MARYLAND
DEPARTMENT OF
NATURAL RESOURCES

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2005 Upper Patuxent River
Shallow Water Monitoring Data Report

November, 2006

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2005 Upper Patuxent River Shallow Water Monitoring Data Report

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1. Introduction

The Maryland Department of Natural Resources (DNR) maintained three shallow water continuous monitoring stations, one of which included a weather station, within the Chesapeake Bay National Estuarine Research Reserve (CBNERR-MD) system on the Patuxent River, through funding provided by the NOAA National Estuarine Research Reserve System (NERRS) program in 2005. These continuous monitoring stations, located in Jug Bay in the upper Patuxent River, included Iron Pot Landing, Railroad Bridge and Mataponi Creek (Figures 2-1 and 2-2). DNR has been maintaining shallow water monitoring technologies since 2000 in cooperation with the University of Maryland's Chesapeake Biological Laboratory, EPA and NOAA and implemented a Maryland-wide program in 2003. In 2005, Maryland DNR deployed and maintained 39 continuous monitoring stations in 18 river systems in the Chesapeake and Coastal Bays. These shallow water monitoring technologies have been extremely successful, providing a wealth of physical and nutrient information that supply the necessary data to evaluate new water quality criteria for dissolved oxygen, water clarity and chlorophyll, assess potential submerged aquatic vegetation (SAV) restoration sites and determine if areas are meeting their designated use.

The Jug Bay project's aim was to monitor ambient water quality parameters, nutrient concentrations and meteorological conditions in order to characterize water quality and habitat conditions. Water quality measurements were collected every 15 minutes from January 1 to December 31, 2005 using YSI 6600EDS data loggers approximately 0.3 m from the river bottom. Data for the Railroad Bridge, Iron Pot Landing and Mataponi Creek stations are available on DNR's "Eyes on the Bay" web site (http://www.eyesonthebay.net) and through the NERRS national database (http://cdmo.baruch.sc.edu/).

Nutrient grab samples were collected by Maryland DNR on a monthly basis from February to December at all three sites (Table 1-1). Duplicate samples were taken once monthly and analyzed for chlorophyll a, nitrate, nitrite, ammonium and orthophosphate. An additional round of sampling (not in duplicate) was conducted each month at each site in collaboration with Maryland DNR's Continuous Monitoring Program. Diel nutrient sampling was conducted once monthly at the Railroad Bridge station from January through December 2005 and included the core NERRS nutrients. Unattended samplers were programmed to collect water samples every two and one half hours, over a 24-hour period. Weather data (air temperature, relative humidity, barometric pressure, rainfall, wind speed, wind direction and photosynthetically active radiation) was collected from January 1 through December 31, 2005. Water quality, nutrient and meteorological data are available through the NERRS national database (http://cdmo.baruch.sc.edu/).

Table 1-1. Dates of 2005 Sample Collection.

Dates	Iron Pot Landing	Railroad Bridge	Mataponi Creek	Other Events and Details
01/04/2005	X	X	X	
01/20/2005	X	X		Duplicate Grab Samples Collected
02/24/2005		X	X	Duplicate Grab Samples Collected
02/24/2005		X		Railroad Bridge Diel Grab Sampling
03/10/2005	X	X	X	
03/30/2005	X	X	X	Duplicate Grab Samples Collected
03/30/2005		X		Railroad Bridge Diel Grab Sampling
04/12/2005	X	X	X	
04/26/2005	X	X	X	Duplicate Grab Samples Collected
04/26/2005		X		Railroad Bridge Diel Grab Sampling
05/10/2005	X	X	X	
05/24/2005	X	X	X	Duplicate Grab Samples Collected
05/24/2005		X		Railroad Bridge Diel Grab Sampling
06/07/2005	X	X	X	
06/21/2005	X	X	X	Duplicate Grab Samples Collected
06/30/2005		X		Railroad Bridge Diel Grab Sampling
07/06/2005	X	X	X	
07/19/2005	X	X	X	Duplicate Grab Samples Collected
07/26/2005		X		Railroad Bridge Diel Grab Sampling
08/02/2005	X	X	X	
08/16/2005	X	X	X	
08/30/2005	X	X	X	Duplicate Grab Samples Collected
08/30/2005		X		Railroad Bridge Diel Grab Sampling
09/13/2005	X	X	X	
09/27/2005	X	X	X	Duplicate Grab Samples Collected
09/29/2005		X		Railroad Bridge Diel Grab Sampling
10/11/2005	X	X	X	
10/25/2005	X	X	X	Duplicate Grab Samples Collected
10/25/2005		X		Railroad Bridge Diel Grab Sampling
11/09/2005	X	X	X	
11/22/2005	X	X	X	Duplicate Grab Samples Collected
11/23/2005		X		Railroad Bridge Diel Grab Sampling
12/06/2005	X	X	X	
12/20/2005		X	X	Duplicate Grab Samples Collected
01/05/2006		X		Railroad Bridge Diel Grab Sampling

2. Site Locations and Descriptions

Mataponi Creek 38° 44.599'N, 76° 42.446'W (NAD83)

The Mataponi Creek site is located in a small tributary (Mataponi Creek) off the upper tidal headwaters of the Patuxent River (Figures 2-1 and 2-2). The site is 2.4 km upstream from the mouth and located in the midchannel of the creek, which is approximately 7 m wide. Average depth at the site is 0.7 m with a mean tidal fluctuation of approximately 0.6 m. The bottom habitat is soft sediment, with submerged aquatic vegetation (SAV) abundant and dense during the summer months. Because of the dense SAV and limited degree of anthropogenic activities occurring within the watershed of this site, Mataponi Creek is thought to be a "reference" water quality site for the Jug Bay Reserve.

Railroad Bridge 38° 46.877'N, 76° 42.822'W (NAD83)
Railroad Bridge site is located slightly upstream (0.3 km) from Jackson's Landing at the Patuxent River Park. The site is roughly 1 km downstream of the confluence of the Western Branch tributary and the Patuxent River Mainstem (Figures 2-1 and 2-2). This section of the Patuxent River is approximately 70 m wide, with an average depth at the site of 1.4 m. Mean tidal fluctuation is approximately 0.6 m. The bottom habitat is characterized by soft sediment, with SAV evident in the shallow areas during the summer.

Iron Pot Landing 38° 47.760'N, 76° 43.248'W (NAD83)
Iron Pot Landing is located 2.09 km from the mouth of the Western Branch. The monitoring site is attached to a small pier near midchannel of the river and has an average depth of 1.6 m. The site is roughly 1 km downstream of a large (10-20 mgd) wastewater treatment plant effluent discharge site (Figures 2-1 and 2-2). The river is approximately 15 m wide at this site and flows through extensive riparian buffers. Tides are semi-diurnal and mean tidal fluctuation is approximately 0.6 m. Bottom habitat is soft sediment, with narrow SAV beds occasionally evident in the summer. Because of the proximity of this site to the discharge location for the wastewater treatment plant, this site is considered "impacted".

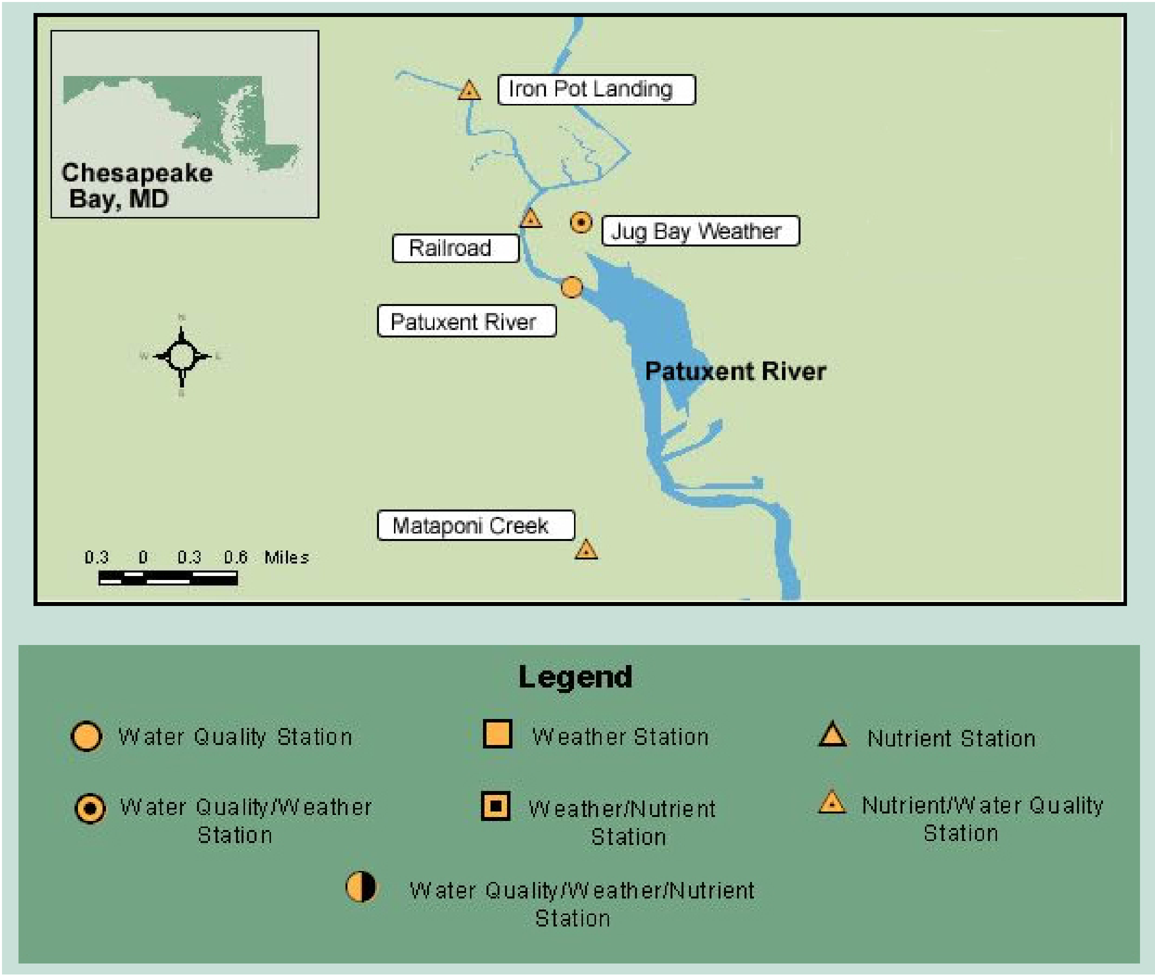


Figure 2-1. Map of Jug Bay NERR in the upper Patuxent River (Courtesy of NOAA NERRS).

Iron Pot Landing | **Railroad Bridge** | **Mataponi Creek**

Figure 2-2. Continuous monitoring stations in Jug Bay NERR.

3. Continuous Monitoring Results

The purpose of the water quality monitoring program was to conform to the NERRS System Wide Monitoring Program (SWMP) and to identify trends in water quality (water temperature, salinity, pH, dissolved oxygen, chlorophyll and turbidity) over both temporal and spatial scales. Water quality measurements were collected every 15 minutes from January 1 to December 31, 2005 at Railroad Bridge and Iron Pot Landing and from January 1 to December 20, 2005 at Mataponi Creek using YSI 6600EDS data loggers. Water quality conditions at each of the three stations exhibited temporal and spatial trends in response to a variety of biological, oceanographic and meteorological conditions that occurred in 2005. Missing data resulted from the rejection of "bad" data during quality assurance and quality control checks.

3.1 Temperature

As expected, water temperatures varied over the course of deployment, with highest temperatures occurring during the summer (late July/early August), followed by a decline in late September (Table 3-1, Figure 3-3). Railroad Bridge experienced both the lowest winter median temperature (5.50 ^{o}C) and the highest median summer temperature (25.83 ^{o}C) compared to the other two stations. All three stations experienced highest median temperatures in summer, followed by similar temperatures in the spring and fall, and lowest temperatures in winter (Table 3-1).

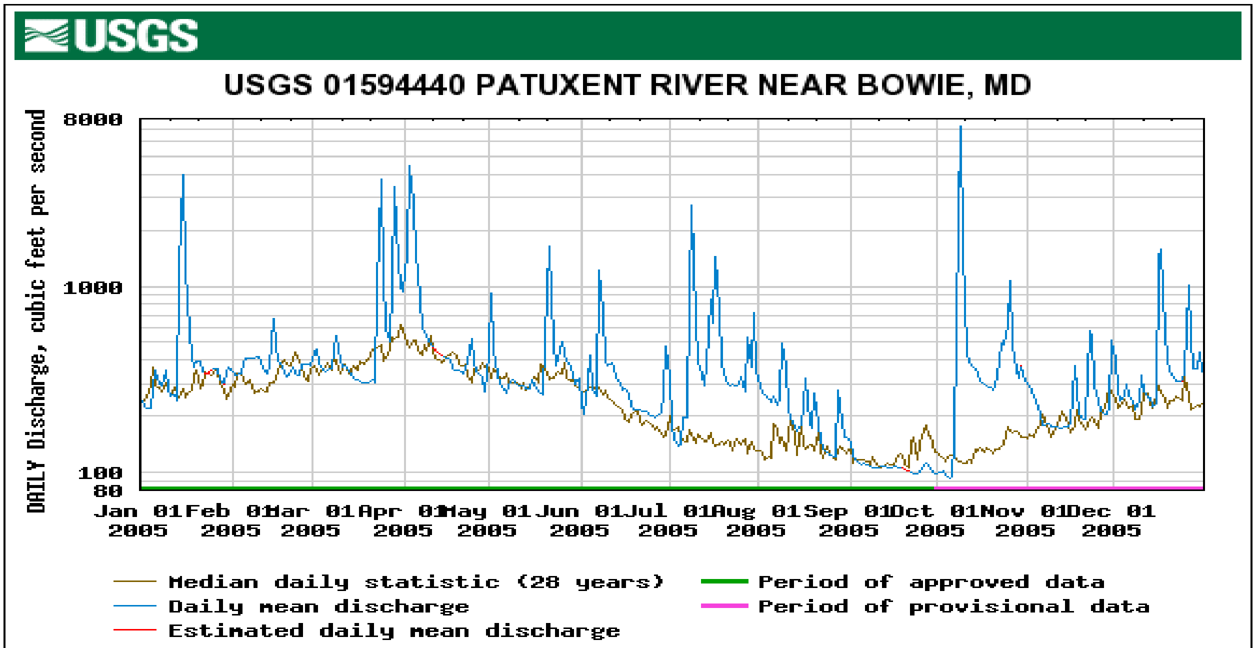
Table 3-1. Description of median temperatures for winter (Jan.-Mar.), spring (Apr.-Jun), summer (Jul.-Sep.) and fall (Oct.-Dec.) at upper Patuxent River stations in 2005.

Season	Iron Pot Landing	Railroad Bridge	Mataponi Creek
All	15.14°C	15.24°C	15.50°C
Winter	7.62 ^{o}C	5.50 ^{o}C	6.41 ^{o}C
Spring	16.94 ^{o}C	17.58 ^{o}C	17.07 ^{o}C
Summer	24.19 ^{o}C	25.83 ^{o}C	24.96 ^{o}C
Fall	11.13 ^{o}C	11.04 ^{o}C	10.00 ^{o}C

3.2 Salinity

The upper Patuxent River in the vicinity of Jug Bay is considered tidal freshwater. 2005 salinity levels were similar in all three stations, with a range of 0.0 – 1.5 ppt. Salinity approached its maximum at both Railroad Bridge and Iron Pot Landing between late January and early March. This was a period of very little precipitation. Spring rains in late March and April brought salinity levels back down to approximately 0.2 ppt. Levels remained constant until a very dry September allowed higher-salinity water from the lower part of the river to again infiltrate the area. Railroad Bridge and Mataponi Creek both recorded their 2005 salinity maximums in late October, just prior to the major rain event which once again brought salinity down to levels below 0.2 ppt.

a)



b)

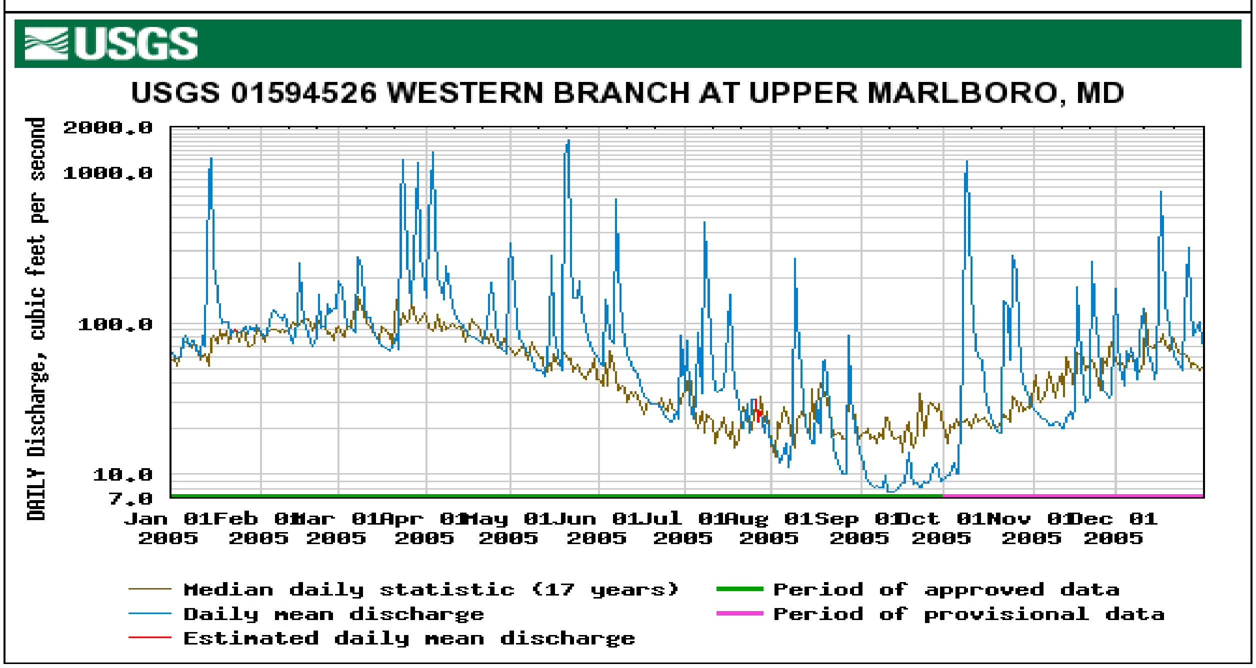


Figure 3-1. USGS Patuxent River discharge data for a) the Patuxent River above Jug Bay and b) Western Branch above Iron Pot Landing in 2005.

Table 3-2. Description of median salinity for winter (Jan.-Mar.), spring (Apr.-Jun), summer (Jul.-Sep.) and fall (Oct.-Dec.) at upper Patuxent River stations in 2005.

Season	Iron Pot Landing	Railroad Bridge	Mataponi Creek
All	0.20 ppt	0.14 ppt	0.11 ppt
Winter	0.25 ppt	0.19 ppt	0.10 ppt
Spring	0.17 ppt	0.13 ppt	0.08 ppt
Summer	0.21 ppt	0.15 ppt	0.12 ppt
Fall	0.21 ppt	0.15 ppt	0.17 ppt

3.3 pH

Seasonal median pH values ranged from 6.47 at the Mataponi Creek site to 7.31 at the Iron Pot Landing site (Table 3-3, Figure 3-5). Railroad Bridge experienced periods of elevated pH during the summer (Figure 3-5b). These elevated pH levels are often found during alga1 blooms due to chemical processes associated with photosynthesis. Periods of high pH at the Railroad Bridge station corresponded to periods of high oxygen and chlorophyll concentrations. The Mataponi site shows a dramatic drop in pH immediately following a large rain event which occurred October 7 – 8. This likely results from an overflow of the marshy bog which exists just upstream of the sample site (Figure 3.2).

Table 3-3. Description of median pH for winter (Jan.-Mar.), spring (Apr.-Jun), summer (Jul.-Sep.) and fall (Oct.-Dec.) at upper Patuxent River stations in 2005.

Season	Iron Pot Landing	Railroad Bridge	Mataponi Creek
All	7.17	7.12	6.62
Winter	7.18	7.18	6.66
Spring	7.06	7.16	6.53
Summer	7.15	7.03	6.72
Fall	7.31	7.18	6.47

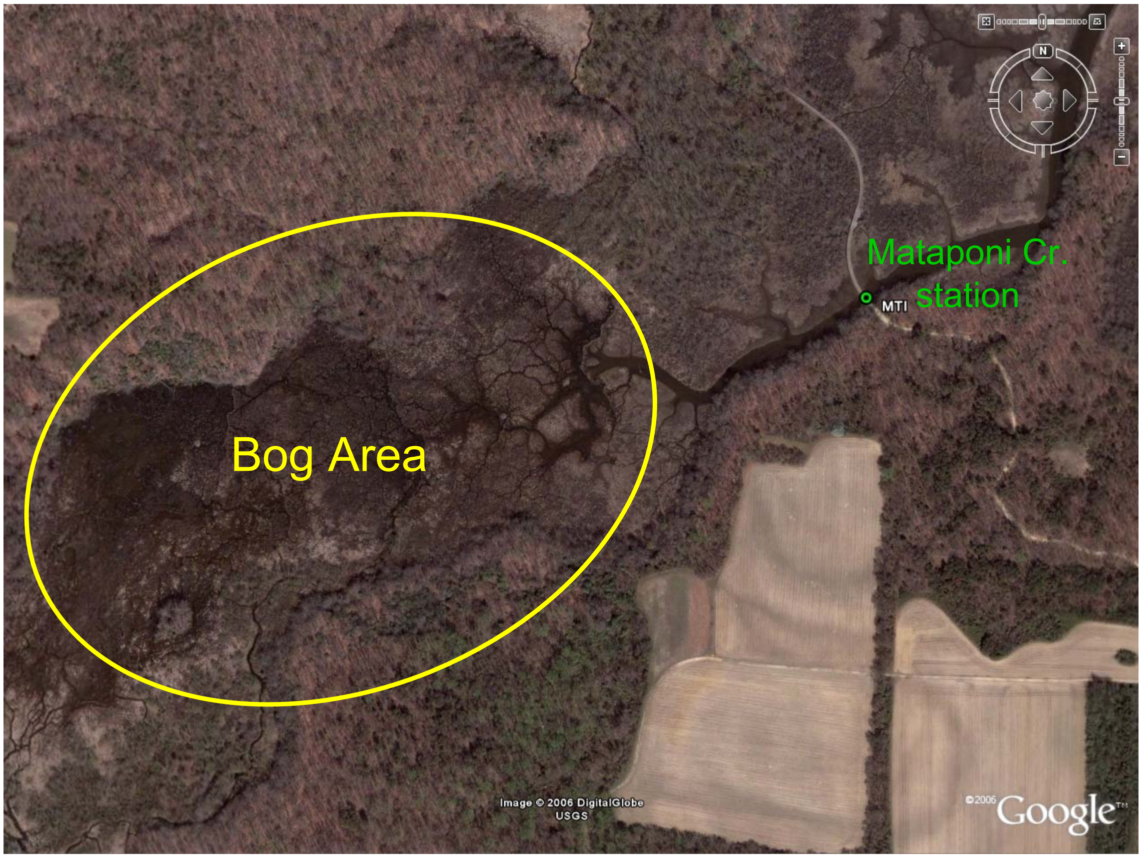


Figure 3.2. Overhead view of area upstream of Mataponi Creek station (*image from Google Earth*.)

3.4 Dissolved Oxygen

Dissolved oxygen (DO) concentrations varied diurnally and seasonally at all stations (Table 3-4, Figure 3-6). Maximum median dissolved oxygen concentrations corresponded to lower winter water temperatures, which can hold more oxygen than warmer waters (Table 3-4). Median summer dissolved oxygen concentrations ranged from 4.04 mg/l at Mataponi Creek to 6.34 mg/l at Iron Pot Landing. The frequency of dissolved oxygen concentrations below 5.0 mg/l was greatest at Mataponi Creek (27.6%), followed by Railroad Bridge (6.4%) and Iron Pot Landing (1.5%). Examining the summer readings only (July – September) shows that the sites each increased the frequency of non attainment. This is due to higher biological oxygen demand when large algae populations use oxygen at night during respiration. Oxygen concentrations below 5 mg/l exceed the threshold of the Bays' more sensitive organisms, such as fish, especially if exposed to these conditions for prolonged periods. The Mataponi Creek site was shallow (0.6m MLW) compared to Iron Pot Landing (1.6m MLW) and Railroad Bridge (1.3m MLW), and increased water temperatures and oxygen demand during the summer may have contributed to the steep drop in DO concentrations in May and subsequent low concentrations throughout the summer (Figure 3-6c) at this site.

Table 3-4. Description of median dissolved oxygen for winter (Jan.-Mar.), spring (Apr.-Jun), summer (Jul.-Sep.) and fall (Oct.-Dec.) at upper Patuxent River stations in 2005.

Season	Iron Pot Landing	Railroad Bridge	Mataponi Creek
All	8.84 mg/l	8.88 mg/l	7.40 mg/l
Winter	12.00 mg/l	12.48 mg/l	11.42 mg/l
Spring	8.15 mg/l	8.34 mg/l	7.45 mg/l
Summer	6.34 mg/l	6.14 mg/l	4.04 mg/l
Fall	7.31 mg/l	9.36 mg/l	7.55 mg/l

Table 3-5. Frequency of dissolved oxygen concentrations below 5 mg/l

	Iron Pot Landing	Railroad Bridge	Mataponi Creek
Total Records	30976	34382	30646
Records where DO < 5.0 mg/l	468	2204	8470
Frequency	1.5%	6.4%	27.6%
Summer Records Jul – Sept.	7438	8831	8661
Records where DO < 5.0 mg/l	468	1859	5403
Frequency	6.2%	21.0%	62.4%

3.5 Chlorophyll

Several algal blooms were observed at Railroad Bridge, the most significant occurring in early October. This is likely in part due to additional species of phytoplankton moving into the area with the increased salinity levels. The elevated chlorophyll levels quickly dropped following the early October rain event.

Highest median chlorophyll concentrations occurred in the spring and summer with lowest concentrations occurring in the winter (Table 3-6). Spring and early summer algal blooms are typical due to increases in nutrients (made available by winter mixing) and increased sunlight, both of which are necessary for algal growth. Chlorophyll concentrations at Railroad Bridge were greater throughout the deployment period when compared to Iron Pot Landing and Mataponi Creek. The Patuxent River and several creeks flow into Jug Bay and during the low-flow periods of the summer months, increased water temperatures and excessive nutrient levels resulted in frequent algal blooms in the area (Figure 3-7b). These bloom events corresponded with periods of elevated pH and DO concentrations.

Overall, the frequency of bloom events was very low compared to the total number of chlorophyll observations at the continuous monitoring stations. Median chlorophyll concentrations at all stations during the entire deployment period were well below the 15 µg/l SAV habitat limit. Chlorophyll concentrations exceeding this limit reduce the light reaching SAV and inhibit its growth.

Table 3-6. Description of median chlorophyll for winter (Jan.-Mar.), spring (Apr.-Jun), summer (Jul.-Sep.) and fall (Oct.-Dec.) at upper Patuxent River stations in 2005.

Season	Iron Pot Landing	Railroad Bridge	Mataponi Creek
All	2.3 µg/l	3.9 µg/l	2.8 µg/l
Winter	2.2 µg/l	2.9 µg/l	1.8 µg/l
Spring	2.3 µg/l	4.1 µg/l	2.4 µg/l
Summer	2.7 µg/l	6.9 µg/l	3.6 µg/l
Fall	2.0 µg/l	3.3 µg/l	2.5 µg/l

3.6 Turbidity

Turbidity was highest in the spring for all three stations. Median turbidity values at the Railroad Bridge site exceeded turbidity threshold limits (15 NTU) during the spring, summer and fall, while median turbidity concentrations at the other two sites were below the thresholds for each season. Turbidity levels greater than 15 NTU have been shown to negatively impact SAV. The majority of high turbidity values (Figure 3.8), however, were short-lived and corresponded with rain events and corresponding high flows or with high chlorophyll values resulting in algae blooms (Figures 3.1 and 3-7). Rain events carry suspended solids into the system in the form of stormwater run-off. Large algae blooms will increase turbidity due to the increased amount of algal biomass in the water columns. High turbidity observed at Mataponi late in the year may be due to re-suspension of bottom sediments during periods of low water level.

Table 3-7. Description of median turbidity for winter (Jan.-Mar.), spring (Apr.-Jun), summer (Jul.-Sep.) and fall (Oct.-Dec.) at upper Patuxent River stations in 2005.

Season	Iron Pot Landing	Railroad Bridge	Mataponi Creek
All	9.8	17.2	10.6
Winter	8.0	14.0	9.9
Spring	13.1	20.0	14.1
Summer	9.6	16.2	6.4
Fall	7.7	17.3	9.1

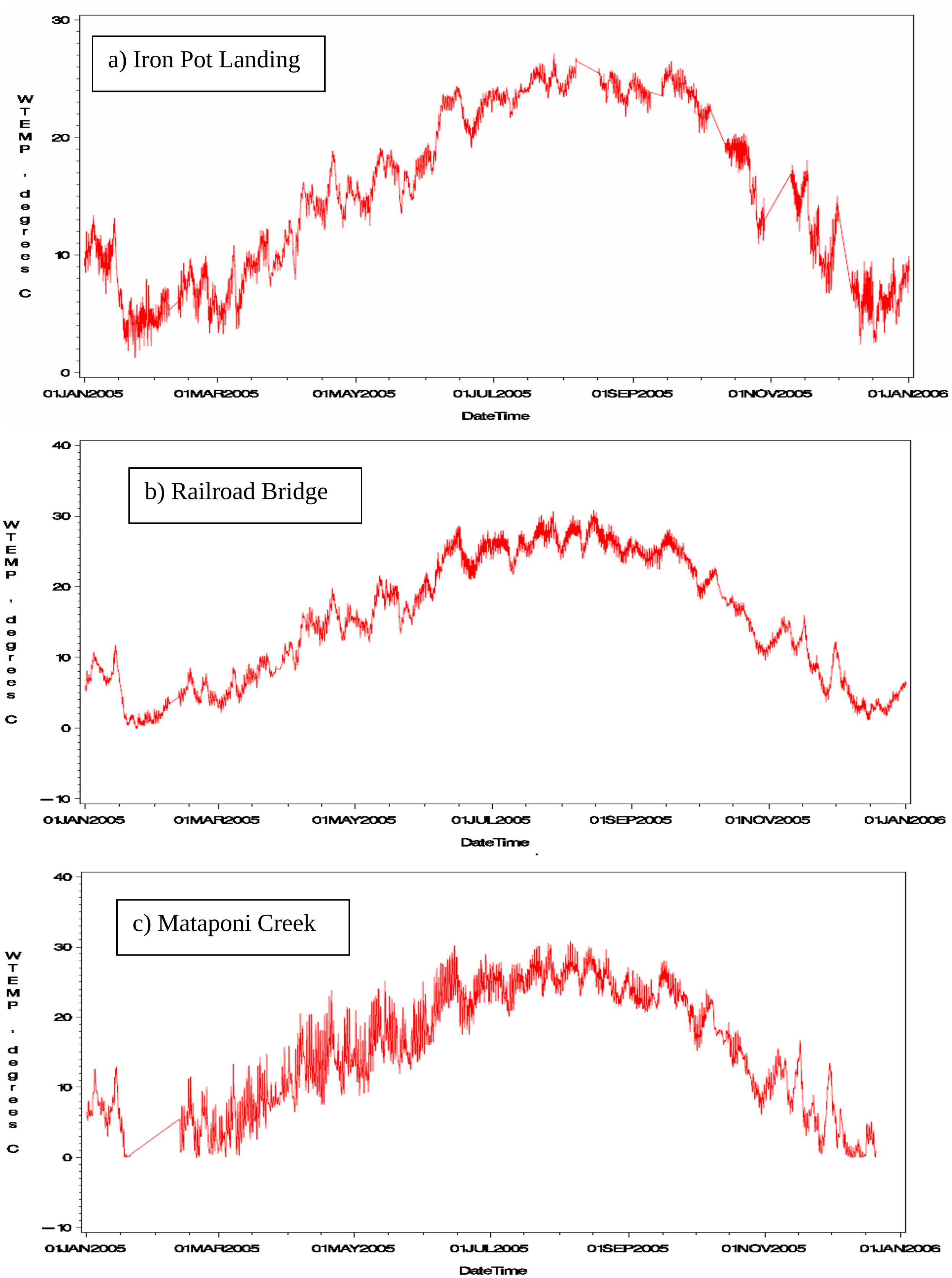


Figure 3-3. Time series of continuous monitoring temperature data at a) Iron Pot Landing, b) Railroad Bridge and c) Mataponi Creek from January through December 2005.

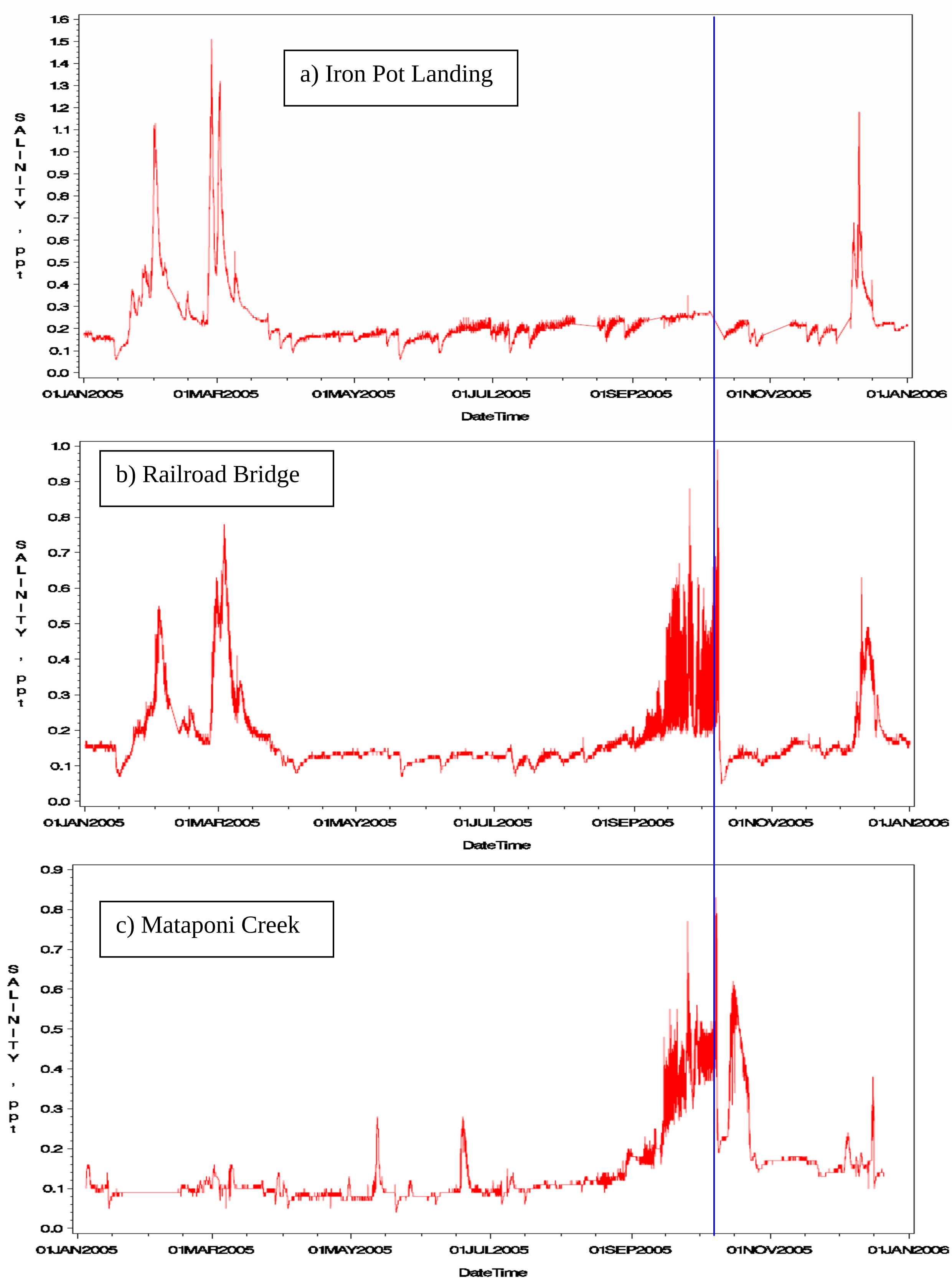


Figure 3-4. Time series of continuous monitoring salinity data at a) Iron Pot Landing, b) Railroad Bridge and c) Mataponi Creek from January through December 2005. The blue line indicates the large rain event of October 7 – 8.

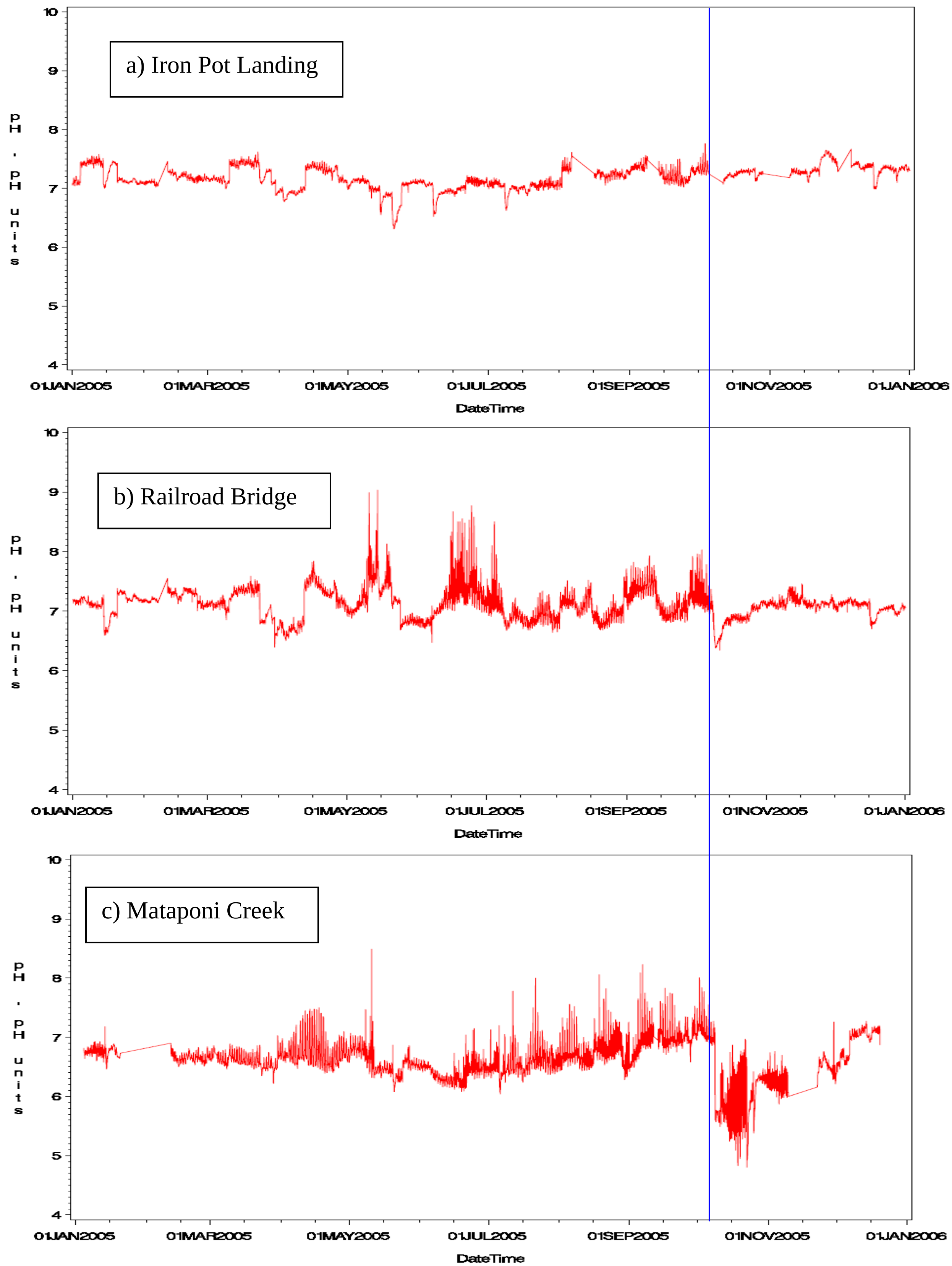


Figure 3-5. Time series of continuous monitoring pH data at a) Iron Pot Landing, b) Railroad Bridge and c) Mataponi Creek from January through December 2005. The blue line indicates the large rain event of October 7 – 8.

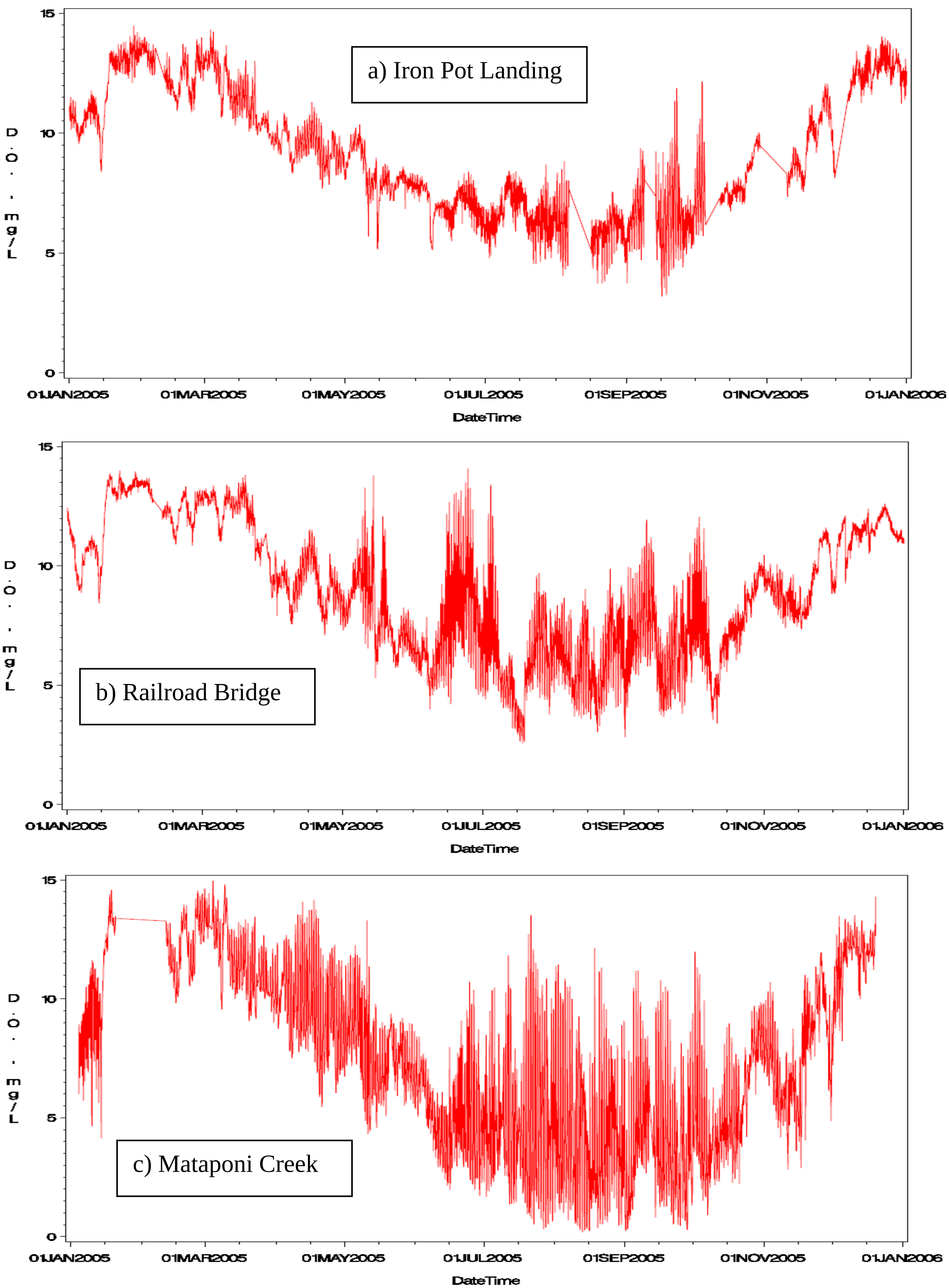


Figure 3-6. Time series of continuous monitoring dissolved oxygen data at a) Iron Pot Landing, b) Railroad Bridge and c) Mataponi Creek from January through December 2005.

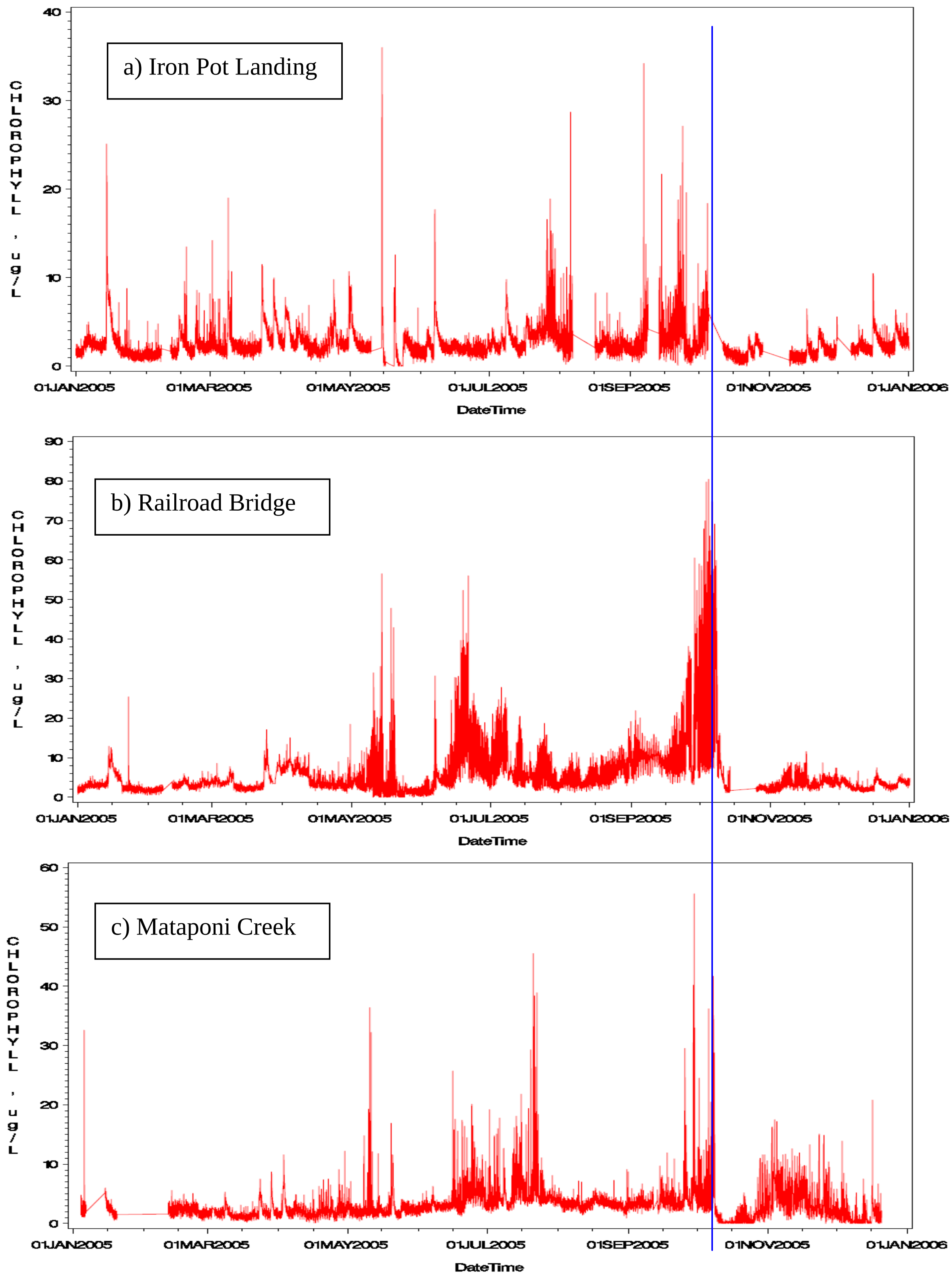


Figure 3-7. Time series of continuous monitoring chlorophyll a data at a) Iron Pot Landing, b) Railroad Bridge and c) Mataponi Creek from January through December 2005. The blue line indicates the large rain event of October 7 – 8.

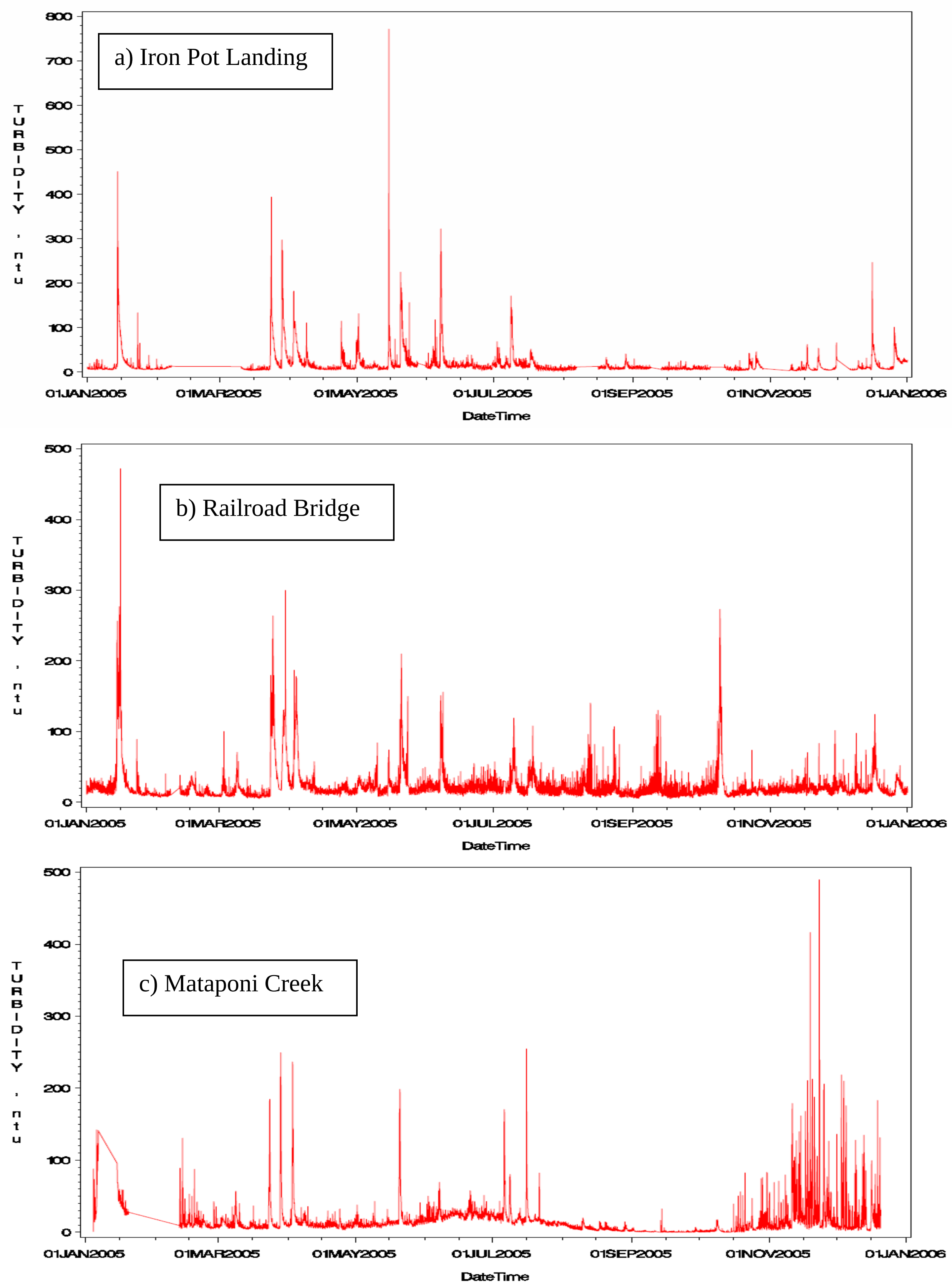


Figure 3-8. Time series of continuous monitoring turbidity data at a) Iron Pot Landing, b) Railroad Bridge and c) Mataponi Creek from January through December 2005.

3.8 Monthly Grab Sampling Results

The goals of the monthly nutrient sampling were to create a long-term database of nutrient information at each site for the purpose of detecting changes over time and across sites. Samples for nutrient analyses were collected monthly at each site during the continuous monitoring deployment period. Nutrient grab samples were collected by Maryland DNR on a monthly basis from February to December at all three sites (Table 1-1). Duplicate samples were taken once monthly and analyzed for chlorophyll *a*, nitrate, nitrite, ammonium and orthophosphate. An additional round of sampling (not in duplicate) was conducted each month at each site in collaboration with Maryland DNR's Continuous Monitoring Program. Diel nutrient sampling was conducted once monthly at the Railroad Bridge station from February through December 2005 and included the core NERRS nutrients. Unattended samplers were programmed to collect water samples every two and one half hours, over a 24 hour period. Nutrient samples were analyzed by the Nutrient and Analytical Services Laboratory (NASL) at Chesapeake Biological Laboratory. Missing data was rejected and deleted through QA/QC procedures.

Highest mean chlorophyll *a* concentrations occurred at Railroad Bridge, with the highest concentrations occurring during the summer and the lowest occurring in the spring (Tables 3-9, 3-10 and 3-11). This trend was different at Mataponi Creek and Iron Pot Landing where the highest chlorophyll *a* concentrations were present in the fall. Overall, chlorophyll *a* concentrations at Railroad Bridge were greater throughout the deployment period when compared to Iron Pot Landing and Mataponi Creek (Tables 3-9, 3-10 and 3-11). Twenty two percent (5 out of 23 samples) of chlorophyll *a* observations exceeded the 15 μg/l SAV habitat limit at the Railroad Bridge site during the time of deployment. Mataponi Creek and Iron Pot Landing exceeded the 15 μg/l SAV habitat limit 5% and 5% of the deployment period, respectively a vast improvement over 2004.

Nutrient concentrations also varied by season and site (Tables 3-9, 3-10 and 3-11). Orthophosphate concentrations were highest at Railroad Bridge and lowest at Iron Pot Landing. Ammonium concentrations were highest at Railroad Bridge and lowest at Mataponi Creek. The highest nitrite and nitrate concentrations occurred at Railroad Bridge, while lowest nitrite and nitrate levels were present at Mataponi Creek. Ammonium concentrations were greater in the spring at Railroad Bridge, while orthophosphate concentrations were greatest in the summer. Ammonium concentrations were also greater in the spring at Iron Pot Landing, while at Mataponi Creek they were greater in the fall. Orthophosphate concentrations were greatest in the fall at Iron Pot Landing while they were greater during the summer at Mataponi Creek. Nitrate levels were highest in the spring at Railroad Bridge, Iron Pot Landing and Mataponi Creek while nitrite levels were highest in the spring at Railroad Bridge but highest in the summer at Iron Pot Landing and Mataponi Creek.

Chlorophyll *a* concentrations exhibited responses to diel and tidal cycles (Figures 3-11 through 3-21). Peaks in chlorophyll *a* tended to corresponded with high tide. Orthophosphate and nitrate concentrations showed the greatest response to tidal cycle and chlorophyll concentration (Figures 3-11 through 3-21). The greatest concentrations of orthophosphate and nitrate occurred during periods of low tide and were inversely proportional to chlorophyll concentrations. Nitrite and ammonium concentrations were low throughout the diel sampling period and did not show significant fluctuations due to tidal or diel cycles.

Table 3-9. **Iron Pot Landing** 2005 monthly Orthophosphate (PO_4), Ammonium (NH_4), Nitrite (NO_2), Nitrate (NO_3) and Chlorophyll a (CHLA) data.

	Date	Time	Replicate	PO4F	NH4F	NO2F	NO3F	CHLA
	mm/dd/yy	hh:mm		mg/L	mg/L	mg/L	mg/L	μg/L
	1/4/05	1045	1		0.082	0.0079	0.5501	2.43
	1/20/05	0300	2		0.11	0.005	1.53	1.196
Spring	03/10/05	1100	1	0.0428	0.056	0.007	0.446	8.224
	03/30/05	1115	2	0.01865	0.081	0.00765	0.61635	
	04/12/05	1215	1	0.0479	0.043	0.0048	0.4442	3.289
	04/26/05	1115	2	0.103	0.0295	0.0046	0.4884	3.364
	05/10/05	1000	1	0.286	0.048	0.0045	0.6695	1.196
	05/24/05	0930	2	0.0213	0.0905	0.0107	0.4358	3.177
Mean				**.0866**	**.6675**	**.0065**	**.6475**	**3.268**
Median				**.0454**	**.0685**	**.006**	**.5193**	**3.177**
St. Dev.				**.1023**	**.0275**	**.0022**	**.3668**	**2.3759**
Summer	06/07/05	0930	1	0.0355	0.108	0.0213	0.3527	6.542
	06/21/05	1000	2	0.159	0.0445	0.0066	0.5869	1.869
	07/06/05	1030	1	0.0646	0.089	0.0116	0.5014	5.233
	07/19/05	0800	2	0.1228	0.081	0.0071	0.2694	2.492
	08/02/05	0800	1		0.152	0.0056	1.3044	5.084
	08/16/05	0915	1	0.3269	0.086	0.0059	0.3611	2.617
	08/30/05	0915	2	0.203	0.056	0.00585	0.31515	6.4795
Mean				**.1520**	**.0881**	**.0091**	**.5273**	**4.3309**
Median				**.1409**	**.086**	**.0066**	**.3611**	**5.084**
St. Dev.				**.1052**	**.0353**	**.0058**	**.3600**	**1.9692**
Fall	09/13/05	1215	1	0.649	0.033	0.0029	0.4701	20.036
	09/27/05	0300	2	0.0945	0.0435	0.0024	0.1586	1.196
	10/11/05	1145	1	0.0412	0.063	0.0058	0.2652	4.486
	10/25/05	1200	2	0.05525	0.0345	0.0056	0.3114	3.987
	11/09/05	0300	1	0.1391	0.028	0.0011	0.5409	2.093
	11/22/05	1145	2	0.0417	0.0205	0.00615	0.27035	5.607
Mean				**.1701**	**.0371**	**.0040**	**.3361**	**6.2342**
Median				**.0749**	**.0338**	**.0043**	**.2909**	**4.2365**
St. Dev.				**.2376**	**.0148**	**.0021**	**.1424**	**6.9501**
	12/06/05	1130	1	0.104	0.048	0.0026	0.1914	1.196
Annual								
Mean				**.1345**	**.0649**	**.0065**	**.5036**	**4.3711**
Median				**.0945**	**.056**	**.0058**	**.4451**	**3.289**
St. Dev.				**.1517**	**.0328**	**.0041**	**.3278**	**4.1115**

Table 3-10. **Railroad Bridge** 2005 monthly Orthophosphate (PO_4), Ammonium (NH_4), Nitrite (NO_2), Nitrate (NO_3) and Chlorophyll a (CHLA) data.

	Date	Time	Replicate	PO4F	NH4F	NO2F	NO3F	CHLA
	mm/dd/yy	hh:mm		mg/L	mg/L	mg/L	mg/L	μg/L
	01/04/05	0930	1		0.228	0.0217	1.2783	3.489
	01/20/05	1145	2		0.176	0.02145	1.39855	1.0465
	02/24/05	1115	2	0.01095	0.0685	0.0154		3.738
Spring	03/10/05	0930	1	0.011	0.082	0.0194	1.1106	17.942
	03/30/05	0930	2	0.0175	0.0915	0.0133	0.7312	4.486
	04/12/05	1000	1	0.0164	0.033	0.0112	1.0188	7.476
	04/26/05	0930	2	0.02405	0.059	0.01215	0.95035	3.987
	05/10/05	0830	1	0.0115	0.009	0.0112	0.4508	22.428
	05/24/05	1100	2	0.02235	0.099	0.013	0.5995	3.364
Mean				**.0163**	**.094**	**.0154**	**.9422**	**7.5507**
Median				**.0164**	**.082**	**.0133**	**.9846**	**3.987**
St. Dev.				**.0054**	**.0686**	**.0043**	**.3293**	**7.4354**
Summer	06/07/05	1100	1	0.0368	0.101	0.0219	0.6241	3.738
	06/21/05	0815	2	0.0153	0.0125	0.01095	0.40105	87.843
	07/06/05	0845	1	0.022	0.026	0.0114	0.1876	59.31
	07/19/05	0915	2	0.0298	0.058	0.0128	0.4757	2.99
	08/02/05	0915	1	0.0306	0.032	0.0102	0.5988	13.457
	08/16/05	1030	1	0.0467	0.053	0.0102	0.5398	11.962
	08/30/05	0715	2	0.03135	0.0385	0.0104	0.6096	9.1585
Mean				**.0304**	**.0459**	**.0126**	**.4910**	**26.9226**
Median				**.0306**	**.0385**	**.0110**	**.5398**	**11.962**
St. Dev.				**.0101**	**.0289**	**.0042**	**.1561**	**33.1442**
Fall	09/13/05	0115	1	0.0126	0.017	0.0043	0.1127	22.926
	09/27/05	0115	2	0.0252	0.04	0.01045	0.43455	11.214
	10/11/05	0100	1	0.0383	0.074	0.0085	0.5685	1.994
	10/25/05	0115	2	0.03405	0.0425	0.0067	0.6698	3.738
	11/09/05	1230	1	0.0234	0.036	0.0099	0.9771	11.463
	11/22/05	0100	2	0.0288	0.069	0.00605	0.68745	11.214
Mean				**.0271**	**.0464**	**.0077**	**.5750**	**10.4248**
Median				**.027**	**.0413**	**.0076**	**.6192**	**11.214**
St. Dev.				**.0090**	**.0215**	**.0024**	**.2887**	**7.4080**
	12/06/05	1030	1	0.0234	0.095	0.0074	1.0926	1.196
	12/20/05	1045	2	0.0288	0.101	0.0086	1.1714	
Annual								
Mean				**.0246**	**.0684**	**.0120**	**.7256**	**13.92**
Median				**.0237**	**.0585**	**.0111**	**.6241**	**7.476**
St. Dev.				**.0097**	**.0507**	**.0048**	**.3406**	**20.3288**

Table 3-11. **Mataponi Creek 2005** monthly Orthophosphate (PO_4), Ammonium (NH_4), Nitrite (NO_2), Nitrate (NO_3) and Chlorophyll a (CHLA) data.

	Date	Time	Replicate	PO4F	NH4F	NO2F	NO3F	CHLA
	mm/dd/yy	hh:mm		mg/L	mg/L	mg/L	mg/L	μg/L
	01/04/05	1145	1		0.067	0.0156	0.5824	1.196
	02/24/05	0945	2	0.0145	0.0435	0.009		3.24
Spring	03/10/05	1215	1	0.0132	0.06	0.0069	0.7001	4.486
	03/30/05	0100	2	0.0172	0.0415	0.0079	0.6106	
	04/12/05	0115	1	0.014	0.007	0.0057	0.6943	12.709
	04/26/05	1230	2	0.01785	0.0175	0.00375	0.58475	5.084
	05/10/05	1100	1	0.0138	0.037	0.0068	0.3672	3.588
	05/24/05	0815	2	0.0179	0.101	0.00975	0.54825	1.4955
Mean				**.0155**	**.0468**	**.0082**	**.5839**	**4.5426**
Median				**.0145**	**.0425**	**.0074**	**.5848**	**3.588**
St. Dev.				**.0021**	**.0295**	**.0035**	**.1115**	**3.8747**
Summer	06/07/05	0745	1	0.0281	0.092	0.0143	0.4367	3.738
	06/21/05	1115	2	0.02565	0.0865	0.01795	0.44605	6.7285
	07/06/05	1145	1	0.0176	0.119	0.0122	0.3488	4.486
	07/19/05	0645	2	0.0262	0.043	0.0076	0.2804	2.741
	08/02/05	0700	1	0.0364	0.036	0.0007	0.0254	2.99
	08/16/05	0800	1	0.018	0.009	0.0051	0.0345	3.289
	08/30/05	1030	2	0.0131	0.0205	0.0019	0.03595	6.9155
Mean				**.0236**	**.058**	**.0085**	**.2297**	**4.4126**
Median				**.0257**	**.043**	**.0076**	**.2804**	**3.738**
St. Dev.				**.0079**	**.0412**	**.0065**	**.1931**	**1.7402**
Fall	09/13/05	1115	1	0.0126	0.012	0.0006	0.0205	5.383
	09/27/05	0415	2	0.0142	0.0345	0.00735	0.19915	4.037
	10/11/05	1015	1	0.0102	0.134	0.0052	0.2238	35.137
	10/25/05	1045	2	0.0049	0.0735	0.0011	0.1609	2.617
	11/09/05	0400	1	0.005	0.063	0.0011	0.0962	5.981
	11/22/05	1030	2	0.00865	0.0575	0.0018	0.1277	12.7095
Mean				**.0093**	**.0624**	**.0029**	**.1380**	**10.9774**
Median				**.0094**	**.0603**	**.0015**	**.1443**	**5.682**
St. Dev.				**.0039**	**.0415**	**.0028**	**.0739**	**12.3370**
	12/06/05	1245	1	0.008	0.077	0.002	0.192	3.588
	12/20/05	0100	2	0.0058	0.104	0.00345	0.62655	5.981
Annual								
Mean				**.0156**	**.0581**	**.0064**	**.3337**	**6.2781**
Median				**.0141**	**.0575**	**.0057**	**.3146**	**4.2615**
St. Dev.				**.0079**	**.0360**	**.0050**	**.2366**	**7.0863**

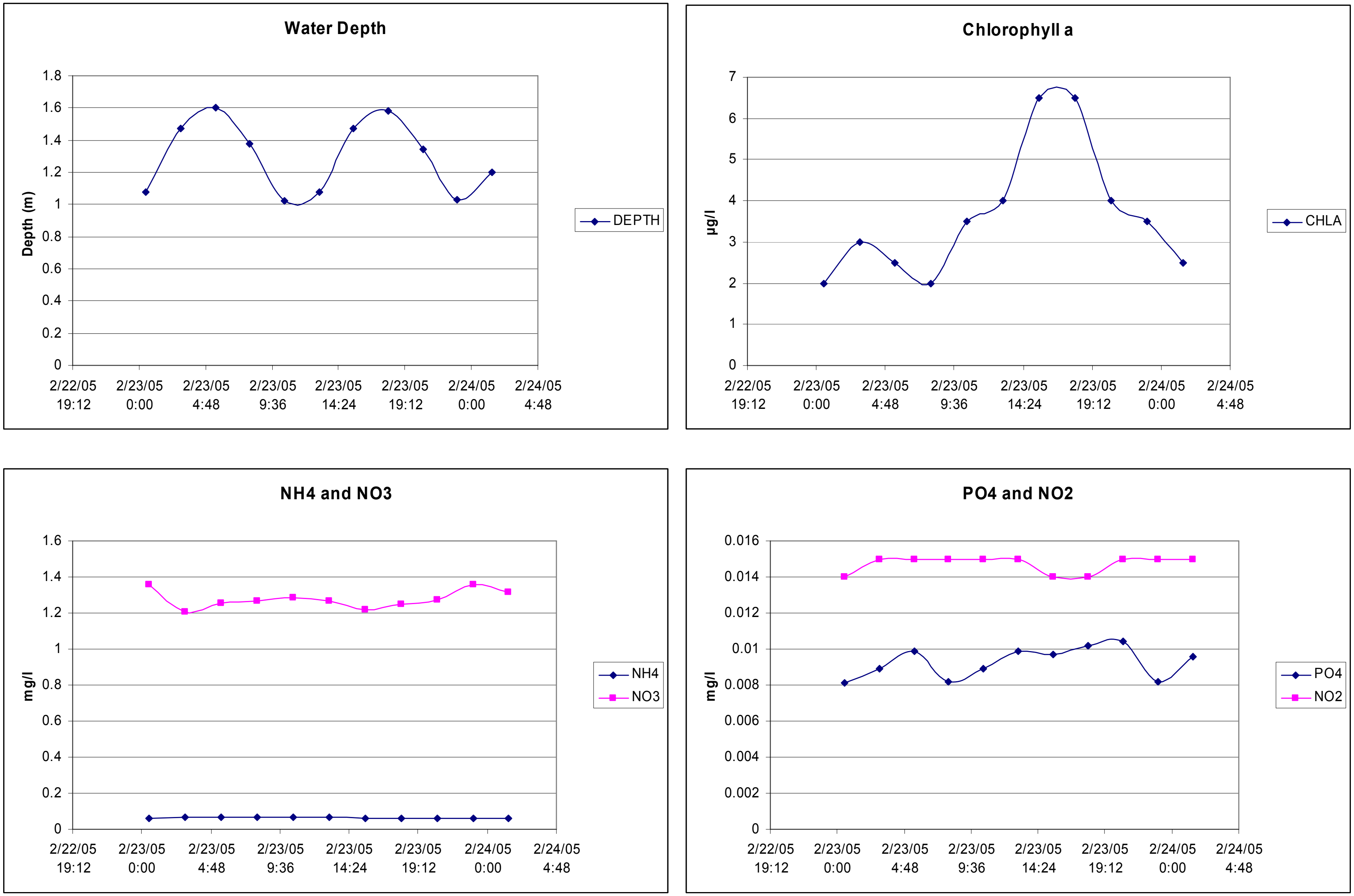


Figure 3-11. February 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

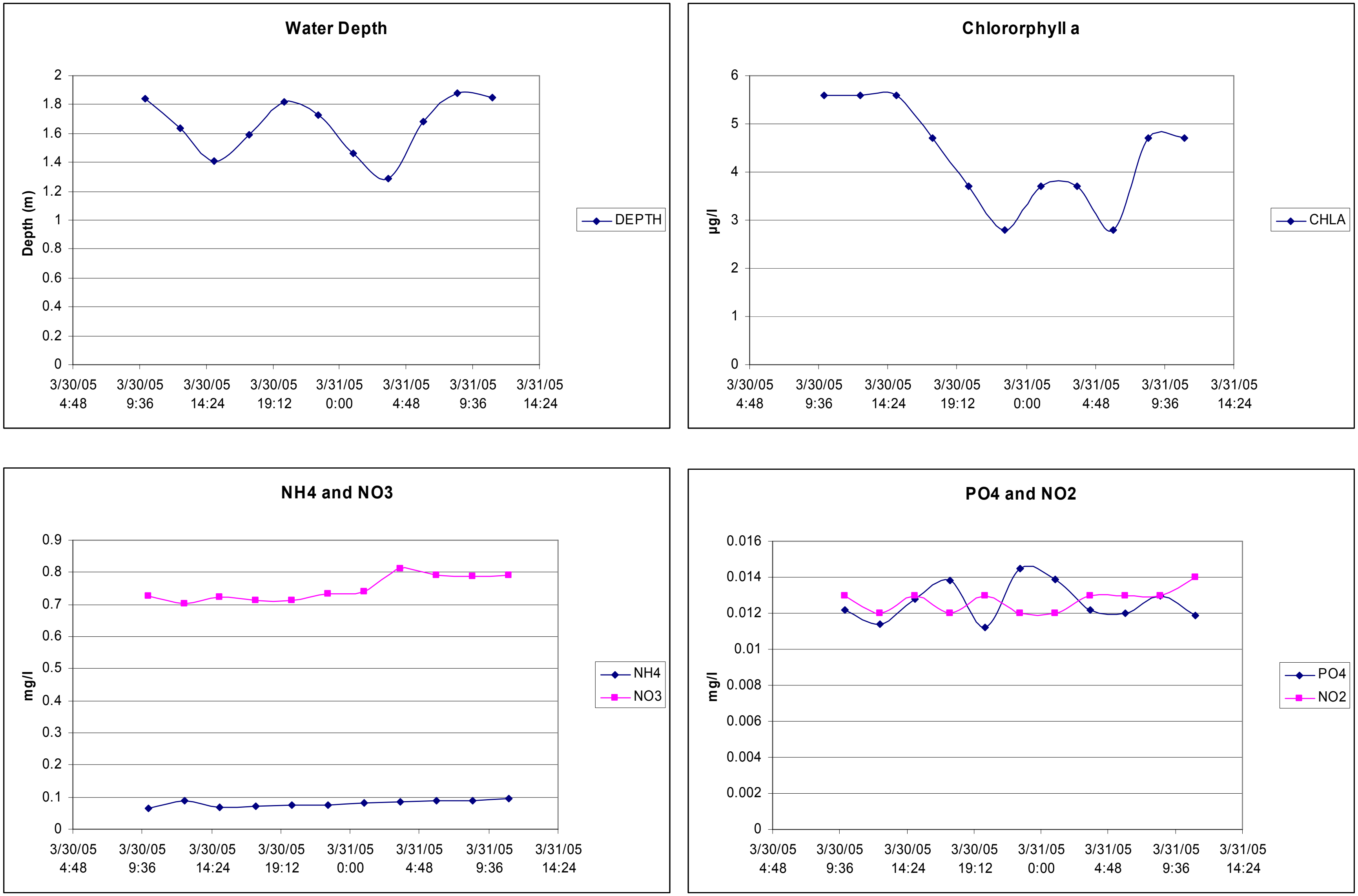


Figure 3-12. March 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

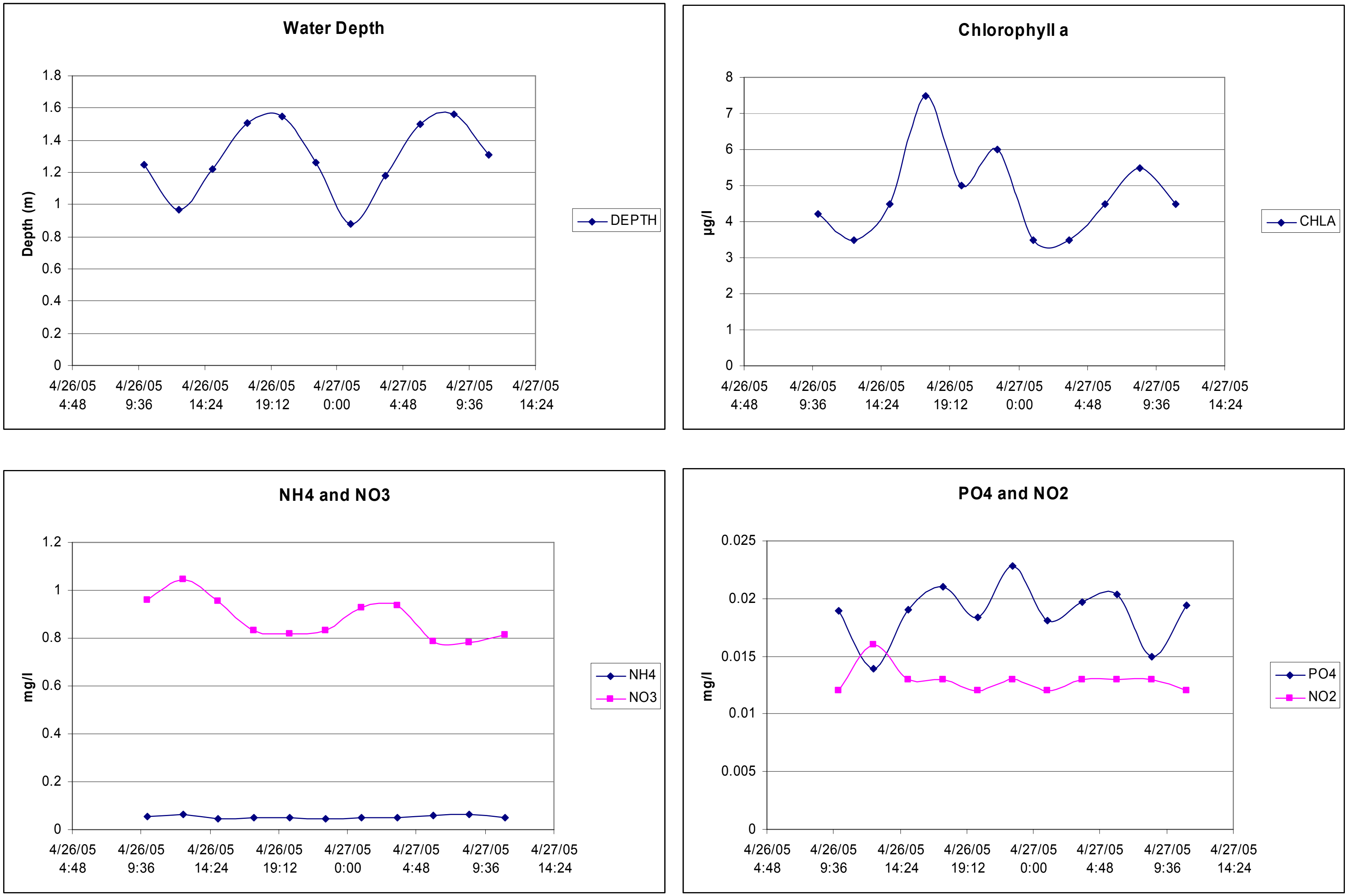


Figure 3-13. April 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

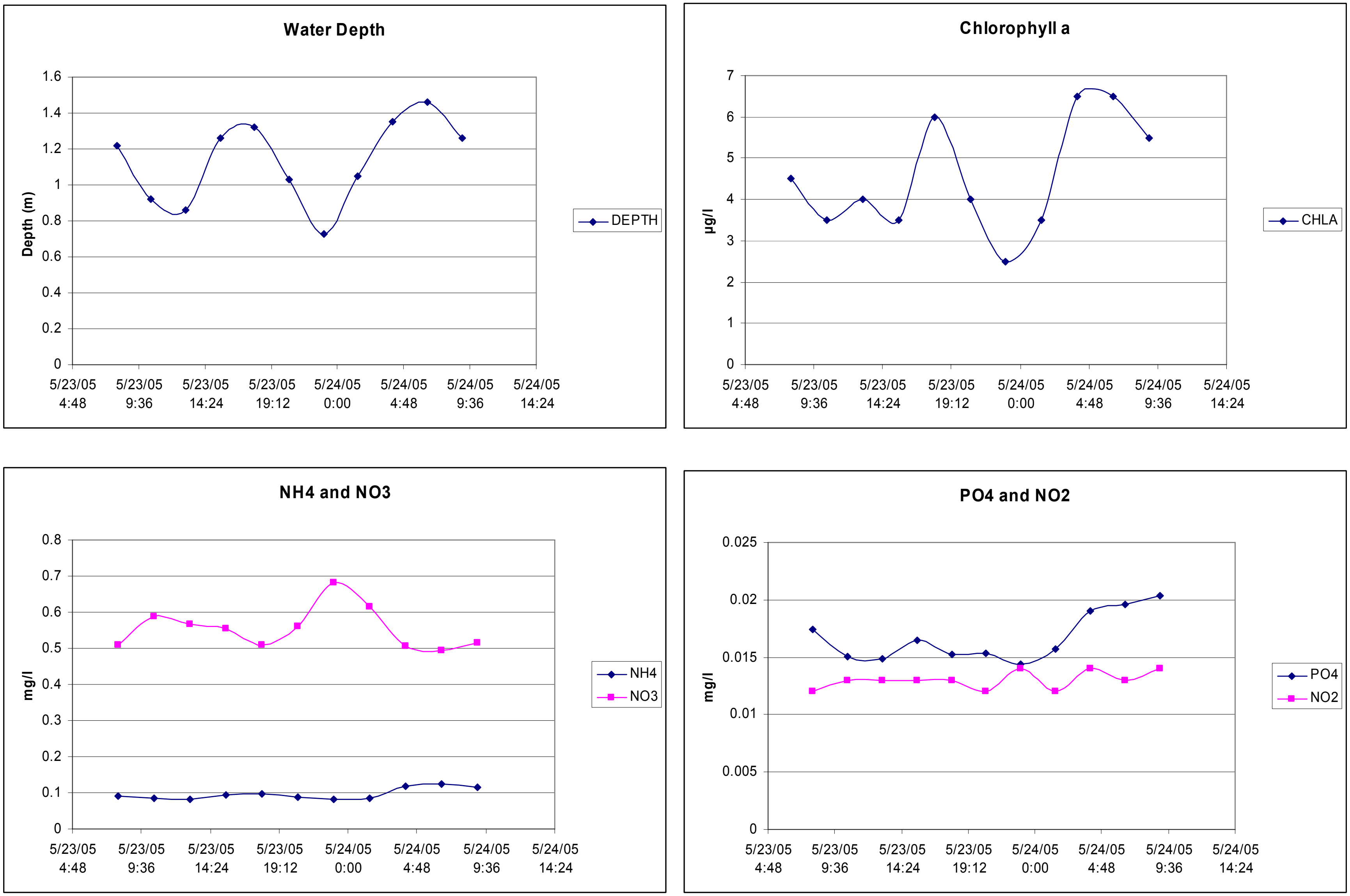


Figure 3-14. May 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

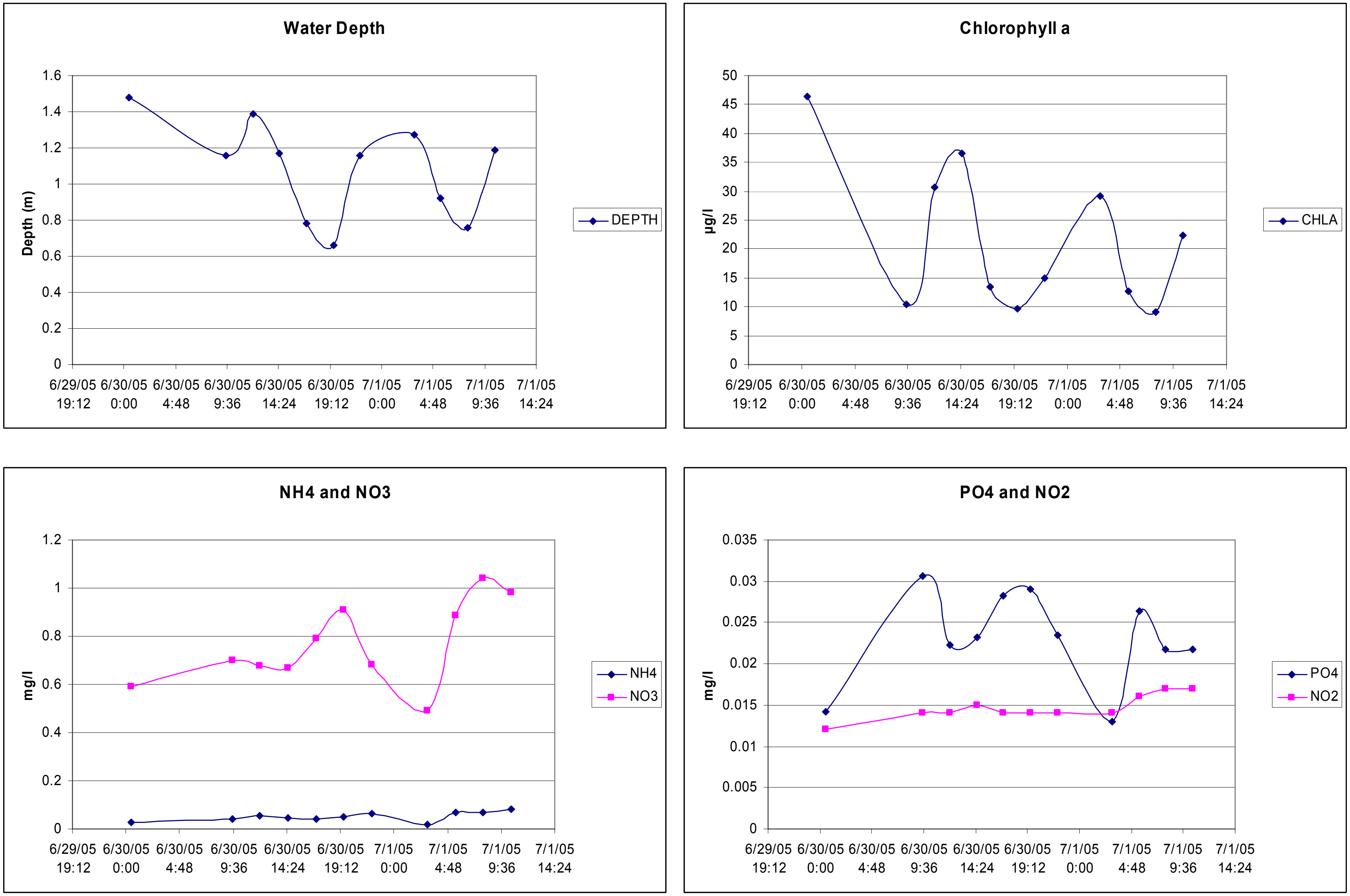


Figure 3-15. June 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

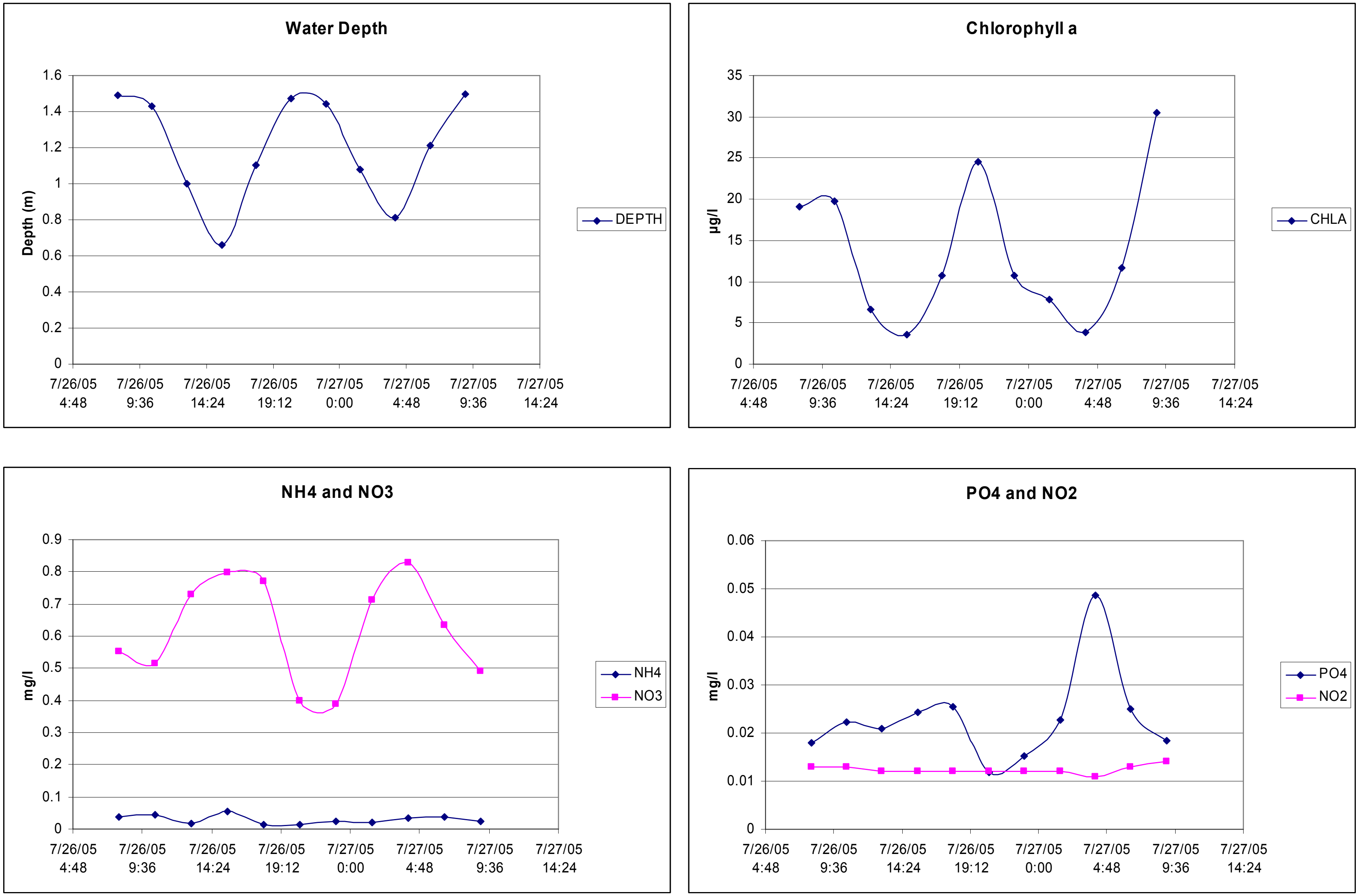


Figure 3-16. July 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

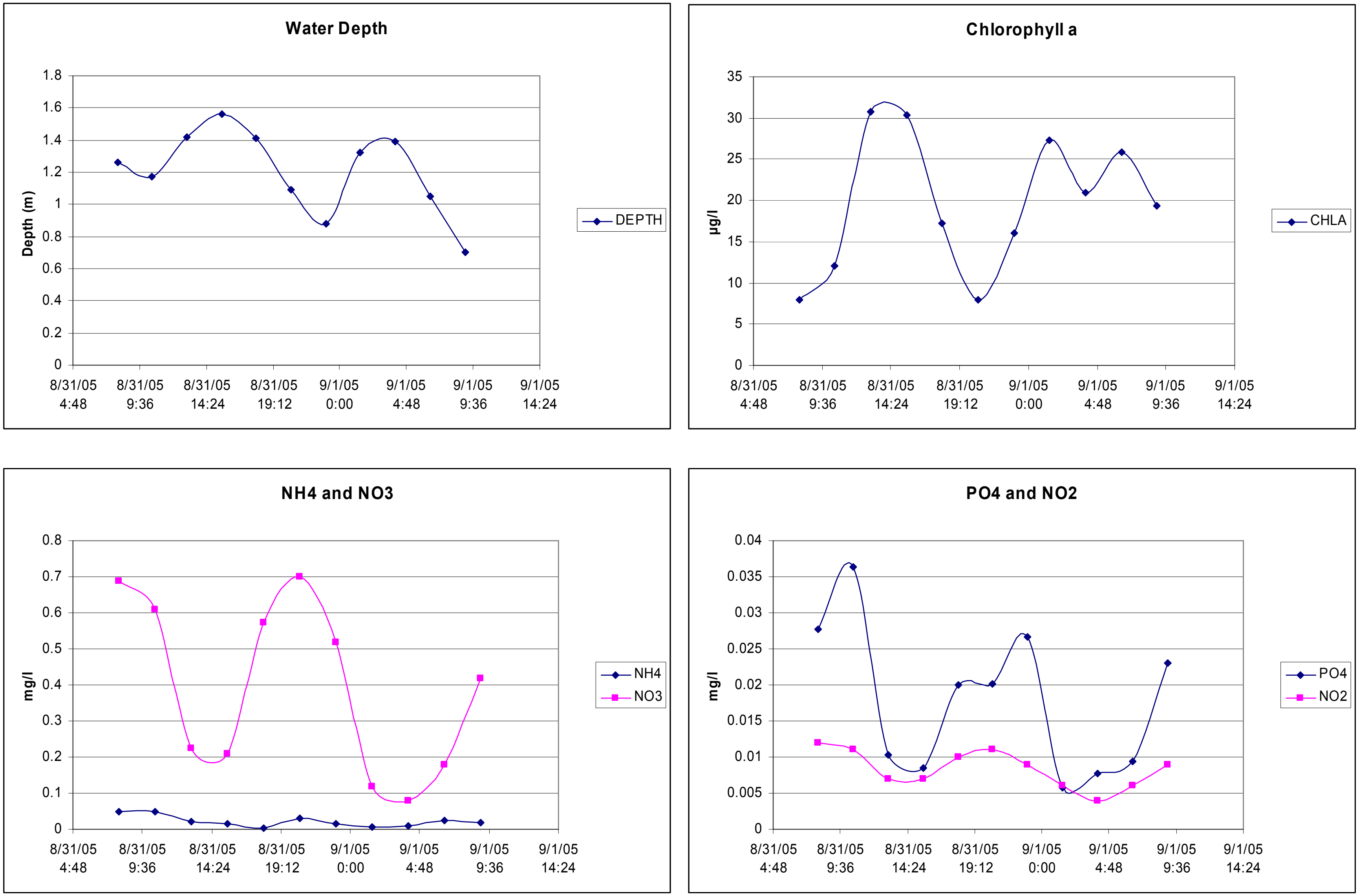


Figure 3-17. August 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

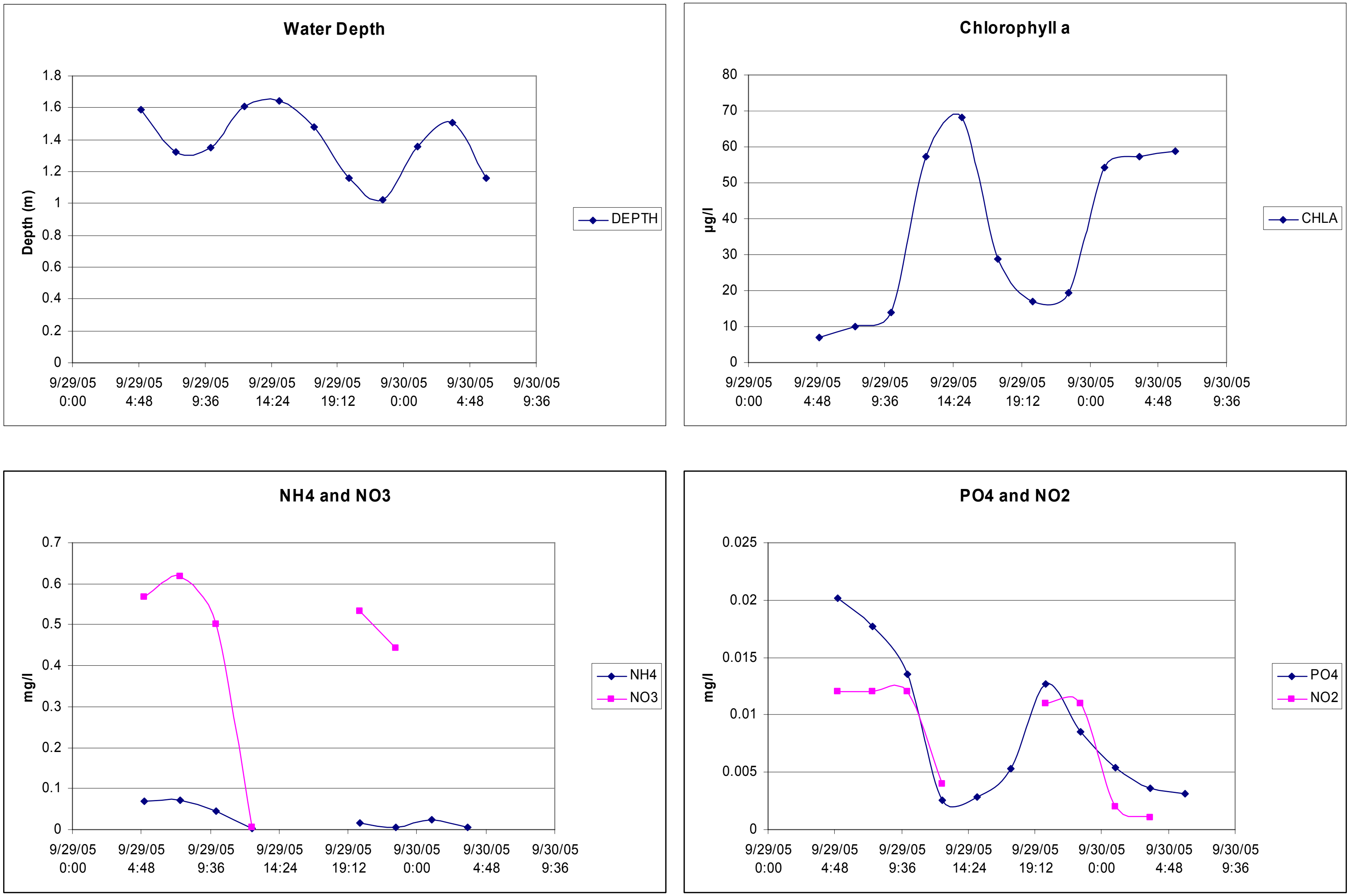


Figure 3-18. September 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

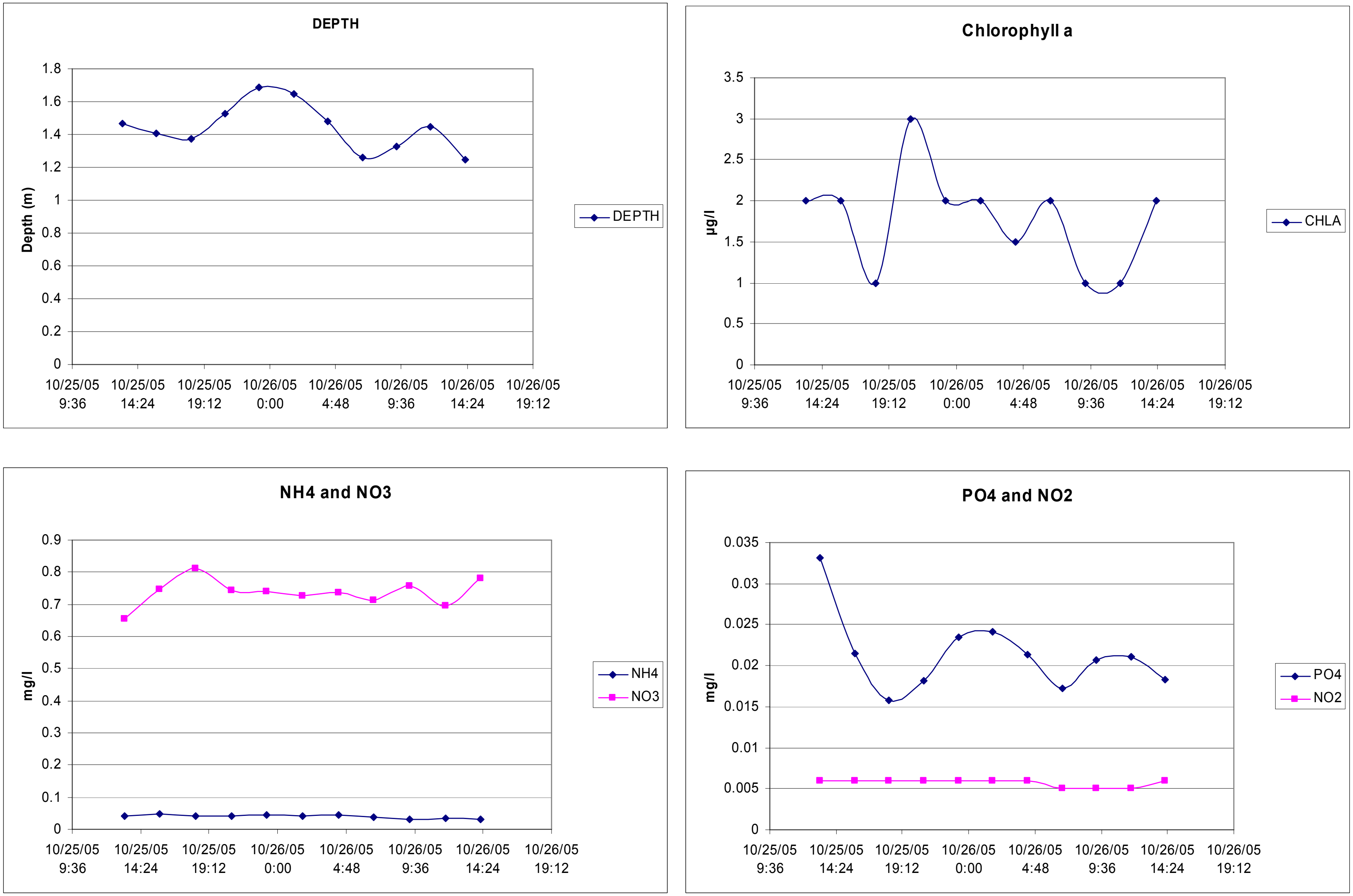


Figure 3-19. October 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

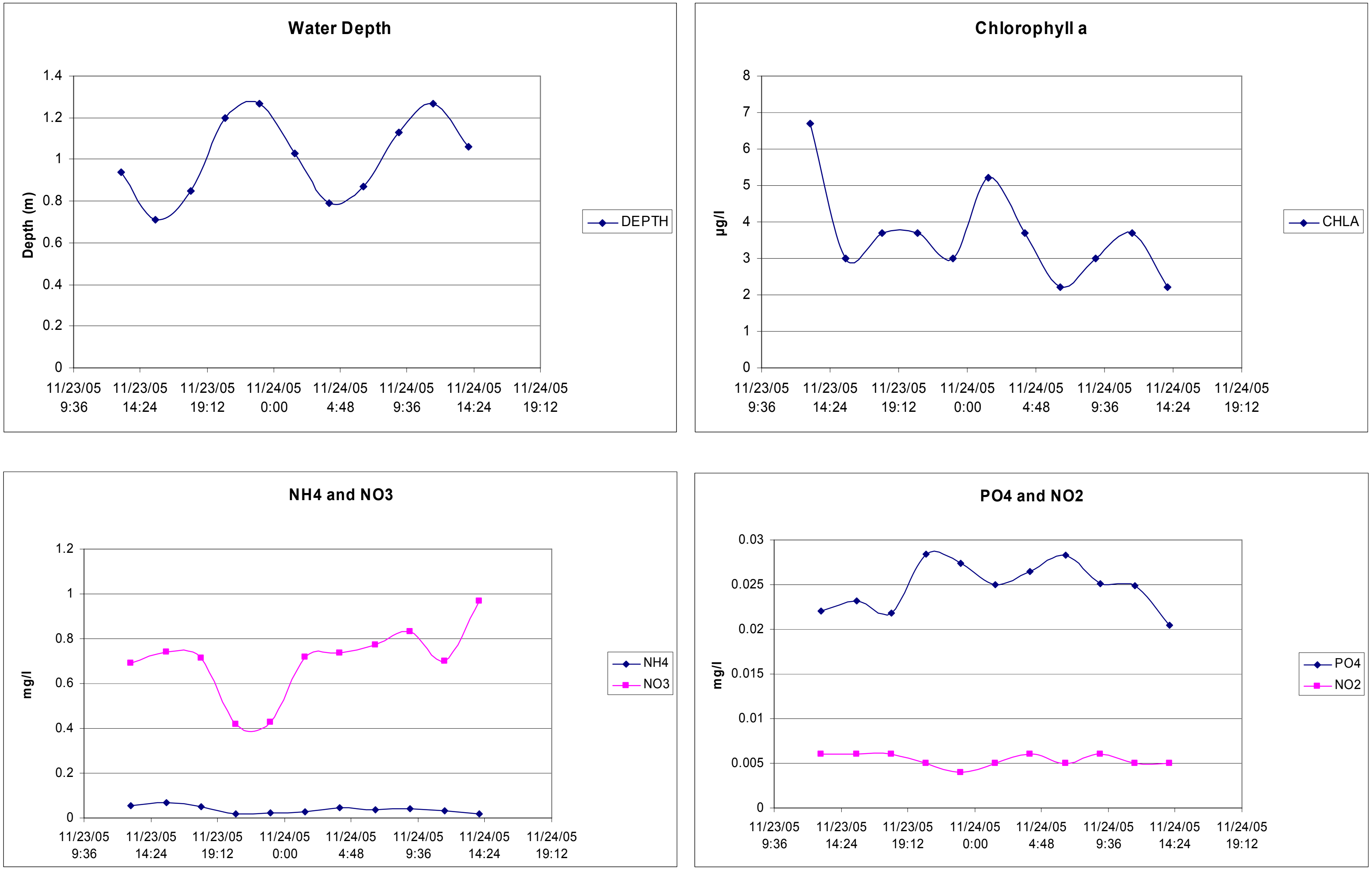


Figure 3-20. November 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

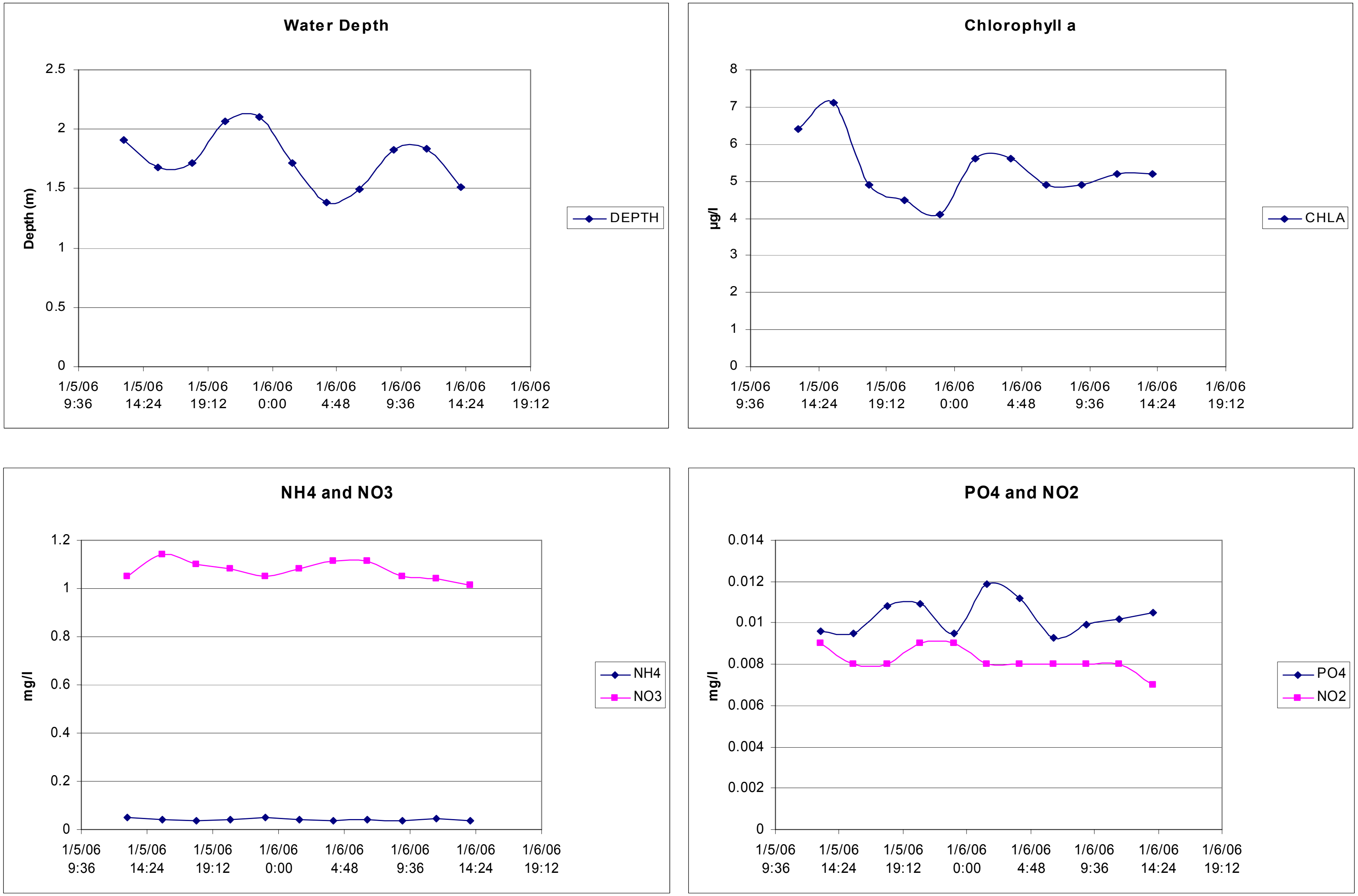


Figure 3-21. December 2005 Diel Nutrient and Chlorophyll Data. (Water Depth is from continuous monitoring data).

3.9 Meteorological Results

The principle objective of the meteorological information is to track and record atmospheric and meteorological conditions, create a database capable of detecting long-term changes in weather patterns, and to record and identify the impact of storms, hurricanes, heavy rain and other episodic weather events capable of influencing environmental conditions, such as water quality. The Campbell Scientific weather station is located at the north end of Jug Bay marsh along a small tidal creek that feeds the Patuxent River and is situated at 38 deg 46'50.6" N and -76 deg 42'29.1" W. Meteorological data was collected and stored on a CR10X module until November of 2005. In November the weather station was upgraded to a CR1000 unit and GOES telemetry system. At this time data became available near real-time and can be accessed at http://cdmo.baruch.sc.edu/QueryPages/googlemap.cfm. On both systems, data was collected and stored every 5 seconds and then used to create 15 minute, hourly, and daily averages, maximums, and minimums of air temperature, relative humidity, barometric pressure, precipitation, wind speed, wind direction, and photosynthetic active radiation (PAR). The 2005 dataset includes data from January 21, 2005 to December 31, 2005. Data quality assurance and control was conducted using the NERR Format Macro and EQWin software. All missing, anomalous, and deleted data rejected through the QA/QC process were recorded in a metadata file following standard NERR protocol (available upon request). Statistical analysis using the EQWin software generated Table 3-12 below. In 2005 the maximum temperature was 37.4°C on July 12 and the minimum temperature was -15.2°C on January 24. The median relative humidity was 78% and the median barometric pressure was 1017 inches of Hg. Total rainfall in 2005 at the railroad bridge meteorological station was 29.3 inches (see figure 3-22 Daily precipitation totals).

Table 3-12. 2005 statistical data from Railroad Bridge weather station from January-December.

	ATemp	BP	RH	WSpd	TotPAR	TotPrcp
Minimum	-15.2	986	6	0.2	-0.9	0
1st Quartile	5.7	1013	56	0.4	0	0
Median	15.4	1017	78	1.2	12.8	0
3rd Quartile	22.9	1021	92	2.4	389.9	0
Maximum	37.4	1045	99	10.4	3071.4	6.4
Average	14.3	1017	73	1.6	233	0
Standard deviation	10.7	2	21	1.5	347.3	0.2
Number of Values	30951	30951	30951	30951	30951	30949

Figure 3-22 Daily precipitation totals at Railroad Bridge meteorological station January - December.