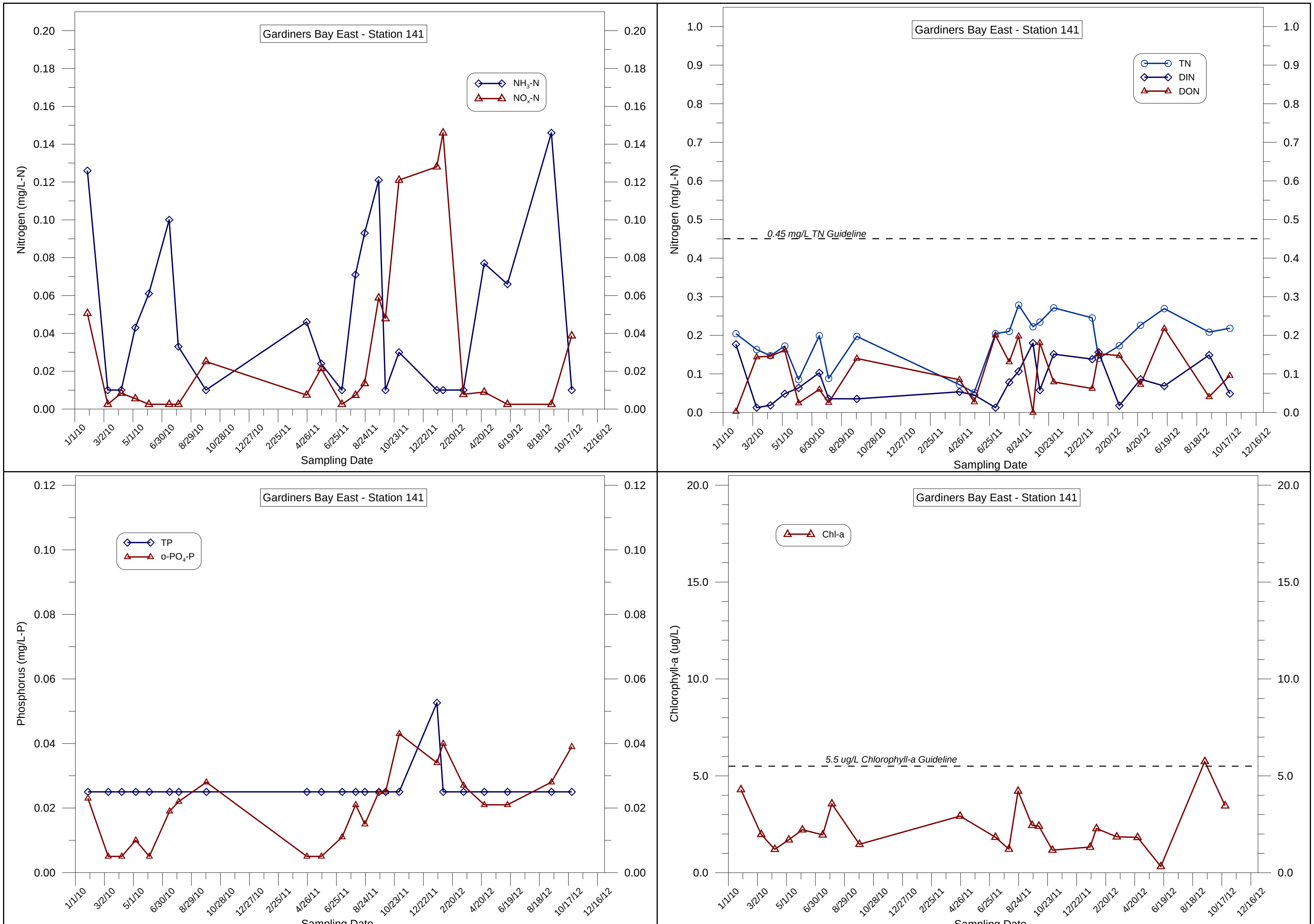
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Napeague Harbor (Station 060134), 2010-2012

Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Lake Montauk (Station 060135), 2010-2012

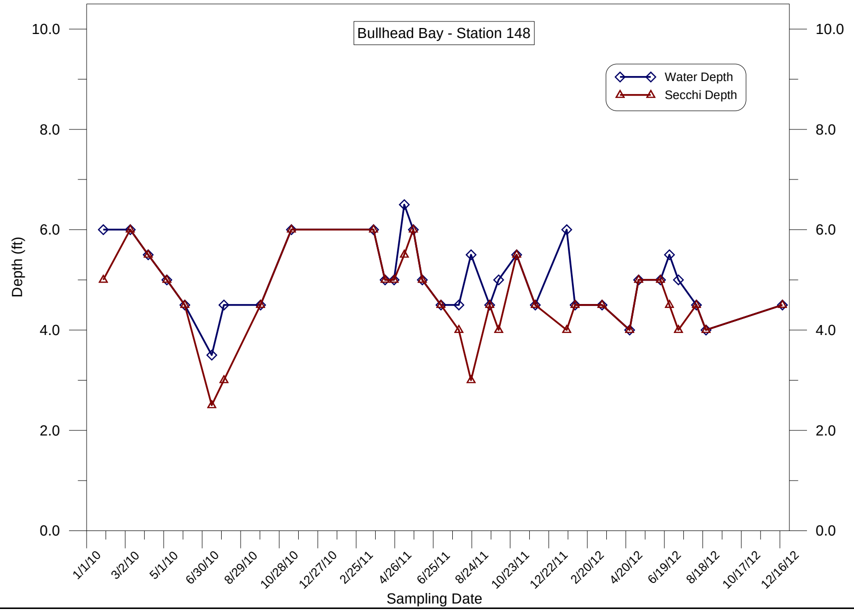


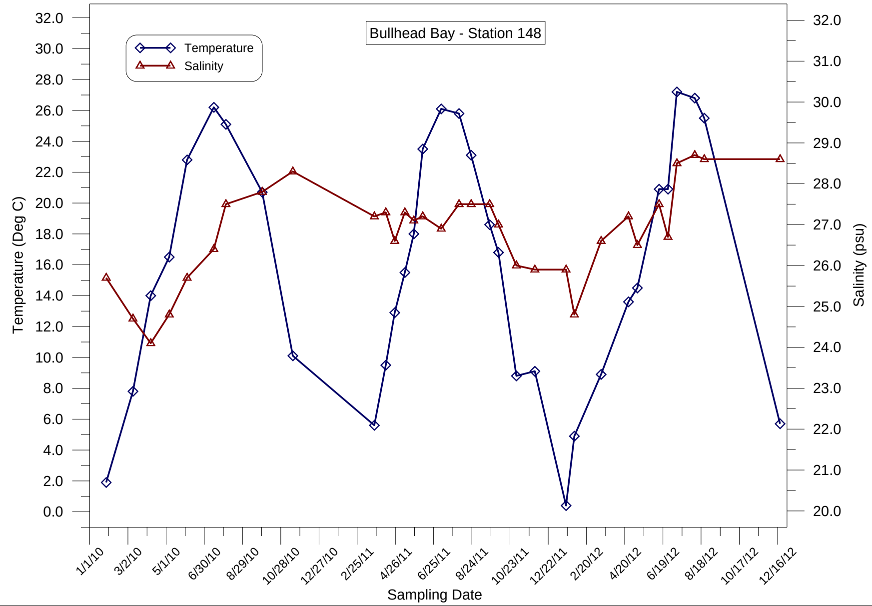
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Lake Montauk (Station 060135), 2010-2012

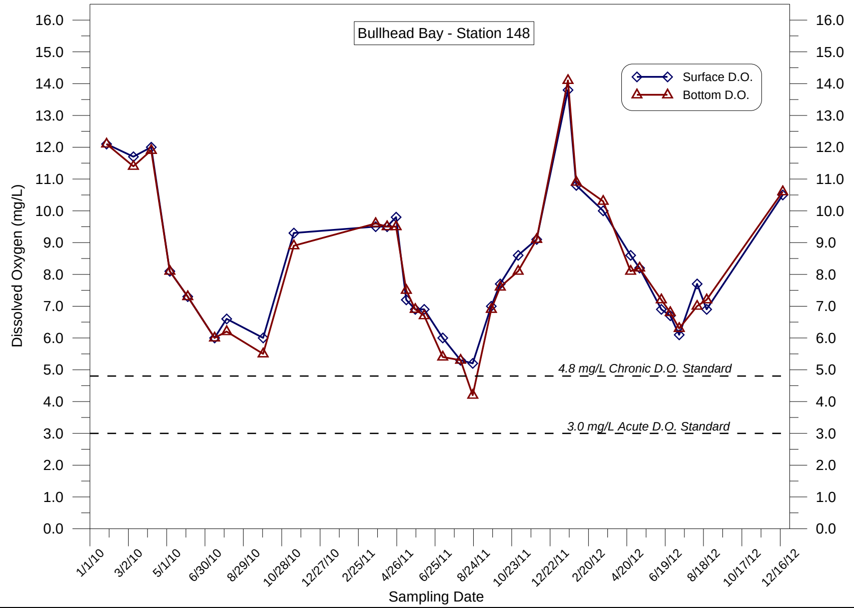
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Eastern Gardiners Bay (Station 060141), 2010-2012

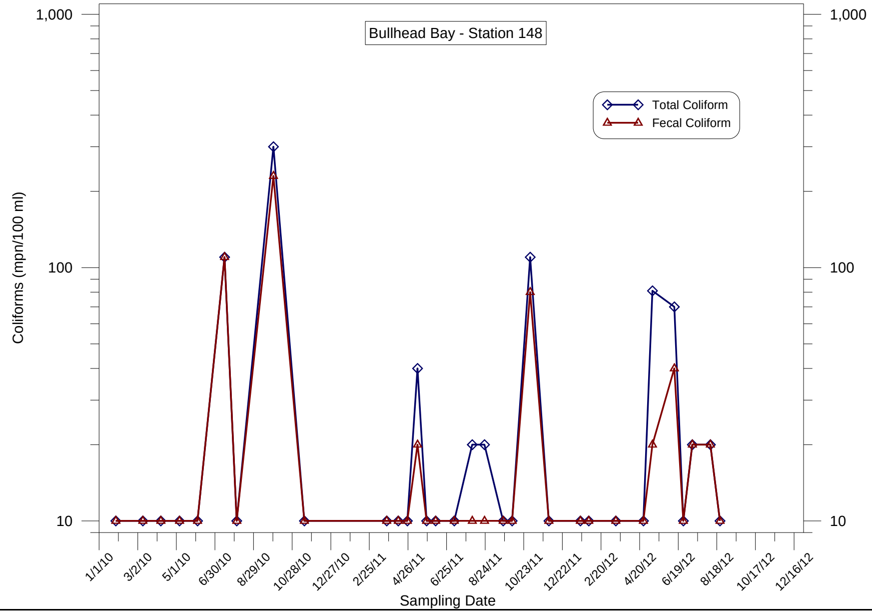


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Eastern Gardiners Bay (Station 060141), 2010-2012

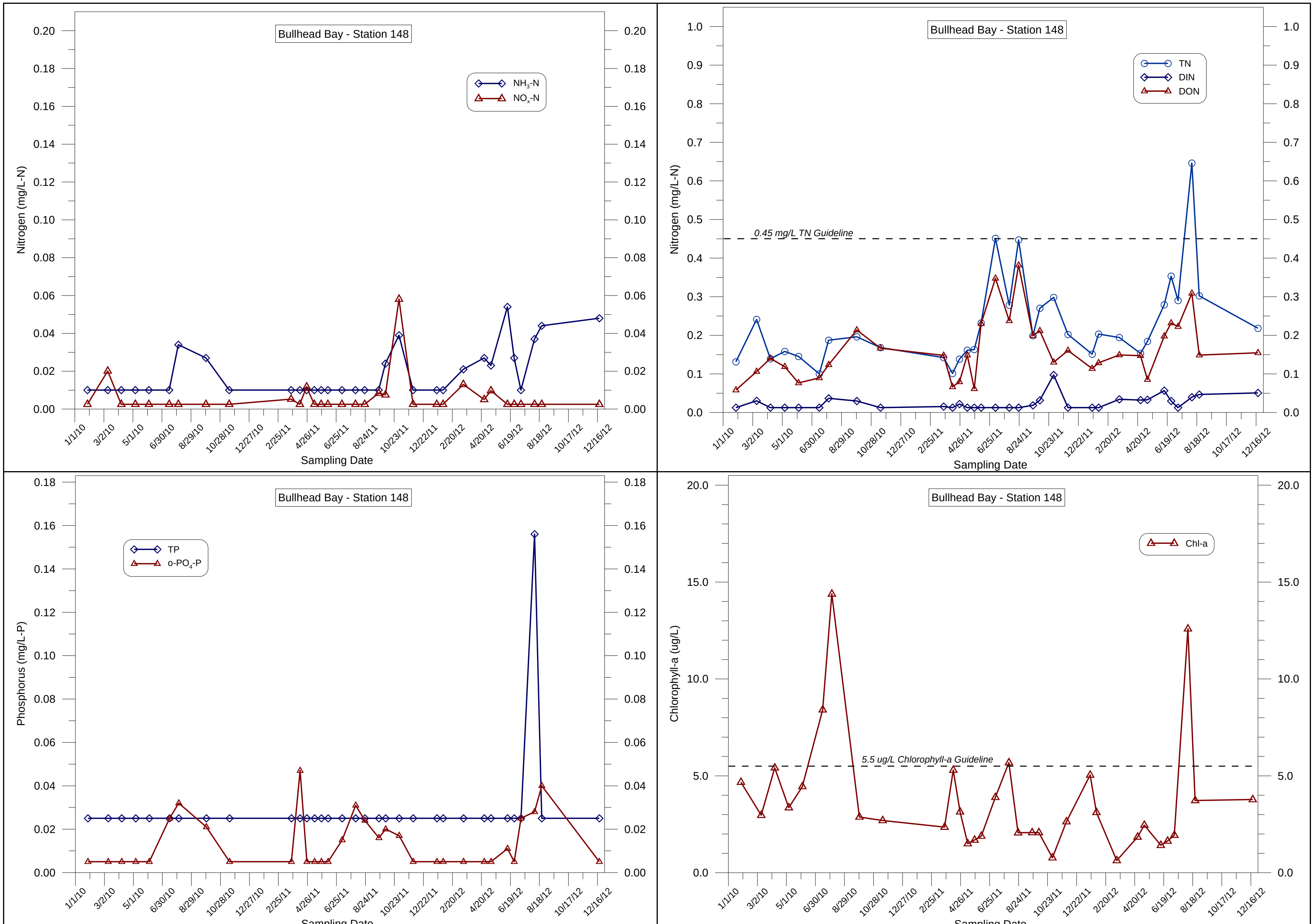






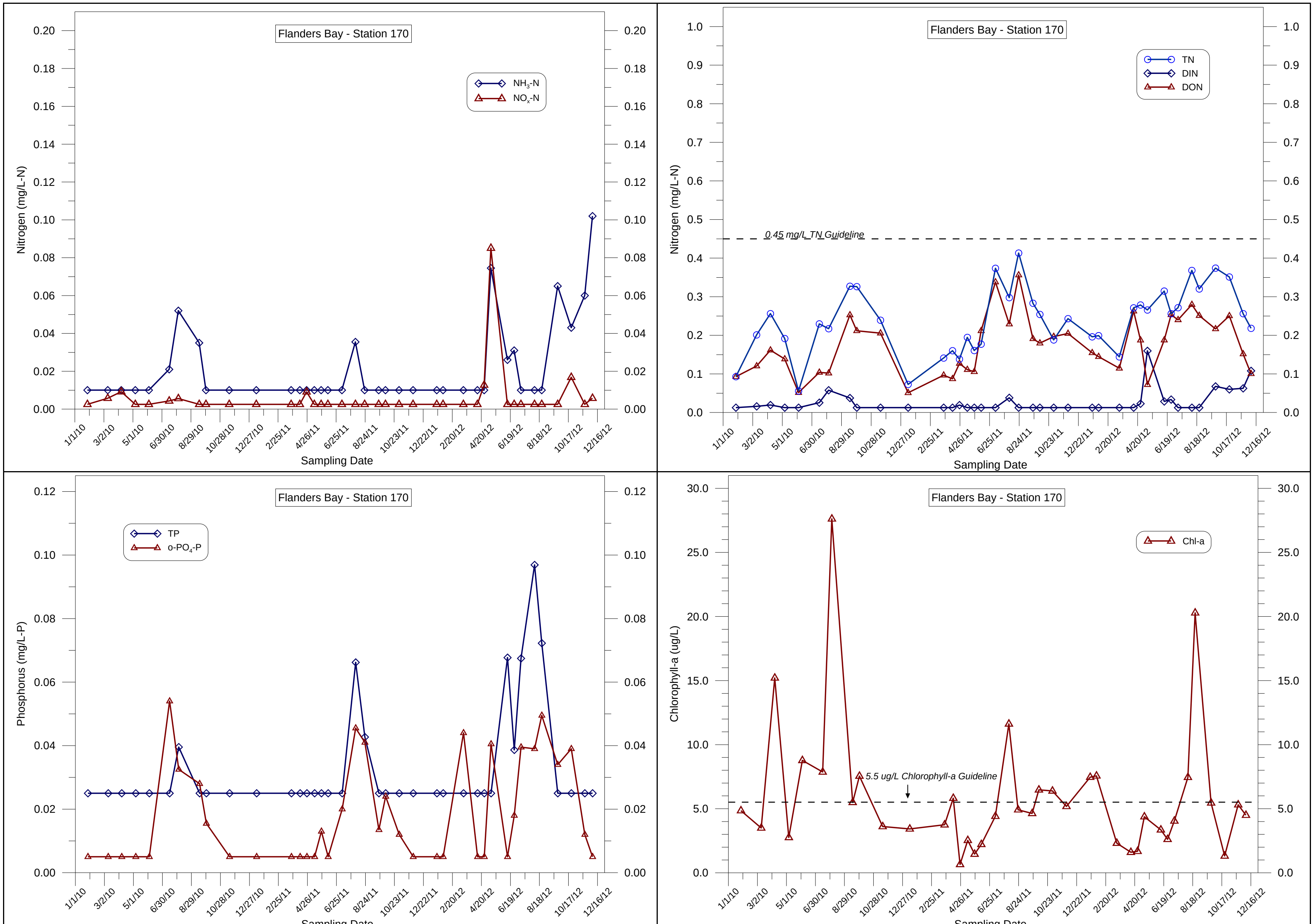


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Bullhead Bay (Station 060148), 2010-2012

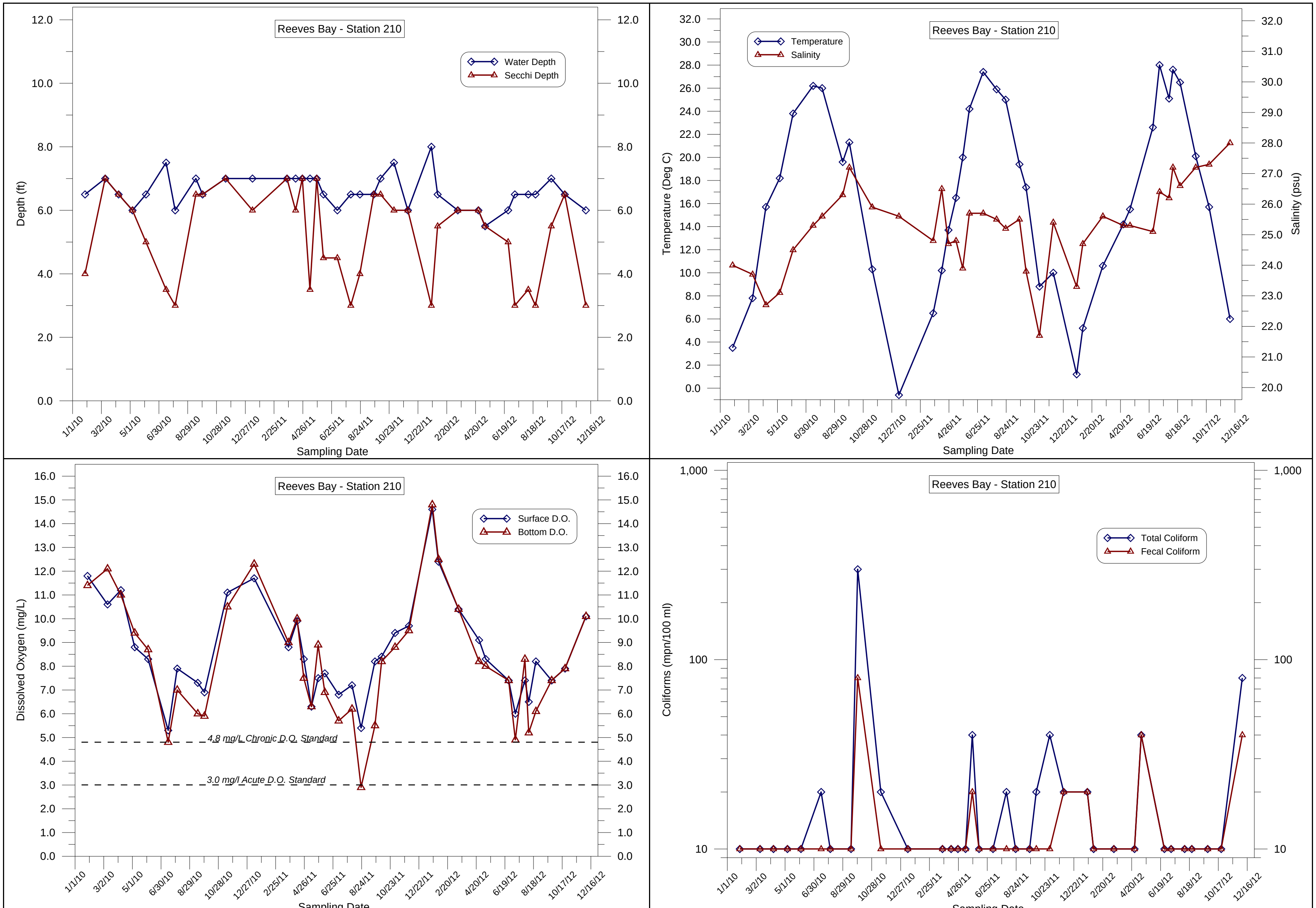


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Bullhead Bay (Station 060148), 2010-2012

Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Flanders Bay (Station 060170), 2010-2012

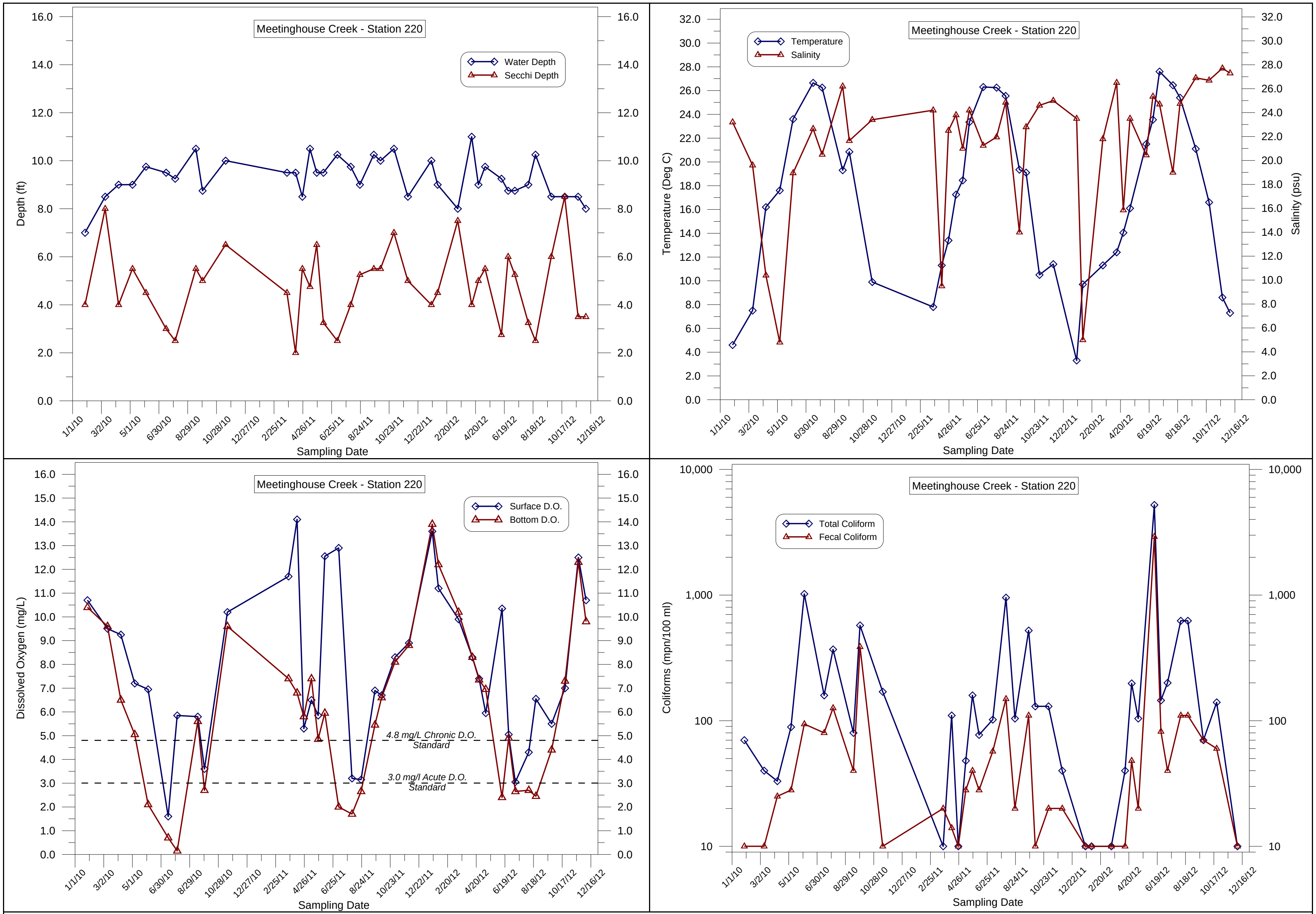


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Flanders Bay (Station 060170), 2010-2012

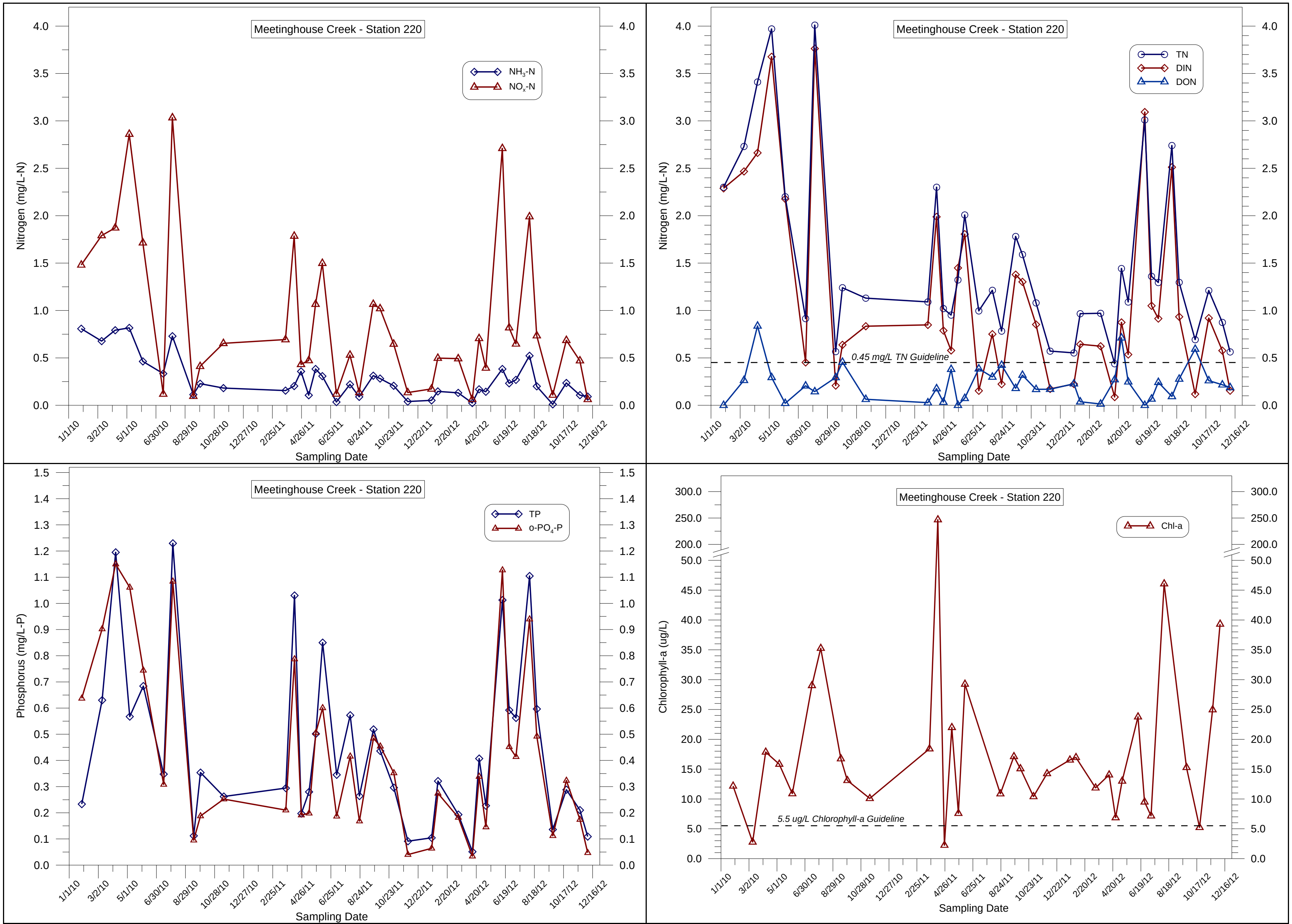


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Reeves Bay (Station 060210), 2010-2012

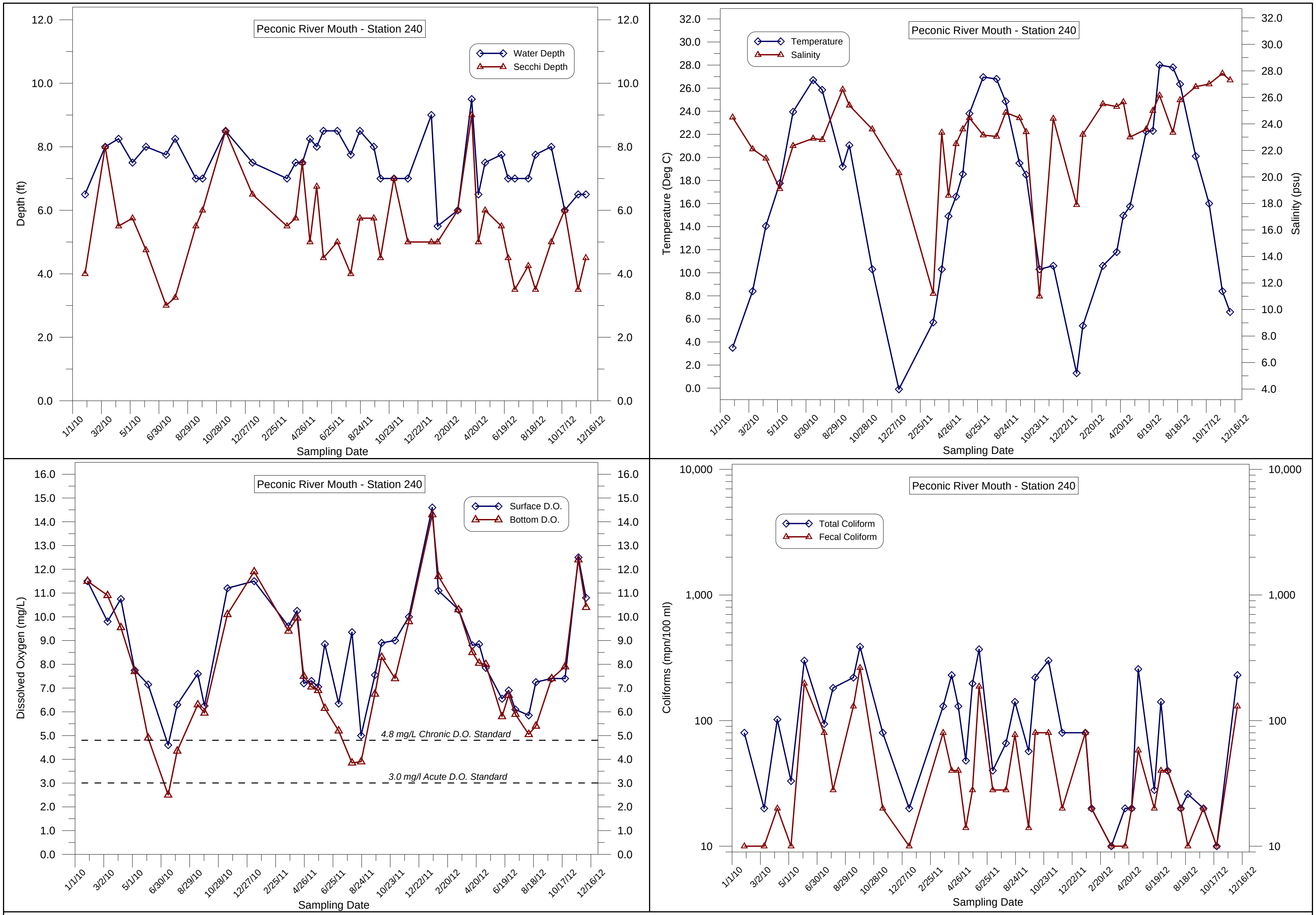
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Reeves Bay (Station 060210), 2010-2012



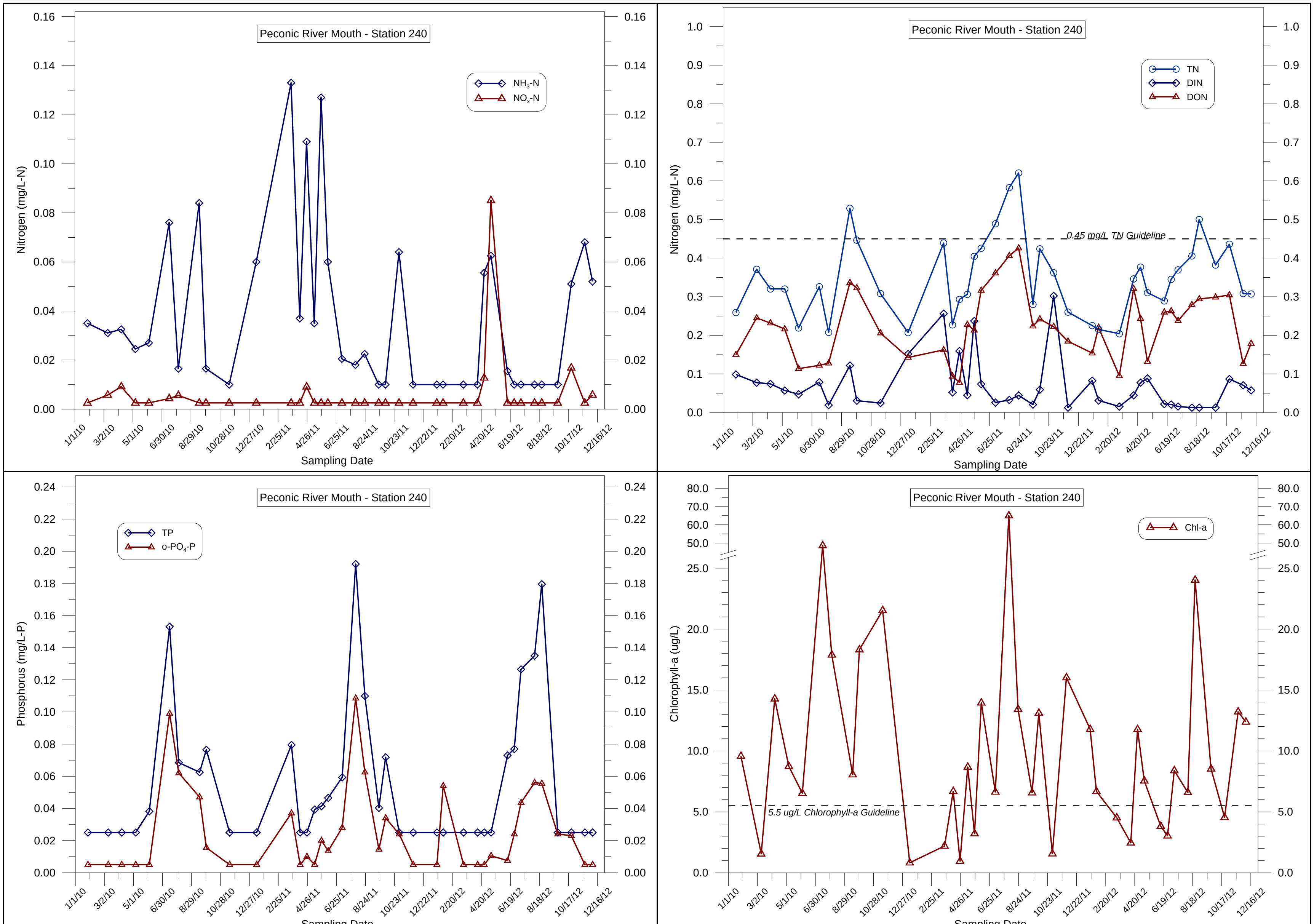
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Meetinghouse Creek (Station 060220), 2010-2012



Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Meetinghouse Creek (Station 060220), 2010-2012



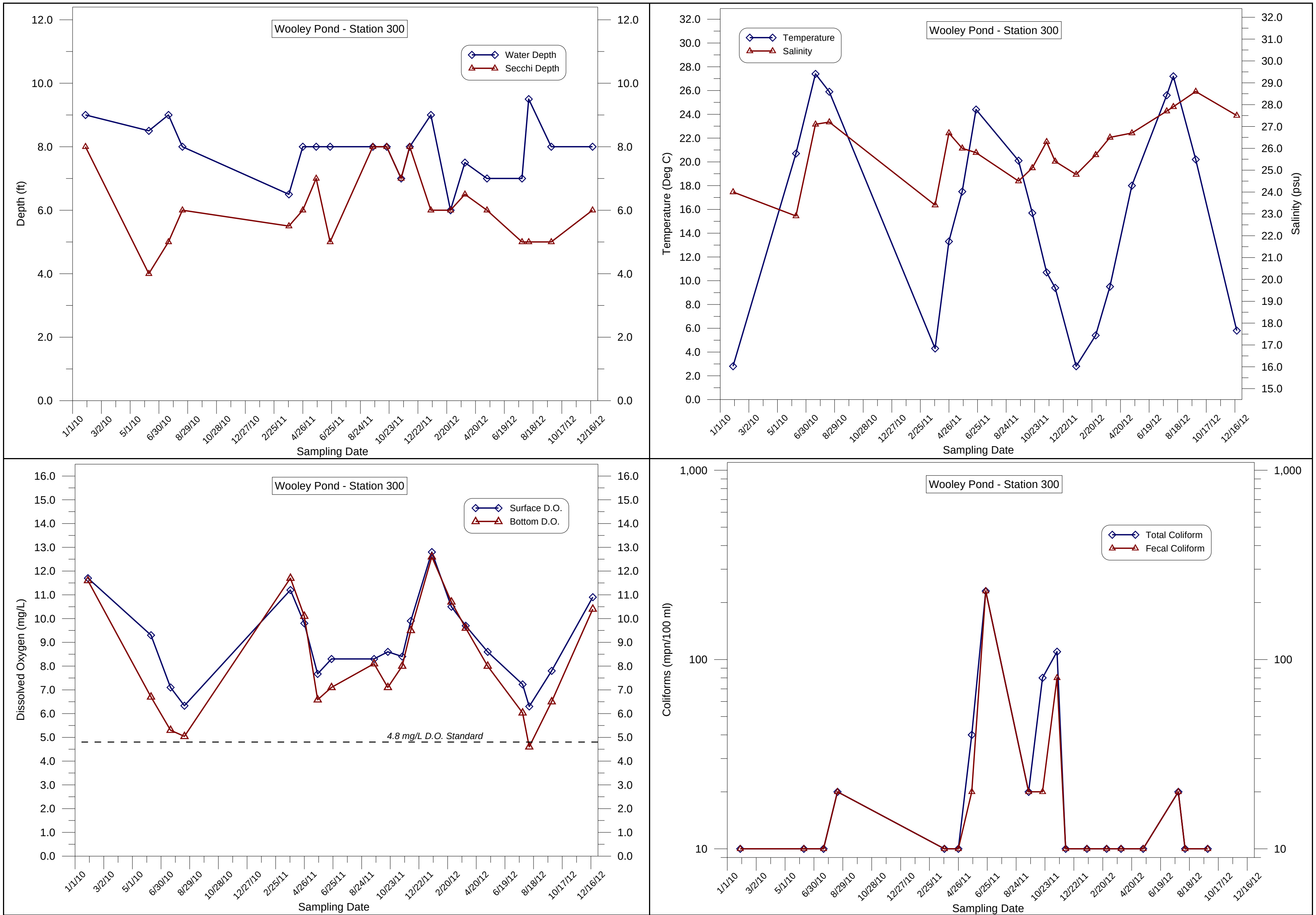
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in the Peconic River Mouth (Station 060240), 2010-2012



Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in the Peconic River Mouth (Station 060240), 2010-2012

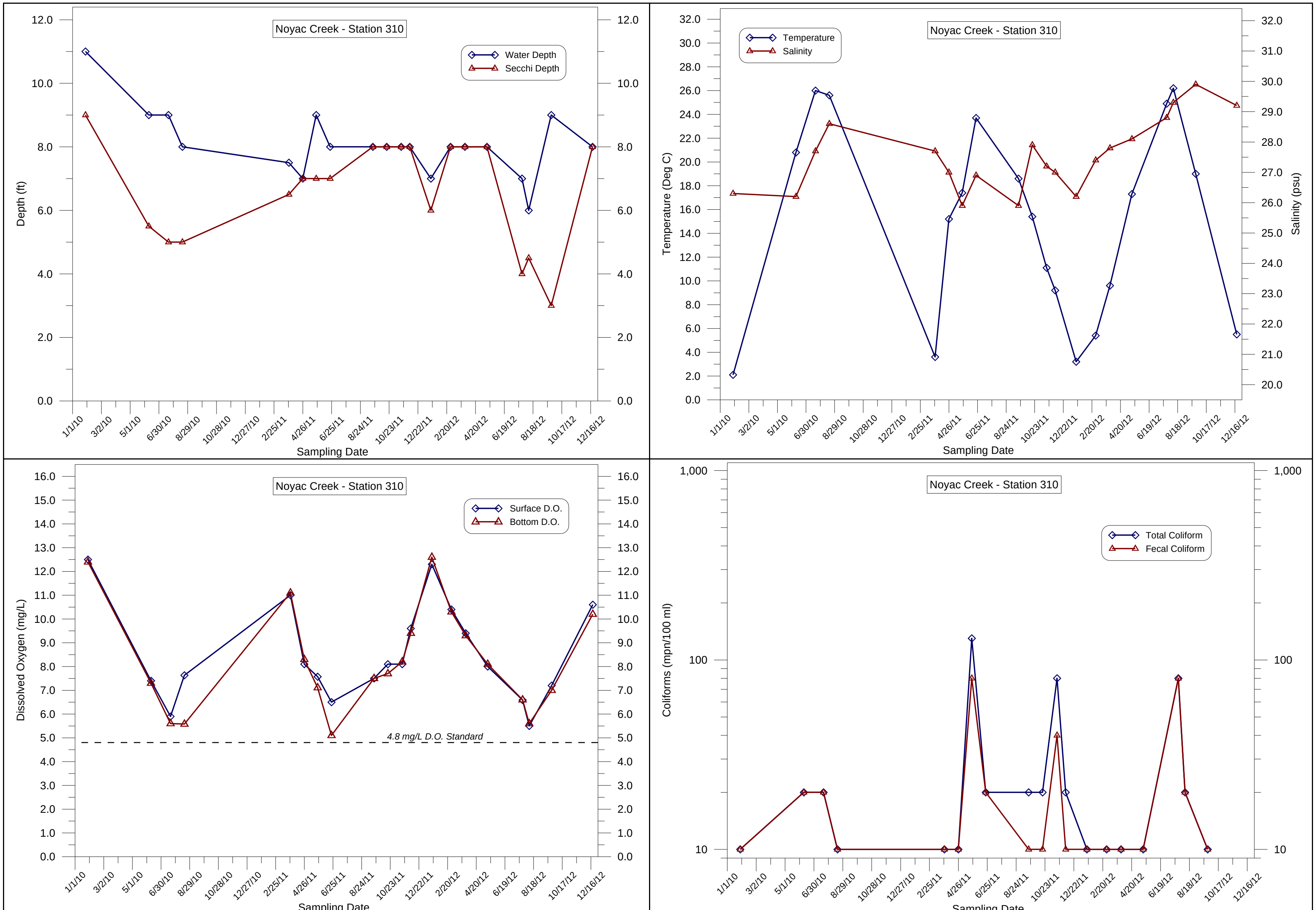
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Cold Spring Pond (Station 060290), 2010-2012

Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Cold Spring Pond (Station 060290), 2010-2012

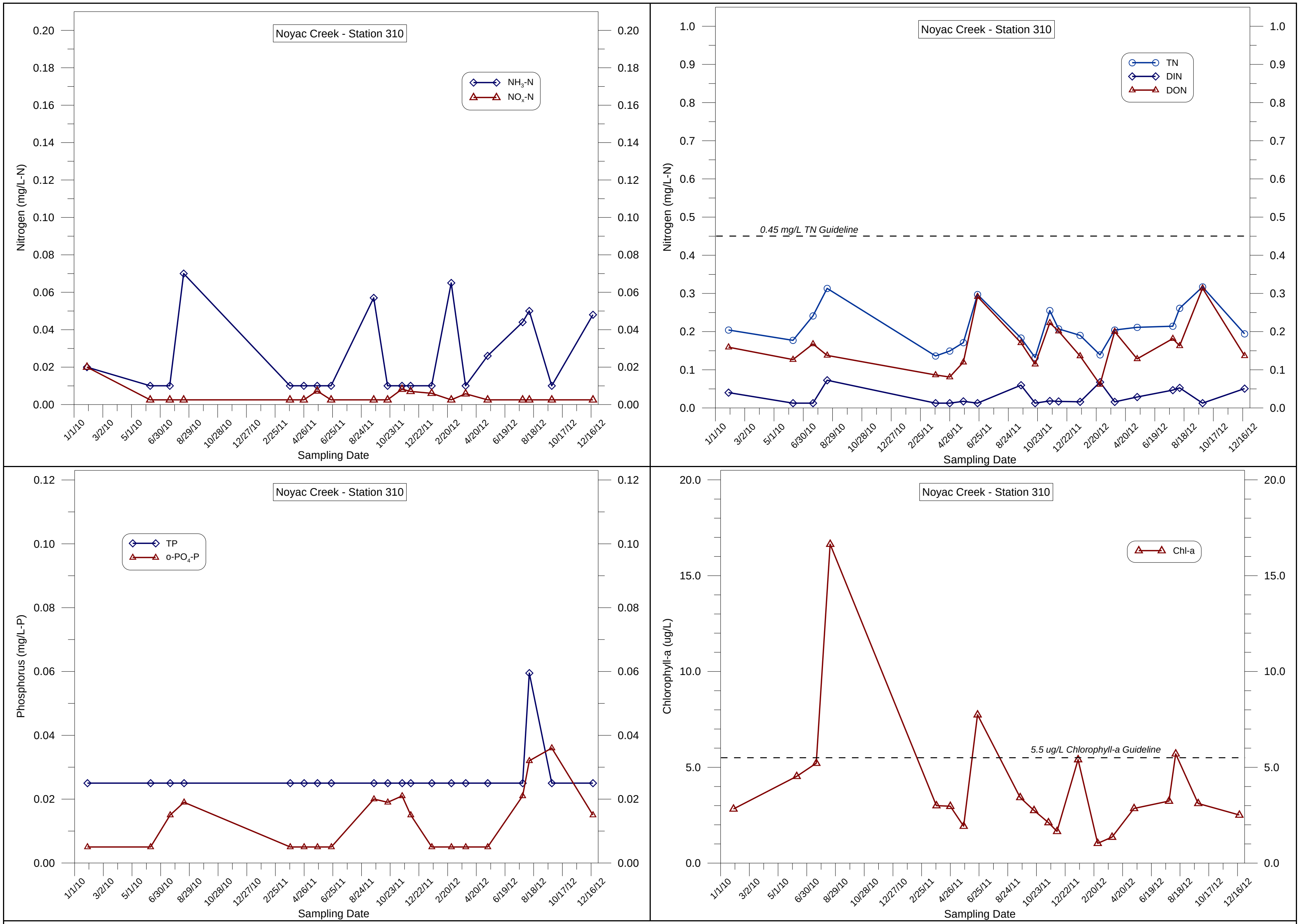


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Wooley Pond (Station 060300), 2010-2012

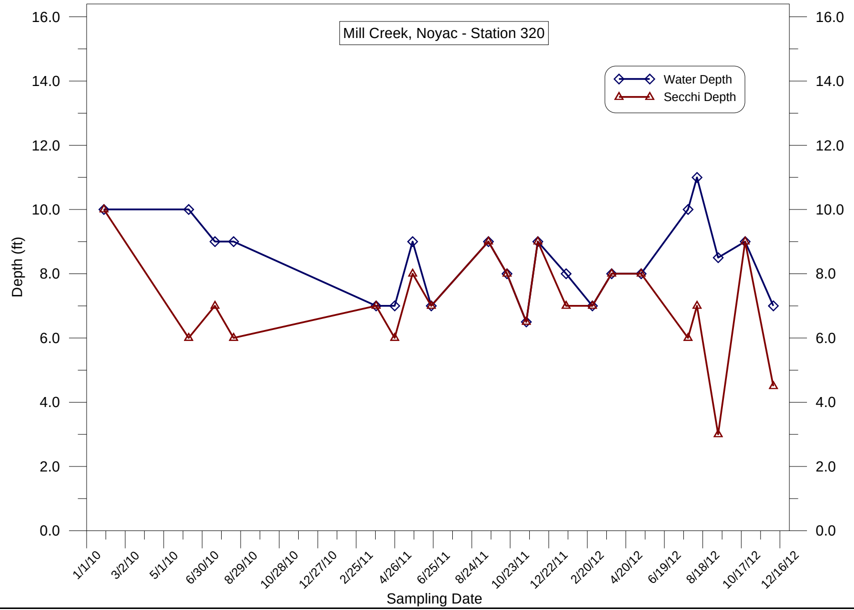
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Wooley Pond (Station 060300), 2010-2012

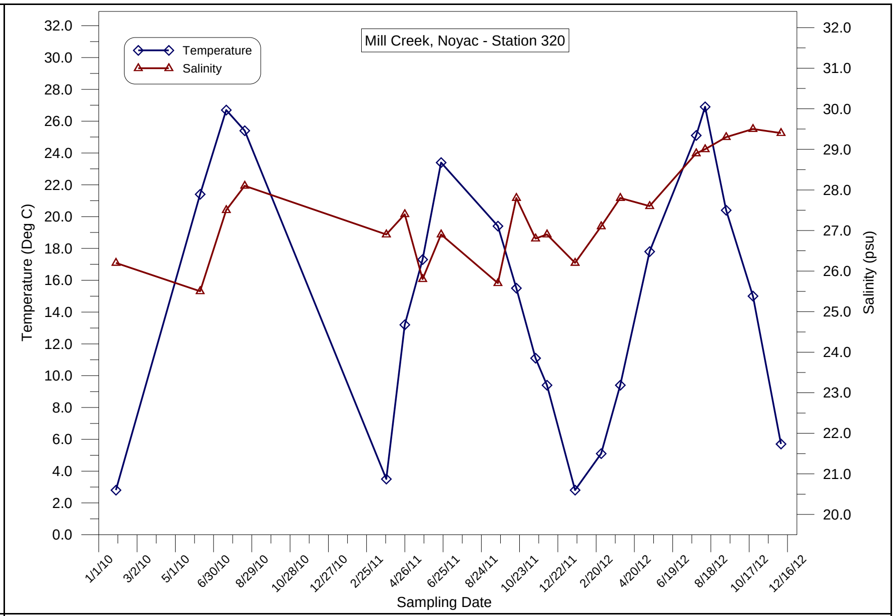


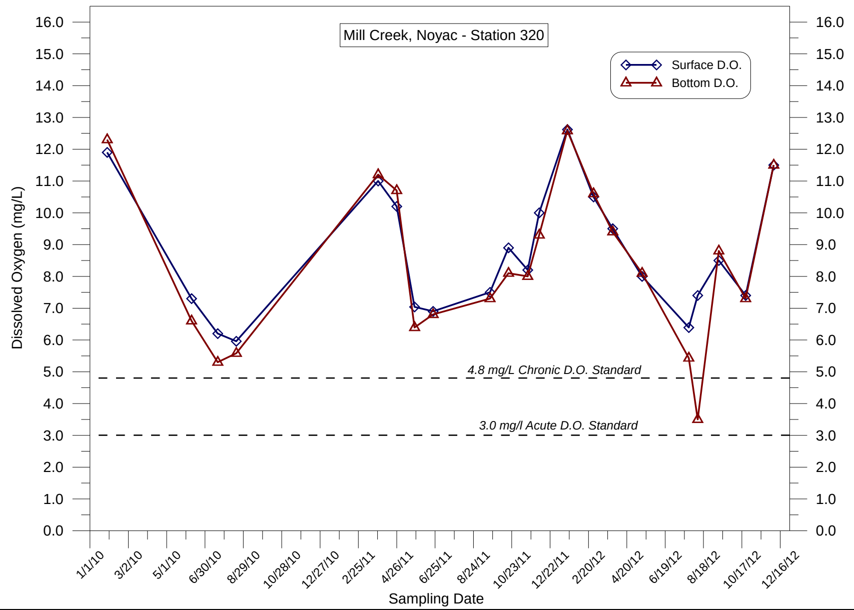
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Noyac Creek (Station 060310), 2010-2012

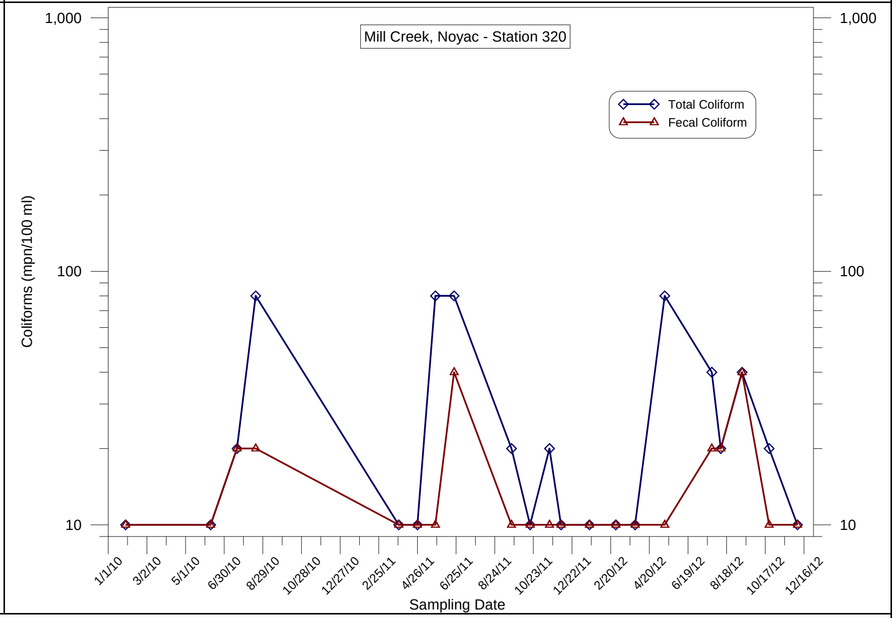


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Noyac Creek (Station 060310), 2010-2012

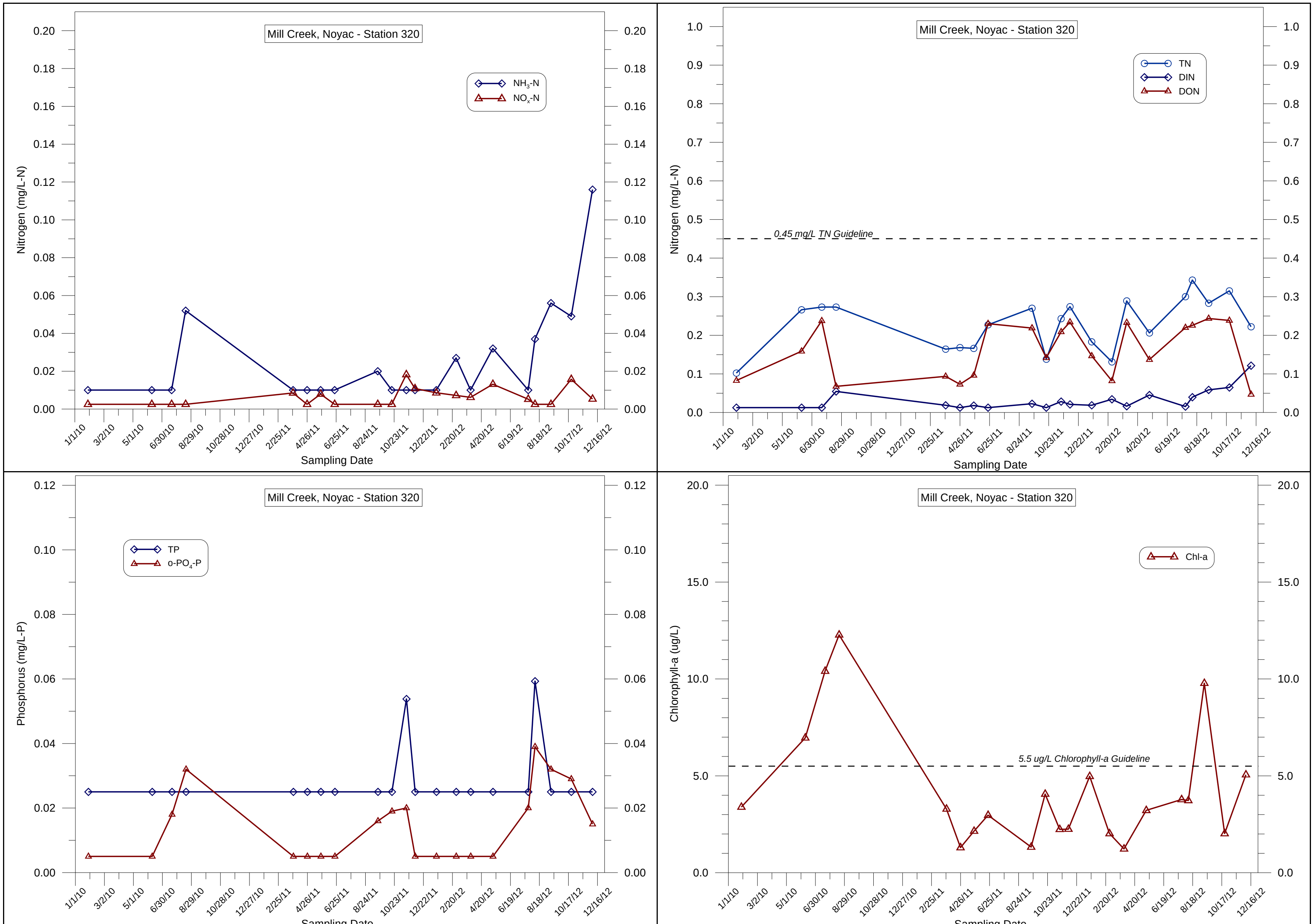




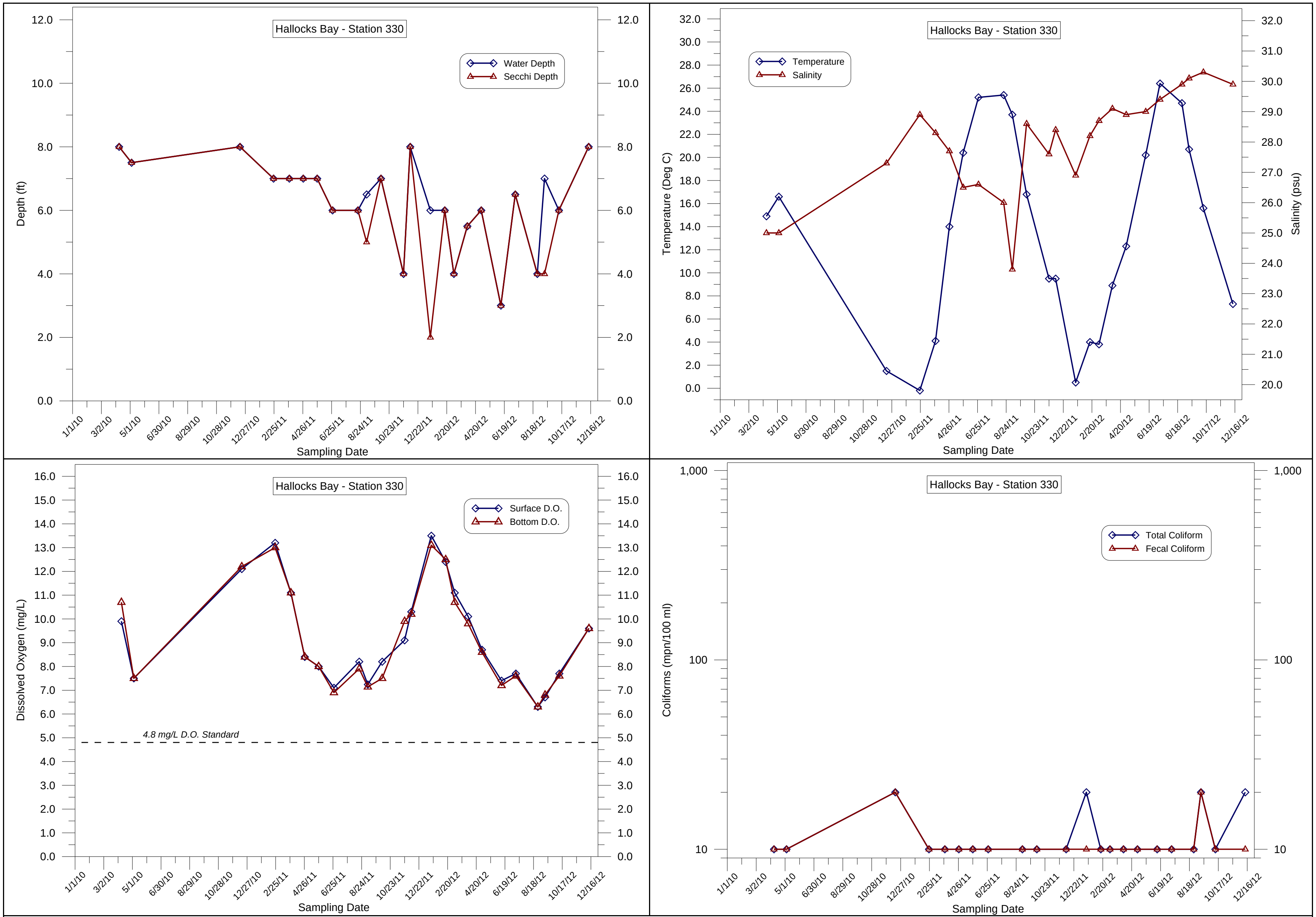




Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Mill Creek, Noyac (Station 060320), 2010-2012

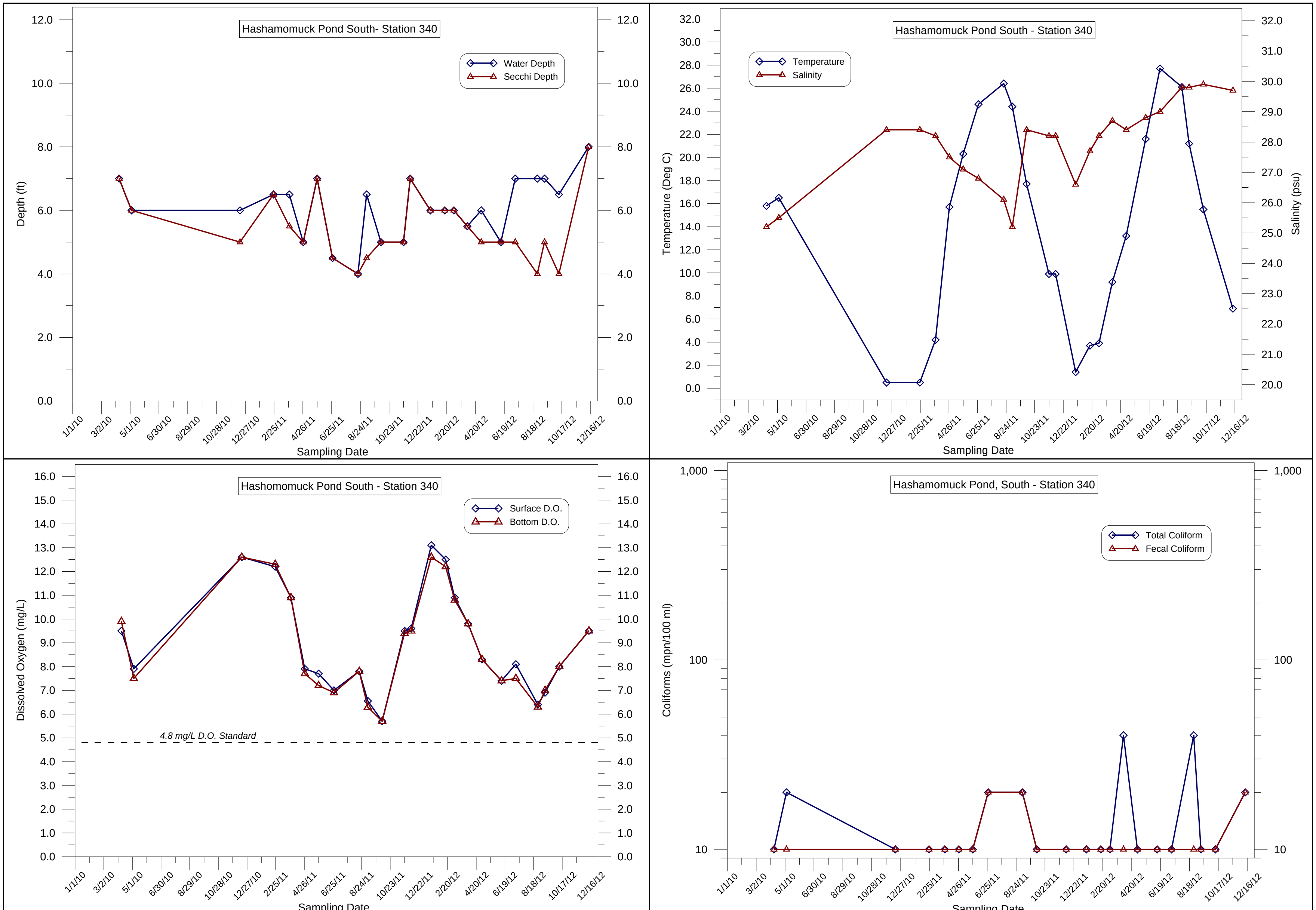


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Mill Creek, Noyac (Station 060320), 2010-2012

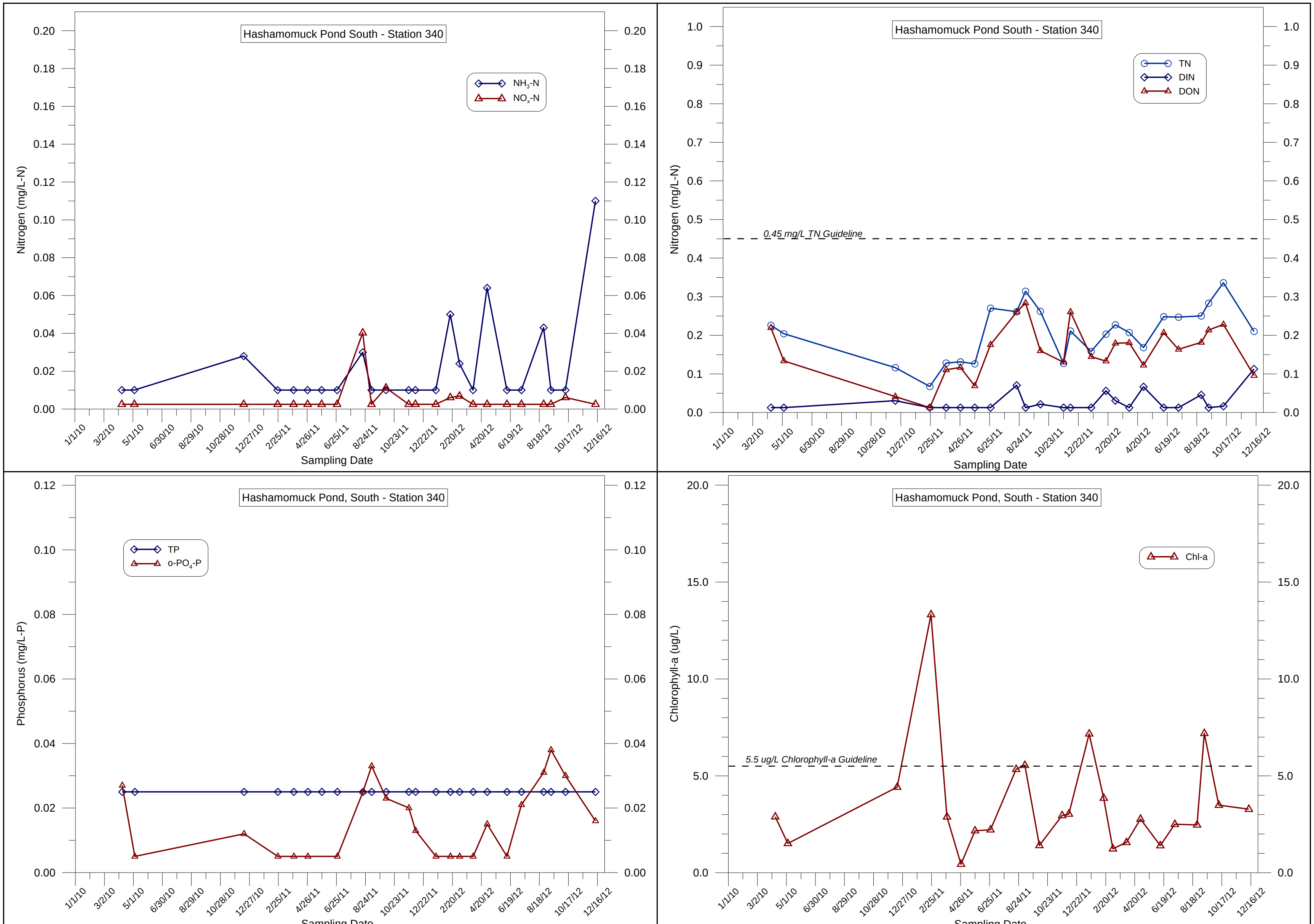


Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Hallocks Bay (Station 060330), 2010-2012

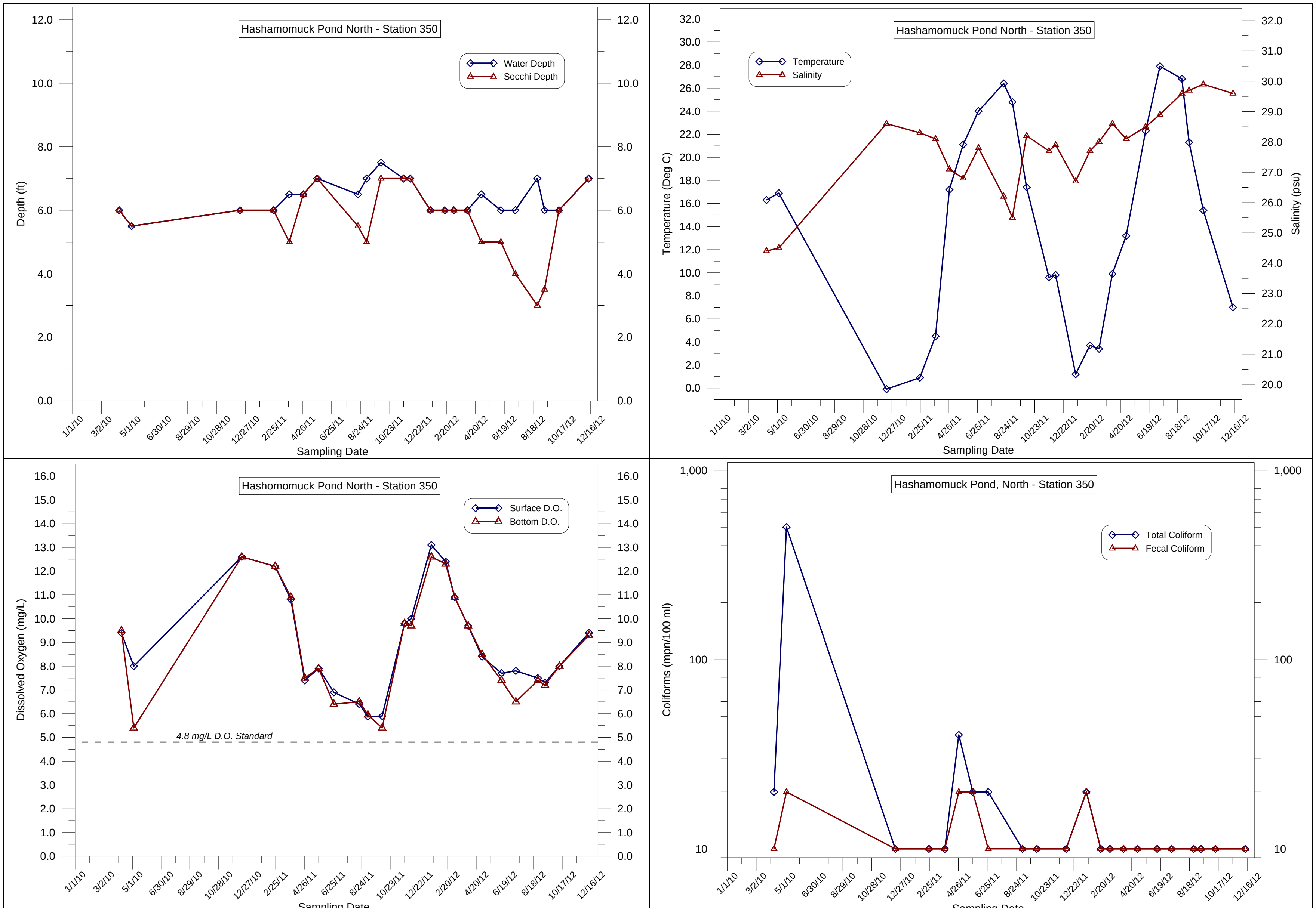
Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Hallocks Bay (Station 060330), 2010-2012



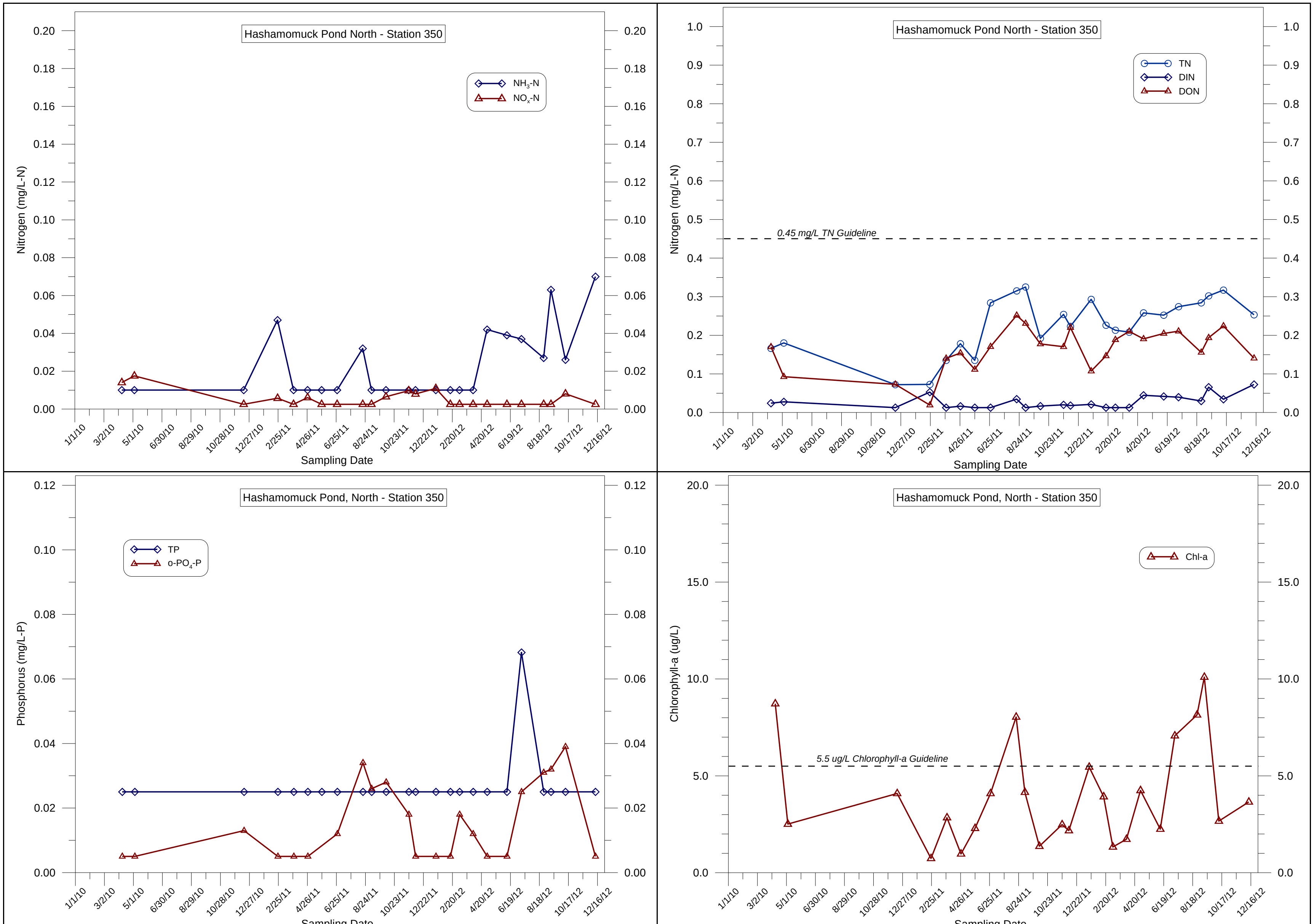
Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Hashamomuck Pond (Station 060340), 2010-2012



Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Hashamomuck Pond (Station 060340), 2010-2012



Seasonal variations in water depth, secchi depth, temperature, salinity, dissolved oxygen and coliform bacteria in Hashamomuck Pond (Station 060350), 2010-2012

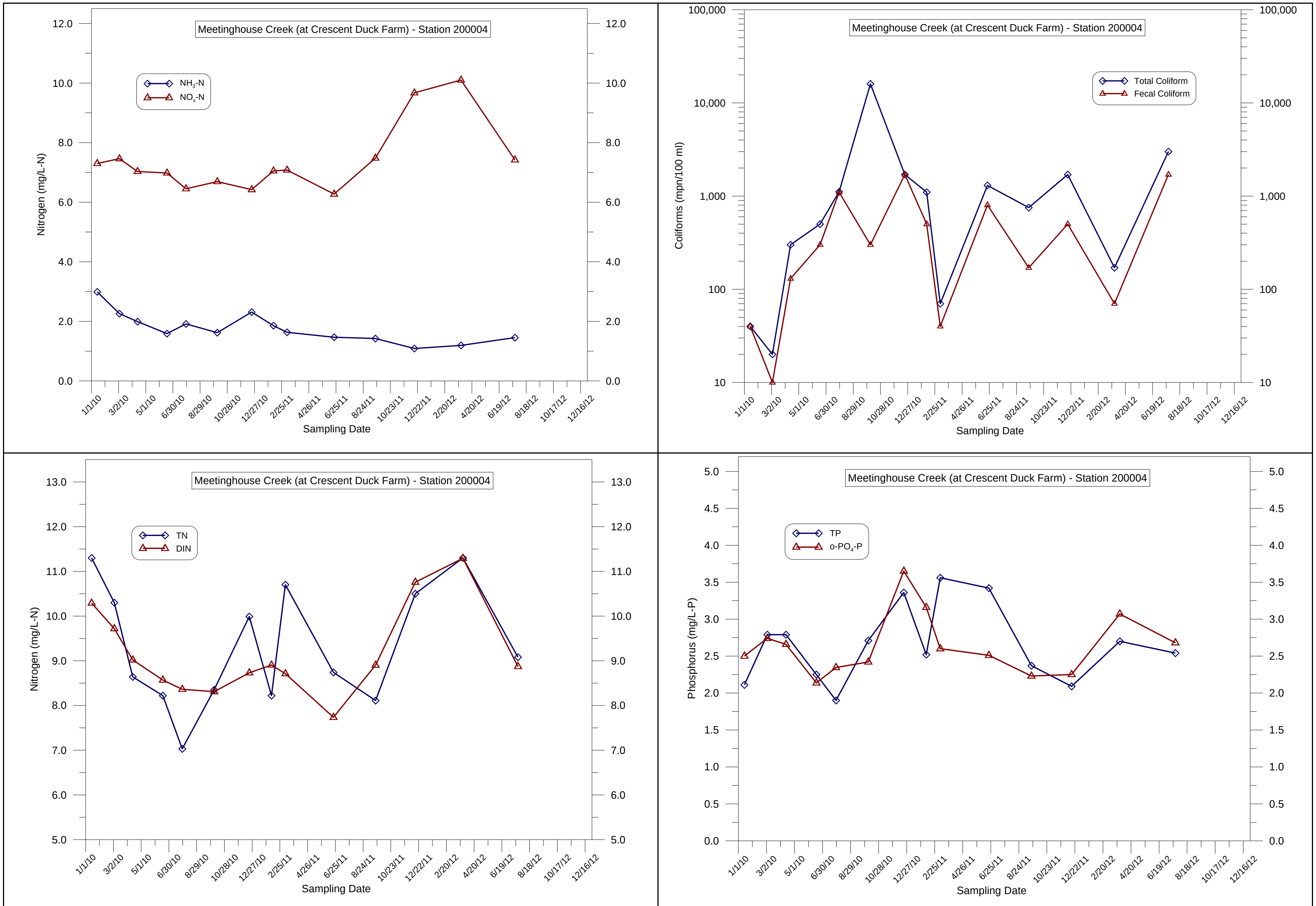


Seasonal variations in ammonia (NH_3-N), nitrate+nitrite (NO_x-N), dissolved inorganic nitrogen (DIN), dissolved organic nitrogen (DON), total nitrogen (TN), total phosphorus (TP), ortho-phosphate (o-PO_4-P) and chlorophyll-a in Hashamomuck Pond (Station 060350), 2010-2012

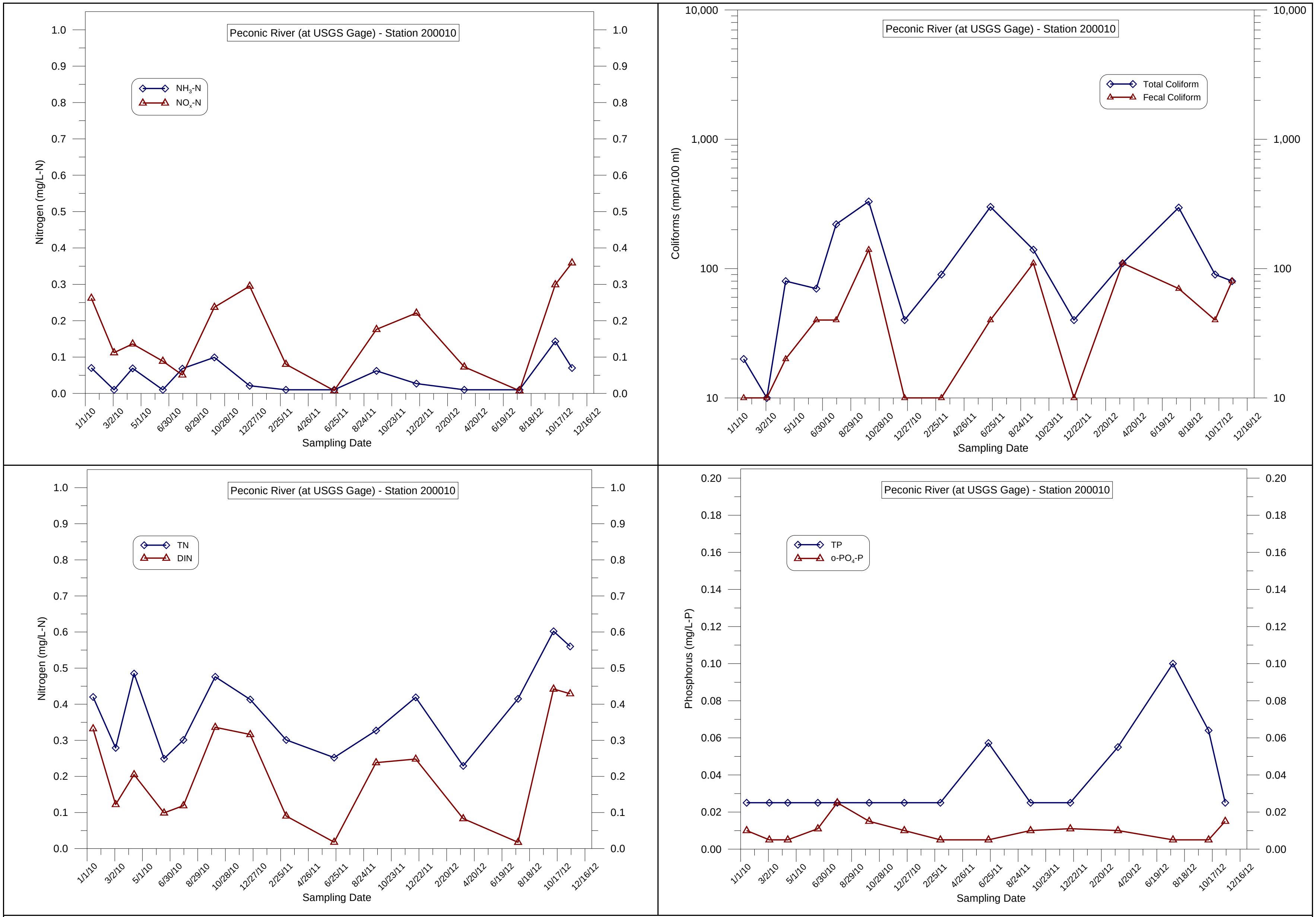
Appendix C2

Time Series Plots for Stream Sampling Locations

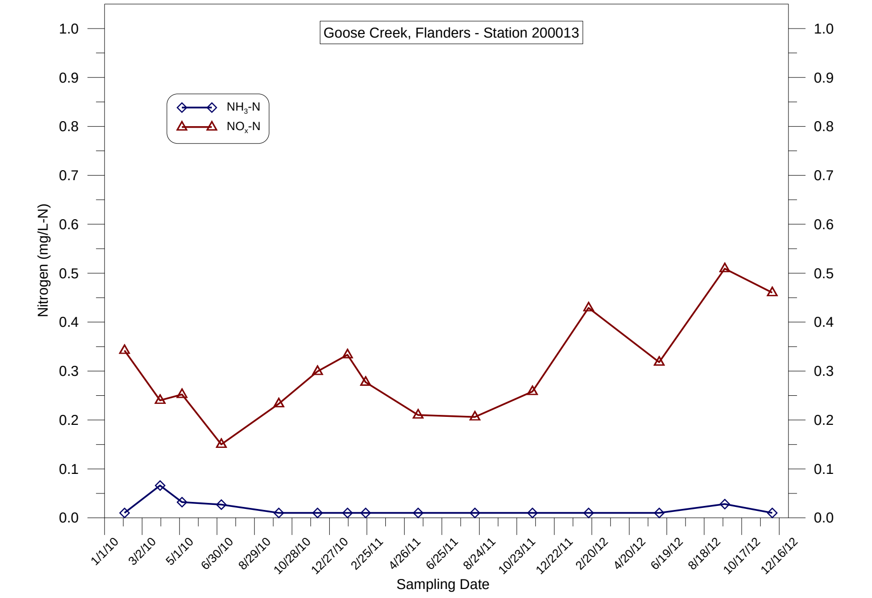
Parameters include:
Coliform Bacteria
Ammonia (NH_3-N)
Nitrate+Nitrite (NO_x-N)
Dissolved Inorganic Nitrogen (DIN)
Total Nitrogen (TN)
Total Phosphorus (TP)
ortho-Phosphate (o-PO_4-P)

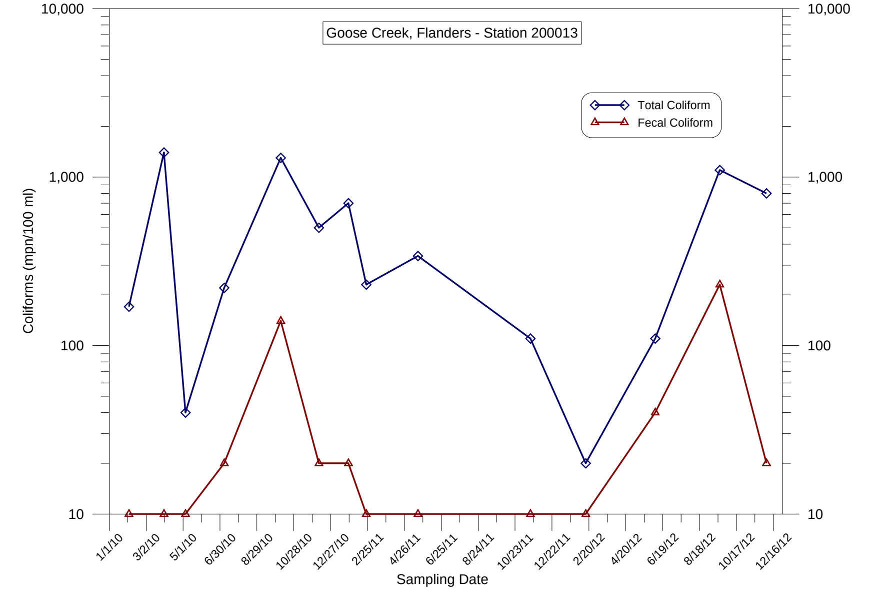


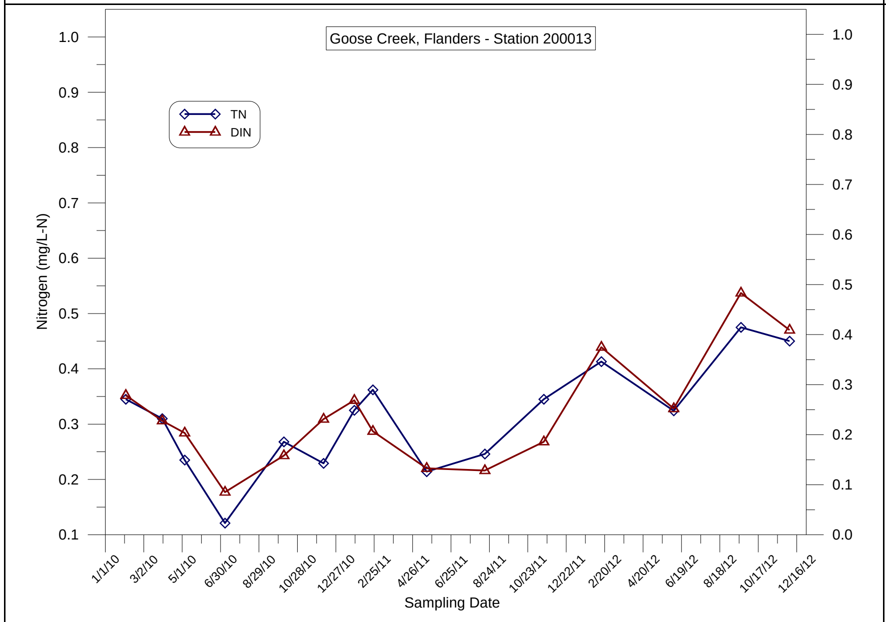
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Meetinghouse Creek (Station 200004), 2010-2012

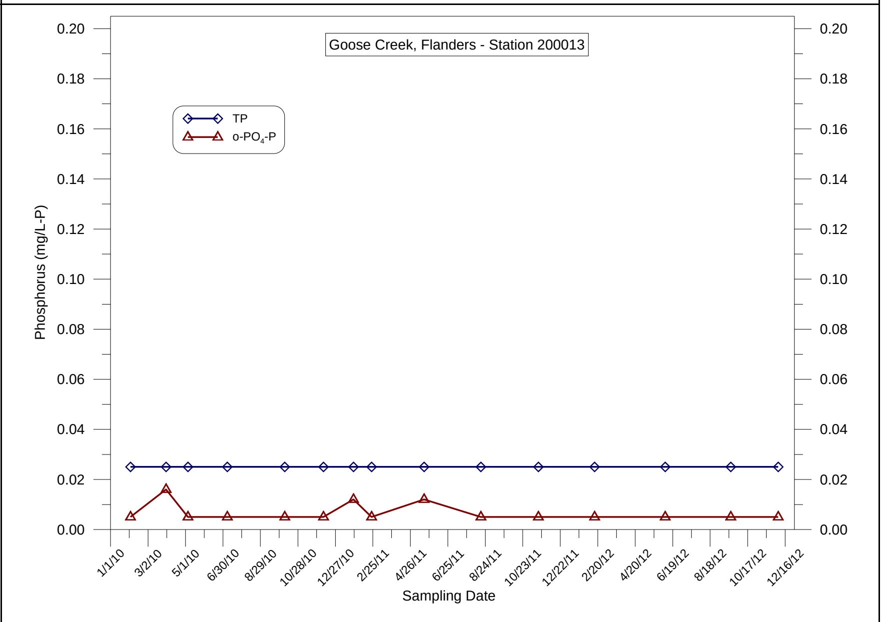


Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in the Peconic River (Station 200010), 2010-2012



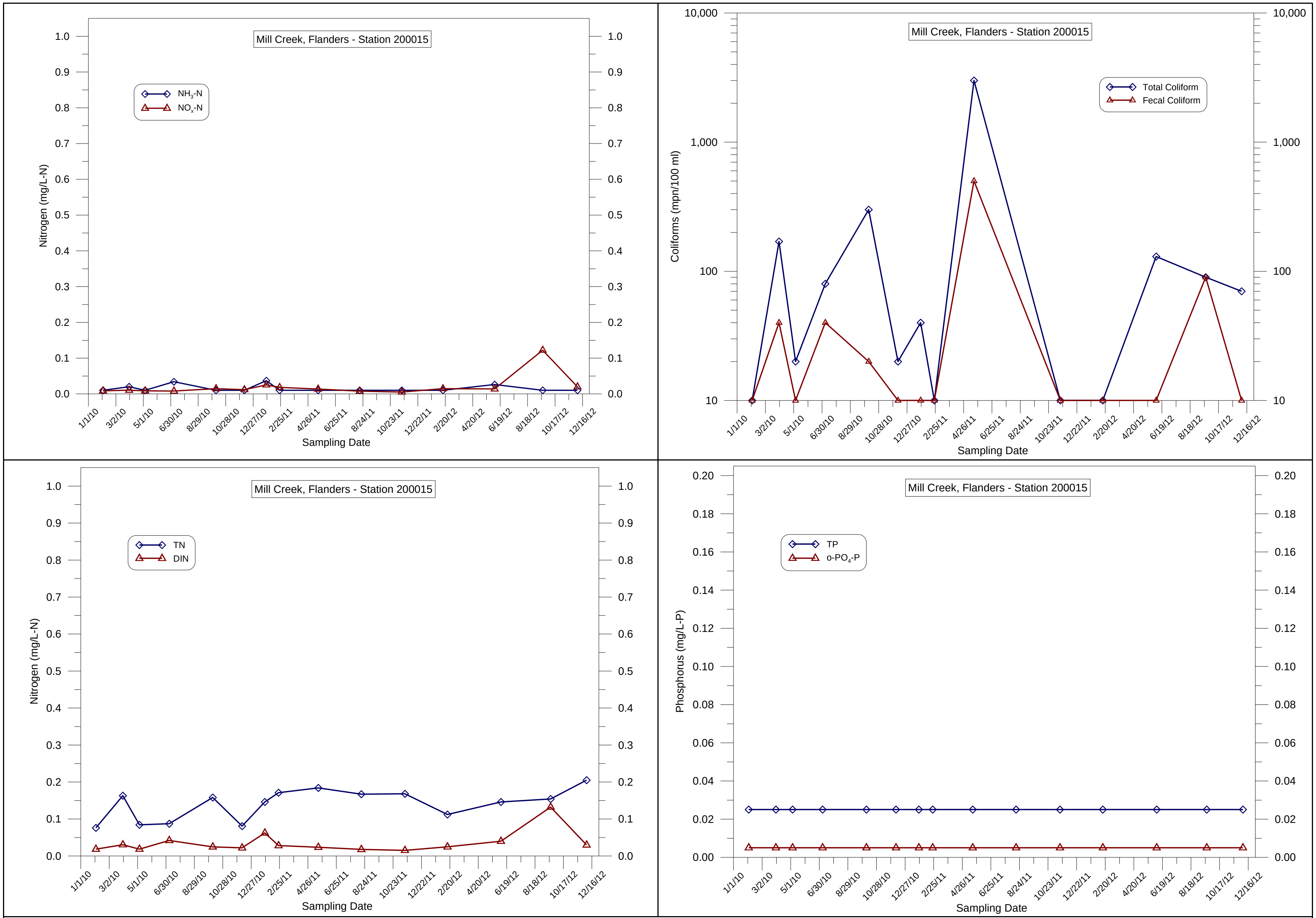




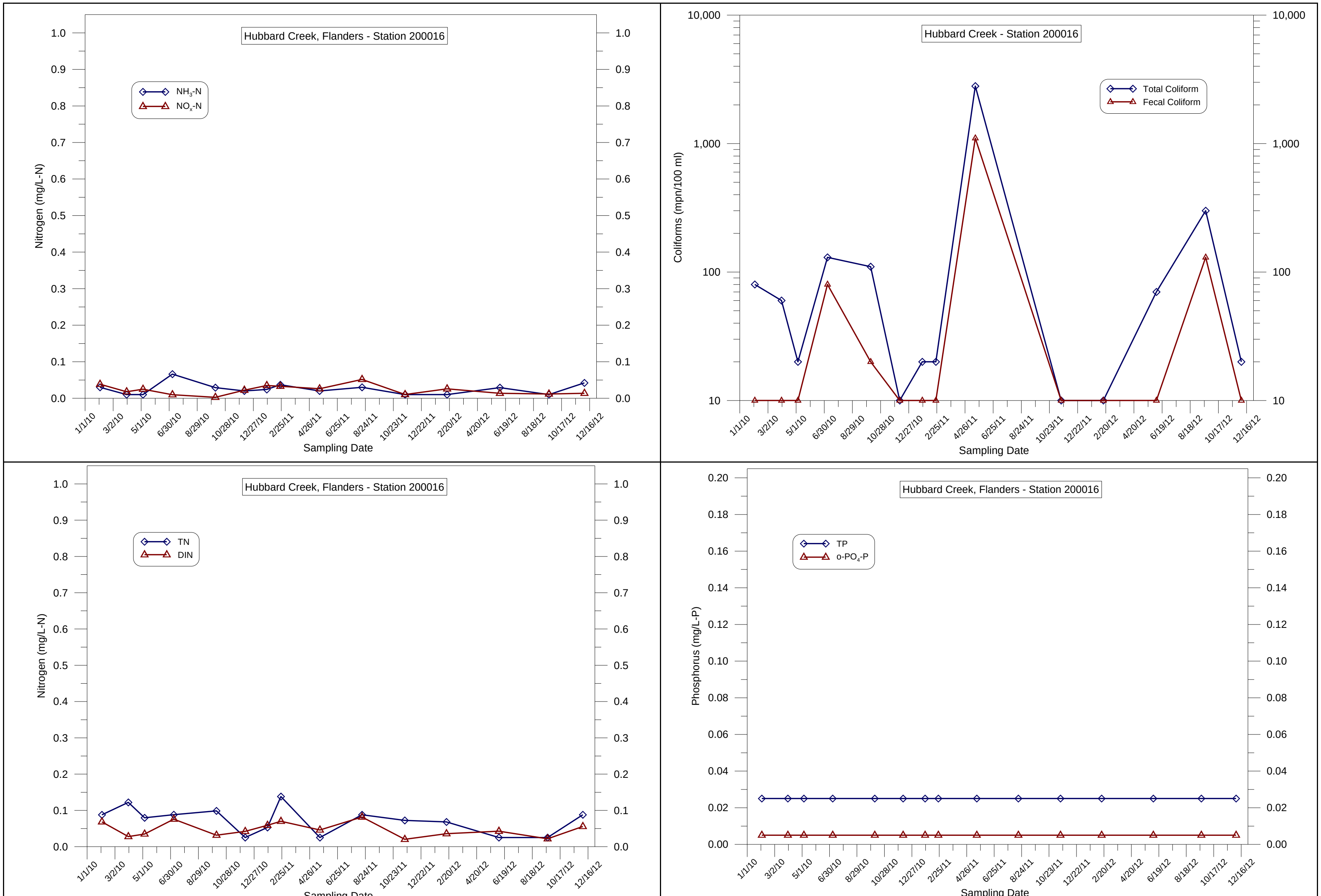


Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Goose Creek (Station 200013), 2010-2012

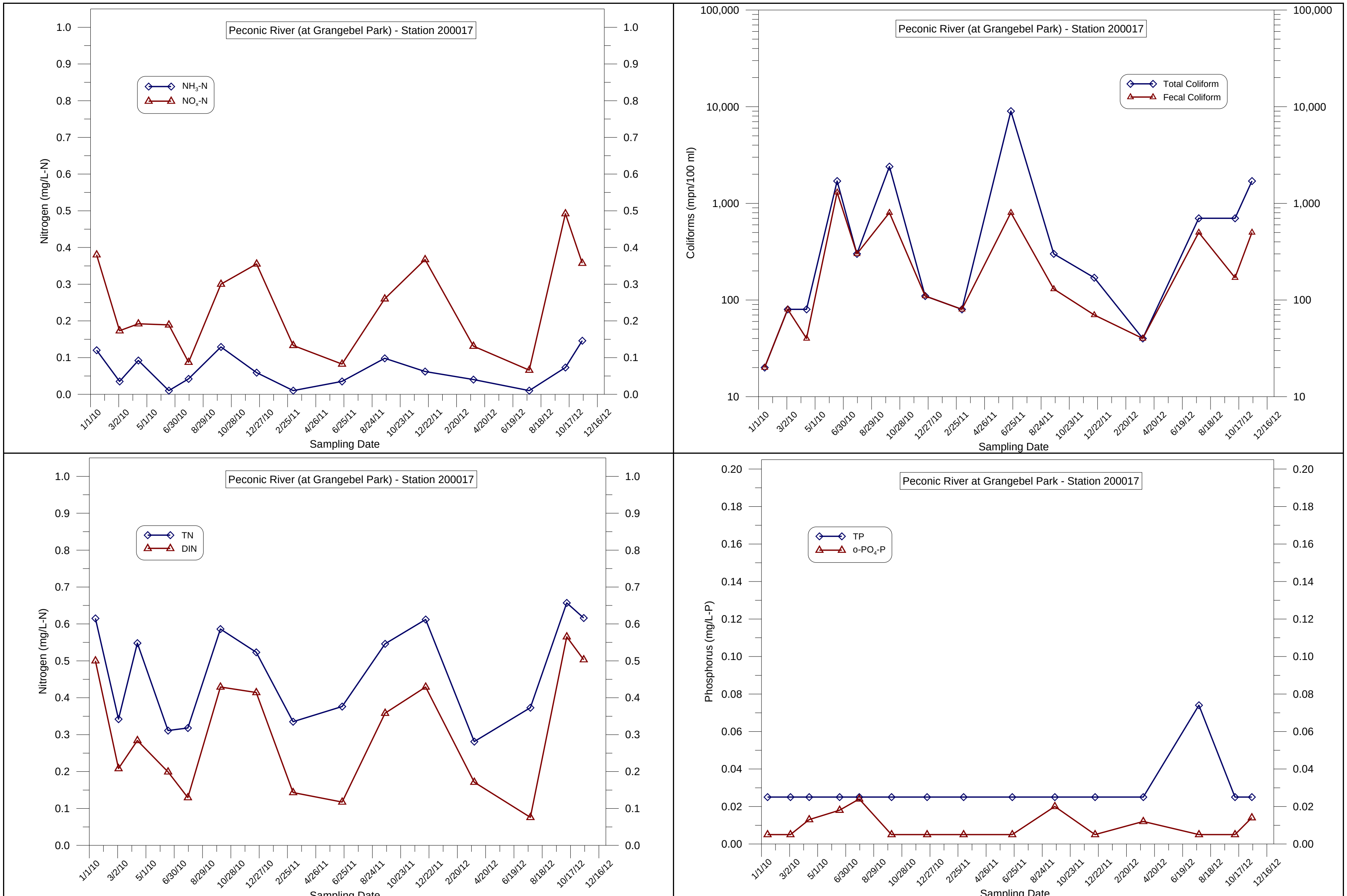
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Birch Creek (Station 200014), 2010-2012



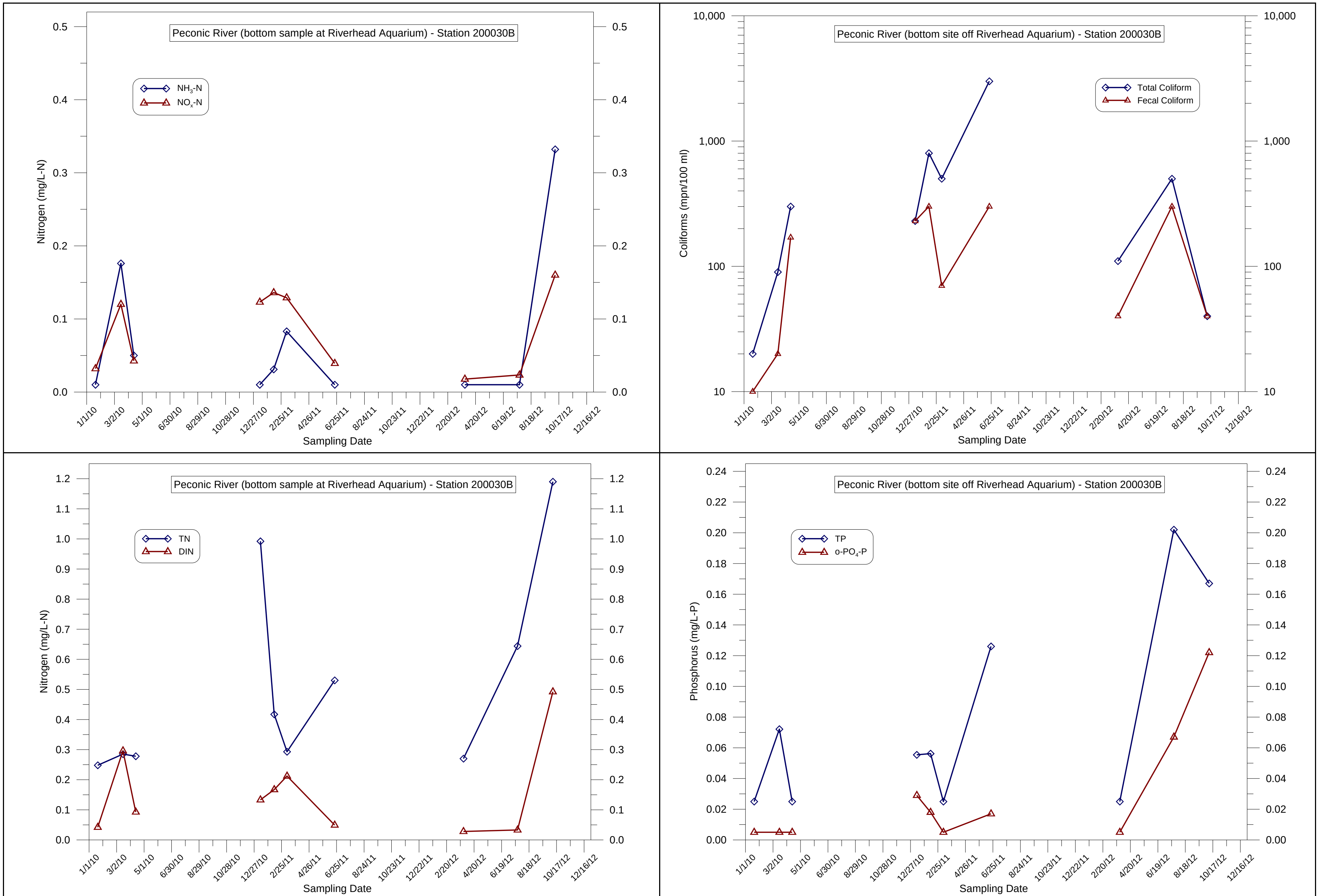
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Mill Creek (Station 200015), 2010-2012



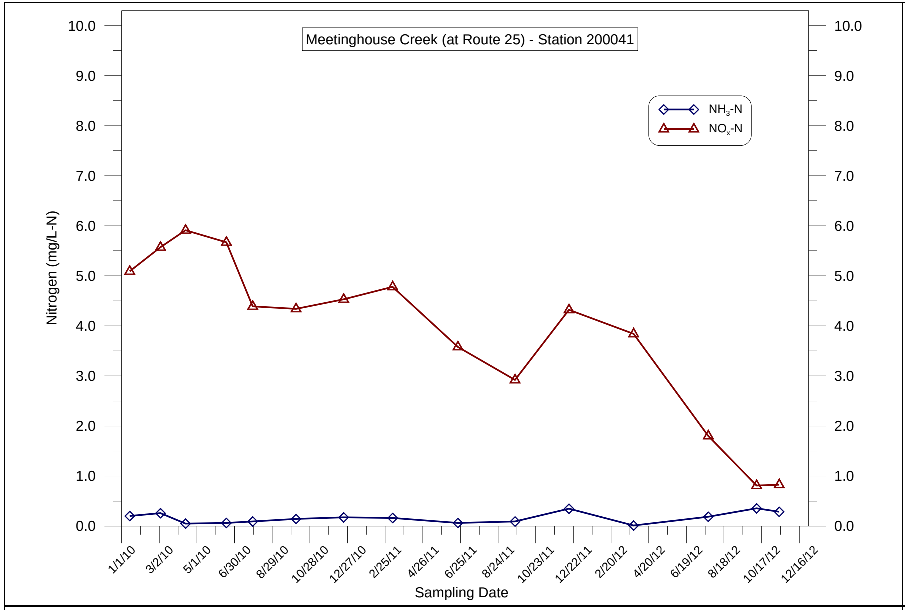
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Hubbard Creek (Station 200016), 2010-2012

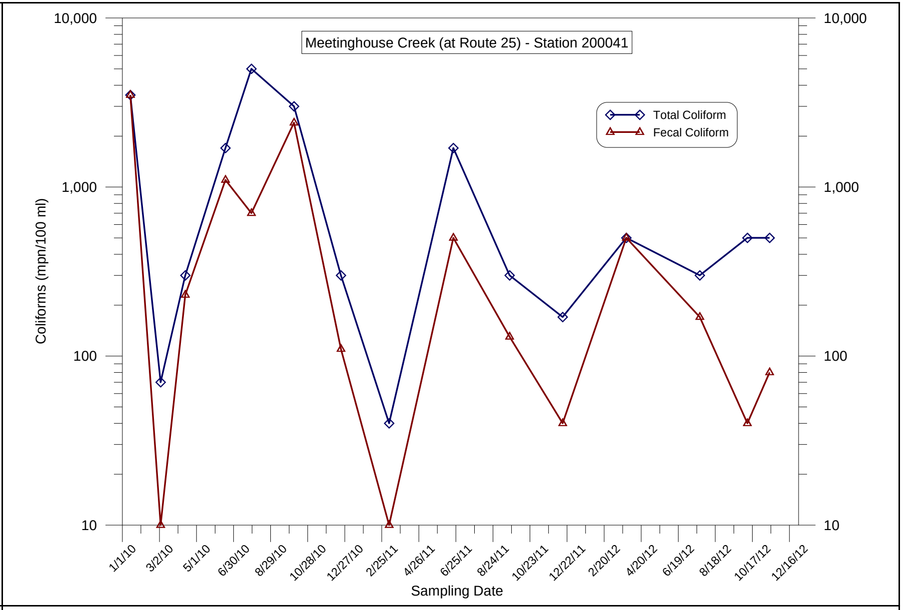


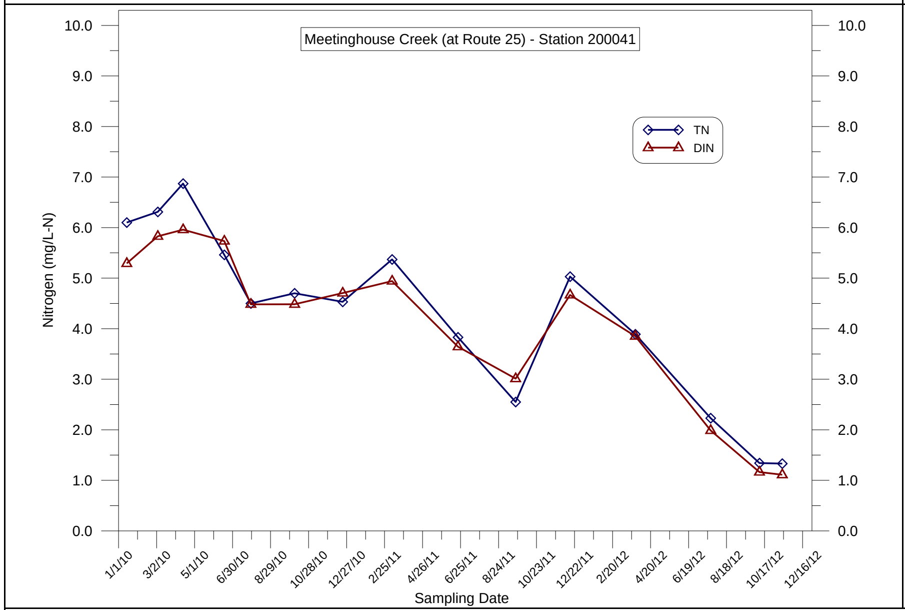
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in the Peconic River at Grangebel Park (Station 200017), 2010-2012

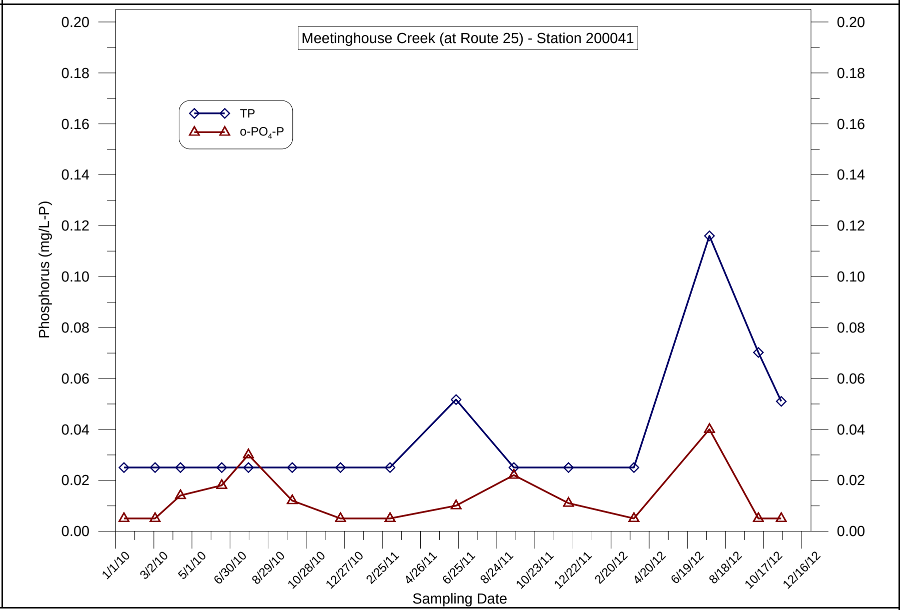


Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in the Peconic River at Long Island Aquarium (Station 200030B), 2010-2012

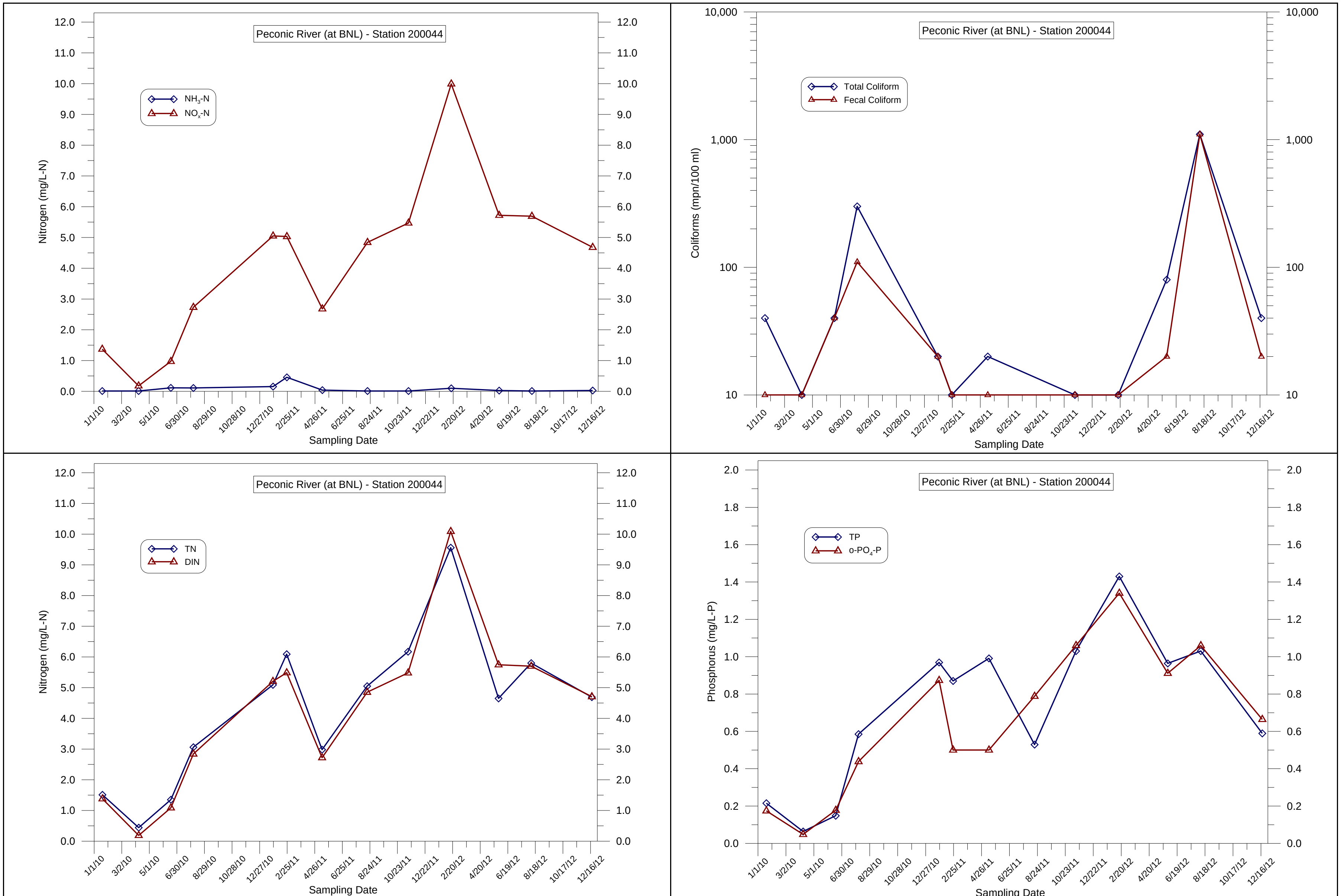




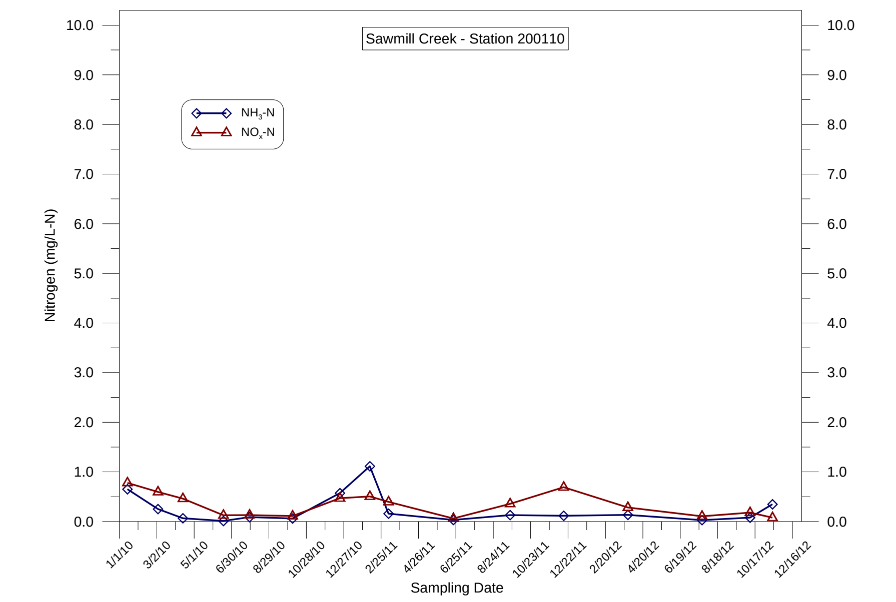


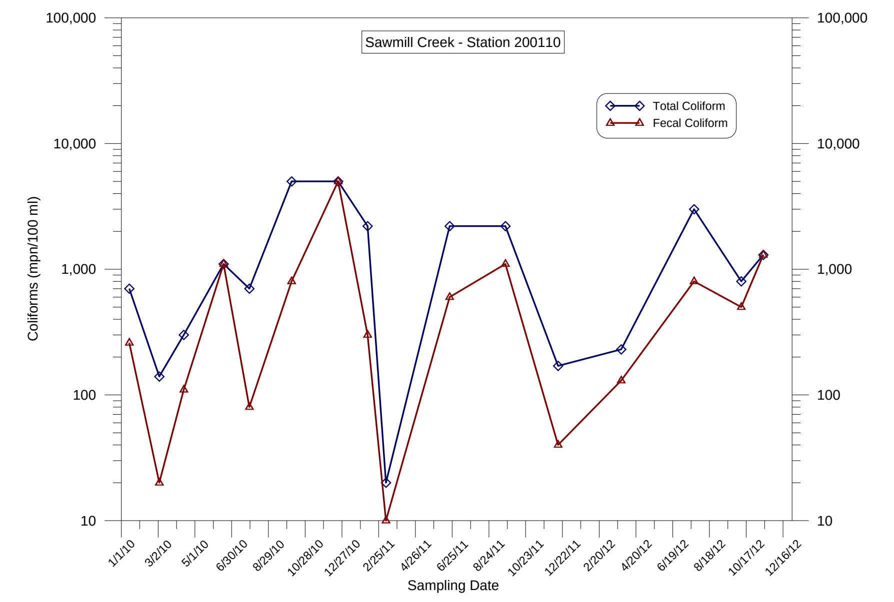


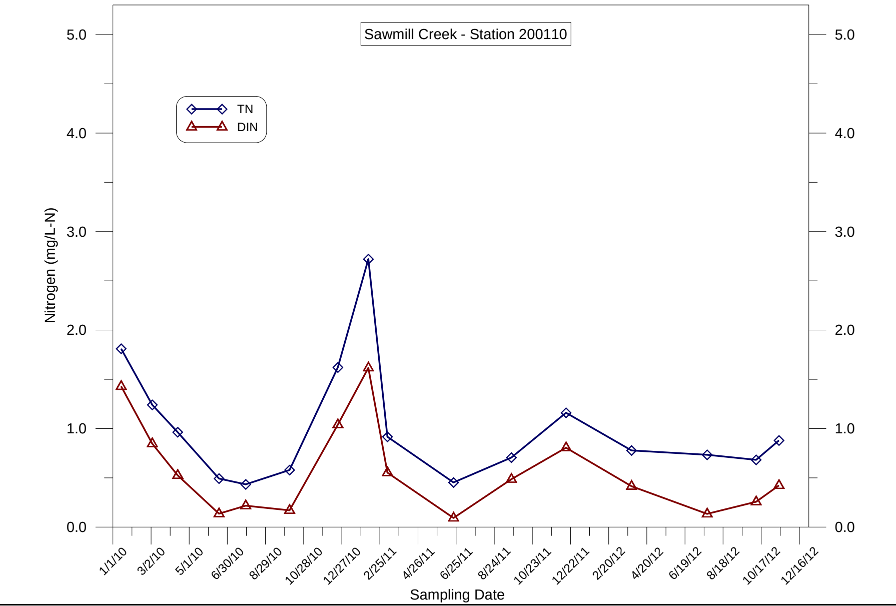
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Meetinghouse Creek at Route 25 (Station 200041), 2010-2012

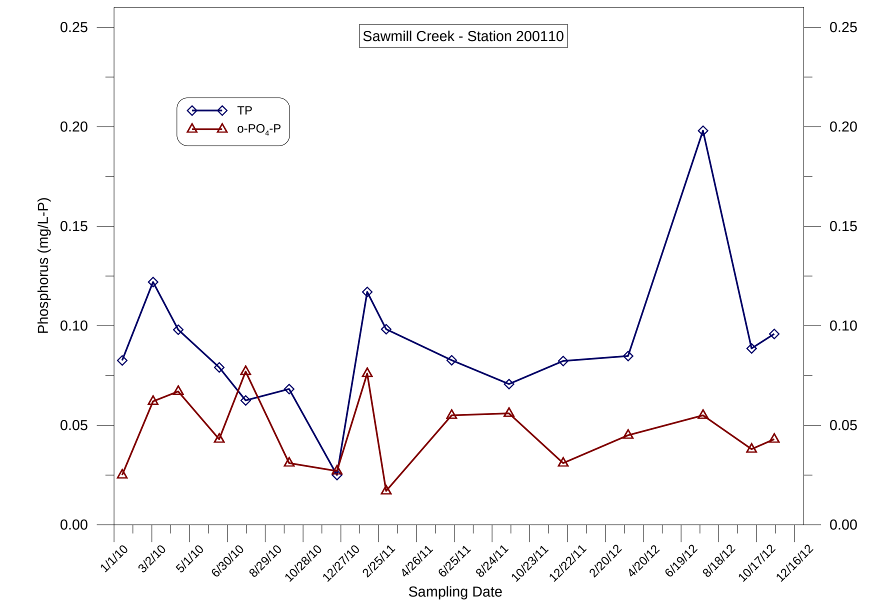


Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in the Peconic River Downstream from BNL (Station 200044), 2010-2012

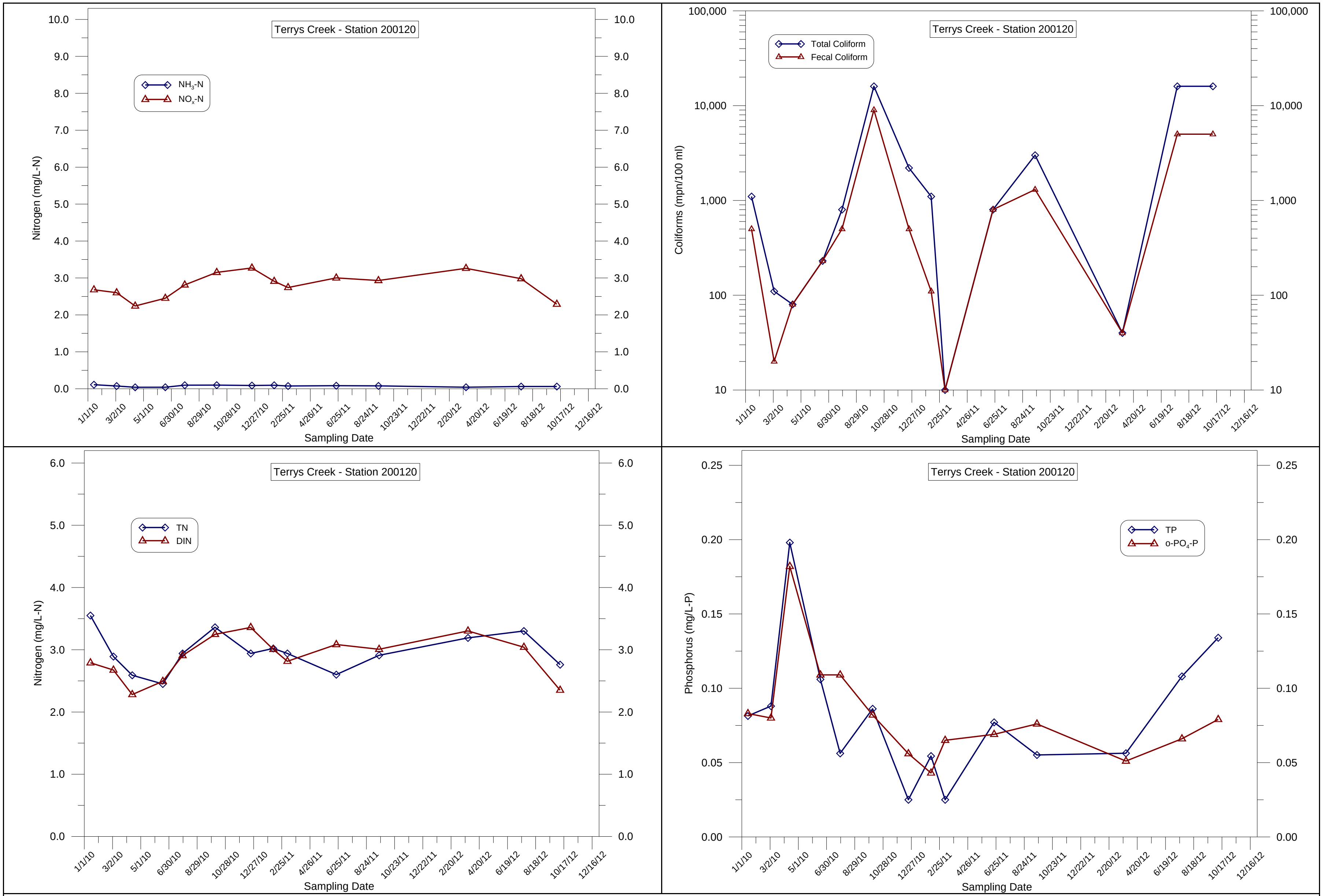




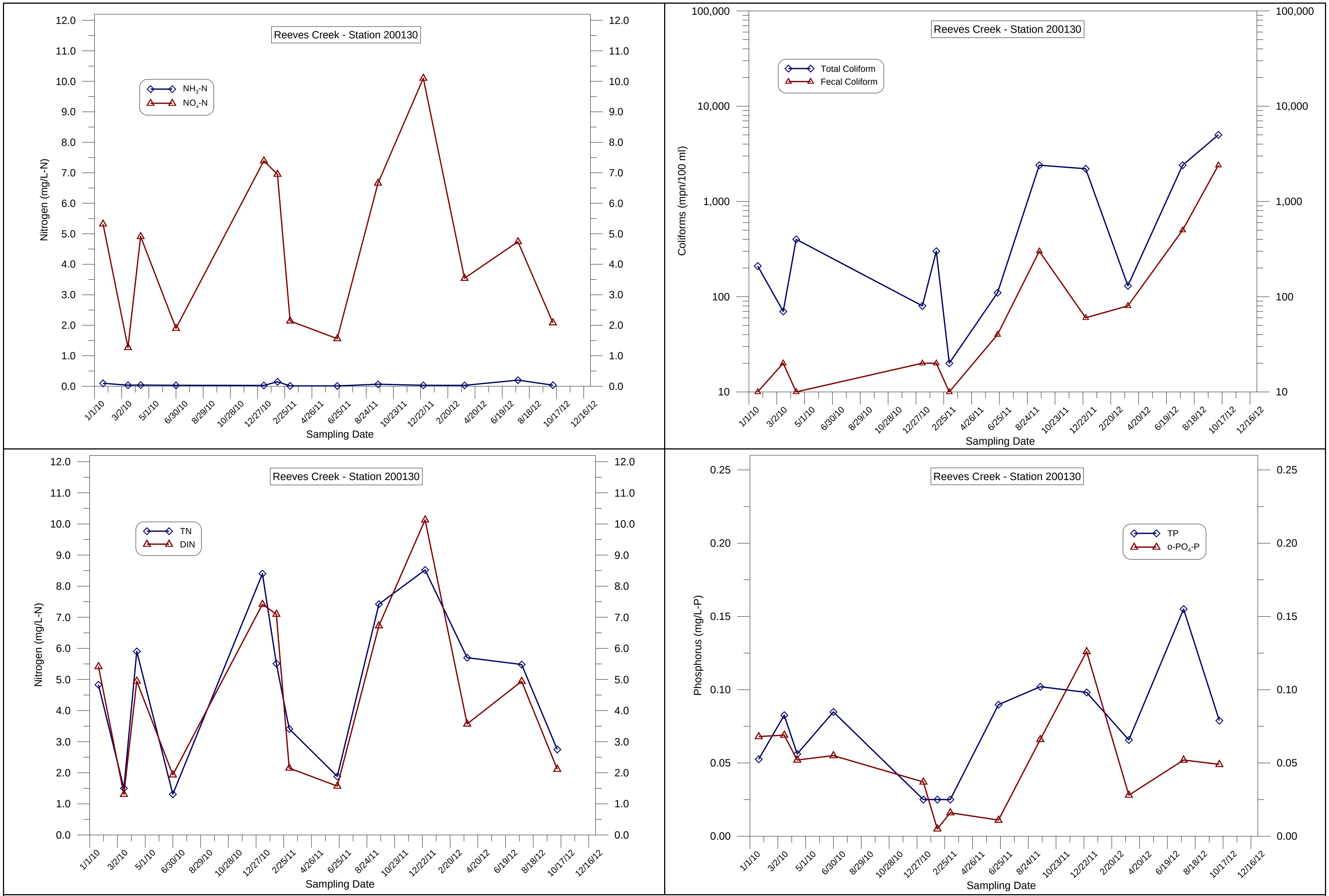




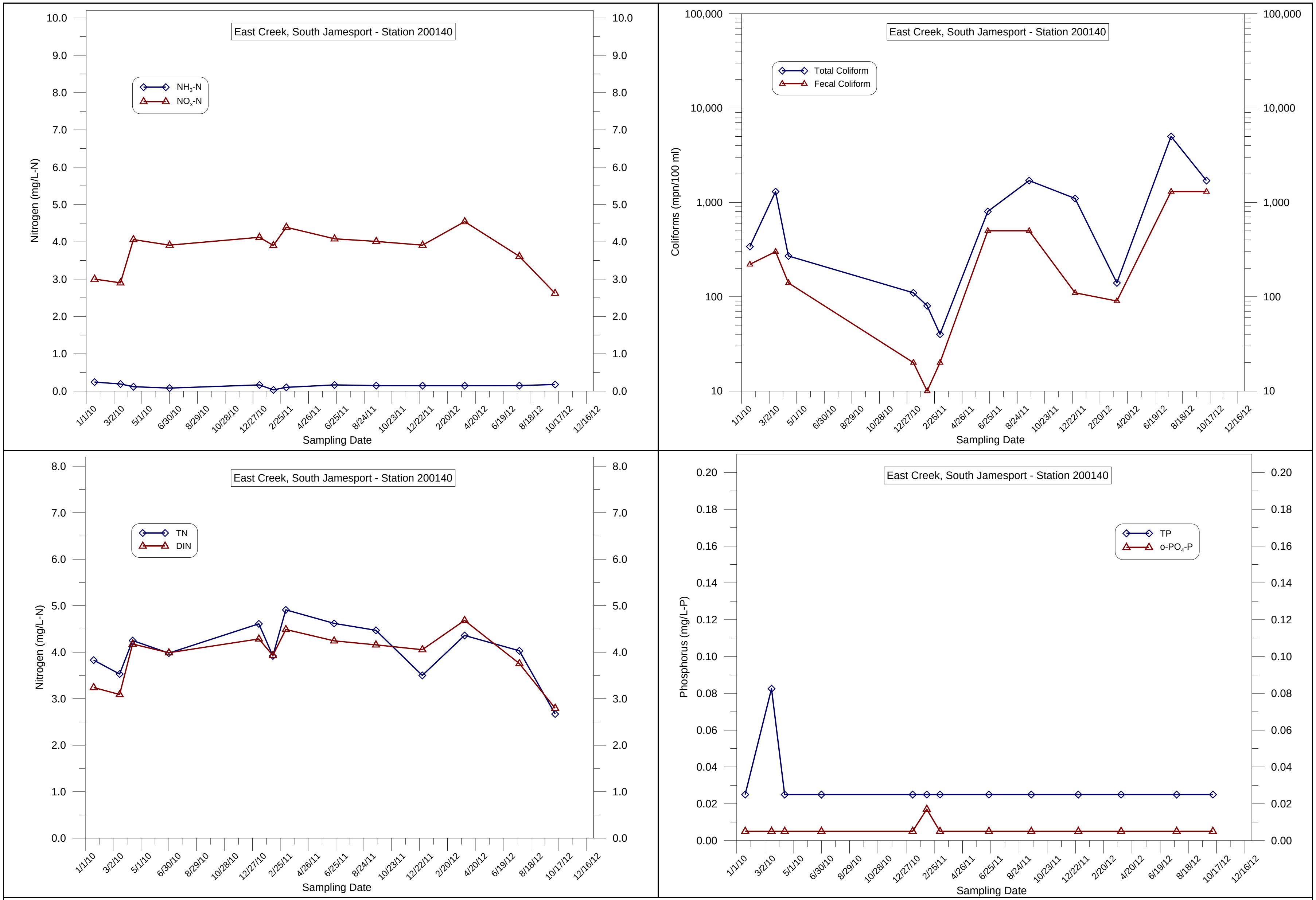
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Sawmill Creek (Station 2000110), 2010-2012



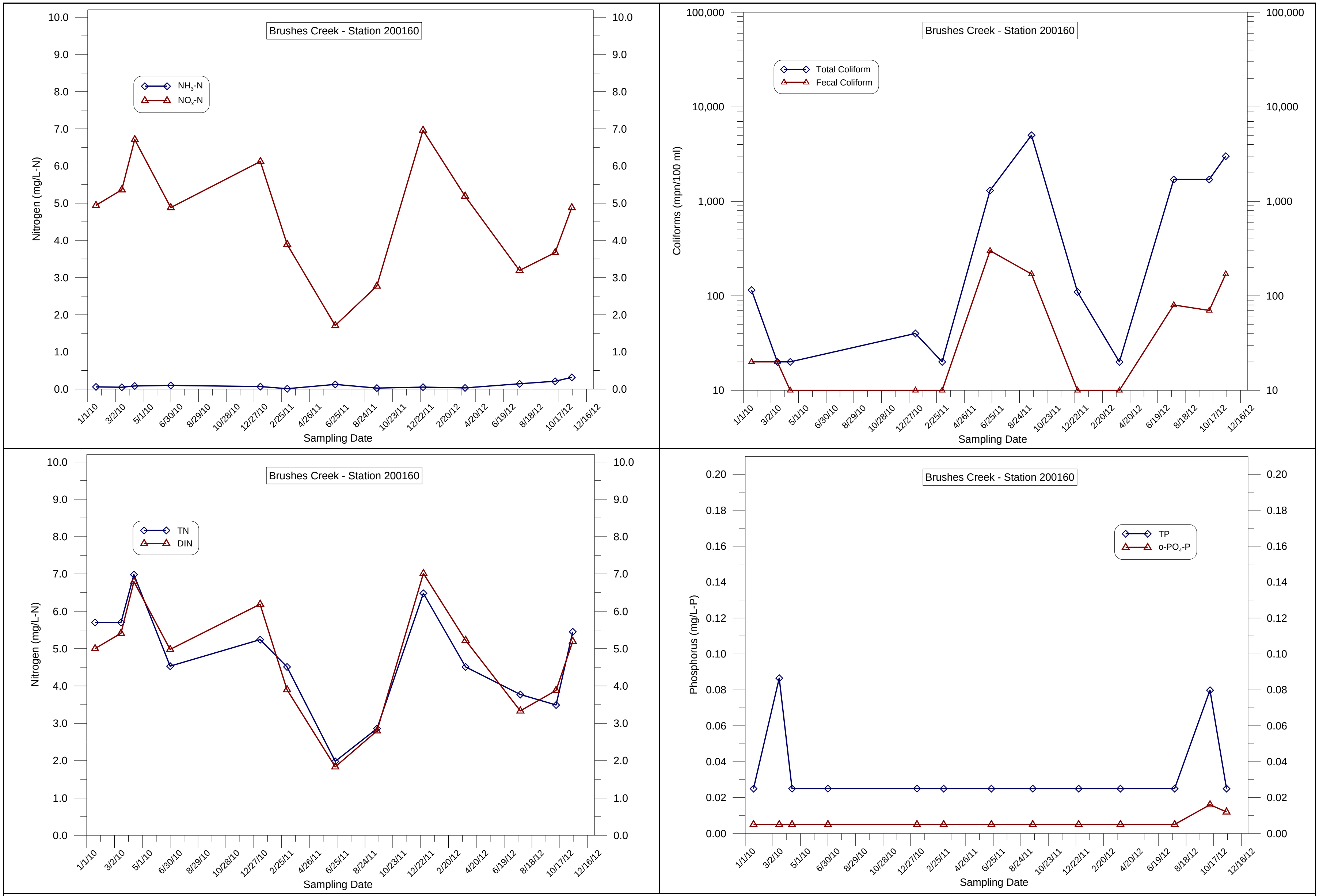
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Terrys Creek (Station 200120), 2010-2012



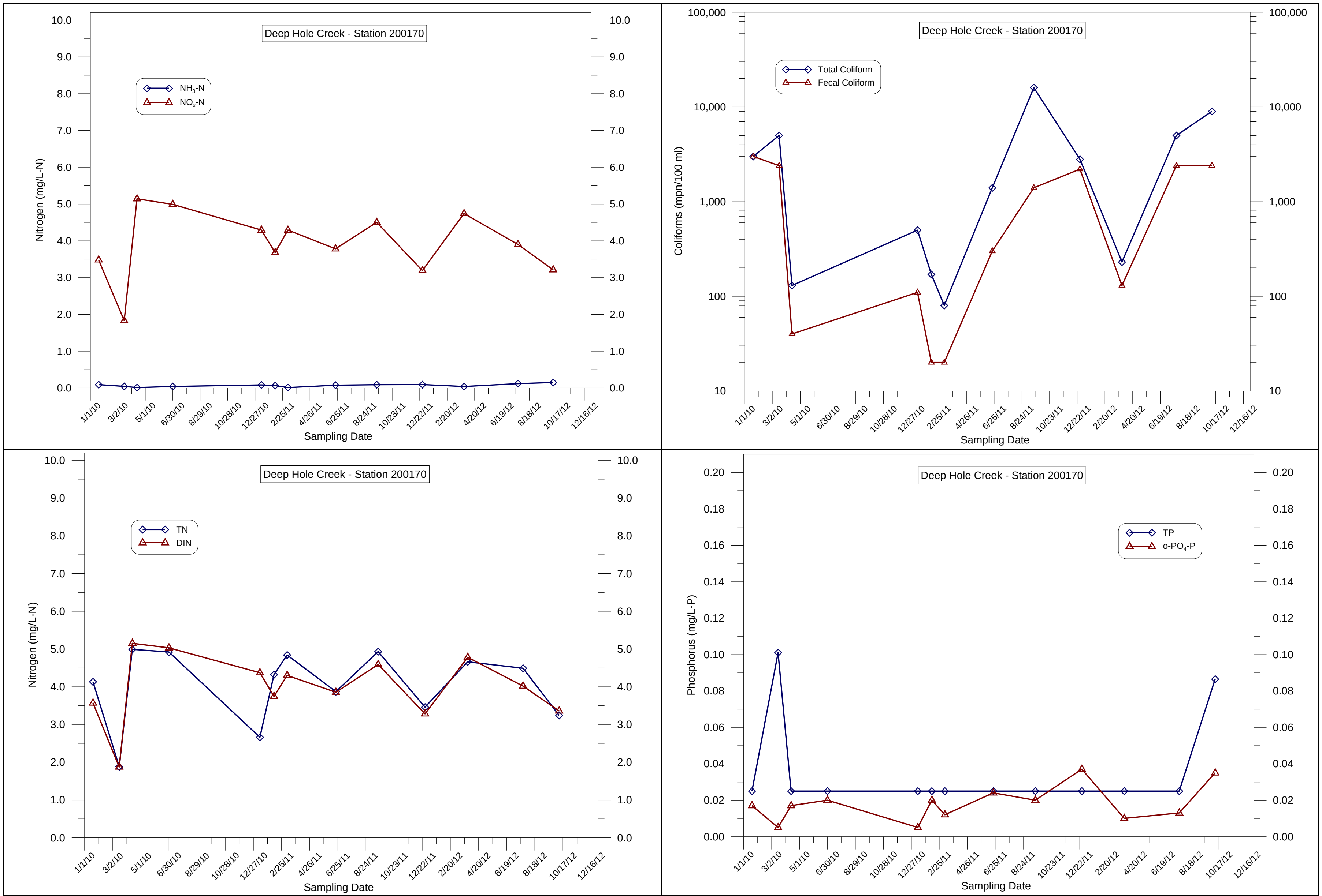
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Reeves Creek (Station 200130), 2010-2012



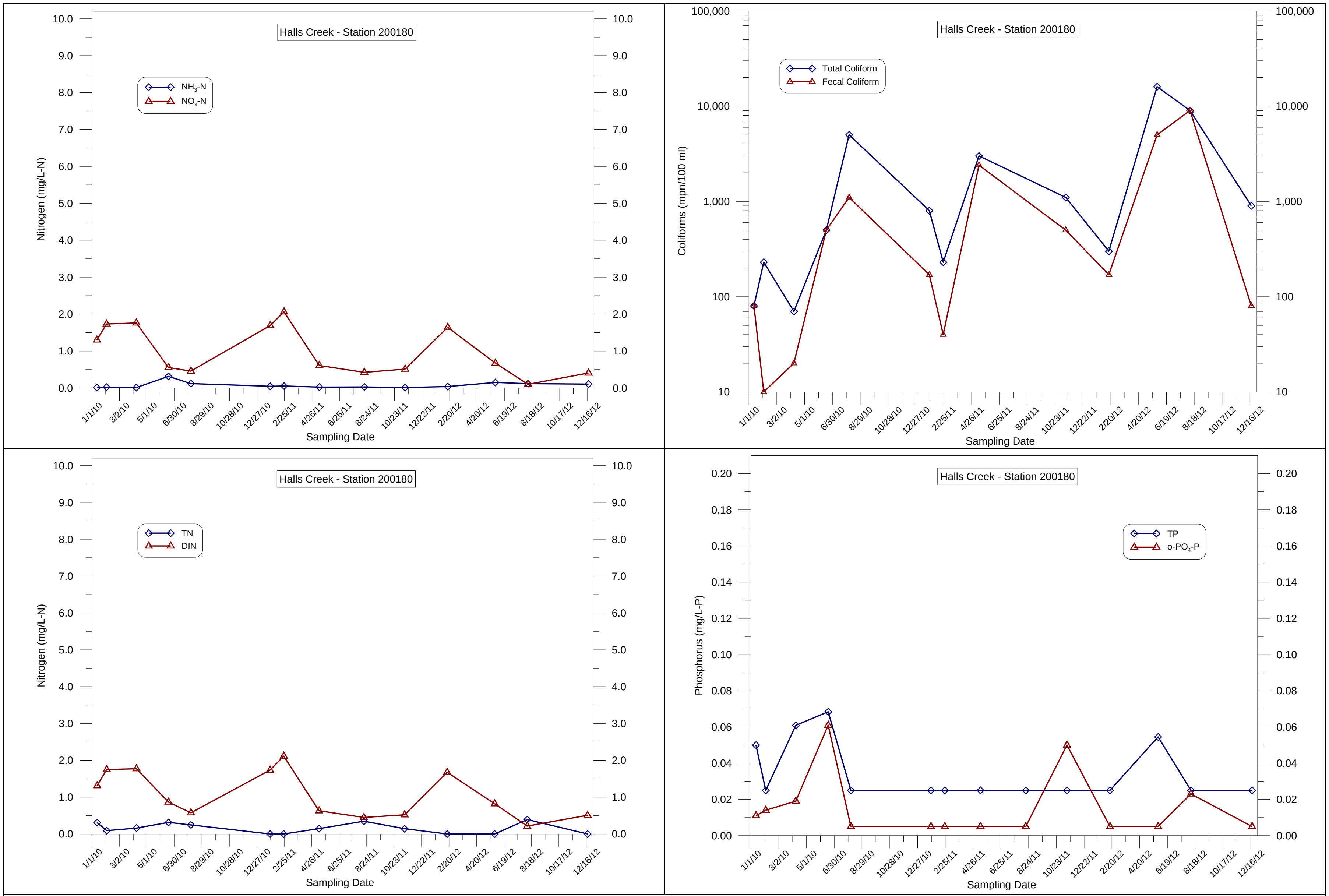
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in East Creek, S. Jamesport (Station 200140), 2010-2012



Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Brushes Creek (Station 200160), 2010-2012

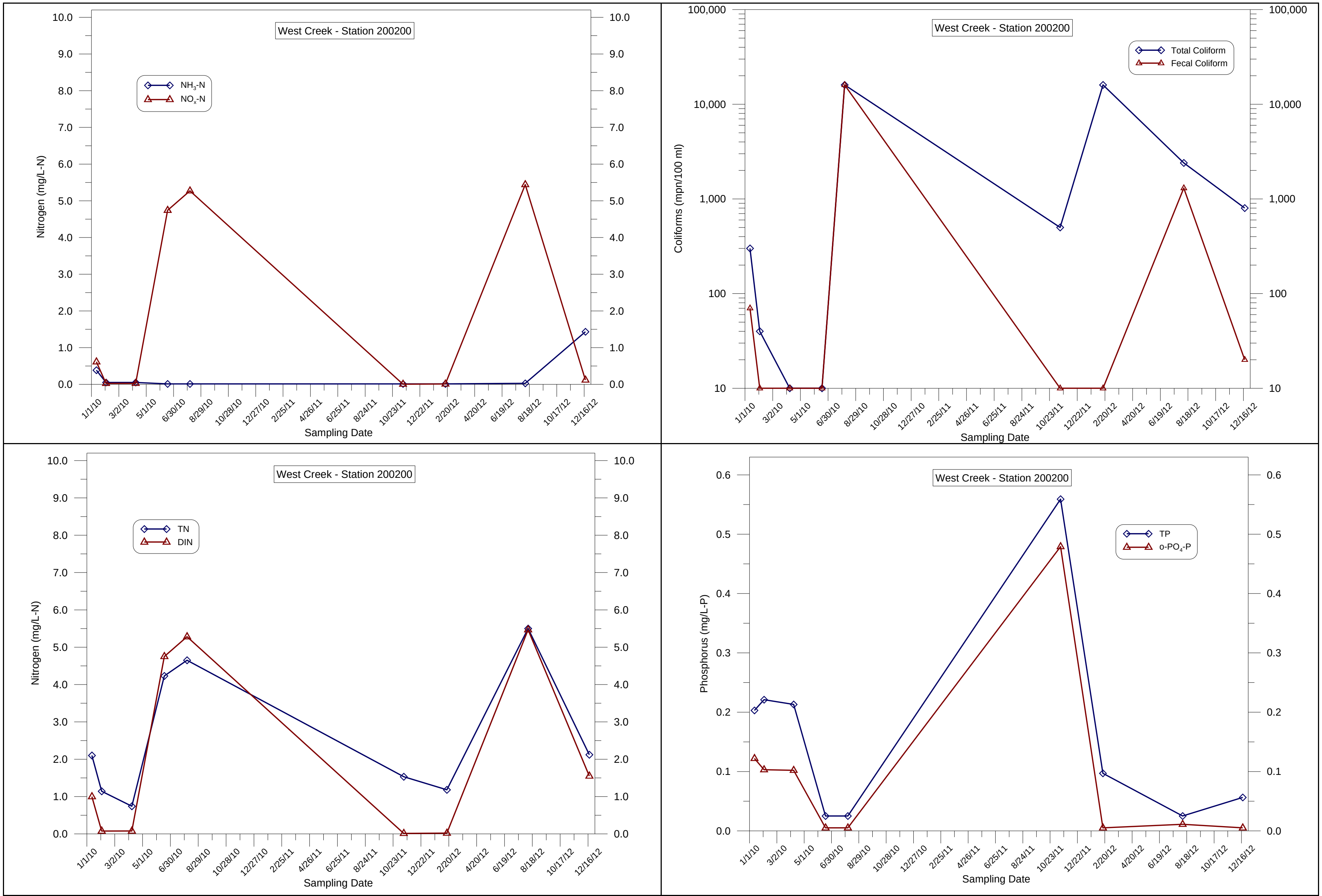


Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Deep Hole Creek (Station 200170), 2010-2012



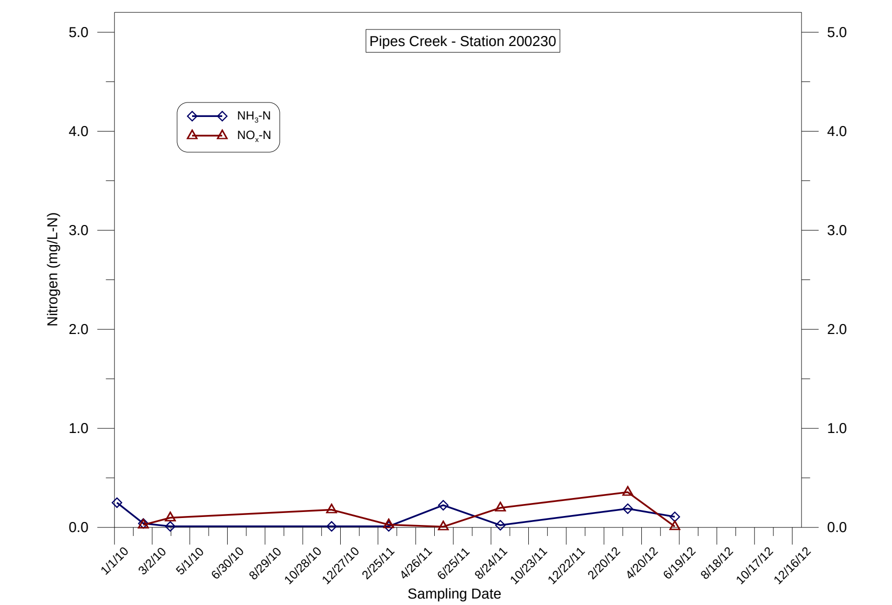
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Halls Creek (Station 200180), 2010-2012

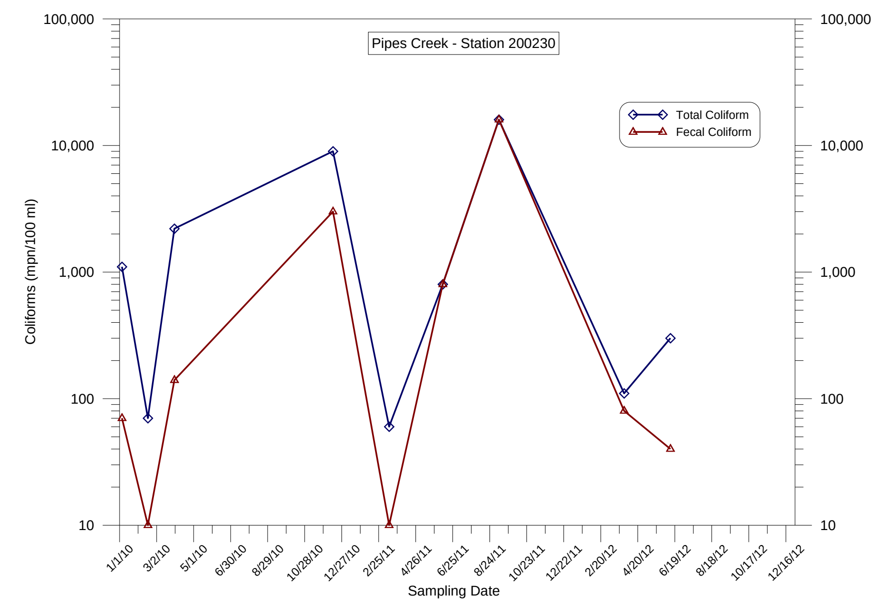
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Downs Creek (Station 200190), 2010-2012

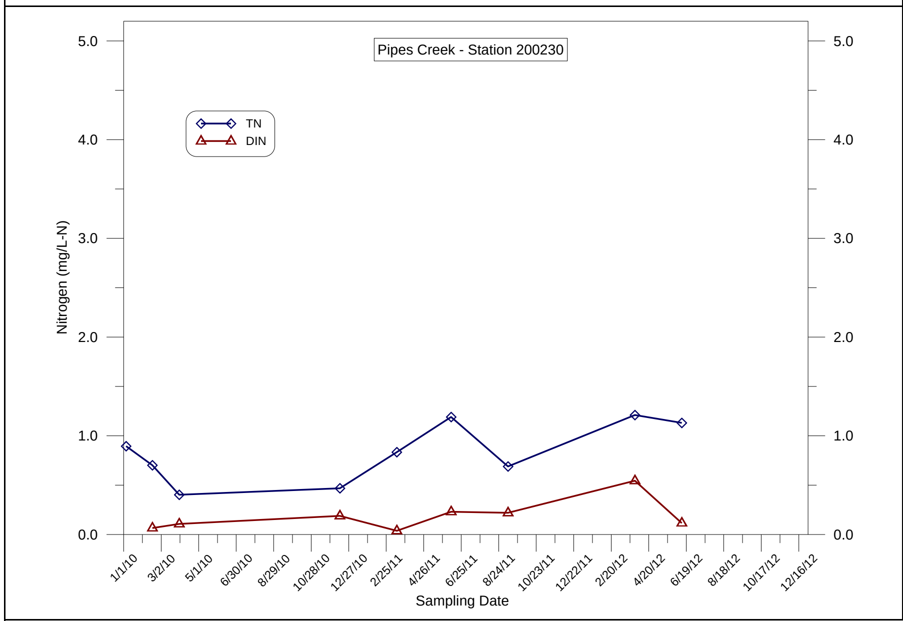


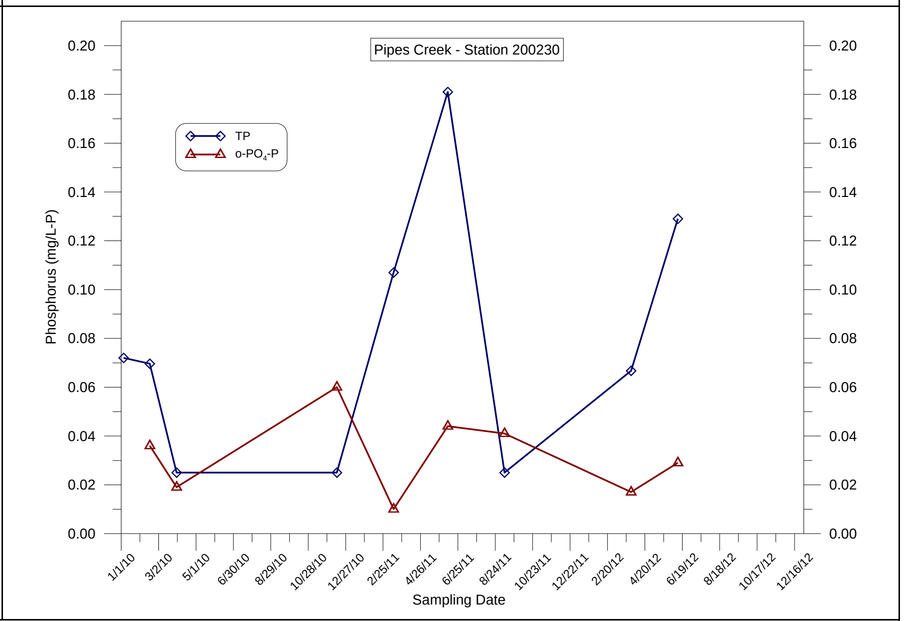
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in West Creek (Station 200200), 2010-2012

Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in East Creek, Cutchogue (Station 200210), 2010-2012

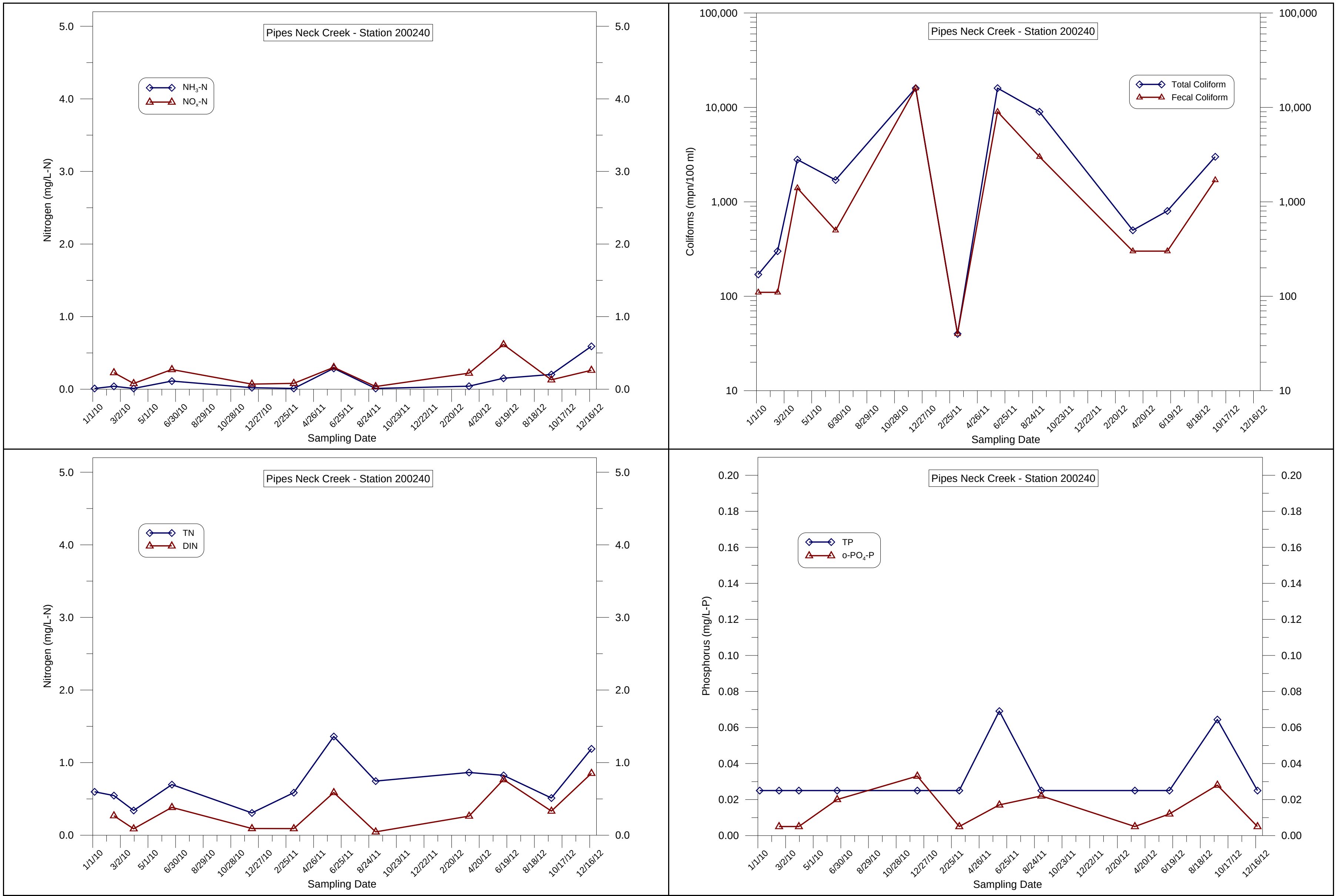




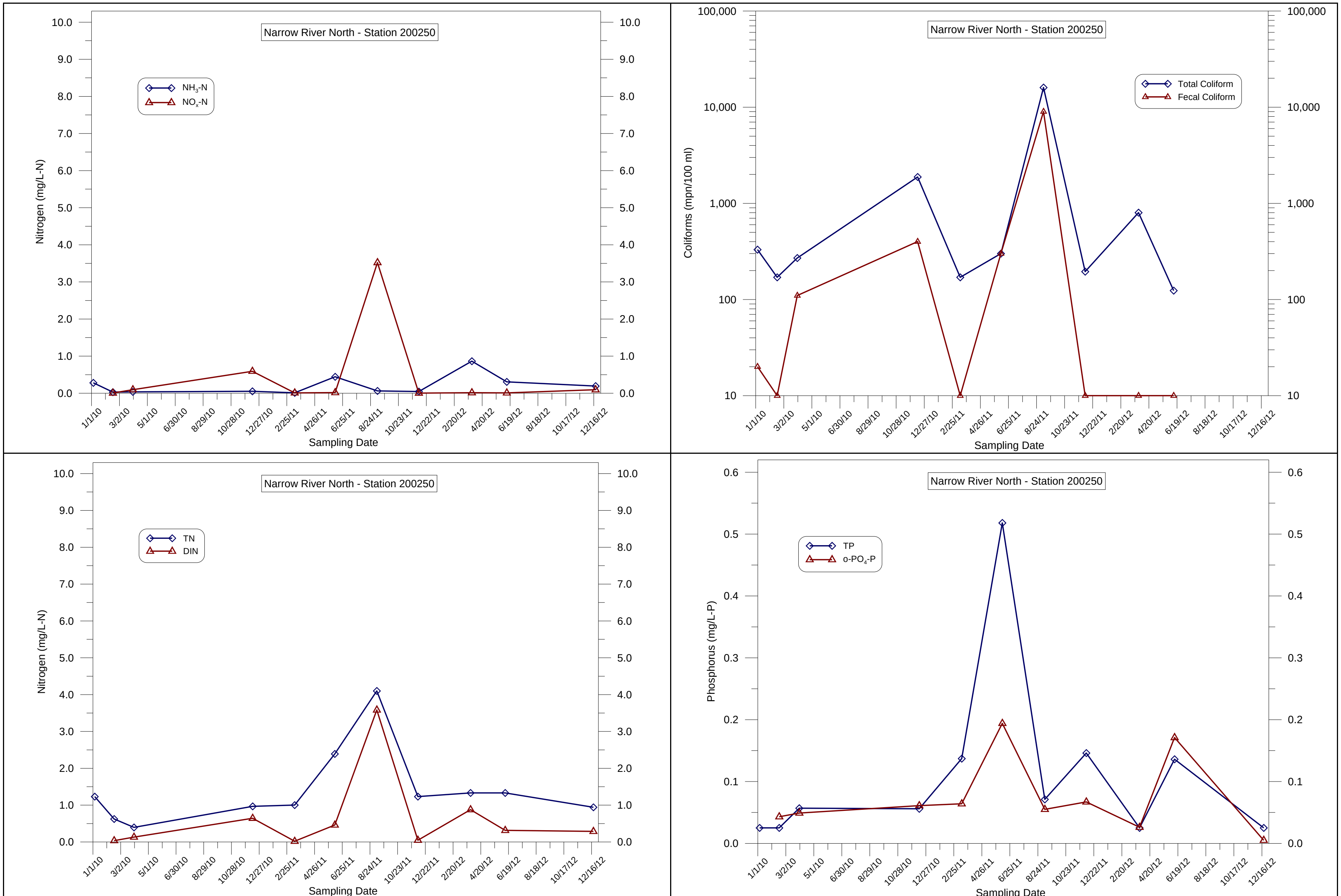




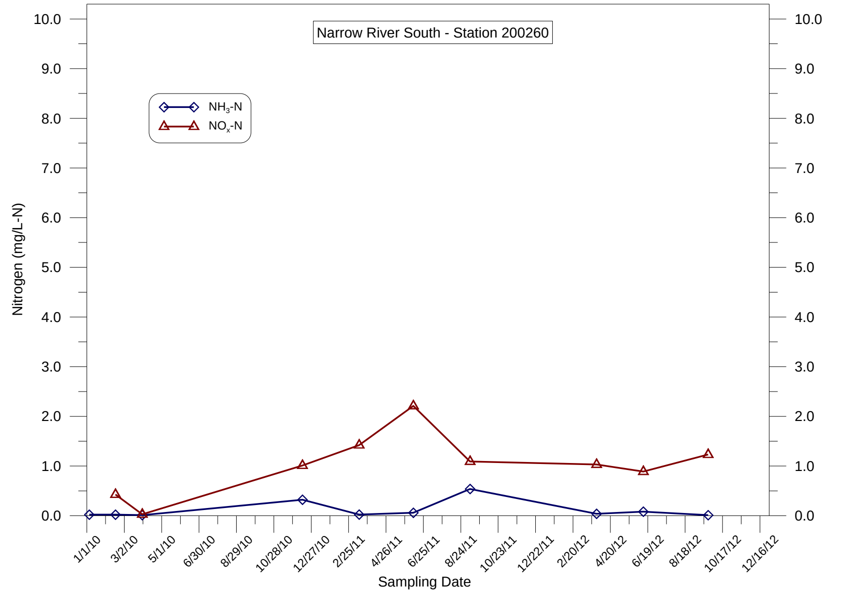
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Pipes Creek (Station 200230), 2010-2012

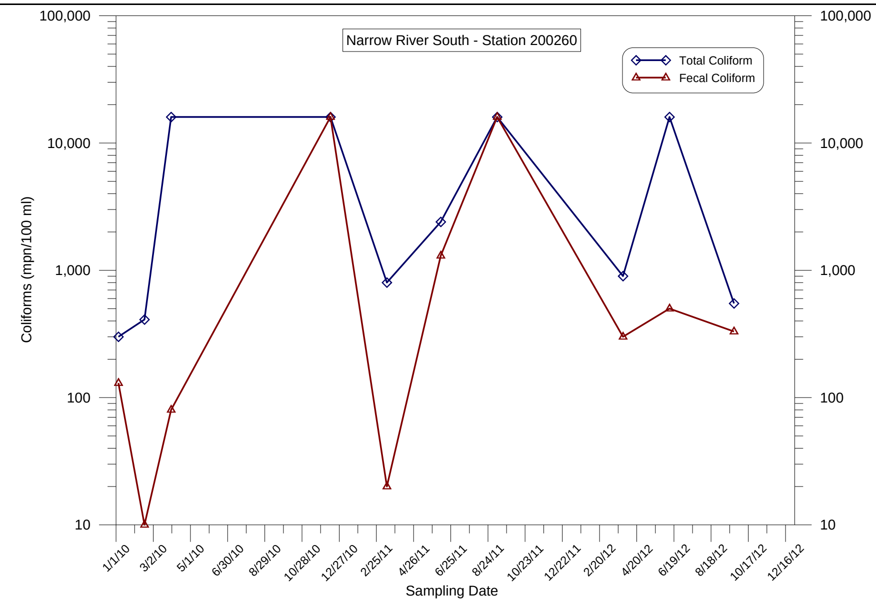


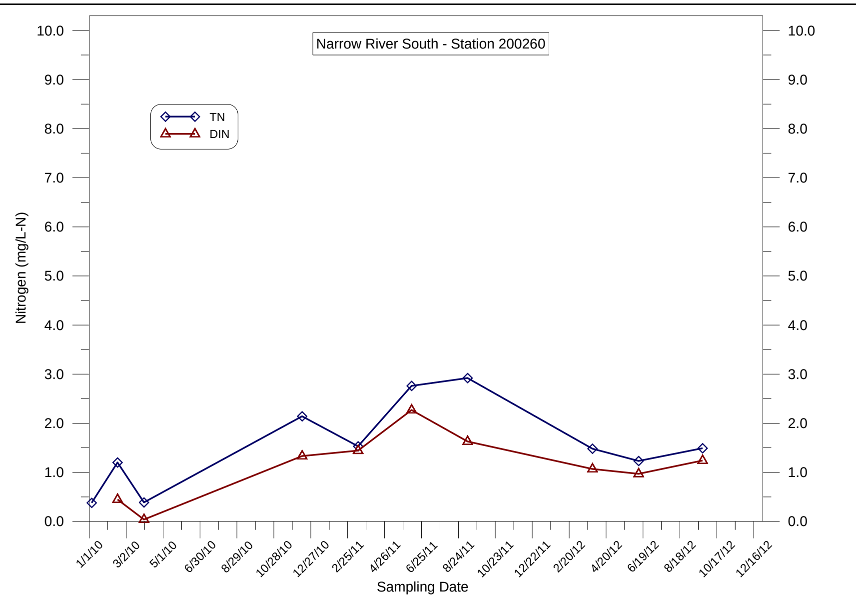
Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Pipes Neck Creek (Station 200240), 2010-2012

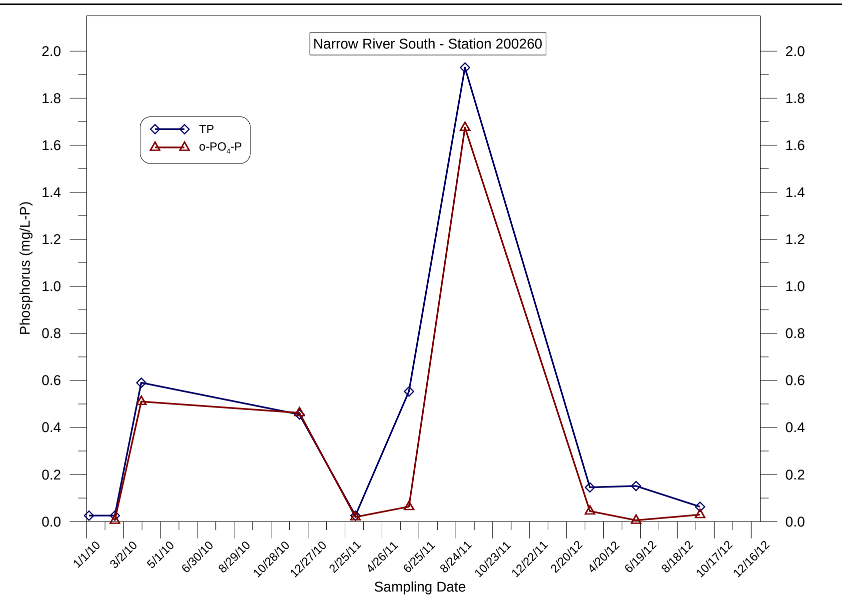


Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO_4-P), Ammonia (NH_3-N), Nitrate+Nitrite (NO_x-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Narrow River (Station 200250), 2010-2012









Temporal variations in Total and Fecal Coliform Bacteria, Total Phosphorus (TP), ortho-Phosphate (o-PO$_4$-P), Ammonia (NH$_3$-N), Nitrate+Nitrite (NO$_x$-N), Total Nitrogen (TN) and Dissolved Inorganic Nitrogen (DIN) in Narrow River (Station 200260), 2010-2012

Appendix D1

Organic Compounds Monitored in Peconic Estuary Streams

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method

Compound Name	Units	MRL
Methyl Carbamate Pesticides (EPA Method 531.1):		
1-Naphthol	ug/l	1
3-Hydroxycarbofuran	ug/l	1
Aldicarb	ug/l	1
Aldicarb sulfone	ug/l	1
Aldicarb sulfoxide	ug/l	1
A-Naphthol	ug/l	1
Carbaryl	ug/l	1
Carbofuran	ug/l	1
Methiocarb	ug/l	1
Methiocarb sulfone	ug/L	0.5
Methomyl	ug/l	1
Oxamyl	ug/l	1
Propoxur	ug/l	1
Chlorinated Acids (EPA Method 555):		
2,4,5-T	ug/l	0.5
2,4-D	ug/l	0.5
2,4-DB	ug/l	0.5
3,5-Dichlorobenzoic Acid	ug/l	0.5
4-Nitrophenol	ug/l	0.5
Acifluorfen	ug/l	0.5
Bentazon	ug/l	0.5
Chloramben	ug/l	0.5
Dicamba	ug/l	0.5
Dichloroprop	ug/l	0.5
Dinoseb	ug/l	0.5
MCPA	ug/l	0.5
MCPP	ug/l	0.5
Pentachlorophenol	ug/l	0.5
Picloram	ug/l	0.5
Silvex (2,4,5-TP)	ug/l	0.5

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued

Compound Name	Units	MRL
Dacthal Metabolites (Suffolk County Method No. 1):		
Monomethyltetrachloroterephthalate	ug/l	10
Tetrachloroterephthalic Acid	ug/l	10
Herbicide Metabolites (Suffolk County Method No. 2):		
2,6-Dichlorobenzamide	ug/L	0.5
2-Hydroxyatrazine	ug/l	0.3
Alachlor ESA	ug/l	0.2
Alachlor OA	ug/l	0.4
Deisopropylatrazine	ug/l	0.2
Desethylatrazine	ug/l	0.4
Didealkylatrazine	ug/l	0.8
Diuron	ug/L	0.2
Imidacloprid	ug/L	0.2
Imidacloprid Urea	ug/L	0.2
Malaoxon	ug/l	0.2
Metolachlor ESA (CGA-354743)	ug/l	0.2
Metolachlor Metabolite (CGA-37735)	ug/l	0.2
Metolachlor Metabolite (CGA-40172)	ug/l	0.3
Metolachlor Metabolite (CGA-41638)	ug/l	0.2
Metolachlor Metabolite (CGA-67125)	ug/l	0.3
Metolachlor OA (CGA-51202)	ug/l	0.3
Propamocarb hydrochloride	ug/L	0.3
Siduron	ug/L	0.3
Trichlorfon	ug/L	0.3
Microextractables (EPA Method 504.1):		
1,2-dibromo-3-chloropropane	ug/l	0.02
1,2-Dibromoethane	ug/l	0.02
Organohalide Pesticides (EPA Method 505):		
4,4 DDD	ug/l	0.2
4,4 DDE	ug/l	0.2
4,4 DDT	ug/l	0.2
Alachlor	ug/l	0.5

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued		
Compound Name	**Units**	**MRL**
Organohalide Pesticides (EPA Method 505), continued:		
Aldrin	ug/l	0.2
Alpha - BHC	ug/l	0.2
Beta - BHC	ug/l	0.2
Chlordane	ug/l	1
Delta - BHC	ug/l	0.2
Dieldrin	ug/l	0.2
Endosulfan I	ug/l	0.2
Endosulfan II	ug/l	0.2
Endosulfan sulfate	ug/l	0.2
Endrin	ug/l	0.2
Endrin aldehyde	ug/l	0.2
Gamma - BHC	ug/l	0.2
Heptachlor	ug/l	0.2
Heptachlor epoxide	ug/l	0.2
Methoxychlor	ug/l	0.5
Semi-volatile Organic Compounds (EPA Method 525.2):		
1-Methylnaphthalene	ug/l	0.2
2-Methylnaphthalene	ug/l	0.2
4-Hydroxyphenytoin	ug/L	0.5
Acenaphthene	mg/L	0.2
Acenaphthylene	mg/L	0.2
Acetaminophen	ug/L	0.2
Acetochlor	ug/l	0.2
Allethrin	ug/l	0.2
Anthracene	mg/L	0.5
Atrazine	ug/l	0.2
Azoxystrobin	ug/l	0.5
Benfluralin	ug/l	0.5
Benzo(a)anthracene	mg/L	0.5
Benzo(b)fluoranthene	mg/L	0.2
Benzo(ghi)perylene	mg/L	0.2

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued		
Compound Name	**Units**	**MRL**
Semi-volatile Organic Compounds (EPA Method 525.2), continued:		
Benzo-a-pyrene	ug/l	0.2
Benzophenone	mg/L	0.2
Benzyl butyl phthalate	ug/l	0.2
bis(2-ethylhexyl) adipate	ug/l	0.5
bis(2-ethylhexyl) phthalate	ug/l	2
Bisphenol A	ug/L	0.2
Bloc	ug/l	0.2
Bromacil	ug/l	0.5
Butachlor	ug/l	0.2
Butylated Hydroxyanisole	mg/L	0.5
Butylated Hydroxytoluene	mg/L	0.2
Caffeine	ug/l	0.2
Carbamazepine	ug/L	0.2
Carbazole	ug/L	0.2
Carisoprodol	mg/L	0.2
Chlorofenvinphos	mg/L	0.2
Chlorothalonil	ug/l	1
Chloroxylenol	mg/L	0.2
Chlorpyriphos	ug/l	0.2
Chrysene	mg/L	0.2
Cyanazine	ug/l	0.2
Cyfluthrin	ug/l	0.2
Cypermethrin	ug/l	0.5
Dacthal	ug/l	0.2
Deltamethrin	ug/l	0.5
Diazinon	ug/l	0.2
Dibenzo(a,h)anthracene	mg/L	0.2
Dibutyl phthalate	ug/l	1
Dichlobenil	ug/l	0.2
Dichlorvos	ug/l	0.5
Diethyl phthalate	ug/l	1

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued		
Compound Name	**Units**	**MRL**
Semi-volatile Organic Compounds (EPA Method 525.2), continued:		
Diethyltoluamide (DEET)	mg/L	0.2
Dimethyl phthalate	ug/l	0.2
Dioctyl phthalate	ug/l	0.2
Disulfoton	ug/l	0.5
Disulfoton sulfone	ug/l	0.2
EPTC	ug/l	0.2
Ethofumesate	ug/l	0.2
Ethyl parathion	ug/l	0.2
Fluoranthene	mg/L	0.2
Fluorene	mg/L	0.2
Gemfibrozil	mg/L	0.5
Hexachlorobenzene	ug/l	0.2
Hexachlorocyclopentadiene	ug/l	1
Hexachloroethane	ug/L	1
Hexazinone	ug/L	0.2
Ibuprofen	mg/L	0.2
Indeno(1,2,3-cd)pyrene	mg/L	0.2
Iodofenphos	ug/l	0.2
Iprodione	ug/l	0.5
Isofenphos	ug/l	0.5
Kelthane	ug/l	0.5
Malathion	ug/l	0.5
Metalaxyl	ug/l	0.2
Methoprene	ug/l	0.2
Methyl parathion	ug/l	0.2
Metolachlor	ug/l	0.2
Metribuzin	ug/l	0.2
Naled (Dibrom)	ug/l	0.2
Napropamide	ug/l	0.2
Pendimethalin	ug/l	0.2
Pentachlorobenzene	ug/l	0.2

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued		
Compound Name	**Units**	**MRL**
Semi-volatile Organic Compounds (EPA Method 525.2), continued:		
Pentachloronitrobenzene	ug/l	0.2
Permethrin	ug/l	0.2
Phenanthrene	mg/L	0.2
Phenytoin (Dilantin)	ug/L	0.2
Piperonyl butoxide	ug/l	0.5
Prometon	ug/l	0.5
Prometryne	ug/l	0.2
Propachlor	ug/l	0.2
Propiconazole (TILT)	ug/l	0.2
Pyrene	mg/L	0.5
Resmethrin	ug/l	0.2
Ronstar	ug/L	0.2
Simazine	ug/l	0.2
Sumithrin	ug/l	0.2
Tebuthiuron	ug/l	0.5
Terbacil	ug/l	0.5
Terbufos	ug/l	0.2
Triadimefon	ug/l	0.5
Triclosan	mg/L	0.2
Trifluralin	ug/l	0.5
Triphenyl phosphate	ugL	0.5
Vinclozolin	ug/L	0.5
Volatile Organic Compounds (EPA Method 524.2):		
1,1,1,2-Tetrachloroethane	ug/l	0.5
1,1,1-Trichloroethane	ug/l	0.5
1,1,2,2-Tetrachloroethane	ug/l	0.5
1,1,2-Trichloroethane	ug/l	0.5
1,1-Dichloroethane	ug/l	0.5
1,1-Dichloroethene	ug/l	0.5
1,1-Dichloropropene	ug/l	0.5
1,2 dibromoethane	ug/l	0.02

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued

Compound Name	Units	MRL
Volatile Organic Compounds (EPA Method 524.2), continued:		
1,2 dibromomethane	ug/l	0.02
1,2,3-Trichlorobenzene	ug/l	0.5
1,2,3-Trichloropropane	ug/l	0.5
1,2,4,5-Tetramethylbenzene	ug/l	0.5
1,2,4-Trichlorobenzene	ug/l	0.5
1,2,4-Trimethylbenzene	ug/l	0.5
1,2-Dichlorobenzene (o)	ug/l	0.5
1,2-Dichloroethane	ug/l	0.5
1,2-Dichloropropane	ug/l	0.5
1,3,5-Trimethylbenzene	ug/l	0.5
1,3-Dichlorobenzene (m)	ug/l	0.5
1,3-Dichloropropane	ug/l	0.5
1,4-Dichlorobenzene (p)	ug/l	0.5
1,4-Dichlorobutane	ug/l	0.5
1-Bromo-2-chloroethane	ug/l	0.5
1-Methylethylbenzene	ug/l	0.5
2,2-Dichloropropane	ug/l	0.5
2,3-Dichloropropene	ug/l	0.5
2-Bromo-1-chloropropane	ug/l	0.5
2-Butanone (MEK)	ug/l	20
2-Chlorotoluene	ug/l	0.5
3-Chlorotoluene	ug/l	0.5
4-Chlorotoluene	ug/l	0.5
Acrylonitrile	ug/l	0.5
Allyl chloride	ug/l	0.5
Benzene	ug/l	0.5
Bromobenzene	ug/l	0.5
Bromochloromethane	ug/l	0.5
Bromodichloromethane	ug/l	0.5
Bromoform	ug/l	0.5
Bromomethane	ug/l	0.5

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued		
Compound Name	**Units**	**MRL**
Volatile Organic Compounds (EPA Method 524.2), continued:		
Carbon disulfide	ug/l	0.5
Carbon Tetrachloride	ug/l	0.5
Chlorobenzene	ug/l	0.5
Chlorodibromomethane	ug/l	0.5
Chlorodifluoromethane	ug/l	0.5
Chloroethane	ug/l	0.5
Chloroform	ug/l	0.5
Chloromethane	ug/l	0.5
cis-1,2-Dichloroethene	ug/l	0.5
cis-1,3-Dichloropropene	ug/l	0.5
Dibromomethane	ug/l	0.5
Dichlorodifluoromethane	ug/l	0.5
Diethyl ether	ug/l	0.5
Dimethyldisulfide	ug/l	0.5
d-Limonene	ug/l	0.5
Ethenylbenzene (Styrene)	ug/l	0.5
Ethylbenzene	ug/l	0.5
Ethylmethacrylate	ug/l	0.5
Freon 113	ug/l	0.5
Hexachlorobutadiene	ug/l	0.5
Isobutane	ug/L	2
Isopropylbenzene	ug/L	0.5
Isopropyltoluene (p-cymene)	ug/l	0.5
m,p-Dichlorobenzene	ug/l	0.5
m,p-Xylene	ug/l	0.5
Methacrylonitrile	ug/l	0.5
Methyl isothiocyanate	ug/l	2
Methyl sulfide	ug/l	0.5
Methylene Chloride	ug/l	0.5
Methylmethacrylate	ug/l	0.5
Methyl-Tertiary-Butyl-Ether	ug/l	0.5

Appendix D1. Organic Compounds Monitored in Peconic Estuary Streams, Listed by Laboratory Method, continued

Compound Name	Units	MRL
Volatile Organic Compounds (EPA Method 524.2), continued:		
m-Xylene	ug/l	0.5
Naphthalene	ug/l	0.5
n-Butane	ug/L	2
n-Butylbenzene	ug/l	0.5
n-Propane	ug/L	2
n-Propylbenzene	ug/l	0.5
o-Xylene	ug/l	0.5
p-Diethylbenzene	ug/l	0.5
p-Isopropyltoluene	ug/L	0.5
Propanal	ug/l	15
p-Xylene	ug/l	0.5
sec-Butylbenzene	ug/l	0.5
tert-Amyl-Methyl-Ether	ug/l	0.5
tert-Butylbenzene	ug/l	0.5
tert-Butyl-Ethyl-Ether	ug/l	0.5
Tetrachloroethene	ug/l	0.5
Tetrahydrofuran	ug/l	20
Toluene	ug/l	0.5
Total Chlorotoluene	ug/l	0.5
Total Xylene	ug/l	0.5
trans-1,2-Dichloroethene	ug/l	0.5
trans-1,3-Dichloropropene	ug/l	0.5
Trichloroethene	ug/l	0.5
Trichlorofluoromethane	ug/l	0.5
Vinyl Chloride	ug/L	0.5

Appendix D2

Metal Analytes Monitored in Peconic Estuary Streams

Appendix D2. Metal Analytes Monitored in Peconic Estuary Streams		
Analyte Name	Units	MRL
Aluminum	ug/L	5
Antimony	ug/L	0.4
Arsenic	ug/L	1
Barium	ug/L	1
Beryllium	ug/L	0.3
Cadmium	ug/L	1
Calcium	mg/L	0.1
Chromium	ug/L	1
Cobalt	ug/L	1
Copper	ug/L	1
Germanium	ug/L	1
Iron	mg/L	0.1
Lead	ug/L	1
Magnesium	mg/L	0.1
Manganese	ug/L	1
Mercury	ug/L	0.4
Molybdenum	ug/L	1
Nickel	ug/L	0.5
Potassium	mg/L	0.1
Selenium	ug/L	4
Silver	ug/L	5
Sodium	mg/L	1
Strontium	ug/L	1
Tellurium	ug/L	1
Thallium	ug/L	0.3
Thorium	ug/L	4
Titanium	ug/L	1
Uranium	ug/L	1
Vanadium	ug/L	1
Zinc	ug/L	50

Appendix E1

Organic Compounds Identified in Peconic Estuary Streams With the Number of Detects, Detection Frequency and Sample Concentrations

Appendix E1. Organic Compounds Identified in Peconic Estuary Streams with the Number of Detects, Detection Frequency and Sample Concentrations (2010-2012)

Station	Compound Detected	Compound Group	No. of Samples	No. of Positive Detects	Detection[1] Frequency (%)	Concentration (ug/L)	
						Mean	Max
Meetinghouse Creek (duck farm site) Station 200004	Alachlor ESA	Herbicide Metabolite	14	11	79	0.2	0.3
	Caffeine	PPCP	14	1	7	0.3	0.3
	Methyl-tertiary-butyl-ether	VOC	13	5	38	1.2	2.6
	Metolachlor ESA	Herbicide Metabolite	14	12	86	0.6	1.1
	Metolachlor OA	Herbicide Metabolite	14	12	86	0.4	0.5
Meetinghouse Creek (at Rt. 25) Station 200041	Aldicarb sulfone	Insecticide Metabolite	15	5	33	0.5	0.5
	Diethyltoluamide (DEET)	PPCP	15	2	13	0.3	0.3
Peconic River (at USGS Gage) Station 200010	1,1-Dichloroethene	VOC	14	3	21	0.6	0.7
	Freon 113	VOC	14	11	79	1.2	2.2
Peconic River (at Grangebel Park) Station 200017	Freon 113	VOC	14	5	36	0.6	0.9
Peconic River (at BNL) Station 200044	Bisphenol A	PPCP	13	1	8	0.2	0.2
	Chlorodifluoromethane	VOC	13	1	8	0.6	0.6
	Chloroform	VOC	13	1	8	0.9	0.9
	Diethyl ether	VOC	13	1	8	8.4	8.4
	Diethyltoluamide (DEET)	PPCP	13	1	8	0.2	0.2
	Phenytoin (Dilantin)	PPCP	13	1	8	0.2	0.2

[1] *Refers to the percentage of positive detects in samples from each station rather than a percentage of all organic samples collected*

Appendix E1. Organic Compounds Identified in Peconic Estuary Streams with the Number of Detects, Detection Frequency and Sample Concentrations (2010-2012), continued

Station	Compound Detected	Compound Group	No. of Samples	No. of Positive Detects	Detection[1] Frequency (%)	Concentration (ug/L)	
						Mean	Max
Goose Creek Station 200013	Diethyltoluamide (DEET)	PPCP	15	1	7	1.4	1.4
Birch Creek Station 200014	Caffeine	PPCP	15	1	7	0.2	0.2
	Diethyltoluamide (DEET)	PPCP	15	1	7	1.1	1.1
Mill Creek Station 200015	Caffeine	PPCP	15	1	7	0.2	0.2
	Diethyltoluamide (DEET)	PPCP	15	1	7	0.7	0.7
Hubbard Creek Station 200016	Diethyltoluamide (DEET)	PPCP	15	1	7	1.8	1.8
Sawmill Creek Station 200110	Dichlorvos	Insecticide	16	1	6	0.7	0.7
	Methyl-tertiary-butyl-ether	VOC	15	3	20	1.2	2.2
	Metolachlor ESA	Herbicide Metabolite	16	13	81	0.6	1.4
	Metolachlor OA	Herbicide Metabolite	16	3	19	0.4	0.5
	Simazine	Herbicide	16	1	6	0.5	0.5
Terrys Creek Station 200120	Aldicarb sulfoxide	Insecticide Metabolite	14	2	14	0.5	0.5
	Metolachlor ESA	Herbicide Metabolite	14	14	100	0.7	1.5
	Metolachlor OA	Herbicide Metabolite	14	13	93	0.5	0.7
Reeves Creek Station 200130	Alachlor ESA	Herbicide Metabolite	13	2	15	0.2	0.2
	Bromoform	VOC	13	1	8	0.6	0.6
	Diethyltoluamide (DEET)	PPCP	13	1	8	4.7	4.7
	Metalaxyl	Fungicide	13	4	31	0.2	0.3
	Metolachlor ESA	Herbicide Metabolite	13	13	100	1.5	2.8
	Metolachlor OA	Herbicide Metabolite	13	12	92	1.2	3.5
	Propanal	VOC	13	1	8	16.0	16.0

[1] *Refers to the percentage of positive detects in samples from each station rather than a percentage of all organic samples collected*

Appendix E1. Organic Compounds Identified in Peconic Estuary Streams with the Number of Detects, Detection Frequency and Sample Concentrations (2010-2012), continued

Station	Compound Detected	Compound Group	No. of Samples	No. of Positive Detects	Detection[1] Frequency (%)	Concentration (ug/L)	
						Mean	Max
East Creek, South Jamesport Station 200140	2,6-Dichlorobenzamide	Herbicide Metabolite	13	2	15	0.6	0.6
	Alachlor ESA	Herbicide Metabolite	13	12	92	0.3	0.6
	Caffeine	PPCP	13	1	8	0.5	0.5
	Deisopropylatrazine	Herbicide Metabolite	13	1	8	0.2	0.2
	Diethyltoluamide (DEET)	PPCP	13	2	15	4.2	8.1
	Metalaxyl	Fungicide	13	4	31	0.3	0.4
	Metolachlor	Herbicide	13	1	8	0.2	0.2
	Metolachlor ESA	Herbicide Metabolite	13	13	100	2.0	5.5
	Metolachlor OA	Herbicide Metabolite	13	12	92	1.5	2.7
Brushes Creek Station 200160	2,6-Dichlorobenzamide	Herbicide Metabolite	13	13	100	7.0	9.7
	Alachlor ESA	Herbicide Metabolite	13	13	100	0.7	1.7
	Deisopropylatrazine	Herbicide Metabolite	13	5	38	0.5	0.9
	Dichlobenil	Herbicide	13	3	23	1.3	1.5
	Diethyltoluamide (DEET)	PPCP	13	1	8	44.0	44.0
	Imidacloprid	Insecticide	13	5	38	0.3	0.5
	Metalaxyl	Fungicide	13	12	92	0.6	1.4
	Metolachlor ESA	Herbicide Metabolite	13	13	100	0.6	0.9
	Metolachlor OA	Herbicide Metabolite	13	6	46	0.4	0.4
	Ronstar	Herbicide	13	2	15	1.3	2.0

[1] *Refers to the percentage of positive detects in samples from each station rather than a percentage of all organic samples collected*

Appendix E1. Organic Compounds Identified in Peconic Estuary Streams with the Number of Detects, Detection Frequency and Sample Concentrations (2010-2012), continued

Station	Compound Detected	Compound Group	No. of Samples	No. of Positive Detects	Detection[1] Frequency (%)	Concentration (ug/L)	
						Mean	Max
Deep Hole Creek Station 200170	Aldicarb sulfone	Insecticide Metabolite	13	1	8	0.7	0.7
	Aldicarb sulfoxide	Insecticide Metabolite	13	1	8	0.6	0.6
	Deisopropylatrazine	Herbicide Metabolite	13	3	23	0.2	0.3
	Diethyltoluamide (DEET)	PPCP	13	1	8	17.0	17.0
	Metolachlor	Herbicide	13	12	92	0.5	0.7
	Metolachlor ESA	Herbicide Metabolite	13	13	100	1.0	1.6
	Metolachlor OA	Herbicide Metabolite	13	10	77	0.3	0.4
Halls Creek Station 200180	Alachlor ESA	Herbicide Metabolite	14	10	71	0.3	0.5
	Caffeine	PPCP	14	1	7	0.2	0.2
	Dinoseb	Herbicide	14	3	21	0.7	1.0
	Metolachlor	Herbicide	14	7	50	0.3	0.5
	Metolachlor ESA	Herbicide Metabolite	14	14	100	0.9	2.5
	Metolachlor OA	Herbicide Metabolite	14	10	71	0.6	0.8
Downs Creek Station 200190	Alachlor ESA	Herbicide Metabolite	14	1	7	0.2	0.2
	Aldicarb sulfoxide	Insecticide Metabolite	14	1	7	0.5	0.5
	Caffeine	PPCP	14	1	7	0.2	0.2
	Metolachlor ESA	Herbicide Metabolite	14	14	100	1.3	4.0
	Metolachlor OA	Herbicide Metabolite	14	12	86	1.3	2.8

[1] *Refers to the percentage of positive detects in samples from each station rather than a percentage of all organic samples collected*

Appendix E1. Organic Compounds Identified in Peconic Estuary Streams with the Number of Detects, Detection Frequency and Sample Concentrations (2010-2012), continued

Station	Compound Detected	Compound Group	No. of Samples	No. of Positive Detects	Detection[1] Frequency (%)	Concentration (ug/L)	
						Mean	Max
West Creek Station 200200	Aldicarb sulfone	Insecticide Metabolite	9	3	33	0.7	0.8
	Aldicarb sulfoxide	Insecticide Metabolite	9	1	11	0.5	0.5
	Caffeine	PPCP	9	1	11	0.2	0.2
	Deisopropylatrazine	Herbicide Metabolite	9	1	11	0.2	0.2
	Diethyltoluamide (DEET)	PPCP	9	1	11	0.2	0.2
East Creek, Cutchogue Station 200210	Aldicarb sulfone	Insecticide Metabolite	14	1	7	1.5	1.5
	Aldicarb sulfoxide	Insecticide Metabolite	14	1	7	1.8	1.8
	Caffeine	PPCP	14	1	7	0.3	0.3
	Metalaxyl	Fungicide	14	1	7	0.2	0.2
	Metolachlor ESA	Herbicide Metabolite	14	1	7	0.3	0.3
Pipes Creek Station 200230	Caffeine	PPCP	10	1	10	0.9	0.9
	Diethyltoluamide (DEET)	PPCP	10	1	10	0.2	0.2
	Tebuthiuron	Herbicide	10	1	10	0.3	0.3
	Toluene	VOC	10	1	10	0.5	0.5
Narrow River, North Station 200250	Caffeine	PPCP	11	1	9	0.2	0.2
	Toluene	VOC	11	3	27	1.8	3.2
Narrow River, South Station 200260	Alachlor ESA	Herbicide Metabolite	11	4	36	0.2	0.2
	Metolachlor ESA	Herbicide Metabolite	11	9	82	0.6	0.9
	Metolachlor OA	Herbicide Metabolite	11	5	45	0.4	0.5

[1] *Refers to the percentage of positive detects in samples from each station rather than a percentage of all organic samples collected*

Appendix E2

Metals of Concern Identified in Peconic Estuary Streams With the Number of Detects, Mean and Maximum Concentrations and the Number of Results Exceeding Water Quality Standards

Appendix E2. Metals of Concern Identified in Peconic Estuary Streams with the Number of Detects, Mean and Maximum Concentrations (ug/L) and the Number of Results Exceeding Standards

Station	Statistic	Arsenic (MRL = 1)	Cadmium (MRL = 1)	Chromium (MRL = 1)	Copper (MRL = 1)	Lead (MRL = 1)	Mercury (MRL = 0.4)	Nickel (MRL = 0.5)	Selenium (MRL = 4)	Silver (MRL = 5)	Zinc (MRL = 50)
Meetinghouse Creek (duck farm site) Sta. 200004	Results >MRL	14	0	5	14	0	0	14	0	0	2
	Mean	2.4	----	1.3	2.4	----	----	2.6	----	----	88
	Max	6.2	----	1.5	8.1	----	----	3.1	----	----	110
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
Peconic River (USGS gage) Sta. 200010	Results >MRL	2	0	0	0	0	0	6	0	0	3
	Mean	1.1	----	----	----	----	----	0.5	----	----	118
	Max	1.1	----	----	----	----	----	0.6	----	----	199
	# > Std	0	0	0	0	0	0	0	0	0	1[2]
Goose Creek Sta. 200013	Results >MRL	0	0	0	1	0	0	1	0	0	1
	Mean	----	----	----	3.2	----	----	0.6	----	----	110
	Max	----	----	----	3.2	----	----	0.6	----	----	110
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
Birch Creek Sta. 200014	Results >MRL	0	0	0	1	1	0	3	0	0	2
	Mean	----	----	----	2.0	1.0	----	0.6	----	----	110
	Max	----	----	----	2.0	1.0	----	0.6	----	----	149
	# > Std	0	0	0	0[1]	0	0	0	0	0	1[2]
Mill Creek Sta. 200015	Results >MRL	0	0	1	2	0	0	2	0	0	1
	Mean	----	----	1.1	1.9	----	----	0.6	----	----	60
	Max	----	----	1.1	2.2	----	----	0.6	----	----	60
	# > Std	0	0	0	0[1]	0	0	0	0	0	0

[1] Relative to the NYS standard for Class A,AA fresh waters and groundwater (200 ug/L) – hardness data not available to calculate the NYS standard for Class B,C fresh waters
[2] Exceedance of the USEPA national recommended aquatic life criteria, chronic and acute (120 ug/L)

Appendix E2. Metals of Concern Identified in Peconic Estuary Streams with the Number of Detects, Mean and Maximum Concentrations and the Number of Results Exceeding Standards, continued

Station	Statistic	Arsenic (MRL = 1)	Cadmium (MRL = 1)	Chromium (MRL = 1)	Copper (MRL = 1)	Lead (MRL = 1)	Mercury (MRL = 0.4)	Nickel (MRL = 0.5)	Selenium (MRL = 4)	Silver (MRL = 5)	Zinc (MRL = 50)
Hubbard Creek Sta. 200016	Results >MRL	11	0	0	0	0	0	5	0	0	1
	Mean	1.5	----	----	----	----	----	1.0	----	----	89.7
	Max	3.3	----	----	----	----	----	2.7	----	----	89.7
	# > Std	0	0	0	0	0	0	0	0	0	0
Peconic River (at Grangebel Park) Sta. 200017	Results >MRL	7	0	0	3	0	0	8	0	0	4
	Mean	1.2	----	----	1.9	----	----	0.8	----	----	231
	Max	1.5	----	----	3.6	----	----	1.3	----	----	278
	# > Std	0	0	0	0[1]	0	0	0	0	0	4[2]
Meetinghouse Creek (at Rt. 25) Sta. 200041	Results >MRL	3	0	0	7	0	0	15	0	0	2
	Mean	1.4	----	----	1.3	----	----	1.1	----	----	113
	Max	1.5	----	----	1.5	----	----	1.5	----	----	176
	# > Std	0	0	0	0[1]	0	0	0	0	0	1[2]
Peconic River (at BNL) Sta. 200044	Results >MRL	9	0	3	13	9	0	13	0	0	10
	Mean	1.3	----	1.1	22.0	2.0	----	3.2	----	----	78.8
	Max	1.8	----	1.3	58.4	4.1	----	5.1	----	----	124
	# > Std	0	0	0	0[1]	2[3]	0	0	0	0	1[2]
Sawmill Creek Sta. 200110	Results >MRL	11	0	2	5	0	0	16	0	0	6
	Mean	1.2	----	1.1	2.1	----	----	0.7	----	----	72.3
	Max	1.5	----	1.1	5.4	----	----	1.1	----	----	104
	# > Std	0	0	0	0[1]	0	0	0	0	0	0

[1] Relative to the NYS copper standard for Class A,AA waters and groundwater (200 ug/L) – hardness data not available to calculate the NYS standard for Class B,C fresh waters
[2] Exceedance of the USEPA national recommended aquatic life criteria (acute and chronic) for zinc (120 ug/L)
[3] Exceedance of the USEPA national recommended aquatic life criteria (chronic) for lead (2.5 ug/L)

Appendix E2. Metals of Concern Identified in Peconic Estuary Streams with the Number of Detects, Mean and Maximum Concentrations and the Number of Results Exceeding Standards, continued

Station	Statistic	Arsenic (MRL = 1)	Cadmium (MRL = 1)	Chromium (MRL = 1)	Copper (MRL = 1)	Lead (MRL = 1)	Mercury (MRL = 0.4)	Nickel (MRL = 0.5)	Selenium (MRL = 4)	Silver (MRL = 5)	Zinc (MRL = 50)
Terrys Creek Sta. 200120	Results >MRL	9	0	1	5	0	0	13	0	0	1
	Mean	2.1	----	1.1	1.2	----	----	0.8	----	----	53.8
	Max	4.0	----	1.1	1.5	----	----	1.1	----	----	53.8
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
Reeves Creek Sta. 200130	Results >MRL	5	0	0	5	0	0	5	0	0	0
	Mean	8.0	----	----	1.8	----	----	1.6	----	----	----
	Max	10.6	----	----	3.0	----	----	1.8	----	----	----
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
East Creek (S. Jamesport) Sta. 200140	Results >MRL	12	0	0	5	0	0	12	1	0	2
	Mean	3.5	----	----	1.4	----	----	1.2	4.2	----	65.4
	Max	9.2	----	----	2.0	----	----	1.5	4.2	----	78.9
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
Brushes Creek Sta. 200160	Results >MRL	4	0	1	1	0	0	12	0	0	2
	Mean	1.7	----	1.1	1.1	----	----	1.1	----	----	328
	Max	3.3	----	1.1	1.1	----	----	2.7	----	----	438
	# > Std	0	0	0	0[1]	0	0	0	0	0	2[2]
Deep Hole Creek Sta. 200170	Results >MRL	9	0	2	4	0	0	12	1	0	0
	Mean	7.3	----	1.1	1.8	----	----	1.2	4.1	----	----
	Max	18.1	----	1.1	2.8	----	----	2.3	4.1	----	----
	# > Std	0	0	0	0[1]	0	0	0	0	0	0

[1] Relative to the NYS copper standard for Class A,AA fresh waters and groundwater (200 ug/L) – hardness data not available to calculate the NYS standard for Class B,C waters
[2] Exceedance of the USEPA national recommended aquatic life criteria (acute and chronic) for zinc (120 ug/L)

Appendix E2. Metals of Concern Identified in Peconic Estuary Streams with the Number of Detects, Mean and Maximum Concentrations and the Number of Results Exceeding Standards, continued

Station	Statistic	Arsenic (MRL = 1)	Cadmium (MRL = 1)	Chromium (MRL = 1)	Copper (MRL = 1)	Lead (MRL = 1)	Mercury (MRL = 0.4)	Nickel (MRL = 0.5)	Selenium (MRL = 4)	Silver (MRL = 5)	Zinc (MRL = 50)
Halls Creek Sta. 200180	Results >MRL	12	0	1	7	0	0	11	1	0	4
	Mean	5.8	----	1.0	1.6	----	----	1.2	4.0	----	101
	Max	13.8	----	1.0	2.5	----	----	1.9	4.0	----	161
	# > Std	0	0	0	0[1]	0	0	0	0	0	1[2]
Downs Creek Sta. 200190	Results >MRL	8	0	0	5	0	0	14	1	0	2
	Mean	2.0	----	----	1.2	----	----	0.8	14.2	----	127
	Max	3.9	----	----	1.4	----	----	1.1	14.2	----	154
	# > Std	0	0	0	0[1]	0	0	0	1[4,5,6]	0	1[2]
West Creek Sta. 200200	Results >MRL	5	0	1	4	1	0	4	0	0	2
	Mean	2.2	----	1.5	1.8	1.1	----	0.9	----	----	84.6
	Max	3.2	----	1.5	2.5	1.1	----	1.2	----	----	118
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
East Creek (Cutchogue) Sta. 200210	Results >MRL	2	0	0	2	0	0	11	0	0	0
	Mean	4.5	----	----	1.2	----	----	1.2	----	----	----
	Max	5.1	----	----	1.4	----	----	3.7	----	----	----
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
Pipes Creek Sta. 200230	Results >MRL	9	0	5	10	3	0	10	1	0	2
	Mean	3.1	----	1.6	4.2	2.5	----	1.1	5.9	----	51.3
	Max	9.1	----	2.7	15.0	4.2	----	1.5	5.9	----	51.8
	# > Std	0	0	0	0[1]	1[3]	0	0	1[4,5]	0	0

[1] Relative to the NYS copper standard for Class A,AA fresh waters and groundwater (200 ug/L) – hardness data not available to calculate the NYS standard for Class B,C waters
[2] Exceedance of the USEPA national recommended aquatic life criteria (acute and chronic) for zinc (120 ug/L)
[3] Exceedance of the USEPA national recommended aquatic life criteria (chronic) for lead (2.5 ug/L)
[4] Exceedance of the USEPA national recommended aquatic life criteria (chronic) for selenium (5 ug/L)
[5] Exceedance of the NYS surface water standard for selenium in Class B,C waters (4.6 ug/L)
[6] Exceedance of the NYS surface water standard for selenium in Class A, AA & GA waters (10 ug/L)

Appendix E2. Metals of Concern Identified in Peconic Estuary Streams with the Number of Detects, Mean and Maximum Concentrations and the Number of Results Exceeding Standards, continued

Station	Statistic	Arsenic (MRL = 1)	Cadmium (MRL = 1)	Chromium (MRL = 1)	Copper (MRL = 1)	Lead (MRL = 1)	Mercury (MRL = 0.4)	Nickel (MRL = 0.5)	Selenium (MRL = 4)	Silver (MRL = 5)	Zinc (MRL = 50)
Pipes Neck Creek Sta. 200240	Results >MRL	8	0	6	9	0	0	9	0	0	1
	Mean	4.2	----	1.6	1.6	----	----	1.5	----	----	318
	Max	7.9	----	2.4	2.3	----	----	2.4	----	----	318
	# > Std	0	0	0	0[1]	0	0	0	0	0	1[2]
Narrow River North Sta. 200250	Results >MRL	10	0	5	10	7	0	8	0	0	6
	Mean	4.3	----	1.4	2.3	1.6	----	0.7	----	----	83.1
	Max	11.7	----	1.8	6.0	2.4	----	1.1	----	----	118
	# > Std	0	0	0	0[1]	0	0	0	0	0	0
Narrow River South Sta. 200260	Results >MRL	7	0	2	7	2	0	7	1	0	2
	Mean	10.9	----	1.7	8.8	1.3	----	1.1	8.3	----	79.5
	Max	24.2	----	2.4	18.9	1.3	----	1.6	8.3	----	94.7
	# > Std	0	0	0	0[1]	0	0	0	1[4,5]	0	0

[1] Relative to the NYS copper standard for Class A,AA fresh waters and groundwater (200 ug/L) – hardness data not available to calculate the NYS standard for Class B,C waters
[2] Exceedance of the USEPA national recommended aquatic life criteria (acute and chronic) for zinc (120 ug/L)
[4] Exceedance of the USEPA national recommended aquatic life criteria (chronic) for selenium (5 ug/L)
[5] Exceedance of the NYS surface water standard for selenium in Class B,C waters (4.6 ug/L)

Water Quality Standards/Criteria:

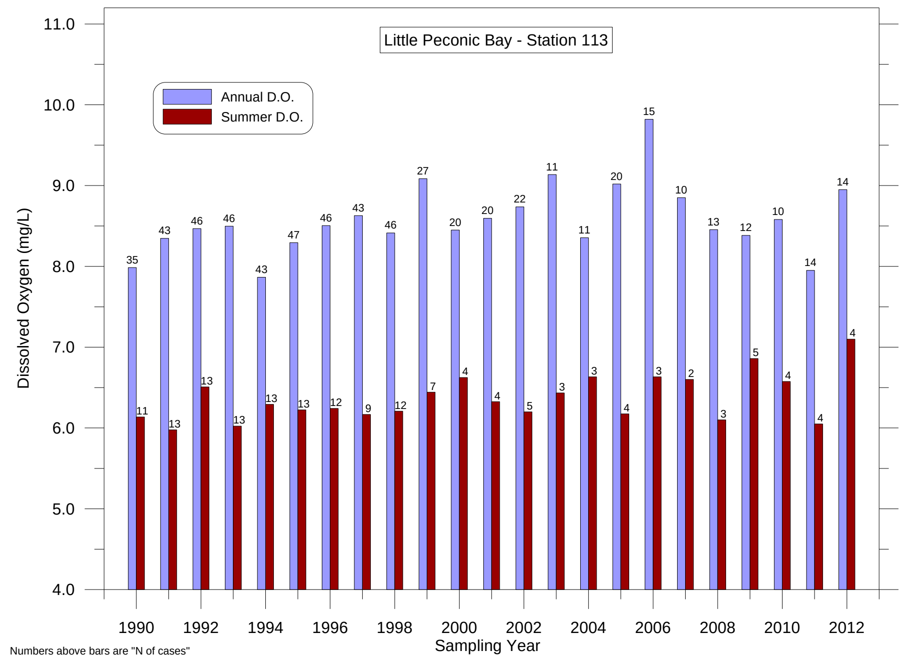
		Arsenic	Cadmium	Chromium	Copper	Lead	Mercury	Nickel	Selenium	Silver	Zinc
NYS Part 703 Water Quality Standards (ug/L)		50 (A,AA), 25 (GA), 150 (B,C)	5 (A,AA,GA) * (B,C)	50 (A,AA,GA) * (B,C)	200 (A,AA,GA) * (B,C)	50 (A,AA) 25 (GA) * (B,C)	0.7 (A,AA,GA) 0.77 (B,C)	100 (A,AA,GA) * (B,C)	10 (A,AA,GA) 4.6 (B,C)	50 (A,AA,GA) 0.1 (B,C)	* (A,AA,GA) * (B,C)
EPA National Recommended Aquatic Life Criteria (ug/L)	Acute	340	2	570	**	65	1.4	470	---	3.2	120
	Chronic	150	0.25	74	**	2.5	0.77	52	5	---	120

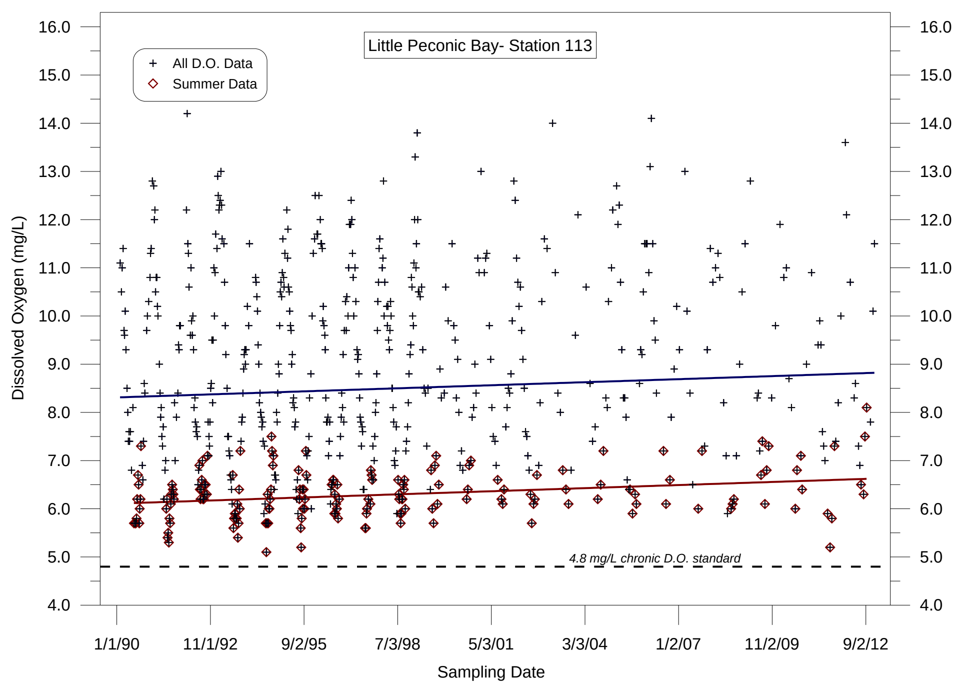
* Requires values for water hardness, which was not monitored, to compute the standard
** Derived using a bioavailability model (Biotic Ligand Model) that requires the input of ten parameters to calculate the copper criteria – data for a number of the inputs, including dissolved organic carbon and alkalinity, were not available

Appendix F1

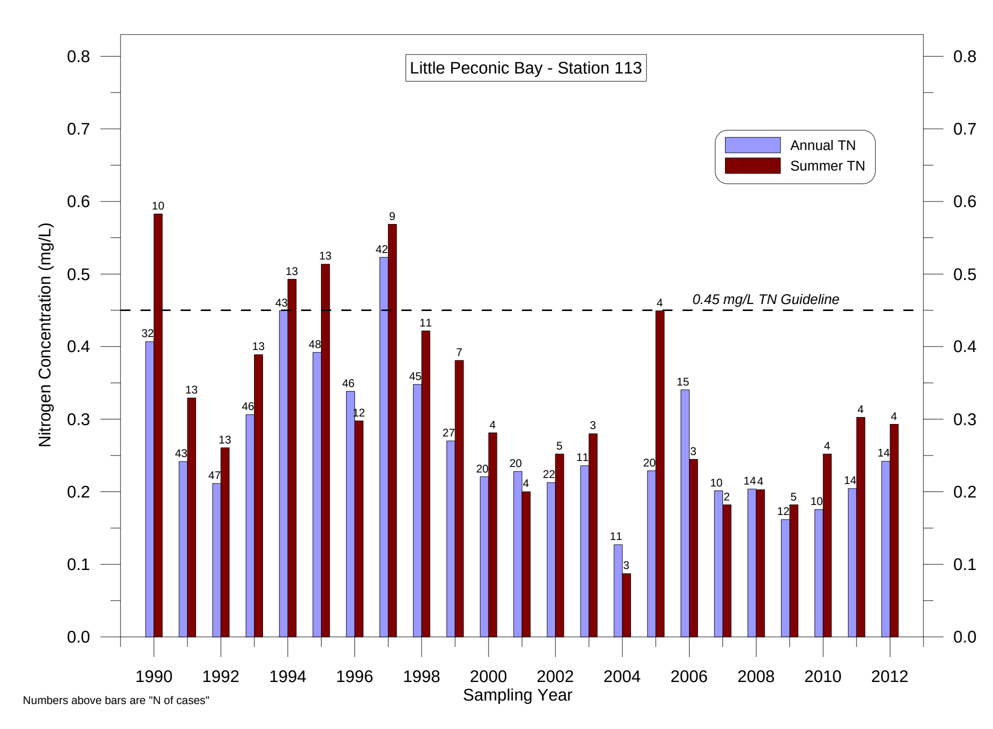
Plots of Historic (1990-2012) Dissolved Oxygen, Total Nitrogen and Chlorophyll-a Concentrations at Select Marine Sampling Locations:

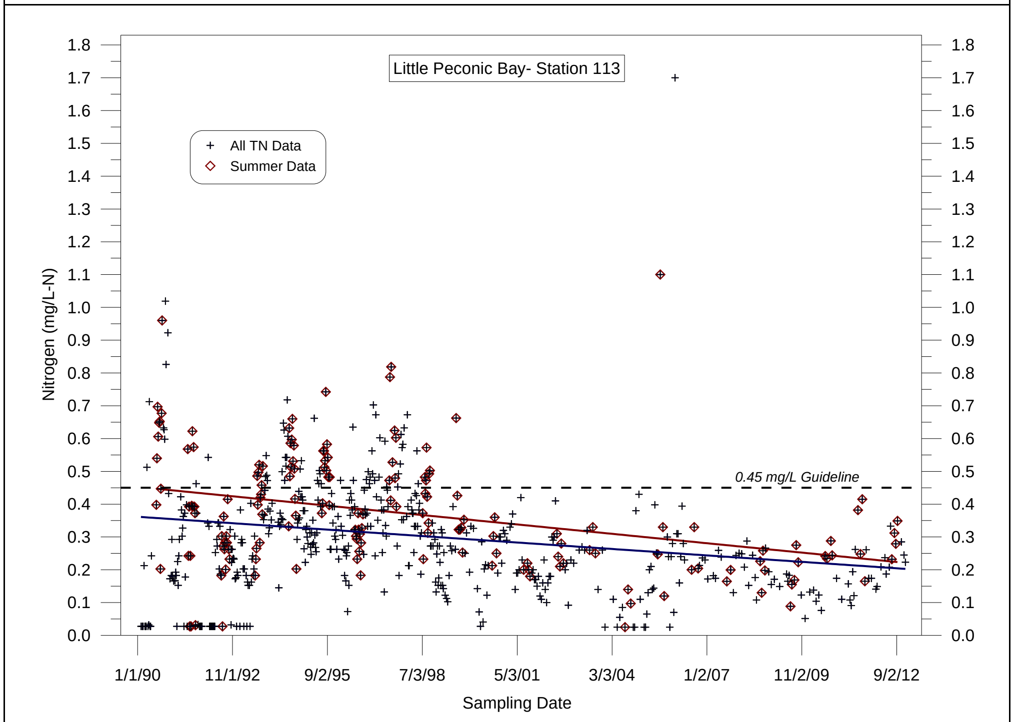
Little Peconic Bay (060113)
Shelter Island Sound (060114)
Orient Harbor (060115)
Gardiners Bay West (060116)
Northwest Harbor (060118)
West Neck Bay (060119)
Great Peconic Bay (060130)
Flanders Bay (060170)
Meetinghouse Creek (060220)
Peconic River Mouth (060240)



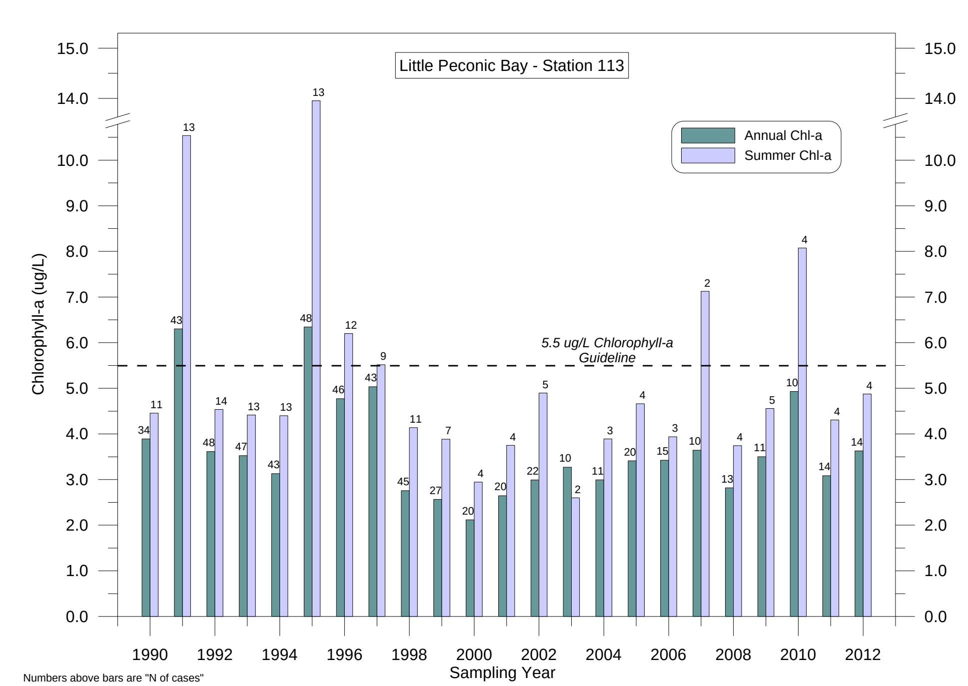


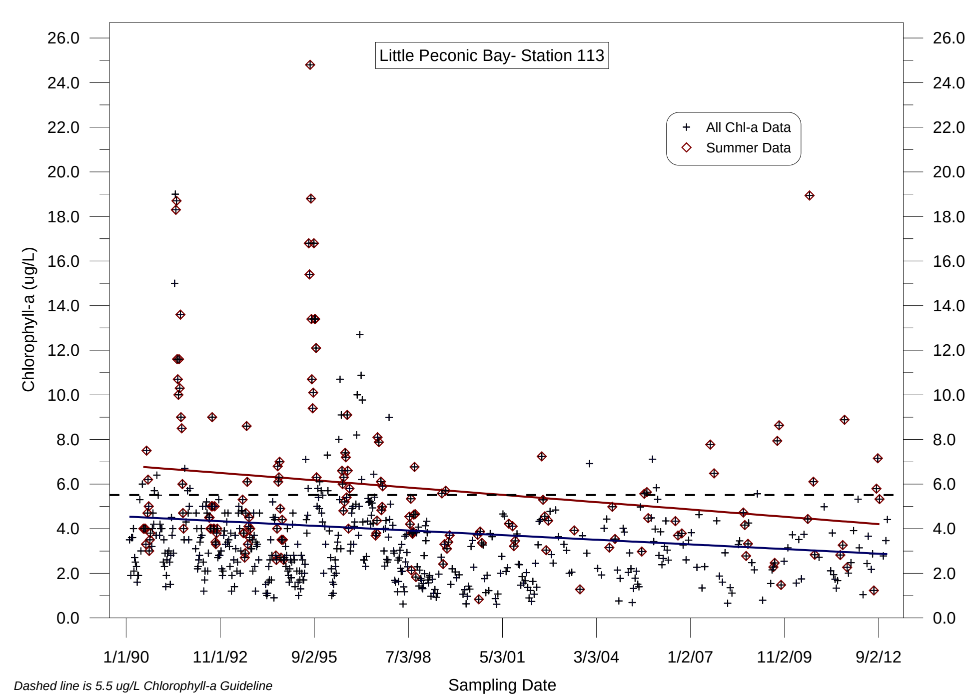
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Little Peconic Bay Station 060113 (1990-2012)



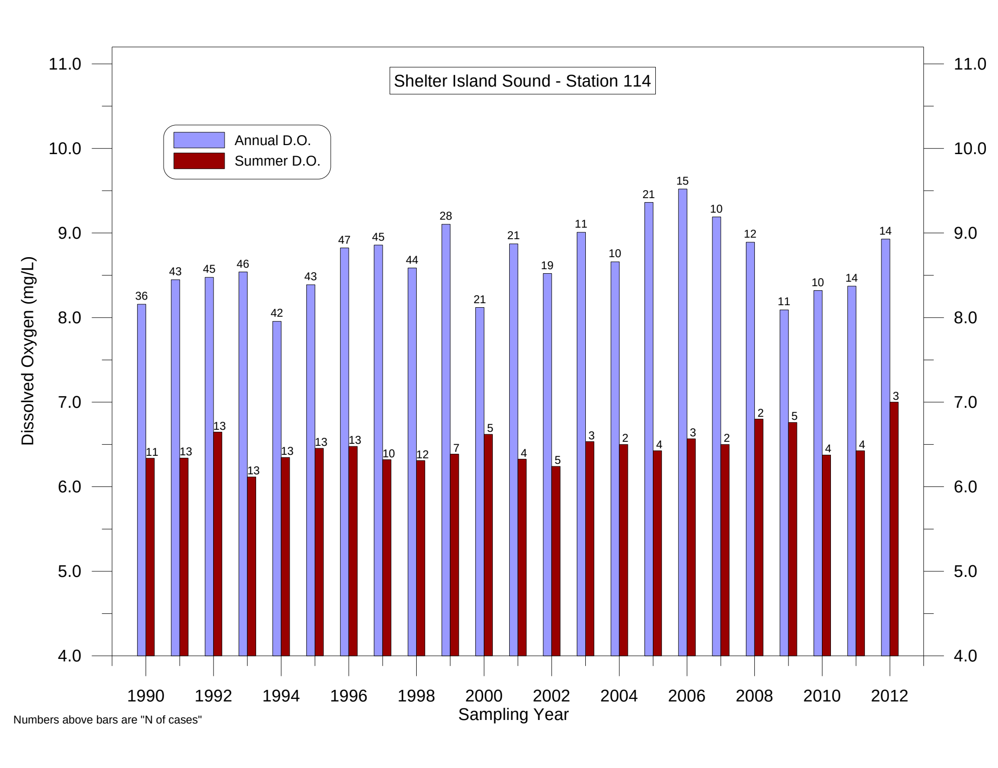


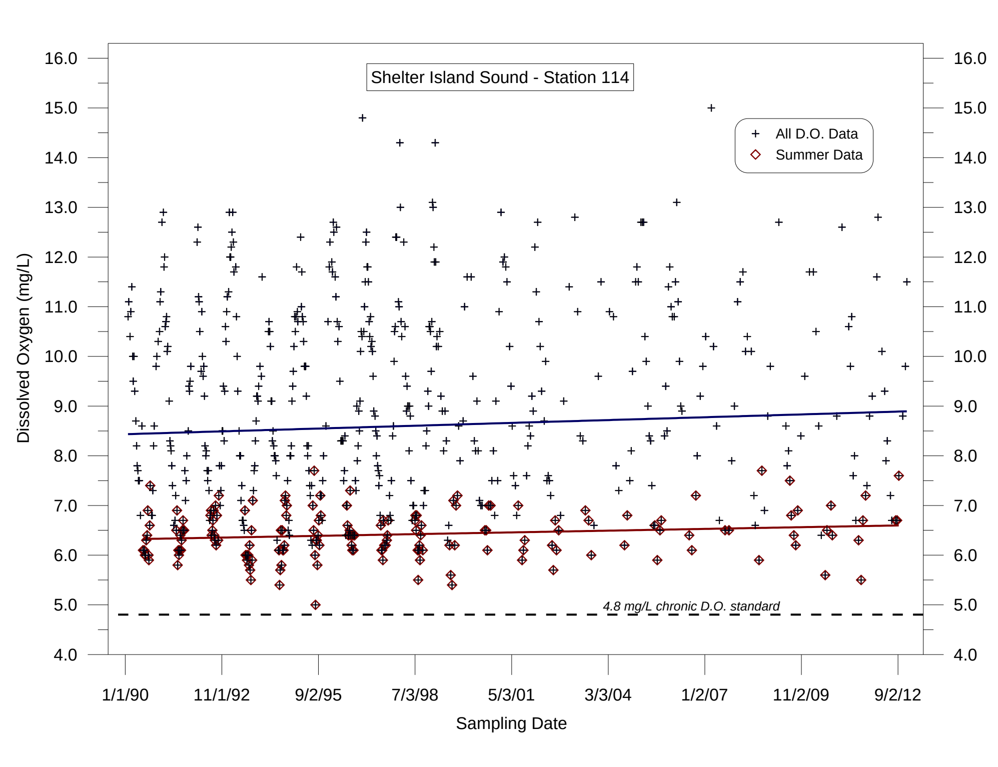
Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Little Peconic Bay Station 060113 (1990-2012)



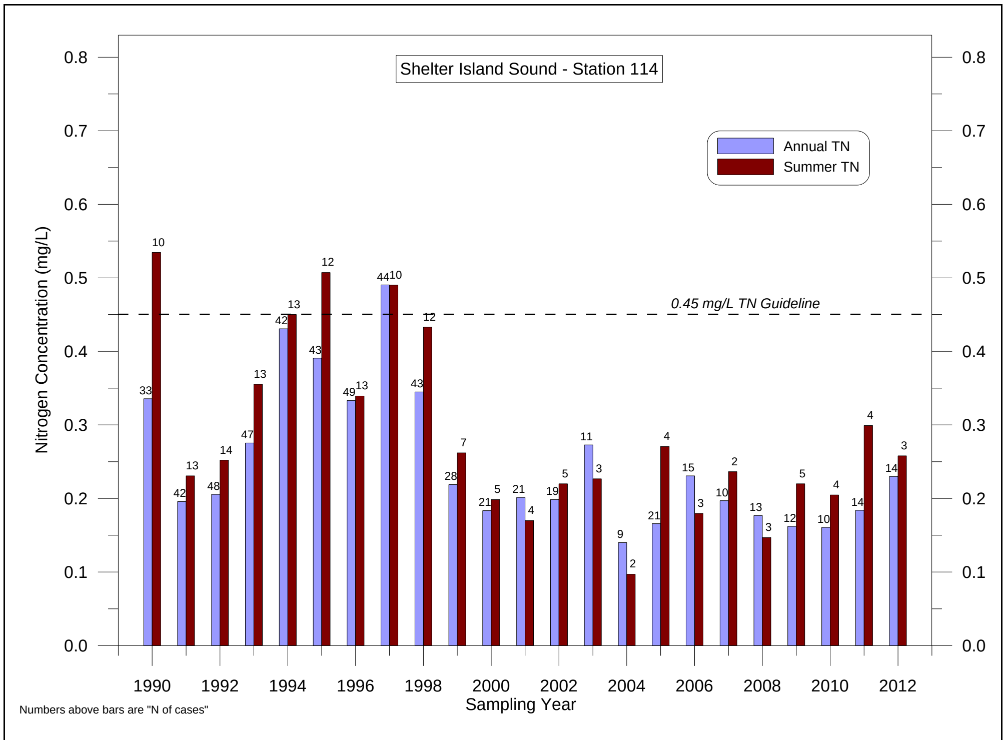


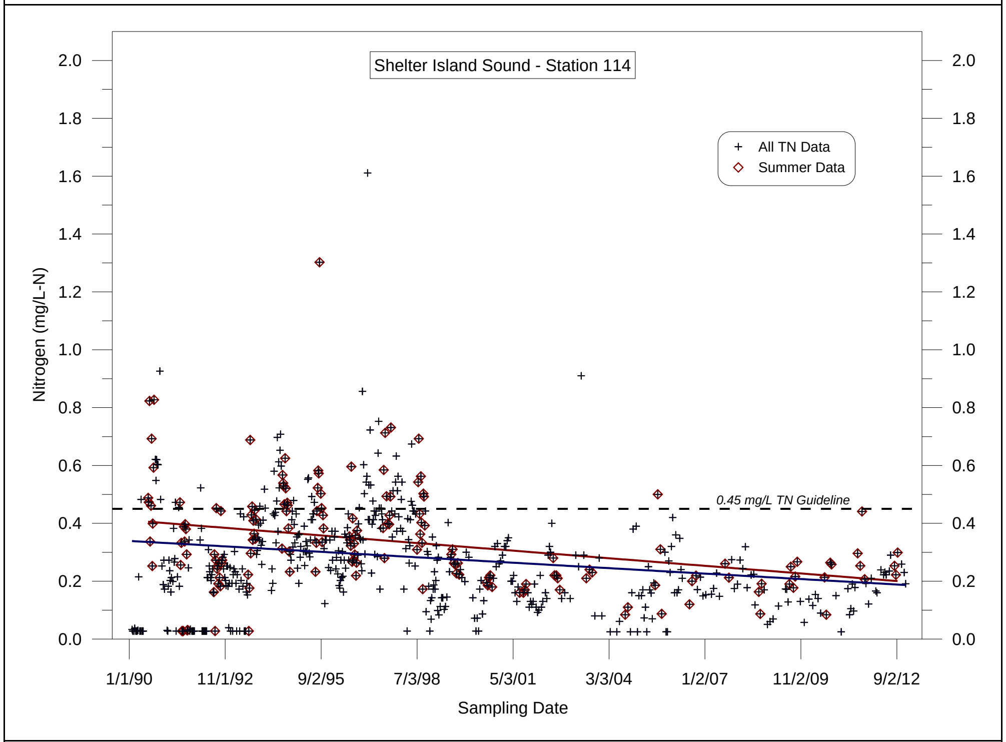
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Little Peconic Bay Station 060113 (1990-2012)



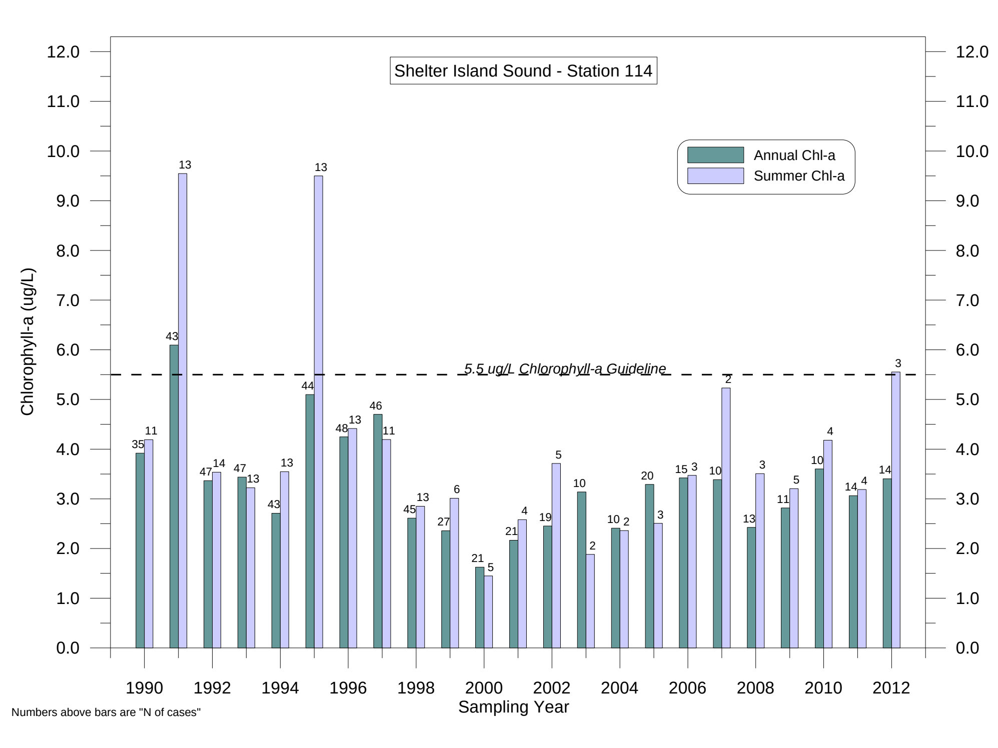


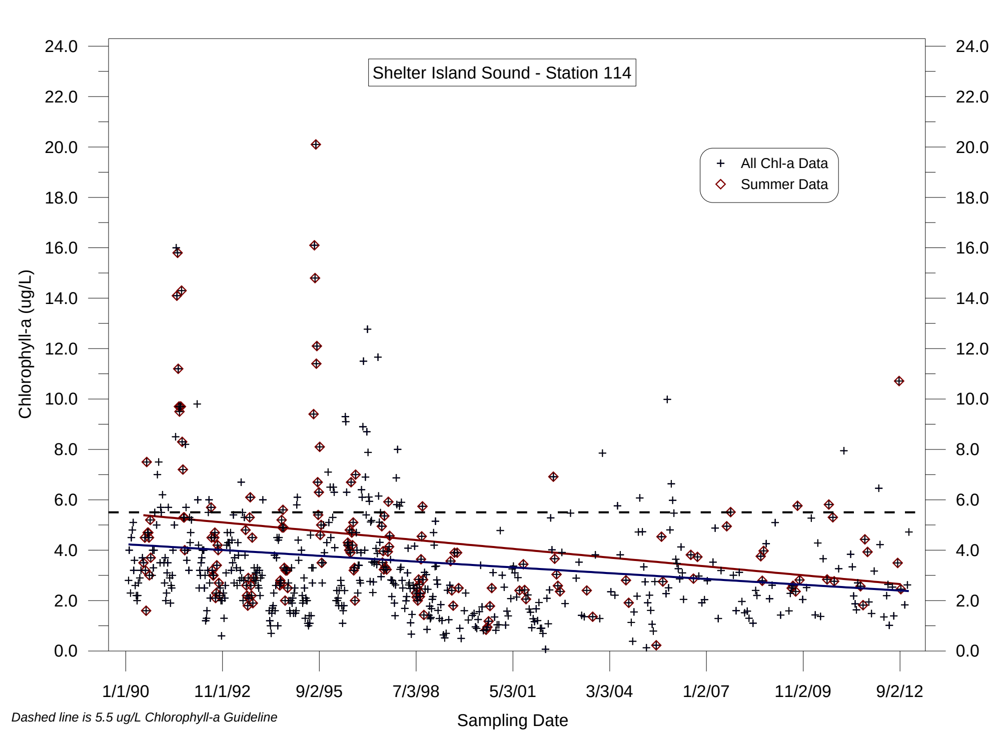
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Shelter Island Sound Station 060114 (1990-2012)



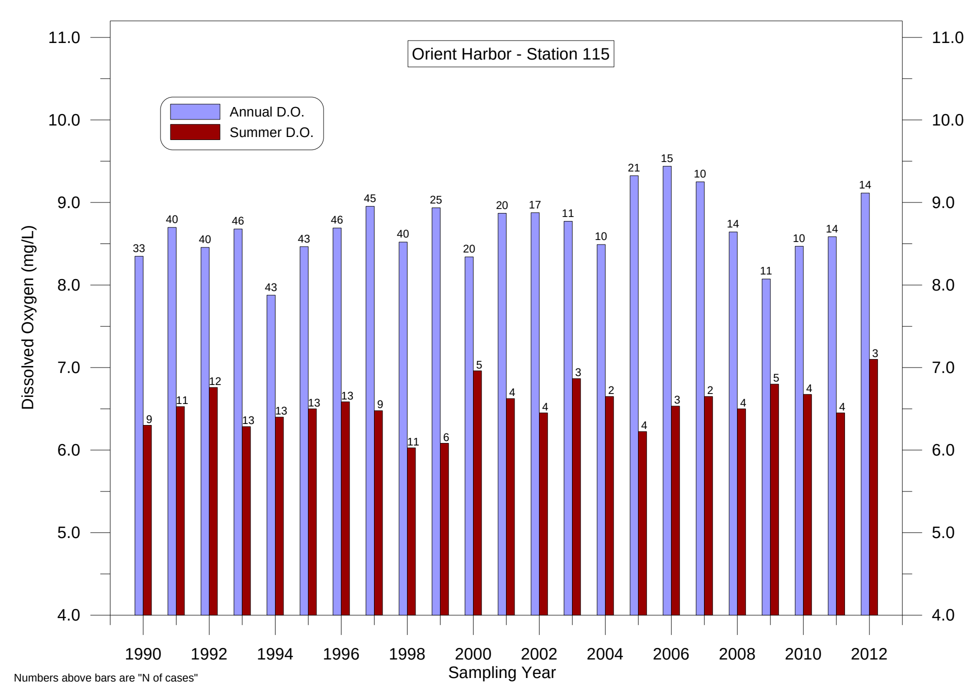


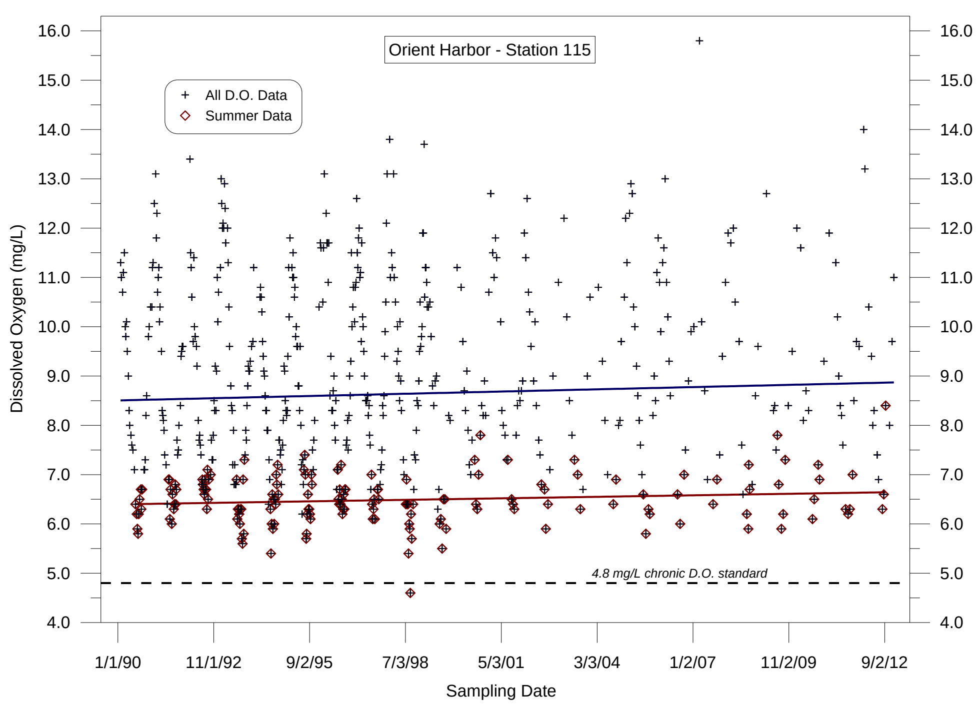
Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Shelter Island Sound Station 060114 (1990-2012)



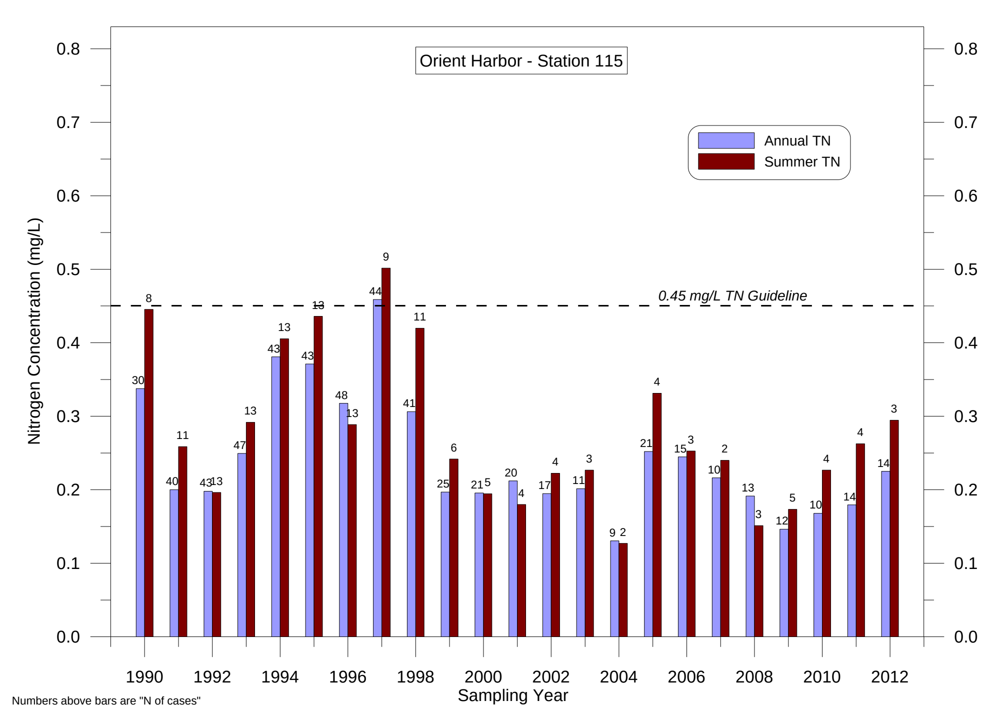


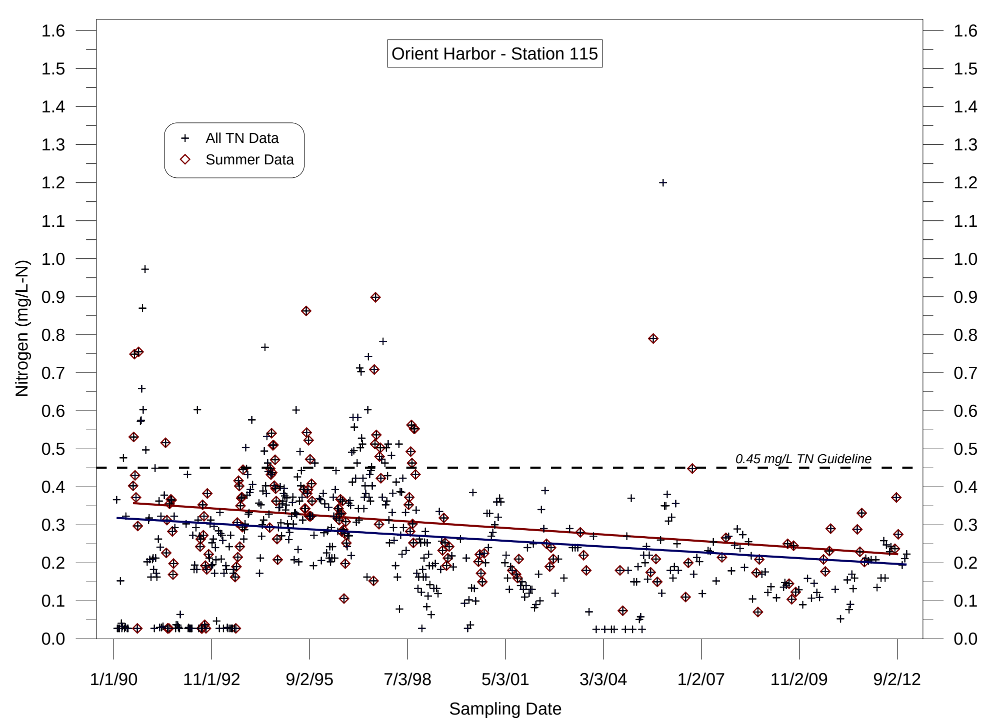
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Shelter Island Sound Station 060114 (1990-2012)



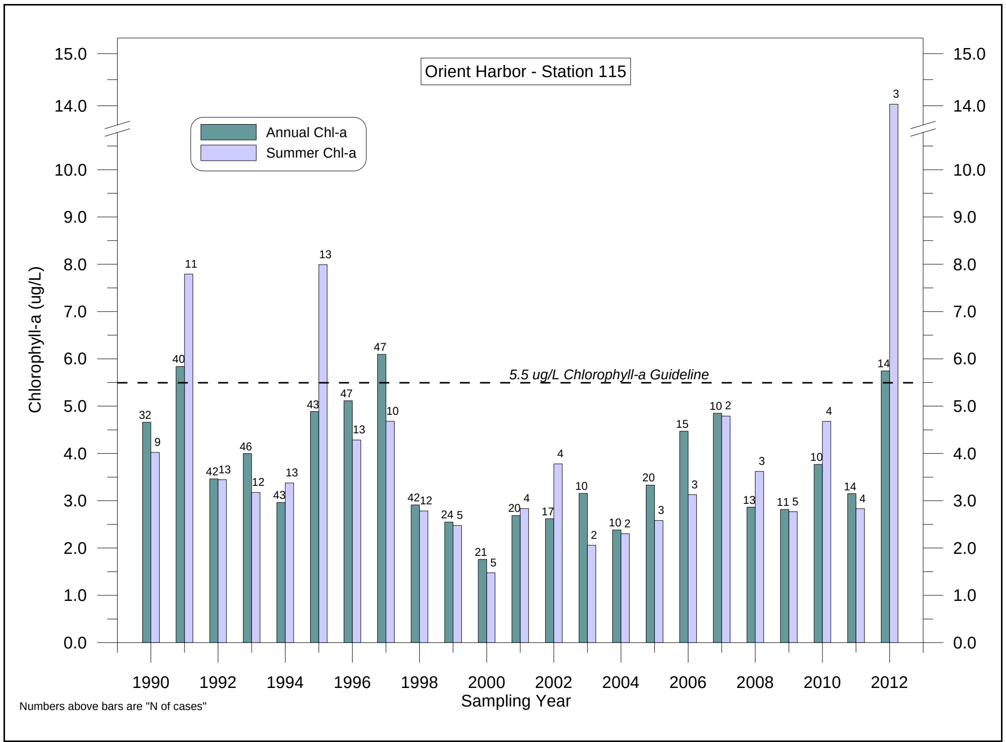


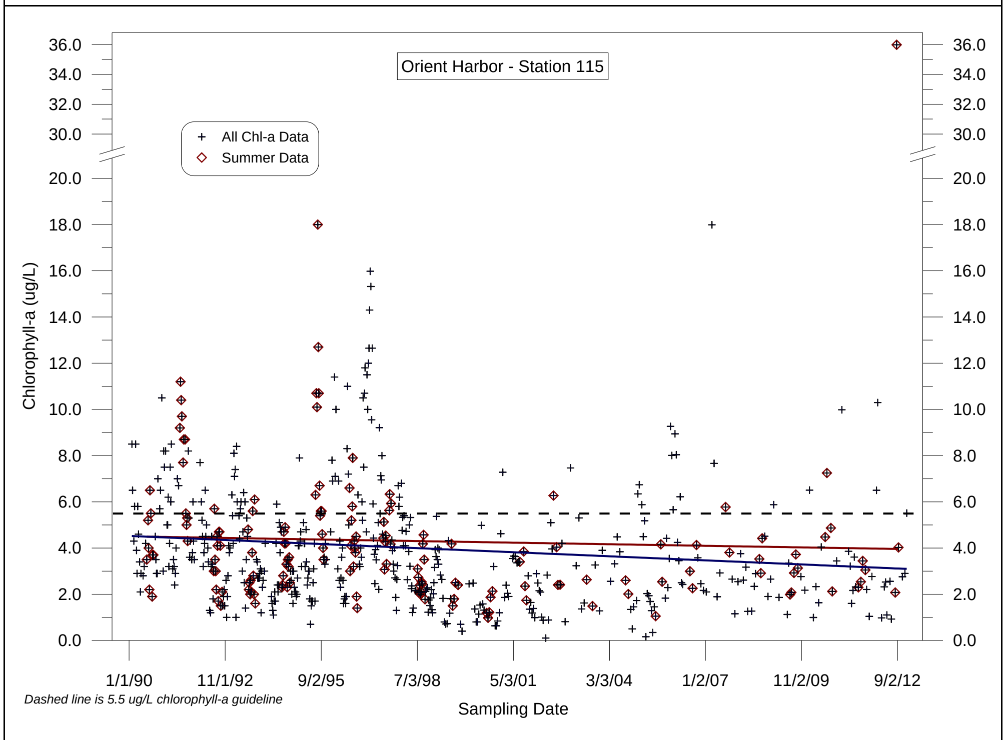
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Orient Harbor Station 060115 (1990-2012)



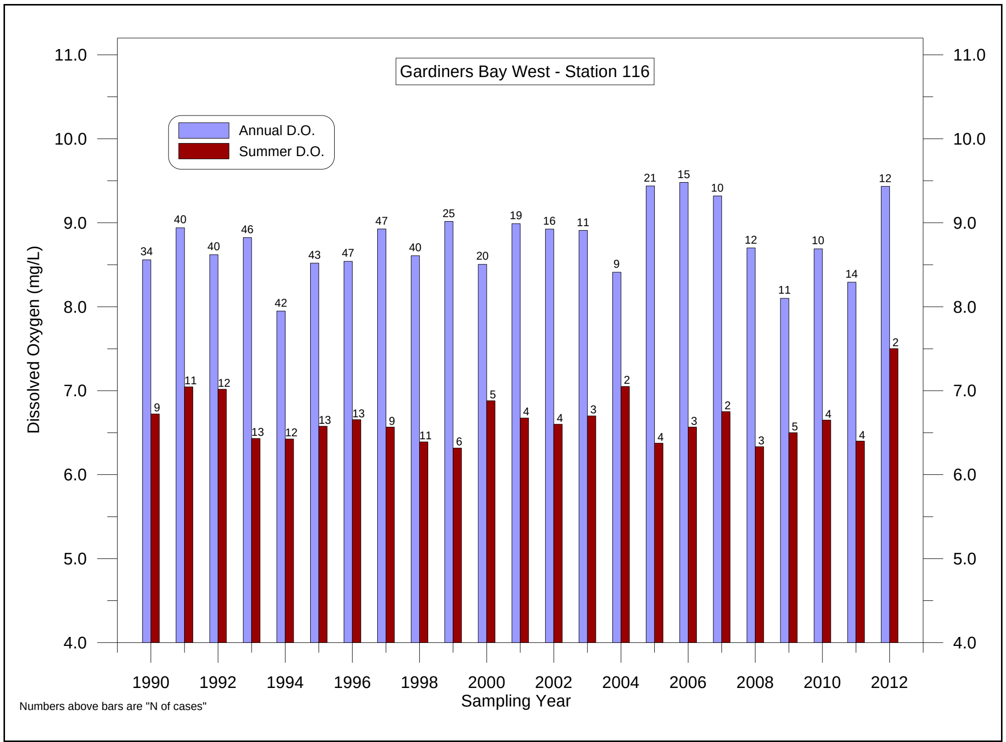


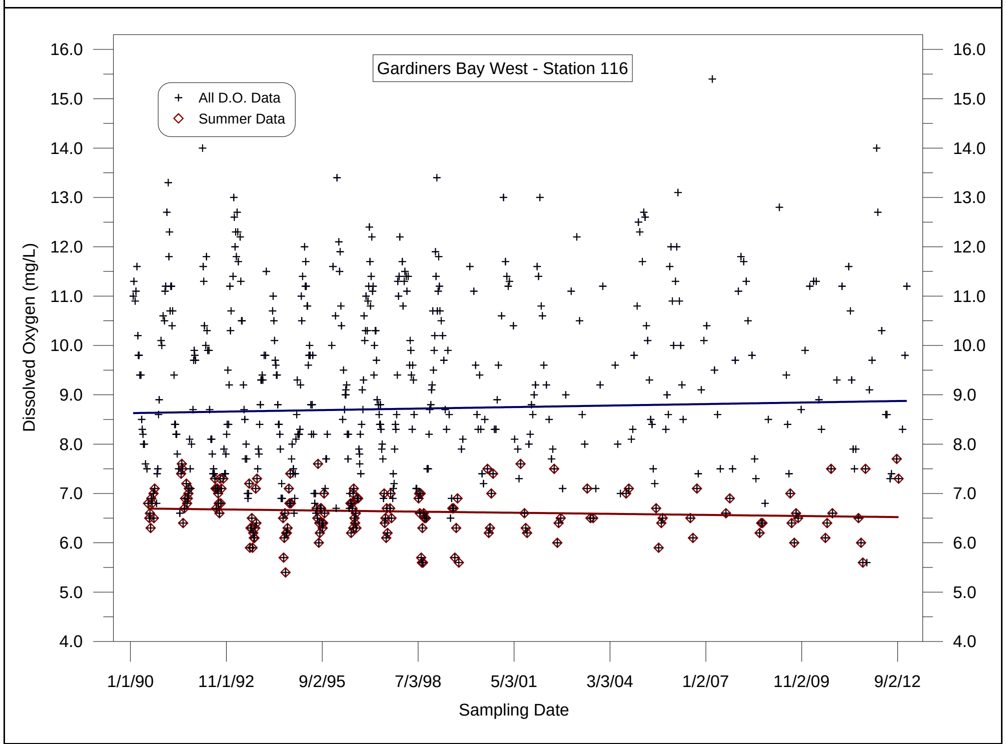
Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Orient Harbor Station 060115 (1990-2012)



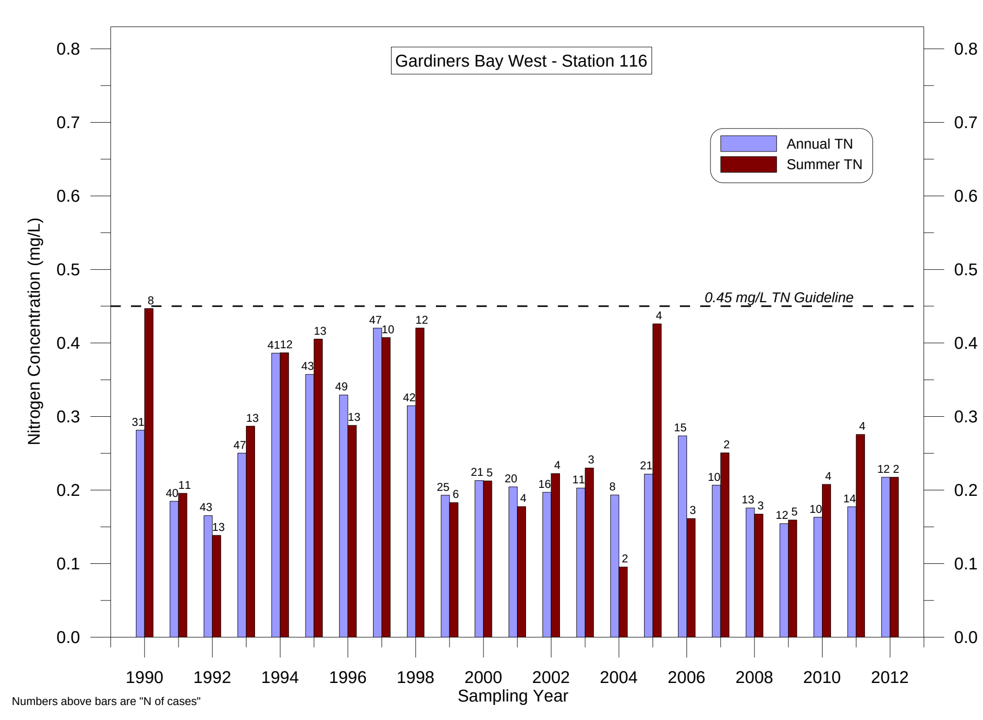


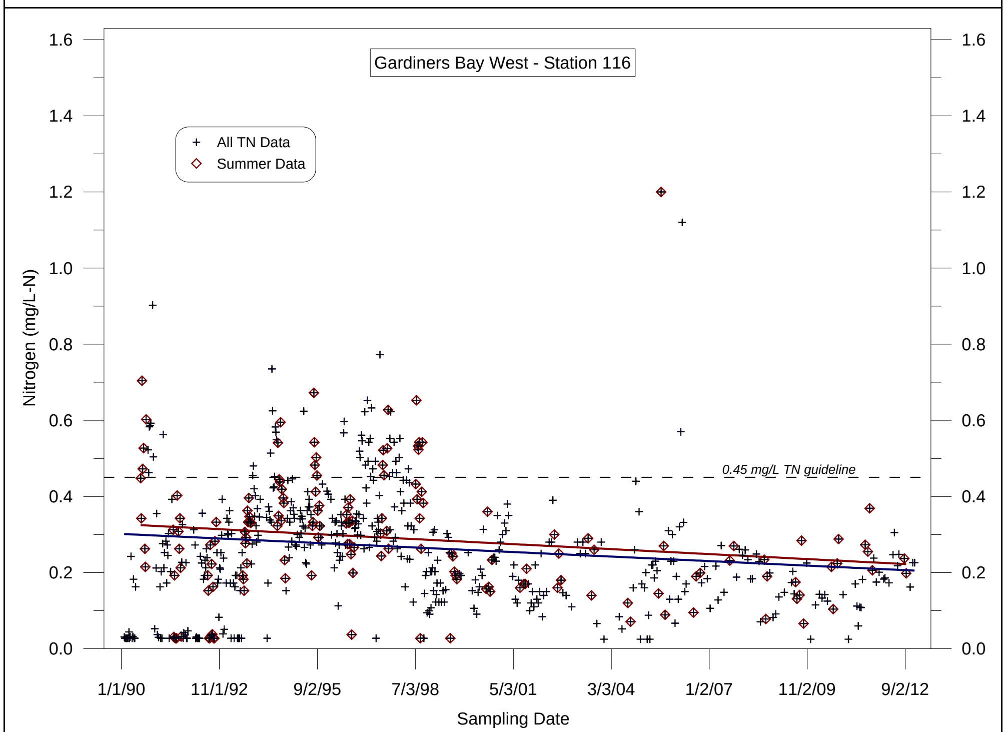
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Orient Harbor Station 060115 (1990-2012)



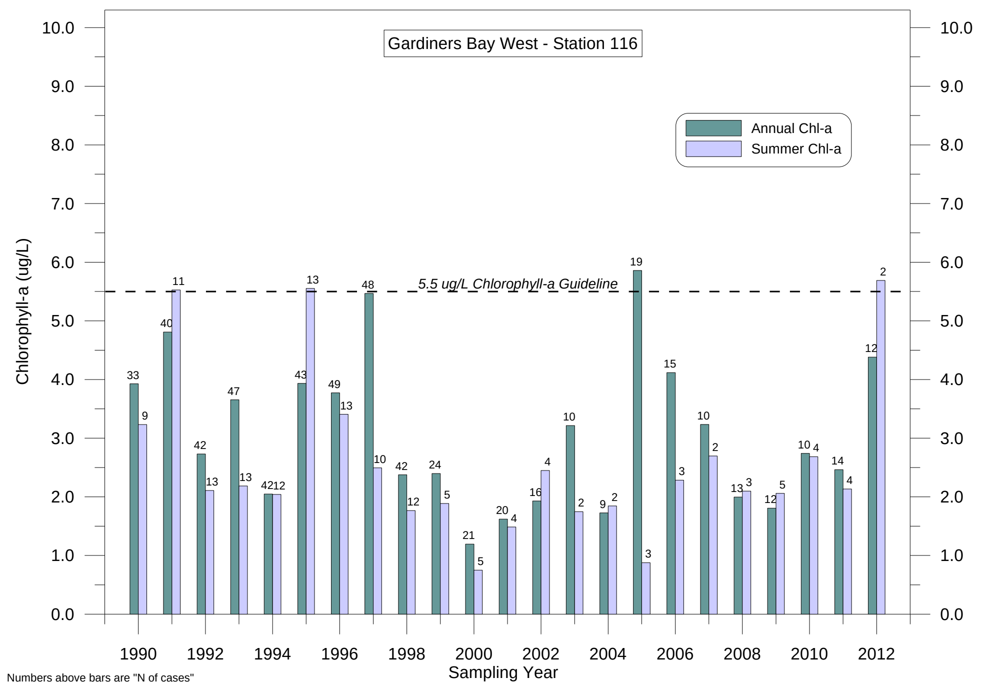


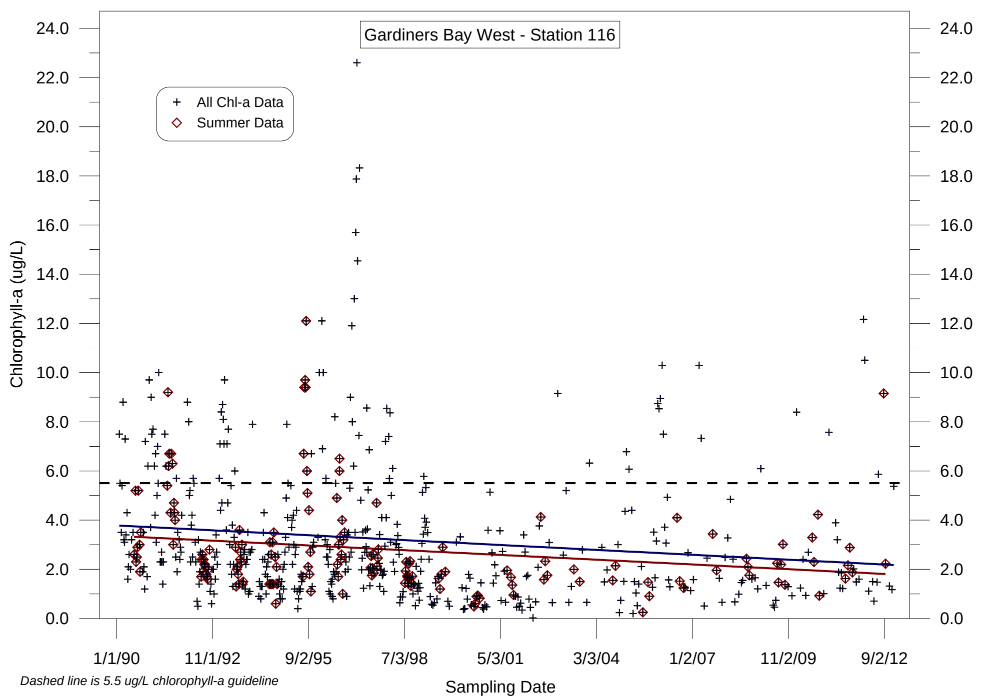
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Western Gardiners Bay Station 060116 (1990-2012)



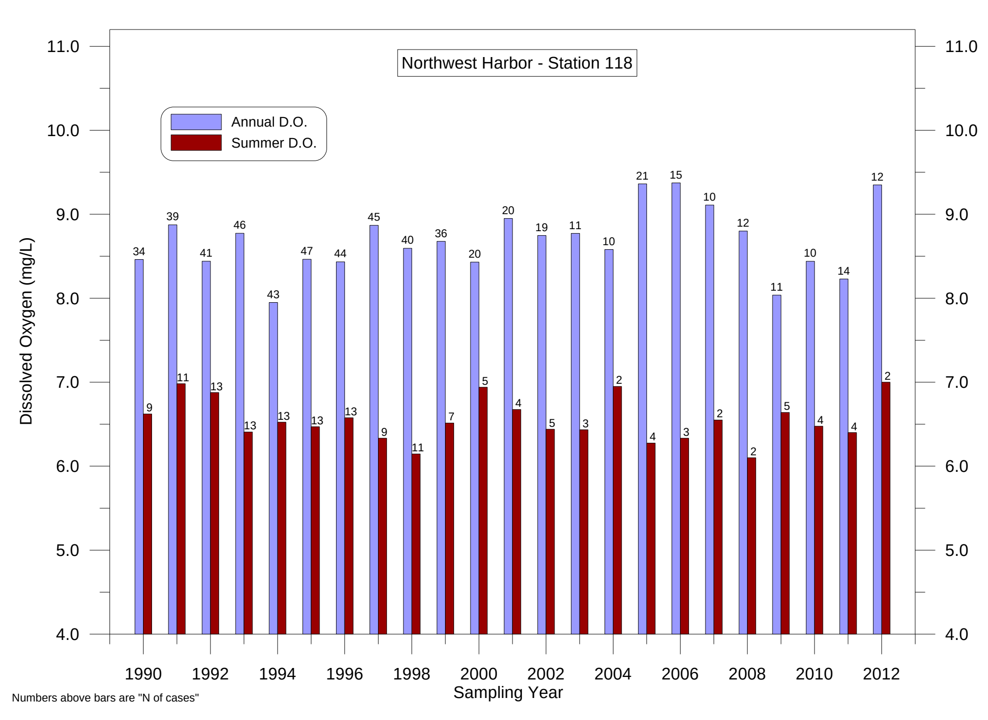


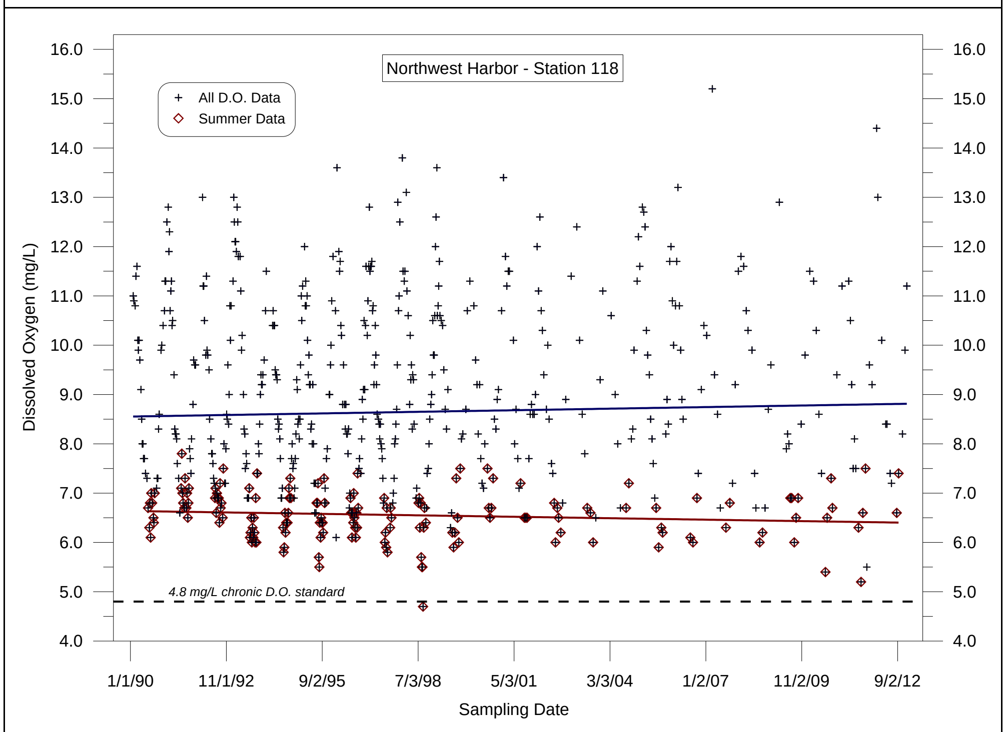
Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Western Gardiners Bay Station 060116 (1990-2012)



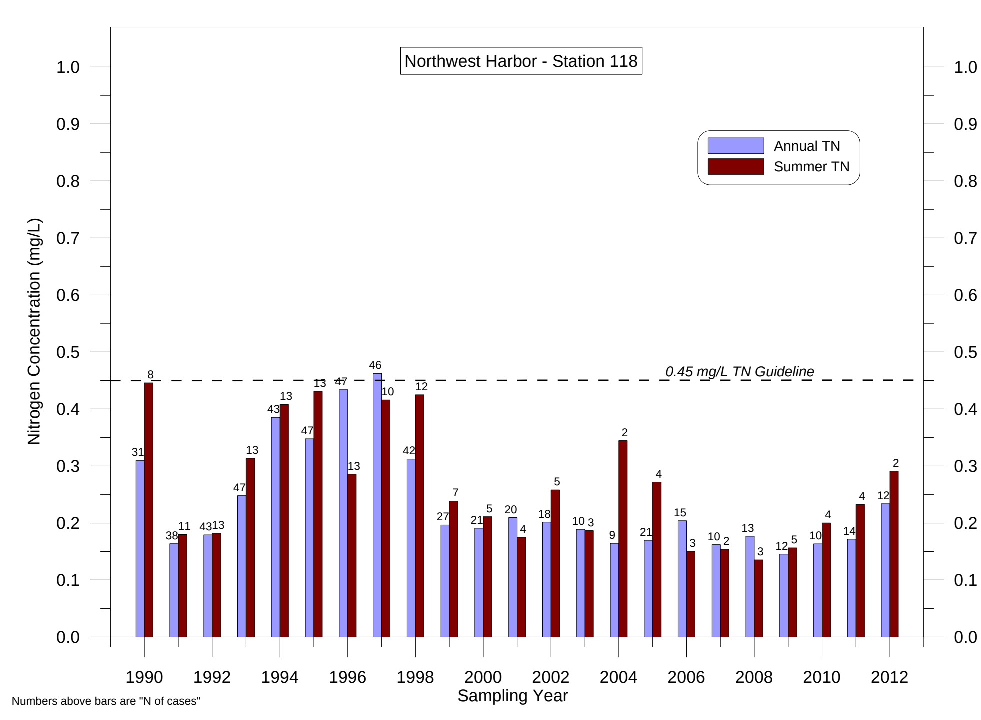


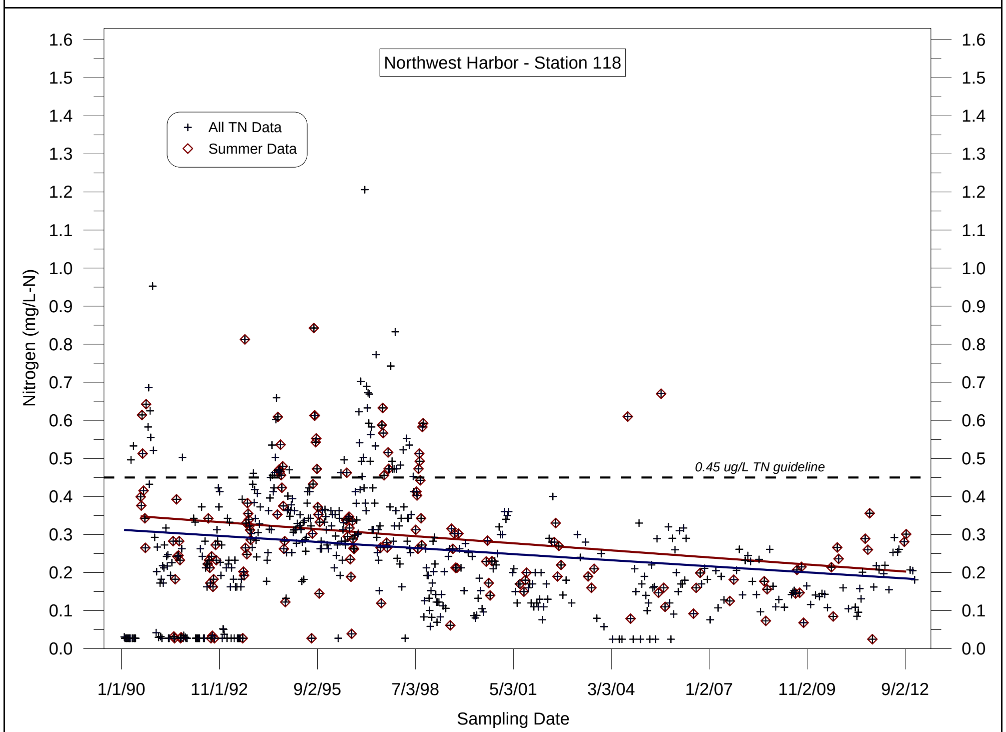
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Western Gardiners Bay Station 060116 (1990-2012)



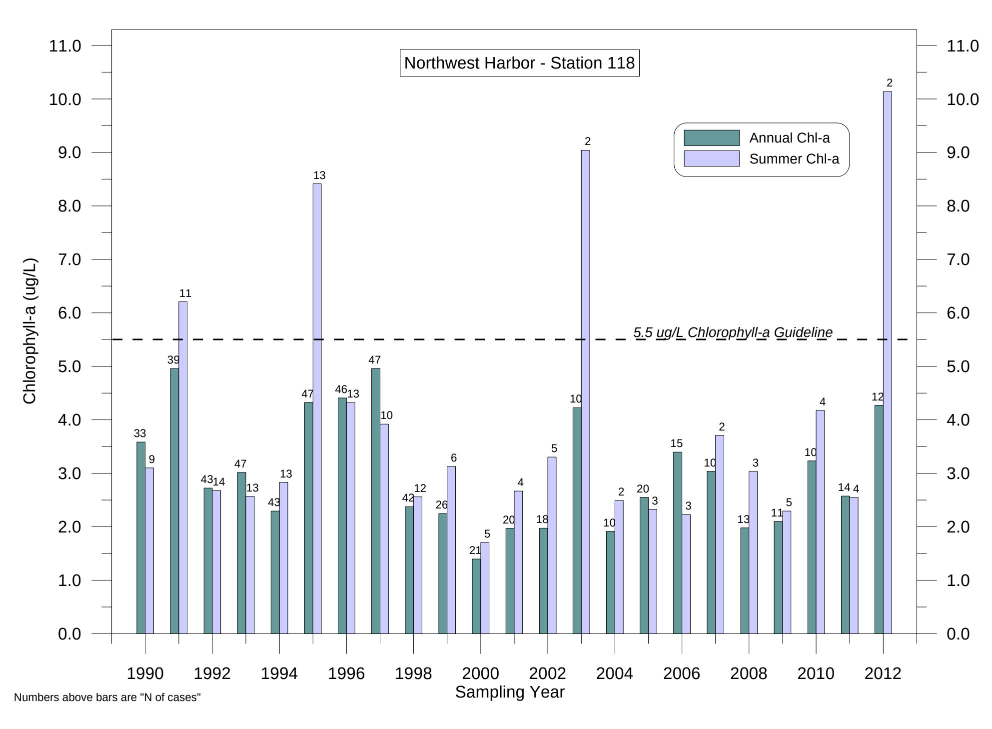


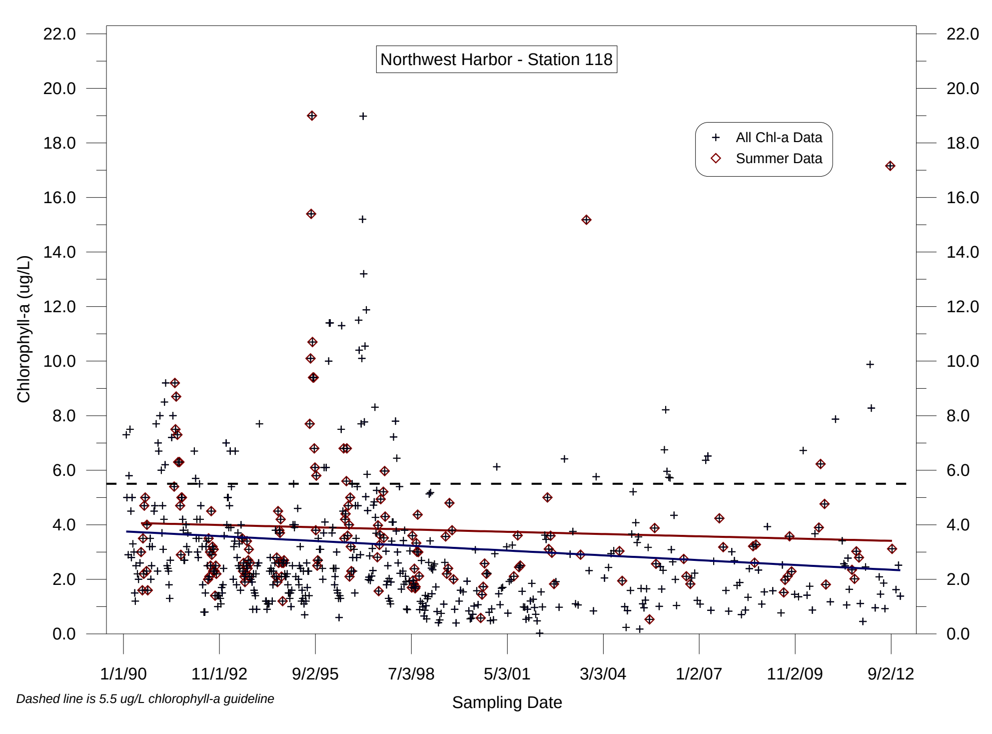
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Northwest Harbor Station 060118 (1990-2012)



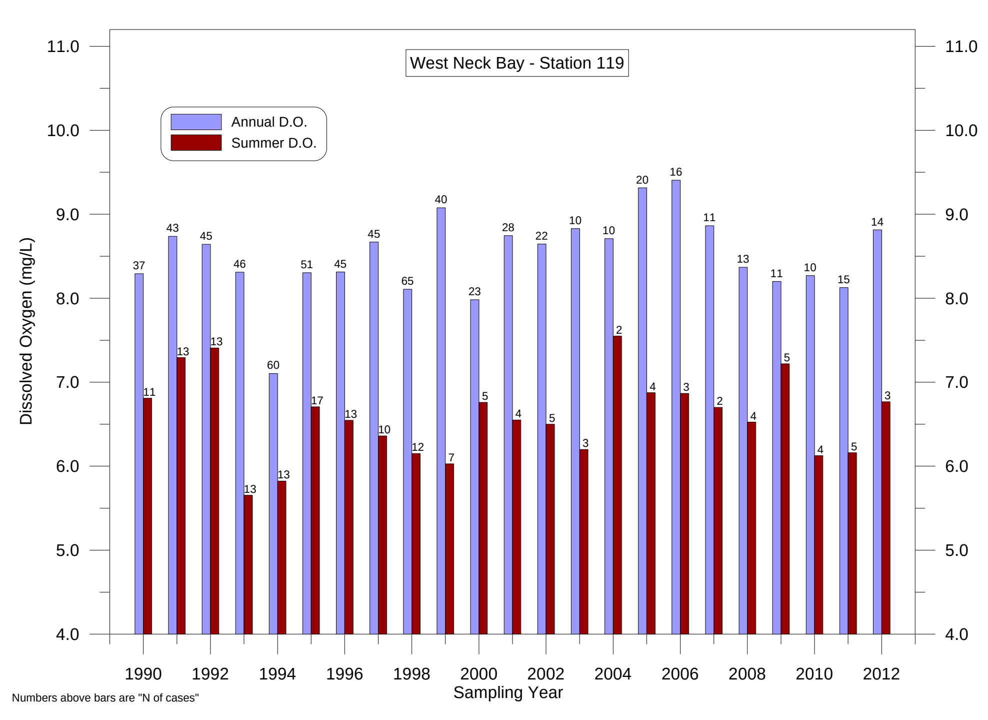


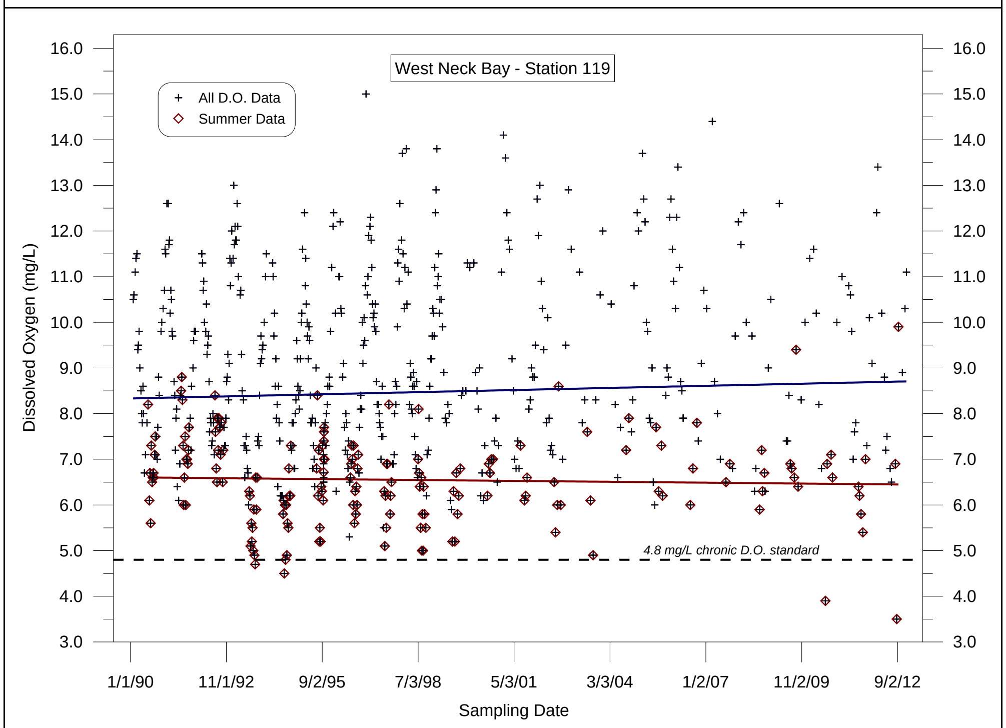
Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Northwest Harbor Station 060118 (1990-2012)



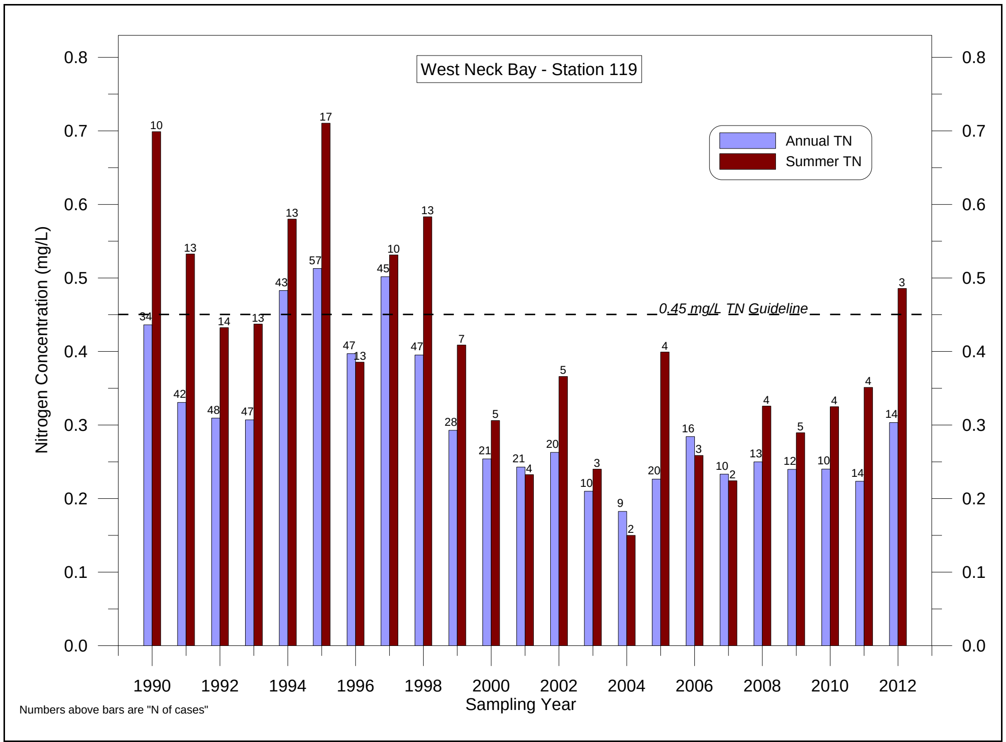


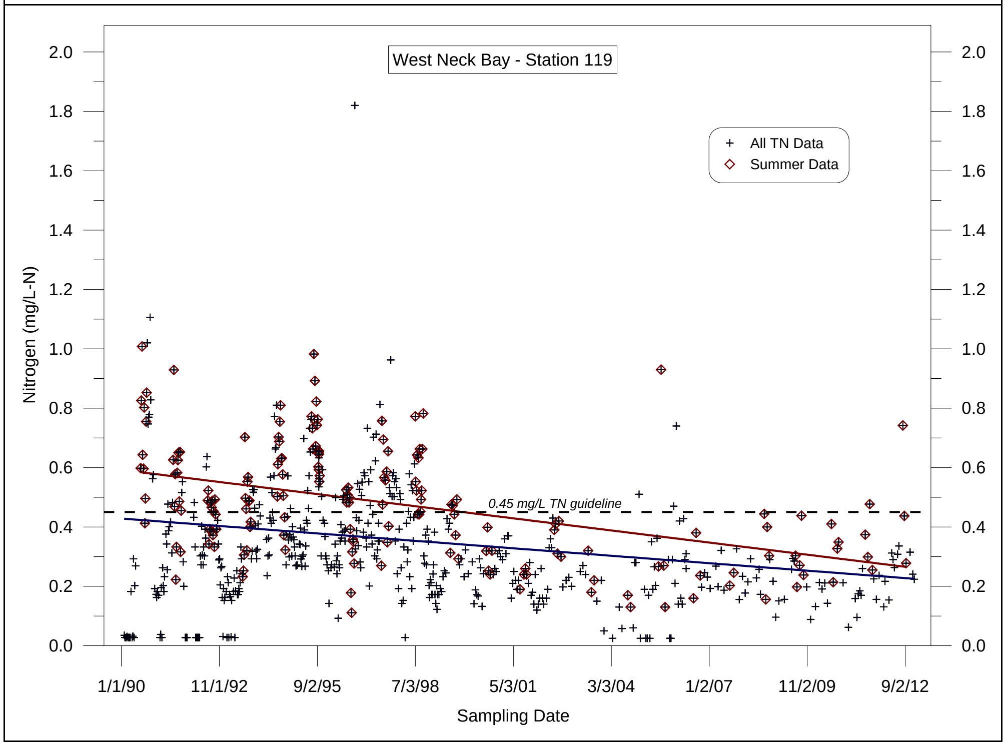
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Northwest Harbor Station 060118 (1990-2012)



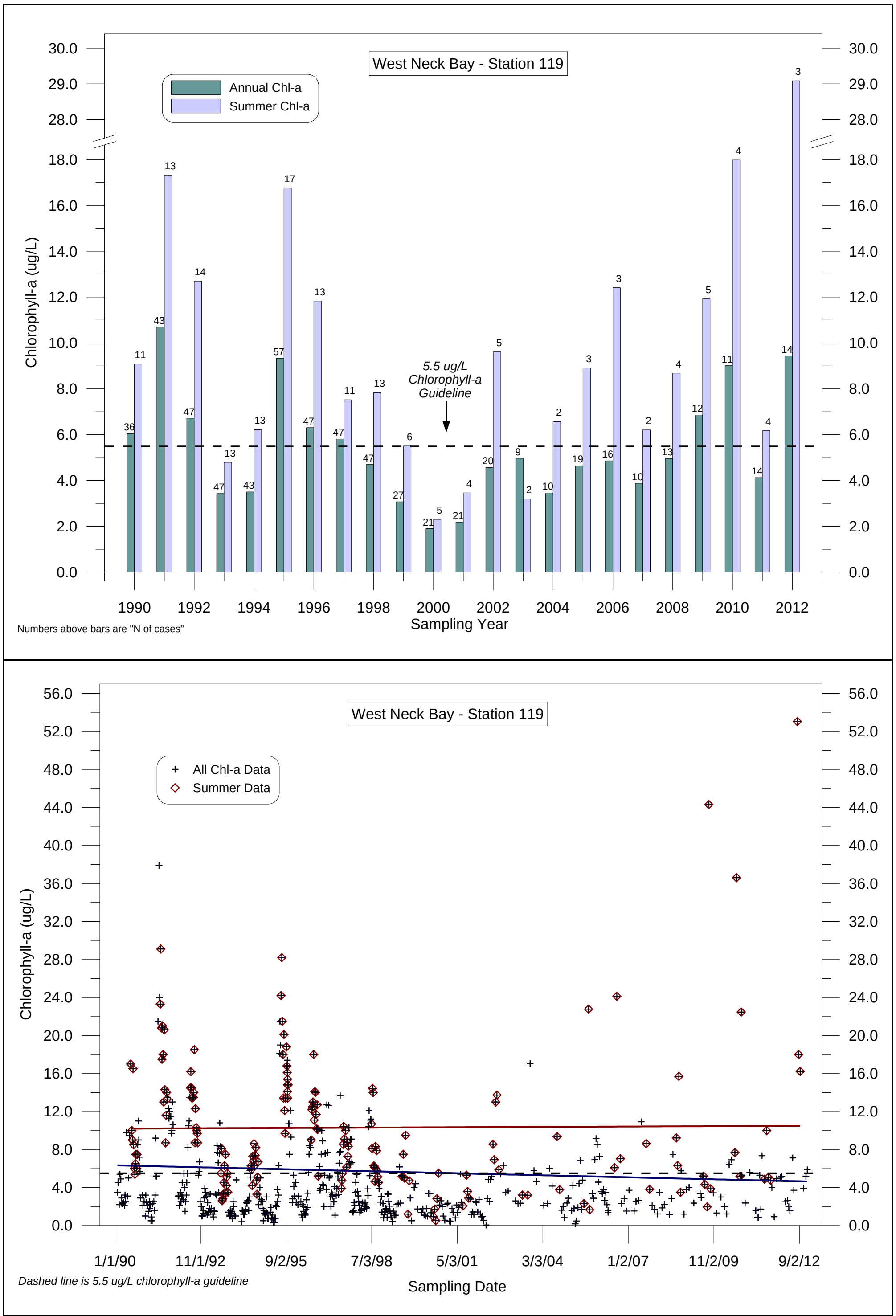


Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at West Neck Bay Station 060119 (1990-2012)

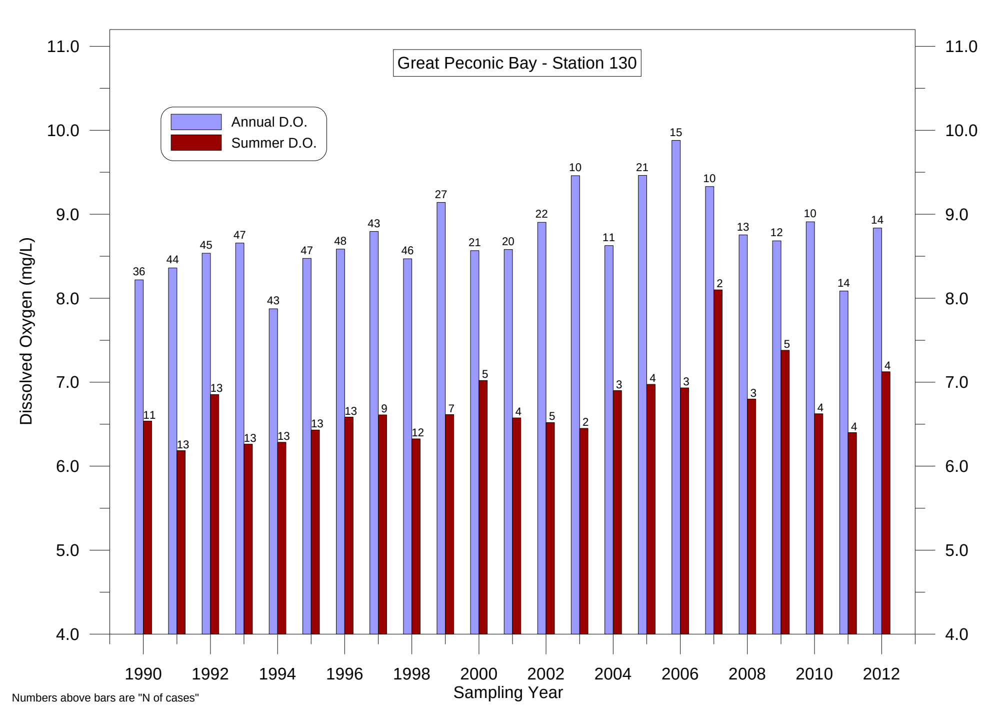


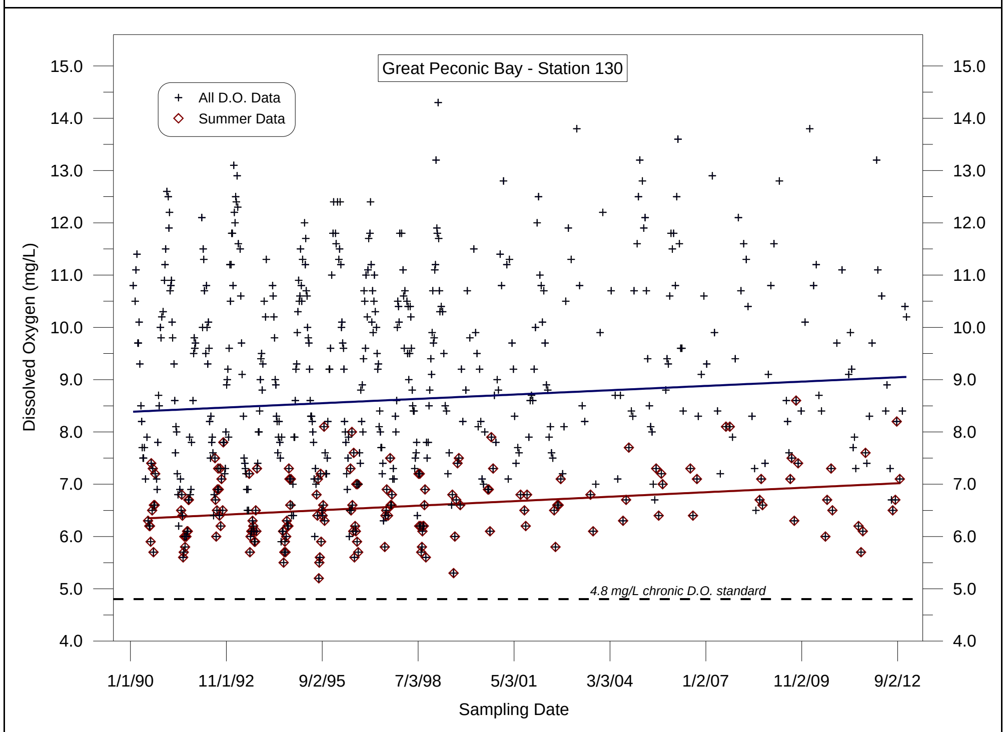


Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at West Neck Bay Station 060119 (1990-2012)

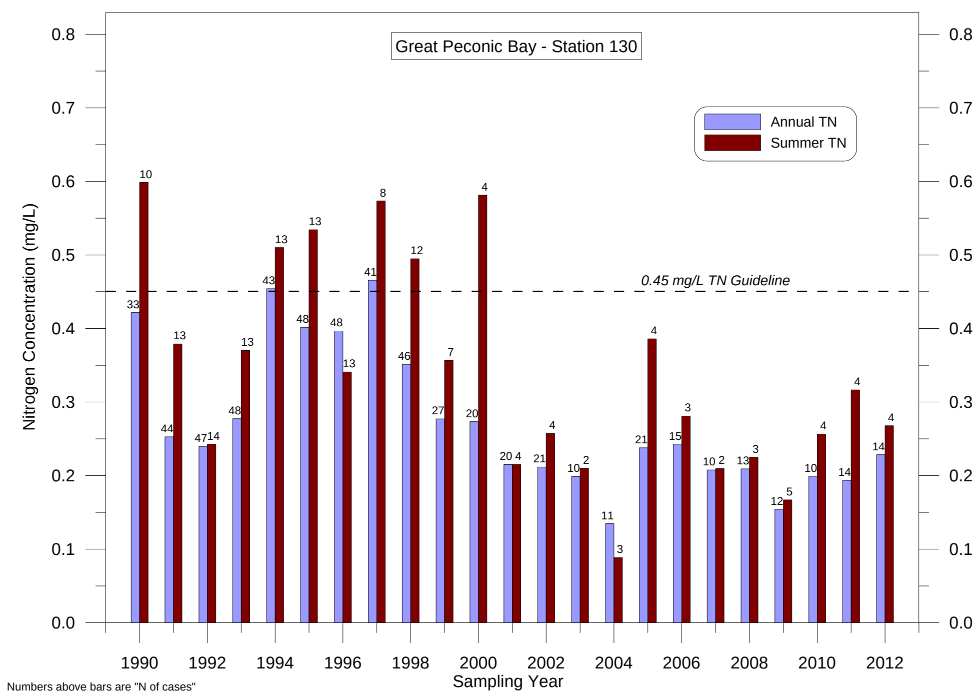


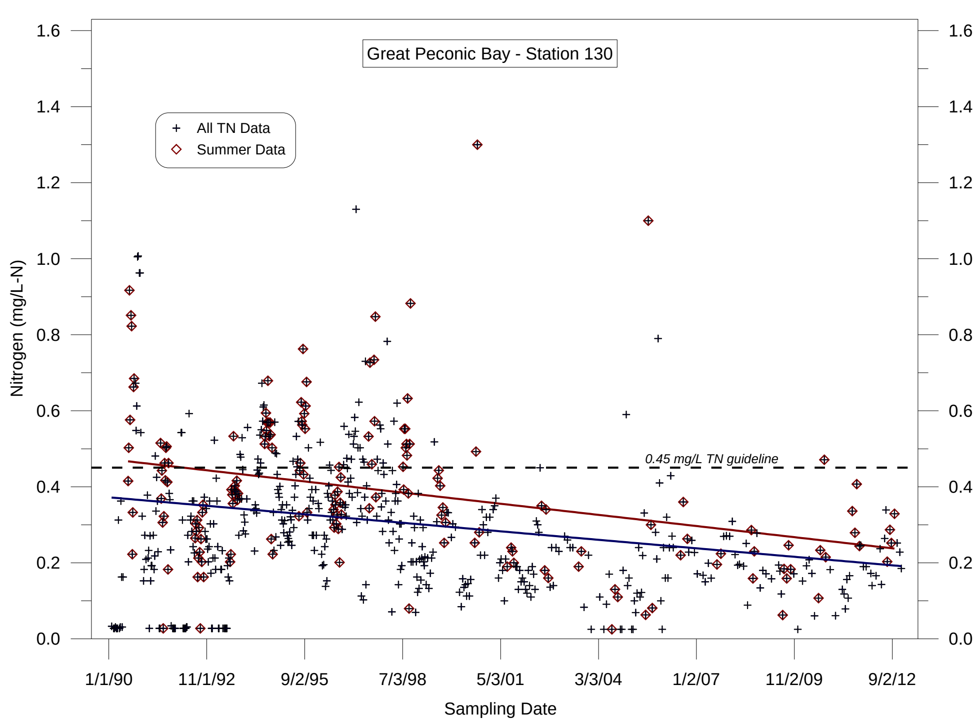
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at West Neck Bay Station 060119 (1990-2012)



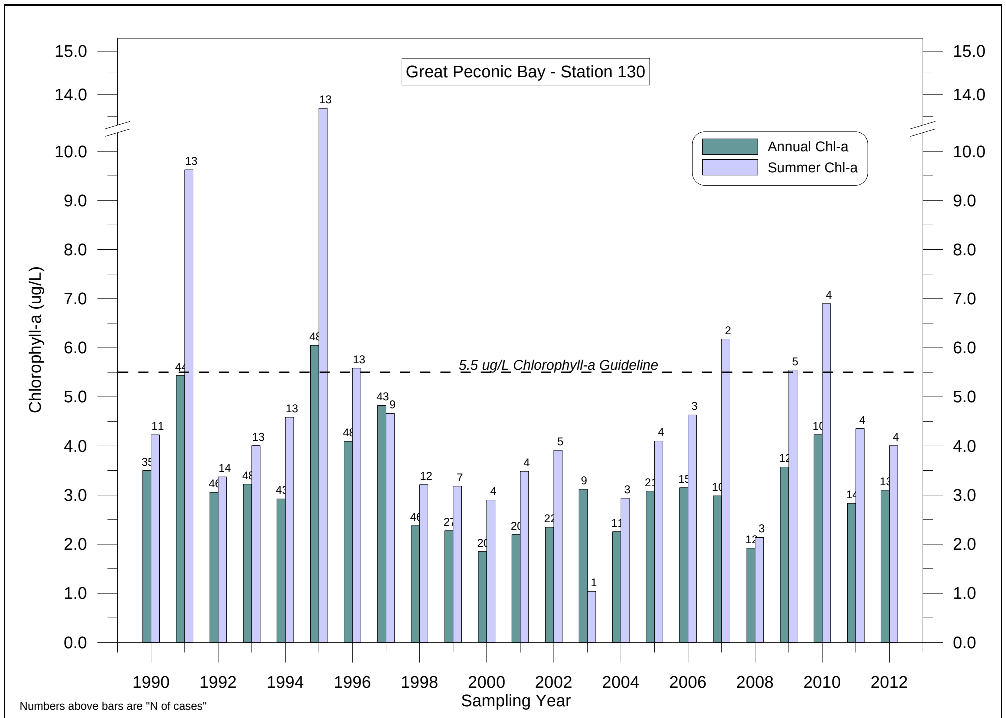


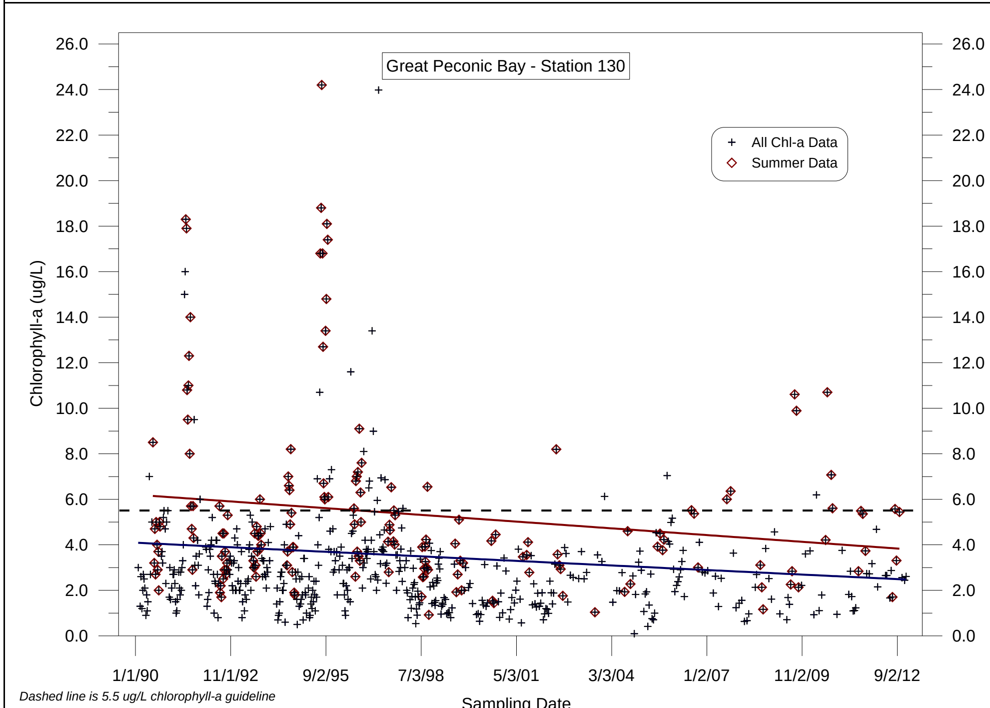
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Great Peconic Bay Station 060130 (1990-2012)



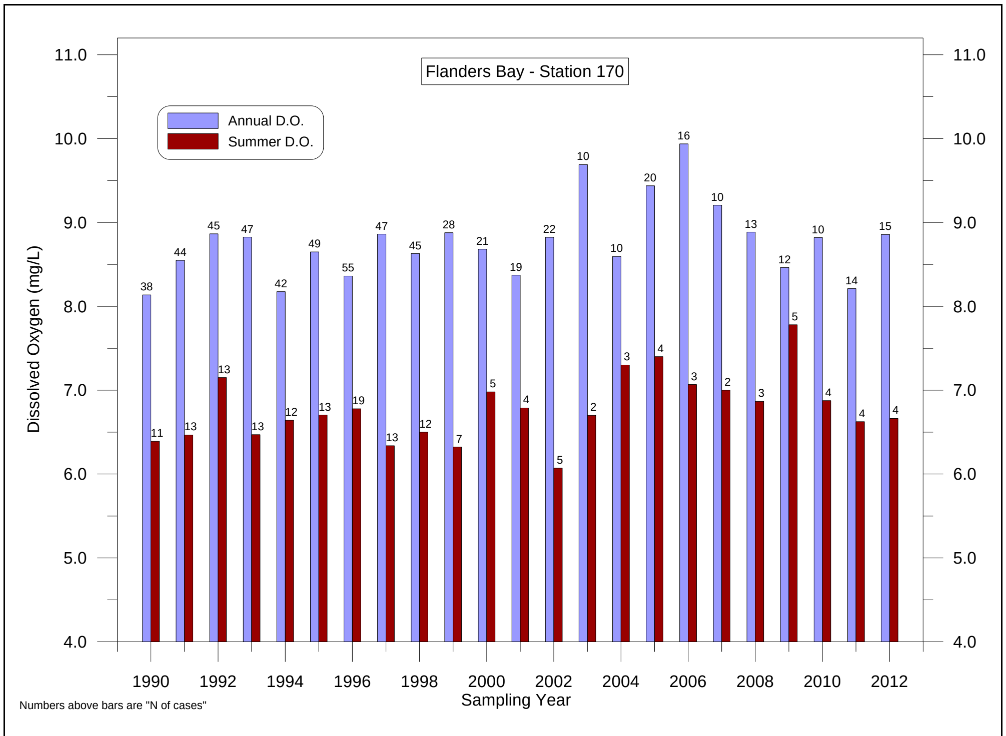


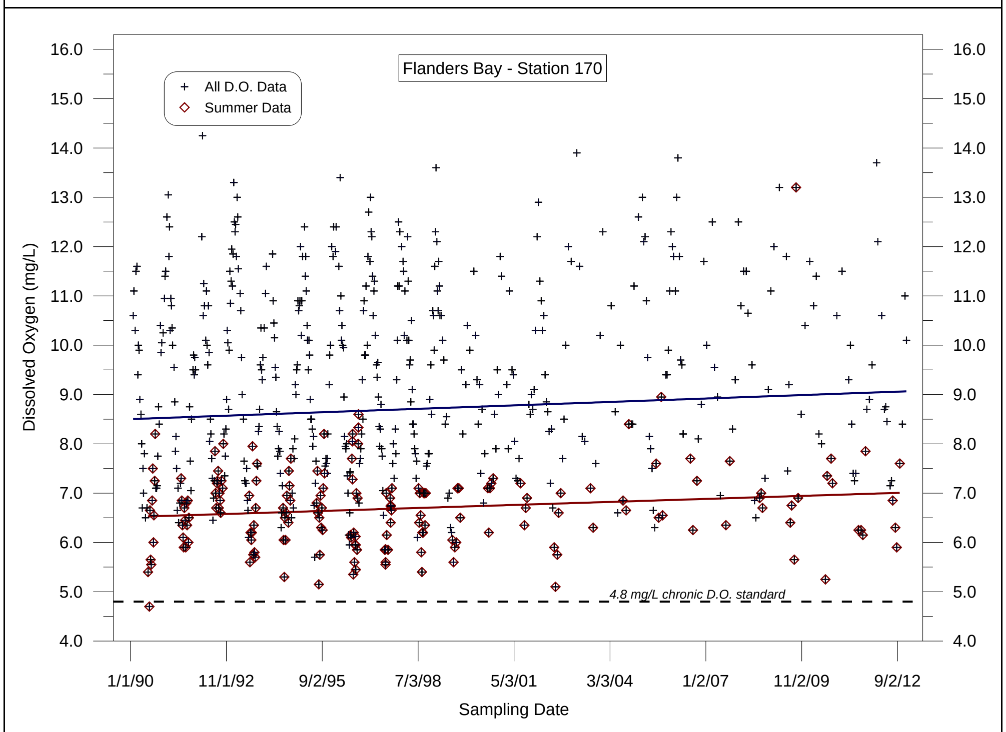
Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Great Peconic Bay Station 060130 (1990-2012)



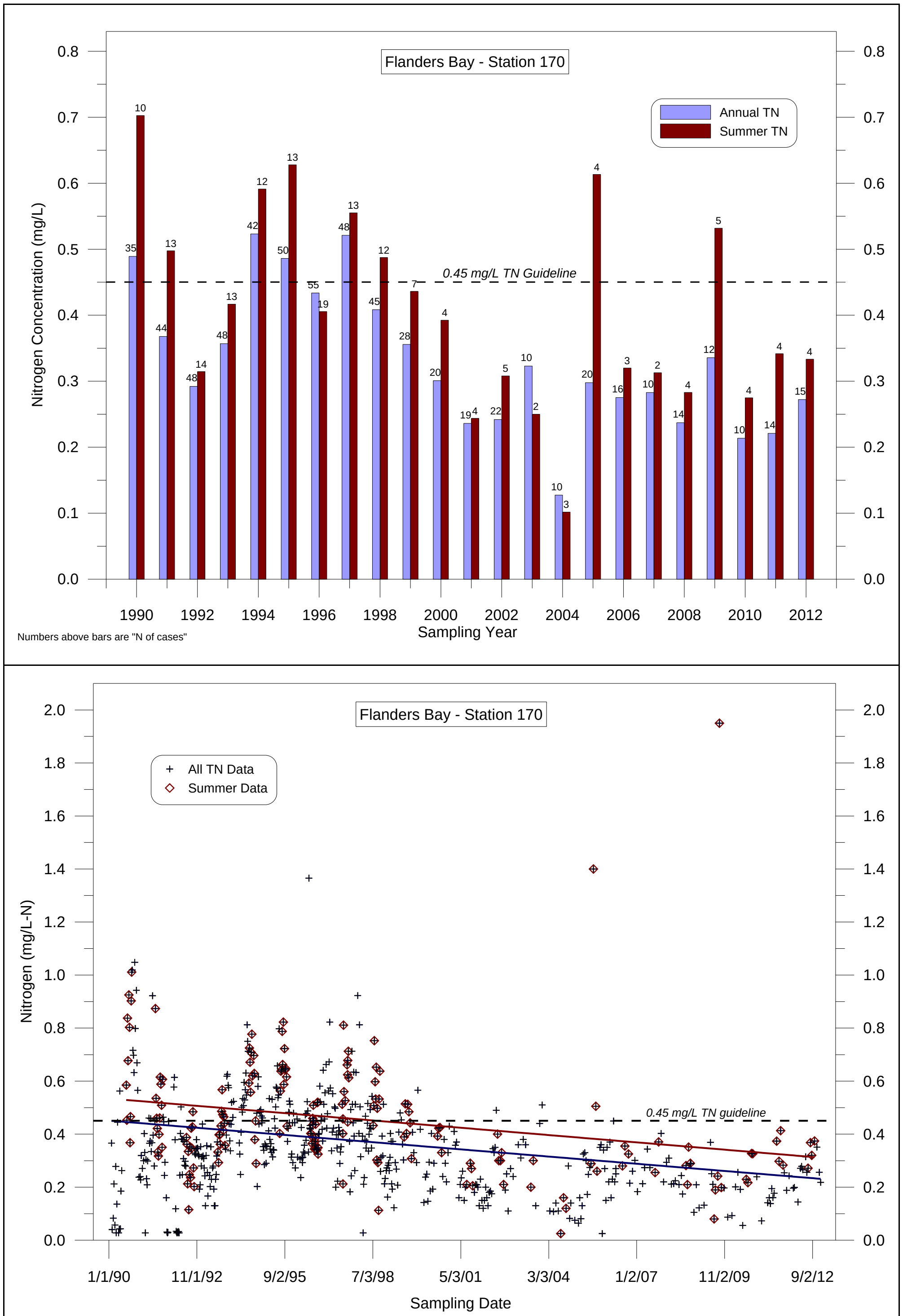


Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Great Peconic Bay Station 060130 (1990-2012)

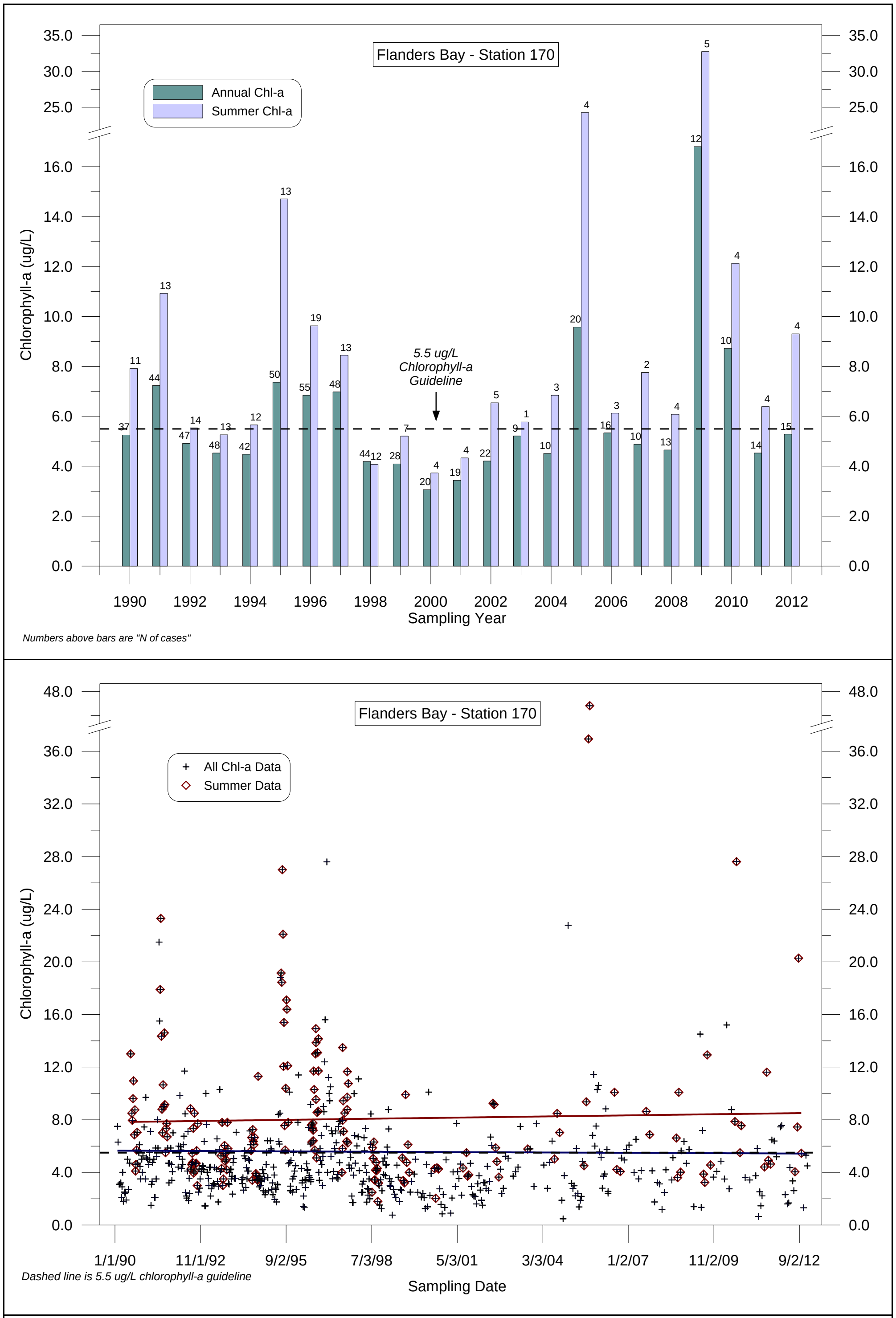




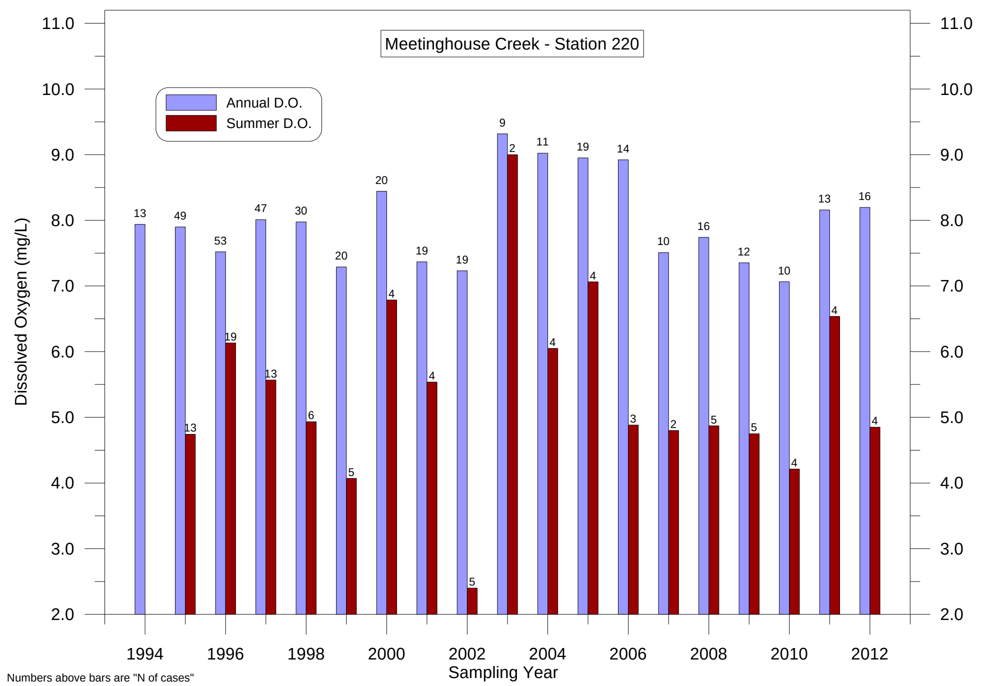
Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Flanders Bay Station 060170 (1990-2012)

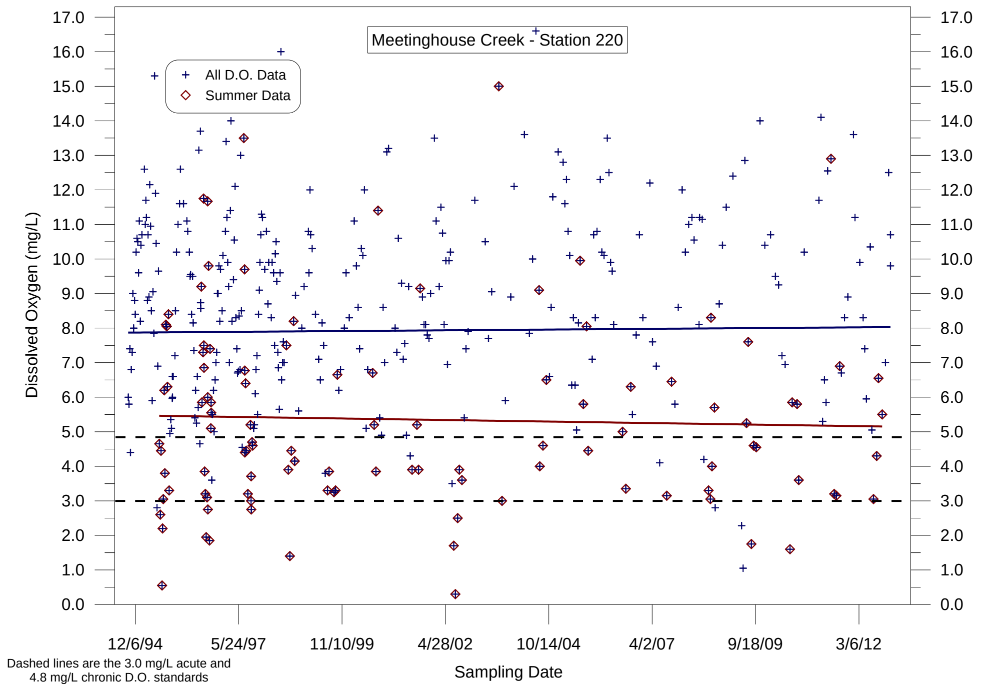


Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Flanders Bay Station 060170 (1990-2012)

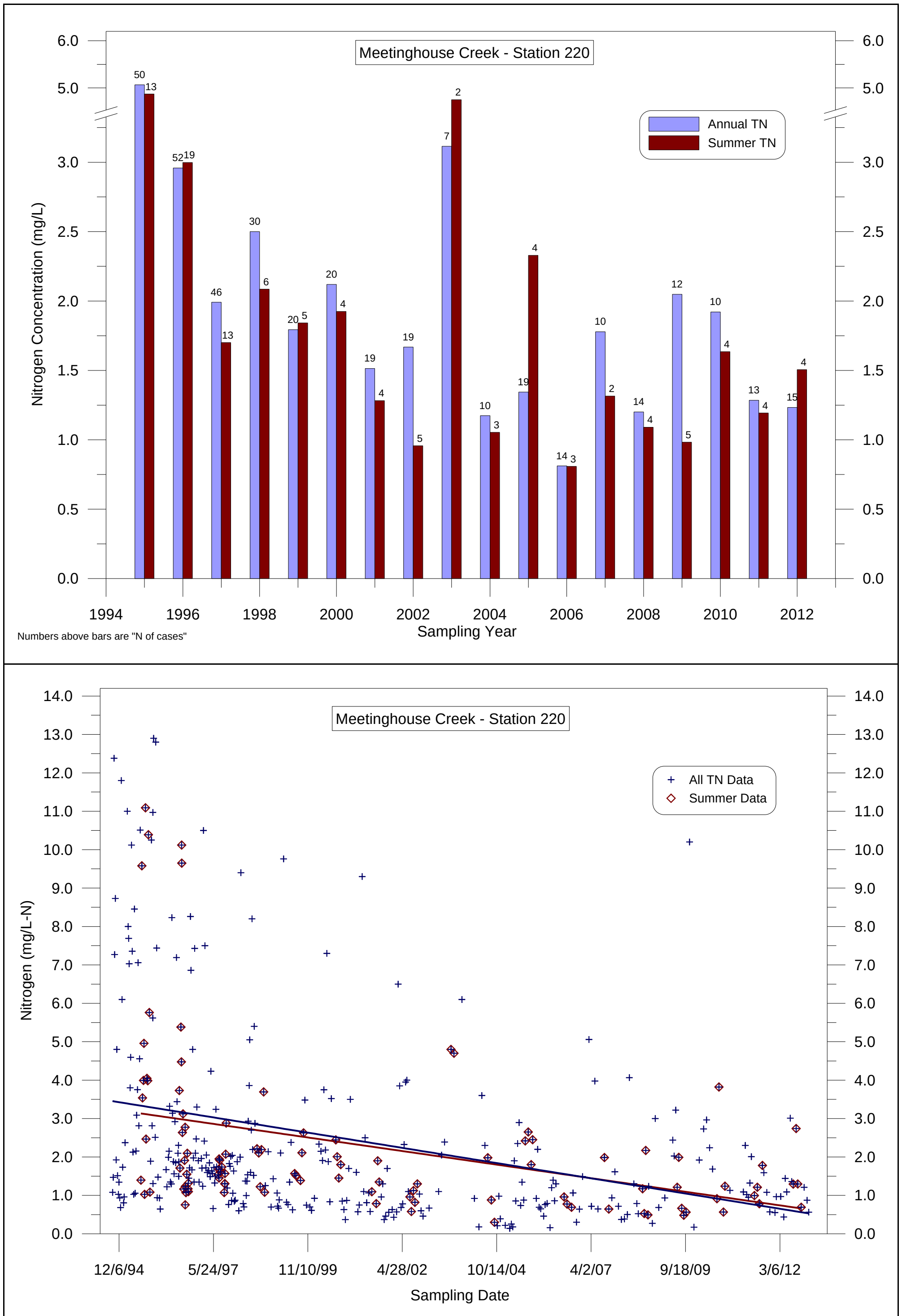


Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Flanders Bay Station 060170 (1990-2012)

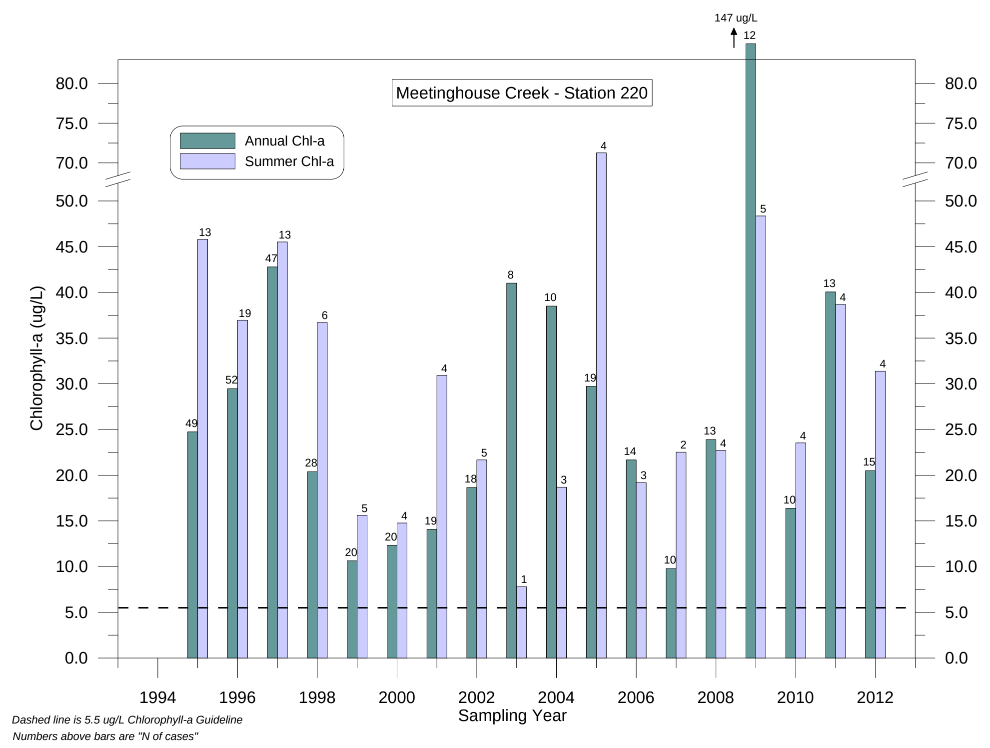


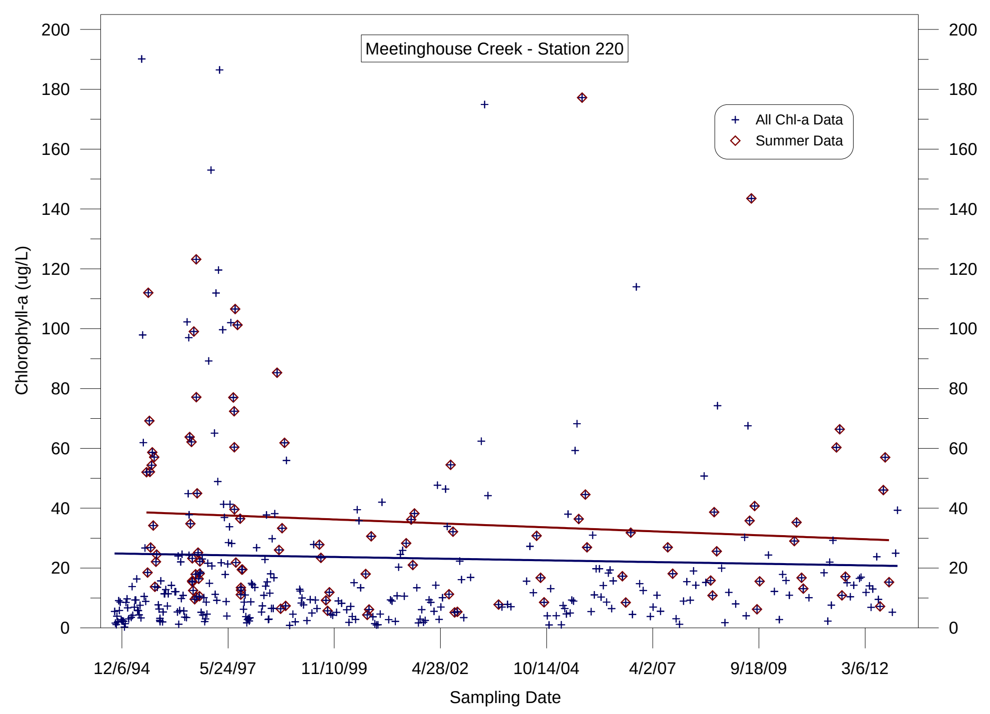


Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Meetinghouse Creek Station 060220 (1990-2012)

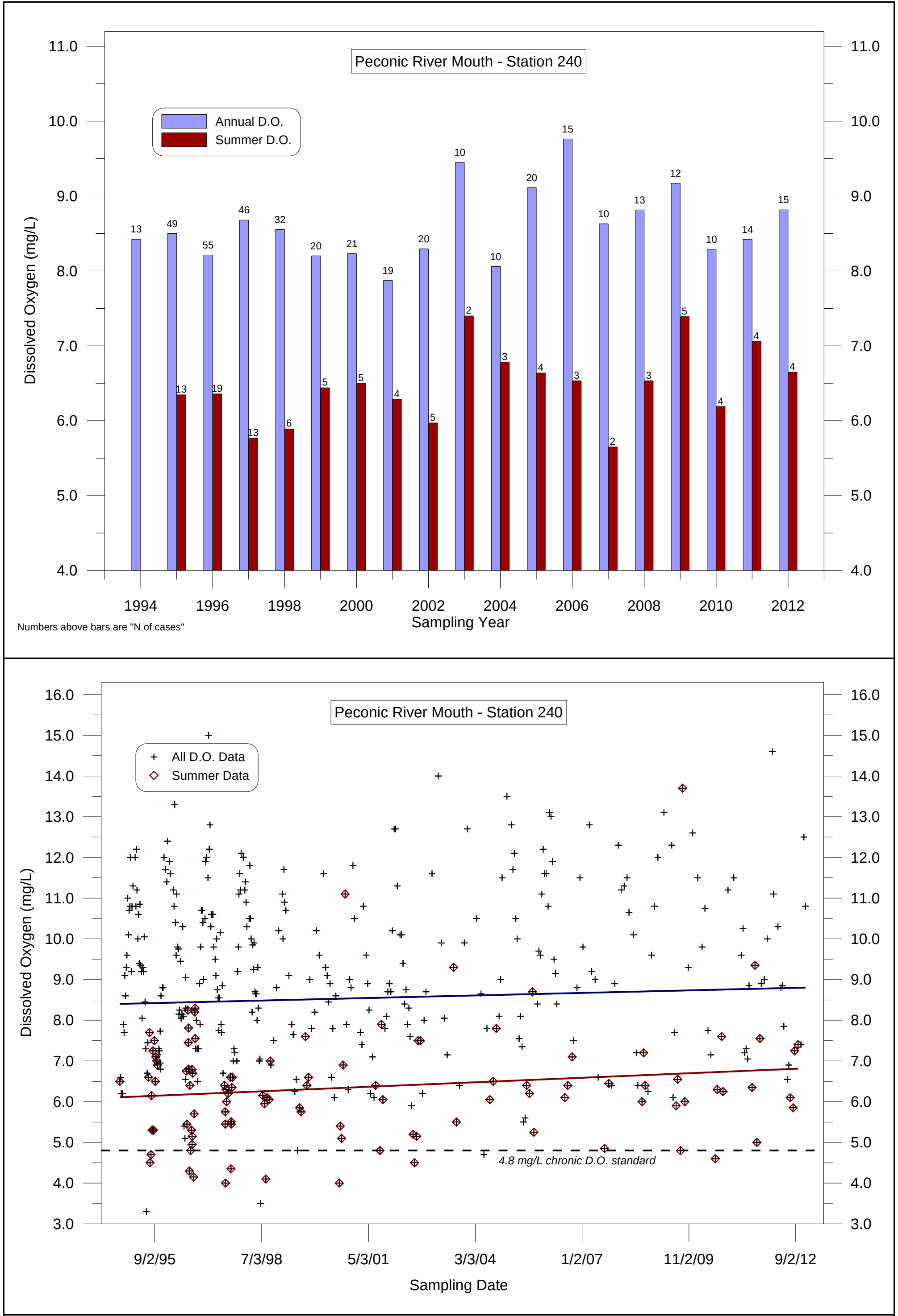


Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Meetinghouse Creek Station 060220 (1990-2012)

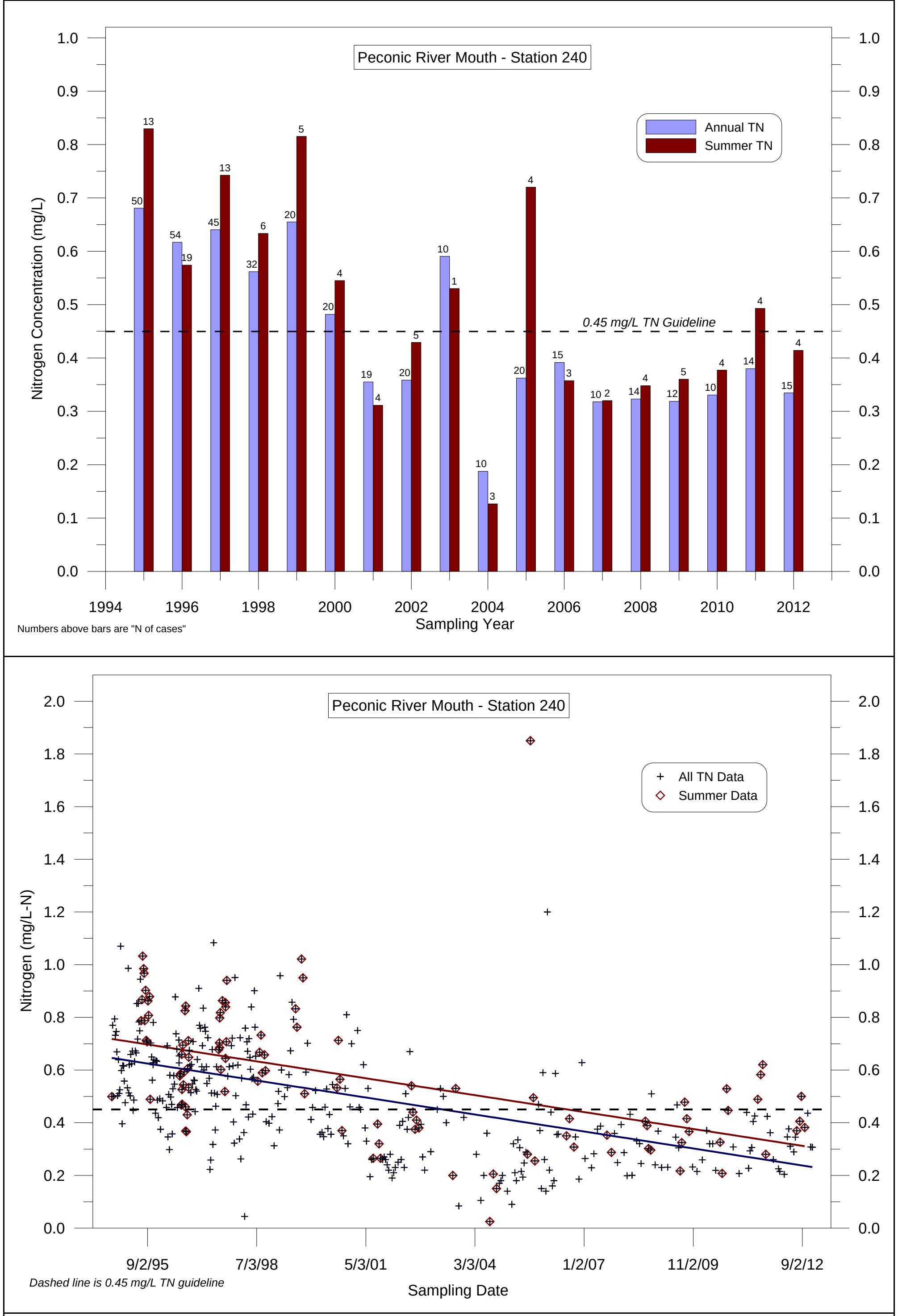




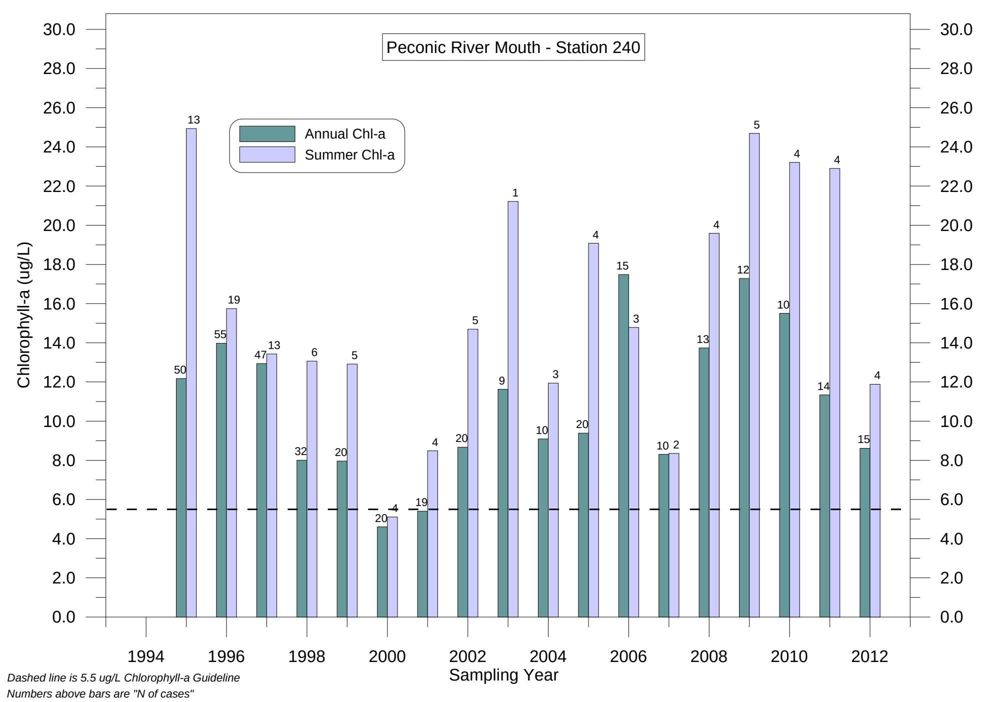
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Meetinghouse Creek Station 060220 (1990-2012)

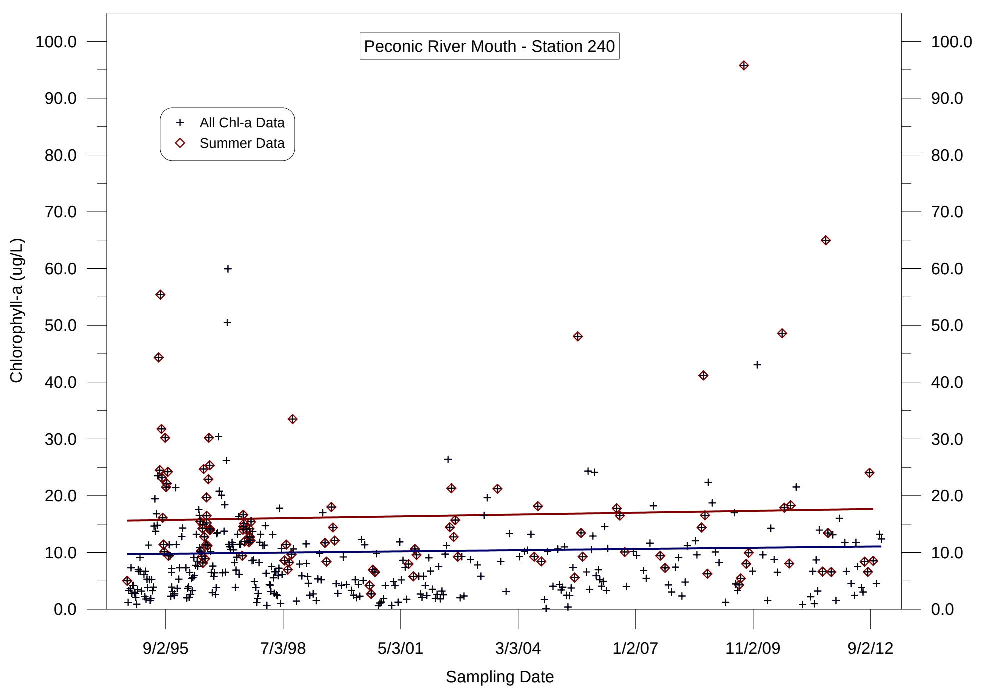


Annual and Summer Means and Data Scatterplot for Dissolved Oxygen Results at Peconic River Mouth Station 060240 (1990-2012)



Annual and Summer Means and Data Scatterplot for Total Nitrogen Results at Peconic River Mouth Station 060240 (1990-2012)



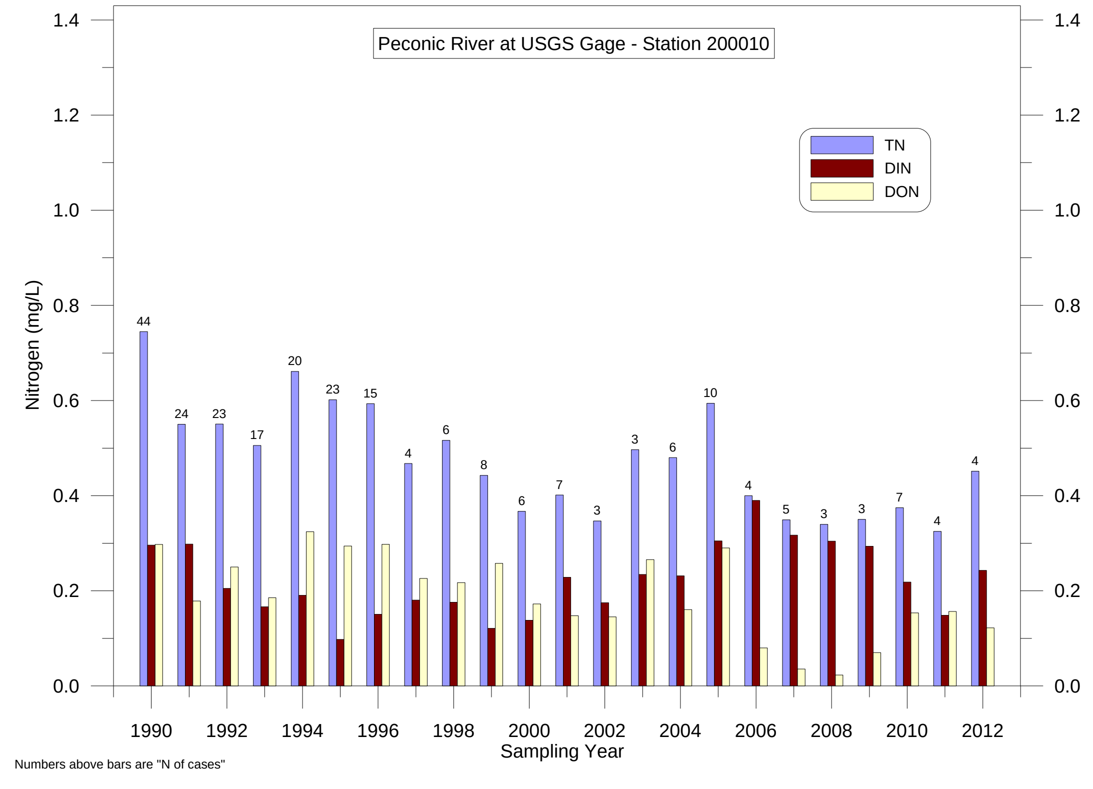


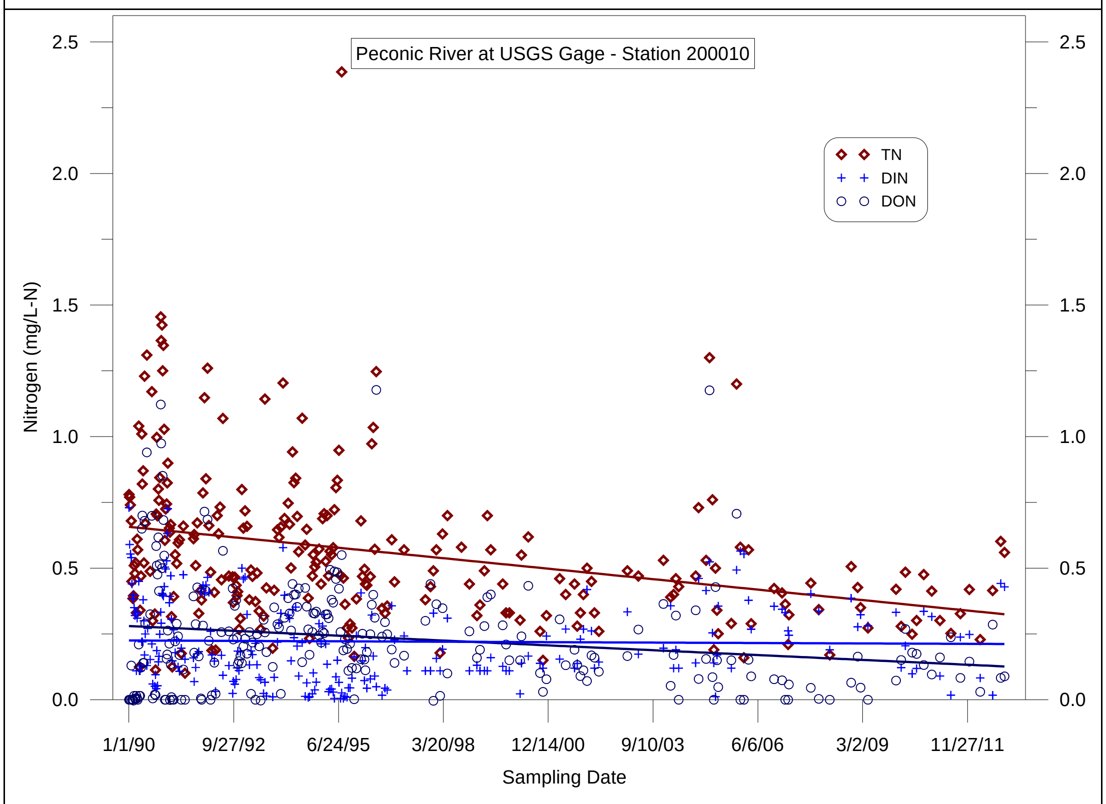
Annual and Summer Means and Data Scatterplot for Chlorophyll-a Results at Peconic River Mouth Station 060240 (1990-2012)

Appendix F2.

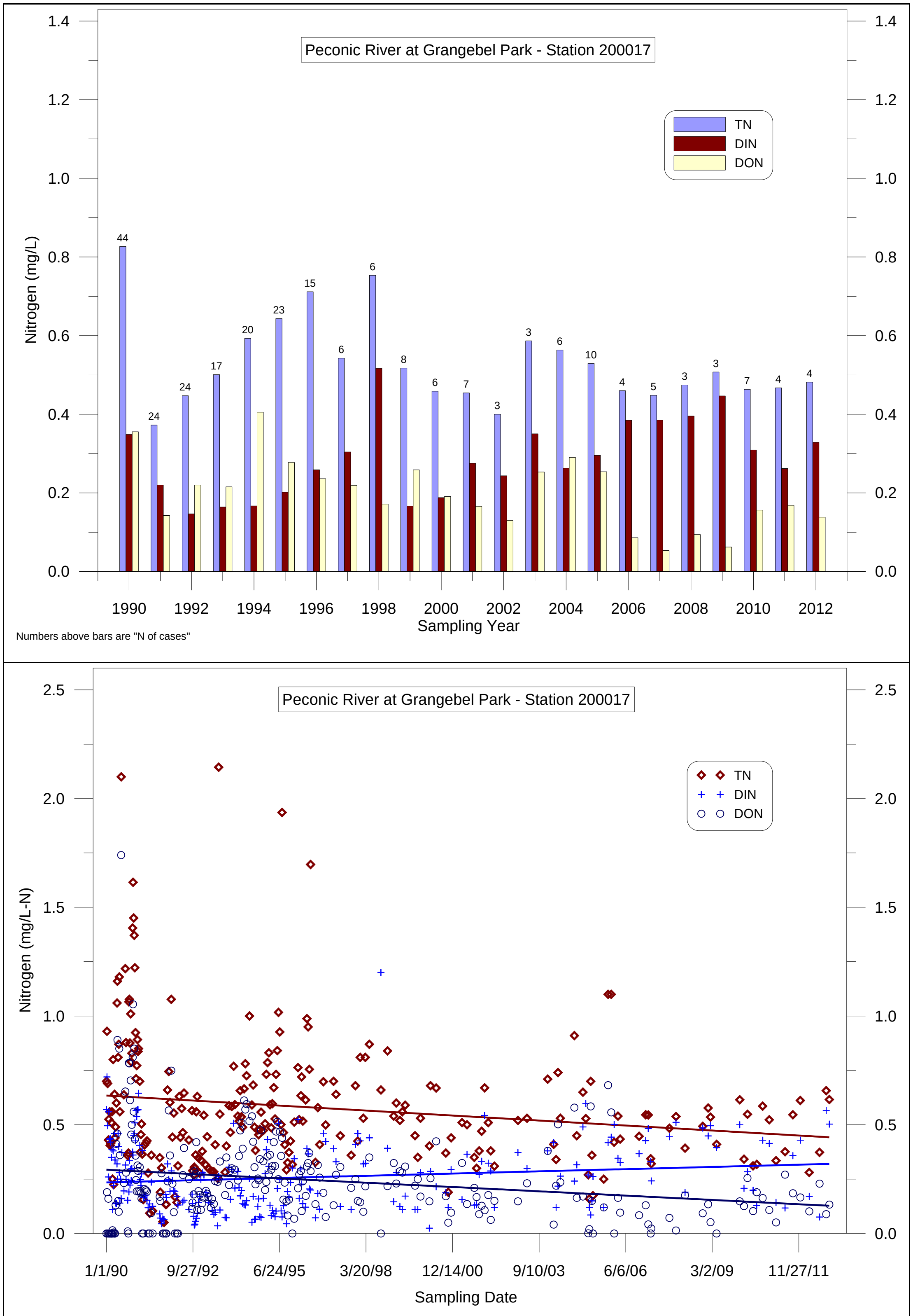
Plots of Historic (1990-2012) Nitrogen Concentrations at Select Stream and Point Source Sampling Locations

Peconic River at USGS Gage (200010)
Peconic River at Grangebel Park (200017)
Peconic River at the Brookhaven National Lab (200044)
Goose Creek (200013)
Birch Creek (200014)
Mill Creek (200015)
Hubbard Creek (200016)
Meetinghouse Creek at Rt. 25 (200041)
Meetinghouse Creek at Corwin Duck Farm (200004)
Sawmill Creek (200110)
Terrys Creek (200120)
Reeves Creek (200130)
East Creek, South Jamesport (200140)
Brushes Creek (200160)
Deep Hole Creek (200170)
Halls Creek (200180)
Downs Creek (200190)
West Creek (200200)
East Creek, Cutchogue (200210)
Pipes Creek (200230)
Pipes Neck Creek (200240)
Narrow River North (200250)
Narrow River South (200260)

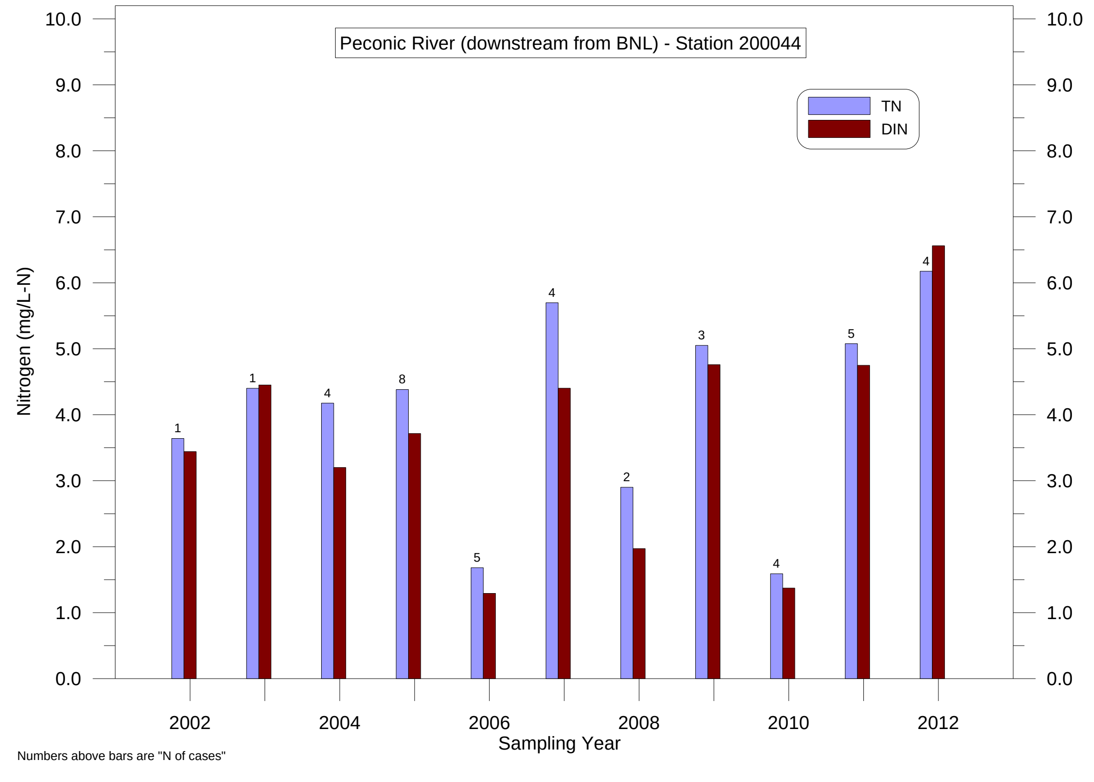


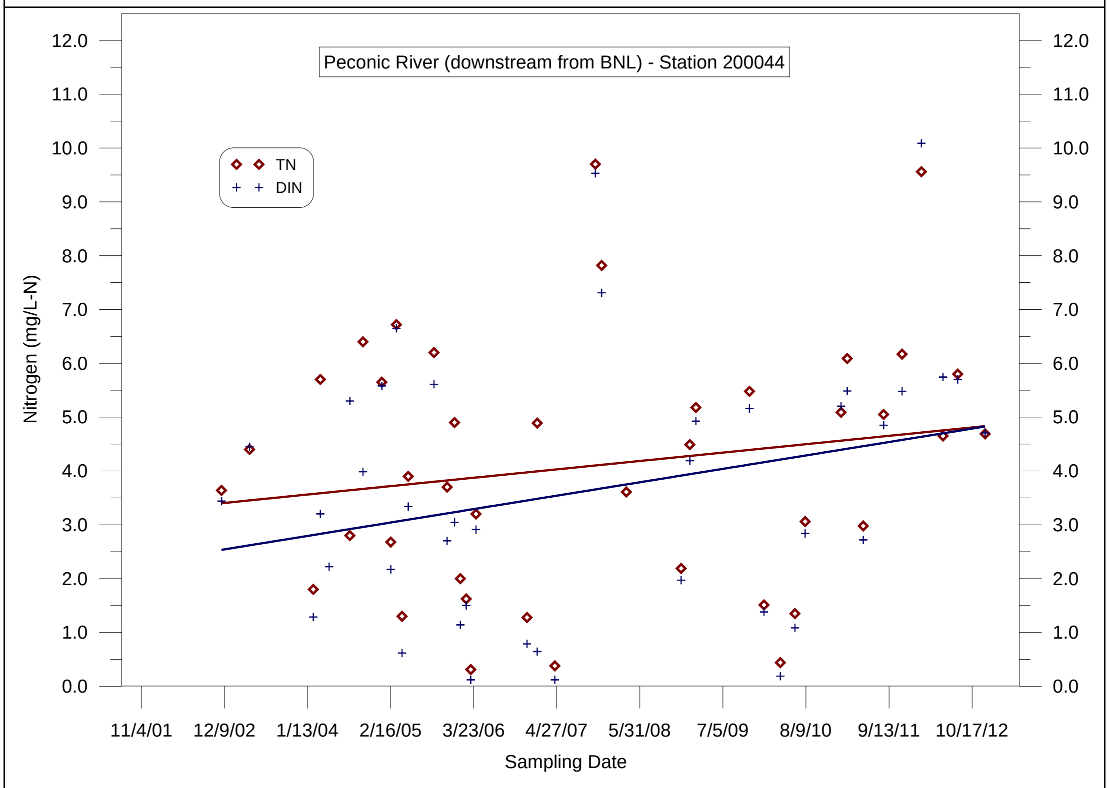


Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Peconic River Station 200010 (1990-2012)

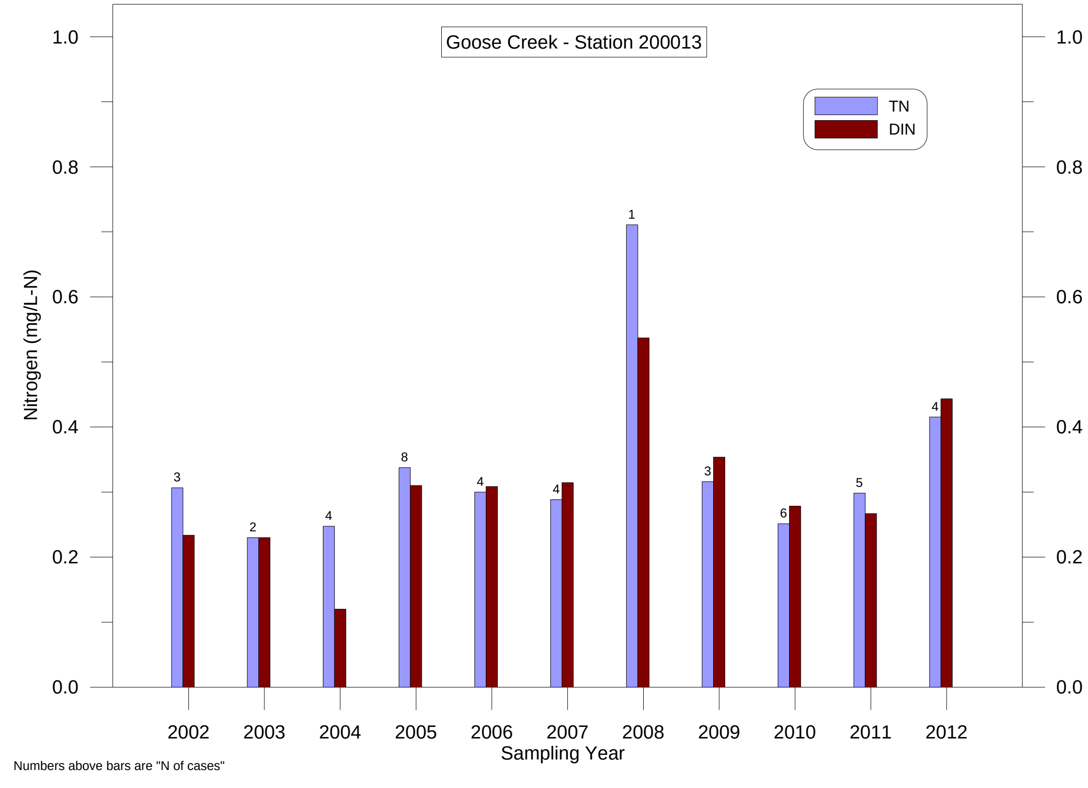


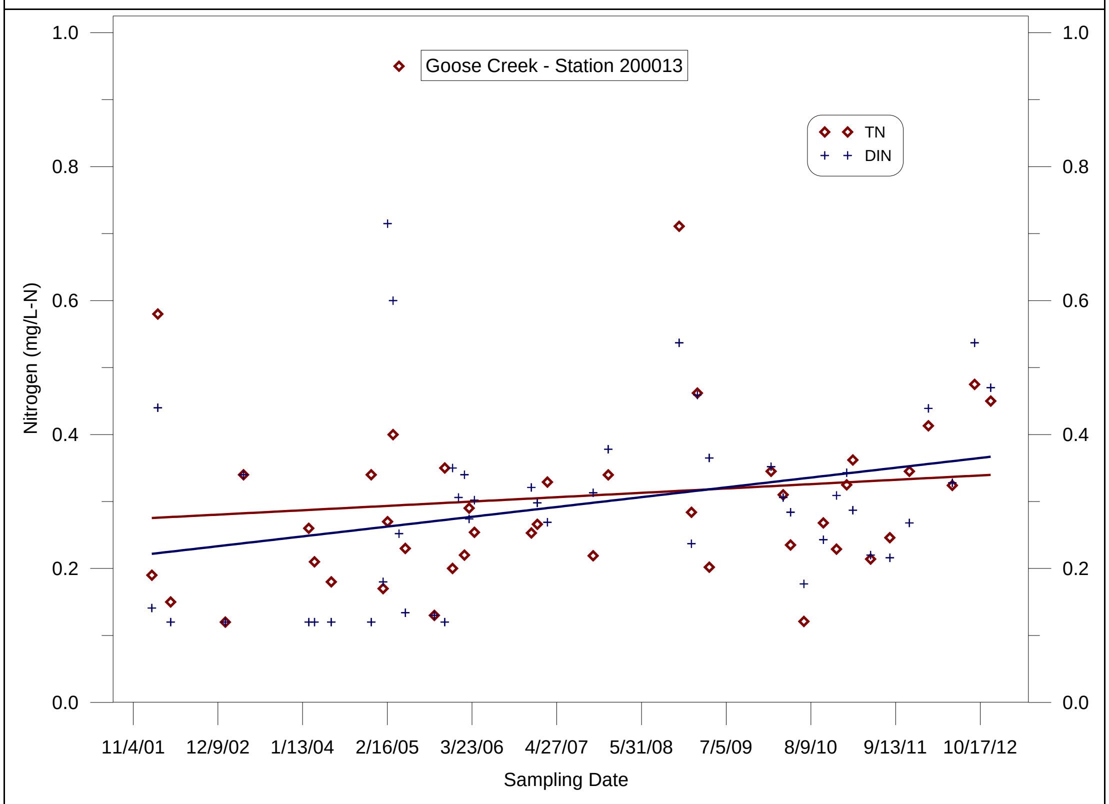
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Peconic River Station 200017 (1990-2012)



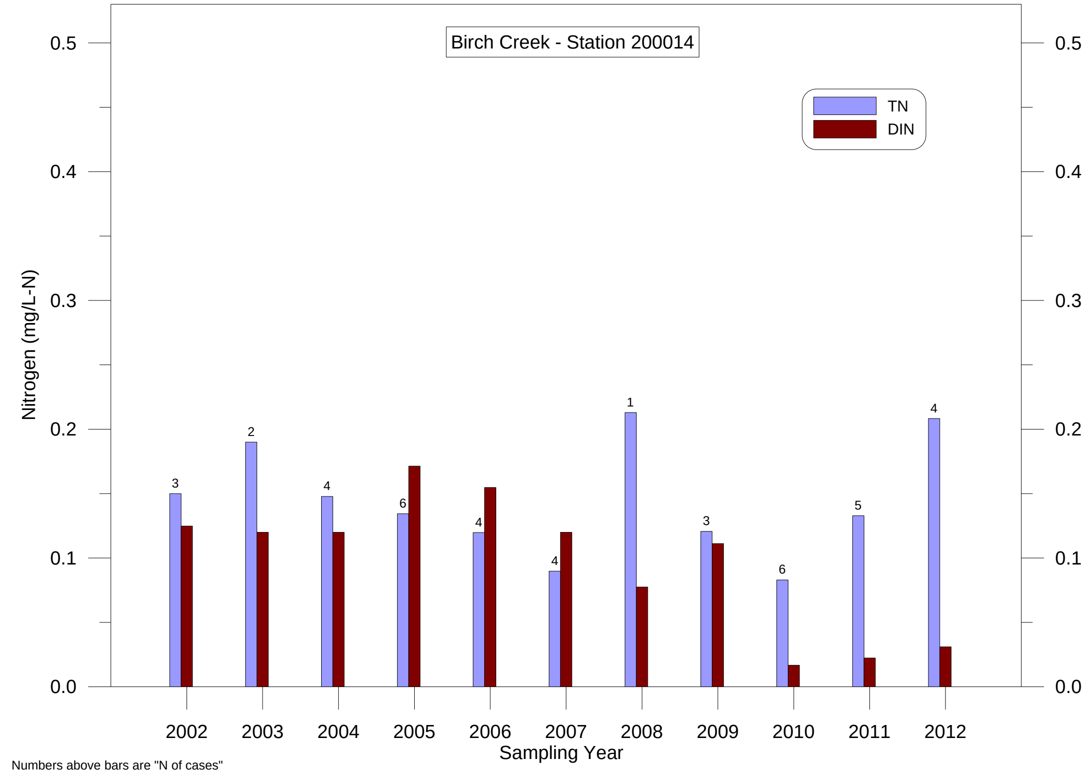


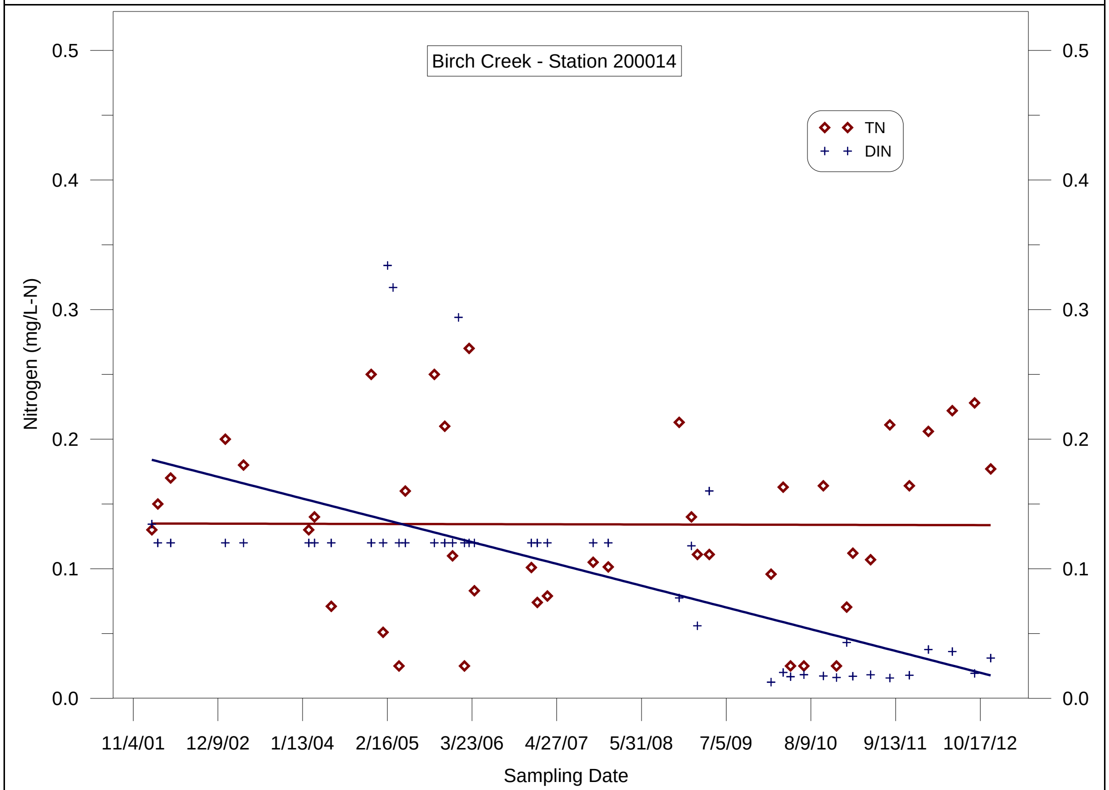
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Peconic River Station 200044 (1990-2012)



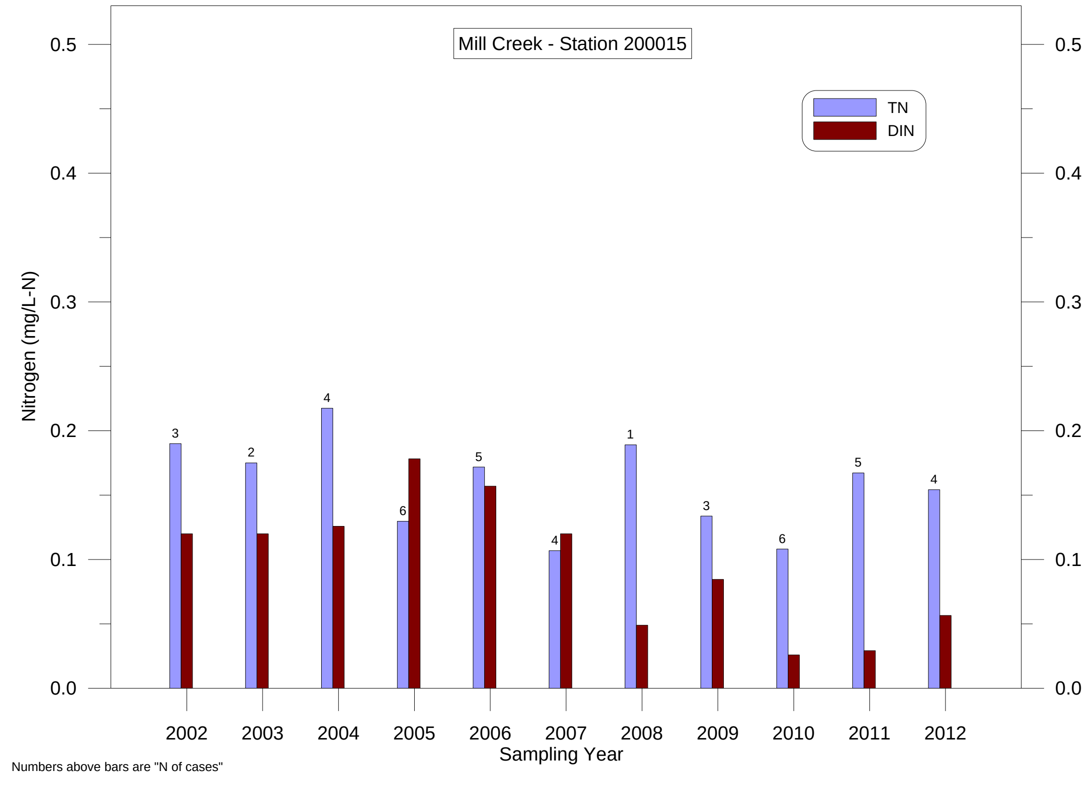


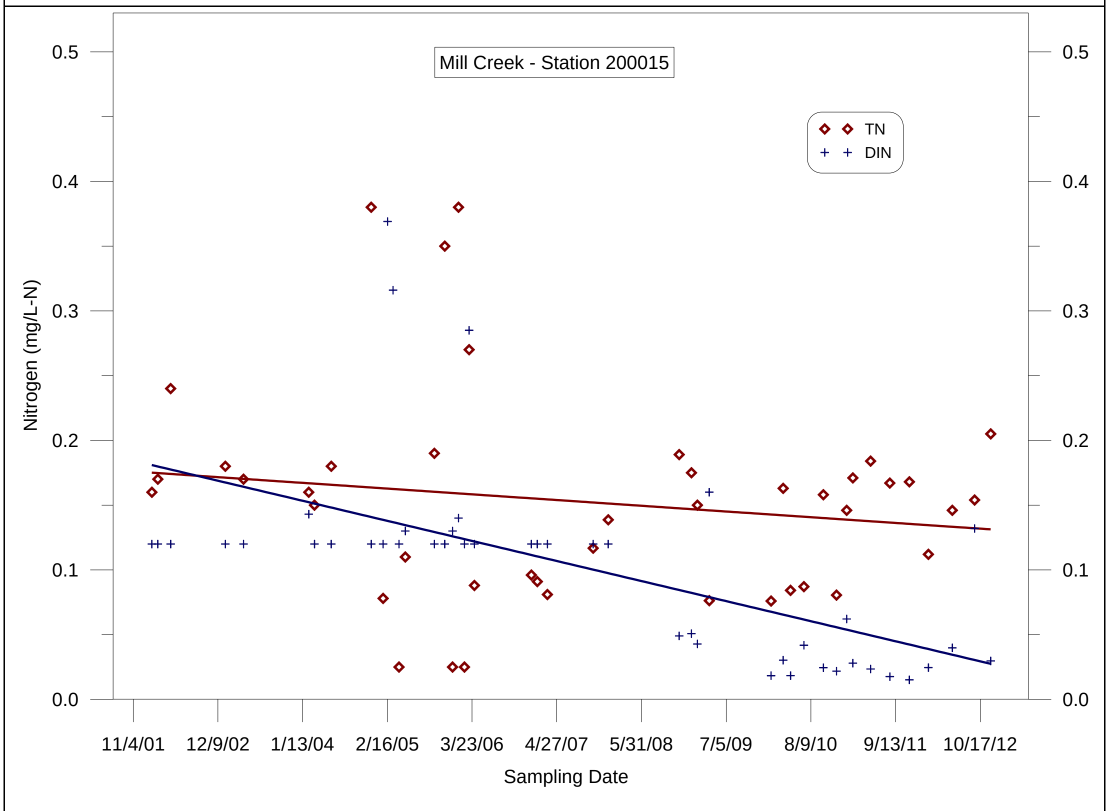
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Goose Creek Station 200013 (1990-2012)



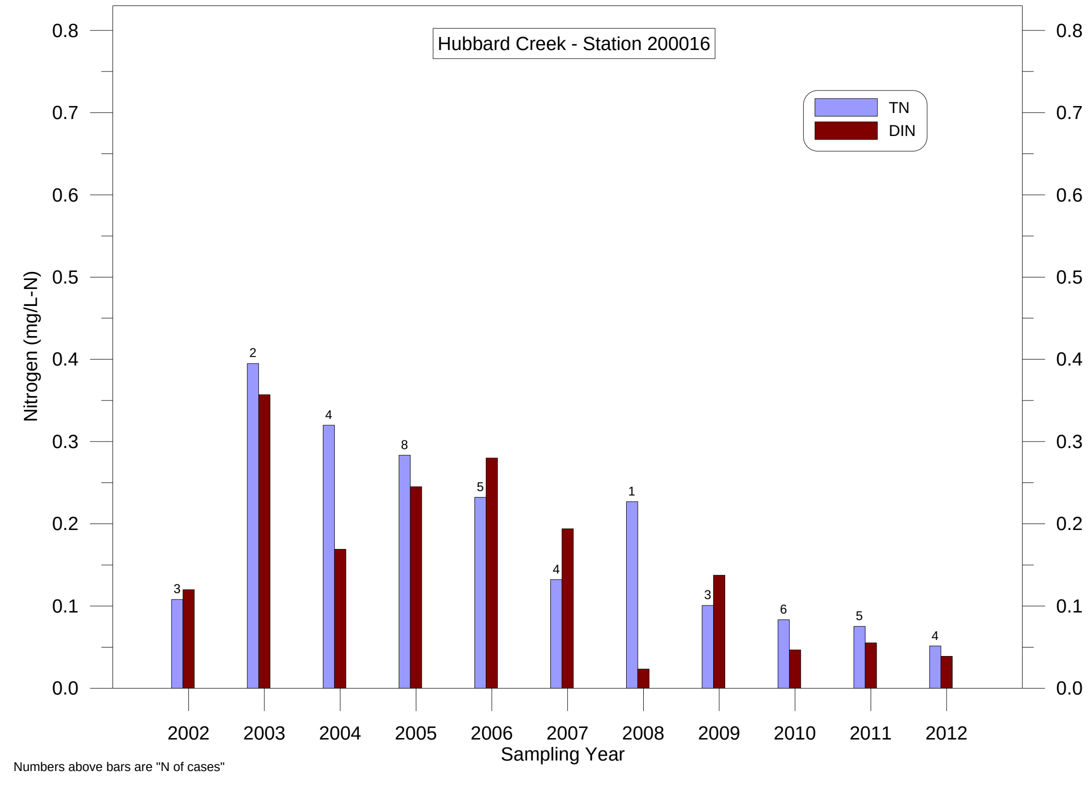


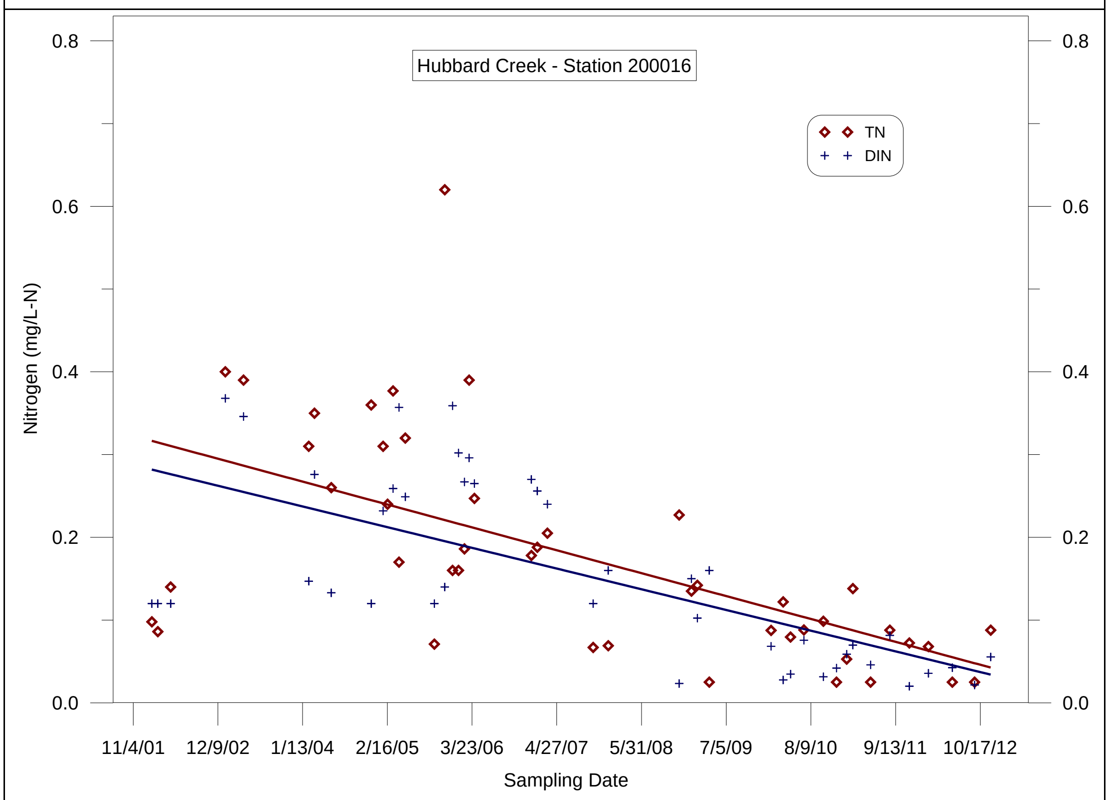
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Birch Creek Station 200014 (1990-2012)



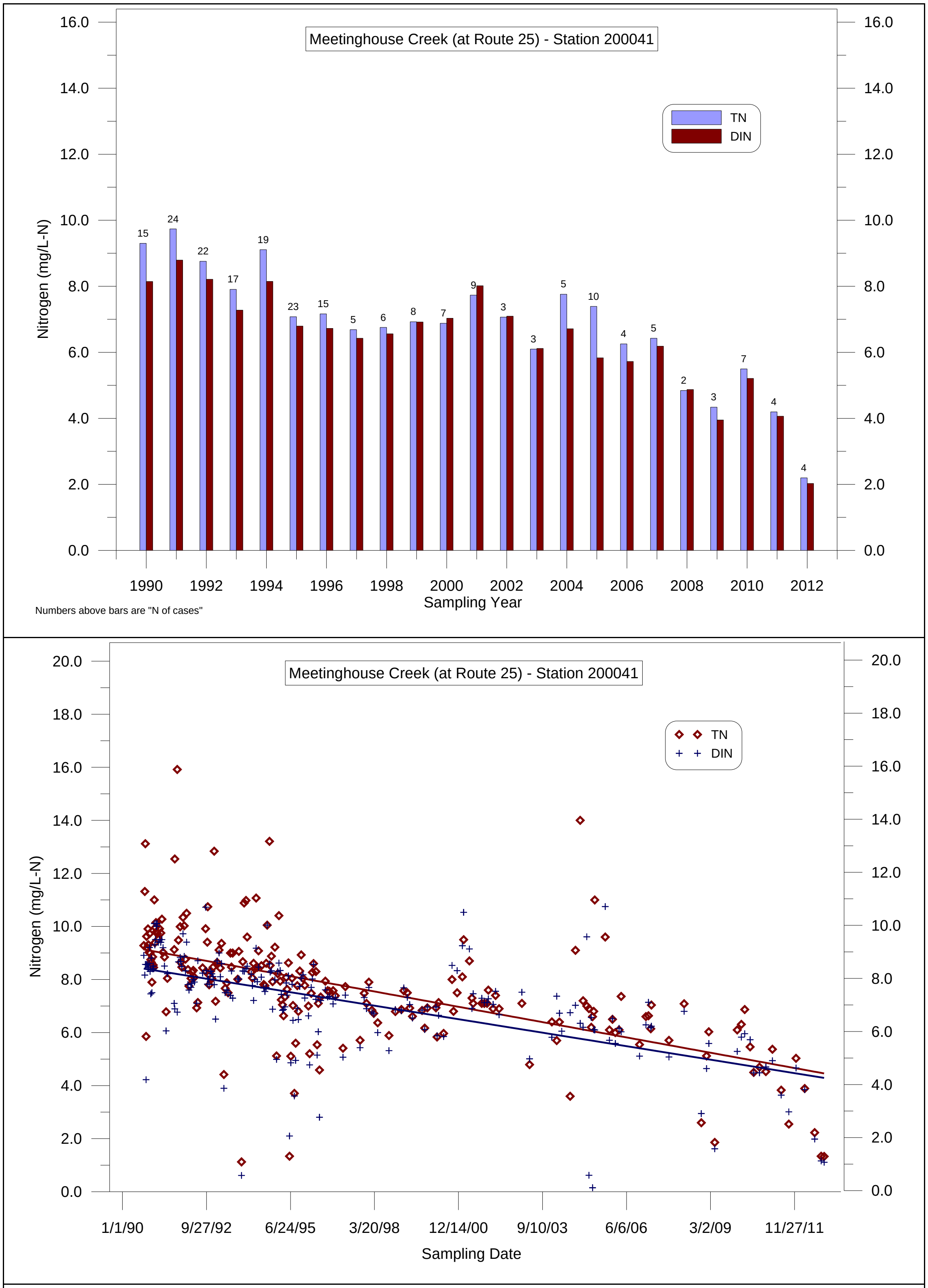


Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Mill Creek Station 200015 (1990-2012)

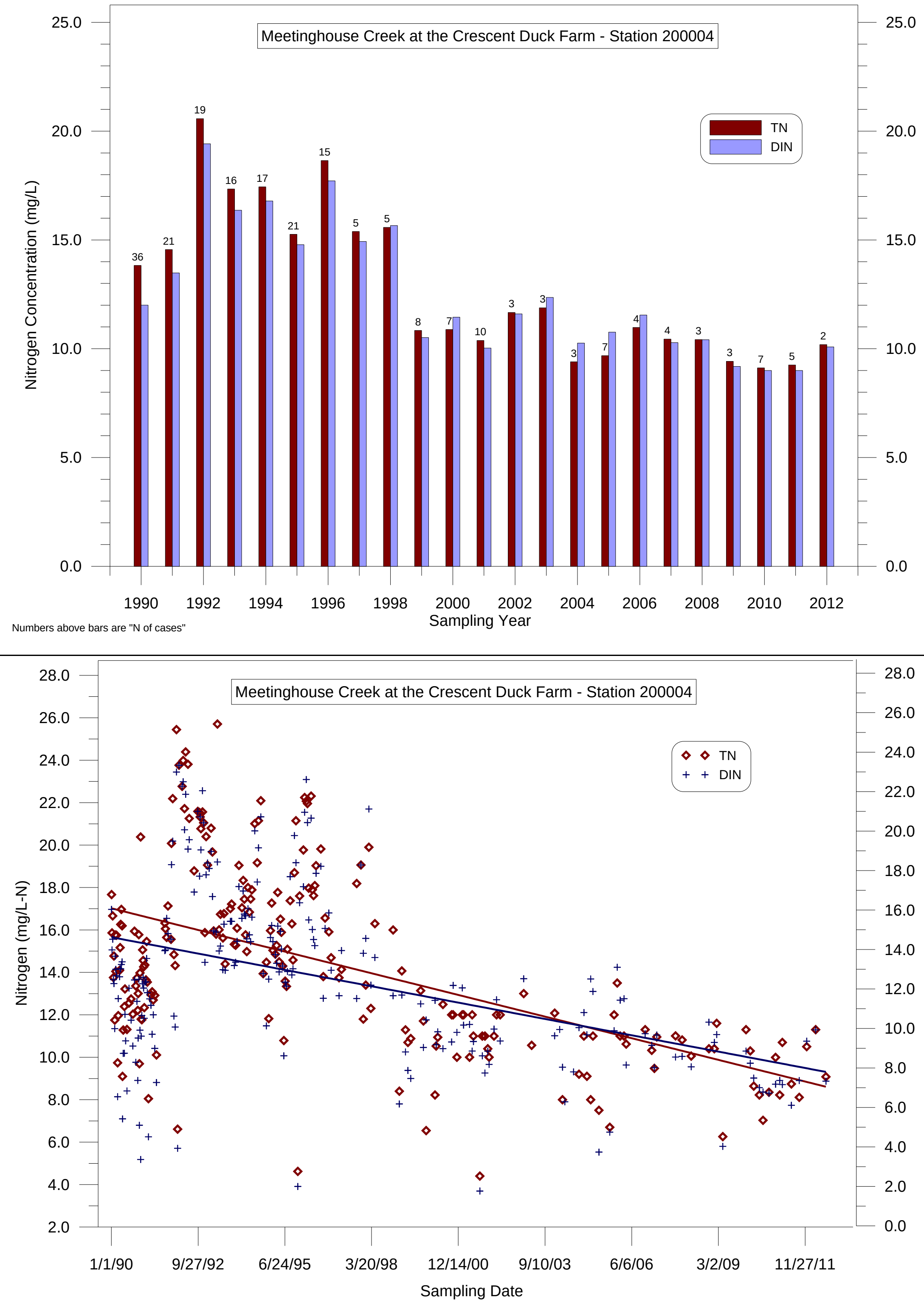




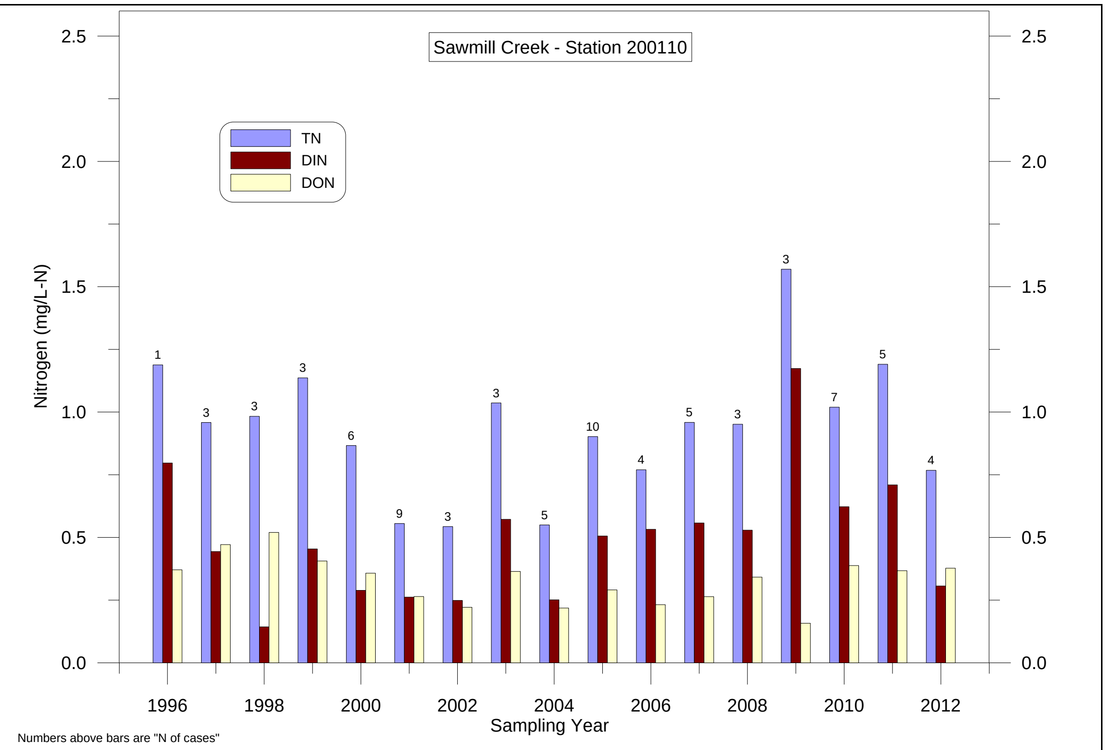
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Hubbard Creek Station 200016 (1990-2012)

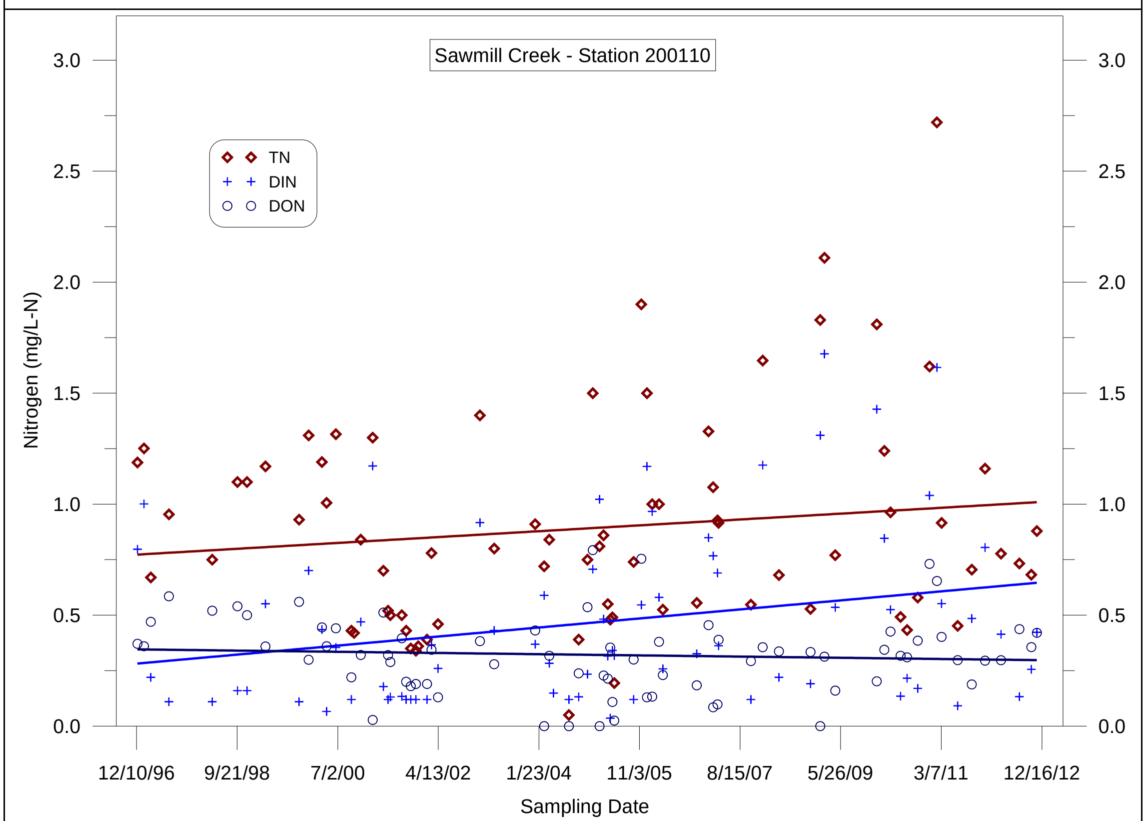


Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Meetinghouse Creek Station 200041 (1990-2012)

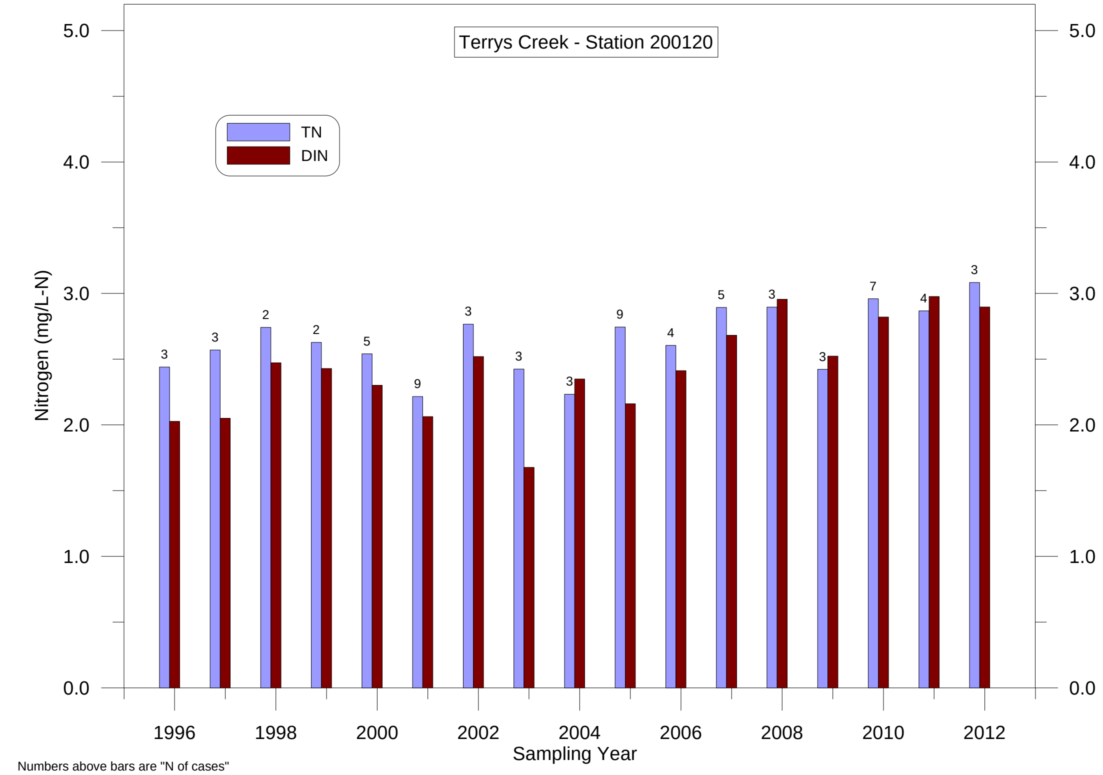


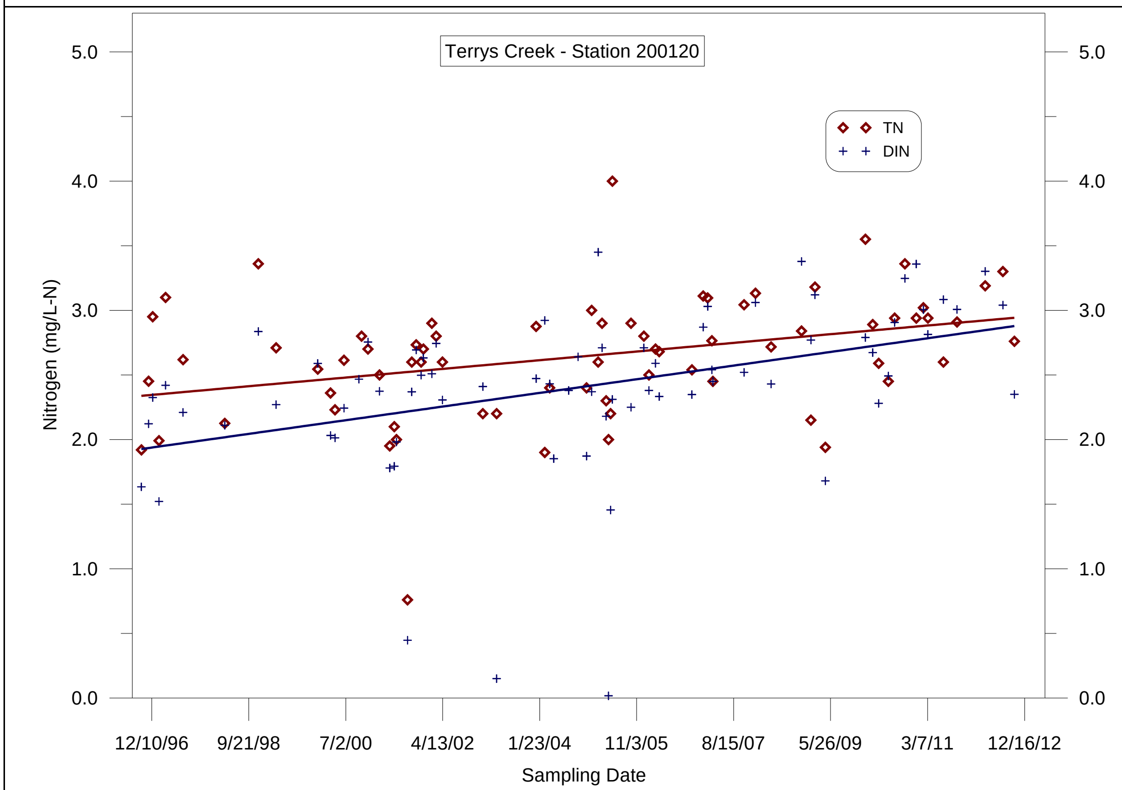
Annual Mean Concentrations of and the Long Term Distribution of Data Points at Meetinghouse Creek Station 200004 (1990-2012)



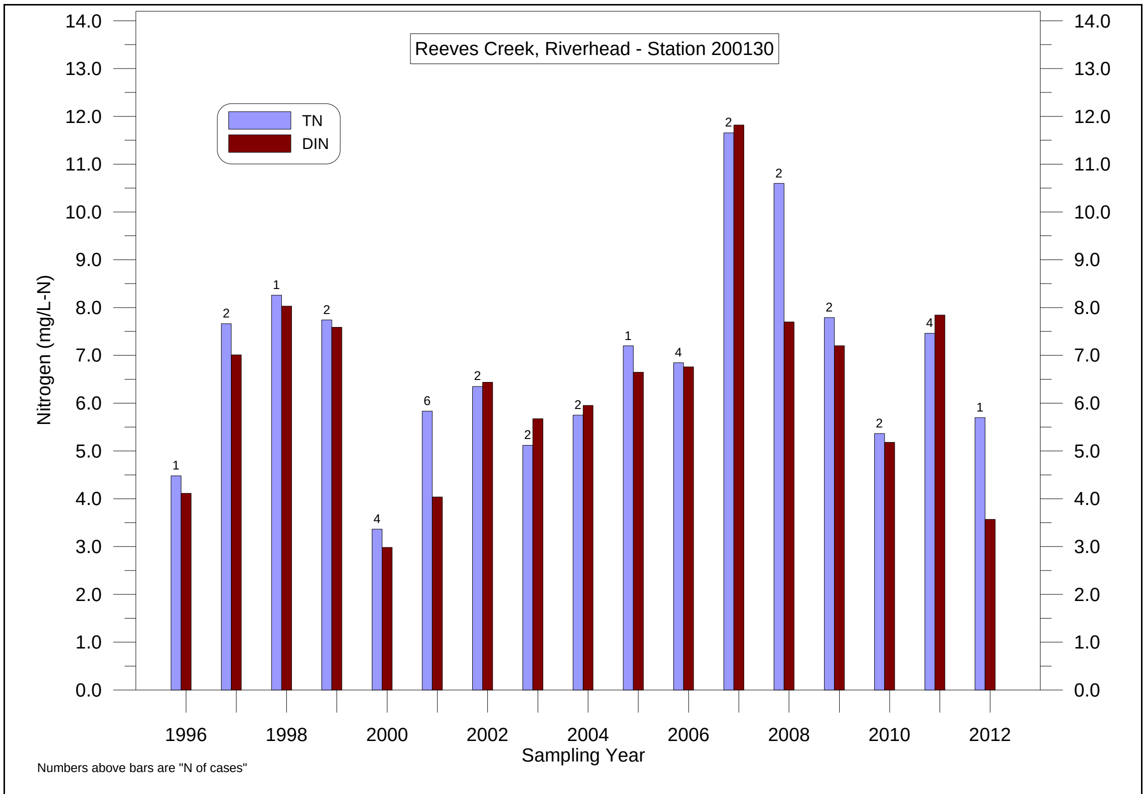


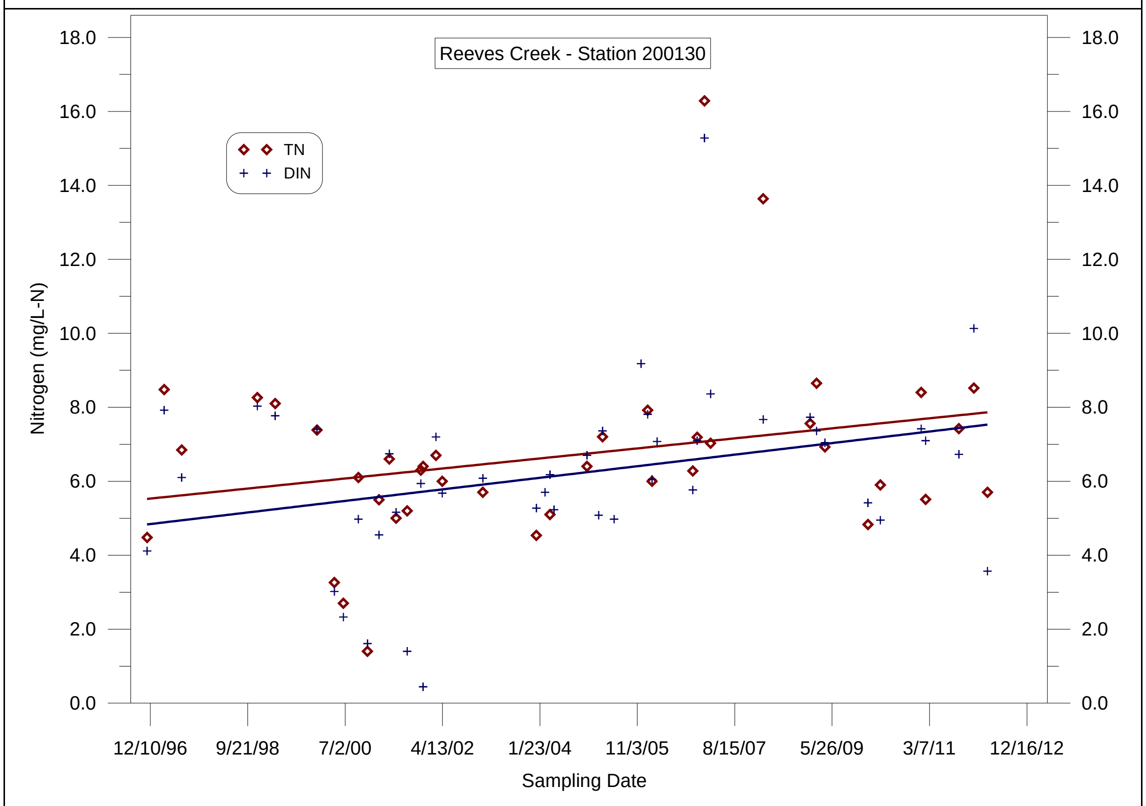
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Sawmill Creek Station 200110 (1996-2012)



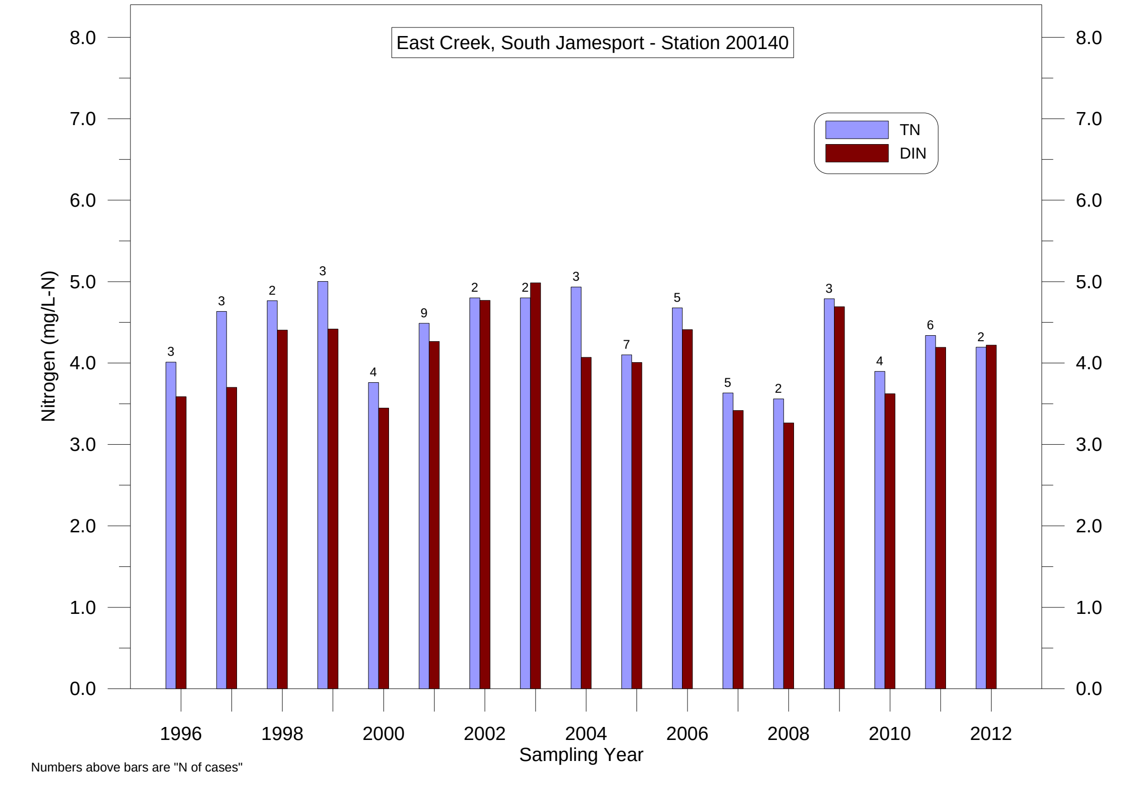


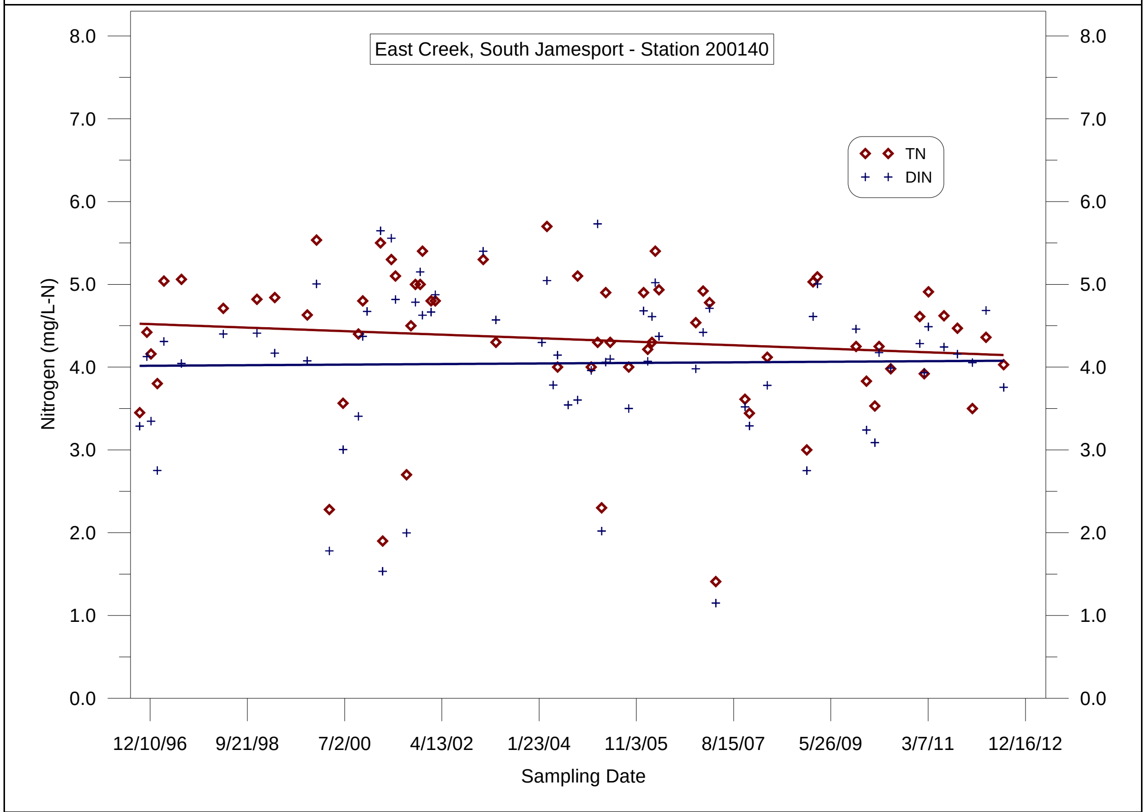
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Terrys Creek Station 200120 (1996-2012)



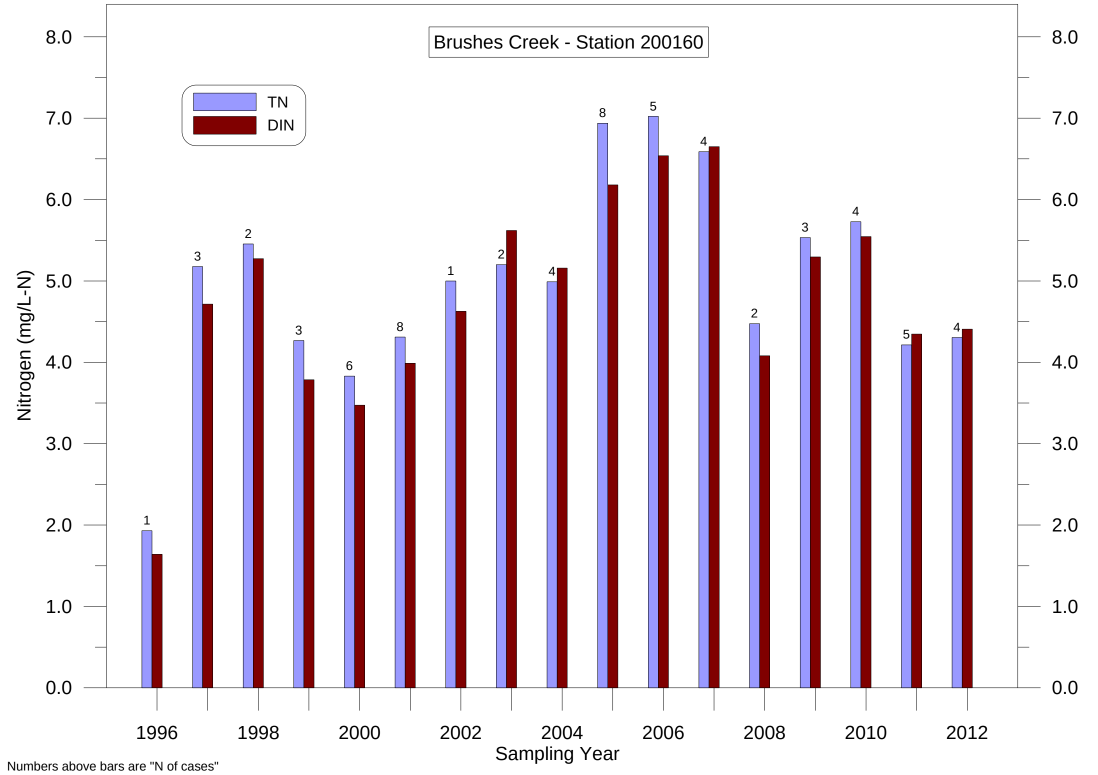


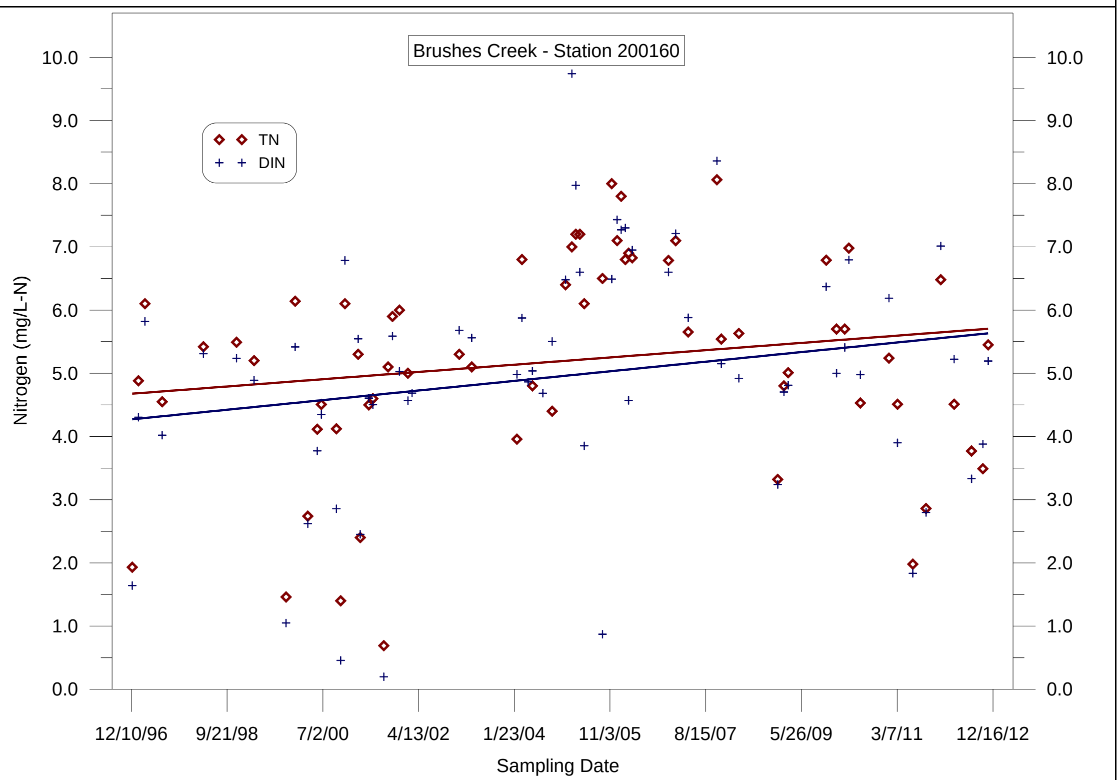
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Reeves Creek Station 200130 (1996-2012)



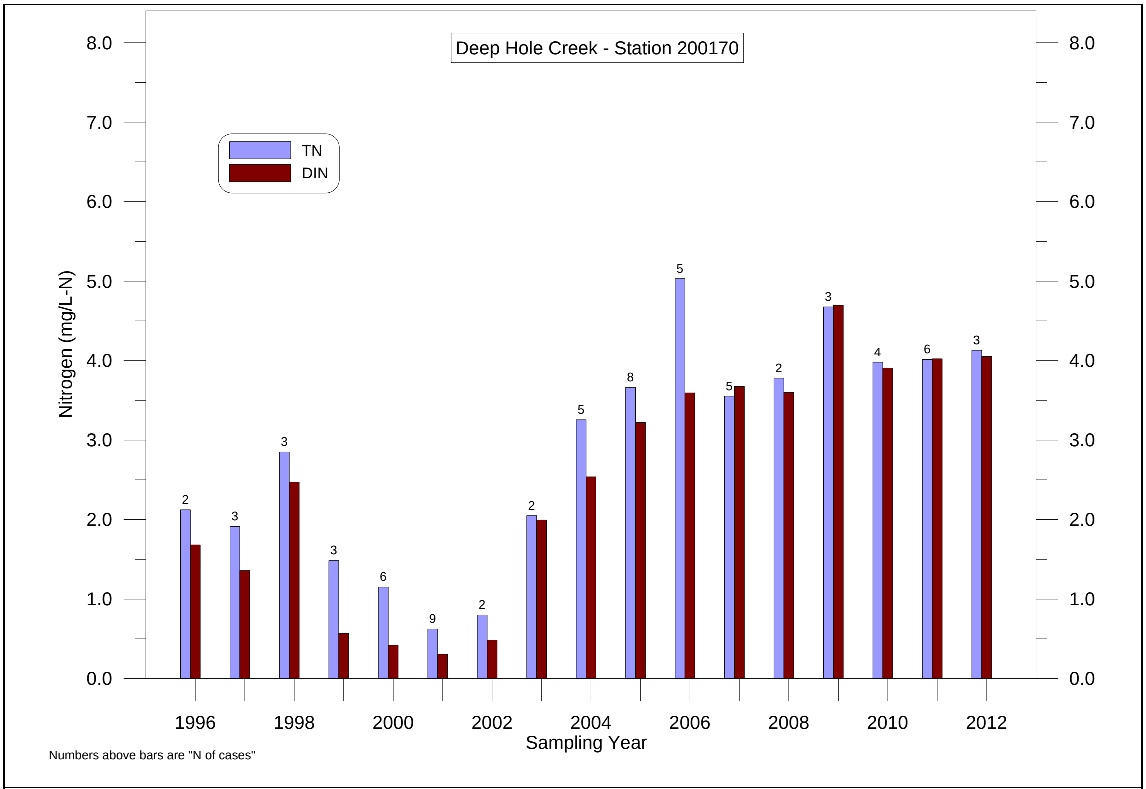


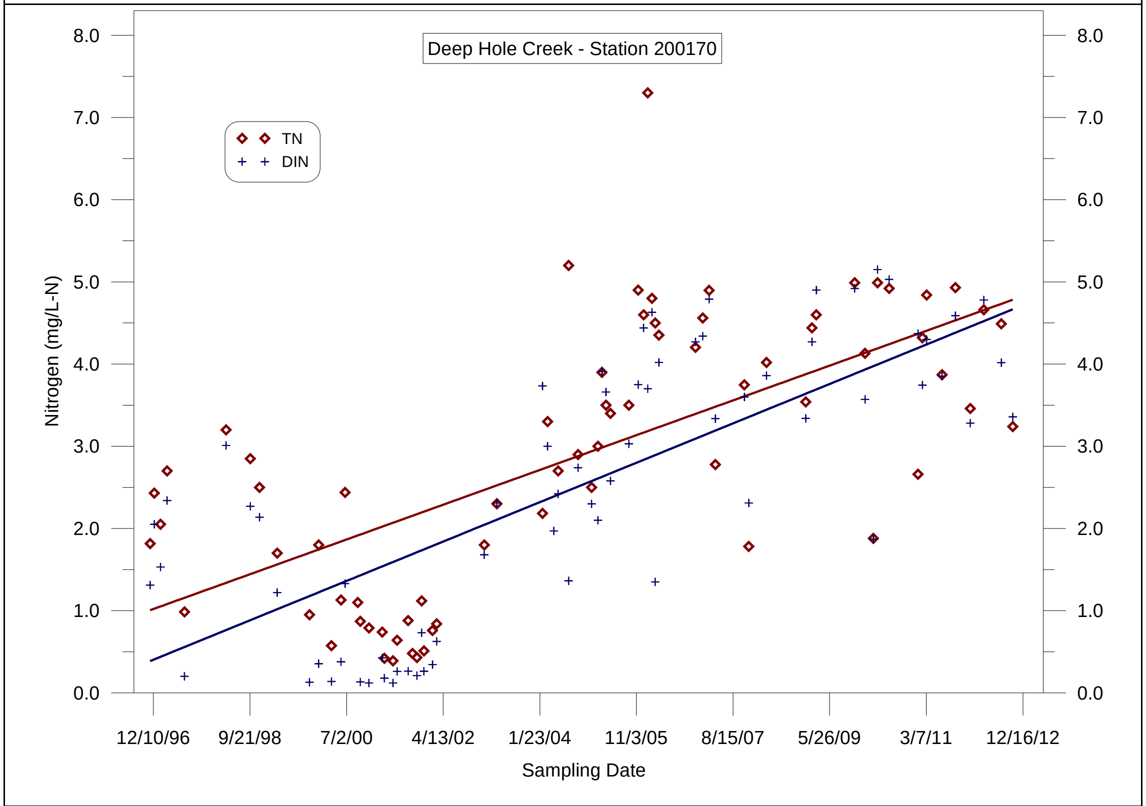
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at East Creek Station 200140 (1996-2012)



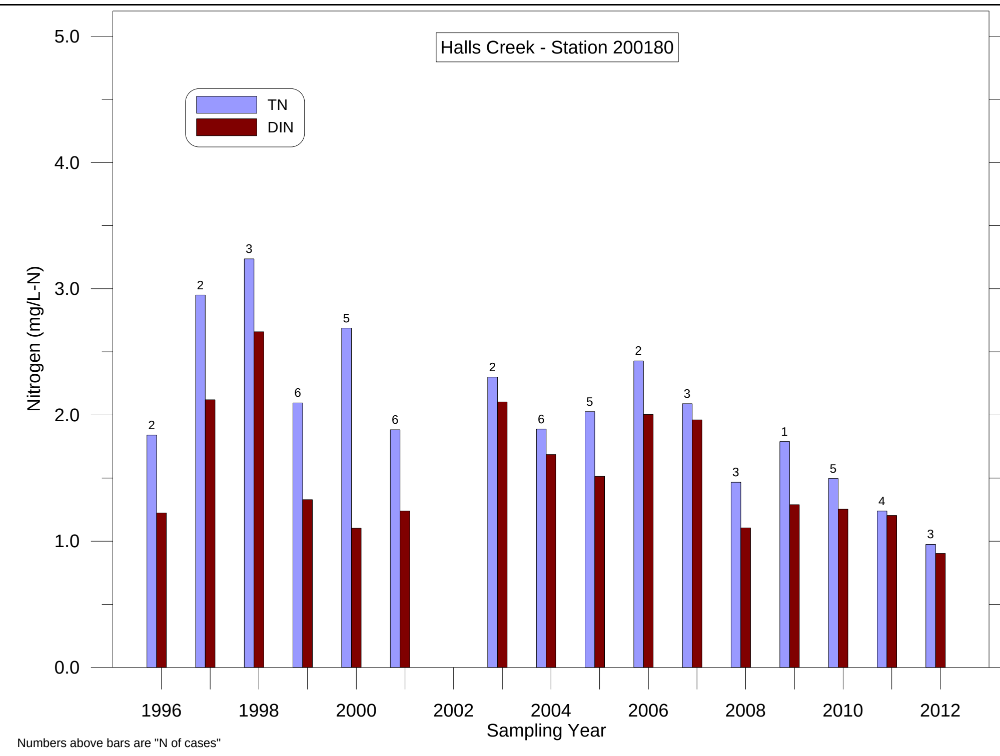


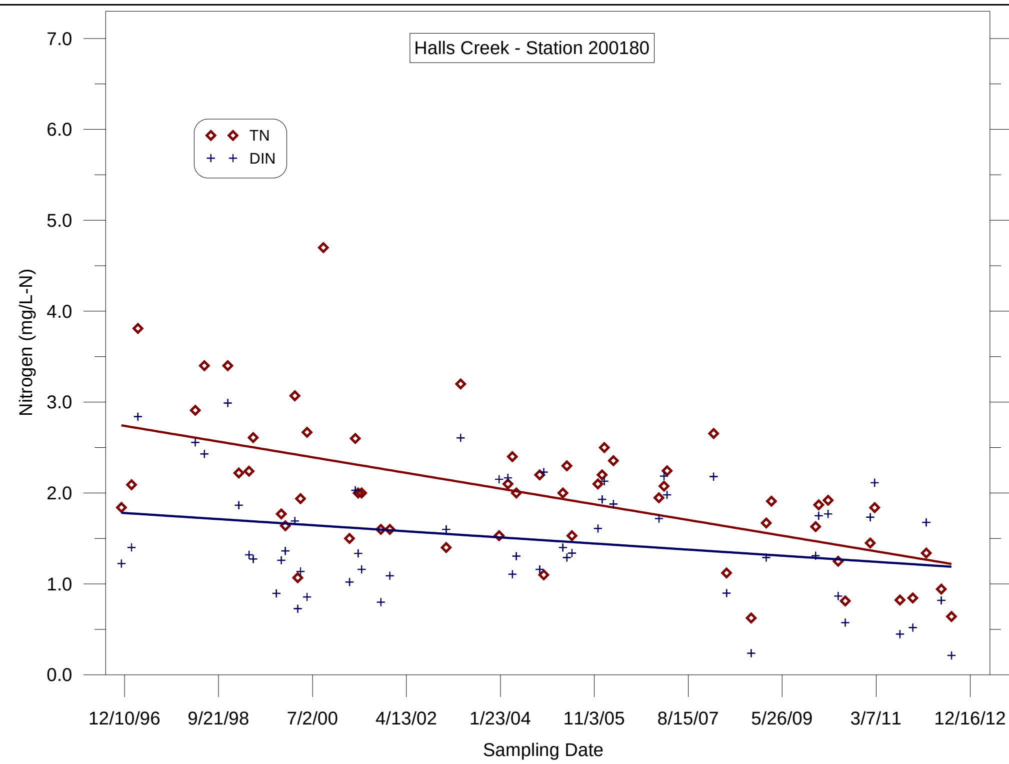
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Brushes Creek Station 200160 (1996-2012)



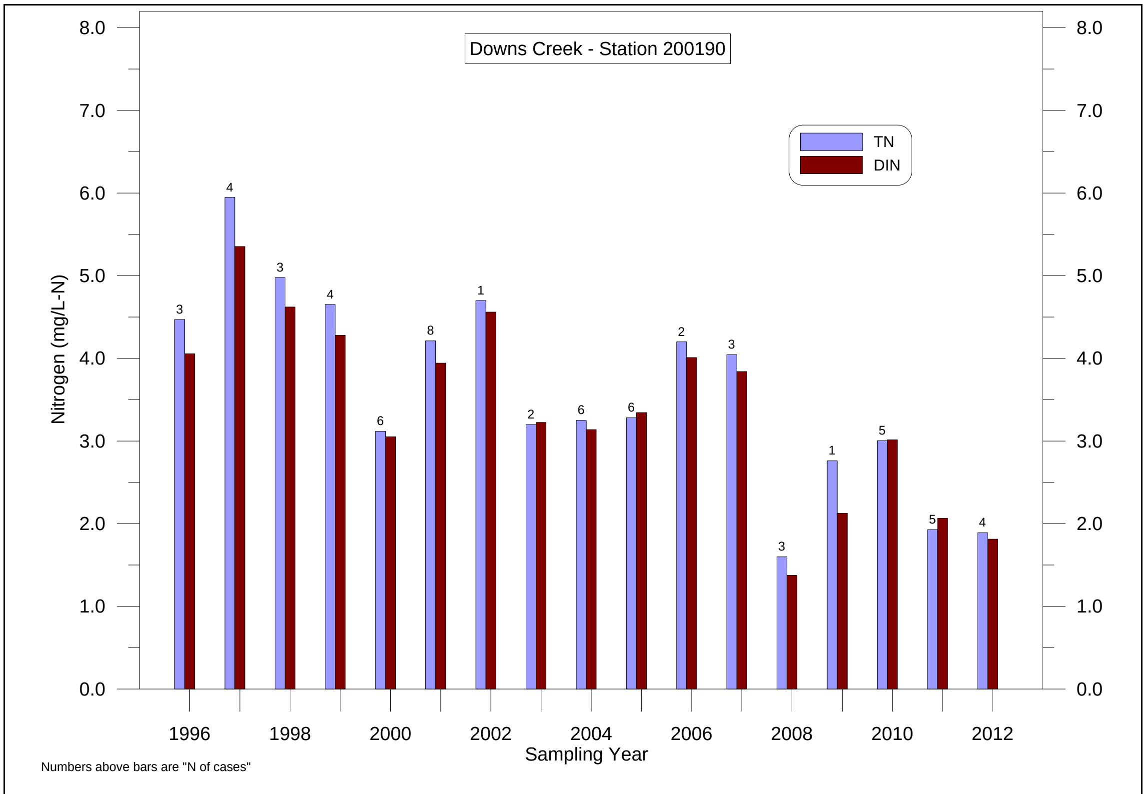


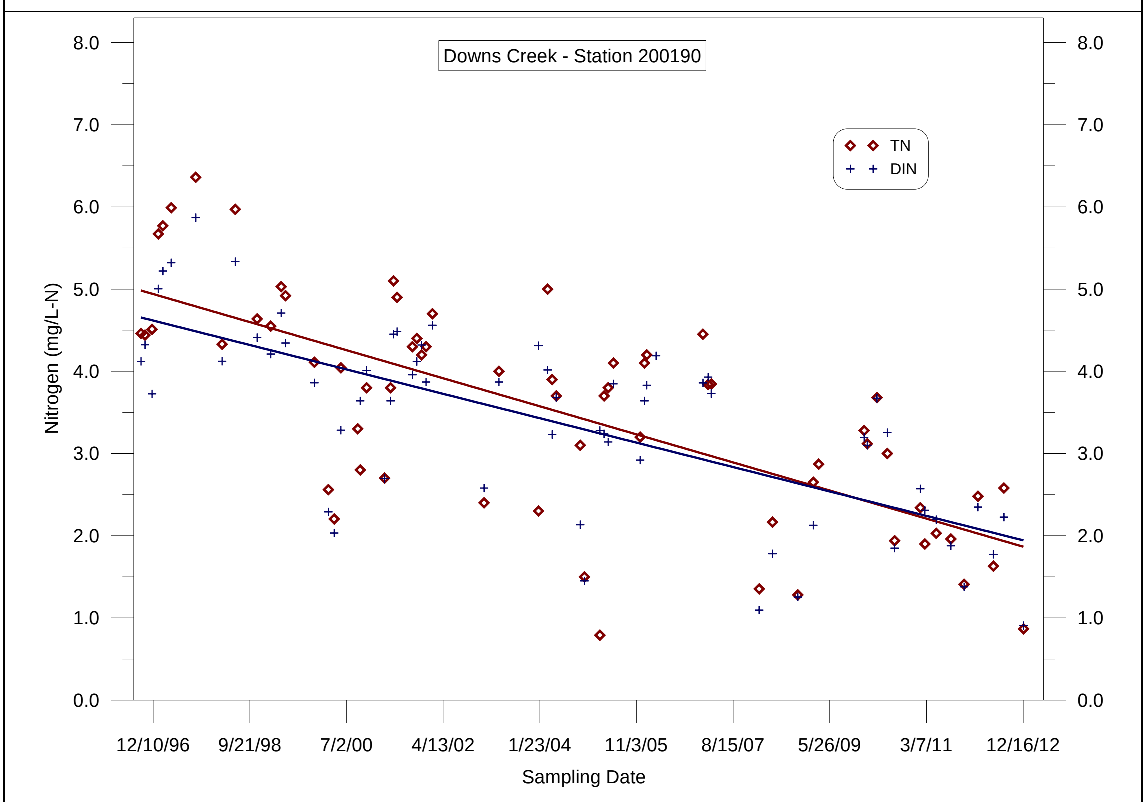
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Deep Hole Creek Station 200170 (1996-2012)



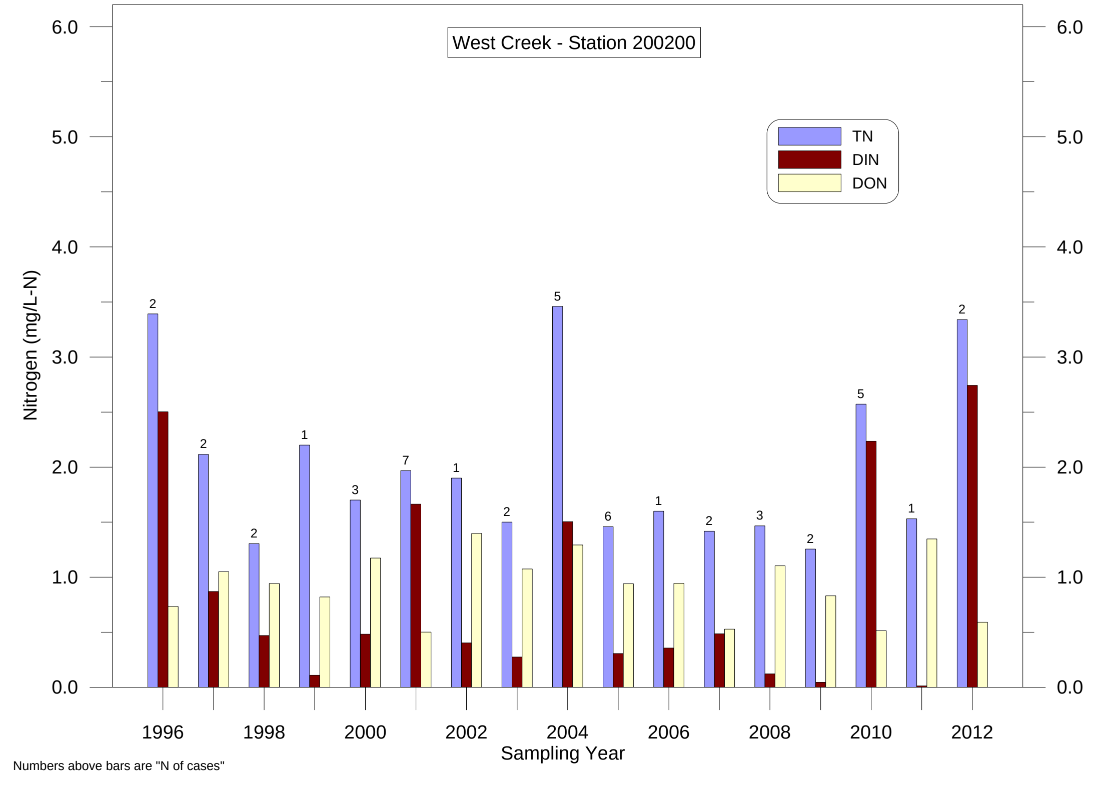


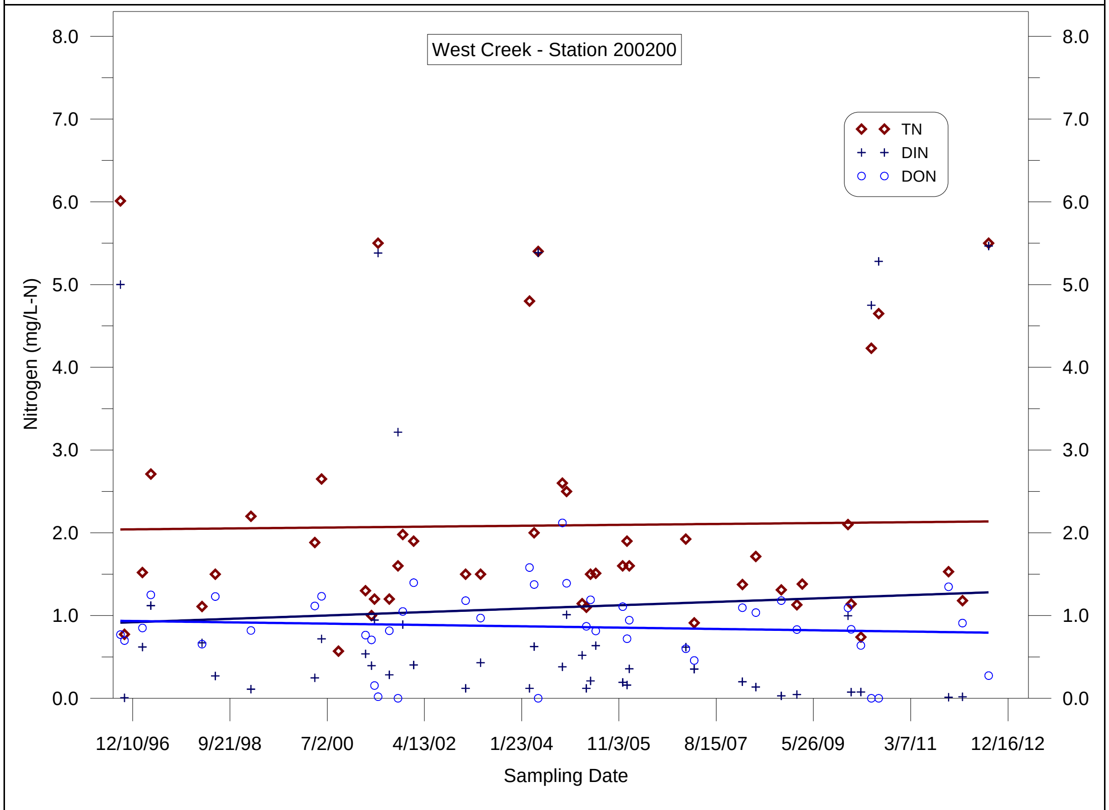
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Halls Creek Station 200180 (1996-2012)



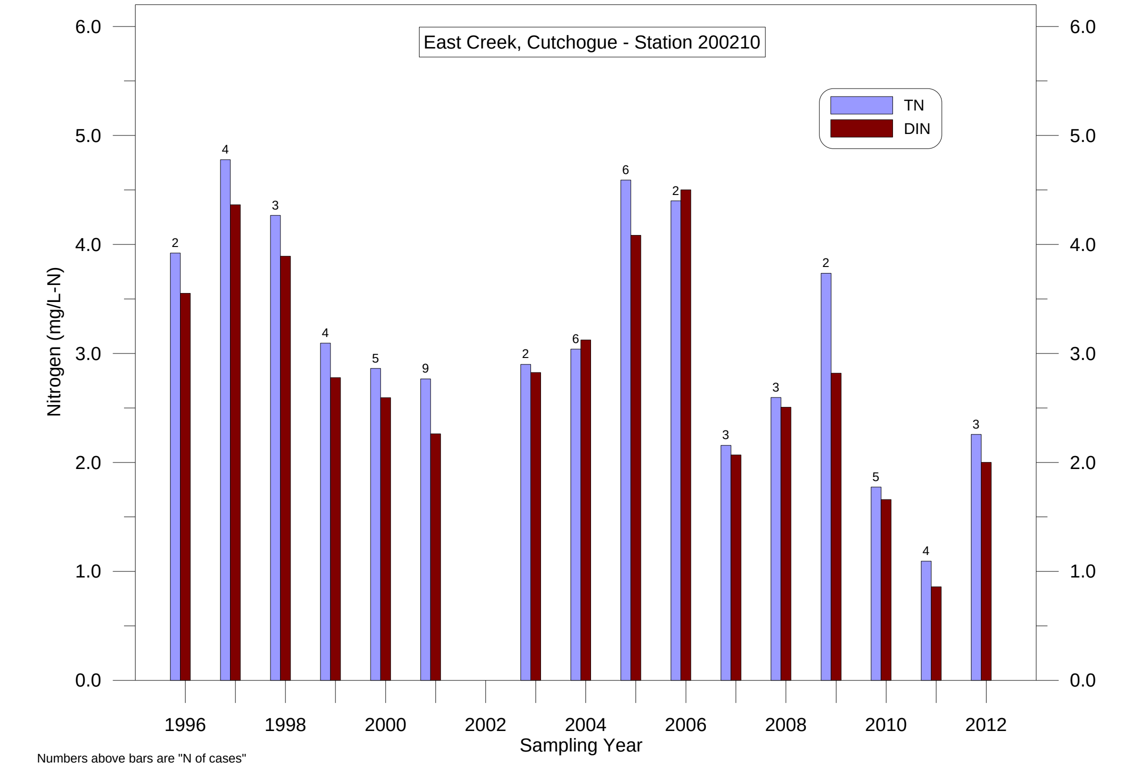


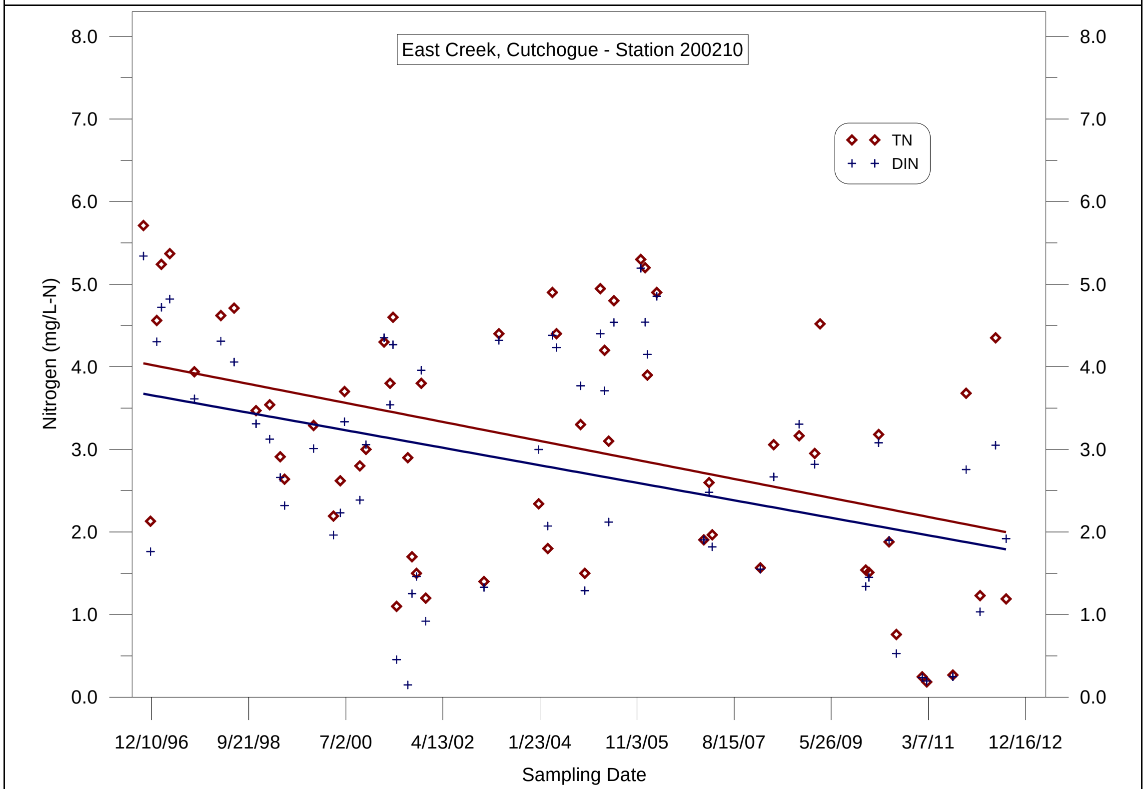
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Downs Creek Station 200190 (1996-2012)



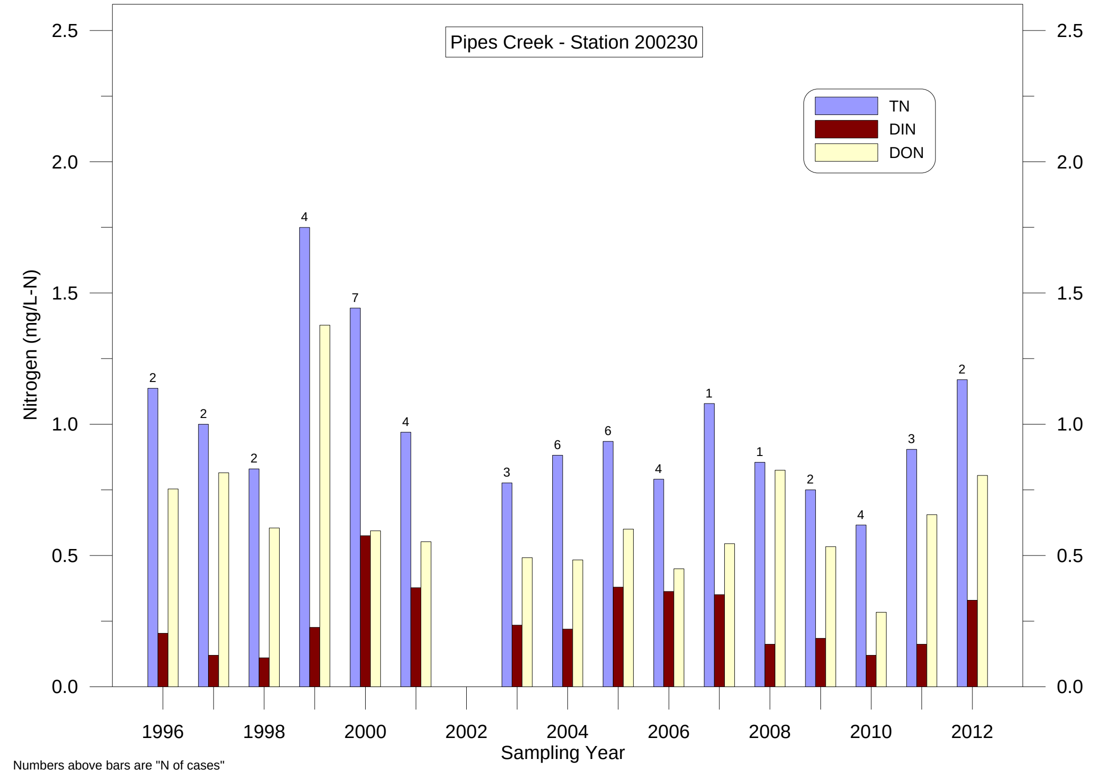


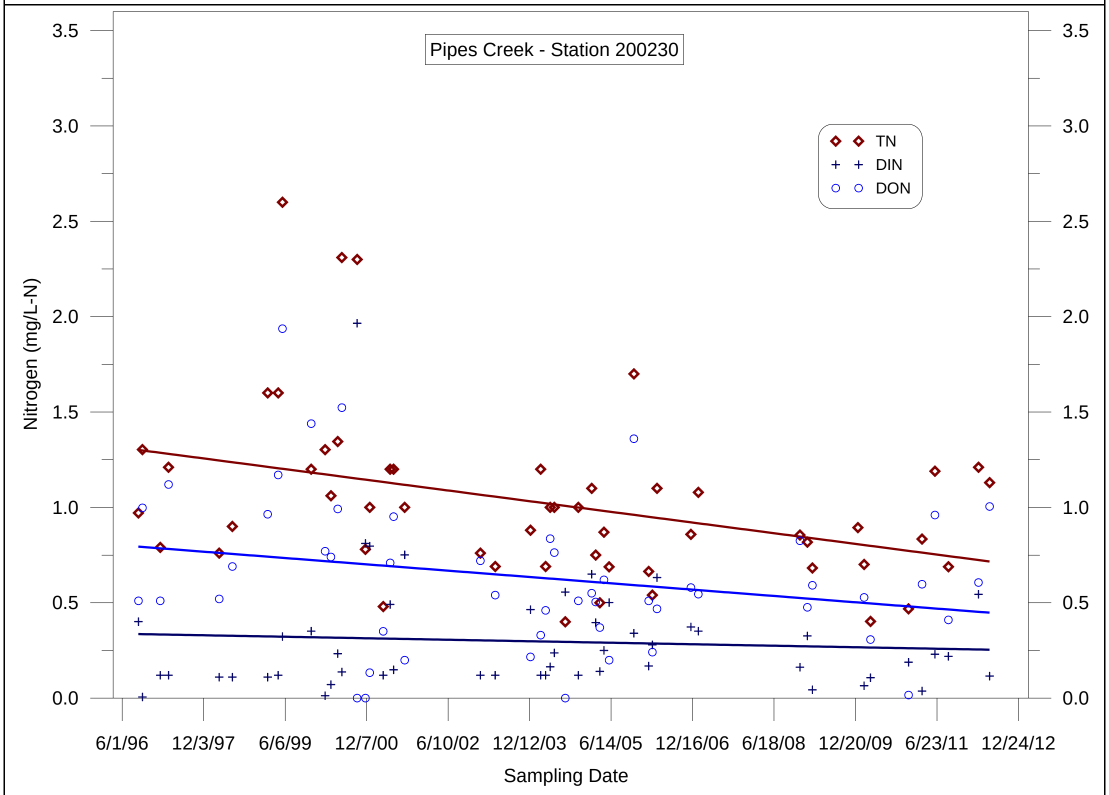
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at West Creek Station 200200 (1990-2012)



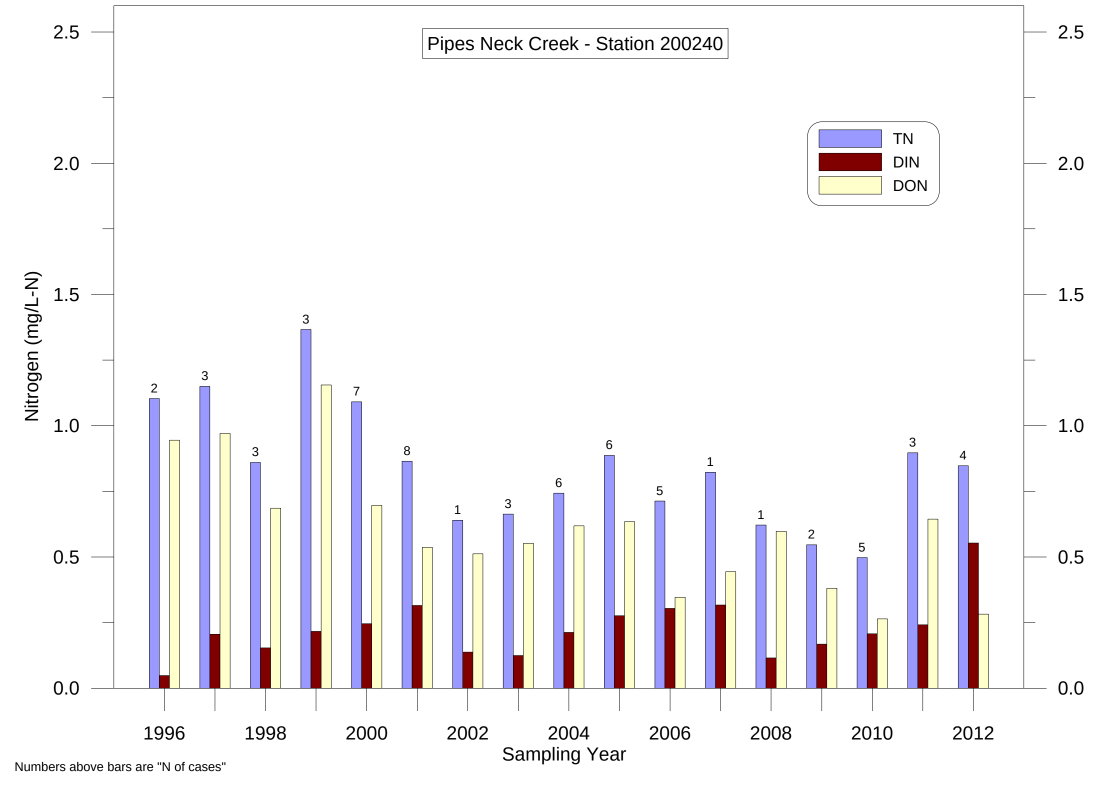


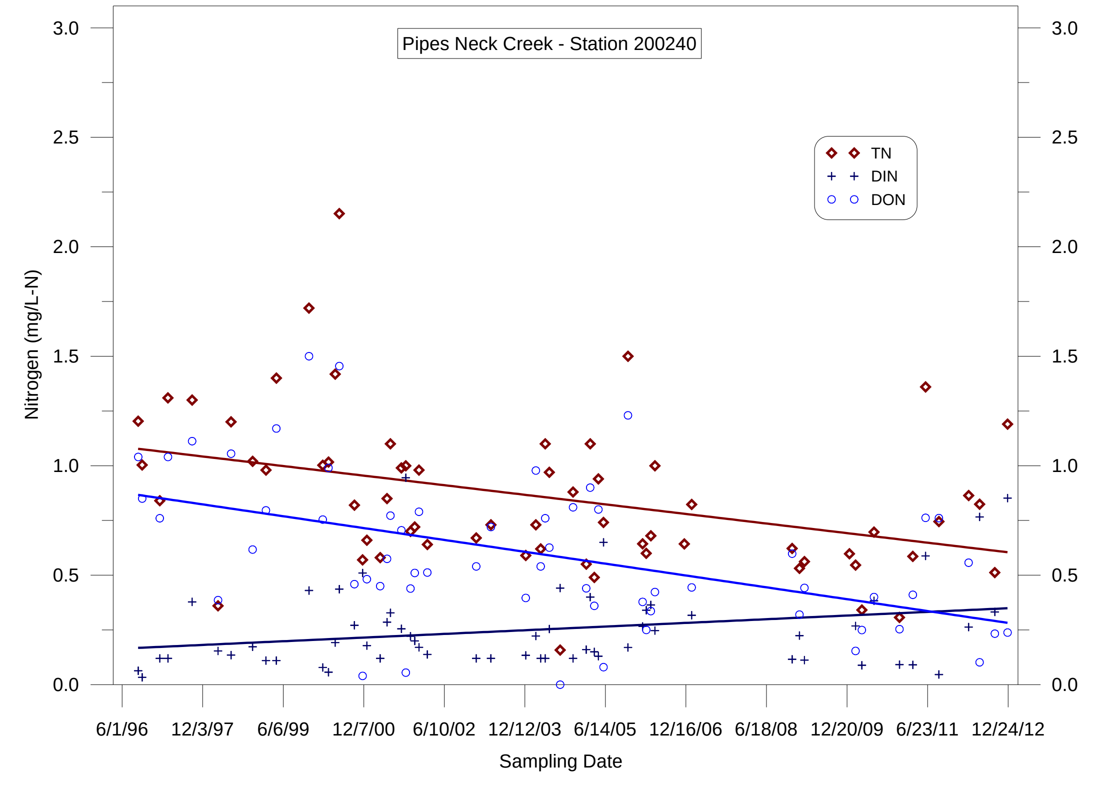
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at East Creek Station 200210 (1996-2012)



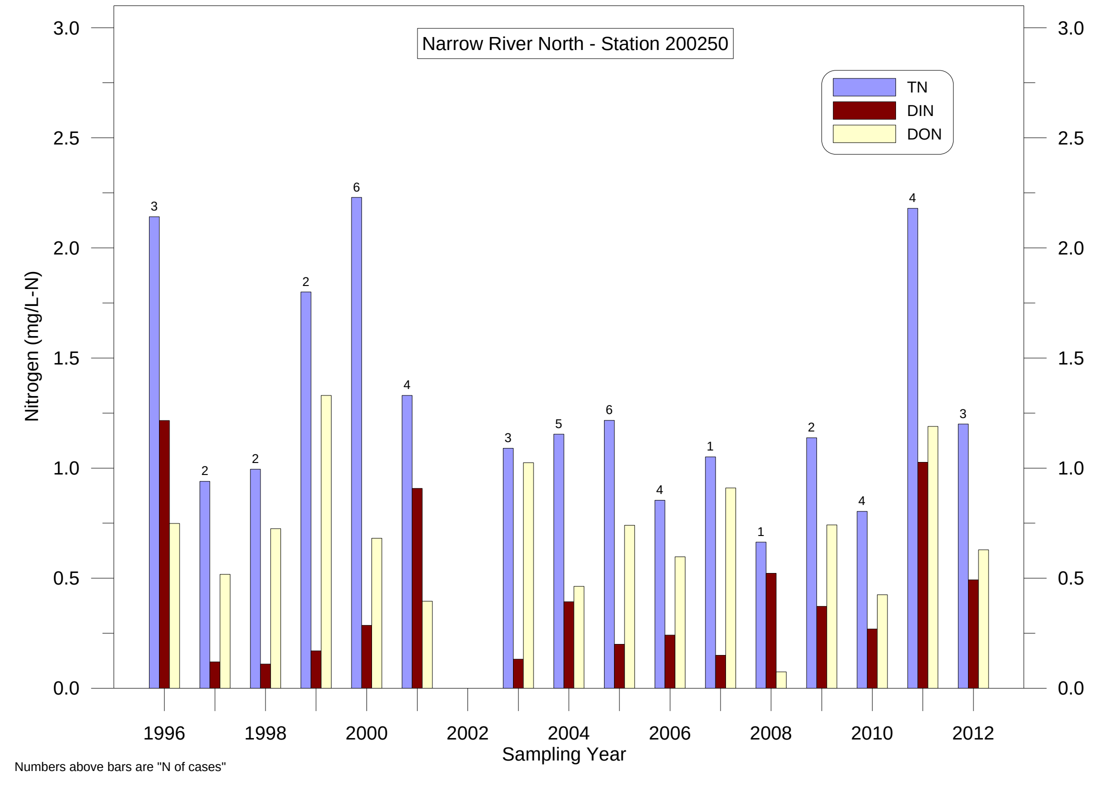


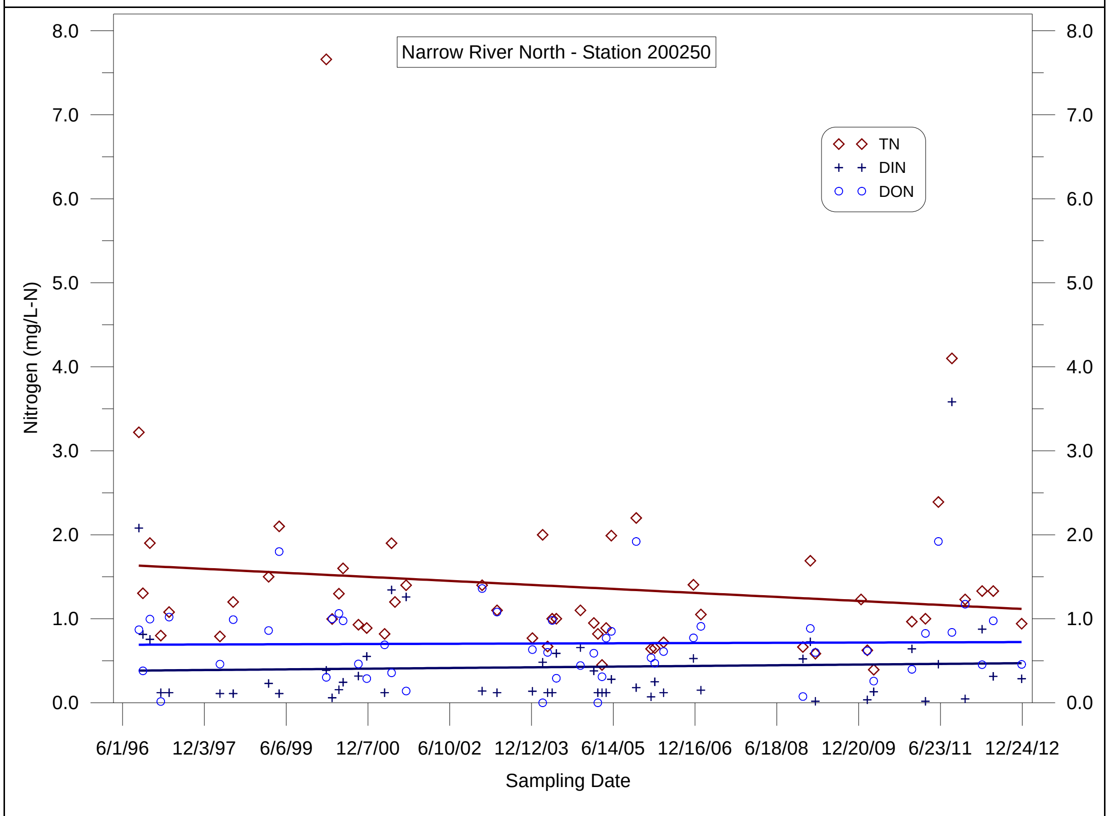
Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Pipes Creek Station 200230 (1990-2012)



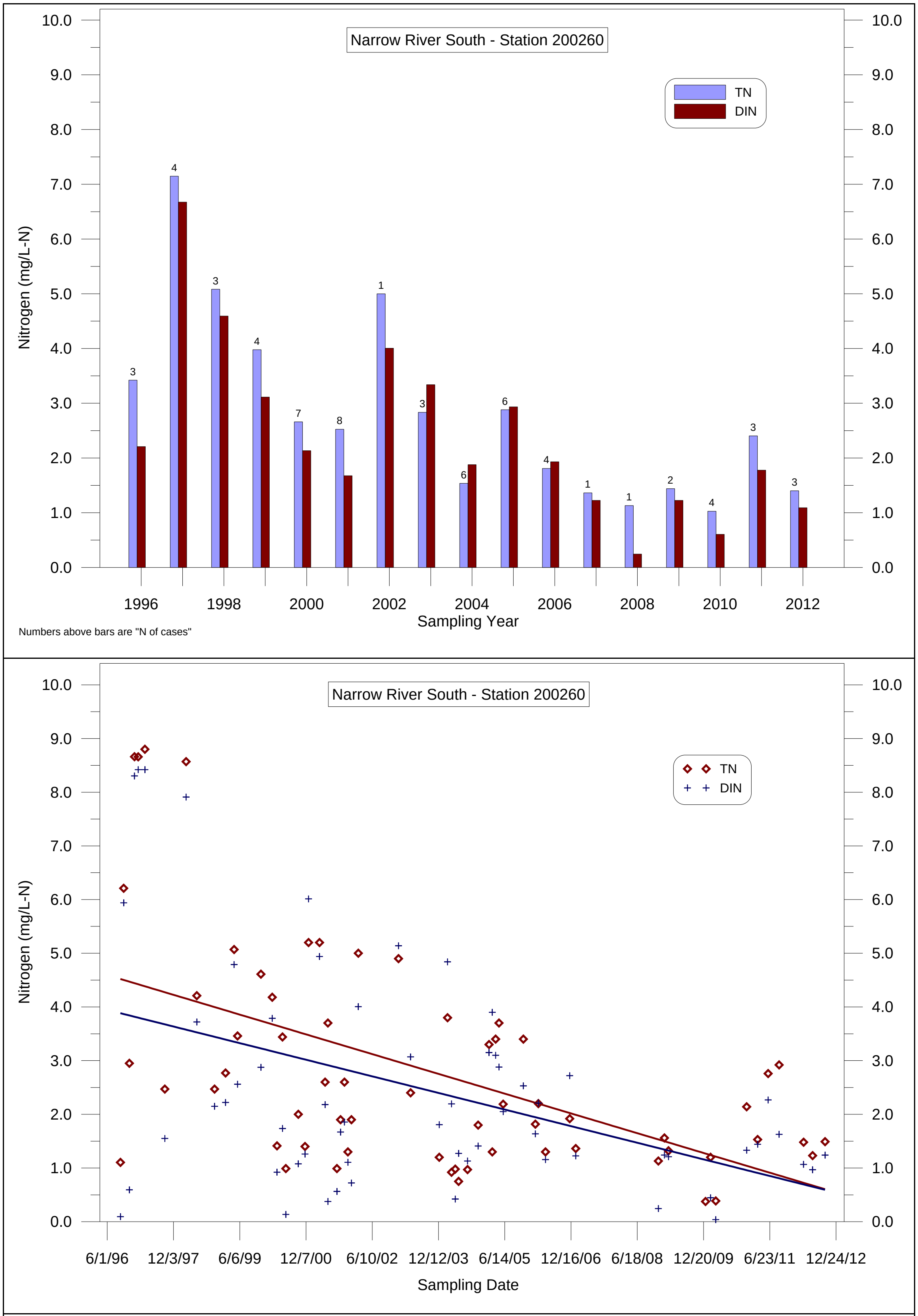


Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Pipes Neck Creek Station 200240 (1990-2012)

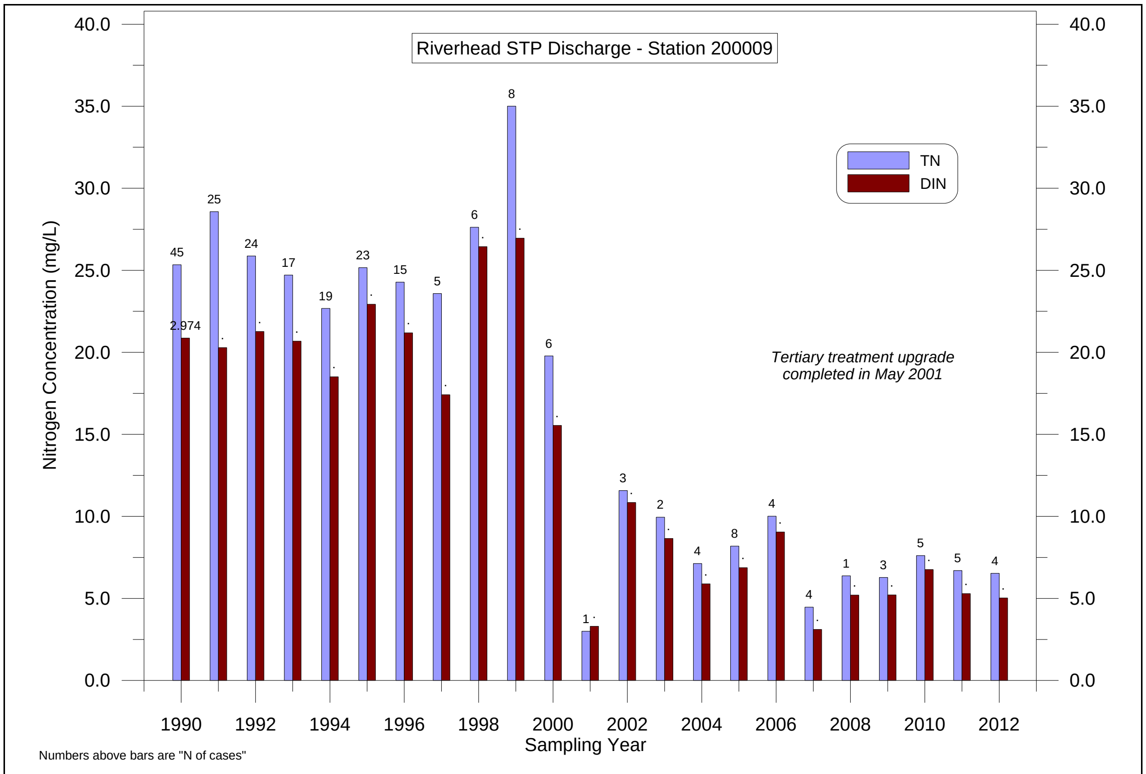


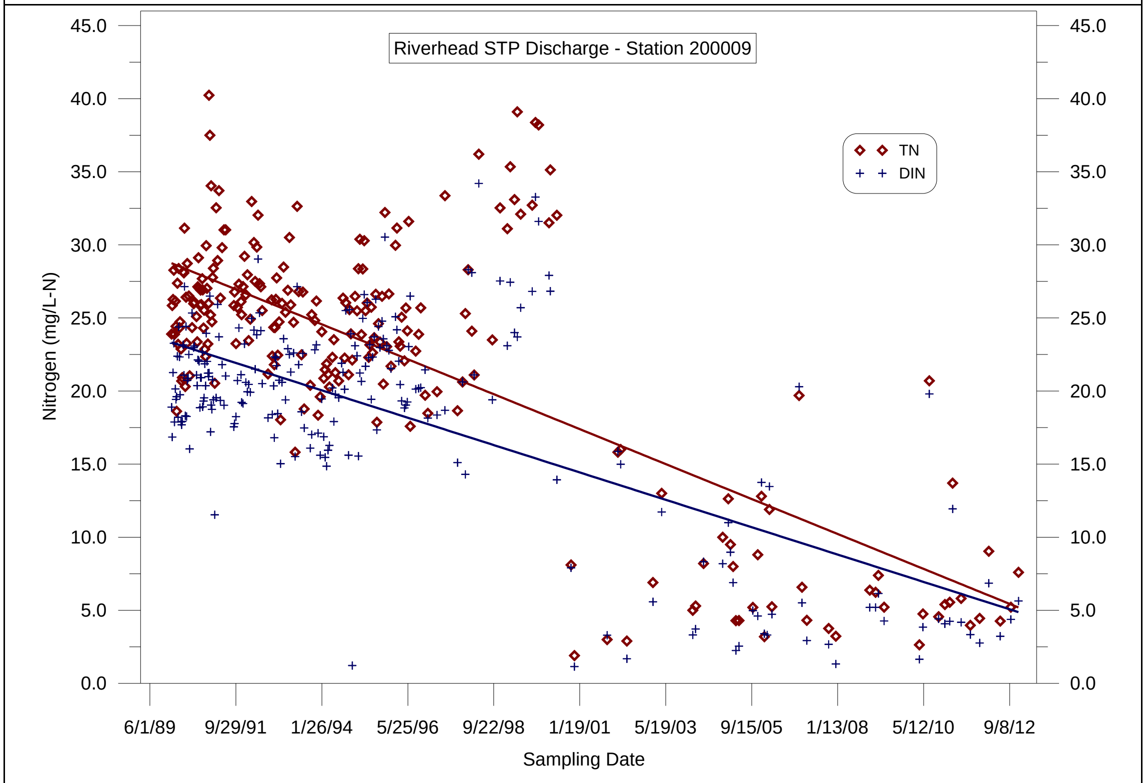


Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Narrow River North Station 200250 (1990-2012)



Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at Narrow River South Station 200260 (1990-2012)





Annual Mean Concentrations of Nitrogen and the Long Term Distribution of Data Points at the Riverhead STP Discharge Station 200009 (1990-2012)