

# Final Report

## 2004 Dissolved Oxygen Monitoring Project

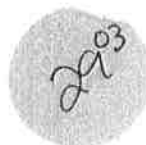
Prepared for the

**CASCO BAY ESTUARY PARTNERSHIP**

by

**FRIENDS OF CASCO BAY**

August 2005



CBEP OFFICE COPY  
Please DO Not REMOVE

## 1.0 Introduction

Friends of Casco Bay and the Casco Bay Estuary Partnership have monitored for low dissolved oxygen and other parameters related to poor water quality since 1999 through an annual short-term study. These annual studies in Casco Bay followed a statewide effort in 1995 and 1996. Generally, the results from previous years have directed the project, and it has evolved from a broad screening study to a more focused and intensive effort. Recently, the project has narrowed to focus on just two water bodies, Quahog Bay and the New Meadows River. These two systems have consistently demonstrated reduced water quality.

In 2001, the project monitored the temperature, salinity, pH, dissolved oxygen, chlorophyll fluorescence, and dissolved inorganic nutrient concentrations at four sites in Quahog Bay and four sites in the New Meadows River. In 2004, the decision was made to replicate the 2001 project and compare the results from both years. The null hypothesis for the 2004 effort was that there would be no change from the 2001 project results.

## 2.0 Methods and Materials

### 2.1 Site Selection

The 2004 project monitored at eight sampling sites, four in Quahog Bay and four in the New Meadows River. These are the same sites that were sampled in 2001. The sites run in a rough south to north transect from the mouth of each bay up to the inshore waters. Table 1 lists the site names and a brief description of each, and a map of the site locations is found in Figure 1.

**Table 1**

Site Code	Site Description	Water Depth (feet)
QB2	Between Pinkham Point and Pole Island	66
QB4	South of Snow Island	19
QB5	Mouth of Orr's Cove	15
QB6	Great Island Boatyard	8
NM1	Mouth of New Meadows River	76
NM2a	The Basin	33
NM5	South and west of Middle Ground	26
NM6	New Meadows Marina	4

### 2.2 Field Logistics

Two boat crews were used to cover all of the sites so that the data could be collected during a critical three-hour period between 0600 and 0900. The original lines of sight

that were used during the 2001 project to reoccupy each monitoring site were employed again in 2004, and GPS coordinates were also recorded. Every attempt was made to be at the first site by 0600. The boats were not anchored at any site but allowed to drift with the water that was being sampled. Sites were sampled from the mouth of the waterbody up to the head. A YSI data sonde was deployed at the final site to record data hourly for at least 24 hours. Prior to the unattended deployment, the water column profile data was uploaded from the sonde, and the dissolved oxygen calibration was checked.

### **2.3 Data Collection**

Data was collected over three sampling dates: August 20, September 3, and September 19. These dates were chosen to closely match the dates from the 2001 event, which were August 24, September 6, and September 20.

Temperature, salinity, pH, dissolved oxygen (DO), and chlorophyll fluorescence were measured with a YSI data sonde. Water for analysis of dissolved inorganic nutrients was collected, filtered through a 0.45-micron filter, fixed with chloroform, and frozen. The frozen samples were delivered to the University of Maine School of Marine Sciences for analysis. The nutrients that were analyzed were: Nitrate+Nitrite (NO<sub>3</sub>+NO<sub>2</sub>), Silicate (SiO<sub>4</sub>), Ammonium (NH<sub>4</sub>), and Phosphate (PO<sub>4</sub>).

The data sonde measurements were taken throughout the water column at each site. The sonde was allowed to equilibrate at the surface prior to recording the measurements, and then the process was repeated at a depth of one meter, at a depth of two meters, and then at every two meters on down to the bottom. Water samples were collected at the surface and at the bottom for dissolved inorganic nutrient analysis. Weather data and a secchi depth measurement were also recorded for each site.

Prior to each sampling event, both sondes used in the project were calibrated against known standards and compared against each other. At the end of each sampling event, the two sondes underwent a check against calibration standards and were once again compared to each other.

Sampling was done in the early morning and at low tide in order to capture theoretical “worst-case” conditions. Dissolved oxygen concentrations will generally be at their lowest after a full night of respiration, and highest during the late afternoon and early evening after a full day of photosynthesis. Low tide conditions may also influence dissolved oxygen levels, since the incoming tide will bring in colder, more oxygenated water.

After the water column profile measurements were completed at each site, each data sonde was set to record temperature, salinity, pH, dissolved oxygen, and chlorophyll fluorescence every 15 minutes. In 2001 the unattended measurements were recorded hourly. The data sondes were secured by lock and chain to a float at the final sampling sites, NM6 and QB6, and left to record surface measurements for at least 24 hours. This

unattended sampling allows us to examine diurnal swings in dissolved oxygen, pH, and chlorophyll fluorescence, as well as the tidal variations in temperature and salinity.

### 3.0 Results

#### 3.1 Water Column Profile Data

Table 2 presents the mean values for each site for the 2001 and 2004 projects. Appendix A includes all of the data from 2001 and 2004, grouped by site. There were very strong similarities in the data between years, with the exception of chlorophyll fluorescence and dissolved inorganic nutrient concentrations.

The mean **temperature** was 16.5 degrees Celsius for the New Meadows in 2004 and 16.3 in 2001. In Quahog Bay the mean climbed from 16.1 in 2001 to 16.7 in 2004. As expected, the mean temperature was always higher at those sites further up in the water bodies than at the mouth. This was most pronounced in the New Meadows, which is a much longer and more restricted embayment than Quahog Bay.

**Salinity** values were also very similar between water bodies. However, mean salinity was generally higher in 2001 by about 1 part per thousand (ppt). The New Meadows and Quahog Bay had mean values of 30.6 and 30.5 ppt, respectively, in 2004. In 2001 the levels were 31.4 and 31.7, respectively.

**Dissolved oxygen**, measured as both concentration and percent saturation, had similar overall means in 2001 and 2004, with the lowest site means generally occurring at the uppermost site in each waterbody. This was more notable in 2001. However, there was much greater variability around the mean at the deeper sites at the mouth of each waterbody. A relatively high mean was often the product of low bottom water DO and high surface water DO. Figures 2 and 3 show the mean DO concentrations at each site in 2001 and 2004. The clear trend of decreasing mean DO concentrations toward the head of the embayments is evident, as is the similarity in values between years. The lowest concentration in 2004 was 4.8 mg/l found at depth (4 meters) on September 3. This concentration coincided with the lowest percent saturation (57.3%) found during the 2004 project.

The **chlorophyll fluorescence** values were slightly lower in 2004 compared to 2001. The overall mean for the New Meadows in 2001 was elevated by high values found in the upper river.

Overall **nutrient** concentrations were slightly higher in 2004. The nitrate+nitrite concentrations were generally higher at depth than at the surface. Where the water column was well mixed, concentrations were somewhat consistent. Only rarely were the levels higher at the surface. The mean total dissolved nitrogen concentrations ( $\text{NO}_3 + \text{NO}_2 + \text{NH}_4$ ) were higher in 2004, but the highest site mean was found in 2001 at NM6 (10.5  $\mu\text{M}$ ). This value, and the mean values from 2004 are higher than what is

considered “normal” for summer nitrogen concentrations. Silicate concentrations were nearly identical in 2001 and 2004, and included surprisingly high values found in the upper New Meadows during both years.

### **3.2 Unattended Data**

The unattended data, recorded just at the surface of NM6 and QB6, revealed very similar trends in temperature and salinity. Temperature generally did not fluctuate with the tide or time of day. The only apparent trend was cooling water temperatures by the third and final sampling date in late September. Salinity was extremely stable. Of 1,390 discrete measurements, the total of all unattended data from the 2004 project including both the New Meadows and Quahog Bay, the highest salinity value was 31.1 ppt and the lowest was 28.9 ppt. For all data recorded in 2004, the DO concentrations fell between 10.2 mg/l and 5.6 mg/l, with a mean of 7.7 mg/l. In 2001 the DO concentrations were strikingly similar: a mean of 7.2 mg/l, a high of 10.0 mg/l, and a low of 5.9 mg/l. The lowest values were generally found between 0600 and 0900 during both projects.

When comparing waterbodies in 2004, the New Meadows had a higher mean water temperature (20.6° C) than Quahog Bay (18.5° C). Salinity was, as noted, very consistent throughout the entire project and did not vary between sites. The DO means were about the same, 8.0 mg/l in the New Meadows and 7.5 mg/l in Quahog Bay, but the minimum and maximum values were both lower in Quahog Bay.

The difference in DO concentration values measured from the early morning to late afternoon was roughly equivalent in both waterbodies. Neither showed any significant swing in DO that would indicate high primary productivity.

## **4.0 Discussion**

### **4.1 Water Column Profile Data**

The principle finding from the 2004 Dissolved Oxygen Monitoring Project was that most parameters measured displayed very similar values to what was seen during the 2001 project. Only salinity, chlorophyll fluorescence and dissolved inorganic nutrient levels were appreciably different between 2004 and 2001. Mean salinity values were just slightly lower in 2004. Chlorophyll fluorescence values were lower in 2004 and dissolved inorganic nutrient concentrations were higher in 2004.

Stratification was similar in 2001 and 2004: a strong thermocline evident in August and early September began to break up by late September. Water column mixing did not seem to have any influence on dissolved oxygen concentrations.

The salinity differences between projects were most likely a result of the increase in wet weather events experienced in 2004. More freshwater from stormwater runoff probably

resulted in the slightly lower values. The dry conditions in 2001 allowed for the higher salinities. During both the 2001 and 2004 projects, however, there was no tidal influence on salinity. Both waterbodies are true embayments with very little freshwater contribution.

When looking at the slightly higher chlorophyll fluorescence concentrations during 2001, and the lower nitrogen concentrations, an obvious conclusion would be that the nitrogen was simply converted to biomass and incorporated into phytoplankton tissue. This shift from inorganic to organic nitrogen was not large enough to produce a strong difference in dissolved oxygen or pH, but clear enough in the overall mean values.

However, the elevated dissolved inorganic nutrient levels seen during the 2004 project seemed to be a Bay-wide phenomenon. Nutrient levels, especially nitrogen, were slightly higher than in previous years. This may also have been due to an increase in wet weather events in 2004. More atmospheric deposition and stormwater runoff may have resulted in the higher nutrient concentrations.

In any event, a look at the ratio of nitrate+nitrite to total dissolved inorganic nitrogen concentrations can be used to determine the amount of “new” nitrogen versus what is recycled within a system. This is called the f-ratio. A higher ratio indicates a predominance of new nitrogen while a lower ratio indicates that the available nitrogen has been recycled by bacteria within the system, either in the water column or within the sediment. The overall mean f-ratio values seen during this project and the 2001 project were very similar, but a look at the individual site means reveals a trend toward higher ratios downstream and lower ratios at the head of the embayments. This is much more pronounced in 2001, where the ratio approaches 0.0 at NM6 and 0.1 at QB6. The mean total DIN is about the same from 2001 to 2004, but a higher proportion of the source of the nitrogen was recycled in 2001. The trend of higher DIN concentration in the upper New Meadows, most of which is present as ammonium, has been evident in other studies and monitoring efforts as well.

The higher nitrate+nitrite concentrations found at depth are somewhat puzzling. High amounts of runoff from land or atmospheric deposition should result in elevated concentrations at the surface. It is possible that phytoplankton and algae at the surface have drawn down the available nutrients there, or perhaps the colder and more nutrient-rich water from off shore is moving in at depth.

Silicate concentrations were high in the upper New Meadows in both years. Generally, high levels of silicate are found near the mouths of rivers and other major freshwater sources, yet this is a system without a dominant freshwater inflow. This may be a sign of groundwater discharge in the system, but more likely the silicate has been recycled from diatoms produced during the spring bloom. The latter explanation would be further evidence of a large spring bloom, especially in the New Meadows. The high levels of recycled nitrogen and silicate would correlate well with the very high primary productivity seen through a series of early summer projects in the upper New Meadows conducted from 2000 to 2004.

Higher concentrations of phosphate during the 2001 project, coupled with the slightly lower nitrogen concentrations that year, produce very low ratios of nitrogen to phosphorous. During both projects this Redfield ratio was lower than the 16:1 nitrogen to phosphate ratio required for maximum growth by phytoplankton, but this was much more pronounced in 2001. This further suggests that the supply of available nitrogen had been used up earlier during the summer. Bottom up control rather than top down by grazing is likely occurring in both water bodies, and heterotrophic bacteria are breaking down the organic matter produced during the spring blooms.

#### **4.2 Unattended Data**

The low dissolved oxygen concentrations seen in the unattended data was similar in Quahog Bay and the New Meadows, and also similar in the 2001 and the 2004 projects. These low values were most often seen during the early morning hours when we conducted the profile monitoring. The high dissolved oxygen values expected during the late afternoon provided a measure of the primary productivity in each water body. This is the benefit of collecting the unattended diurnal data. While there was a modest swing in dissolved oxygen values from early morning to late afternoon in both embayments, neither waterbody exhibited the wide ranges that would have suggested high phytoplankton biomass. This is more evidence that the substantial spring blooms were over, and the low dissolved oxygen concentrations were the result of heterotrophic respiration subsidized by the decomposition of the large blooms.

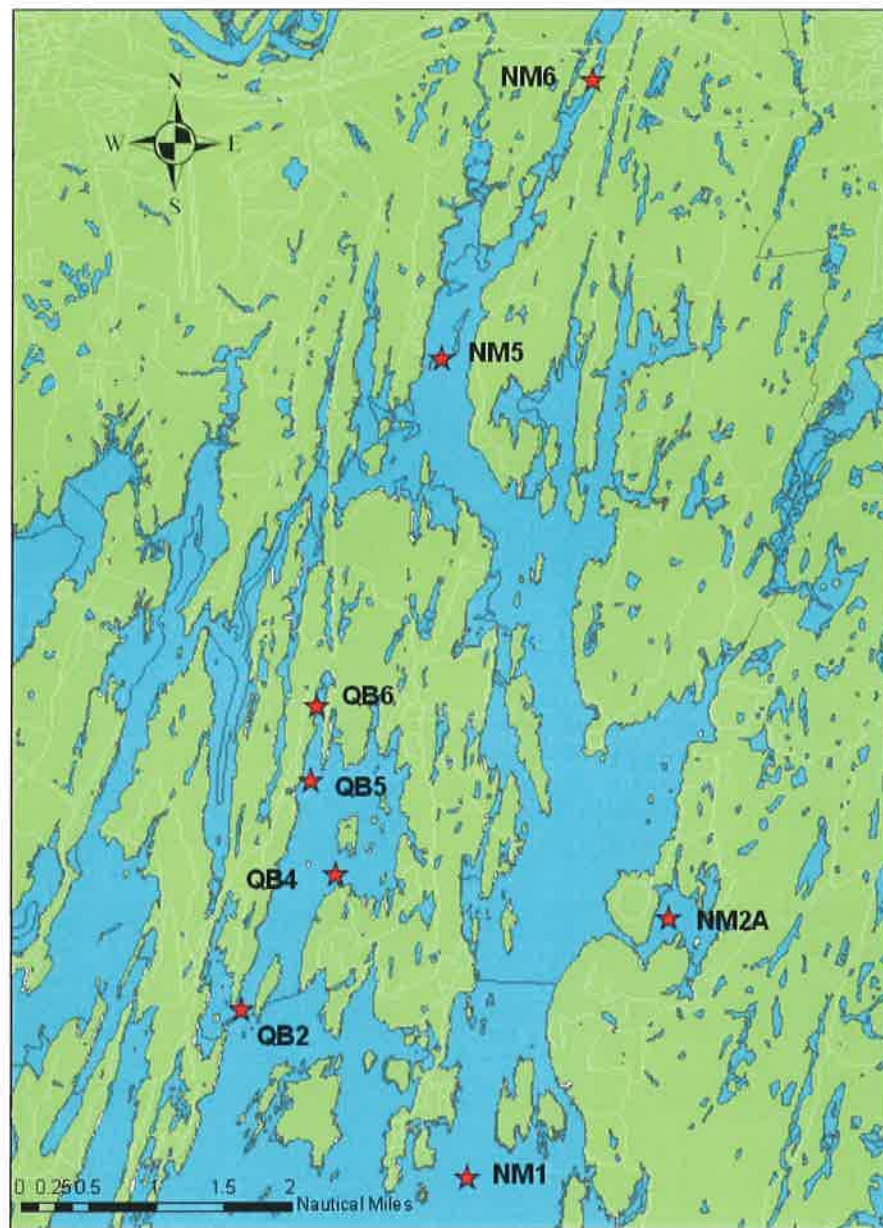
There appeared to be no obvious advantage gained by monitoring in 15-minute increments rather than hourly. Also there was no tidal influence on salinity or temperature values evident in the unattended data.

#### **5. Conclusion**

The data collected through the 2004 project was very similar to what was collected in 2001, even though the two seasons had dramatically different weather patterns. This supports our null hypothesis that there would be no significant difference between projects. The persistent low dissolved oxygen concentrations at depth reflect high microbial activity, most likely promoted by deposition of a large spring phytoplankton bloom. Both systems would seem to be poorly flushed, with high amounts of labile organic carbon that allow for the low dissolved oxygen conditions. Additional work should focus on facilitating an understanding of the flushing rates in each embayment.

Figure 1.

## 2004 Dissolved Oxygen Monitoring Project

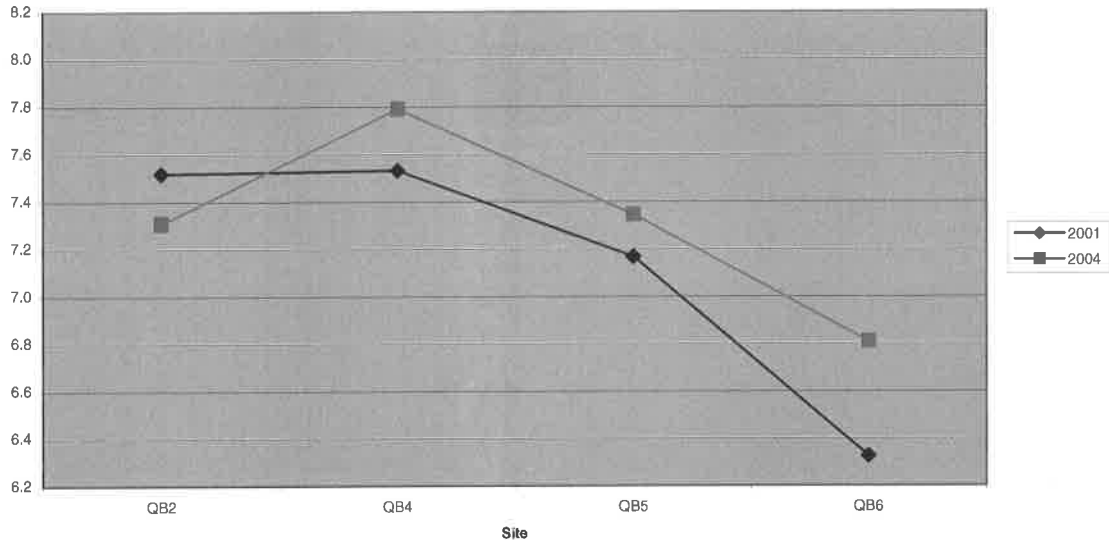


Quahog Bay and the New Meadows River



**Figure 2**

**Quahog Bay Mean Dissolved Oxygen Concentrations by Site**  
Dissolved Oxygen units are mg/l



**Figure 3**

**New Meadows River Mean Dissolved Oxygen Concentrations by Site**  
Dissolved Oxygen units are mg/l

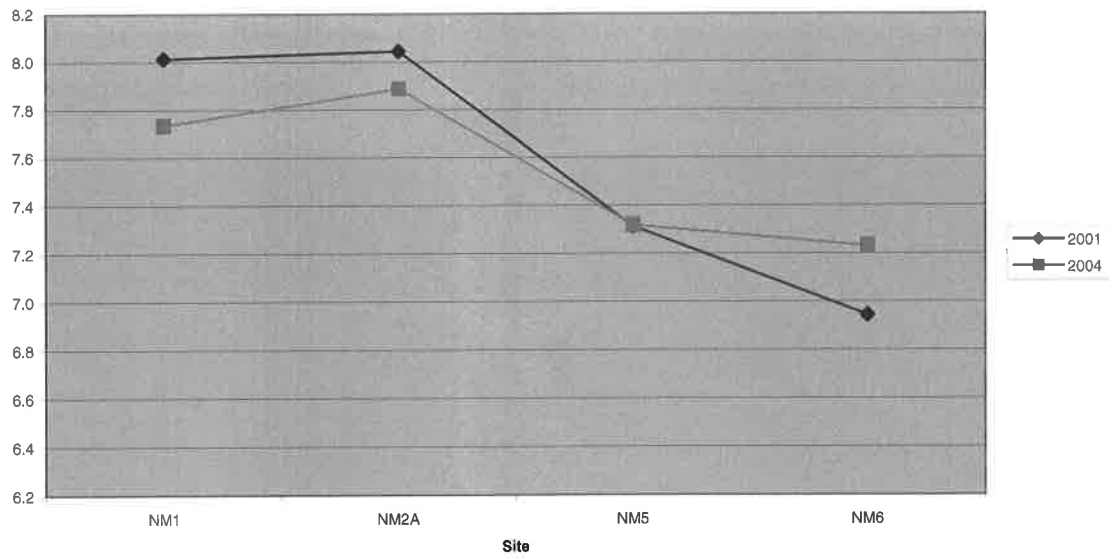


Table 2

## Summary data for the 2004 and 2001 Dissolved Oxygen Monitoring Projects

2004		Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll (ug/L)	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)	DIN (uM)	NO3+NO2 DIN	DIN PO4
NM1		13.1	31.2	7.7	89.4	7.9	4.3	4.4	5.1	1.4	0.5	5.8	0.8	12.3
NM2A		15.4	30.7	7.9	95.2	7.9	5.8	2.1	6.1	2.0	0.3	4.1	0.5	12.1
NM5		17.4	30.8	7.3	91.9	7.9	7.0	2.4	11.5	2.8	0.7	5.1	0.5	7.6
NM6		19.9	29.6	7.2	94.7	7.8	7.9	2.5	31.3	3.2	0.9	5.6	0.4	6.6
mean		16.5	30.6	7.5	92.8	7.9	6.3	2.8	13.5	2.3	0.6	5.2	0.5	9.7
QB2		15.1	30.8	7.3	88.2	7.9	4.0	1.8	5.8	2.8	0.7	4.7	0.4	7.0
QB4		16.8	30.5	7.8	96.9	8.0	5.2	2.2	4.1	2.7	0.5	4.9	0.5	9.2
QB5		16.9	30.6	7.3	91.8	7.9	7.0	2.3	4.2	1.8	0.5	4.2	0.6	7.7
QB6		17.7	30.4	6.8	86.1	7.9	5.5	2.6	4.3	2.6	0.4	5.2	0.5	12.2
mean		16.7	30.5	7.3	90.7	7.9	5.4	2.2	4.6	2.5	0.5	4.7	0.5	9.0
2001		Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll (ug/L)	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)	DIN (uM)	NO3+NO2 DIN	DIN PO4
NM1		13.0	31.5	8.0	92.7	7.9	5.2	1.2	5.0	0.4	0.9	1.6	0.7	1.7
NM2A		14.9	31.5	8.0	96.6	8.0	8.2	0.7	5.2	0.1	0.8	0.9	0.9	1.1
NM5		17.3	31.4	7.3	92.1	7.9	11.4	0.4	10.6	1.1	1.2	1.6	0.3	1.3
NM6		20.1	31.4	6.9	92.0	7.8	10.0	0.5	37.0	9.9	3.5	10.5	0.0	3.0
mean		16.3	31.4	7.6	93.3	7.9	8.7	0.7	14.4	2.9	1.6	3.6	0.5	1.8
QB2		15.1	31.7	7.5	91.0	7.8	5.2	0.9	5.4	1.0	0.9	2.0	0.5	2.2
QB4		16.3	31.6	7.5	93.2	7.9	5.5	0.7	4.4	0.7	0.9	1.3	0.5	1.4
QB5		16.3	31.6	7.2	88.7	7.8	6.4	0.4	3.7	0.3	0.9	0.7	0.5	0.8
QB6		16.5	31.6	6.3	78.5	7.8	8.5	0.3	4.2	1.9	1.1	2.2	0.1	2.0
mean		16.1	31.7	7.1	87.9	7.8	6.4	0.6	4.4	1.0	1.0	1.5	0.4	1.6

Appendix A

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
NM1	8/20/2004	6:54:07	0.0	18.2	29.3	7.9	99.9	8.1	4.3	1.36	2.50	0.86	0.14
NM1	8/20/2004	6:53:31	1.1	18.0	29.5	7.8	98.0	8.0	4.5				
NM1	8/20/2004	6:53:11	2.0	17.8	29.7	7.7	97.1	8.0	4.6				
NM1	8/20/2004	6:52:35	4.0	17.5	29.8	7.7	95.7	8.0	4.3				
NM1	8/20/2004	6:51:23	6.1	12.3	31.4	7.1	80.6	7.8	1.4				
NM1	8/20/2004	6:50:55	8.1	11.4	31.5	7.2	80.2	7.8	1.6				
NM1	8/20/2004	6:50:03	10.0	10.9	31.6	7.3	80.7	7.8	1.5				
NM1	8/20/2004	6:49:23	12.0	10.6	31.6	7.4	81.2	7.8	1.8				
NM1	8/20/2004	6:48:43	14.0	10.3	31.7	7.5	81.6	7.8	1.4				
NM1	8/20/2004	6:48:19	16.2	10.3	31.7	7.5	81.7	7.8	1.4				
NM1	8/20/2004	6:47:23	18.1	10.2	31.7	7.6	82.5	7.8	2.4				
NM1	8/20/2004	6:46:47	20.0	10.1	31.7	7.6	82.7	7.8	2.0				
NM1	8/20/2004	6:44:31	20.6	10.1	31.7	7.6	82.7	7.8	6.7	2.48	7.38	2.35	0.90
NM1	9/3/2004	7:08:37	0.1	16.2	30.6	8.5	104.6	8.0	4.7	2.85	2.13	1.95	0.10
NM1	9/3/2004	7:08:17	1.1	16.2	30.6	8.5	103.5	8.0	4.7				
NM1	9/3/2004	7:08:01	2.1	16.1	30.6	8.3	101.7	8.0	5.2				
NM1	9/3/2004	7:07:49	4.1	16.1	30.7	8.2	99.6	8.0	5.0				
NM1	9/3/2004	7:07:29	6.1	15.5	31.0	7.9	95.1	7.9	5.1				
NM1	9/3/2004	7:07:09	8.1	13.9	31.3	7.8	92.1	7.9	4.1				
NM1	9/3/2004	7:06:45	10.1	13.3	31.3	7.9	91.6	7.9	3.8				
NM1	9/3/2004	7:04:53	12.0	12.3	31.4	7.9	89.6	7.9	2.8				
NM1	9/3/2004	7:04:29	14.1	12.2	31.5	7.9	89.6	7.9	2.5				
NM1	9/3/2004	7:03:41	16.0	12.1	31.5	7.9	89.9	7.9	2.4				
NM1	9/3/2004	7:02:25	17.3	12.0	31.5	8.0	90.8	7.9	2.6	8.23	6.62	1.47	0.48
NM1	9/19/2004	7:37:30	0.0	13.4	30.9	8.2	95.2	7.9	18.2	4.38	3.80	0.00	0.37
NM1	9/19/2004	7:37:08	1.1	13.4	30.9	8.1	94.2	7.9	6.2				
NM1	9/19/2004	7:36:47	2.0	13.4	30.9	8.0	92.6	7.9	6.6				
NM1	9/19/2004	7:36:22	4.1	13.3	31.0	7.8	90.6	7.9	6.2				
NM1	9/19/2004	7:36:09	6.1	13.2	31.0	7.7	89.3	7.9	6.1				
NM1	9/19/2004	7:35:42	8.0	13.0	31.2	7.6	87.4	7.9	5.7				
NM1	9/19/2004	7:35:19	10.2	12.7	31.3	7.5	85.8	7.8	5.4				
NM1	9/19/2004	7:34:37	12.0	11.7	31.7	7.4	83.2	7.8	3.7				
NM1	9/19/2004	7:33:51	14.1	11.6	31.8	7.4	83.1	7.8	4.4				
NM1	9/19/2004	7:32:22	16.0	11.3	31.8	7.4	82.9	7.8	4.4				
NM1	9/19/2004	7:31:33	18.1	11.3	31.8	7.5	83.2	7.8	5.0				
NM1	9/19/2004	7:30:09	19.9	11.3	31.8	7.5	83.7	7.8	3.7	7.10	7.92	1.77	0.83
NM1	9/19/2004	7:28:51	21.1	11.3	31.8	7.5	84.5	7.8	4.3				
		AVE	9.6	13.1	31.2	7.7	89.4	7.9	4.3	4.4	5.1	1.4	0.5
		MAX	21.1	18.2	31.8	8.5	104.6	8.1	18.2	8.2	7.9	2.4	0.9
		MIN	0.0	10.1	29.3	7.1	80.2	7.8	1.4	1.4	2.1	0.0	0.1
		STDEV	6.8	2.4	0.7	0.3	7.2	0.1	2.8	2.7	2.6	0.8	0.3

**Appendix A**

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
NM1	8/24/2001	6:46:17	0.0	16.9	31.1	8.4	104.7	7.9	8.4	0.24	4.28	0.00	0.92
NM1	8/24/2001	6:45:53	1.1	16.3	31.3	8.2	101.3	7.9	8.2				
NM1	8/24/2001	6:44:09	2.1	15.0	31.4	8.0	96.3	7.9	7.7	0.09	6.38	0.00	1.12
NM1	8/24/2001	6:43:49	4.0	14.3	31.3	8.0	94.5	7.9	7.3				
NM1	8/24/2001	6:43:29	6.2	14.0	31.3	7.9	92.8	7.9	6.3				
NM1	8/24/2001	6:42:57	8.0	12.9	31.5	7.8	90.2	7.9	4.2				
NM1	8/24/2001	6:41:17	10.3	12.6	31.5	7.8	89.5	7.9	4.0	0.42	7.16	1.14	1.10
NM1	8/24/2001	6:40:49	12.1	12.0	31.6	7.9	89.2	7.9	3.5				
NM1	8/24/2001	6:40:29	14.0	11.5	31.6	7.9	88.8	7.9	3.4				
NM1	8/24/2001	6:39:53	16.1	11.5	31.5	7.9	88.7	7.9	2.6				
NM1	8/24/2001	6:39:17	17.9	11.4	31.6	7.9	88.7	7.9	3.0				
NM1	8/24/2001	6:38:57	19.9	11.4	31.6	7.9	88.5	7.9	2.6				
NM1	8/24/2001	6:38:41	21.9	11.4	31.6	7.9	88.6	7.9	2.8	1.35	6.91	1.13	1.09
NM1	9/6/2001	6:42:49	0.2	14.3	31.5	8.3	97.9	7.9	7.5	0.55	3.27	0.00	0.73
NM1	9/6/2001	6:44:13	1.2	14.0	31.6	8.2	96.7	7.9	7.9				
NM1	9/6/2001	6:45:25	2.1	13.7	31.6	8.1	95.2	7.9	7.1	1.00	3.92	0.00	0.86
NM1	9/6/2001	6:54:41	4.1	12.6	31.6	7.7	88.5	7.9	5.6				
NM1	9/6/2001	6:54:01	6.1	12.0	31.7	7.6	86.1	7.9	4.8				
NM1	9/6/2001	6:51:49	8.1	10.8	31.8	7.5	83.1	7.9	3.6				
NM1	9/6/2001	6:50:41	10.0	10.6	31.8	7.5	82.6	7.9	3.1				
NM1	9/6/2001	6:50:21	12.0	10.5	31.8	7.5	82.4	7.9	3.1				
NM1	9/6/2001	6:49:33	14.1	10.1	31.9	7.6	82.3	7.9	2.1				
NM1	9/6/2001	6:49:01	15.3	10.1	31.9	7.6	82.3	7.9	2.1	4.83	9.13	1.24	1.27
NM1	9/20/2001	6:34:40	0.2	14.6	30.7	9.2	109.7	8.0	5.6	0.04	0.19	0.00	0.53
NM1	9/20/2001	6:39:52	1.1	14.6	30.7	9.1	108.4	8.0	6.0				
NM1	9/20/2001	6:40:56	2.1	14.5	30.9	9.0	107.2	8.0	5.9				
NM1	9/20/2001	7:00:04	4.0	14.5	31.0	8.9	105.1	8.0	6.3				
NM1	9/20/2001	6:56:24	6.1	14.4	31.2	8.6	101.4	8.0	7.3	0.04	1.27	0.00	0.67
NM1	9/20/2001	6:55:20	8.0	14.1	31.5	8.3	97.4	8.0	7.7				
NM1	9/20/2001	6:52:00	10.0	13.7	31.6	7.9	92.8	7.9	6.4	0.76	3.76	0.00	0.88
NM1	9/20/2001	6:50:32	11.7	13.2	31.7	7.6	88.4	7.9	5.5				
NM1	9/20/2001	6:48:48	14.2	13.0	31.7	7.6	87.6	7.9	5.3				
NM1	9/20/2001	6:47:56	15.8	12.9	31.7	7.6	87.3	7.9	5.4				
NM1	9/20/2001	6:45:12	17.8	12.9	31.7	7.6	87.4	7.9	5.6	1.62	5.79	1.01	1.02
	AVE		8.8	13.0	31.5	8.0	92.7	7.9	5.2	1.2	5.0	0.4	0.9
	MAX		21.9	16.9	31.9	9.2	109.7	8.0	8.4	4.8	9.1	1.2	1.3
	MIN		0.0	10.1	30.7	7.5	82.3	7.9	2.1	0.0	0.2	0.0	0.5
	STDEV		6.4	1.7	0.3	0.5	7.9	0.0	2.0	1.5	2.7	0.6	0.2

**Appendix A**

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
NM2a	8/20/2004	7:19:54	0.0	18.6	30.2	7.6	96.8	8.0	5.3	2.24	6.62	1.64	0.13
NM2a	8/20/2004	7:20:38	1.0	18.4	30.2	7.6	97.0	8.0	5.7				
NM2a	8/20/2004	7:21:10	2.1	18.2	30.2	7.7	98.4	8.0	5.4				
NM2a	8/20/2004	7:21:38	4.0	17.8	30.2	7.9	99.0	8.0	5.1				
NM2a	8/20/2004	7:22:02	6.0	17.4	30.2	7.9	98.8	8.0	5.1				
NM2a	8/20/2004	7:22:22	8.0	17.1	30.2	7.9	98.2	8.0	5.5				
NM2a	8/20/2004	7:22:58	10.1	16.8	30.3	7.9	97.9	8.0	4.7	2.41	4.91	2.03	0.34
NM2a	9/3/2004	7:33:38	0.2	15.8	31.0	8.5	103.3	8.0	4.2	2.51	5.58	1.18	0.36
NM2a	9/3/2004	7:33:54	1.1	15.8	31.0	8.5	103.1	8.0	3.6				
NM2a	9/3/2004	7:34:06	2.1	15.7	31.0	8.5	103.0	8.0	5.1				
NM2a	9/3/2004	7:34:26	4.1	15.5	31.1	8.5	103.0	8.0	5.4				
NM2a	9/3/2004	7:34:46	6.2	15.5	31.1	8.5	102.3	8.0	5.4				
NM2a	9/3/2004	7:35:30	8.1	15.4	31.1	8.3	100.5	8.0	4.9				
NM2a	9/3/2004	7:35:54	8.8	15.3	31.1	8.3	99.8	8.0	5.5	3.79	4.90	5.22	0.20
NM2a	9/19/2004	8:00:31	0.0	14.1	29.6	7.9	92.1	7.9	6.8	1.27	8.01	0.00	0.57
NM2a	9/19/2004	8:01:19	1.0	14.2	30.0	7.8	91.0	7.9	8.6				
NM2a	9/19/2004	8:01:41	2.0	14.2	30.7	7.7	90.5	7.9	8.7				
NM2a	9/19/2004	8:02:09	4.0	13.7	30.9	7.6	88.7	7.9	7.4				
NM2a	9/19/2004	8:02:36	6.1	13.4	31.0	7.5	86.9	7.9	6.6				
NM2a	9/19/2004	8:03:06	8.0	13.0	31.2	7.4	85.6	7.9	6.4				
NM2a	9/19/2004	8:03:40	10.0	12.8	31.3	7.5	85.5	7.9	5.2				
NM2a	9/19/2004	8:04:12	12.0	12.7	31.3	7.4	85.1	7.9	5.7				
NM2a	9/19/2004	8:04:44	12.8	12.7	31.3	7.3	84.1	7.8	6.4	0.50	6.60	2.07	0.46
		AVE	5.1	15.4	30.7	7.9	95.2	7.9	5.8	2.1	6.1	2.0	0.3
		MAX	12.8	18.6	31.3	8.5	103.3	8.0	8.7	3.8	8.0	5.2	0.6
		MIN	0.0	12.7	29.6	7.3	84.1	7.8	3.6	0.5	4.9	0.0	0.1
		STDEV	4.0	1.9	0.5	0.4	6.7	0.0	1.2	1.1	1.2	1.7	0.2

Appendix A

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
NM2a	8/24/2001	7:43:51	0.1	17.4	31.3	8.4	106.1	8.0	9.5	1.70	8.20	0.00	0.89
NM2a	8/24/2001	7:43:19	1.2	16.7	31.2	8.3	103.3	7.9	10.2				
NM2a	8/24/2001	7:42:47	2.1	16.3	31.3	8.4	103.3	7.9	12.5	0.09	7.85	0.00	0.68
NM2a	8/24/2001	7:41:59	4.1	16.1	31.2	8.5	103.9	7.9	10.7				
NM2a	8/24/2001	7:41:35	6.2	16.1	31.2	8.4	103.2	7.9	11.0				
NM2a	8/24/2001	7:40:55	8.2	16.0	31.2	8.3	101.5	7.9	10.9				
NM2a	8/24/2001	7:40:27	10.1	15.9	31.2	8.2	100.4	7.9	10.2				
NM2a	8/24/2001	7:40:07	11.4	15.8	31.2	8.2	100.2	7.9	9.3	0.09	8.00	0.00	0.82
NM2a	9/6/2001	7:24:24	0.3	15.6	31.4	8.3	100.6	8.0	0.7	0.04	1.52	0.00	0.83
NM2a	9/6/2001	7:24:40	1.2	15.5	31.4	8.3	100.5	8.0	6.0				
NM2a	9/6/2001	7:26:24	2.3	14.9	31.5	8.0	95.7	8.0	9.8	0.32	3.01	0.00	0.82
NM2a	9/6/2001	7:32:36	4.2	14.1	31.5	7.5	89.0	7.9	7.8				
NM2a	9/6/2001	7:30:28	6.1	13.9	31.6	7.5	87.8	7.9	6.9	1.39	4.75	0.10	0.82
NM2a	9/6/2001	7:29:40	8.3	12.4	31.7	7.6	86.7	7.9	4.9				
NM2a	9/6/2001	7:28:44	9.2	12.3	31.7	7.6	86.9	7.9	4.7	2.89	7.07	0.94	0.97
NM2a	9/20/2001	7:31:16	0.3	14.2	31.7	8.1	95.4	8.0	6.9	0.08	3.22	0.00	0.72
NM2a	9/20/2001	7:33:40	1.2	14.2	31.7	7.9	94.1	8.0	7.6				
NM2a	9/20/2001	7:34:24	2.1	14.2	31.7	7.9	94.2	8.0	7.9				
NM2a	9/20/2001	7:41:12	4.0	14.2	31.7	7.9	93.8	8.0	7.7				
NM2a	9/20/2001	7:40:28	6.1	14.2	31.7	7.9	93.7	8.0	7.7				
NM2a	9/20/2001	7:39:44	8.1	14.2	31.7	7.9	93.8	8.0	9.6				
NM2a	9/20/2001	7:38:40	10.1	14.2	31.7	7.9	93.9	8.0	7.9				
NM2a	9/20/2001	7:35:40	11.1	14.2	31.7	8.0	94.7	8.0	7.4	0.04	3.19	0.00	0.69
		AVE	5.1	14.9	31.5	8.0	96.6	8.0	8.2	0.7	5.2	0.1	0.8
		MAX	11.4	17.4	31.7	8.5	106.1	8.0	12.5	2.9	8.2	0.9	1.0
		MIN	0.1	12.3	31.2	7.5	86.7	7.9	0.7	0.0	1.5	0.0	0.7
		STDEV	3.8	1.3	0.2	0.3	5.8	0.0	2.6	1.0	2.6	0.3	0.1

Appendix A

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
NM5	8/20/2004	7:51:36	0.1	20.0	30.7	7.0	92.8	7.8	8.8	2.54	14.65	3.39	0.58
NM5	8/20/2004	7:51:52	1.1	20.0	30.7	7.0	92.6	7.8	8.6				
NM5	8/20/2004	7:52:04	2.0	20.0	30.7	7.0	92.3	7.8	8.1				
NM5	8/20/2004	7:52:32	4.0	19.9	30.7	7.0	91.5	7.8	9.5				
NM5	8/20/2004	7:52:48	6.0	19.9	30.7	6.9	91.2	7.8	9.4				
NM5	8/20/2004	7:53:44	7.1	19.8	30.8	6.9	90.2	7.8	15.2	2.89	10.35	4.53	0.50
NM5	9/3/2004	8:06:15	0.1	18.0	30.8	7.7	97.9	7.9	2.7	2.98	11.52	2.35	0.27
NM5	9/3/2004	8:06:39	1.1	18.0	30.8	7.7	97.5	7.9	3.8				
NM5	9/3/2004	8:06:59	2.1	17.9	30.8	7.7	97.1	7.9	6.7				
NM5	9/3/2004	8:07:15	4.1	17.6	30.8	7.7	96.5	7.9	6.9				
NM5	9/3/2004	8:07:39	6.1	17.4	30.9	7.6	95.9	7.9	6.0				
NM5	9/3/2004	8:08:07	6.9	17.2	30.9	7.6	95.2	7.9	6.3	3.30	9.99	2.48	0.41
NM5	9/19/2004	8:44:08	0.0	15.5	30.3	7.4	89.5	7.9	5.3	1.78	10.99	1.87	1.05
NM5	9/19/2004	8:45:20	1.1	15.4	30.4	7.4	89.1	7.9	5.8				
NM5	9/19/2004	8:46:00	2.1	15.2	30.4	7.4	88.9	7.9	6.5				
NM5	9/19/2004	8:46:56	4.0	14.6	30.8	7.3	87.0	7.9	5.3				
NM5	9/19/2004	8:52:16	6.0	13.8	31.2	7.2	84.5	7.8	5.7				
NM5	9/19/2004	8:52:52	7.1	13.3	31.4	7.2	83.8	7.8	5.3	0.70	11.54	2.01	1.22
		AVE	3.4	17.4	30.8	7.3	91.9	7.9	7.0	2.4	11.5	2.8	0.7
		MAX	7.1	20.0	31.4	7.7	97.9	7.9	15.2	3.3	14.7	4.5	1.2
		MIN	0.0	13.3	30.3	6.9	83.8	7.8	2.7	0.7	10.0	1.9	0.3
		STDEV	2.6	2.3	0.2	0.3	4.3	0.0	2.8	1.0	1.7	1.0	0.4
NM5	8/24/2001	8:35:08	0.1	19.5	31.3	7.3	95.3	7.8	14.7	0.86	14.52	0.18	1.33
NM5	8/24/2001	8:34:36	1.3	19.4	31.3	7.3	95.0	7.8	14.8				
NM5	8/24/2001	8:33:24	2.2	19.4	31.3	7.3	95.0	7.8	14.8				
NM5	8/24/2001	8:32:40	4.0	19.2	31.3	7.3	95.2	7.8	14.9				
NM5	8/24/2001	8:31:20	5.4	19.2	31.3	7.4	96.4	7.9	15.3	0.10	17.34	0.00	1.00
NM5	9/6/2001	8:06:50	0.3	17.2	31.2	7.8	97.3	7.9	11.1	0.04	8.95	0.00	0.91
NM5	9/6/2001	8:11:10	1.2	17.1	31.2	7.6	94.6	7.9	15.8				
NM5	9/6/2001	8:10:38	2.2	16.9	31.2	7.5	93.1	7.9	12.2				
NM5	9/6/2001	8:09:38	4.1	16.2	31.3	7.4	90.7	7.9	10.4				
NM5	9/6/2001	8:08:46	6.2	14.8	31.5	7.4	88.7	7.9	8.7	1.01	7.25	0.97	1.29
NM5	9/20/2001	8:21:55	0.3	16.3	31.8	7.2	89.0	7.9	7.2	0.33	7.79	2.67	1.15
NM5	9/20/2001	8:24:07	1.0	16.2	31.8	7.1	88.0	7.9	7.5				
NM5	9/20/2001	8:24:35	2.1	16.2	31.8	7.1	87.9	7.9	7.7				
NM5	9/20/2001	8:27:51	4.2	16.2	31.8	7.1	87.3	7.9	8.1				
NM5	9/20/2001	8:25:39	5.7	16.2	31.8	7.1	87.3	7.9	7.8	0.34	7.79	2.87	1.27
		AVE	2.7	17.3	31.4	7.3	92.1	7.9	11.4	0.4	10.6	1.1	1.2
		MAX	6.2	19.5	31.8	7.8	97.3	7.9	15.8	1.0	17.3	2.9	1.3
		MIN	0.1	14.8	31.2	7.1	87.3	7.8	7.2	0.0	7.3	0.0	0.9
		STDEV	2.1	1.6	0.3	0.2	3.7	0.0	3.4	0.4	4.3	1.3	0.2

**Appendix A**

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO%	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
NM6	8/20/2004	8:26:30	0.1	21.9	30.1	7.0	95.7	7.8	11.6	2.74	41.39	3.29	0.53
NM6	8/20/2004	8:27:46	1.0	21.7	30.2	6.9	93.2	7.8	11.9				
NM6	8/20/2004	8:28:38	1.6	21.5	30.3	6.8	91.9	7.8	12.4	2.87	31.31	3.45	1.04
NM6	9/3/2004	8:40:18	0.2	21.0	29.5	8.1	108.3	8.1	6.3	3.22	31.62	2.06	0.32
NM6	9/3/2004	8:41:30	0.7	20.9	29.6	7.9	105.2	8.0	6.6	3.67	33.36	3.11	0.00
NM6	9/19/2004	9:20:02	0.0	17.5	29.0	7.3	91.3	7.7	4.3	0.93	22.73	4.05	1.49
NM6	9/19/2004	9:20:46	1.0	17.6	29.1	7.1	88.5	7.7	4.9				
NM6	9/19/2004	9:21:54	1.4	17.6	29.3	6.7	83.3	7.8	5.3	1.28	27.13	3.17	1.74
		AVE	0.8	19.9	29.6	7.2	94.7	7.8	7.9	2.5	31.3	3.2	0.9
		MAX	1.6	21.9	30.3	8.1	108.3	8.1	12.4	3.7	41.4	4.1	1.7
		MIN	0.0	17.5	29.0	6.7	83.3	7.7	4.3	0.9	22.7	2.1	0.0
		STDEV	0.6	2.0	0.5	0.5	8.3	0.1	3.4	1.1	6.3	0.6	0.7
NM6	8/24/2001	9:05:20	0.1	22.4	31.2	6.6	90.7	7.7	10.2	0.85	36.00	6.29	3.69
NM6	8/24/2001	9:03:56	0.8	22.3	31.3	6.6	90.9	7.7	10.6	0.09	36.10	6.54	3.68
NM6	9/6/2001	8:46:48	0.3	19.8	31.1	6.9	91.2	8.0	4.0	0.18	34.60	0.85	2.91
NM6	9/6/2001	8:49:00	1.2	19.7	31.1	6.9	90.7	8.0	21.3	0.20	35.50	0.60	2.69
NM6	9/20/2001	9:00:51	0.3	18.1	31.8	7.4	94.1	7.9	7.0	0.88	39.50	28.00	3.92
NM6	9/20/2001	9:03:47	1.0	18.1	31.9	7.3	94.1	7.8	6.7	0.90	40.10	17.40	4.18
		AVE	0.6	20.1	31.4	6.9	92.0	7.8	10.0	0.5	37.0	9.9	3.5
		MAX	1.2	22.4	31.9	7.4	94.1	8.0	21.3	0.9	40.1	28.0	4.2
		MIN	0.1	18.1	31.1	6.6	90.7	7.7	4.0	0.1	34.6	0.6	2.7
		STDEV	0.4	1.9	0.4	0.3	1.7	0.1	6.1	0.4	2.3	10.7	0.6



**Appendix A**

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH) <sub>4</sub> (uM)	NH4 (uM)	PO4 (uM)
QB2	8/20/2004	6:43:16	0.5	19.2	30.0	8.2	106.4	8.0	3.8	1.04	3.24	0.76	0.41
QB2	8/20/2004	6:44:52	0.9	19.2	30.0	8.2	106.2	8.0	3.8				
QB2	8/20/2004	6:45:40	2.0	19.2	30.0	8.2	106.5	8.0	4.3				
QB2	8/20/2004	6:46:28	4.0	19.0	30.0	8.3	106.7	8.1	4.4				
QB2	8/20/2004	6:47:20	6.1	18.8	30.1	8.1	103.9	8.0	4.8				
QB2	8/20/2004	6:48:48	8.0	17.3	30.5	6.9	85.7	7.9	3.7				
QB2	8/20/2004	6:50:08	10.0	14.2	31.1	6.4	75.8	7.8	1.6				
QB2	8/20/2004	6:51:56	12.0	12.2	31.4	6.3	71.9	7.8	1.5				
QB2	8/20/2004	6:52:40	14.0	12.1	31.4	6.3	71.5	7.8	0.4				
QB2	8/20/2004	6:53:32	16.1	11.9	31.4	6.3	71.2	7.8	1.0	2.25	12.95	6.07	1.08
QB2	9/3/2004	6:46:06	0.1	17.7	30.5	8.8	111.1	8.2	4.4	3.26	3.40	0.95	0.00
QB2	9/3/2004	6:47:34	1.0	17.4	30.6	8.8	110.8	8.1	3.7				
QB2	9/3/2004	6:49:06	2.0	16.7	30.7	8.7	108.1	8.1	4.2				
QB2	9/3/2004	6:50:30	4.0	16.6	30.7	8.6	106.1	8.1	3.9				
QB2	9/3/2004	6:52:14	6.0	16.4	30.7	8.1	100.2	8.1	4.5				
QB2	9/3/2004	6:54:54	8.0	16.1	30.8	7.6	93.0	8.0	5.9				
QB2	9/3/2004	6:56:14	10.0	15.2	30.9	7.1	85.7	7.9	4.7				
QB2	9/3/2004	6:57:30	12.0	14.5	31.0	6.6	78.6	7.9	5.7				
QB2	9/3/2004	6:59:22	14.0	14.1	31.0	6.1	72.0	7.9	6.6				
QB2	9/3/2004	7:01:10	16.0	13.6	31.1	6.1	70.7	7.8	6.2				
QB2	9/3/2004	7:03:06	18.0	12.9	31.2	6.2	71.6	7.9	4.4				
QB2	9/3/2004	7:06:10	18.3	12.8	31.2	6.3	72.3	7.9	3.9	3.94	10.57	4.58	0.52
QB2	9/19/2004	6:52:33	0.4	14.2	30.6	7.6	89.0	7.8	5.0	0.04	1.60	1.17	0.90
QB2	9/19/2004	6:54:46	1.0	14.2	30.6	7.6	89.1	7.8	4.9				
QB2	9/19/2004	6:56:00	2.0	14.3	30.6	7.6	89.0	7.8	4.0				
QB2	9/19/2004	6:56:43	4.1	13.9	30.8	7.4	86.2	7.8	4.3				
QB2	9/19/2004	6:57:23	6.0	13.7	30.9	7.2	83.7	7.8	4.1				
QB2	9/19/2004	6:58:20	8.1	13.5	31.0	7.0	81.7	7.8	2.9				
QB2	9/19/2004	6:59:19	10.1	13.5	31.1	6.9	80.3	7.8	3.8				
QB2	9/19/2004	7:00:17	12.0	12.8	31.3	6.6	75.7	7.7	2.7				
QB2	9/19/2004	7:01:52	12.9	12.5	31.4	6.4	72.8	7.7	3.4	0.38	3.00	3.54	1.10
		AVE	7.7	15.1	30.8	7.3	88.2	7.9	4.0	1.8	5.8	2.8	0.7
		MAX	18.3	19.2	31.4	8.8	111.1	8.2	6.6	3.9	13.0	6.1	1.1
		MIN	0.1	11.9	30.0	6.1	70.7	7.7	0.4	0.0	1.6	0.8	0.0
		STDEV	5.7	2.4	0.4	0.9	14.4	0.1	1.4	1.6	4.7	2.2	0.4

Appendix A

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
QB2	8/24/2001	6:53:53	0.1	19.2	31.3	8.2	106.9	7.9	3.2	0.09	2.03	0.00	0.44
QB2	8/24/2001	6:55:53	1.1	19.1	31.3	8.2	106.6	7.9	3.5				
QB2	8/24/2001	6:57:05	2.0	19.0	31.3	8.2	106.0	7.9	3.6				
QB2	8/24/2001	6:58:37	4.0	18.5	31.3	8.0	103.3	7.9	4.2				
QB2	8/24/2001	7:00:37	6.0	18.0	31.3	7.8	98.9	7.9	4.6				
QB2	8/24/2001	7:02:37	8.0	16.4	31.4	7.6	93.5	7.8	3.9	0.34	5.91	0.00	0.74
QB2	8/24/2001	7:05:29	10.1	14.9	31.5	7.2	86.7	7.8	3.2	0.56	6.98	0.36	0.83
QB2	8/24/2001	7:09:29	11.9	13.6	31.5	6.7	78.2	7.7	11.3	0.98	8.42	1.91	0.94
QB2	9/6/2001	6:58:04	0.1	16.5	31.6	8.1	99.8	7.9	3.8	0.04	0.61	0.00	0.65
QB2	9/6/2001	6:59:56	1.1	16.5	31.6	8.1	99.9	7.9	3.7				
QB2	9/6/2001	7:00:40	2.1	16.4	31.6	8.0	99.2	7.9	4.1				
QB2	9/6/2001	7:01:32	4.0	14.9	31.7	7.8	93.9	7.9	3.7	0.60	3.41	0.00	0.75
QB2	9/6/2001	7:03:28	6.0	14.1	31.7	7.5	89.1	7.8	3.8				
QB2	9/6/2001	7:04:28	8.0	13.6	31.8	7.5	87.3	7.8	4.2				
QB2	9/6/2001	7:07:28	10.0	12.5	31.8	7.0	80.4	7.8	3.5	2.33	8.00	2.70	1.02
QB2	9/6/2001	7:08:36	12.1	11.7	31.9	6.9	77.8	7.7	3.2				
QB2	9/6/2001	7:09:36	14.2	11.3	31.9	6.8	75.5	7.7	2.8				
QB2	9/6/2001	7:11:04	16.1	11.2	31.9	6.6	73.9	7.7	2.7				
QB2	9/6/2001	7:12:40	18.0	11.2	31.9	6.6	73.0	7.7	21.5	3.44	10.63	3.62	1.37
QB2	9/20/2001	6:50:02	0.1	15.4	31.9	7.9	95.9	7.9	5.1	0.04	2.50	0.00	0.93
QB2	9/20/2001	6:51:26	1.0	15.4	31.9	7.9	95.8	7.9	5.6				
QB2	9/20/2001	6:52:18	2.1	15.3	31.9	7.9	95.7	7.9	5.4				
QB2	9/20/2001	6:53:10	4.1	15.3	31.9	7.8	95.1	7.9	5.9				
QB2	9/20/2001	6:53:58	6.1	15.2	31.9	7.8	94.1	7.9	6.0				
QB2	9/20/2001	6:55:30	8.0	15.1	31.9	7.6	92.0	7.9	5.6				
QB2	9/20/2001	6:56:34	10.0	15.0	31.9	7.5	90.5	7.9	5.7				
QB2	9/20/2001	6:57:46	12.1	14.9	31.9	7.4	89.4	7.9	5.6				
QB2	9/20/2001	6:58:58	14.1	14.7	31.9	7.2	86.2	7.8	5.3				
QB2	9/20/2001	7:00:14	16.1	14.5	31.9	7.0	83.8	7.8	5.3				
QB2	9/20/2001	7:03:02	17.2	14.5	31.9	6.9	82.2	7.8	7.4	0.63	5.71	1.87	1.13
		AVE	7.5	15.1	31.7	7.5	91.0	7.8	5.2	0.9	5.4	1.0	0.9
		MAX	18.0	19.2	31.9	8.2	106.9	7.9	21.5	3.4	10.6	3.6	1.4
		MIN	0.1	11.2	31.3	6.6	73.0	7.7	2.7	0.0	0.6	0.0	0.4
		STDEV	5.7	2.2	0.2	0.5	9.8	0.1	3.5	1.1	3.2	1.4	0.3

**Appendix A**

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
QB4	8/20/2004	7:15:55	0.4	19.5	30.0	8.2	106.3	8.1	5.3	1.07	3.09	0.81	0.54
QB4	8/20/2004	7:18:39	1.0	19.5	30.0	8.1	105.9	8.1	5.3				
QB4	8/20/2004	7:19:15	2.1	19.5	30.0	8.1	105.8	8.1	5.7				
QB4	8/20/2004	7:19:51	4.0	19.4	30.0	8.1	105.1	8.1	4.7				
QB4	8/20/2004	7:21:15	4.6	19.4	30.0	8.0	103.8	8.2	5.1	1.02	3.22	1.08	0.56
QB4	9/3/2004	7:30:02	0.1	18.1	30.5	8.9	113.0	8.2	4.6	3.10	3.52	1.28	0.00
QB4	9/3/2004	7:31:26	1.0	17.4	30.7	8.7	109.4	8.1	6.0				
QB4	9/3/2004	7:32:10	2.0	17.4	30.6	8.7	108.8	8.1	5.4				
QB4	9/3/2004	7:33:22	4.0	16.5	30.8	8.3	102.3	8.1	5.7				
QB4	9/3/2004	7:35:10	4.8	15.5	30.9	6.1	73.4	7.9	5.7	3.37	8.44	5.76	0.28
QB4	9/19/2004	7:32:04	0.1	14.5	30.2	7.9	93.1	7.9	4.2	1.89	0.84	0.00	0.59
QB4	9/19/2004	7:34:15	1.0	14.6	30.2	7.5	89.0	7.9	5.6				
QB4	9/19/2004	7:34:38	2.1	14.4	30.5	7.5	88.4	7.8	6.4				
QB4	9/19/2004	7:35:43	4.0	13.7	31.1	6.7	77.9	7.7	3.6				
QB4	9/19/2004	7:36:38	5.0	13.1	31.3	6.2	71.2	7.7	4.0	2.74	5.31	7.18	1.23
		AVE	2.4	16.8	30.5	7.8	96.9	8.0	5.2	2.2	4.1	2.7	0.5
		MAX	5.0	19.5	31.3	8.9	113.0	8.2	6.4	3.4	8.4	7.2	1.2
		MIN	0.1	13.1	30.0	6.1	71.2	7.7	3.6	1.0	0.8	0.0	0.0
		STDEV	1.8	2.4	0.4	0.9	13.8	0.2	0.8	1.0	2.6	3.0	0.4
QB4	8/24/2001	7:58:51	0.1	19.8	31.3	8.1	107.1	8.0	4.4	0.09	1.68	0.00	0.53
QB4	8/24/2001	8:01:11	1.0	19.8	31.3	8.1	106.7	8.0	4.5				
QB4	8/24/2001	8:02:35	2.1	19.7	31.3	8.1	106.7	8.0	4.8				
QB4	8/24/2001	8:03:47	4.1	17.8	31.3	7.3	92.3	7.9	4.7				
QB4	8/24/2001	8:05:23	4.8	16.4	31.4	6.7	82.9	7.8	6.0	0.09	6.14	0.00	0.86
QB4	9/6/2001	7:52:44	0.1	16.7	31.5	8.2	101.5	7.9	4.5	0.04	0.35	0.00	0.75
QB4	9/6/2001	7:55:12	1.1	16.0	31.6	7.7	95.1	7.9	4.8				
QB4	9/6/2001	7:56:20	2.0	15.4	31.6	7.6	92.3	7.9	6.6				
QB4	9/6/2001	7:58:52	4.0	12.6	31.8	6.5	74.3	7.7	4.7	1.97	8.14	1.48	1.10
QB4	9/6/2001	8:05:40	4.6	12.4	31.8	6.2	70.7	7.7	8.7	2.41	9.05	3.11	1.39
QB4	9/20/2001	7:41:57	0.0	15.4	31.9	7.8	94.7	7.9	5.2	0.04	2.41	0.00	0.98
QB4	9/20/2001	7:42:37	1.0	15.4	31.9	7.8	94.6	7.9	5.5				
QB4	9/20/2001	7:43:17	2.0	15.3	31.9	7.8	94.1	7.9	6.0	0.04	3.10	0.00	0.93
QB4	9/20/2001	7:44:33	4.1	15.2	31.9	7.6	92.3	7.9	6.1	0.7	4.4	0.7	0.9
		AVE	2.2	16.3	31.6	7.5	93.2	7.9	5.5	2.4	9.1	3.1	1.4
		MAX	4.8	19.8	31.9	8.2	107.1	8.0	8.7	0.0	0.4	0.0	0.5
		MIN	0.0	12.4	31.3	6.2	70.7	7.7	4.4	1.0	3.4	1.2	0.3
		STDEV	1.8	2.4	0.3	0.6	11.1	0.1	1.2				

**Appendix A**

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
QB5	8/20/2004	7:35:42	0.4	20.0	30.1	8.0	105.4	8.1	4.9	1.04	2.62	0.90	0.47
QB5	8/20/2004	7:36:22	0.8	20.0	30.1	8.0	105.6	8.1	5.9				
QB5	8/20/2004	7:36:58	2.1	20.0	30.1	8.1	105.8	8.1	5.2				
QB5	8/20/2004	7:38:14	3.3	19.7	30.1	8.1	105.5	8.1	5.2	1.12	3.07	1.03	0.50
QB5	9/3/2004	7:59:02	0.0	18.3	30.5	9.0	115.2	8.2	3.7	3.59	3.12	0.95	0.00
QB5	9/3/2004	8:00:14	1.0	18.2	30.5	8.9	113.9	8.2	6.7				
QB5	9/3/2004	8:01:34	2.0	17.9	30.7	8.5	107.0	8.1	7.6				
QB5	9/3/2004	8:04:18	3.8	15.4	30.9	4.9	59.7	7.8	8.1				
QB5	9/3/2004	8:06:02	4.0	15.1	30.9	4.8	57.3	7.7	25.8	3.08	8.99	0.71	0.00
QB5	9/19/2004	7:57:51	0.1	14.2	30.5	7.6	88.9	7.8	4.8	2.34	2.29	2.48	0.93
QB5	9/19/2004	8:00:19	1.0	14.3	30.6	6.6	77.6	7.8	4.0				
QB5	9/19/2004	8:00:49	2.0	13.8	31.0	6.7	78.5	7.8	5.4				
QB5	9/19/2004	8:01:35	3.2	13.3	31.2	6.3	73.5	7.7	3.7	2.86	5.30	5.02	1.38
		AVE	1.8	16.9	30.6	7.3	91.8	7.9	7.0	2.3	4.2	1.8	0.5
		MAX	4.0	20.0	31.2	9.0	115.2	8.2	25.8	3.6	9.0	5.0	1.4
		MIN	0.0	13.3	30.1	4.8	57.3	7.7	3.7	1.0	2.3	0.7	0.0
		STDEV	1.4	2.6	0.4	1.4	20.3	0.2	5.8	1.1	2.6	1.7	0.5
QB5	8/24/2001	8:49:40	0.1	19.7	31.3	7.2	95.0	7.9	5.2	0.09	2.62	0.00	0.67
QB5	8/24/2001	8:50:44	1.1	19.6	31.3	7.3	95.4	7.9	6.2				
QB5	8/24/2001	8:51:44	2.0	18.1	31.3	7.5	95.5	7.9	6.1				
QB5	8/24/2001	8:53:00	3.2	17.1	31.3	6.9	86.9	7.8	6.1	0.09	4.30	0.00	0.78
QB5	9/6/2001	8:34:43	0.2	16.1	31.6	7.7	94.8	7.9	3.5	0.04	0.78	0.00	0.87
QB5	9/6/2001	8:35:35	1.0	16.0	31.6	7.7	94.2	7.9	4.7				
QB5	9/6/2001	8:36:35	2.0	14.4	31.7	7.3	86.8	7.8	7.6				
QB5	9/6/2001	8:44:03	3.8	12.6	31.8	6.3	72.0	7.7	4.7	2.00	8.58	2.00	1.44
QB5	9/20/2001	8:22:46	0.0	15.7	31.9	7.5	91.5	7.9	7.5	0.04	2.25	0.00	0.88
QB5	9/20/2001	8:24:10	1.1	15.7	31.9	7.4	90.7	7.9	8.5				
QB5	9/20/2001	8:25:14	2.0	15.7	31.9	7.4	90.1	7.9	8.3				
QB5	9/20/2001	8:28:02	3.5	15.3	31.9	5.9	71.4	7.8	8.4	0.04	3.96	0.00	1.01
		AVE	1.7	16.3	31.6	7.2	88.7	7.8	6.4	0.4	3.7	0.3	0.9
		MAX	3.8	19.7	31.9	7.7	95.5	7.9	8.5	2.0	8.6	2.0	1.4
		MIN	0.0	12.6	31.3	5.9	71.4	7.7	3.5	0.0	0.8	0.0	0.7
		STDEV	1.3	2.0	0.3	0.6	8.5	0.1	1.7	0.8	2.7	0.8	0.3

## Appendix A

Site	Date M/D/Y	Time hh:mm:ss	Depth m	Temp C	Salinity ppt	DO Conc mg/L	DO% %	pH	Chlorophyll ug/L	NO3+NO2 (uM)	Si(OH)4 (uM)	NH4 (uM)	PO4 (uM)
QB6	8/20/2004	8:01:07	0.3	20.5	30.1	7.2	95.6	8.0	6.4	1.37	3.13	1.38	0.34
QB6	8/20/2004	8:01:35	1.0	20.5	30.2	7.2	95.8	8.0	5.9				
QB6	8/20/2004	8:02:23	1.5	20.4	30.2	7.2	95.7	8.0	4.4	2.05	2.64	2.16	0.25
QB6	9/3/2004	8:25:04	0.0	18.1	30.4	7.2	91.6	8.0	8.3	3.45	5.51	1.19	0.00
QB6	9/3/2004	8:26:00	1.0	18.1	30.4	7.1	89.8	8.0	6.9				
QB6	9/3/2004	8:27:52	1.8	18.1	30.5	7.0	88.8	8.0	7.1	3.71	5.59	1.47	0.00
QB6	9/19/2004	8:28:13	0.2	14.5	30.1	6.3	73.9	7.7	2.9	2.53	4.39	2.99	0.83
QB6	9/19/2004	8:28:29	1.1	14.6	30.7	6.2	73.0	7.7	3.8				
QB6	9/19/2004	8:28:45	1.2	14.5	30.8	5.9	70.5	7.7	4.2	2.63	4.36	6.35	1.15
		AVE	0.9	17.7	30.4	6.8	86.1	7.9	5.5	2.6	4.3	2.6	0.4
		MAX	1.8	20.5	30.8	7.2	95.8	8.0	8.3	3.7	5.6	6.4	1.2
		MIN	0.0	14.5	30.1	5.9	70.5	7.7	2.9	1.4	2.6	1.2	0.0
		STDEV	0.6	2.6	0.2	0.5	10.6	0.2	1.8	0.9	1.2	2.0	0.5
QB6	8/24/2001	9:25:17	0.1	20.3	31.3	6.6	87.5	7.8	4.1	0.09	3.09	0.01	0.93
QB6	8/24/2001	9:26:17	1.0	20.1	31.3	6.5	85.6	7.8	5.2				
QB6	8/24/2001	9:28:09	2.0	18.7	31.3	5.5	71.0	7.7	7.3	0.09	4.88	0.24	1.05
QB6	9/6/2001	9:09:01	0.2	16.0	31.6	6.7	82.0	7.8	3.0	0.04	1.47	3.01	1.11
QB6	9/6/2001	9:10:57	1.1	15.9	31.6	6.5	79.8	7.8	4.5				
QB6	9/6/2001	9:12:17	2.0	13.6	31.8	6.2	72.2	7.7	5.8				
QB6	9/6/2001	9:15:33	2.9	13.4	31.7	6.0	69.5	7.7	37.8	1.46	7.99	2.29	1.34
QB6	9/20/2001	9:01:00	0.1	15.7	31.9	6.5	79.2	7.8	5.1	0.04	3.69	2.75	1.02
QB6	9/20/2001	9:02:16	1.1	15.7	31.9	6.5	78.8	7.8	7.1				
QB6	9/20/2001	9:03:24	2.0	15.7	31.9	6.5	79.1	7.8	5.2	0.04	3.90	2.89	1.07
		AVE	1.3	16.5	31.6	6.3	78.5	7.8	8.5	0.3	4.2	1.9	1.1
		MAX	2.9	20.3	31.9	6.7	87.5	7.8	37.8	1.5	8.0	3.0	1.3
		MIN	0.1	13.4	31.3	5.5	69.5	7.7	3.0	0.0	1.5	0.0	0.9
		STDEV	1.0	2.4	0.2	0.4	6.0	0.0	10.4	0.6	2.2	1.4	0.1