

# **Chemical, Physical and Biological Characterization of Devils Lake 1995-2007**

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**North Dakota Department of Health  
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Characterization of Devils Lake  
1995-2007

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### **Acknowledgements**

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## 1.0 Introduction

The Devils Lake Basin is comprised of 2.4 million acres in northeastern North Dakota (Figure 1). The watershed is located in the Northern Glaciated Plains ecoregion and is an undulating mix of integrated and nonintegrated drainage patterns. Streams within the basin are primarily intermittent. The Devils Lake chain, consisting of several bays and East Devils Lake, is located in southern Ramsey and northern Benson counties of North Dakota.

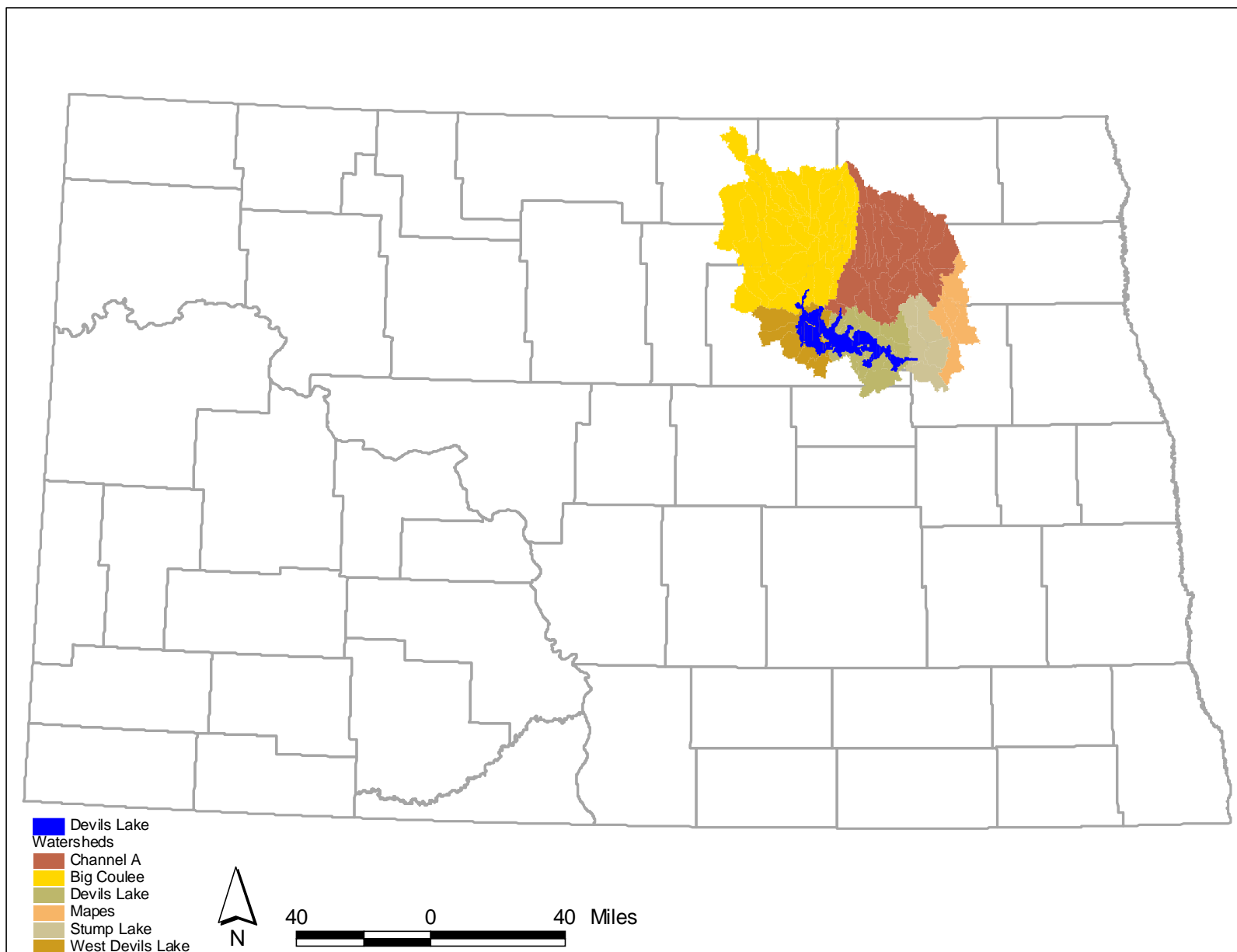
Two primary drainages within the basin are Channel A and Big Coulee (Mauvais Coulee). Channel A drains the Dry Lake, Edmore, Starkweather and Sweetwater areas, while Big Coulee drains Lake Irving, Lake Alice, Chain of Lakes and Mauvais Coulee (Figure 1). Spring runoff is the major source of water. Most runoff enters the system through West Bay (naturally) and Six Mile Bay (Channel A). According to the U.S. Geological Survey (USGS), about 80 percent of the water contributed to Devils Lake enters through these two sources (Greg Wiche, personal communication). Groundwater also contributes to the hydrologic budget. As a result, Devils Lake is susceptible to widely fluctuating lake levels.

Since water levels for Devils Lake were first recorded in 1860, there have been tremendous variations in the surface elevation (Figure 2). Currently, Devils Lake covers an area of approximately 140,000 acres. Fluctuating water levels are primarily related to the closed-basin nature of the system. The absence of a surface outlet and the fact that annual evaporation frequently exceeds annual precipitation are important causes of the high total dissolved solids (TDS) concentrations. Water level changes have also caused changes in nutrients concentrations.

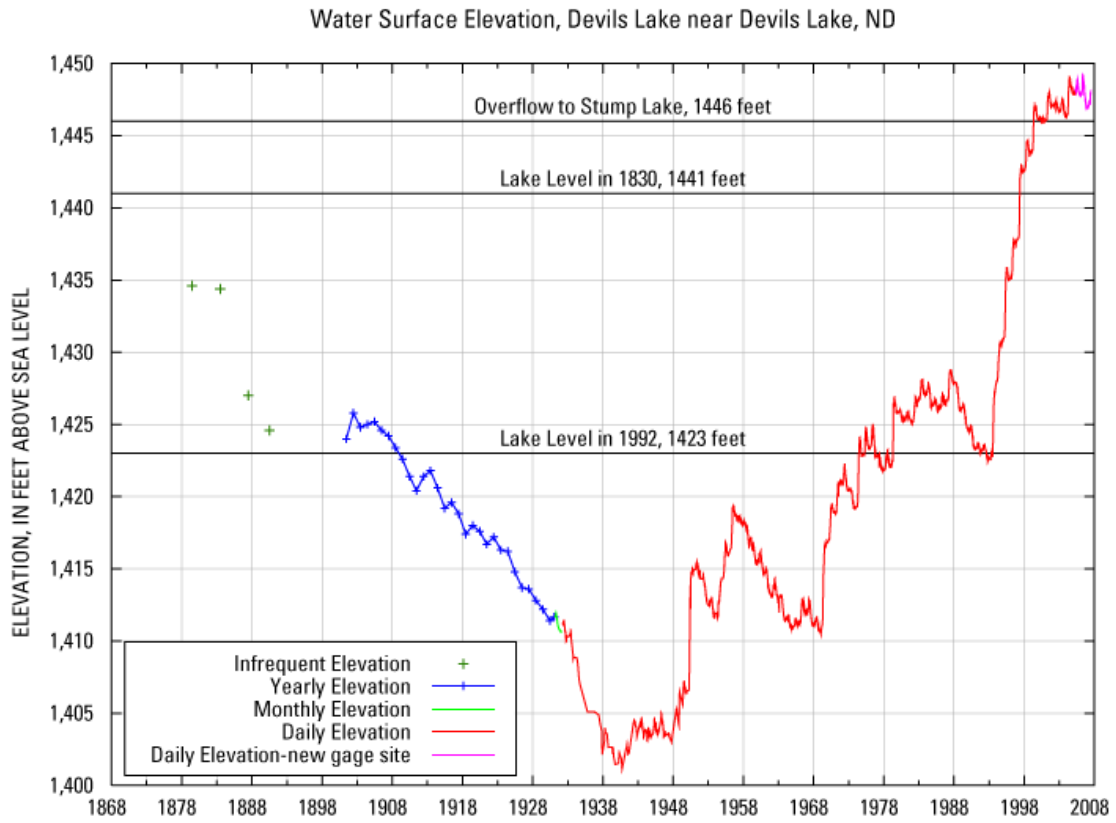
Variations of TDS and nutrient concentrations are identified as important variables affecting water quality and the aquatic community structure in Devils Lake. High concentrations of TDS affect fish reproduction, fish growth and algal blooms. Furthermore, high nutrient concentrations result in a lake classification of hypereutrophic (nutrient-rich) evidenced by low-light transparency and frequent, prolific, nuisance algal blooms. These algal blooms are dominated by cyanophyta (blue-green algae) and result in impaired water-based recreation.

## 2.0 Methods

Currently, seven sites are sampled each year across the Devils Lake chain of lakes. The sites and their locations are listed in Table 1 and shown in Figure 2. Sampling began at the Pelican Lake site in 1999 and the SW West Bay site in 1997. Sampling was initiated at the remaining five sites in 1995. Sites are typically sampled four times annually, once in each of the following months: February (under ice cover), May, August and October. In 2007, samples were collected the following days: February 20-21, May 15-16, August 21 and October 24-25. At various times in the past, there were more sites sampled and/or more frequent sampling, but this report will address only those sites currently in the Devils Lake sampling program.



**Figure 1. Major Subwatersheds Within the Devils lake Basin**



**Figure 2. Average Daily Elevation of Devils Lake at USGS Station 05056500 near Devils Lake**

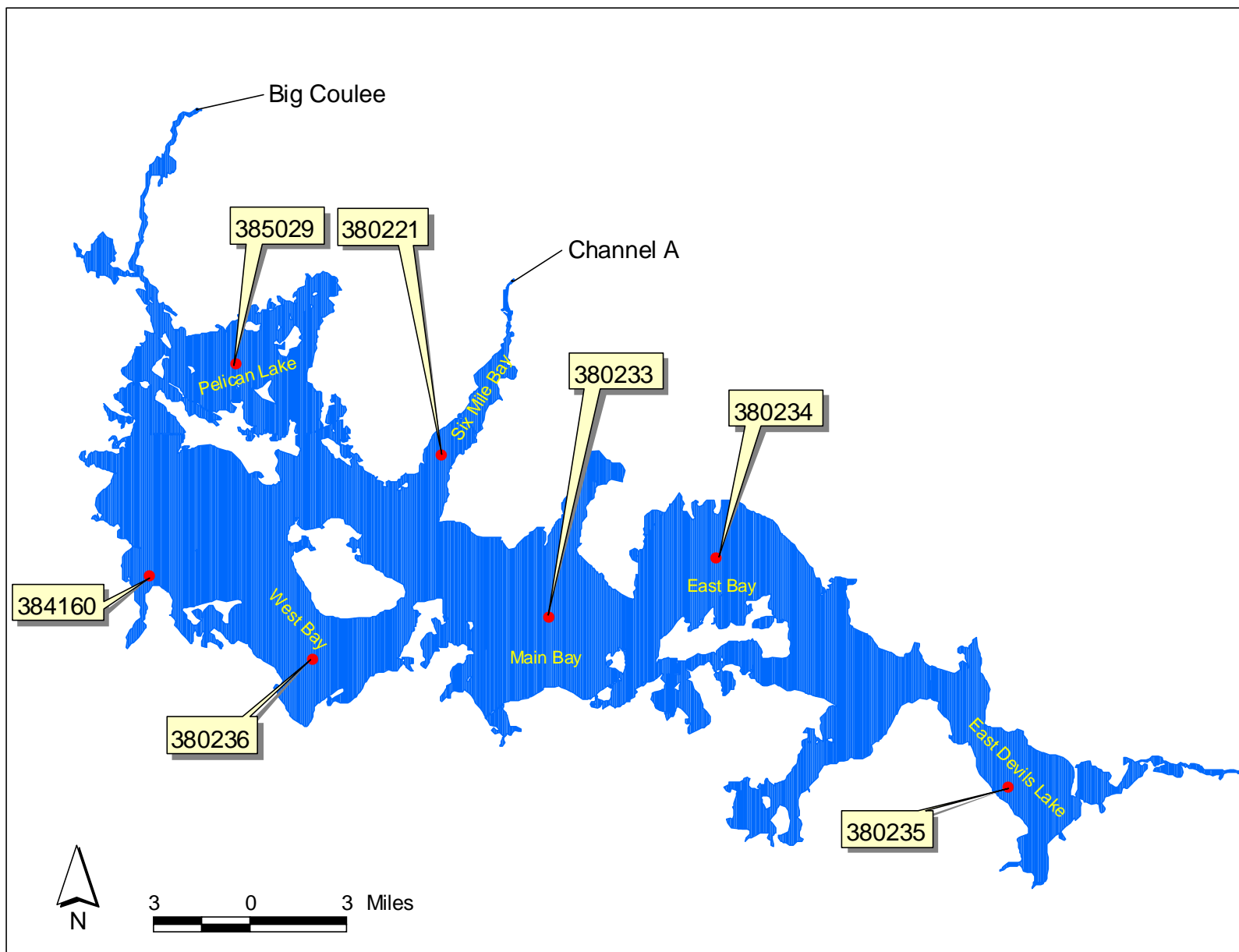


Figure 3. Devils Lake Sample Site Locations



**Table 1. Devils Lake Water Quality Monitoring Locations**

STORET ID	Site Description	Latitude	Longitude
380221	Devils Lake - Six Mile Bay	48.10530	-99.02549
380233	Devils Lake - Main Bay	48.03265	-98.95333
380234	Devils Lake - East Bay	48.05927	-98.84115
380235	East Devils Lake	47.95486	-98.64633
380236	Devils Lake - West Bay	48.01335	-99.11192
384160	Devils Lake - SW West Bay	48.04898	-99.21235
385029	Pelican Lake	48.14634	-99.16399

Physical, chemical and biological variables are sampled at each site and consist of the following: chlorophyll-*a*; phytoplankton; ammonia as nitrogen (N); total Kjeldahl nitrogen as N; nitrate-nitrite as N; total Phosphorus as P (TP); dissolved phosphorus (DP); TDS; major cations/anions; and trace elements. In addition temperature, dissolved oxygen (DO), pH and specific conductivity profiles were recorded at 1-meter intervals. Chlorophyll-*a* and phytoplankton are collected as a composite sample of the top 2 meters of the water column. The remaining chemical variables are analyzed from two discrete samples collected at about 1 meter below the surface and 1 meter above the bottom. A mid-column sample is collected at the center of the water column or just below the thermocline, if present, for sites greater than 4 meters in depth. Secchi disk transparency is also measured at each site.

Water quality samples are collected, handled and tracked in accordance with procedures outlined in the North Dakota Department of Health, Division of Water Quality's *Standard Operating Procedures for Field Samplers* (NDDoH, 2001). Quality assurance/quality control protocols are outlined in the *Standard Operating Procedures for Field Samplers*. Analytical methods and procedures used for analysis of water quality samples are described in the *North Dakota Department of Health, Division of Chemistry's Quality Assurance Plan* (NDDoH, 2000). All results are available in the EPA's STORage and RETrieval database (STORET).

### 3.0 Results and Discussion

Considering the volume and relevancy of data collected for Devils Lake over the last 11 years, this report primarily addresses surface (1 meter) concentrations or measurements of conductivity; chloride (Cl<sup>-</sup>), sulfate (SO<sub>4</sub><sup>-</sup>); TDS; total ammonia (NH<sub>3</sub>-NH<sub>4</sub>); nitrate-nitrite (NO<sub>3</sub><sup>-</sup>-NO<sub>2</sub><sup>-2</sup>); total nitrogen (TN); dissolved phosphorus (DP); total phosphorus (TP); chlorophyll-*a*; and Secchi depth. This report discusses both intra-year (samples taken in 2007) and inter-year (between years 1995-2007) spatial and temporal trends. Annual mean concentrations were used for the inter-year comparison. The existence of trends was determined through visual interpretation of the figures. A more rigorous analysis would be needed to determine the statistical significance of these trends and to possibly detect trends not visible in the figures. In addition, the seasonal temperature and DO profiles for 2007 will be discussed in terms of thermal stratification and DO depletion.

### 3.1 Conductivity, Chloride, Sulfate and TDS

In 2007 and throughout the entire sampling period (1995-2007), there was a consistent spatial trend in conductivity, chloride, sulfate and TDS concentrations. These parameters are closely related, and any one of them could be used as a surrogate for another. In general, the concentrations of these four parameters increased moving from the western areas of the Devils Lake chain to east. East Devils Lake has the highest concentrations by a considerable margin followed by East Bay. Typically, the concentrations in Main Bay, West Bay, SW West Bay and Six Mile Bay are consistent with each other; Pelican Lake has the lowest concentrations (Figures 4a-d).

No significant intra-year temporal trends in conductivity, chloride, sulfate or TDS concentrations were observed in 2007 (Figures 4a-d). However, there are some inter-year temporal trends shown by these four parameters (Figures 5a-d). With heavy snowfalls and subsequent surface runoff, Devils Lake water surface elevations began a rising trend in the spring of 1994. Lake filling continued until the summer of 1999 when Devils Lake began to flow eastward into Stump Lake. Since 1999, the water levels have continued to rise in Stump Lake but have not yet reached equilibrium with Devils Lake (USGS). In Devils Lake's East Bay and East Devils Lake, the annual mean concentrations of these four parameters have decreased considerably since 1995. Contributing factors to this decrease in ion levels are eastward surface-water flow into Stump Lake and dilution from increased surface runoff. The annual mean concentrations in Six Mile Bay and Main Bay have remained fairly consistent since 1995, while increasing slightly in Pelican Lake, SW West Bay and West Bay (Figures 5a-d). Figure 5a shows conductivity values for Six Mile Bay, Main Bay, East Bay, East Devils Lake and West Bay from 1990 and 1991. Considering the high conductivity and its relationship to chloride, sulfate and TDS, it is reasonable to assume that all five bays also experienced considerable decreases in concentrations from 1990 to 1995 (Figure 5a).

### 3.2 Nutrients, Chlorophyll-a and Secchi Depth

Both intra-year and inter-year spatial trends in nutrients, chlorophyll-a concentrations and Secchi depth are difficult to discern because of the temporal variability inherent in those parameters. East Devils Lake was the exception in that nitrate-nitrite and TN concentrations tended to be higher than the other sampling locations between 1995 and 2006 (Figures 5f-g). However, in 2007 concentrations dropped to near non-detectable levels.

An intra-year comparison of nitrate-nitrite and ammonia concentrations at five of the seven sampling locations is relatively constant for three seasons. Those five sites show a seasonal (seasons varying from site to site) increase during the year (Figures 4e-f). Two exceptions were Six Mile Bay, which yielded high nitrate-nitrite in both winter and fall, and East Devils Lake, which held high concentrations of ammonia in both summer and fall. TN at all seven locations varied only slightly through 2007. TP and DP concentrations also varied only slightly through the year, except for summer increases at Pelican Lake, Six Mile Bay, Main Bay and East Devils Lake.

Inter-year temporal trends are observable for TN, TP and DP at some, but not all, sites. TN

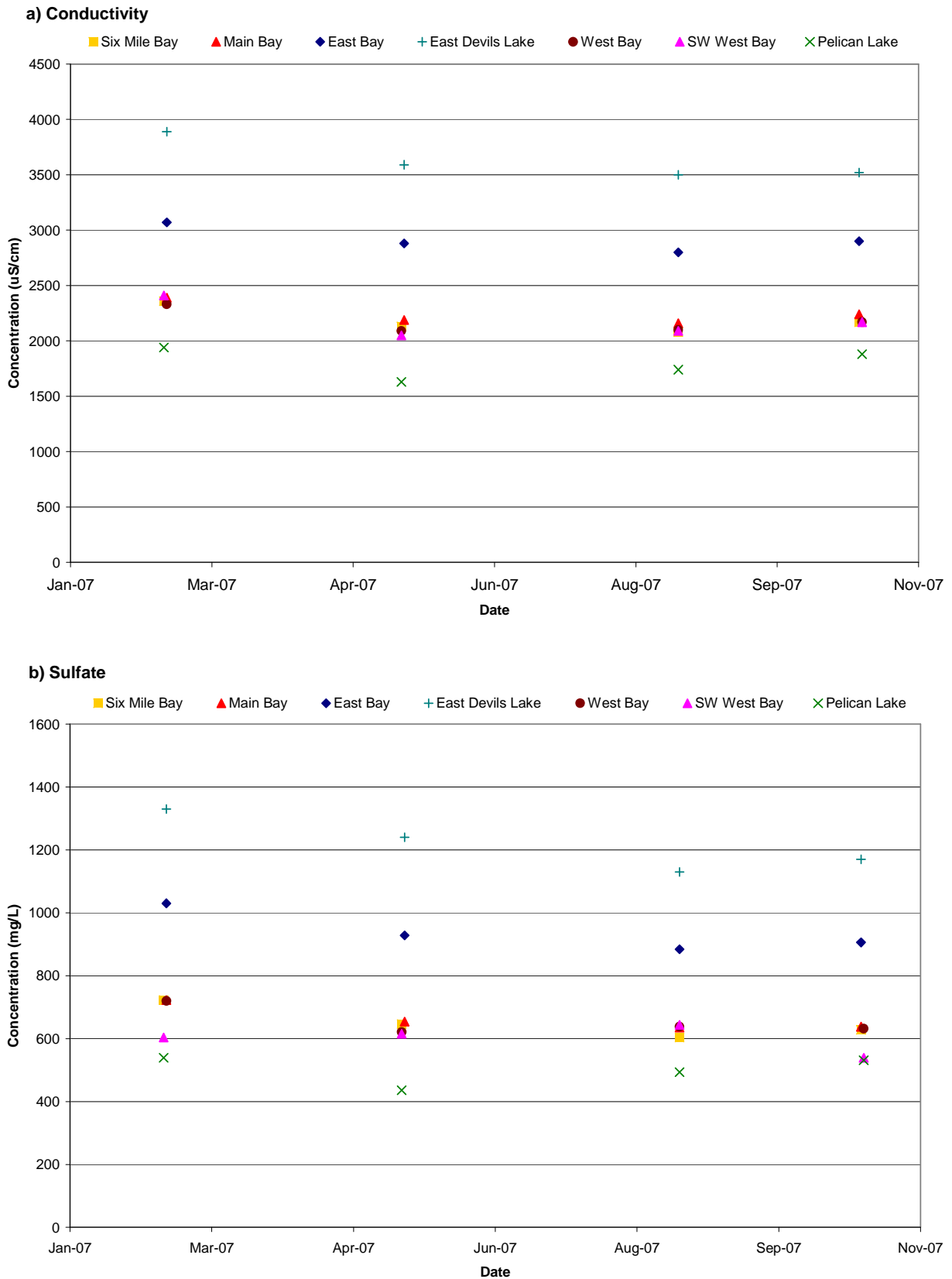
concentrations in East Bay, West Bay and Main Bay decreased considerably in 1998 and then remained relatively consistent through 2006. When 2007 values are compared to 1995-2006 data, 2007 concentrations of ammonia, nitrate-nitrite and TN values increased or decreased within the range of historical data. Phosphorus-related concentrations trended differently than nitrogen concentrations. TP and DP at six sampling locations had average decreases, except for Pelican Lake which showed average increases.

In 2007, intra-year temporal trends are not observable in chlorophyll-a, because it is believed there were problems with laboratory analysis. A corrective algorithm used to account for degraded chlorophyll-a contained in samples was not applied during analysis but was applied after initial data examination. This correction yielded semi-realistic values (still below expected results) for samples taken in the spring. However, summer and fall results remained well below expected values. As a result of the lack in data confidence, results for Chlorophyll a are not addressed further in this data summary.

Secchi disk transparency depth decreased from spring to fall at the majority of the sampling locations. Six Mile Bay, Main Bay and East Devils Lake showed dramatic increases in 2007 measurements when compared with 2000-2006 values (Figures 4k and 5k).

### **3.3 Dissolved Oxygen Profiles and Temperature Profiles**

DO depletion occurs where decomposition of organic matter and respiration exceed oxygen diffusion rates and photosynthesis through the water column. During the winter (February 2007), DO concentrations at Six Mile Bay, Main Bay, East Bay and West Bay noticeably decreased at lower depths in the water column (Figures 6a-g). In seasons other than winter, the DO profile for most sites exhibit steep declines near the water/sediments interface where, due to biological activity, DO readings tend to be very low. No sites exhibited thermal stratification, which the North Dakota Department of Health defines as a thermal gradient change greater than 1 degree Celsius per meter. None of the sampling locations demonstrated significant mid-water column DO depletion or thermal stratification during the spring, summer or fall visits in 2007.



**Figure 4. Surface Concentrations (Collected at 1 Meter) of Selected Parameters and Secchi Disk Transparency for Each Devils Lake Sampling Site and Event in 2007**

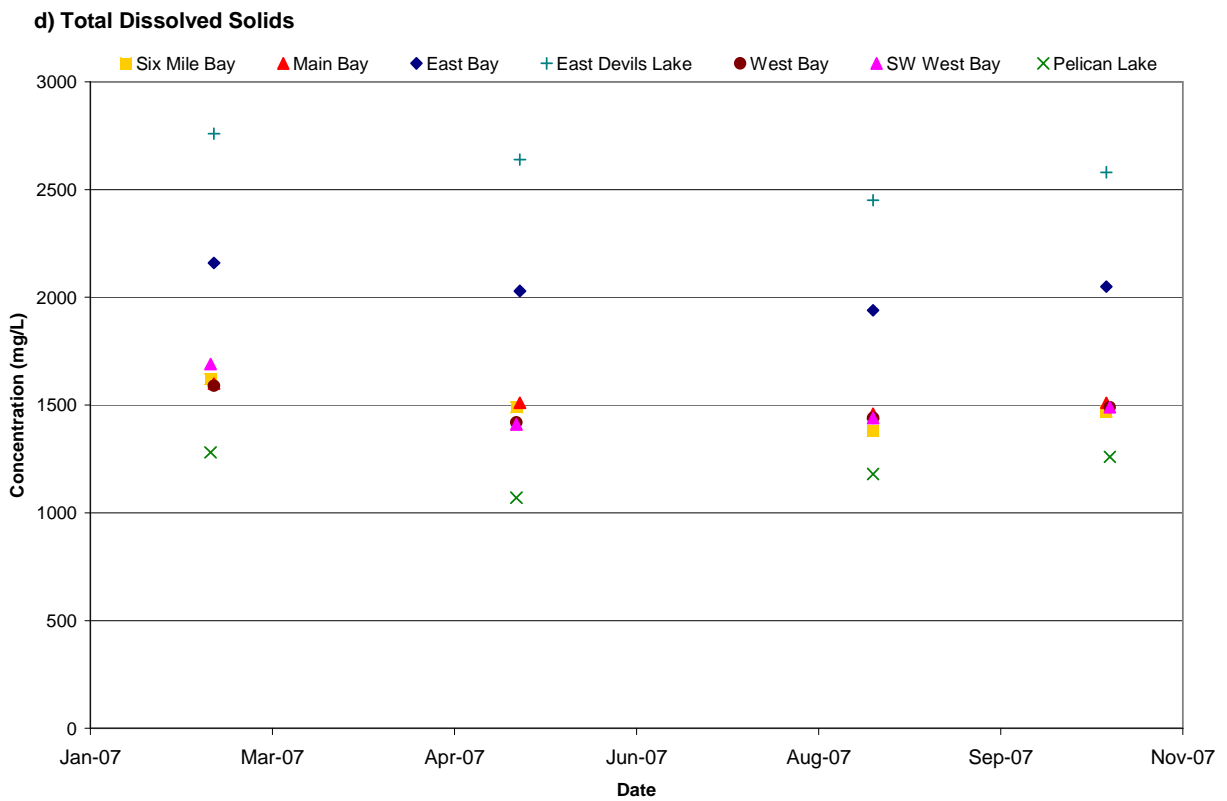
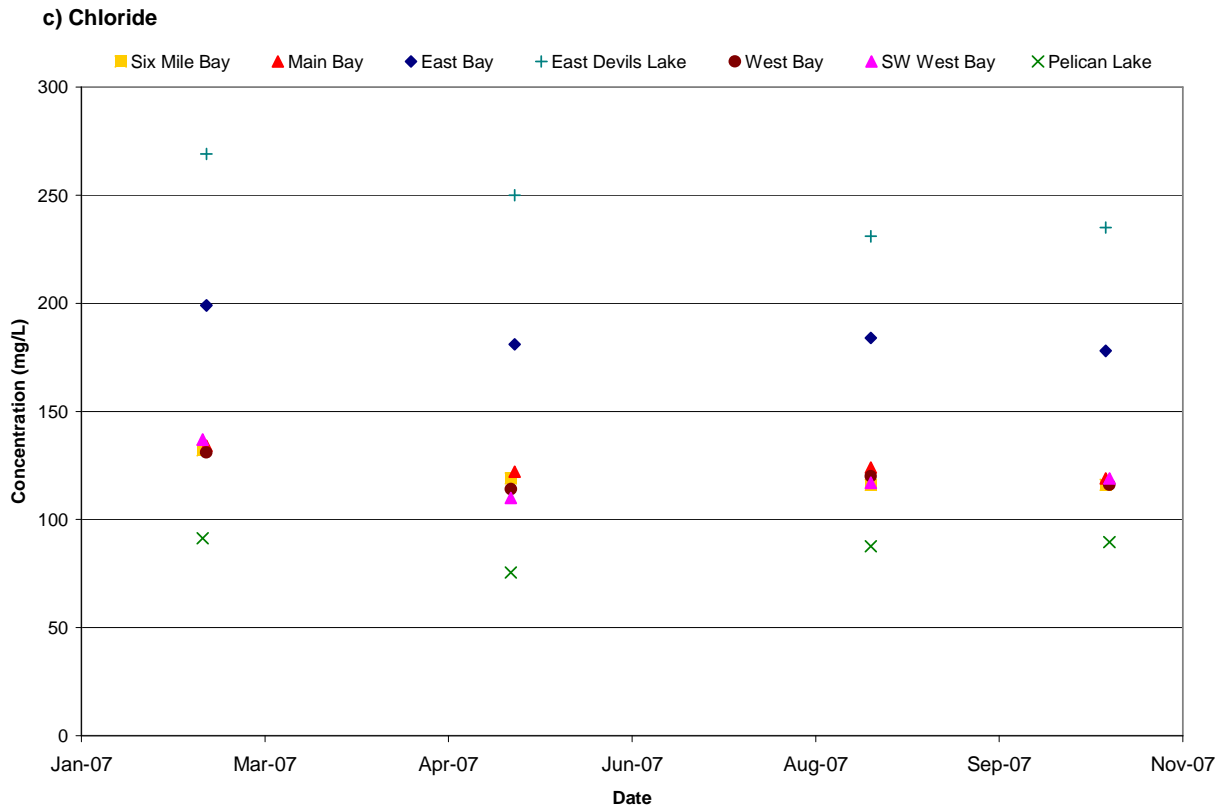


Figure 4. Continued

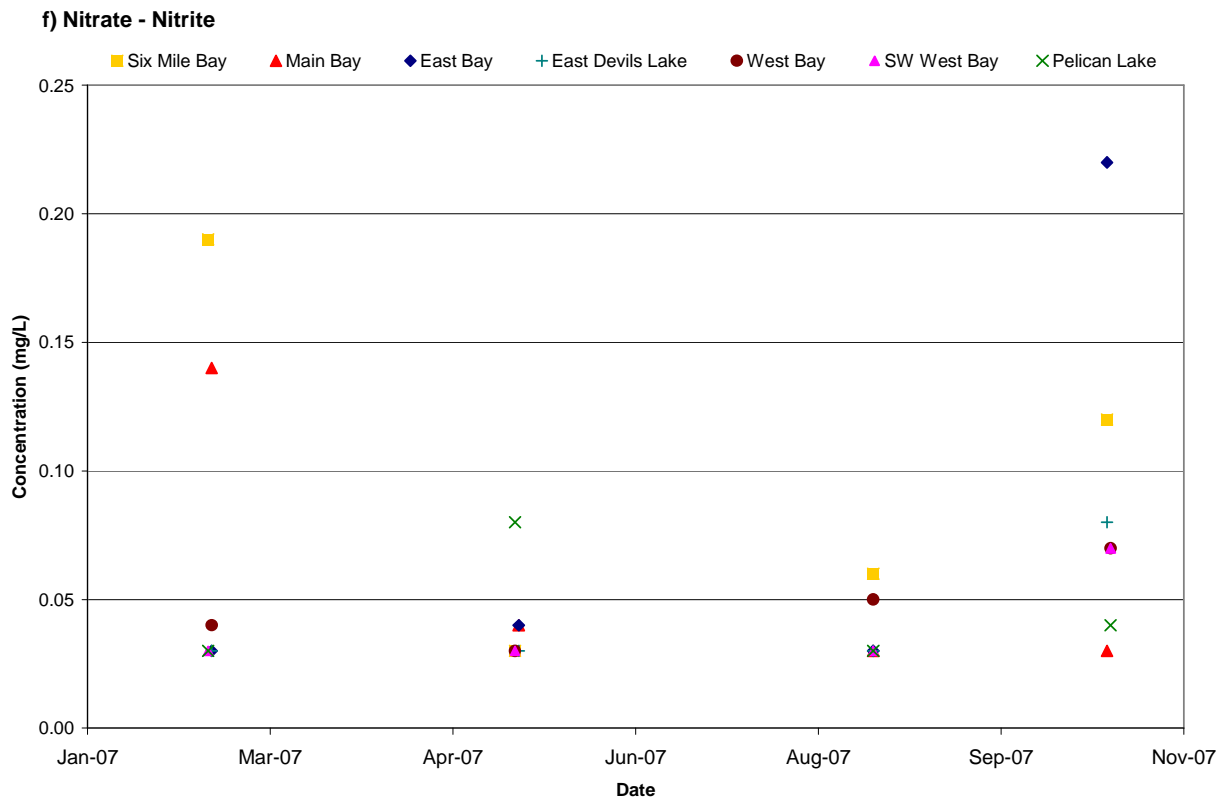
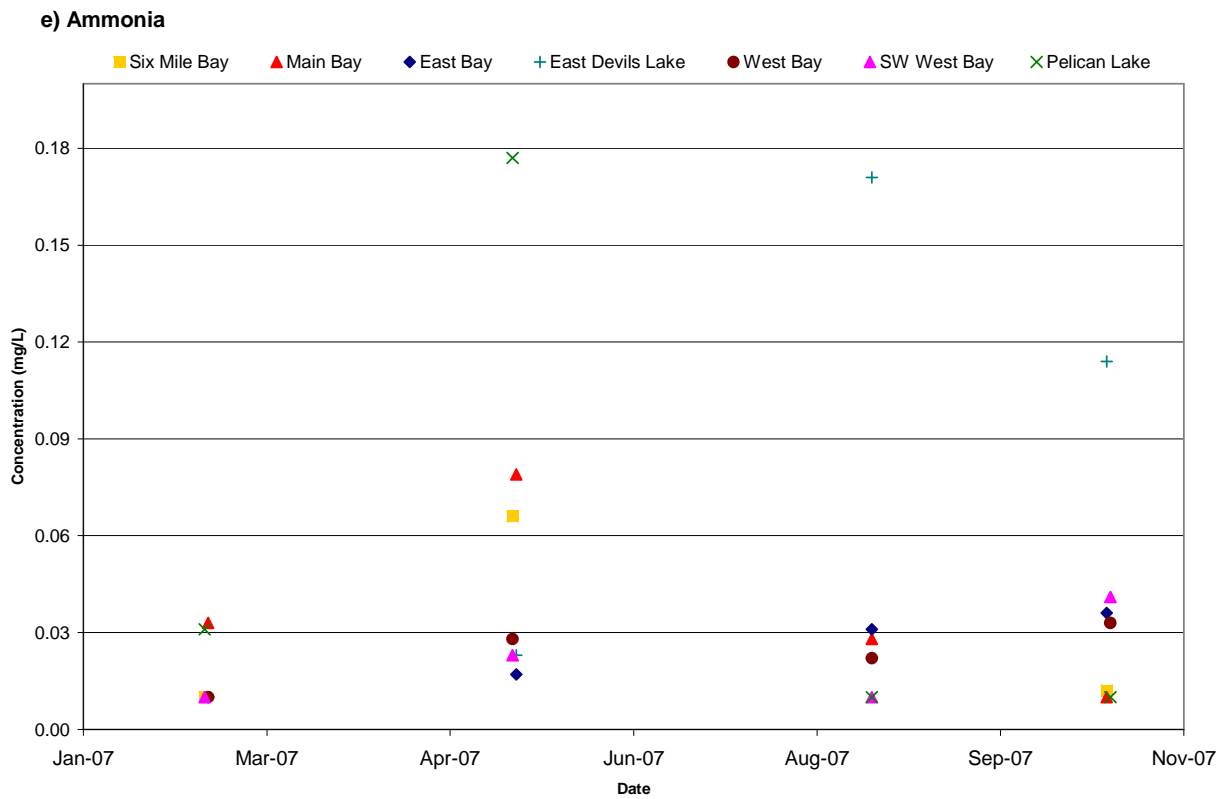


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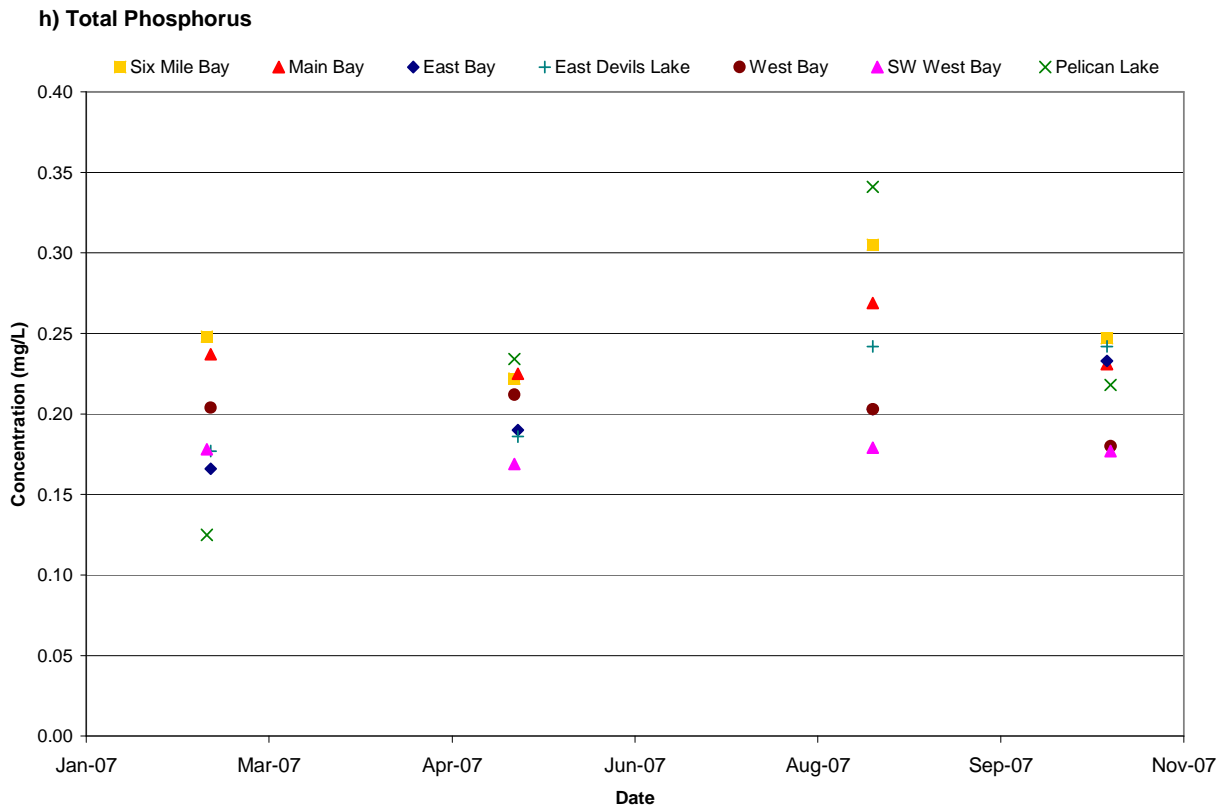
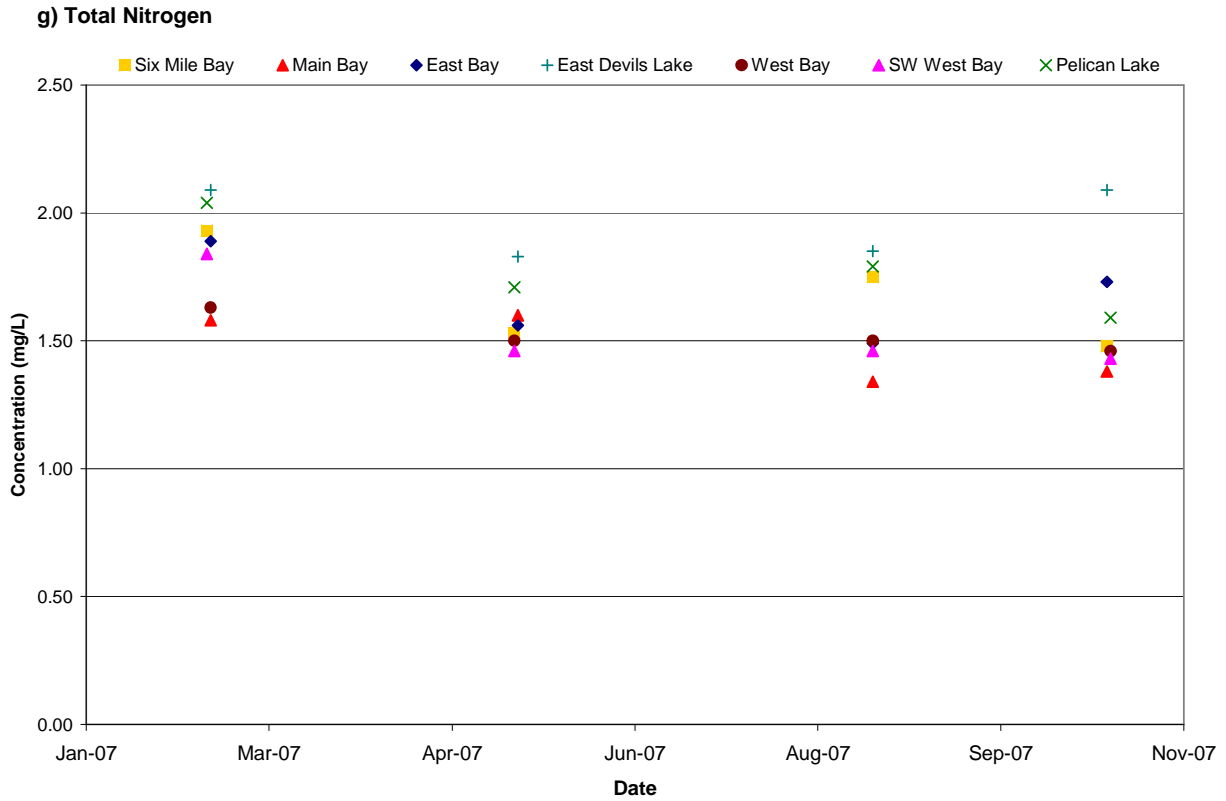


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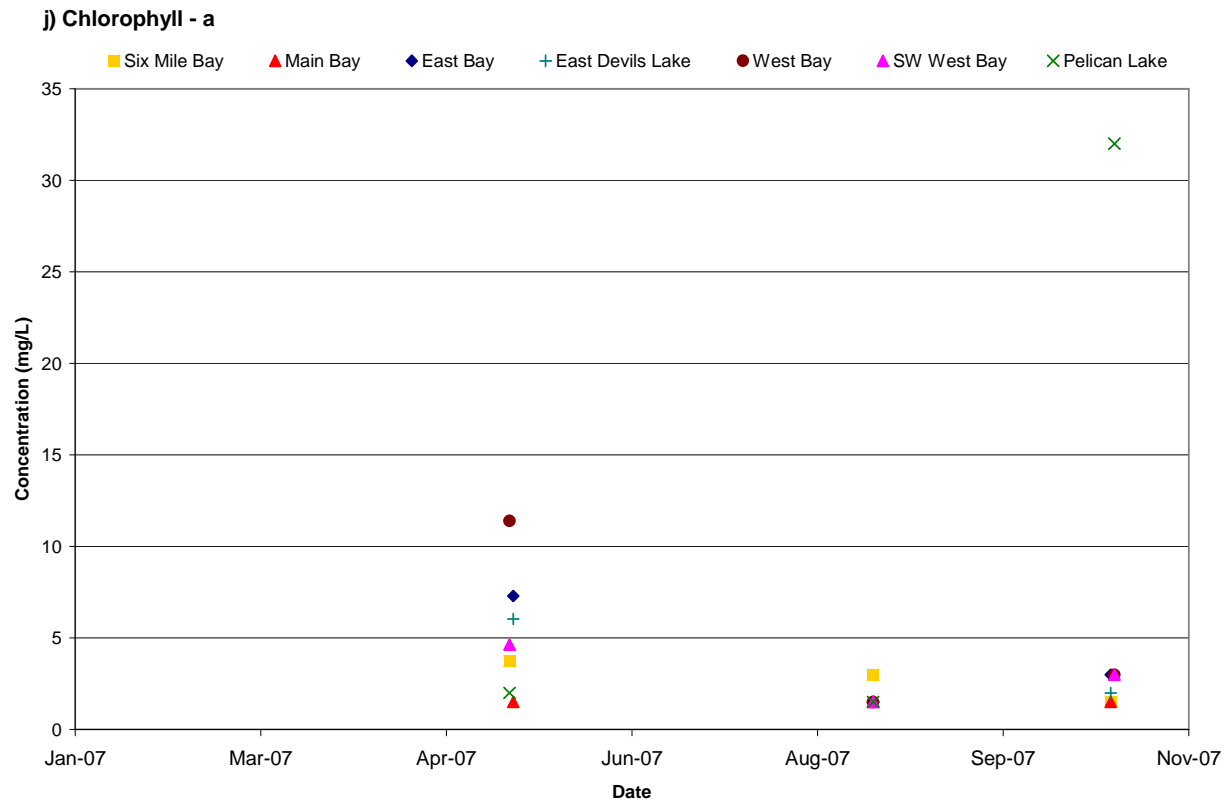
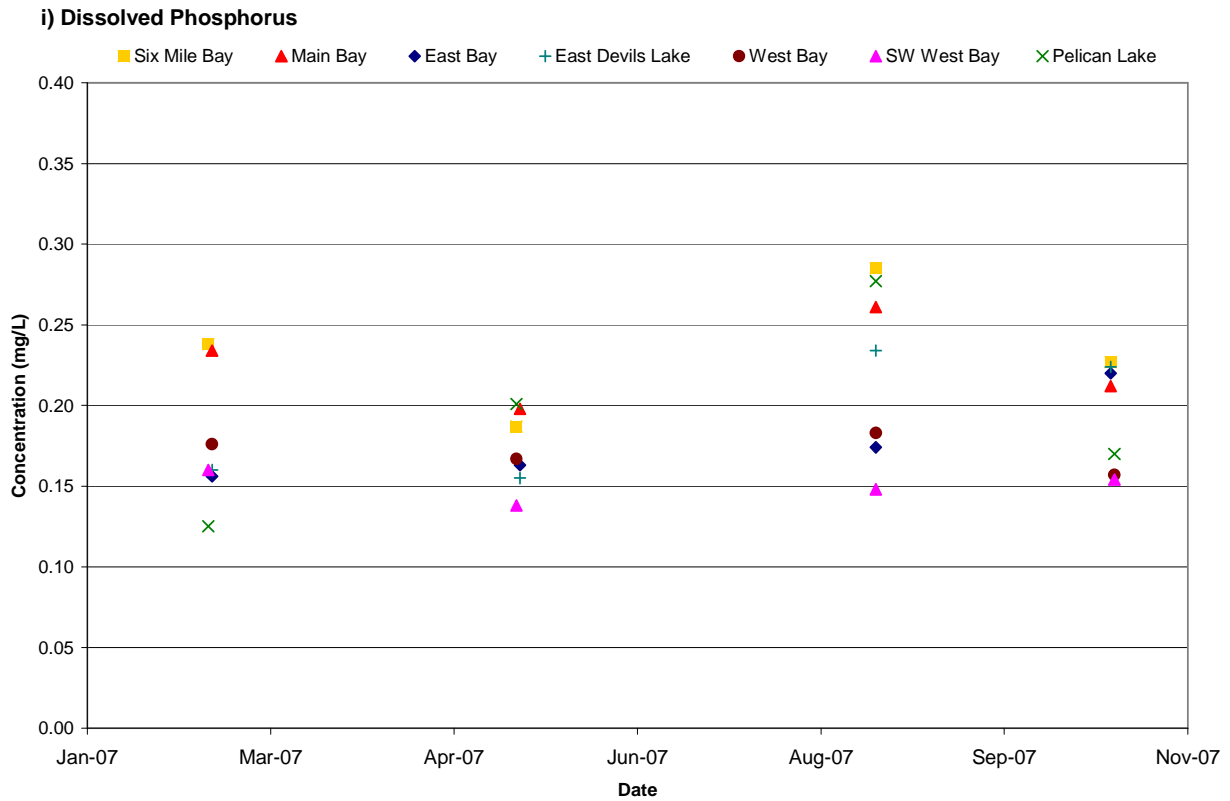


Figure 4. Continued



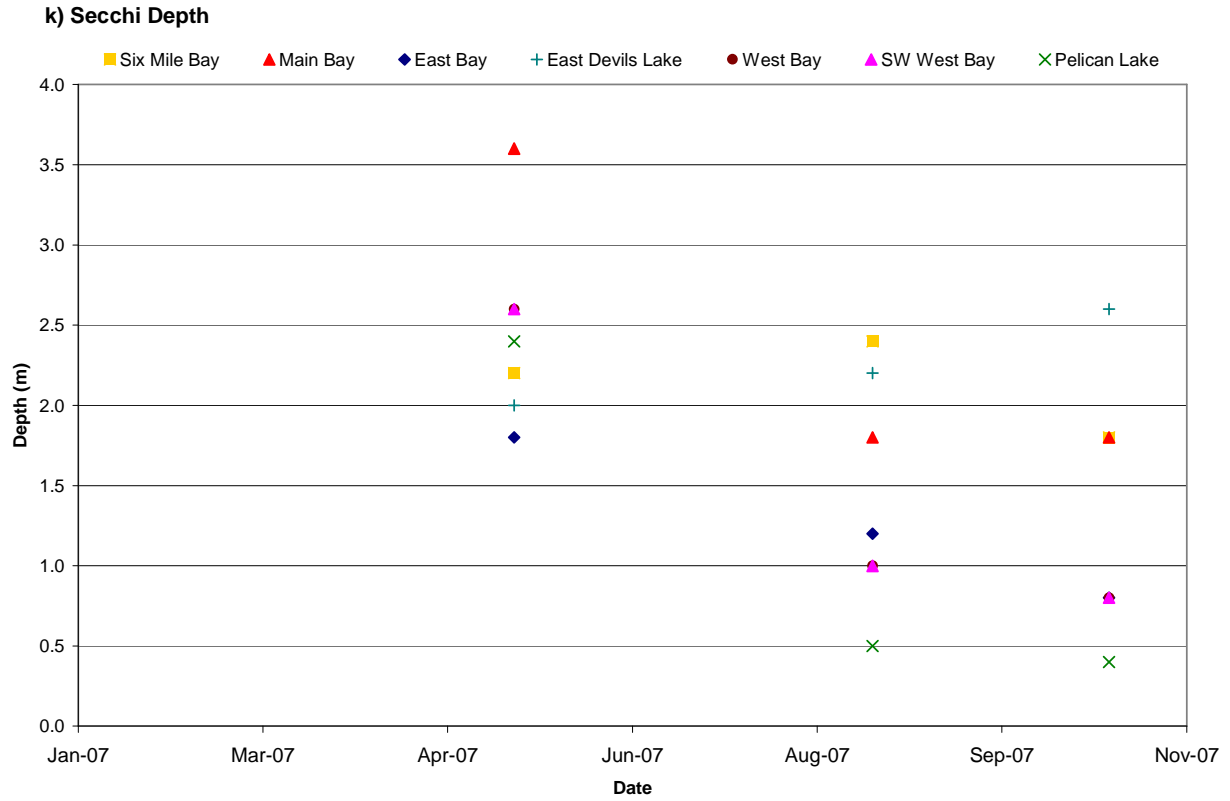
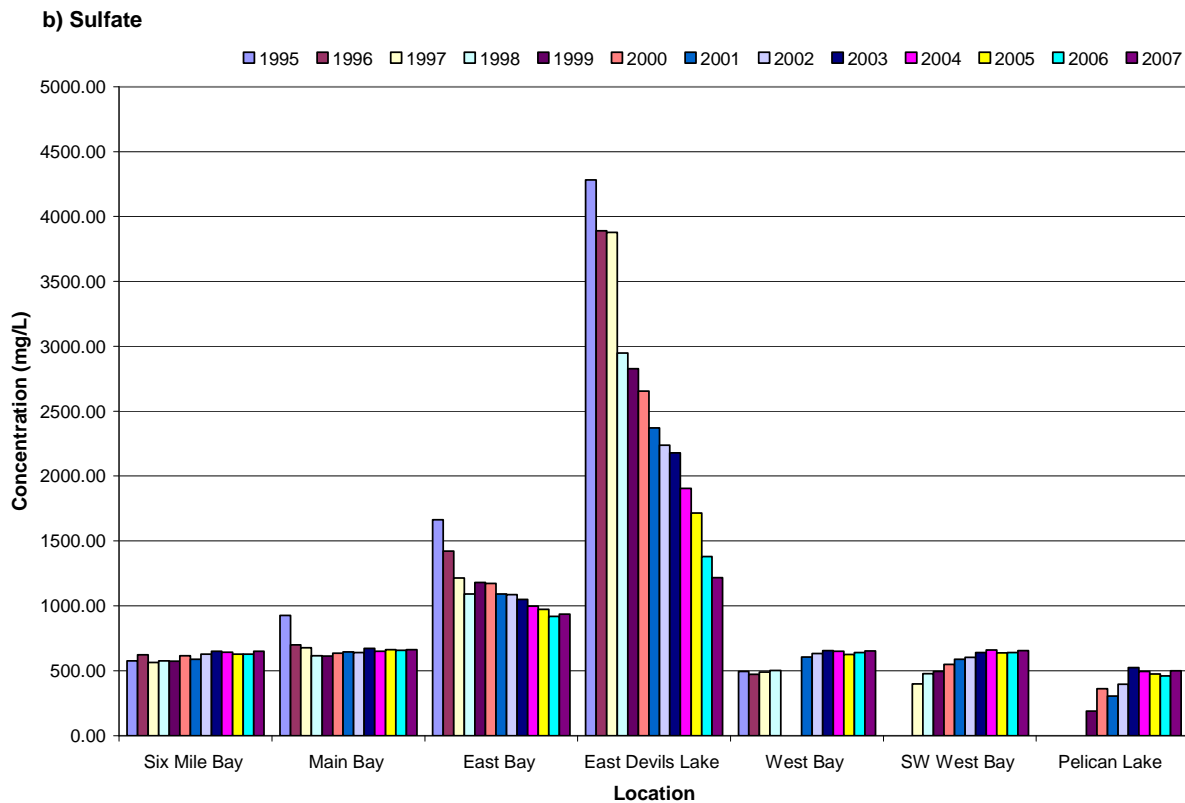
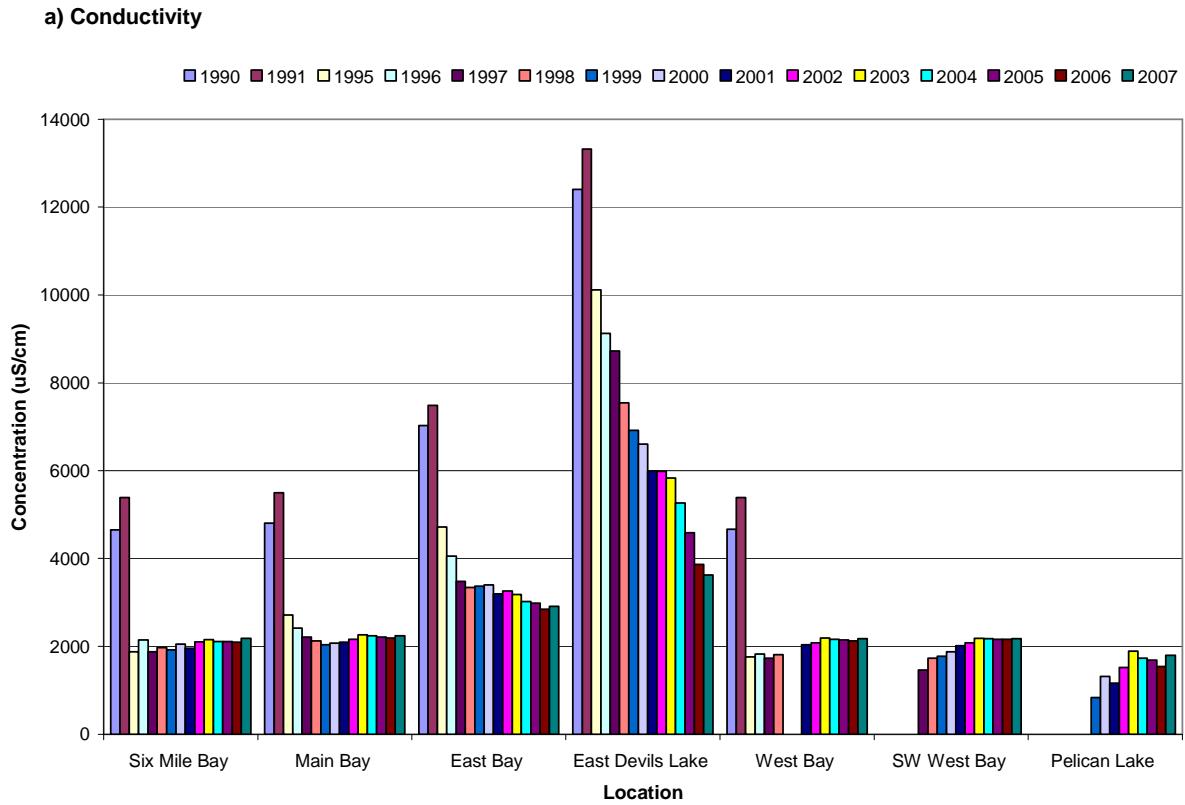


Figure 4. Continued



**Figure 5. Annual Mean Concentration of Selected Parameters (Collected at 1 Meter) at Devils Lake Sampling Sites for the Period of 1995-2007**

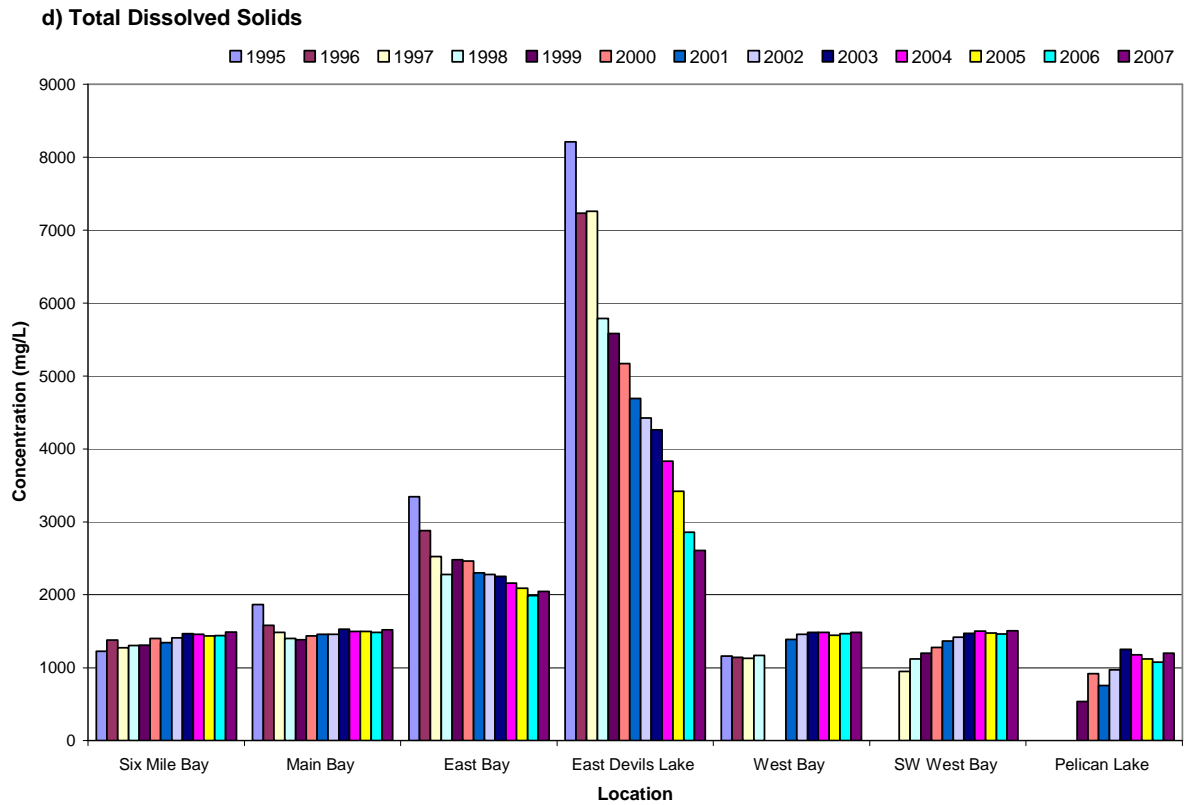
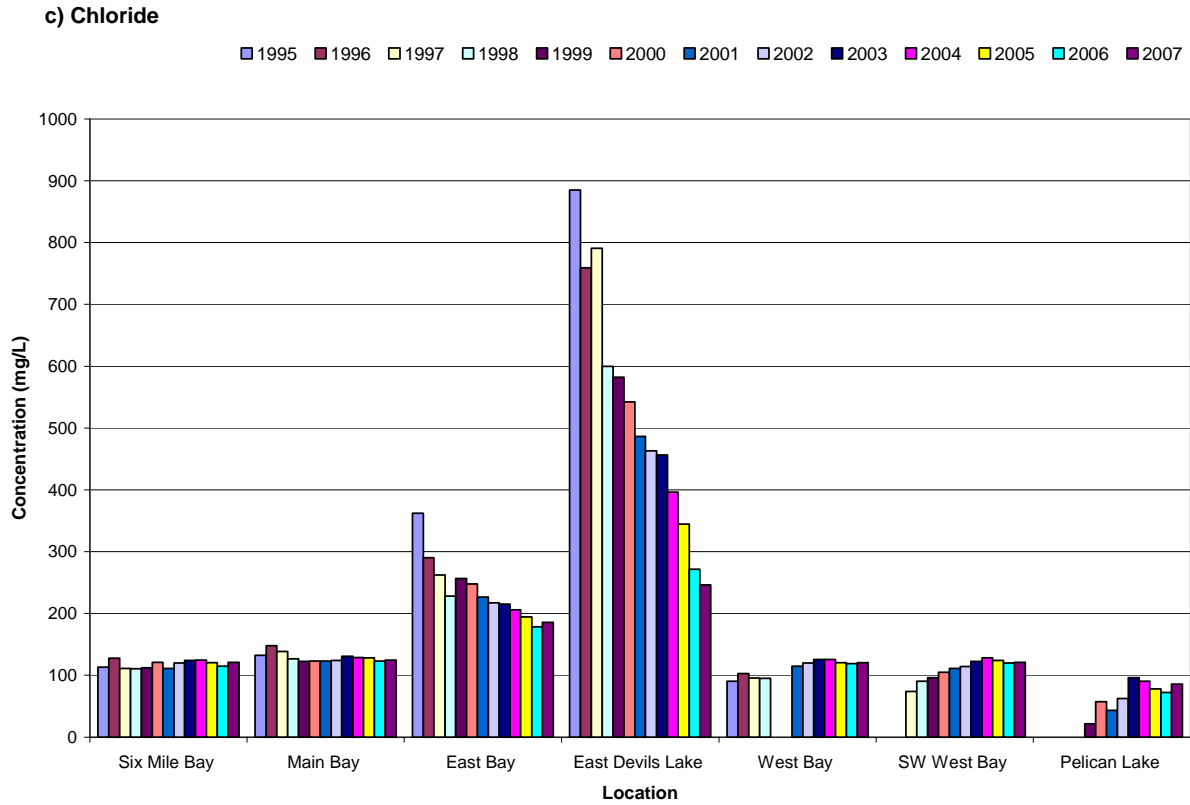


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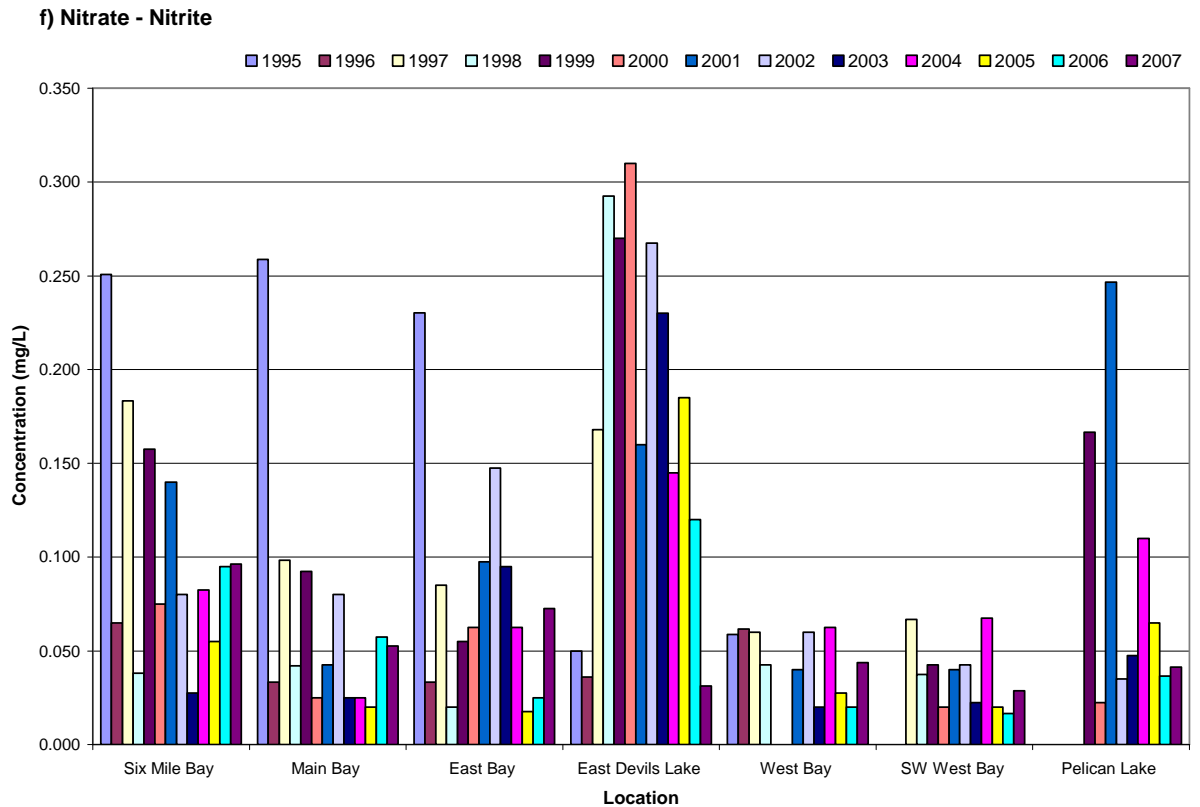
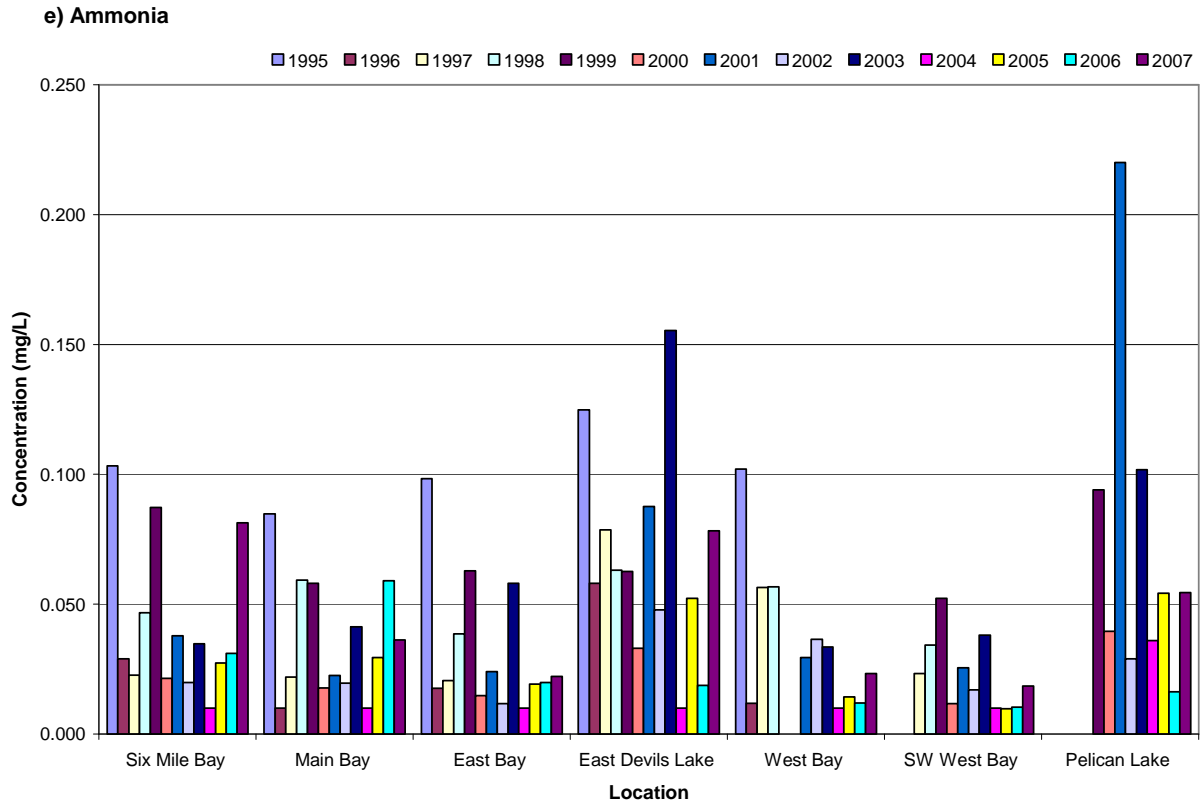


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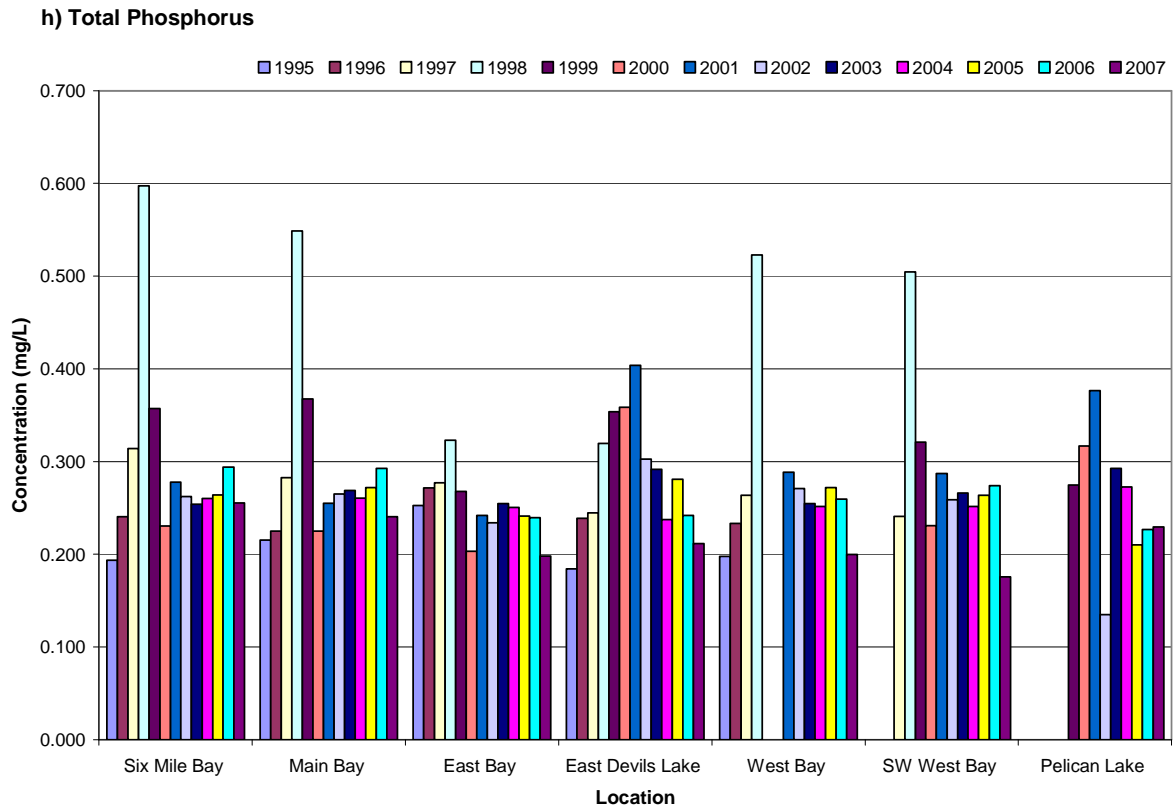
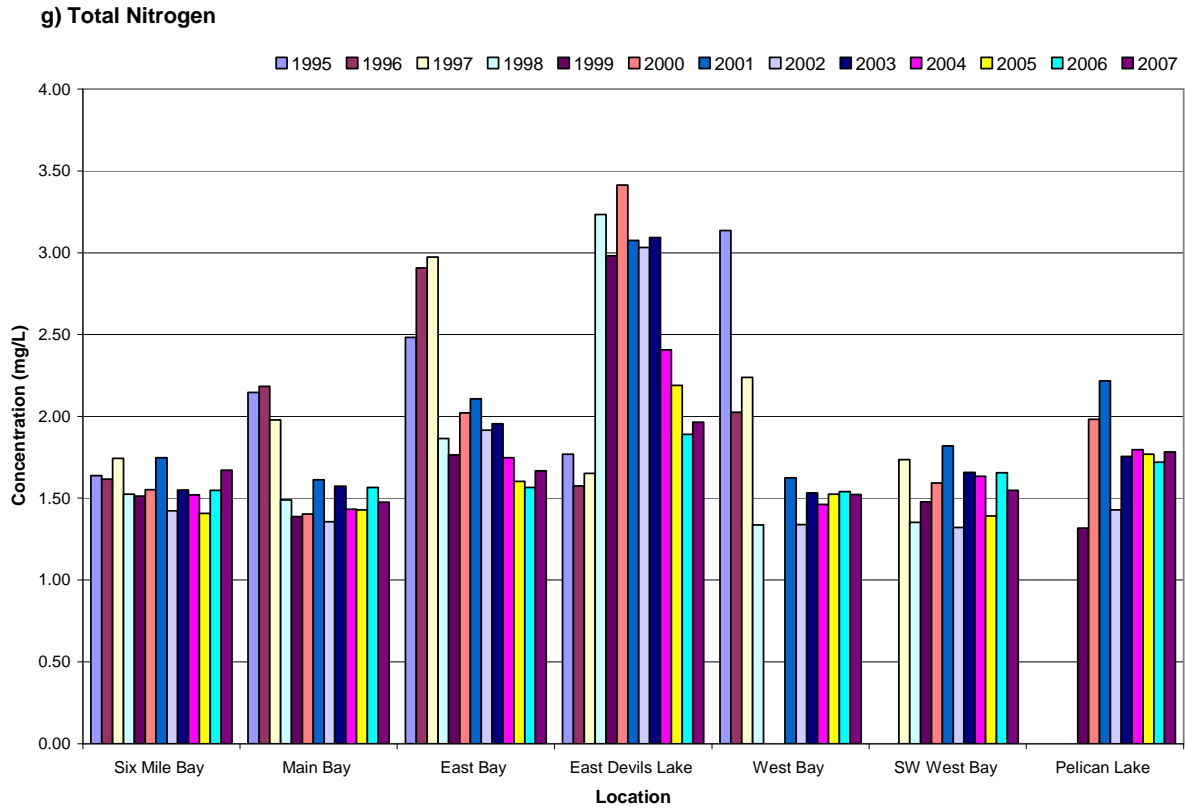


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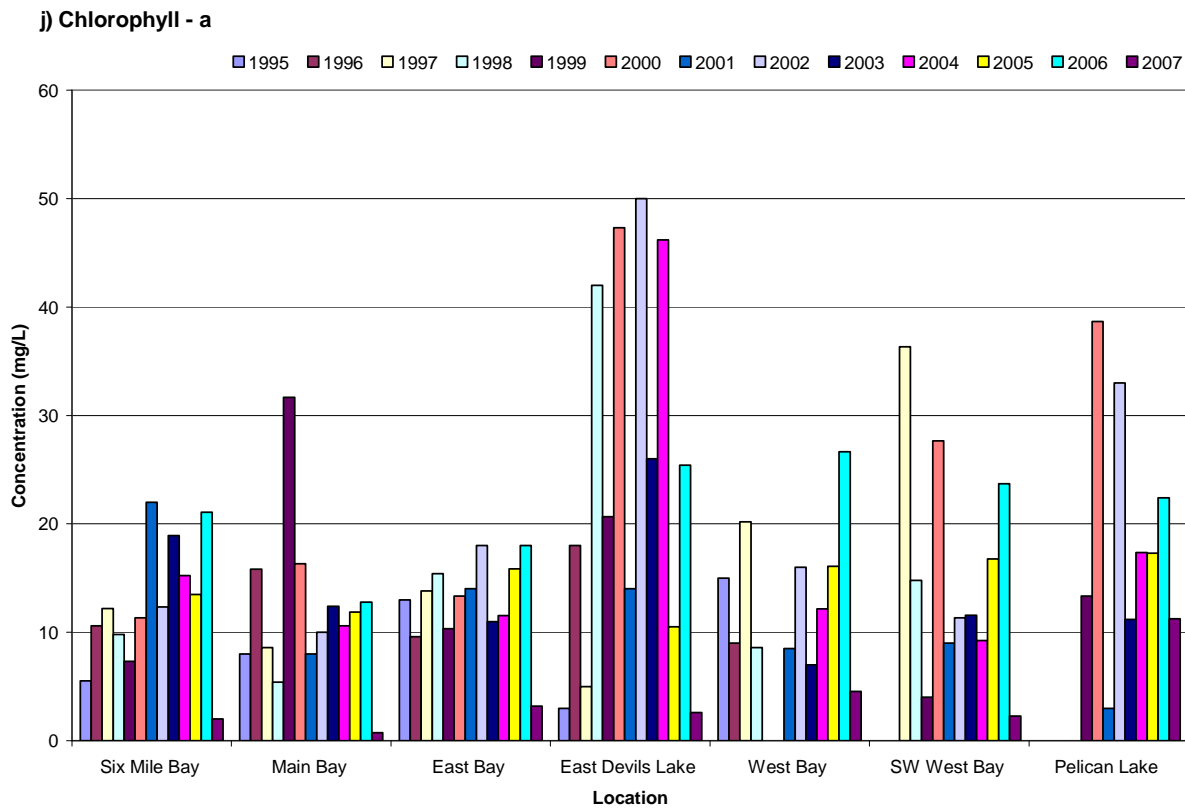
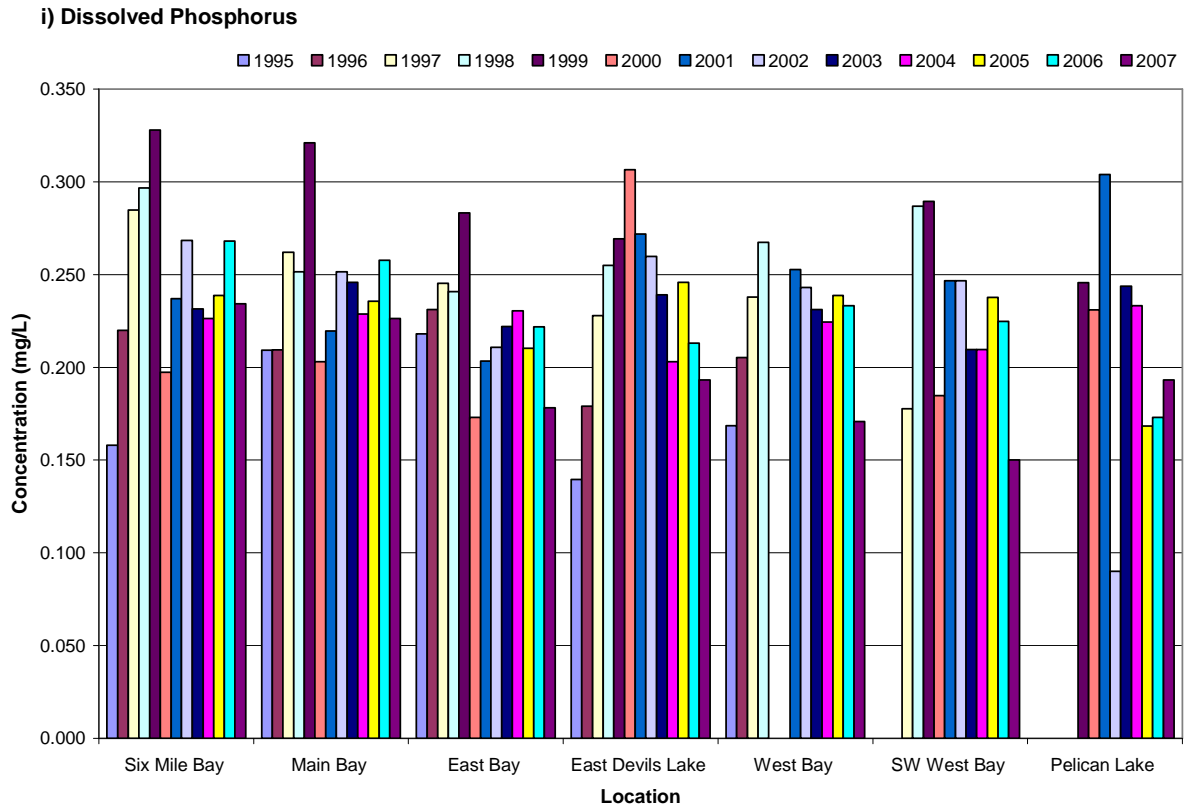


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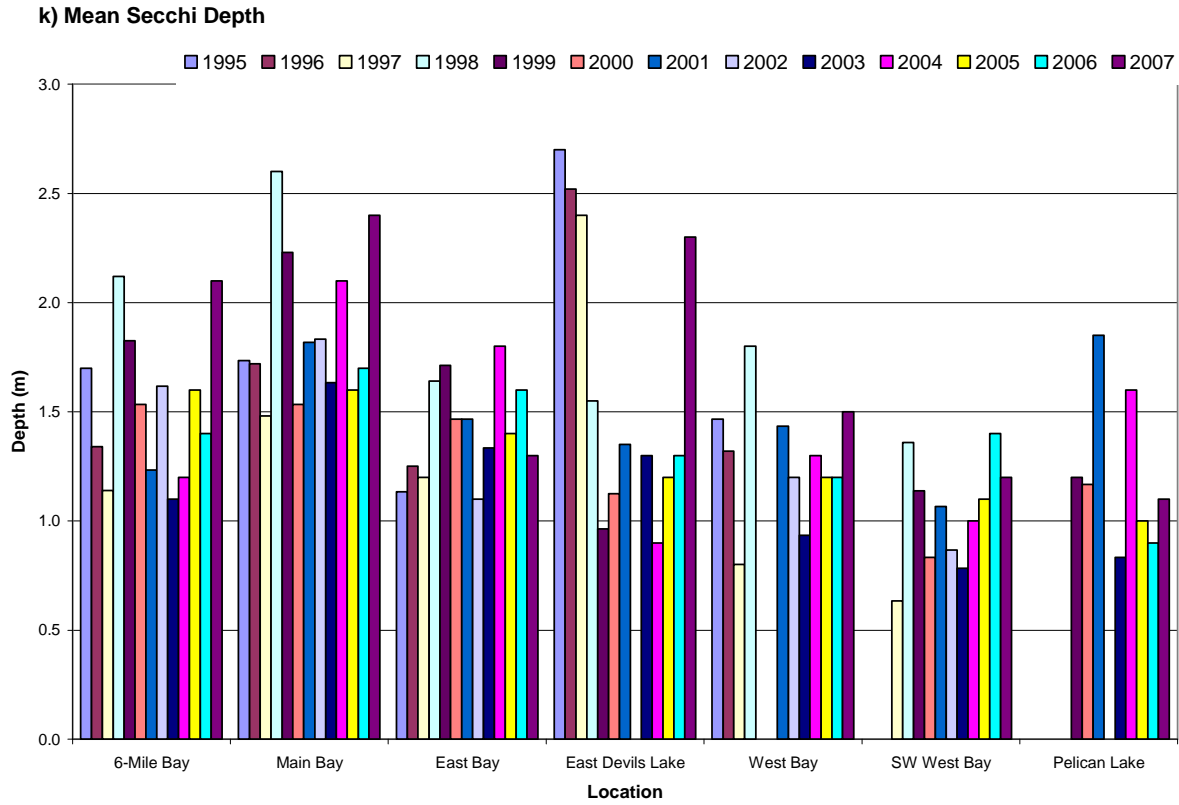


Figure 5. Continued

a) Six Mile Bay

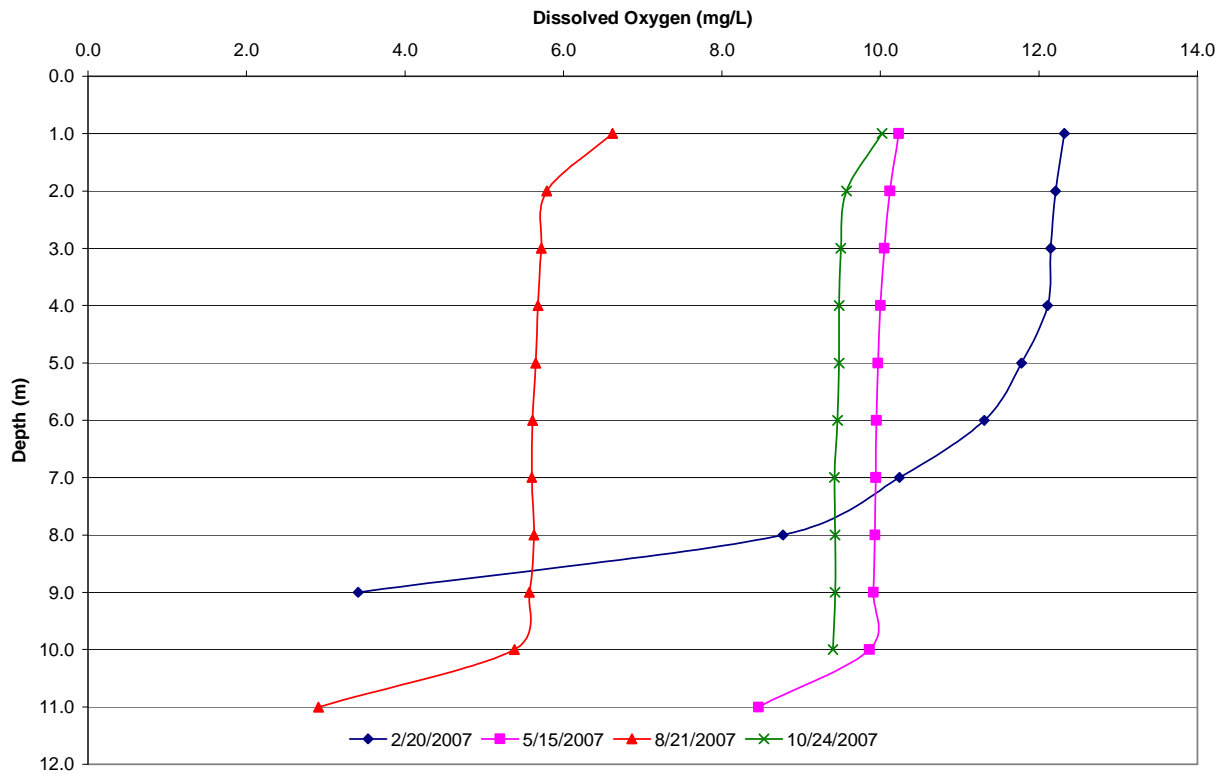
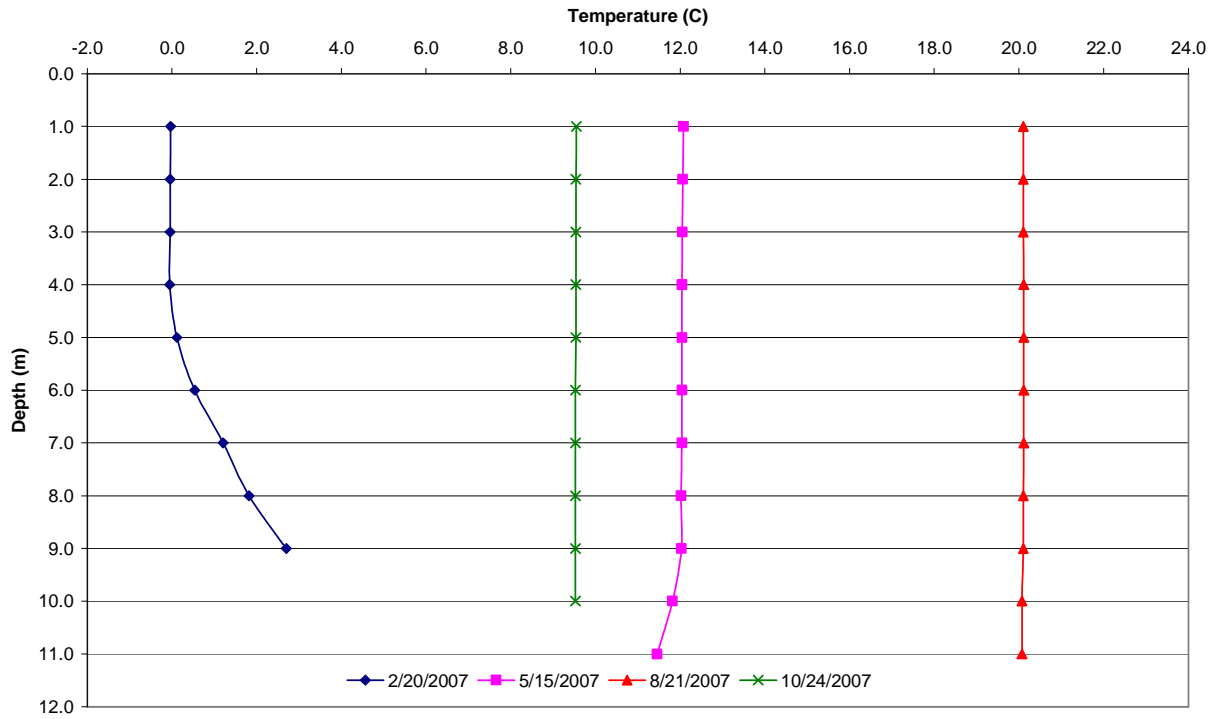


Figure 6. Temperature and Dissolved Oxygen Profiles for Devils Lake Sampling Sites and Events in 2007



b) Main Bay

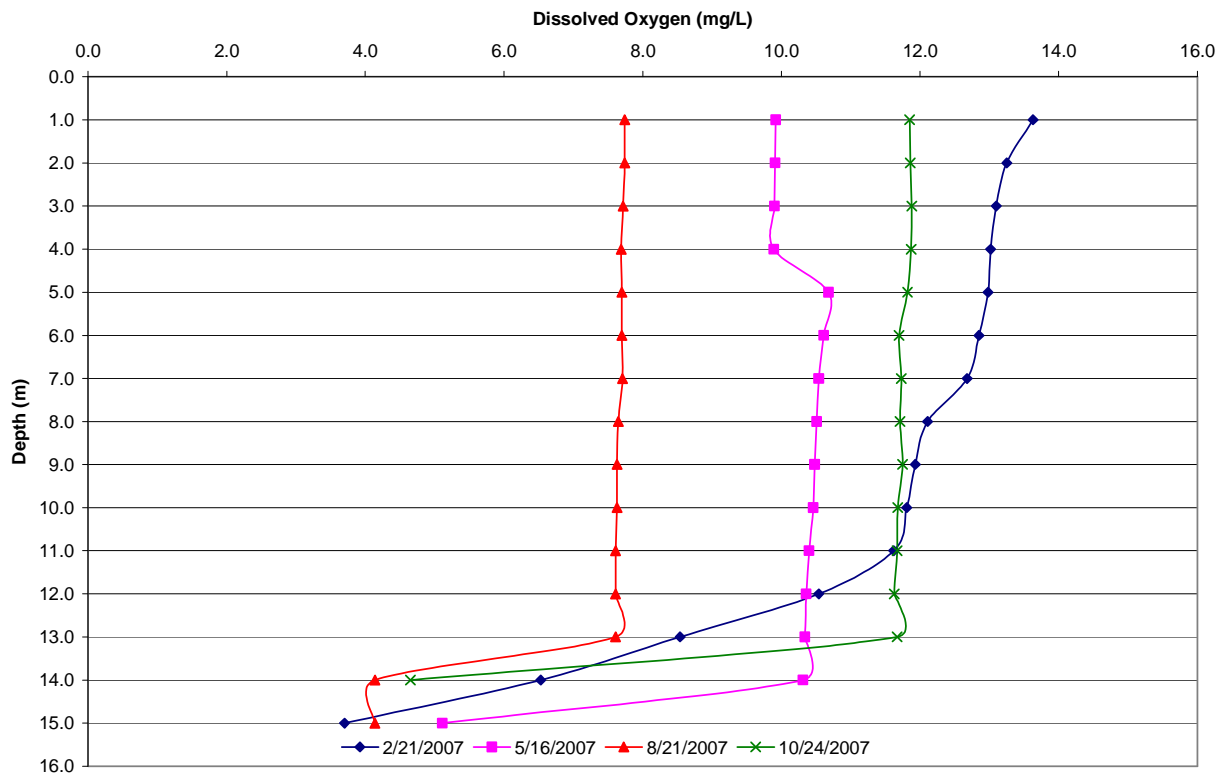
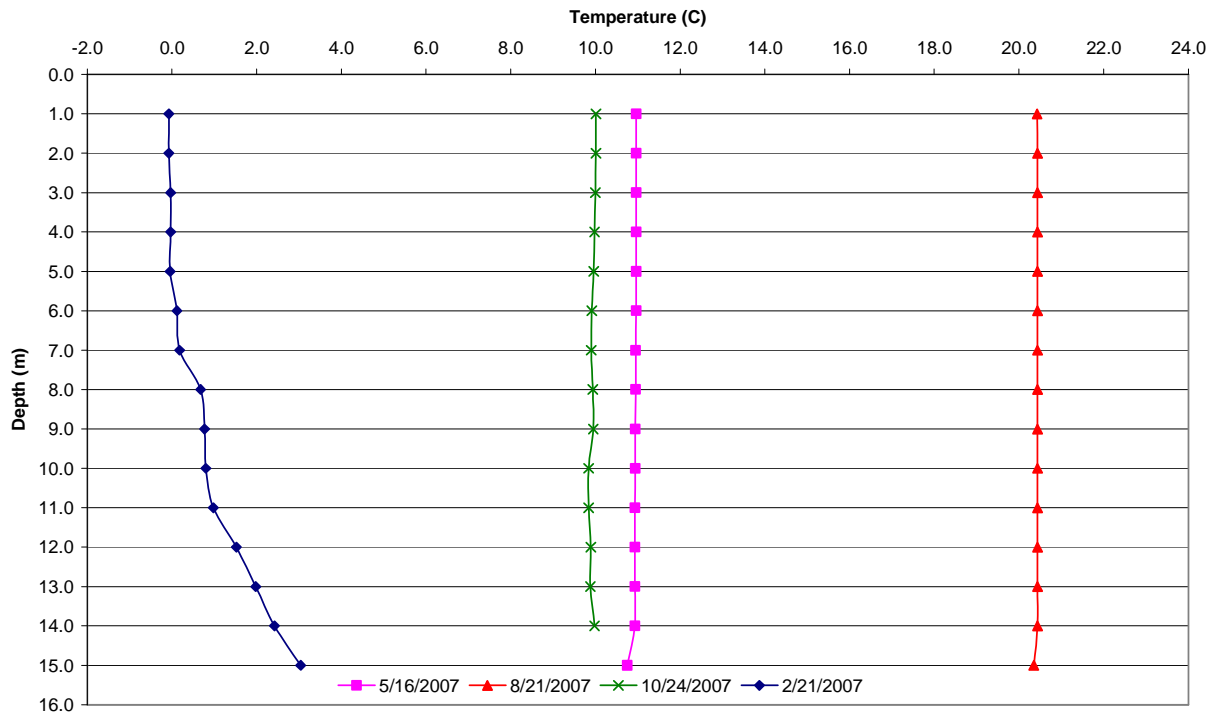


Figure 6. Continued

c) East Bay

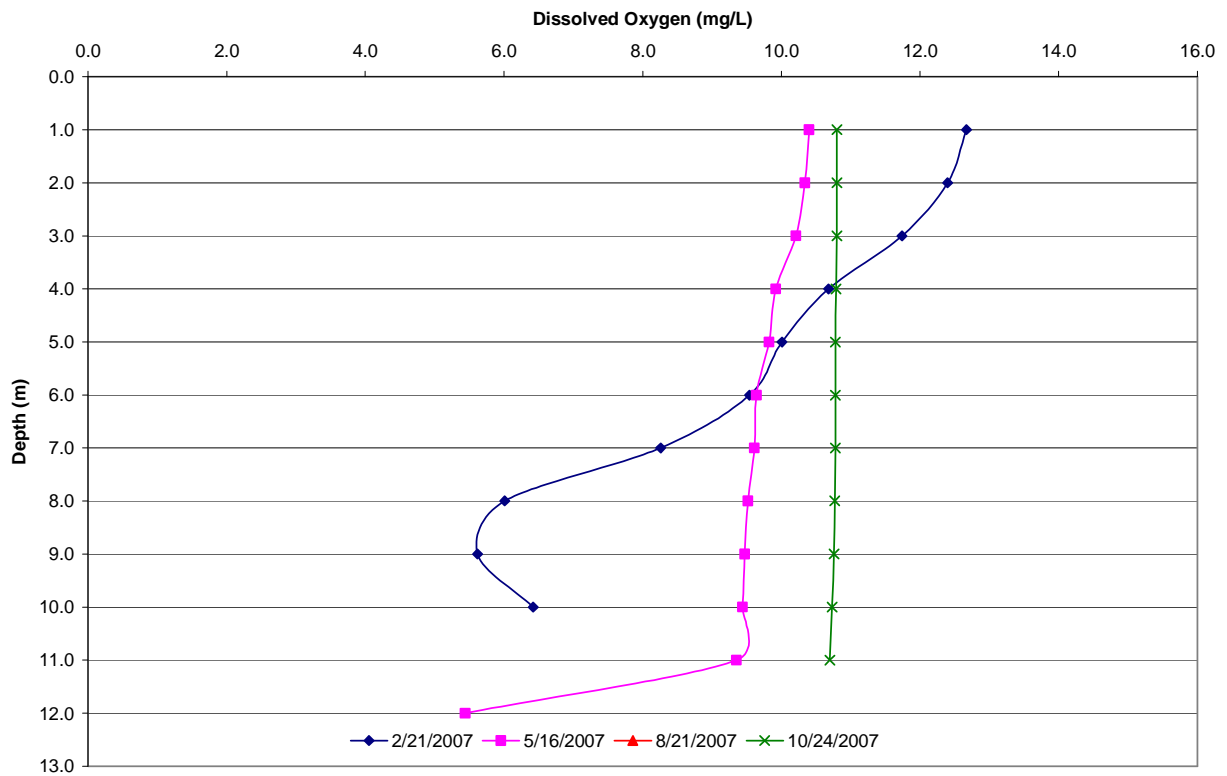
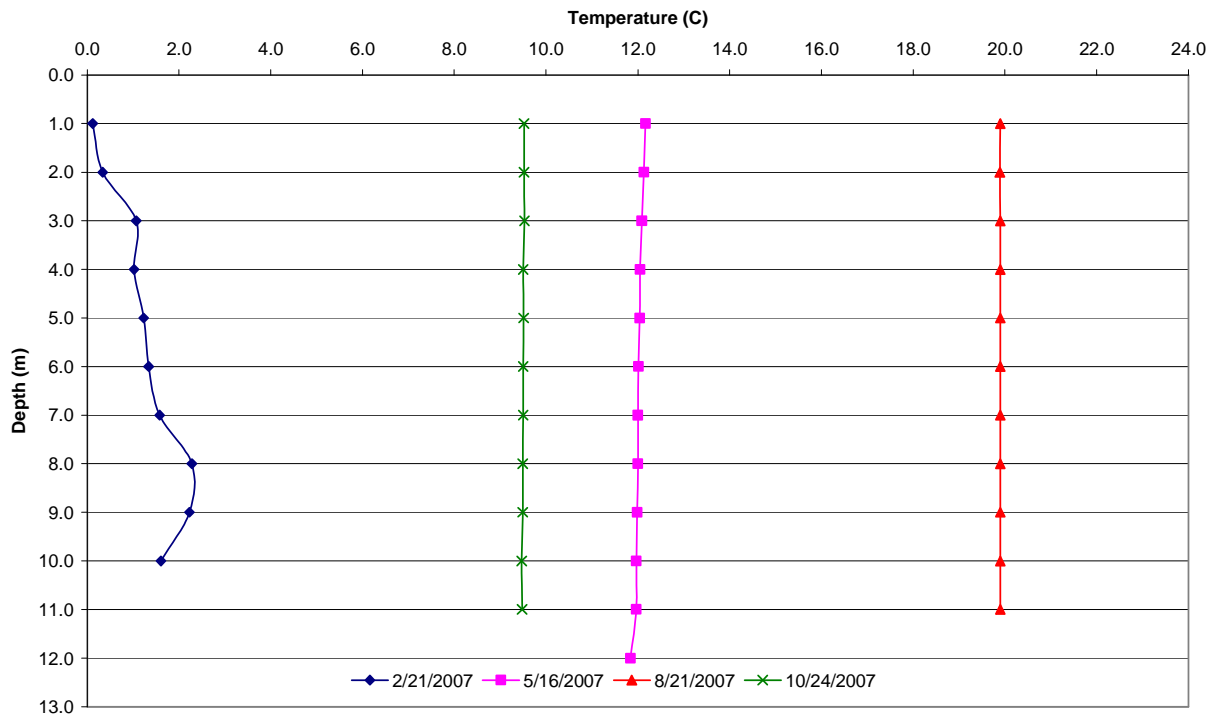


Figure 6. Continued

d) East Devils Lake

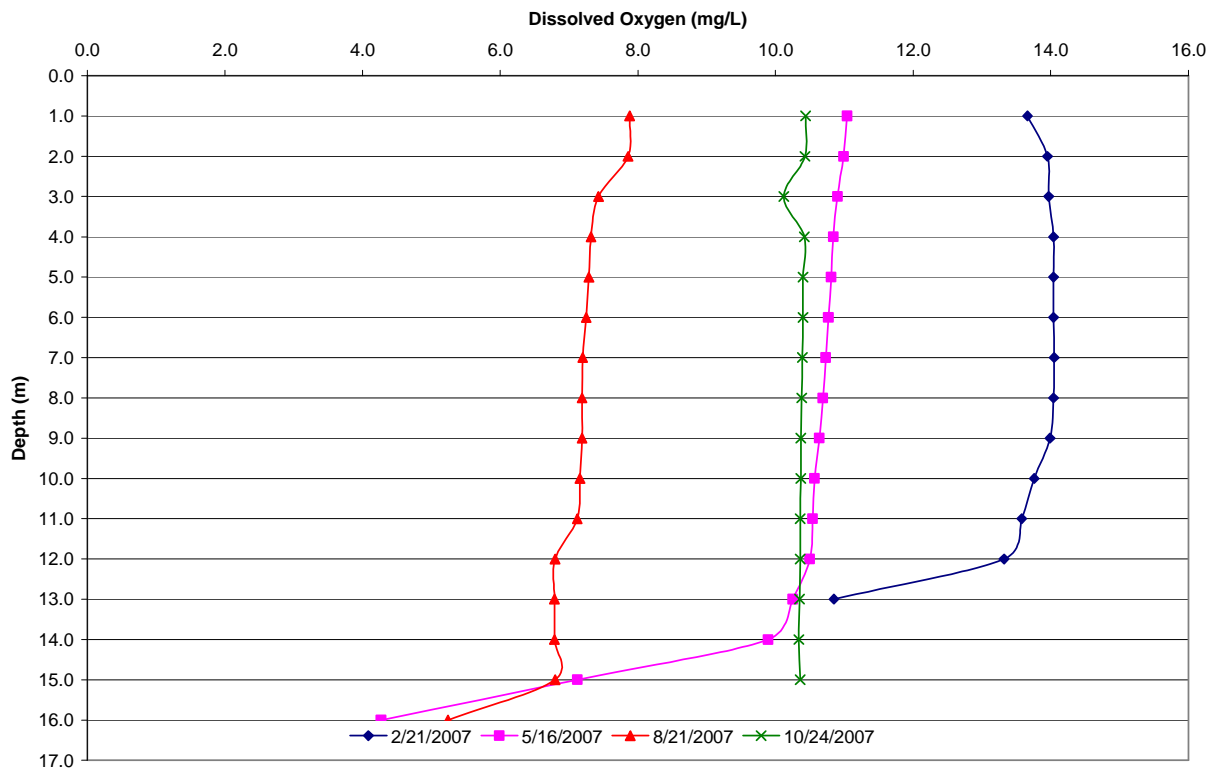
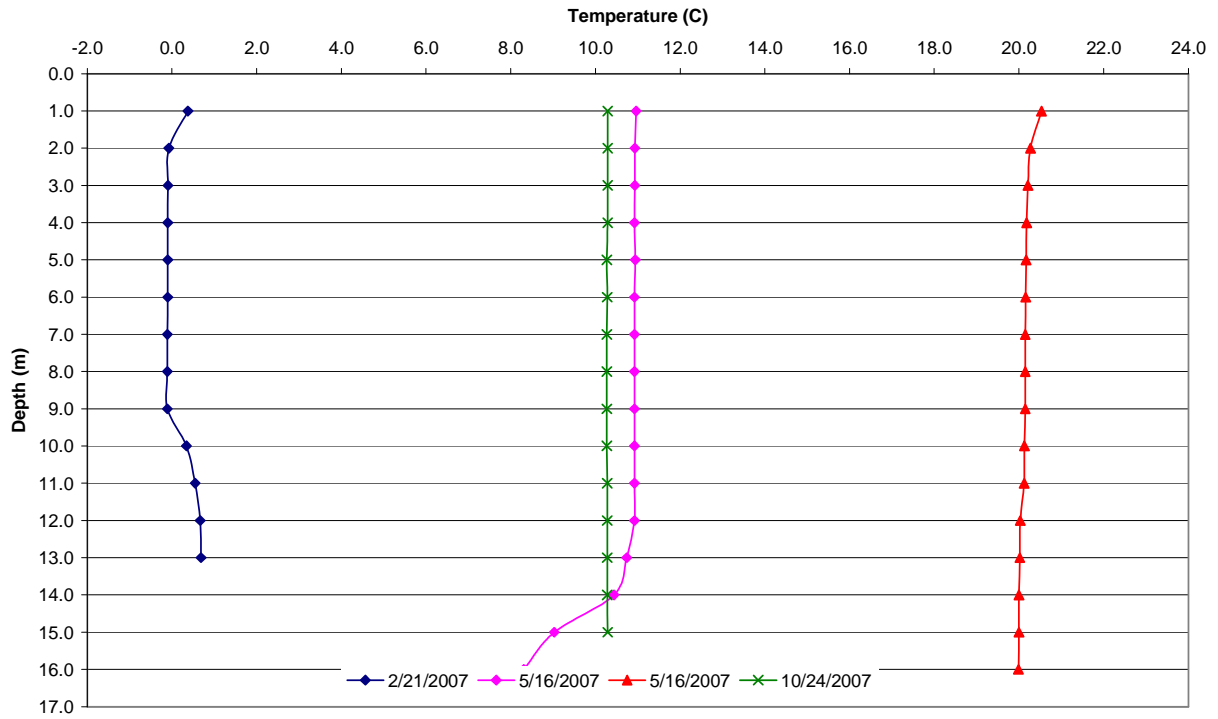


Figure 6. Continued

e) West Bay

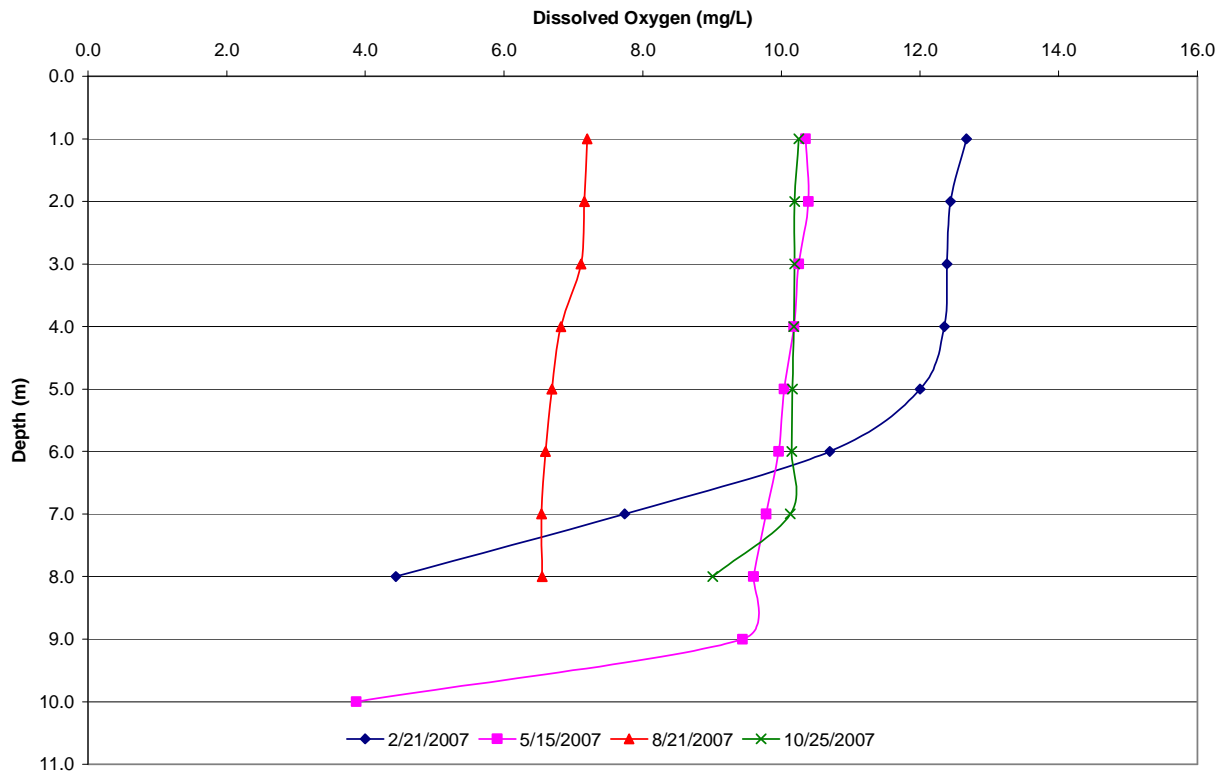
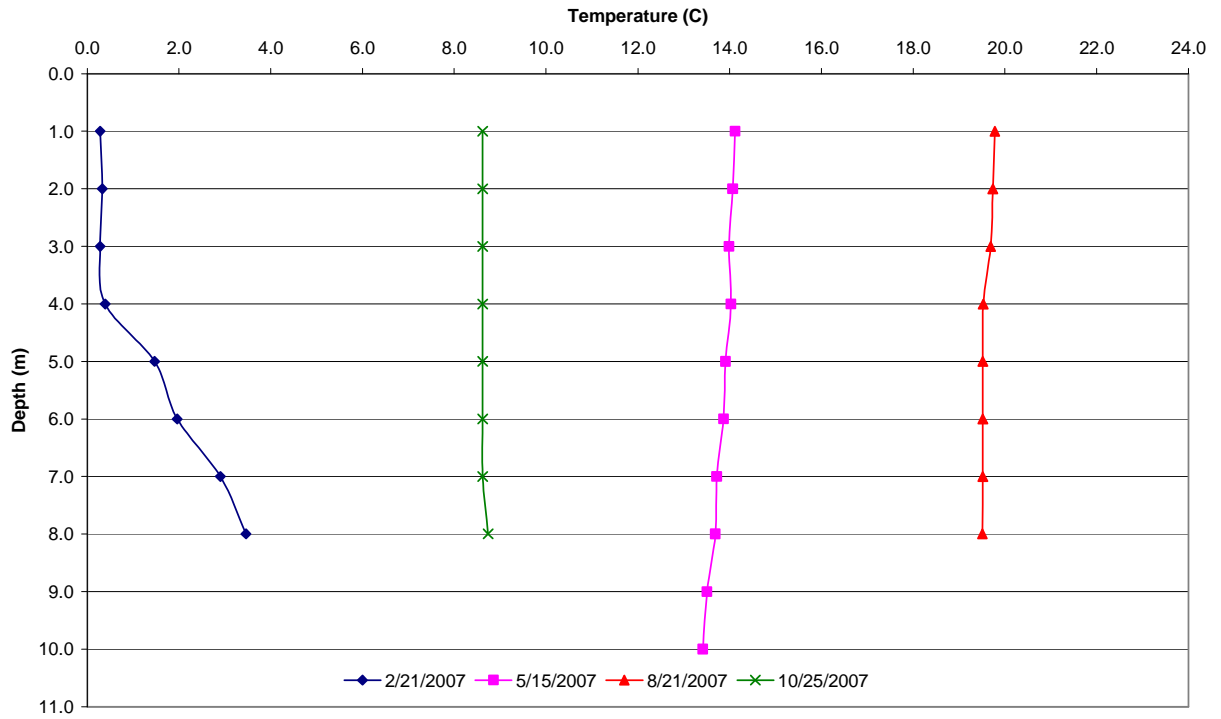


Figure 6. Continued

f) SW West Bay

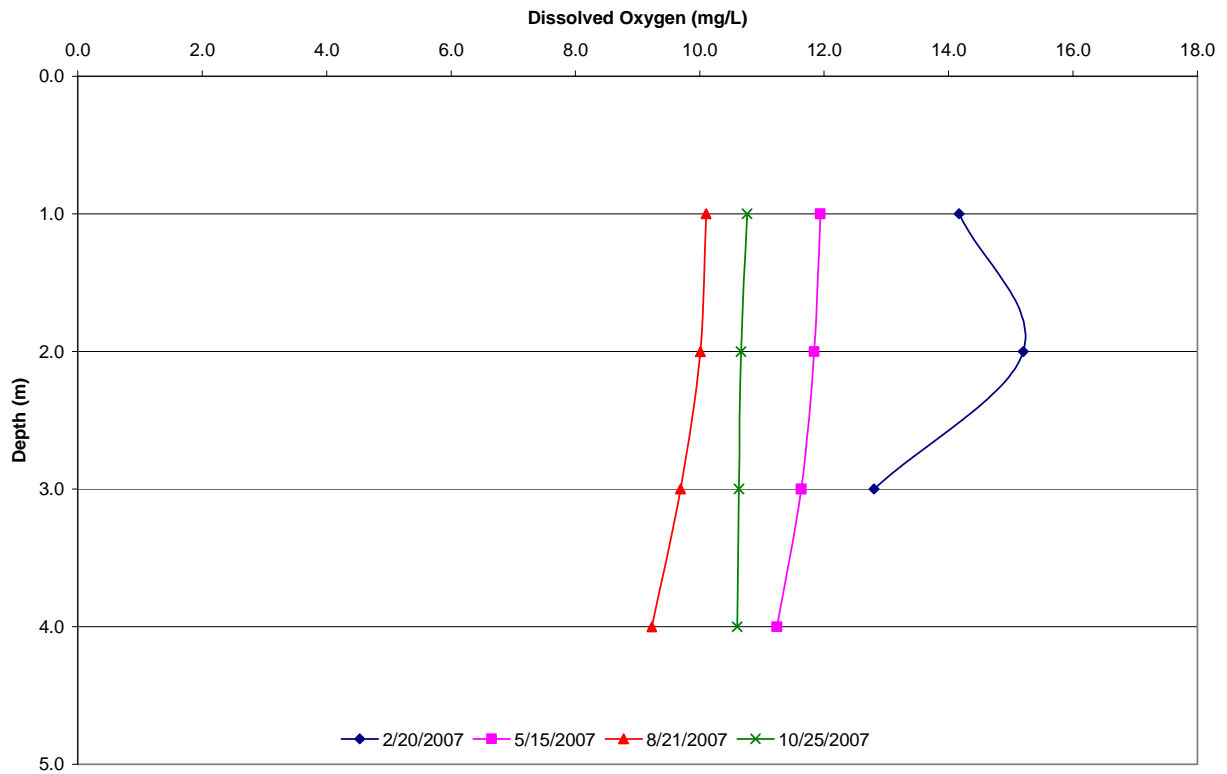
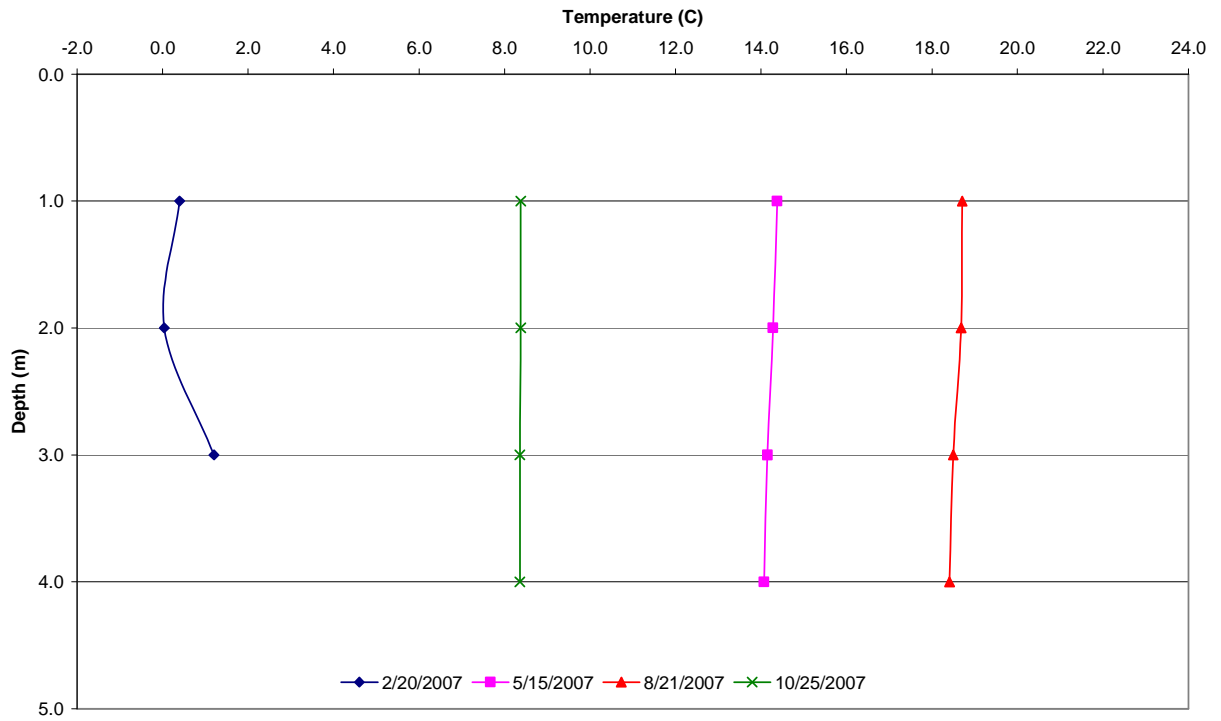
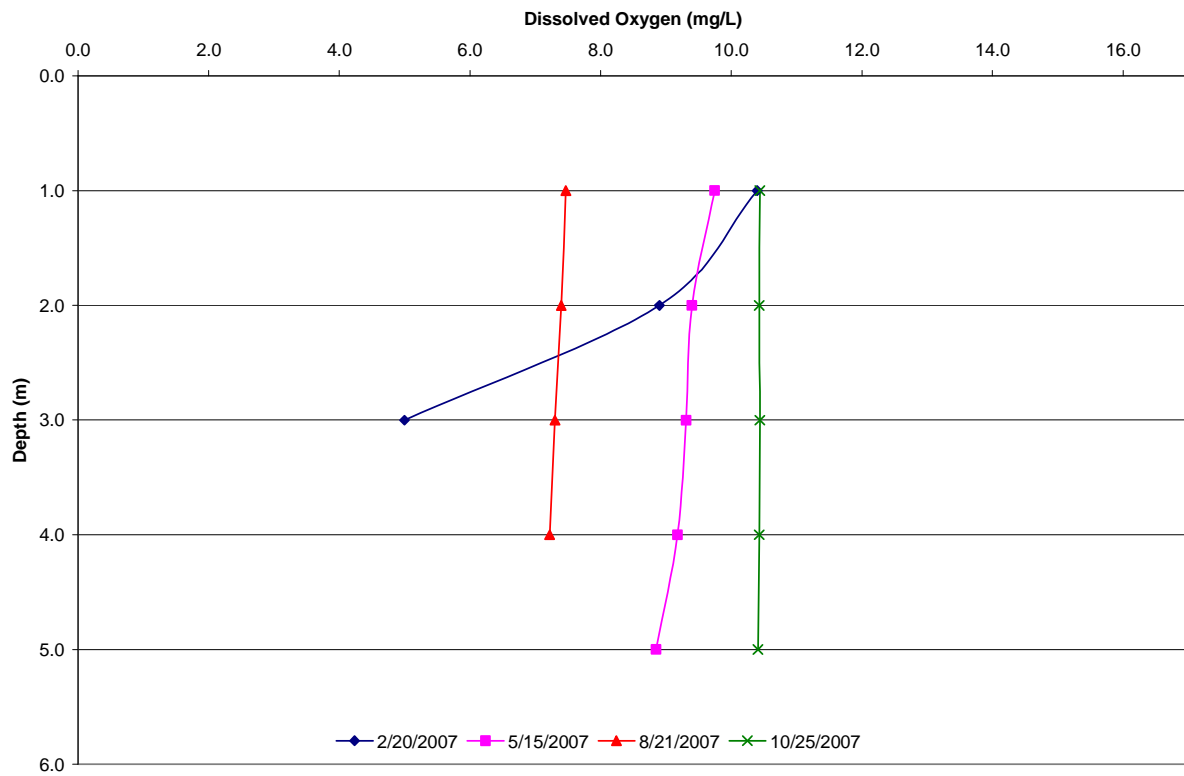
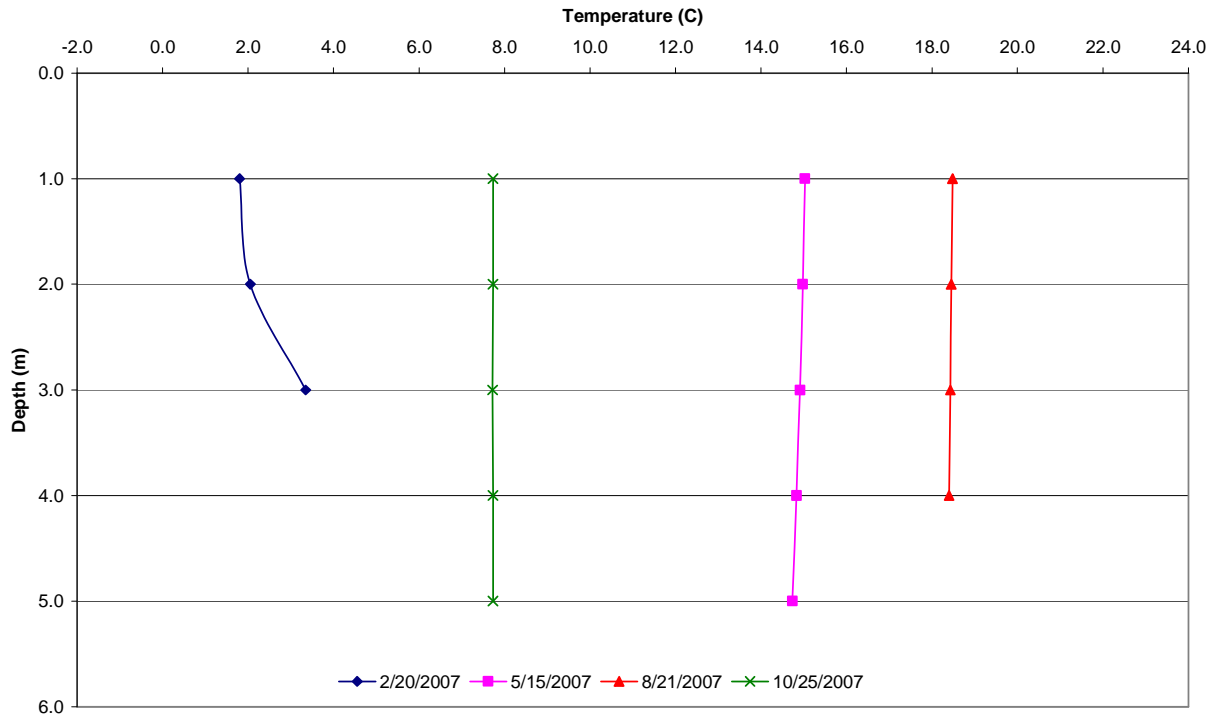


Figure 6. Continued

**g) Pelican Lake**



**Figure 6. Continued**

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Appendix A  
Water Quality Results for Devils Lake 1995-2007



# Devils Lake Report

Analyte 384160	Collection Date 385029	Detect Limit	Depth	380221	380233	380234	380235	380236
<b>Ammonia (N)</b>								
	3/15/1995	2	0.258	0.214	0.18	0.39	0.281	
	3/15/1995	1	0.258	0.214	0.18	0.39	0.281	
	5/15/1995	1	0.055	0.056	0.023	0.035	0.107	
	7/25/1995	0.010	1	0.09	0.059	0.033	*ND	
	7/27/1995		1		0.18			
	10/3/1995	0.010	1	*ND	*ND	*ND	0.041	*ND
	3/25/1996	0.010	1	*ND	*ND	*ND		*ND
	5/20/1996	0.010	1	*ND	*ND	0.016	0.012	0.021
	6/4/1996		0.923	0.085	0.038	0.101	0.062	0.136
	6/17/1996	0.010	1		*ND			
	7/1/1996	0.010	1	*ND	*ND	0.03	0.055	*ND
	8/5/1996	0.010	1	*ND	*ND	*ND	*ND	*ND
	9/3/1996	0.010	1	0.078	*ND	0.03	0.062	*ND
	9/30/1996	0.010	1	0.056	*ND	*ND	0.151	*ND
	3/4/1997		1	0.01	0.051	0.037	0.243	0.121
	5/14/1997	0.010	1	0.061	0.029	*ND	0.042	*ND
	7/8/1997	0.010	1	*ND	*ND	*ND		0.177
	7/16/1997	0.010	1			*ND		
	8/4/1997	0.010	1	*ND	*ND	*ND	*ND	*ND
	9/2/1997	0.010	1	0.035	0.022	0.029	0.088	*ND
	10/6/1997	0.010	1	*ND	*ND	0.027		*ND
	5/19/1998		1	0.047	0.156	0.099	0.058	0.167
	7/6/1998	0.010	1	*ND	*ND	*ND	*ND	*ND
	8/3/1998	0.010	1	0.085	0.033	0.064	*ND	0.047
	9/8/1998	0.010	1	*ND	0.022	*ND		0.021
	10/19/1998	0.010	1	0.081	0.075	*ND		0.038
	10/21/1998		1				0.174	
	2/23/1999		1	0.154	0.104	0.057	0.162	0.095
	5/25/1999		1	0.175	0.108	0.174	0.068	
	8/2/1999	0.010	1	*ND	*ND	*ND	*ND	*ND
	10/11/1999	0.010	1	*ND	*ND	*ND	*ND	*ND
	2/14/2000		1	0.045	0.041	0.029	0.102	0.017
	5/2/2000	0.010	1	*ND	*ND	*ND	*ND	*ND
	8/1/2000	0.010	1	0.021	*ND	*ND	*ND	*ND
	10/9/2000	0.010	1	*ND	*ND	*ND	*ND	*ND
	3/19/2001		1	0.046	0.03	0.019	0.042	0.046
	5/14/2001	0.010	1	*ND	*ND	*ND	*ND	*ND

Analyte  
384160

Collection Date  
385029

Detect Limit Depth

380221

380233

380234

380235

380236

8/6/2001		1	0.059	0.039	0.037	0.11	0.052	0.044	0.042
10/10/2001	0.010	1	0.036	0.011	0.03	0.188	*ND	0.013	0.028
2/11/2002	0.010	1	*ND	*ND	*ND	0.119	*ND	*ND	0.075
5/13/2002		1	0.046	0.027	0.017	0.051	0.116	0.038	0.021
8/13/2002	0.010	1	0.013	0.031	*ND	0.011	*ND	*ND	*ND
10/7/2002	0.010	1	*ND	*ND	*ND	*ND	*ND	*ND	*ND
2/10/2003		1	0.098	0.063	0.16	0.323	0.06	0.12	0.327
5/7/2003		1	0.021	0.013	0.052	0.063	0.022	0.012	0.06
8/12/2003	0.010	1	*ND	0.079	*ND	0.017	0.042	*ND	*ND
10/7/2003	0.010	1	*ND	*ND	*ND	0.218	*ND	*ND	*ND
3/16/2004	0.010	1	*ND	*ND	*ND		*ND	*ND	*ND
5/18/2004	0.010	1	*ND	*ND	*ND	*ND	*ND	*ND	0.114
8/10/2004	0.010	1	*ND	*ND	*ND	*ND	*ND	*ND	*ND
10/6/2004	0.010	1	*ND	*ND	*ND	*ND	*ND	*ND	*ND
3/8/2005	0.010	1	*ND	*ND	*ND	*ND	*ND	*ND	*ND
5/24/2005	0.010	1	*ND	*ND	*ND	0.016	*ND	*ND	0.129
8/16/2005		1	0.094	0.103	0.062	0.078	0.042	0.024	0.078
10/11/2005	0.010	1	*ND	*ND	*ND	0.11	*ND	*ND	*ND
2/14/2006	0.010	1	0.078	0.039	0.024	0.046	0.033	*ND	0.024
5/9/2006	0.010	1	0.021	0.057	0.013	*ND	*ND	*ND	0.185
5/9/2006	0.010	2	0.021	0.057	0.013	*ND	*ND	*ND	0.185
8/15/2006	0.010	1	0.02	0.135	0.037	*ND	*ND	0.021	0.015
10/9/2006	0.010	1	*ND	*ND	*ND		*ND	*ND	*ND
2/20/2007	0.010	1	*ND	0.033	*ND	*ND	0.01	*ND	0.031
5/15/2007		1	0.066	0.079	0.017	0.023	0.028	0.023	0.177
8/21/2007	0.010	1	0.242	0.028	0.031	0.171	0.022	*ND	*ND
10/24/2007	0.010	1	0.012	*ND	0.036	0.114	0.033	0.041	*ND

Chloride

3/15/1995		2	62	20.4	330	975	101		
3/15/1995		1	62	20.4	330	975	101		
5/15/1995		1	104	182	379	858	91.5		
7/25/1995		1	135	165	377	867	76.1		
10/3/1995		1	151	161	362	840	93.1		
3/25/1996		1	164	177	207		127		
5/20/1996		1	110	155	292	741	108		
6/4/1996		0.923	95.8	158	302	738	99		
7/1/1996		1	97.2	141	321	788	94.8		
8/5/1996		1	126	123	301	701	96.9		
9/3/1996		1	137	148	330	816	95.8		
9/30/1996		1	133	144	289	749	94.9		
3/4/1997		1	146	150	251	860	131		

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5/14/1997	1	64.6	151	292	903	97.8		
7/8/1997	1	112	127	248		79.6		
7/16/1997	1				742			
8/4/1997	1	111	129	278	721	85.3	71.6	
9/2/1997	1	116	137	252	728	92.2	67.9	
10/6/1997	1	118	136	254		88	82	
5/19/1998	1	102	137	207	659	89.5	79.3	
7/6/1998	1	105	122	210	565	89.7	84.4	
8/3/1998	1	115	119	232	568	98.9	93.4	
9/8/1998	1	111	125	238		97	99.3	
10/19/1998	1	120	128	254	606	98.5	95.6	
2/23/1999	1	130	140	277	631	123	118	
5/25/1999	1	93.3	121	249	573		85.9	18.6
8/2/1999	1	108	110	247	555		85.5	25.8
10/11/1999	1	116	119	252	570		94.7	20.9
2/14/2000	1	121	125	267	566		107	29.2
5/2/2000	1	115	118	243	545		97.9	55.8
8/1/2000	1	122	124	238	539		107	69.7
10/9/2000	1	125	124	243	520	108	108	73.3
3/19/2001	1	128	124	199	436	120	121	33.2
5/14/2001	1	83	126	250	487	115	108	38
8/6/2001	1	113	117	221	497	109	103	59.1
10/10/2001	1	121	126	236	526	114	112	59.8
2/11/2002	1	126	127	226	513	126	124	62.5
5/13/2002	1	112	107	212	401	110	93.3	63.1
8/13/2002	1	116	125	219	480	117	115	83
10/7/2002	1	126	136	212	457	126	125	41.7
2/10/2003	1	134	140	248	487	138	139	109
5/7/2003	1	101	122	191	442	123	113	77.8
8/12/2003	1	130	131	210	433	120	118	92.1
10/7/2003	1	131	129	211	462	122	120	106
3/16/2004	1	145	153	200		147	158	131
5/18/2004	1	106	130	205	398	120	117	73.4
8/10/2004	1	123	99.7	207		116	120	75.1
10/6/2004	1	123	131	210	395	120	118	81.3
3/8/2005	1	126	133	195	389	130	132	94.6
5/24/2005	1	122	130	195	347	117	125	77.8
8/16/2005	1	112	126	196	332	115	119	68.6
10/11/2005	1	121	123	191	309	120	119	71.8
2/14/2006	1	115	134	175	284	134	133	85.1
5/9/2006	1	103	115	168	268	106	102	46.6

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5/9/2006		2	103	115	168	268	106	102	46.6
8/15/2006		1	118	122	186	263	118	114	61.4
10/9/2006		1	123	122	185		116	112	70.8
2/20/2007		1	132	134	199	269	131	137	91.3
5/15/2007		1	119	122	181	250	114	110	75.4
8/21/2007		1	116	124	184	231	120	117	87.6
10/24/2007		1	116	119	178	235	116	119	89.5

Chlorophyll A

7/25/1995	3.000	0.923	8	13		*ND	21		
7/27/1995		0.923			23				
10/3/1995	3.000	0.923	*ND	*ND	*ND	*ND	9		
5/20/1996	3.000	0.923	16	5	7	15	*ND		
6/4/1996	3.000	0.923	*ND	*ND	*ND	*ND	*ND		
7/1/1996	3.000	0.923	6	52	*ND	*ND	14		
8/5/1996		0.923	9	12	22	25	11		
9/3/1996		0.923	19	16	11	11	6		
9/30/1996	3.000	0.923	*ND	*ND			11		
10/2/1996		0.923			5	36			
5/14/1997	3.000	0.923	23	14	10	*ND	19		
7/8/1997	3.000	0.923	*ND	*ND	36		6		
7/16/1997		0.923				4			
8/4/1997	3.000	0.923	11	7	6	*ND	42	42	
9/2/1997		0.923	15	9	12	10	19	25	
10/6/1997		0.923	9	10	5		15	42	
5/19/1998	3.000	0.923	6	*ND	*ND	5	*ND	*ND	
7/6/1998	3.000	0.923	18	*ND	11	*ND	7	11	
8/3/1998		0.923	9	12	16	140	18	21	
9/8/1998	3.000	0.923	13	5			*ND		
9/10/1998		0.923			18			19	
10/19/1998	3.000	0.923	*ND	4	29	20	12	20	
5/25/1999	3.000	0.923	*ND	*ND	*ND	*ND		*ND	*ND
8/2/1999	3.000	0.923	*ND	16	5	*ND		*ND	9
10/11/1999	6.000	0.923	16	76	23	56		*ND	28
5/2/2000	3.000	0.923	8	11	9	24		9	*ND
8/1/2000		0.923	16	14	12	77		57	78
10/9/2000		0.923	10	24	19	41	11	17	35
5/14/2001	6.000	0.923	30	14			*ND	*ND	
5/15/2001	3.000	0.923			9	20			*ND
10/10/2001		0.923	14	7	19	8	11	12	
5/13/2002	3.000	0.923	*ND	*ND	8	9	*ND	6	22
8/13/2002		0.923	23	15	36	108	27	16	35

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10/7/2002		0.923	11	9	10	33	18	12	42
5/7/2003		0.923	7	6	11	4	7	9	5
8/12/2003		0.923	37	4	16	58	8	20	19
10/7/2003	6.000	0.923	12.8	15	*ND	16	*ND	5.7	9.6
5/18/2004	3.000	0.923	11.5	9.1	5.3	32.6	*ND	5.6	*ND
8/10/2004		0.923	14.7	6.7	11.9		13.2	20	45.9
10/6/2004		0.923	19.5	16	17.4	59.8	20.3	2.1	3.2
5/24/2005		0.923	3.6	2.7	3.5	4.3	6.5	6.8	2.5
8/16/2005		0.923	10.7	13.1	22.7	20.3	15.5	24.6	24.3
10/11/2005		0.923	26.2	19.8	21.4	6.9	26.3	18.9	25.1
5/9/2006	3.000	0.923	9.3	13.9	11.5	*ND	11.4	5.6	
8/15/2006		0.923	35.2	7.9	14.7	49.3	29.6	25.4	211
10/9/2006		0.923	18.7	16.6	27.8		39	40.1	22.4
5/15/2007	2.000	0.92	3.74				11.4	4.63	*ND
5/16/2007	1.500	0.92		*ND	7.3	6.05			
8/21/2007	3.000	1	*ND						
8/21/2007	1.500	1		*ND	*ND	*ND	*ND	*ND	*ND
10/24/2007	3.000	1			*ND		*ND	*ND	32
10/24/2007	2.000	1				*ND			
10/24/2007	1.500	1	*ND	*ND					

Conductivity

3/15/1995		2	1040	3060	4480	11000	2100		
3/15/1995		1	1040	3060	4480	11000	2100		
5/15/1995		1	1800	2830	4780	9900	1700		
7/25/1995		1	2270	2410	4790	9650	1500		
10/3/1995		1	2410	2560	4820	9920	1760		
3/25/1996		1	2660	2730	3140		2100		
5/20/1996		1	1870	2450	4180	8980	1870		
6/4/1996		0.923	1740	2440	4270	9170	1800		
7/1/1996		1	1830	2330	4300	9270	1760		
8/5/1996		1	2060	2280	4130	8950	1720		
9/3/1996		1	2180	2310	4280	9070	1730		
9/30/1996		1	2250	2400	4320	9370	1800		
3/4/1997		1	2490	2540	3670	9820	2360		
5/14/1997		1	1250	2320	3860	8920	1710		
7/8/1997		1	1900	2090	3410		1530		
7/16/1997		1				8380			
8/4/1997		1	1840	2050	3350	8210	1540	1360	
9/2/1997		1	1820	2080	3290	8310	1600	1440	
10/6/1997		1	1950	2160	3330		1650	1580	
5/19/1998		1	1890	2130	3150	8020	1740	1620	

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7/6/1998	1	1940	2130	3280	7530	1780	1700		
8/3/1998	1	1990	2120	3400	7390	1810	1750		
9/8/1998	1	1960	2100	3390		1860	1790		
10/19/1998	1	2060	2130	3480	7230	1850	1800		
2/23/1999	1	2190	2240	3720	7510	2120	2120		
5/25/1999	1	1670	2000	3100	6750		1600		702
8/2/1999	1	1900	1920	3310	6720		1640		864
10/11/1999	1	1930	1970	3350	6710		1730		932
2/14/2000	1	2080	2110	3580	6810		1940		1310
5/2/2000	1	2000	2030	3380	6530		1780		1300
8/1/2000	1	2000	2020	3290	6480		1810		1420
10/9/2000	1	2120	2130	3360	6610	1930	1960		1250
3/19/2001	1	2290	2260	3150	5950	2250	2310		1120
5/14/2001	1	1540	2020	3240	5860	1980	1890		1070
8/6/2001	1	1960	2010	3170	6000	1930	1880		1290
10/10/2001	1	2050	2110	3240	6150	2000	1990		1330
2/11/2002	1	2210	2200	3450	6380	2190	2240		1610
5/13/2002	1	2080	2130	3200	5890	2000	1960		1520
8/13/2002	1	2040	2170	3250	5970	2080	2070		1700
10/7/2002	1	2080	2160	3160	5700	2050	2060		1250
2/10/2003	1	2250	2300	3430	6010	2310	2360		2070
5/7/2003	1	1920	2210	3000	5860	2140	2090		1690
8/12/2003	1	2200	2250	3150	5730	2140	2110		1880
10/7/2003	1	2250	2290	3160	5740	2170	2180		1930
3/16/2004	1	2320	2410	2930		2390	2460		2200
5/18/2004	1	1900	2210	3090	5300	2090	2090		1520
8/10/2004	1	2090	2140	3010		2070	2050		1540
10/6/2004	1	2150	2210	3060	5220	2110	2090		1650
3/8/2005	1	2260	2360	3140	5200	2320	2370		2000
5/24/2005	1	2140	2190	2970	4550	2090	2100		1660
8/16/2005	1	1940	2120	2900	4310	2070	2060		1500
10/11/2005	1	2110	2170	2940	4280	2120	2110		1590
2/14/2006	1	2100	2270	2750	3880	2260	2340		1840
5/9/2006	1	2010	2140	2840	3940	2070	2040		1280
5/9/2006	2	2010	2140	2840	3940	2070	2040		1280
8/15/2006	1	2120	2160	2890	3770	2080	2040		1440
10/9/2006	1	2160	2180	2900		2090	2100		1590
2/20/2007	1	2360	2390	3070	3890	2330	2410		1940
5/15/2007	1	2130	2190	2880	3590	2090	2050		1630
8/21/2007	1	2080	2160	2800	3500	2100	2090		1740
10/24/2007	1	2170	2240	2900	3520	2170	2170		1880

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Analyte 384160	Collection Date 385029	Detect	Limit	Depth	380221	380233	380234	380235	380236
<b>Dissolved Phosphorus as P</b>									
	3/15/1995	1				0.176	0.277		
	3/15/1995	2				0.176	0.277		
	7/25/1995	1	0.253	0.222	0.254	0.13	0.188		
	10/3/1995	1	0.197	0.202	0.267	0.179	0.139		
	3/25/1996	1	0.201	0.148	0.173		0.253		
	5/20/1996	1	0.131	0.166	0.193	0.115	0.139		
	6/4/1996	0.923	0.183	0.188	0.241	0.167	0.222		
	6/17/1996	1		0.183					
	7/1/1996	1	0.244	0.193	0.261	0.187	0.206		
	8/5/1996	1	0.24	0.25	0.295	0.179	0.271		
	9/3/1996	1	0.228	0.241	0.233	0.2	0.238		
	9/30/1996	1	0.276	0.258	0.232	0.214	0.124		
	3/4/1997	1	0.282	0.243	0.291	0.261	0.143		
	5/14/1997	1	0.294	0.304	0.216	0.312	0.249		
	7/8/1997	1	0.299	0.242	0.261		0.223		
	7/16/1997	1				0.185			
	8/4/1997	1	0.256	0.229	0.234	0.157	0.295	0.173	
	9/2/1997	1	0.318	0.306	0.254	0.224	0.3	0.238	
	10/6/1997	1	0.26	0.248	0.216		0.218	0.122	
	5/19/1998	1	0.22	0.23	0.223	0.256	0.218	0.206	
	7/6/1998	1	0.194	0.193	0.179	0.272	0.186	0.205	
	8/3/1998	1	0.341	0.276	0.3	0.22	0.352	0.322	
	9/8/1998	1	0.29	0.296	0.29		0.352	0.318	
	10/19/1998	1	0.438	0.262	0.212	0.272	0.229	0.383	
	2/23/1999	1	0.469	0.486	0.413	0.294	0.431	0.404	
	5/25/1999	1	0.265	0.296	0.244	0.317		0.317	0.25
	8/2/1999	1	0.315	0.258	0.3	0.242		0.276	0.334
	10/11/1999	1	0.263	0.244	0.176	0.224		0.161	0.153
	2/14/2000	1	0.156	0.177	0.157	0.338		0.148	0.106
	5/2/2000	1	0.173	0.181	0.16	0.3		0.173	0.205
	8/1/2000	1	0.206	0.249	0.193	0.268		0.221	0.38
	10/9/2000	1	0.254	0.205	0.182	0.32	0.208	0.197	0.233
	3/19/2001	1	0.179	0.155	0.197	0.325	0.181	0.199	0.315
	5/14/2001	1	0.207	0.162	0.165	0.203	0.208	0.194	0.26
	8/6/2001	1	0.27	0.262	0.223	0.231	0.32	0.296	0.337
	10/10/2001	1	0.292	0.299	0.228	0.328	0.302	0.298	0.058
	2/11/2002	1	0.206	0.237	0.172	0.26	0.21	0.211	0.008
	5/13/2002	1	0.331	0.237	0.194	0.279	0.241	0.227	0.056
	8/13/2002	1	0.298	0.287	0.244	0.257	0.286	0.268	0.256
	10/7/2002	1	0.239	0.245	0.233	0.243	0.235	0.281	0.04

Analyte 384160	Collection Date 385029	Detect	Limit	Depth	380221	380233	380234	380235	380236
	2/10/2003	1	0.197	0.215	0.23	0.351	0.218	0.194	0.274
	5/7/2003	1	0.186	0.224	0.213		0.224	0.212	0.199
	8/12/2003	1	0.265	0.29	0.224	0.153	0.316	0.258	0.309
	10/7/2003	1	0.278	0.254	0.221	0.175	0.167	0.174	0.193
	3/16/2004	1	0.208	0.169	0.203		0.2	0.18	0.282
	5/18/2004	1	0.176	0.187	0.185	0.146	0.179	0.161	0.233
	8/10/2004	1	0.273	0.302	0.275		0.283	0.254	0.269
	10/6/2004	1	0.248	0.257	0.259	0.26	0.236	0.243	0.149
	3/8/2005	1	0.241	0.225	0.227	0.277	0.251	0.241	0.128
	5/24/2005	1	0.192	0.203	0.188	0.245	0.174	0.18	0.166
	8/16/2005	1	0.306	0.29	0.232	0.237	0.281	0.276	0.233
	10/11/2005	1	0.216	0.225	0.194	0.224	0.249	0.254	0.146
	2/14/2006	1	0.268	0.206	0.209	0.198	0.248	0.2	0.134
	5/9/2006	2	0.244	0.233	0.195	0.216	0.196	0.19	0.228
	5/9/2006	1	0.244	0.233	0.195	0.216	0.196	0.19	0.228
	8/15/2006	1	0.311	0.302	0.254	0.225	0.265	0.257	0.268
	10/9/2006	1	0.249	0.29	0.229		0.224	0.217	0.117
	2/20/2007	1	0.238	0.234	0.156	0.16	0.176	0.16	0.125
	5/15/2007	1	0.187	0.198	0.163	0.155	0.167	0.138	0.201
	8/21/2007	1	0.285	0.261	0.174	0.234	0.183	0.148	0.277
	10/24/2007	1	0.227	0.212	0.22	0.224	0.157	0.154	0.17

**Dissolved Solids(C)-Total**

	3/15/1995	2	638	1890	3090	9000	1400		
	3/15/1995	1	638	1890	3090	9000	1400		
	5/15/1995	1	1070	1840	3270	7570	1000		
	7/25/1995	1	1440	1880	3410	8120	960		
	10/3/1995	1	1760	1870	3600	8160	1280		
	3/25/1996	1	1890	1790	2260		1350		
	5/20/1996	1	1090	1500	2750	7650	1110		
	6/4/1996	0.923	1110	1640	3040	7750	1140		
	7/1/1996	1	1150	1530	3060	7520	1110		
	8/5/1996	1	1290	1450	2910	7300	1110		
	9/3/1996	1	1470	1720	3450	7030	1080		
	9/30/1996	1	1380	1490	2850	6660	1090		
	3/4/1997	1	1790	1550	2610	8200	1450		
	5/14/1997	1	812	1660	2910	7860	1160		
	7/8/1997	1	1250	1370	2430		981		
	7/16/1997	1				6740			
	8/4/1997	1	1300	1490	2570	6860	1090	944	
	9/2/1997	1	1200	1400	2280	6640	1020	902	
	10/6/1997	1	1300	1440	2350		1080	1010	



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5/19/1998	1	1230	1360	2140	6310	1100	1050		
7/6/1998	1	1260	1390	2170	5620	1130	1090		
8/3/1998	1	1290	1340	2240	5500	1150	1110		
9/8/1998	1	1310	1440	2380		1250	1160		
10/19/1998	1	1430	1460	2480	5730	1210	1190		
2/23/1999	1	1480	1490	2750	6080	1490	1450		
5/25/1999	1	1130	1390	2340	5430		1090	447	
8/2/1999	1	1290	1300	2380	5380		1110	564	
10/11/1999	1	1340	1360	2460	5450		1140	596	
2/14/2000	1	1440	1470	2590	5410		1330	865	
5/2/2000	1	1360	1420	2450	5180		1230	851	
8/1/2000	1	1400	1420	2380	5110		1250	936	
10/9/2000	1	1400	1440	2420	4990	1310	1300	1020	
3/19/2001	1	1540	1500	2180	4540	1470	1510	721	
5/14/2001	1	1050	1440	2350	4590	1380	1310	699	
8/6/2001	1	1360	1410	2240	4700	1340	1290	854	
10/10/2001	1	1430	1480	2420	4930	1370	1350	877	
2/11/2002	1	1540	1520	2400	4800	1530	1540	1030	
5/13/2002	1	1380	1320	2210	4050	1340	1230	945	
8/13/2002	1	1360	1490	2280	4550	1460	1460	1090	
10/7/2002	1	1370	1490	2220	4290	1500	1450	822	
2/10/2003	1	1580	1630	2520	4440	1630	1660	1440	
5/7/2003	1	1240	1440	2010	4170	1420	1360	1060	
8/12/2003	1	1500	1500	2190	4180	1420	1400	1220	
10/7/2003	1	1540	1540	2280	4250	1480	1470	1290	
3/16/2004	1	1660	1710	2190		1690	1770	1580	
5/18/2004	1	1270	1480	2140	3830	1410	1390	992	
8/10/2004	1	1420	1300	2140		1400	1420	1050	
10/6/2004	1	1470	1510	2170	3840	1440	1430	1090	
3/8/2005	1	1530	1590	2170	3830	1570	1590	1350	
5/24/2005	1	1430	1490	2060	3430	1400	1460	1080	
8/16/2005	1	1350	1460	2080	3300	1380	1420	1000	
10/11/2005	1	1430	1460	2050	3130	1440	1430	1050	
2/14/2006	1	1500	1610	1990	2940	1620	1620	1280	
5/9/2006	1	1350	1460	2030	2930	1380	1360	824	
5/9/2006	2	1350	1460	2030	2930	1380	1360	824	
8/15/2006	1	1440	1460	2000	2710	1420	1410	962	
10/9/2006	1	1470	1420	1930		1440	1360	1020	
2/20/2007	1	1620	1600	2160	2760	1590	1690	1280	
5/15/2007	1	1490	1510	2030	2640	1420	1410	1070	
8/21/2007	1	1380	1460	1940	2450	1440	1440	1180	

Analyte 384160	Collection Date 385029	Detect	Limit	Depth	380221	380233	380234	380235	380236
<b>Nitrate + Nitrite (N)</b>	10/24/2007	1	1470	1510	2050	2580	1490	1490	1260
	3/25/1996	1	0.11	0.04	0.07		0.27		
	5/20/1996	1	*ND	*ND	*ND	*ND	*ND		
	6/4/1996	0.923	*ND	*ND	0.02	0.03	0.05		
	6/17/1996	1		*ND					
	7/1/1996	1	0.03		0.03	0.06	0.02		
	8/5/1996	1	*ND	*ND	*ND	*ND	*ND		
	9/3/1996	1	*ND	*ND	*ND	*ND	*ND		
	9/30/1996	1	0.19	0.08			*ND		
	10/2/1996	1			0.04	0.06			
	3/4/1997	1	0.5	0.24	0.33	0.26	0.09		
	5/14/1997	1	0.29	0.11	*ND	0.51	*ND		
	7/8/1997	1	0.06	0.04	0.02		0.05		
	7/16/1997	1				*ND			
	8/4/1997	1	*ND	*ND	*ND	*ND	*ND	*ND	
	9/2/1997	1	0.04	0.03	0.02	0.03	0.05	0.07	
	10/6/1997	1	0.19	0.15	0.1		0.13	0.11	
	5/19/1998	1	0.1	0.08		0.57			
	7/6/1998	1	*ND	*ND	*ND	0.37	0.04	0.08	
	8/3/1998	1	0.03	*ND	*ND	*ND	0.03	*ND	
	9/8/1998	1	*ND	*ND	*ND		0.04	0.03	
	10/19/1998	1	*ND	0.07	0.02		0.06	0.02	
	10/21/1998	1				0.21			
	2/23/1999	1	0.3	0.2	0.13	0.46	0.05	*ND	
	5/25/1999	1	0.22	0.13	0.05	0.48		0.11	0.22
	8/2/1999	1	*ND	*ND	*ND	*ND		*ND	*ND
	10/11/1999	1	0.09	*ND	*ND	0.12		*ND	0.26
	2/14/2000	1	0.06	*ND	0.02	0.48		*ND	*ND
	5/2/2000	1	*ND	*ND	*ND	0.48		*ND	0.03
	8/1/2000	1	0.02	*ND	*ND	*ND		*ND	*ND
	10/9/2000	1	0.2	0.04	0.19	0.26	0.09	0.02	0.02
	3/19/2001	1	0.11	0.05	0.27	0.51	0.07	0.09	0.66
	5/14/2001	1	0.36	*ND	*ND	0.02	0.04	*ND	0.06
	8/6/2001	1	*ND	*ND	*ND	0.03	*ND	*ND	0.02
	10/10/2001	1	0.07	0.08	0.08	0.08	0.03	0.03	0.09
	2/11/2002	1	0.22	0.19	0.32	0.46	0.14	0.06	0.04
	5/13/2002	1	0.06	0.07	0.09	0.48	0.06	*ND	0.02
	8/13/2002	1	0.02	0.04	0.03	0.03	*ND	0.02	0.06
	10/7/2002	1	0.02	0.02	0.15	0.1	0.02	0.07	0.02
	2/10/2003	1	0.03	0.02	0.23	0.31	0.02	0.02	0.11

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5/7/2003	0.020	1	0.02	*ND	0.05	0.48	*ND	*ND	0.04
8/12/2003	0.020	1	*ND	*ND	*ND	*ND	0.02	*ND	*ND
10/7/2003		1	0.04	0.04	0.08	0.11	0.02	0.03	0.02
3/16/2004	0.020	1	0.21	*ND			0.14	0.09	
3/18/2004		1			0.14				0.35
5/18/2004		1	0.07	0.02	0.04	0.23	0.05	0.12	0.05
8/10/2004		1	0.03	0.04	0.02		0.04	0.03	0.02
10/6/2004	0.020	1	0.02	*ND	0.05	0.06	0.02	0.03	0.02
3/8/2005		1	0.04	0.02	0.02	0.36	0.02	0.02	0.02
5/24/2005		1	0.02	0.02	0.02	0.28	0.02	0.03	0.15
8/16/2005	0.020	1	0.15	0.03	0.02	*ND	0.03	*ND	0.05
10/11/2005	0.020	1	*ND	*ND	*ND	0.09	0.04	0.02	0.04
2/14/2006		1	0.07	0.02	0.02	0.08	0.02	0.02	0.05
5/9/2006	0.020	1	0.17	0.1	0.04	0.27	*ND	*ND	0.09
5/9/2006	0.020	2	0.17	0.1	0.04	0.27	*ND	*ND	0.09
8/15/2006	0.020	1	0.02	0.04	0.03	*ND	*ND	*ND	*ND
10/9/2006	0.020	1	0.12	0.07	*ND		0.04	0.02	0.04
2/20/2007	0.030	1	0.19	0.14	*ND	*ND	0.04	*ND	0.03
5/15/2007	0.030	1	*ND	0.04	0.04	*ND	*ND	*ND	0.08
8/21/2007	0.030	1	0.06	*ND	*ND	*ND	0.05	*ND	*ND
10/24/2007	0.030	1	0.12	*ND	0.22	0.08	0.07	0.07	0.04

Nitrogen (Total)

5/19/1998		1	1.83	1.95		4			
7/6/1998		1	1.5	1.1	1.61	2.83	1.11	1.32	
8/3/1998		1	1.42	1.33	1.8	3.12	1.59	1.55	
9/8/1998		1	1.35	1.54	2.25		1.44	1.4	
10/19/1998		1	1.52	1.53	1.8	2.98	1.21	1.14	
2/23/1999		1	1.81	1.59	2.1	3.62	1.43	1.51	
5/25/1999		1	1.67	1.6	1.94	3.14		2.02	1.5
8/2/1999		1	1.34	1.18	1.49	2.3		1.26	1.05
10/11/1999		1	1.23	1.18	1.53	2.87		1.12	1.4
2/14/2000		1	1.49	1.37	1.98	3.31		1.46	2.3
5/2/2000		1	1.4	1.3	1.93	3.3		1.41	1.64
8/1/2000		1	1.71	1.52	2.01	3.02		1.98	2.35
10/9/2000		1	1.61	1.42	2.17	4.02	1.58	1.52	1.64
3/19/2001		1	1.66	1.51	2.12	3.34	1.69	2.01	2.54
5/14/2001		1	1.7	1.45	1.95	2.46	1.47	1.51	1.56
8/6/2001		1	2.09	1.97	2.48	3.74	1.8	2.17	2.55
10/10/2001		1	1.54	1.52	1.88	2.76	1.54	1.59	1.53
2/11/2002		1	1.83	1.46	2.38	4.45	1.47	1.49	1.93
5/13/2002		1	1.38	1.37	1.8	2.84	1.53	1.53	1.48

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8/13/2002	1	1.09	1.35	1.61	2.42	1.09	1.02	1.23
10/7/2002	1	1.39	1.25	1.87	2.42	1.27	1.25	1.08
2/10/2003	1	1.57	1.65	2.13	3.19	1.64	1.77	2.08
5/7/2003	1	1.44	1.48	1.99	3.17	1.6	1.59	1.7
8/12/2003	1	1.58	1.55	1.97	2.99	1.46	1.77	1.39
10/7/2003	1	1.61	1.61	1.73	3.02	1.43	1.5	1.85
3/16/2004	1	1.6	1.42	1.69		1.46	1.62	1.98
5/18/2004	1	1.34	1.38	1.77	2.5	1.34	1.84	1.72
8/10/2004	1	1.8	1.61	1.97		1.71	1.73	2.05
10/6/2004	1	1.34	1.32	1.56	2.31	1.34	1.35	1.44
3/8/2005	1	1.62	1.44	1.72	2.56	1.72	1.67	2.13
5/24/2005	1	1.38	1.37	1.56	2.24	1.39	1.22	1.82
8/16/2005	1	1.29	1.47	1.6	1.86	1.36	1.29	1.69
10/11/2005	1	1.34	1.43	1.53	2.1	1.63	1.39	1.44
2/14/2006	1	1.63	1.55	1.59	1.98	1.5	1.69	1.9
5/9/2006	2	1.55	1.44	1.54	1.95	1.48	1.58	1.59
5/9/2006	1	1.55	1.44	1.54	1.95	1.48	1.58	1.59
8/15/2006	1	1.43	1.6	1.43	1.74	1.6	1.68	1.66
10/9/2006	1	1.58	1.67	1.7		1.58	1.6	1.6
2/20/2007	1	1.93	1.58	1.89	2.09	1.63	1.84	2.04
5/15/2007	1	1.53	1.6	1.56	1.83	1.5	1.46	1.71
8/21/2007	1	1.75	1.34	1.49	1.85	1.5	1.46	1.79
10/24/2007	1	1.48	1.38	1.73	2.09	1.46	1.43	1.59

Phosphorus (Total) (P)

3/15/1995	1	0.136	0.225	0.253	0.2	0.306		
3/15/1995	2	0.136	0.225	0.253	0.2	0.306		
5/15/1995	1	0.125	0.178	0.191	0.176	0.101		
7/25/1995	1	0.298	0.232	0.269	0.148	0.215		
10/3/1995	1	0.216	0.226	0.297	0.213	0.169		
3/25/1996	1	0.19	0.151	0.172		0.269		
5/20/1996	1	0.174	0.195	0.243	0.181	0.176		
6/4/1996	0.923	0.198	0.194	0.262	0.168	0.215		
6/17/1996	1		0.169					
7/1/1996	1	0.27	0.217	0.298	0.216	0.239		
8/5/1996	1	0.266	0.257	0.286	0.214	0.27		
9/3/1996	1	0.247	0.262	0.34	0.232	0.281		
9/30/1996	1	0.296	0.268	0.29	0.351	0.164		
3/4/1997	1	0.303	0.244	0.32	0.276	0.158		
5/14/1997	1	0.286	0.281	0.257	0.284	0.228		
7/8/1997	1	0.315	0.303	0.309		0.253		
7/16/1997	1				0.223			

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8/4/1997	1	0.315	0.223	0.219	0.186	0.381	0.269		
9/2/1997	1	0.354	0.332	0.277	0.255	0.314	0.262		
10/6/1997	1	0.31	0.312	0.281		0.248	0.191		
5/19/1998	1	0.926	0.948		0.266				
7/6/1998	1	0.417	0.359	0.276	0.361	0.449	0.404		
8/3/1998	1	0.824	0.717	0.265	0.326	0.77	0.851		
9/8/1998	1	0.412	0.352	0.459		0.482	0.485		
10/19/1998	1	0.409	0.368	0.292	0.325	0.39	0.278		
2/23/1999	1	0.398	0.488	0.318	0.336	0.316	0.298		
5/25/1999	1	0.442	0.475	0.278	0.537		0.492	0.261	
8/2/1999	1	0.355	0.296	0.289	0.283		0.315	0.374	
10/11/1999	1	0.234	0.212	0.186	0.259		0.178	0.189	
2/14/2000	1	0.186	0.182	0.151	0.34		0.162	0.195	
5/2/2000	1	0.219	0.2	0.209	0.42		0.221	0.242	
8/1/2000	1	0.239	0.277	0.226	0.31		0.298	0.54	
10/9/2000	1	0.278	0.241	0.226	0.365	0.255	0.242	0.29	
3/19/2001	1	0.214	0.176	0.22	0.344	0.205	0.236	0.397	
5/14/2001	1	0.261	0.21	0.233	0.231	0.253	0.238	0.282	
8/6/2001	1	0.318	0.323	0.267	0.705	0.36	0.346	0.45	
10/10/2001	1	0.318	0.311	0.248	0.335	0.336	0.328	0.07	
2/11/2002	1	0.248	0.236	0.2	0.304	0.236	0.231	0.024	
5/13/2002	1	0.247	0.245	0.234	0.324	0.276	0.261	0.114	
8/13/2002	1	0.3	0.309	0.254	0.298	0.307	0.273	0.308	
10/7/2002	1	0.254	0.27	0.248	0.284	0.264	0.27	0.094	
2/10/2003	1	0.224	0.235	0.272	0.397	0.243	0.248	0.318	
5/7/2003	1	0.212	0.248	0.247	0.343	0.253	0.251	0.238	
8/12/2003	1	0.307	0.311	0.27	0.203	0.333	0.358	0.364	
10/7/2003	1	0.273	0.281	0.23	0.223	0.19	0.207	0.25	
3/16/2004	1	0.234	0.206	0.221		0.212	0.209	0.312	
5/18/2004	1	0.236	0.236	0.235	0.182	0.217	0.228	0.267	
8/10/2004	1	0.296	0.309	0.291		0.309	0.288	0.324	
10/6/2004	1	0.275	0.292	0.255	0.293	0.268	0.281	0.187	
3/8/2005	1	0.265	0.28	0.273	0.323	0.269	0.254	0.2	
5/24/2005	1	0.21	0.217	0.211	0.279	0.192	0.203	0.187	
8/16/2005	1	0.335	0.333	0.257	0.272	0.313	0.31	0.273	
10/11/2005	1	0.246	0.257	0.223	0.249	0.313	0.288	0.181	
2/14/2006	1	0.272	0.247	0.224	0.224	0.226	0.256	0.193	
5/9/2006	1	0.286	0.277	0.228	0.254	0.243	0.256	0.269	
5/9/2006	2	0.286	0.277	0.228	0.254	0.243	0.256	0.269	
8/15/2006	1	0.335	0.336	0.259	0.247	0.299	0.302	0.315	
10/9/2006	1	0.283	0.31	0.246		0.27	0.264	0.172	

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2/20/2007	1	0.248	0.237	0.166	0.177	0.204	0.178	0.125
5/15/2007	1	0.222	0.225	0.19	0.186	0.212	0.169	0.234
8/21/2007	1	0.305	0.269	0.203	0.242	0.203	0.179	0.341
10/24/2007	1	0.247	0.231	0.233	0.242	0.18	0.177	0.218

Sulfate as (SO4)

3/15/1995	1	288	1020	1590	4850	554		
3/15/1995	2	288	1020	1590	4850	554		
5/15/1995	1	461	870	1580	3770	397		
7/25/1995	1	697	930	1780	4280	423		
10/3/1995	1	859	882	1700	4230	600		
3/25/1996	1	950	757	1140		562		
5/20/1996	1	458	643	1300	4120	465		
6/4/1996	0.923	469	708	1510	4420	484		
7/1/1996	1	525	725	1570	4120	474		
8/5/1996	1	547	648	1440	3970	452		
9/3/1996	1	692	773	1710	3760	448		
9/30/1996	1	565	643	1370	3480	443		
3/4/1997	1	777	686	1170	4460	626		
5/14/1997	1	348	780	1500	4200	504		
7/8/1997	1	569	642	1180		427		
7/16/1997	1				3640			
8/4/1997	1	574	662	1200	3580	467	386	
9/2/1997	1	540	632	1110	3510	440	382	
10/6/1997	1	581	655	1130		468	424	
5/19/1998	1	546	596	999	3270	477	440	
7/6/1998	1	545	599	993	2790	470	447	
8/3/1998	1	585	597	1090	2780	511	486	
9/8/1998	1	583	632	1150		524	495	
10/19/1998	1	622	652	1230	2950	529	516	
2/23/1999	1	663	674	1310	3080	622	595	
5/25/1999	1	490	607	1120	2760		449	155
8/2/1999	1	553	562	1110	2690		452	195
10/11/1999	1	589	605	1180	2780		485	219
2/14/2000	1	622	636	1220	2710		560	321
5/2/2000	1	614	644	1200	2740		539	338
8/1/2000	1	611	629	1140	2640		540	385
10/9/2000	1	617	627	1130	2530	561	554	404
3/19/2001	1	662	635	971	2210	627	632	283
5/14/2001	1	463	663	1150	2400	610	577	282
8/6/2001	1	600	627	1090	2390	582	554	350
10/10/2001	1	628	655	1150	2480	599	591	354

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2/11/2002	1	671	683	1120	2480	687	682	415
5/13/2002	1	582	552	1040	1920	579	492	357
8/13/2002	1	635	663	1120	2330	634	632	473
10/7/2002	1	622	660	1060	2220	632	611	336
2/10/2003	1	728	744	1220	2220	735	745	620
5/7/2003	1	518	610	901	2110	611	572	422
8/12/2003	1	656	658	1010	2130	613	608	498
10/7/2003	1	695	679	1070	2260	657	636	555
3/16/2004	1	730	764	967		740	783	680
5/18/2004	1	562	654	984	1900	620	599	419
8/10/2004	1	636	515	1010		607	628	431
10/6/2004	1	639	673	1030	1910	633	625	453
3/8/2005	1	663	683	980	1910	675	688	564
5/24/2005	1	633	663	969	1710	612	611	460
8/16/2005	1	595	650	979	1660	595	626	424
10/11/2005	1	621	648	959	1580	618	625	451
2/14/2006	1	641	691	880	1390	701	703	537
5/9/2006	1	605	667	963	1470	626	605	339
5/9/2006	2	605	667	963	1470	626	605	339
8/15/2006	1	619	633	907	1280	610	604	397
10/9/2006	1	645	637	928		619	612	444
2/20/2007	1	723	723	1030	1330	720	755	539
5/15/2007	1	646	654	928	1240	621	604	436
8/21/2007	1	604	635	884	1130	638	615	493
10/24/2007	1	628	638	906	1170	632	644	531